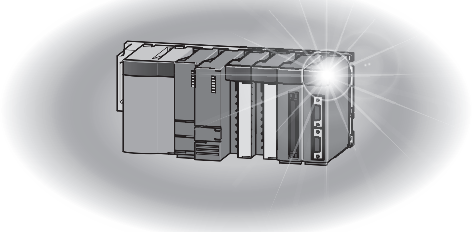
MITSUBISHI
ELECTRIC

Motion Controller

MELSEC Q series

Q173HCPU/Q172HCPU
Motion Controller (SV43)
Programming Manual

-Q172HCPU
-Q173HCPU



● SAFETY PRECAUTIONS ●

(Read these precautions before using.)

When using this equipment, thoroughly read this manual and the associated manuals introduced in this manual. Also pay careful attention to safety and handle the module properly.
These precautions apply only to this equipment. Refer to the Q173HCPU/Q172HCPU Users manual for a description of the Motion controller safety precautions.
These SAFETY PRECAUTIONS classify the safety precautions into two categories: "DANGER" and "CAUTION".

DANGER	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight personal injury or physical damage.

Depending on circumstances, procedures indicated by ⚠ CAUTION may also be linked to serious results.
In any case, it is important to follow the directions for usage.

Store this manual in a safe place so that you can take it out and read it whenever necessary. Always forward it to the end user.

For Safe Operations

1. Prevention of electric shocks

DANGER

- 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 Motion controller 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.
- Be sure to ground the Motion controller, servo amplifier and servomotor. (Ground resistance : 100 Ω or less) 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 Motion controller, 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 Motion controller, servo amplifier or servomotor terminal blocks while the power is ON, as this may lead to electric shocks.
- Do not touch the built-in power supply, built-in grounding or signal wires of the Motion controller and servo amplifier, as this may lead to electric shocks.

2. For fire prevention

CAUTION

- Install the Motion controller, servo amplifier, servomotor and regenerative resistor on inflammable material. Direct installation on flammable material or near flammable material may lead to fire.
- If a fault occurs in the Motion controller or servo amplifier, shut the power OFF at the servo amplifier's power source. If a large current continues to flow, fire 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 fire.
- 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 fire.

3. For injury prevention

⚠ CAUTION

- Do not apply a voltage other than that specified in the instruction manual on any terminal. Doing so may lead to destruction or damage.
- Do not mistake the terminal connections, as this may lead to destruction or damage.
- Do not mistake the polarity (+ / -), as this may lead to destruction or damage.
- Do not touch the servo amplifier's heat radiating fins, regenerative resistor and servomotor, etc., while the power is ON and for a short time after the power is turned OFF. In this timing, these parts become very hot and 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 Motion controller and servo amplifier power source.
- If installation of an electromagnetic contactor for power shut off during an error, etc., is specified in the instruction manual for the servo amplifier, etc., always install the electromagnetic contactor.
- Install the emergency stop circuit externally so that the operation can be stopped immediately and the power shut off.
- Use the Motion controller, servo amplifier, servomotor and regenerative resistor with the combinations listed in the instruction manual. Other combinations may lead to fire or faults.
- If safety standards (ex., robot safety rules, etc.,) apply to the system using the Motion controller, servo amplifier and servomotor, make sure that the safety standards are satisfied.
- Construct a safety circuit externally of the Motion controller or servo amplifier if the abnormal operation of the Motion controller or servo amplifier differ from the safety directive operation in the system.
- In systems where coasting of the servomotor will be a problem during the forced stop, emergency stop, servo OFF or power supply OFF, use dynamic brakes.
- Make sure that the system considers the coasting amount even when using dynamic brakes.

⚠ CAUTION

- In systems where perpendicular shaft dropping may be a problem during the forced stop, emergency stop, servo OFF or power supply OFF, use both dynamic brakes and electromagnetic brakes.
- The dynamic brakes must be used only on errors that cause the forced stop, emergency stop, or servo OFF. These brakes must not be used for normal braking.
- The brakes (electromagnetic brakes) assembled into the servomotor are for holding applications, and must not be used for normal braking.
- The system must have a mechanical allowance so that the machine itself can stop even if the stroke limits switch is passed through at the max. speed.
- Use wires and cables that have a wire diameter, heat resistance and bending resistance compatible with the system.
- Use wires and cables within the length of the range described in the instruction manual.
- The ratings and characteristics of the parts (other than Motion controller, servo amplifier and servomotor) used in a system must be compatible with the Motion controller, 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 electromagnetic 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 Motion controller, 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 supply module. 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.

⚠ CAUTION

- 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 module's instruction manual for the program corresponding to the special function module.

(3) Transportation and installation

⚠ CAUTION

- Transport the product with the correct method according to the mass.
- 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 Motion controller or servo amplifier, never hold the connected wires or cables.
- When transporting the servomotor, never hold the cables, shaft or detector.
- When transporting the Motion controller or servo amplifier, never hold the front case as it may fall off.
- When transporting, installing or removing the Motion controller or servo amplifier, never hold the edges.
- Install the unit according to the instruction manual in a place where the mass can be withstood.

⚠ CAUTION

- Do not get on or place heavy objects on the product.
- Always observe the installation direction.
- Keep the designated clearance between the Motion controller or servo amplifier and control panel inner surface or the Motion controller and servo amplifier, Motion controller or servo amplifier and other devices.
- Do not install or operate Motion controller, 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 Motion controller, servo amplifier or servomotor.
- The Motion controller, servo amplifier and servomotor are precision machines, so do not drop or apply strong impacts on them.
- Securely fix the Motion controller 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.

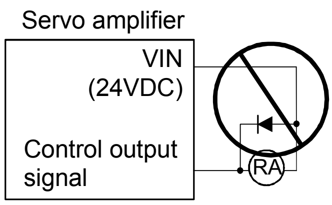
Environment	Conditions	
	Motion controller/Servo amplifier	Servomotor
Ambient temperature	According to each instruction manual.	0°C to +40°C (With no freezing) (32°F to +104°F)
Ambient humidity	According to each instruction manual.	80% RH or less (With no dew condensation)
Storage temperature	According to each instruction manual.	-20°C to +65°C (-4°F to +149°F)
Atmosphere	Indoors (where not subject to direct sunlight). No corrosive gases, flammable gases, oil mist or dust must exist	
Altitude	1000m (3280.84ft.) or less above sea level	
Vibration	According to each instruction manual	

- 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 module for a long time, disconnect the power line from the Motion controller or servo amplifier.
- Place the Motion controller and servo amplifier in static electricity preventing vinyl bags and store.
- When storing for a long time, please contact with our sales representative.

(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 PLC 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 Motion controller or absolute value motor has been replaced, always perform a home position return.

(6) Usge methods

⚠ CAUTION

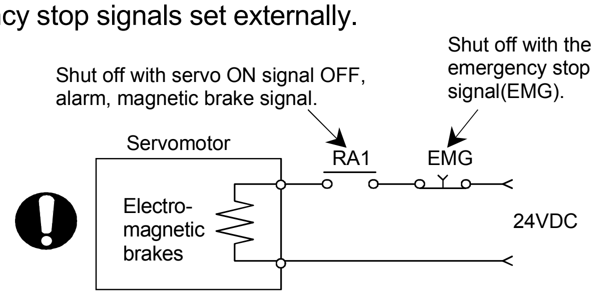
- Immediately turn OFF the power if smoke, abnormal sounds or odors are emitted from the Motion controller, servo amplifier or servomotor.
- Always execute a test operation before starting actual operations after the program or parameters have been changed or after maintenance and inspection.
- The units must be disassembled and repaired by a qualified technician.
- Do not make any modifications to the unit.
- Keep the effect or electromagnetic obstacles to a minimum by installing a noise filter or by using wire shields, etc. Electromagnetic obstacles may affect the electronic devices used near the Motion controller or servo amplifier.
- When using the CE Mark-compliant equipment, refer to the "EMC Installation Guidelines" (data number IB(NA)-67339) for the Motion controllers and refer to the corresponding EMC guideline information for the servo amplifiers, inverters and other equipment.
- Use the units with the following conditions.

Item	Conditions				
	Q61P-A1	Q61P-A2	Q62P	Q63P	Q64P
Input power	100 to 120VAC $^{+10\%}_{-15\%}$ (85 to 132VAC)	200 to 240VAC $^{+10\%}_{-15\%}$ (170 to 264VAC)	100 to 240VAC $^{+10\%}_{-15\%}$ (85 to 264VAC)	24VDC $^{+30\%}_{-35\%}$ (15.6 to 31.2VDC)	100 to 120VAC $^{+10\%}_{-15\%}$ / 200 to 240VAC $^{+10\%}_{-15\%}$ (85 to 132VAC/ 170 to 264VAC)
Input frequency	50/60Hz ±5%				
Tolerable momentary power failure	20ms or less				

(7) Corrective actions for errors

⚠ CAUTION

- If an error occurs in the self diagnosis of the Motion controller 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 electromagnetic brakes or install a brake mechanism externally.
- Use a double circuit construction so that the electromagnetic brake operation circuit can be operated by emergency stop signals set externally.



⚠ CAUTION

- If an error occurs, remove the cause, secure the safety and then resume operation after alarm release.
- 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 Motion controller and servo amplifier.
- Do not place fingers or hands in the clearance when opening or closing any opening.
- Periodically replace consumable parts such as batteries according to the instruction manual.
- Do not touch the lead sections such as ICs or the connector contacts.
- Do not place the Motion controller 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 Motion controller or servo amplifier, always set the new module settings correctly.
- When the Motion 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 Motion controller using programming software, switch on the power again, then perform a home position return operation.
  2) Using the backup function of the programming 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 Motion controller or servo amplifier.
- The electrolytic capacitor and fan will deteriorate. Periodically replace these to prevent secondary damage from faults. Replacements can be made by our sales representative.

(9) About processing of waste

When you discard Motion controller, servo amplifier, a battery (primary battery) and other option articles, please follow the law of each country (area).

⚠ CAUTION

- This product is not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to forestall serious accidents when it is used in facilities where a breakdown in the product is likely to cause a serious accident.

(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
Feb., 2006	IB(NA)-0300115-A	First edition

Japanese Manual Number IB(NA)-0300095

INTRODUCTION

Thank you for choosing the Q173HCPU/Q172HCPU Motion Controller.
Please read this manual carefully so that equipment is used to its optimum.

CONTENTS

About Manuals

The following manuals are related to this product.
Referring to this list, please request the necessary manuals.

Related Manuals

(1) Motion controller

Manual Name	Manual Number (Model Code)
Q173HCPU/Q172HCPU Motion controller User's Manual This manual explains specifications of the Motion CPU modules, Q172LX Servo external signal interface module, Q172EX Serial absolute synchronous encoder interface module, Q173PX Manual pulse generator interface module, Teaching units, Power supply modules, Servo amplifiers, SSCNETⅢ cables, synchronous encoder cables and others. (Optional)	IB-0300110 (1XB910)
Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON) This manual explains the Multiple CPU system configuration, performance specifications, common parameters, auxiliary/applied functions and others. (Optional)	IB-0300111 (1XB911)
Q173HCPU/Q172HCPU Motion controller (SV13/SV22) Programming Manual (Motion SFC) This manual explains the functions, programming, debugging, error codes and others of the Motion SFC. (Optional)	IB-0300112 (1XB912)
Q173HCPU/Q172HCPU Motion controller (SV13/SV22) Programming Manual (REAL MODE) This manual explains the servo parameters, positioning instructions, device list, error list and others. (Optional)	IB-0300113 (1XB913)
Q173HCPU/Q172HCPU Motion controller (SV22) Programming Manual (VIRTUAL MODE) This manual describes the dedicated instructions use to the synchronous control by virtual main shaft, mechanical system program create mechanical module. This manual explains the servo parameters, positioning instructions, device list, error list and others. (Optional)	IB-0300114 (1XB914)

(2) PLC

Manual Name	Manual Number (Model Code)
QCPU User's Manual (Hardware Design, Maintenance and Inspection) This manual explains the specifications of the QCPU modules, power supply modules, base modules, extension cables, memory card battery and others. (Optional)	SH-080483ENG (13JR73)
QCPU User's Manual (Function Explanation, Program Fundamentals) This manual explains the functions, programming methods and devices and others to create programs with the QCPU. (Optional)	SH-080484ENG (13JR74)
QCPU User's Manual (Multiple CPU System) This manual explains the functions, programming methods and cautions and others to construct the Multiple CPU system with the QCPU. (Optional)	SH-080485ENG (13JR75)
QCPU (Q Mode)/QnACPU Programming Manual (Common Instructions) This manual explains how to use the sequence instructions, basic instructions, application instructions and micro computer program. (Optional)	SH-080039 (13JF58)
QCPU (Q Mode)/QnACPU Programming Manual (PID Control Instructions) This manual explains the dedicated instructions used to exercise PID control. (Optional)	SH-080040 (13JF59)
QCPU (Q Mode)/QnACPU Programming Manual (SFC) This manual explains the system configuration, performance specifications, functions, programming, debugging, error codes and others of MELSAP3. (Optional)	SH-080041 (13JF60)
I/O Module Type Building Block User's Manual This manual explains the specifications of the I/O modules, connector, connector/terminal block conversion modules and others. (Optional)	SH-080042 (13JL99)

(3) Servo amplifier

Manual Name	Manual Number (Model Code)
MR-J3-☐B Servo amplifier Instruction Manual This manual explains the I/O signals, parts names, parameters, start-up procedure and others. (Optional)	SH-030051 (1CW202)

1. OVERVIEW

1.1 Overview

This programming manual describes the operating system software packages "SW5RN-SV43Q□" for Motion CPU module (Q173HCPU/Q172HCPU).
In this manual, the following abbreviations are used.

Generic term/Abbreviation	Description
Q173HCPU/Q172HCPU or Motion CPU (module)	Q173HCPU/Q172HCPU Motion CPU module
Q172LX/Q172EX/Q173PX or Motion module	Q172LX Servo external signals interface module/ Q172EX-S2/S3 Serial absolute synchronous encoder interface module(Note-1)/ Q173PX(-S1) Manual pulse generator interface module
MR-J3-□B	Servo amplifier model MR-J3-□B
AMP or Servo amplifier	General name for "servo amplifier model MR-J3-□B"
QCPU, PLC CPU or PLC CPU module	Qn(H)CPU
Multiple CPU system or Motion system	Abbreviation for "Multiple PLC system of the Q series"
CPUn	Abbreviation for "CPU No.n (n= 1 to 4) of the CPU module for the Multiple CPU system"
Programming software package	General name for "MT Developer" and "GX Developer"
Operating system software	General name for "SW□RN-SV□Q□"
SV43	Operating system software for machine tool peripheral use: SW5RN-SV43Q□
MT Developer	Abbreviation for "MT Developer (Version 00M or later)" (Integrated start-up support software package)
GX Developer	Abbreviation for "GX Developer (Version 6 or later)" (GX Developer function software package)
Manual pulse generator or MR-HDP01	Abbreviation for "Manual pulse generator (MR-HDP01)"
Serial absolute synchronous encoder or Q170ENC	Abbreviation for "Serial absolute synchronous encoder (Q170ENC)"
SSCNETⅢ(Note-2)	High speed synchronous network between Motion controller and servo amplifier
SSCNET(Note-2)	High speed serial communication between Motion controller and servo amplifier
Absolute position system	General name for "system using the servomotor and servo amplifier for absolute position"
Battery holder unit	Battery holder unit (Q170HBATC)
External battery	General name for "Q170HBATC" and "Q6BAT"
A□0BD-PCF	A10BD-PCF/A30BD-PCF SSC I/F board
SSC I/F communication cable	Abbreviation for "Cable for SSC I/F board/card"
Intelligent function module	Abbreviation for "MELSECNET/H module/Ethernet module/ CC-Link module/Serial communication module"

(Note-1) : Q172EX can be used in SV22.
(Note-2) : SSCNET: Servo System Controller NETwork

REMARK

For information about the each module, design method for program and parameter, refer to the following manuals relevant to each module.

Item		Reference Manual
Motion CPU module/Motion unit		Q173HCPU/Q172HCPU User's Manual
PLC CPU, peripheral devices for PLC program design, I/O modules and intelligent function module		Manual relevant to each module
Operation method for MT Developer		Help of each software
SV43	• Multiple CPU system configuration • Performance specification • Design method for common parameter • Auxiliary and applied functions (common)	Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)

⚠ CAUTION

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

1.2 Features

The Motion CPU has the following features.

1.2.1 Performance specifications

(1) Basic specifications of Q172HCPU/Q172HCPU

(a) Motion control specifications

<table>
<tr><th colspan="2">Item</th><th>Q173HCPU</th><th>Q172HCPU</th></tr>
<tr><td colspan="2">Number of control axes</td><td>Up to 32 axes</td><td>Up to 8 axes</td></tr>
<tr><td colspan="2">Operation cycle
(Default)</td><td>0.88ms/ 1 to 5 axes
1.77ms/ 6 to 14 axes
3.55ms/15 to 28 axes
7.11ms/29 to 32 axes</td><td>0.88ms/ 1 to 5 axes
1.77ms/ 6 to 8 axes</td></tr>
<tr><td colspan="2">Interpolation functions</td><td colspan="2">Linear interpolation (Up to 4 axes), Circular interpolation (2 axes), Helical interpolation (3 axes)</td></tr>
<tr><td colspan="2">Control modes</td><td colspan="2">PTP (Point to Point) control, Constant speed positioning, High-speed oscillation control</td></tr>
<tr><td rowspan="3">Positioning</td><td>Method</td><td colspan="2">PTP : Select of absolute or incremental data method.
Constant-speed control : Both absolute and incremental data method can be used together.</td></tr>
<tr><td>Position command</td><td colspan="2">Selectable 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>$\times 10^{-4}$ mm</td><td rowspan="2">-2147483648 to 2147483647</td><td rowspan="3">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>
</table></td></tr>
<tr><td>Speed command (Command unit)</td><td colspan="2">
<table>
<tr><th>Control unit</th><th>Speed setting range</th></tr>
<tr><td>mm</td><td>0.01 to 6000000.00 (mm/min)</td></tr>
<tr><td>inch</td><td>0.001 to 600000.000 (inch/min)</td></tr>
<tr><td rowspan="2">degree</td><td>• Speed control 10 × multiplier setting for degree axis is invalid
0.001 to 2147483.647 (degree/min)</td></tr>
<tr><td>• Speed control 10 × multiplier setting for degree axis is valid
0.01 to 21474836.47 (degree/min)</td></tr>
</table></td></tr>
<tr><td rowspan="2">Acceleration/ deceleration control</td><td>Automatic trapezoidal</td><td colspan="2">
<table>
<tr><th>Acceleration-fixed acceleration/deceleration method</th><th>Time-fixed acceleration/deceleration method</th></tr>
<tr><td>Acceleration time : 1 to 65535 ms
Deceleration time : 1 to 65535 ms</td><td>Acceleration/deceleration time :
1 to 5000 ms
(Only constant speed control)</td></tr>
</table>
(Note-1)</td></tr>
<tr><td>S-curve</td><td colspan="2">S-curve ratio : 0 to 100[%]</td></tr>
<tr><td colspan="2">Compensation</td><td colspan="2">Backlash compensation, Electronic gear</td></tr>
<tr><td colspan="2">Programming language</td><td colspan="2">Dedicated instruction (EIA language)</td></tr>
<tr><td colspan="2">Motion program capacity</td><td colspan="2">248k bytes</td></tr>
</table>

Motion control specifications (continued)

<table>
<tr><th colspan="2">Item</th><th>Q173HCPU</th><th>Q172HCPU</th></tr>
<tr><td colspan="2">Number of programs</td><td colspan="2">1024</td></tr>
<tr><td colspan="2">Number of simultaneous start programs</td><td>Axis designation program : 32
Control program : 16</td><td>Axis designation program : 8
Control program : 16</td></tr>
<tr><td colspan="2">Number of positioning points</td><td colspan="2">Approx. 10600 points
(Positioning data can be designated indirectly)</td></tr>
<tr><td colspan="2">Number of I/O (X/Y) points</td><td colspan="2">8192 points</td></tr>
<tr><td colspan="2">Number of real I/O (PX/PY) points</td><td colspan="2">Total 256 points</td></tr>
<tr><td rowspan="4">Number of Devices (internal motion CPU only)</td><td>Internal relays (M)</td><td colspan="2" rowspan="2">Total (M+L) : 8192 points</td></tr>
<tr><td>Latch relays (L)</td></tr>
<tr><td>Link relays (B)</td><td colspan="2">8192 points</td></tr>
<tr><td>Annunciators (F)</td><td colspan="2">2048 points</td></tr>
<tr><td colspan="2">Programming tool</td><td colspan="2">IBM PC/AT</td></tr>
<tr><td colspan="2">Peripheral I/F</td><td colspan="2">USB/SSCNET</td></tr>
<tr><td colspan="2">Teaching operation function</td><td colspan="2">None</td></tr>
<tr><td colspan="2">Home position return function</td><td colspan="2">Proximity dog type (2 types), Count type (3 types), Data set type (2 types), Dog cradle type, Stopper type (2 types), Limit switch combined type
(Home position return re-try function provided, home position shift function provided)</td></tr>
<tr><td colspan="2">JOG operation function</td><td colspan="2">Provided</td></tr>
<tr><td colspan="2">Manual pulse generator operation function</td><td colspan="2">Possible to connect 3 modules.</td></tr>
<tr><td colspan="2">M-code function</td><td colspan="2">M-code output function provided
M-code completion wait function provided</td></tr>
<tr><td colspan="2">Limit switch output function</td><td colspan="2">Number of output points 32 points
Watch data: Motion control data/Word device</td></tr>
<tr><td colspan="2">Skip function</td><td colspan="2">Provided</td></tr>
<tr><td colspan="2">Override ratio setting function</td><td colspan="2">Override ratio setting : 0 to 100[%]</td></tr>
<tr><td colspan="2">Absolute position system</td><td colspan="2">Made compatible by setting battery to servo amplifier.
(Possible to select the absolute data method or incremental method for each axis)</td></tr>
<tr><td colspan="2">Number of SSCNETⅢ systems (Note-2)</td><td>2 systems</td><td>1 system</td></tr>
<tr><td colspan="2">Number of Motion related modules</td><td>Q172LX : 4 modules
Q173PX : 1 module</td><td>Q172LX : 1 module
Q173PX : 1 module</td></tr>
</table>

(Note-1) : Acceleration-fixed/time-fixed acceleration/deceleration method is switched as follows.

Acceleration-fixed acceleration/deceleration method	Time-fixed acceleration/deceleration method
G00 (Without M-code setting.) G28 G30 G53 in G100	G00 (With M-code setting.) G01 G02 G03 G12 G13 G32 in G101
All travel instructions in G101	—

(Note-2) : The servo amplifiers for SSCNET cannot be used.

(b) Motion program performance specifications

Item		Q173HCPU/Q172HCPU
Program capacity	Total of program files	248k bytes
	Number of programs	Up to 1024 (No. 1 to 1024)
Operation controls	Arithmetic operation	Unary operation, Additive operation, Multiplicative operation, Remainder operation
	Comparison operation	Equal to, Not equal to
	Logical operation	Logical shift operation, Logical negation, Logical AND, Logical OR, Exclusive OR
G-codes	Positioning command	G00, G01, G02, G03, G04, G09, G12, G13, G23, G24, G25, G26, G28, G30, G32, G43, G44, G49, G53, G54, G55, G56, G61, G64, G90, G91, G92, G98, G99, G100, G101
M-codes	Output command to data register	M****
Special M-codes	Program control command	M00, M01, M02, M30, M98, M99, M100
Variable	Device variable	X, Y, B, F, D, W, #
Functions	Trigonometric function	SIN, COS, TAN, ASIN, ACOS, ATAN
	Numerical function	ABS, SQR, BIN, LN, EXP, BCD, RND, FIX, FUP, INT, FLT, DFLT, SFLT
Instructions	Start/end	CALL, CLEAR
	Home position return	CHGA
	Speed/torque setting	TL, CHGV, CHGT
	Motion control	WAITON, WAITOFF, EXEON, EXEOFF
	Jump/repetition processing	CALL, GOSUB/GOSUBE, IF…GOTO, IF…THEN…ELSE…END, WHILE…DO
	Data operation	BMOV, BDMOV, FMOV, BSET, BRST, SET, RST, MULTW, MULTR, TO, FROM, ON, OFF, IF…THEN…SET/RST/OUT, PB
Number of controls	Number of program calls (GOSUB/GOSUBE)	Up to 8
	Number of program calls (M98)	Up to 8

1.2.2 Differences between Q173HCPU/Q172HCPU and Q173CPU(N)/Q172CPU(N)

Item	Q173HCPU	Q172HCPU	Q173CPU(N)	Q172CPU(N)
Number of control axes	32 axes	8 axes	32 axes	8 axes
Operation cycle (Default) (It can be set up by parameters.)	0.88ms/ 1 to 5 axes 1.77ms/ 6 to 14 axes 3.55ms/15 to 28 axes 7.11ms/29 to 32 axes	0.88ms/1 to 5 axes 1.77ms/6 to 8 axes	0.88ms/ 1 to 4 axes 1.77ms/ 5 to 12 axes 3.55ms/13 to 24 axes 7.11ms/25 to 32 axes	0.88ms/1 to 4 axes 1.77ms/5 to 8 axes
Peripheral devices I/F	USB/SSCNET		USB/RS-232/SSCNET	
Servo amplifier I/F	SSCNETⅢ (Optical communication) Q173HCPU : 2 systems Q172HCPU : 1 system		SSCNET Q173CPU(N) : 4 systems (Note-1) Q172CPU(N) : 1 system	
Indirect setting of home position return data	Indirect setting with word devices (D, W, #) of Motion CPU.		Only direct setting by programming software.	
Expansion of speed setting range in the unit [degree]	• When the speed control 10×multiplier setting for degree axis is valid ; 0.01 to 21474836.47[degree/min] • When the speed control 10×multiplier setting for degree axis is invalid ; 0.001 to 2147483.647[degree/min]		0.001 to 2147483.647[degree/min] fixed	
Fetch of external signal input	Q172LX/General input of servo amplifier (Note-2)		Q172LX	
Optional data monitor function	3 points/axis (Specified device D, W, #)		—	
Minor error [303], [304]	When the speed change is executed after positioning automatic decerelation start or during decerelation by the JOG start command signal (M3202+20n, M3203+20n) OFF, since the speed change request is ignored, a minor error [303], [304] will not occur.		When the speed change is executed after positioning automatic decerelation start or during decerelation by the JOG start command signal (M3202+20n, M3203+20n) OFF, a minor error [303], [304] will occur.	
Processing with power supply OFF of servo amplifier	Servo OFF is executed for all servo amplifier connected behind servo amplifier with which the control power supply was turned OFF.		Servo OFF is executed for only servo amplifier with which the control power supply was turned OFF.	
Back-up battery for internal memory	Internal rechargeable battery (Set the external battery (Q6BAT) if continuous power off time is longer for 1 month or more.) (Note-3)		Internal rechargeable battery (Set the external battery (A6BAT/MR-BAT) if continuous power off time is longer for 1 month or more.) (Note-4)	

(Note-1) : Use the dividing unit (Q173DV) or dividing cable (Q173J2B△CBL□M/Q173HB△CBL□M).

(Note-2) : When selecting the each servo amplifier general input, the home position return by the count type cannot be executed. And, the external stop input cannot be used.

(Note-3) : When adding the external battery (Q6BAT), use the Q170HBATC.

(Note-4) : When adding the external battery (A6BAT/MR-BAT), use the Q173DV (Q173CPU(N) use) or Q170BAT (Q172CPU(N) use).

2. POSITIONING CONTROL BY THE MOTION CPU

2.1 Positioning Control by the Motion CPU

The positioning control of up to 32 axes in Q173HCPU and up to 8 axes in Q172HCPU is possible in the Motion CPU.

There are following four functions as controls toward the servo amplifier/servomotor.

(1) Servo operation by the positioning instructions.
The positioning instructions are programmed using the Motion program.
The starting method of Motion program is shown below.
   (a) Motion program start request (S(P).SVST) using the PLC program of PLC CPU or Motion program (control program) start request (S(P).SFCS)
   (b) Automatic start setting of Motion program (control program)
   (c) Start by CALL, GOSUB/GOSUBE instruction using other Motion program

(2) JOG operation by the axis command signal of Motion CPU.

(3) Manual pulse generator operation by the positioning dedicated device of Motion CPU.

(4) Speed change and torque limit value change during positioning control by the Motion dedicated PLC instruction (S(P).CHGV, S(P).CHGT instruction) or the CHGV, CHGT, TL instruction in the Motion program.

[Execution of the Motion program start (S(P).SVST instruction)]

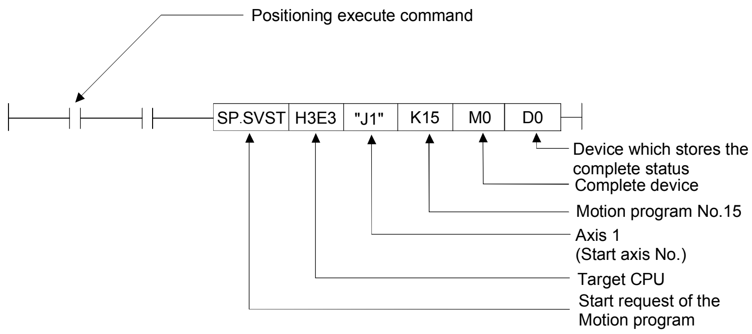
Positioning control is executed by starting the Motion program (axis designation program) specified with S(P).SVST instruction of the PLC CPU in the Motion CPU. An overview of the starting method using the Motion program is shown below.

Multiple CPU control system

PLC CPU

PLC program . . . . Create using a peripheral device (Note-1)

<Example> SP.SVST instruction



1) The Motion program No. and start axis No. are set using the S(P).SVST instruction in the PLC program.
2) When the S(P).SVST instruction is executed, the program of the Motion program No. specified with the Motion CPU is executed.

Point

In the above, it is explained the start of axis designation program.
There are following 2 types as the Motion program.

Control program : Only control instruction can be used, the travel instruction by G-code can not be used.
It is started by the S(P).SFCS of PLC CPU, automatic start with parameter, or CALL, GOSUB/GOSUBE instruction of other control program.

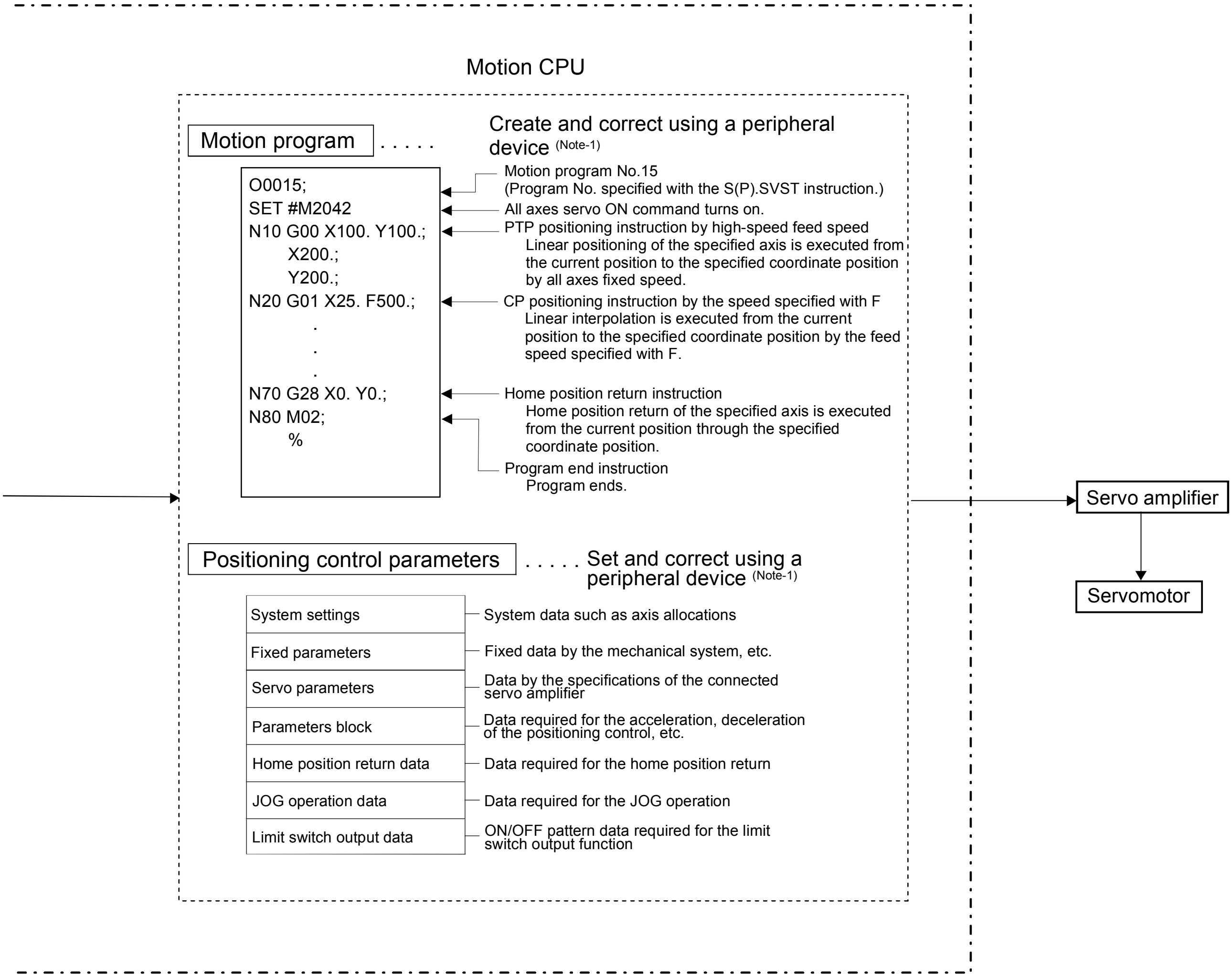
Axis designation program : The travel instruction by G-code and control instruction can be used.
It is started by the S(P).SVST instruction of PLC CPU or CALL, GOSUB/GOSUBE instruction of control program.

Start request of the Motion program

(1) Create the Motion programs and positioning control parameters using a peripheral device.

(2) Perform the positioning start using the PLC program (S(P).SVST instruction) of PLC CPU.
  (a) Motion program No. is specified with the S(P).SVST instruction.
    1) Motion program No. can be set either directly or indirectly.
    2) Start axis No. can be set only directly.

(3) Perform the specified positioning control using the specified with the Motion program.



REMARK

(Note-1) : The following peripheral devices started by the SW6RN-GSV43P can be used.

- The personal computer by which WindowsNT® 4.0/Windows® 98/ Windows® 2000/Windows® XP works. (IBM PC/AT compatible)

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[Execution of the JOG operation]

JOG operation of specified axis is executed using the Motion program in the Motion CPU. JOG operation can also be executed by controlling the JOG dedicated device of specified axis.
An overview of JOG operation is shown below.

Motion CPU control system

Motion program . . . . . Create and correct using a peripheral device (Note-1)

```
O100;
SET #M2042;
N10 IF[[ON #M2415] AND [ON #M2435]] GOTO 20;
GOTO 10;
N20 #D640 = 100000;
#D642L = 100000;
IF [[ON #X003] AND [OFF #M3203]] THEN 1;
SET #M3202;
ELSE 1;
RST #M3202;
END 1;
IF [[ON #X004] AND [OFF #M3202]] THEN 2;
SET #M3203;
ELSE 2;
RST #M3203;
END 2;
    .
    .
    .
N80 M02;
%
```

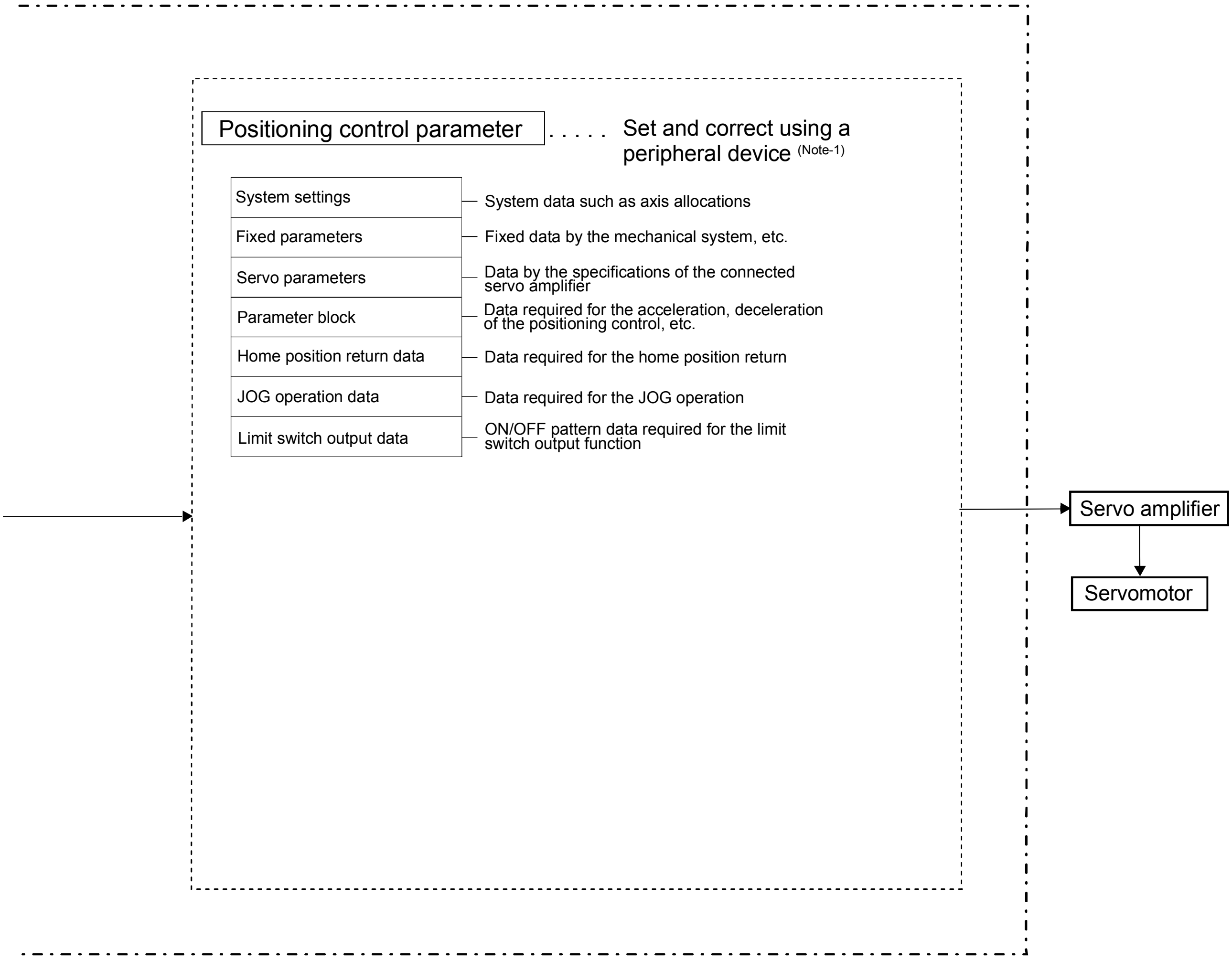
- Motion program No.100 (Program No. specified with the S(P).SFCS instruction.)
- All axes servo ON command turns on.
- Transfer the JOG operation speed to D640L and D642L.
- Program control function instruction: The flow of execute program is controlled by conditions.
- 1 axis forward rotation command SET/RST
- Program control function instruction: The flow of execute program is controlled by conditions.
- 1 axis reverse rotation command SET/RST
- Program end instruction: Program ends.

JOG operation by the JOG dedicated device control

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

(2) Set the JOG speed to the JOG speed setting register for each axis using the Motion program.

(3) Perform the JOG operation while the JOG start command signal is ON in the Motion program.



REMARK

(Note-1) : The following peripheral devices started by the SW6RN-GSV43P can be used.

- The personal computer by which WindowsNT® 4.0/Windows® 98/ Windows® 2000/Windows® XP works. (IBM PC/AT compatible)

[Executing Manual Pulse Generator Operation]

When the positioning control is executed by the manual pulse generator connected to the Q173PX, manual pulse generator operation must be enabled using the Motion program.
An overview of manual pulse generator operation is shown below.

Motion CPU control system

Motion program

```
O100;
SET #M2042;
N10 IF[[ON #M2415] AND [ON #M2435]] GOTO 20;
GOTO 10;
N20 IF[ON #X000] GOTO 30;
GOTO 20;
N30 #D720 = 100;
#D721 = 100;
#D714L = 1;
#D716L = 2;
SET #M2051;
SET #M2052;
N40 IF[OFF #X000] GOTO 50;
GOTO 40;
N50 RST #M2051;
RST #M2052;
M02;
%
```

Motion program No. 100 (Program No. specified with the S(P).SFCS instruction.)
All axes servo ON command turns on.
Wait until axis 1 and axis 2 servo ON.
Wait until manual pulse generator operation start.
Set "axis 1" and "axis 2" 1 pulse input magnification.
Control axis 1 by P1.
Control axis 2 by P2.
Axis 1 and axis 2 manual pulse generator enable flag turn on.
Wait until manual pulse generator operation end.
Axis 1 and axis 2 manual pulse generator enable flag turn off.
Program end instruction
Program ends.

Manual pulse generator operation by the manual pulse generator dedicated device

(Note) : Turn off the axis 1 and axis 2 manual pulse generator enable flag for safety not to continue the manual pulse generator operation at the manual pulse generator operation end.

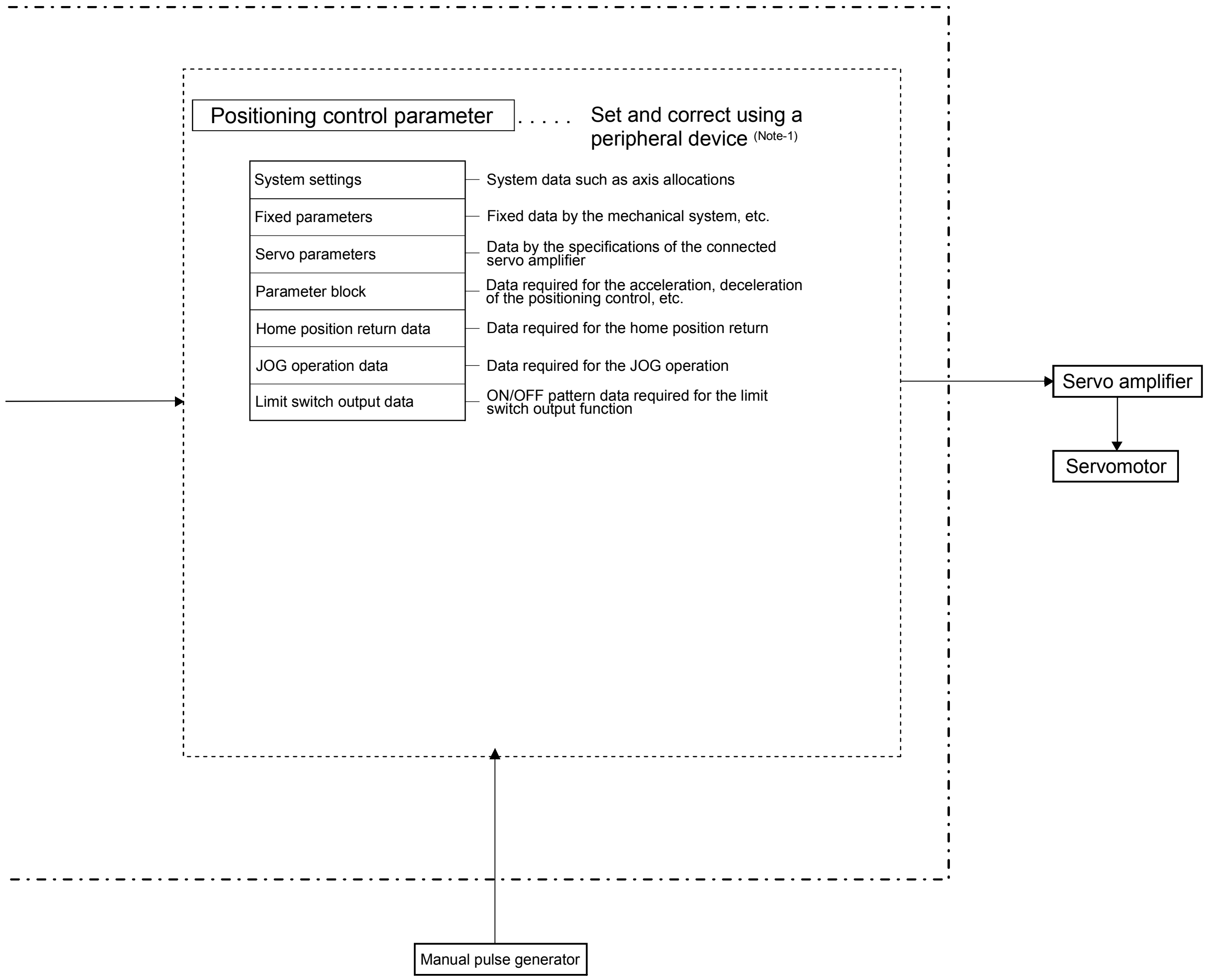
(1) Set the positioning control parameters using a peripheral device.

(2) Set the used manual pulse generator, operated axis No. and magnification for 1 pulse input using the Motion program.

(3) Turn the manual pulse generator enable flag ON using the Motion program
.... Manual pulse generator operation enabled

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

(5) Turn the manual pulse generator enable flag OFF using the Motion program
.... Manual pulse generator operation completion



REMARK

(Note-1) : The following peripheral devices started by the SW6RN-GSV43P can be used.

- The personal computer by which WindowsNT® 4.0/Windows® 98/ Windows® 2000/Windows® XP works. (IBM PC/AT campatible)

(1) Positioning control parameters

There are following seven types as positioning control parameters.
Parameter data can be set and corrected interactively using a peripheral device.

	Item	Description	Reference
1	System settings	Multiple system settings, Motion modules and axis No., etc. are set.	Section 5.1
2	Fixed parameters	Data by such as the mechanical system are set for every axis. They are used for calculation of a command position at the positioning control.	Section 5.2
3	Servo parameters	Data by such as the servo amplifier and motor type with the connected servomotor are set for every axis. They are set to control the servomotors at the positioning control.	(Note-1)
4	Home position return data	Data such as the direction, method and speed of the home position return used at the positioning control are set for every axis.	Section 7.3.1
5	JOG operation data	Data such as the JOG speed limit value and parameter block No. used at the JOG operation are set for every axis.	Section 7.5.1
6	Parameter block	Data such as the acceleration/deceleration time and speed control value at the positioning control are set up to 16 parameter blocks. They are set with the servo program, JOG operation data and home position return data, and it is used to change easily the acceleration/deceleration processing (acceleration/deceleration time and speed limit value) at the positioning control.	Section 5.3
7	Limit switch output data	Output device, watch data, ON section, output enable/disable bit and forced output bit used for the limit output function for every limit output are set.	(Note-2)

(Note-1): Refer to Section 3.3 of the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)".

(Note-2): Refer to Section 4.1 of the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)".

(2) Motion program

The positioning control, JOG operation and manual pulse generator operation are executed in the Motion program. The start request is performed using the PLC program (S(P).SFCS/SVST instruction).

It comprises a Motion program No., G-code, M-code instruction and positioning data.

Refer to Chapter 6 for details.

- Motion program No. .... It is specified using the PLC program (S(P).SFCS/SVST instruction).
- G-code, M-code instruction ..... It indicates the type of positioning control.
- Positioning data .... It is required to execute the G-code, M-code instructions. The required data is fixed for every G-code, M-code instruction.

(3) PLC program

The positioning control by the Motion program can be executed using the Motion dedicated PLC instruction of PLC program.

Refer to Chapter 3 for details.

MEMO

3. MOTION DEDICATED PLC INSTRUCTION

3.1 Motion Dedicated PLC Instruction

(1) The Motion dedicated PLC instruction which can be executed toward the Motion CPU which installed a SV43 operating system software is shown below.

Instruction	Description
S(P).SFCS	Start request of the specified Motion program (Control program)
S(P).SVST	Start request of the specified Motion program (Axis designation program)
S(P).CHGA	Home position return request of the specified axis
S(P).CHGV	Speed change request of the specified axis
S(P).CHGT	Torque control value change request of the specified axis
S(P).DDWR	Write from the PLC CPU to the Motion CPU
S(P).DDRD	Read from the devices of the Motion CPU

(Note) : As for the details of each instruction, it explains after the next section.

3.1.1 Restriction item of the Motion dedicated PLC instruction

(1) To self CPU high speed interrupt accept flag from CPUn.
Common precautions of the Motion dedicated PLC instruction as shown below.

(a) To self CPU high speed interrupt accept flag from CPUn is shown in the following table.
To self CPU high speed interrupt accept flag from CPUn is "No operation" even if the instruction is executed when it is cannot be accepted.
When the Motion dedicated PLC instruction is accepted in the Motion CPU, to self CPU high speed interrupt accept flag from CPUn of the self CPU (Motion CPU) shared CPU memory cannot be accepted and processing toward the instruction for requirement.
When processing is completed and it becomes the condition that it has an instruction accepted, to self CPU high speed interrupt accept flag from CPUn can be accepted.

Shared CPU memory address ( ) is decimal address	Description	Example of the reading (When target is the CPU No.2)
30H(48)	The lowest rank bit (30H(48)) toward executing instruction from CPU No.1.	U3E1/G48.0
31H(49)	The lowest rank bit (31H(49)) toward executing instruction from CPU No.2.	U3E1/G49.0
32H(50)	The lowest rank bit (32H(50)) toward executing instruction from CPU No.3.	U3E1/G50.0
33H(51)	The lowest rank bit (33H(51)) toward executing instruction from CPU No.4.	U3E1/G51.0

(b) "To self CPU high speed interrupt accept flag from CPUn" turn ON/OFF at the executing instruction, when the Multiple CPU dedicated instructions are executed to the same CPU from one PLC CPU.
Therefore, when each instruction is executed only once at approval the executing condition, it is necessary to take an interlock by internal relay (M10) and so on besides "To self CPU high speed interrupt accept flag from CPUn".

(2) Execution of the Motion dedicated PLC instruction

(a) Motion dedicated PLC instruction can be executed with fixed cycle execute type PLC and interrupt PLC. However, as for a complete device, the program turned on according to fixed cycle executed type PLC and program type (scan or low speed) executed interrupt PLC is different.

(b) One Motion CPU can be accepted up to 32 instructions simultaneously from multiple other CPUs. If 33 instructions or more are executed Motion CPU returns the complete status[4C08] error.
As Motion CPU can be accepted up to 32 instructions, number of acceptable instructions changes according to number of CPUs included Motion CPU. Calculation expression is shown below.

(Number of maximum acceptable instructions per one Motion CPU) =
32 – ((Number of all CPUs) – 2) [Number of instructions]

(c) Local devices and file registers as program are written to device by END processing. Do not use the devices below.

- Each instruction complete device
- D1 of S(P).DDRD instruction (The first device of the self CPU which stored the reading data.)

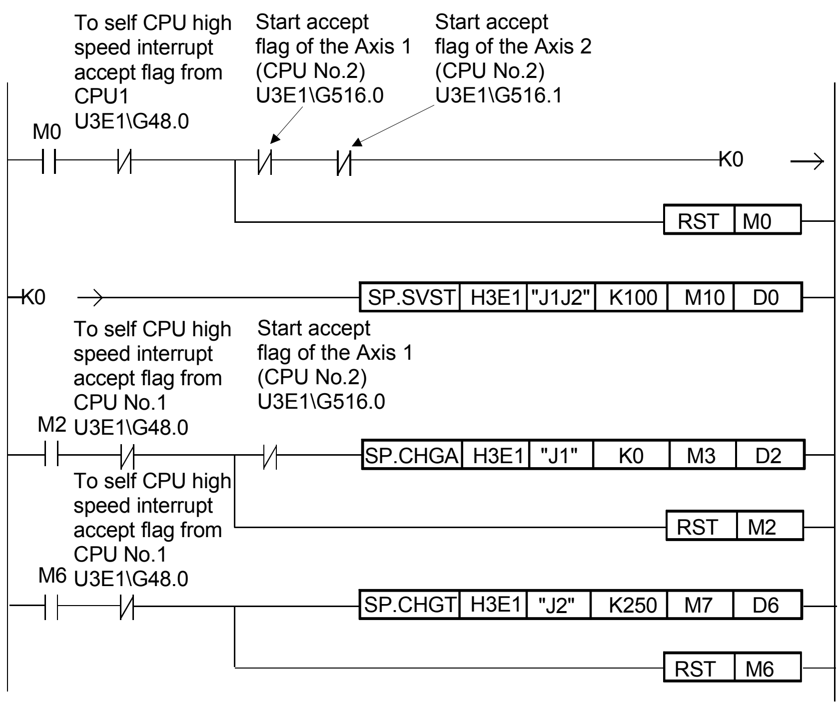
(d) Use a flag in the shared CPU memory which correspond with each instruction not to execute multiple instructions to the same shaft of the Motion CPU of same CPU No. for the interlock condition.
(Program example 1).

(e) S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGVS(P).CHGT/S(P).DDWR/ S(P).DDRD instructions cannot be executed simultaneously. Therefore, it is necessary to take an interlock by to self CPU high speed interrupt accept flag from CPUn.
One PLC CPU can be executed max.32 Motion dedicated PLC instructions simultaneously using to self CPU high speed interrupt accept flag from CPUn.
If 33 instructions or more are executed, the PLC CPU returns the OPERATION ERROR[4107].

(f) When multiple Motion dedicated PLC instructions are directly executed because one contact-point turns on, an instruction may not be executed.
In this case, create a program with reference to program example.
(Program example 2).

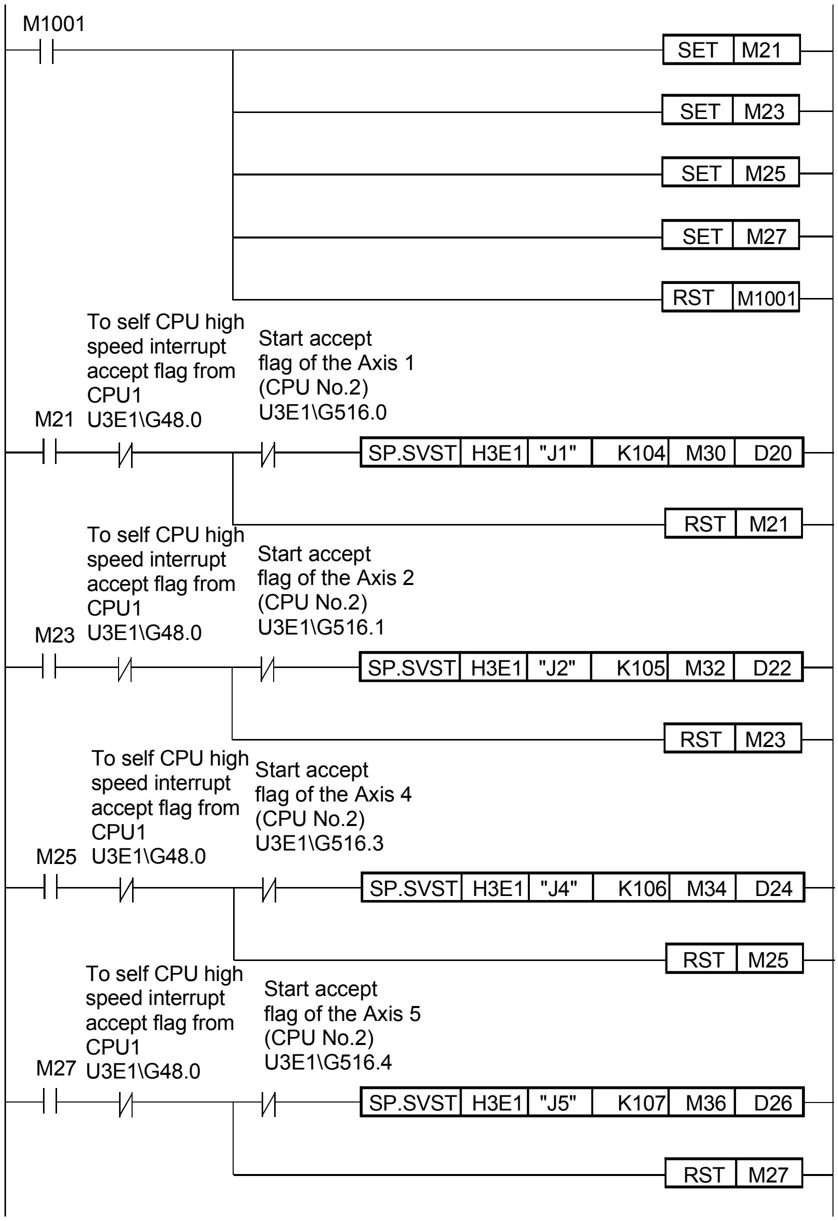
<Program example 1>

Program which executes multiple instructions to the same shaft of the Motion CPU of same CPU No..



<Program example 2>

Program which executes directly multiple Motion dedicated PLC instructions because one contact-point turns on.



POINT

Access from the PLC CPU is processed before the communication processing of the Motion CPU. Therefore, if the Motion dedicated PLC instruction is frequently performed from the PLC CPU, the scan time of the PLC CPU is not only prolonged, but delay will arise in the communication processing of the Motion CPU.
Perform execution of the Motion dedicated PLC instruction from the PLC CPU by S(P).DDWR/S(P).DDRD/S(P).CHGV instruction etc. only at the time of necessity.

(3) Complete status

The error code is stored in the complete status at abnormal completion of the Multiple CPU dedicated instruction. The error code which is stored is shown below. (The error code marked " * " is dedicated with the Motion CPU.)

Complete status (Error code)(H)	Error factor	Corrective action
0	Normal completion	Confirm a program, and correct it to a correct PLC program.
4C00 *	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	
4C01 *	The instruction for the Multiple CPU system which did not be correspond with operating system software of the Motion CPU was executed.	
4C02 *	The Motion program (Control program) No. to start is outside the following range. • The control program is set 1 to1024 • Indirect setting by data register 10000 to 18191 • Indirect setting by motion register 20000 to 28191	
4C03 *	The Motion program (Axis designation program) No. to start is outside the following range. • The control program is set 1 to 1024 • Indirect setting by data register 10000 to 18191 • Indirect setting by motion register 20000 to 28191	
4C04 *	Axis No. set by SVST instruction is injustice.	
4C05 *	Axis No. set by CHGA instruction is injustice.	
4C06 *	Axis No. set by CHGV instruction is injustice.	
4C07 *	Axis No. set by CHGT instruction is injustice.	
4C08 *	• When using the S(P).SFCS/S(P).SVST/S(P).CHGA instruction There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).SFCS, S(P).SVST, S(P).CHGA sum table simultaneously, and the Motion CPU cannot process them. • When using the S(P).DDRD/S(P).DDWR instruction There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).DDRD/S(P).DDWR sum table simultaneously, and the Motion CPU cannot process them.	
4C09 *	CPU No. of the instruction cause is injustice.	
4C0A *	Data error (The instruction which cannot be decoded in the Motion CPU was specified.)	
4C80	H/W error of the target CPU	
4C81		
4C83		
4C84		
4C90	Number over of execute instructions of the target CPU. There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).SFCS, S(P).SVST, S(P).CHGA, S(P).SHGV, S(P).CHGT, S(P).DDRD and S(P).DDWD sum table simultaneously, and the Motion CPU cannot process them.	

(4) Self CPU operation data area used by Motion dedicated instruction (30H to 33H)
The complete status of the to self CPU high speed interrupt accept flag from CPUn is stored in the following address.

Shared CPU memory address	Name	Description
30H(48)	To self CPU high speed interrupt accept flag from CPU1	This area is used to check whether to self CPU high speed interrupt accept flag from CPUn can be accepted or not. 0: To self CPU high speed interrupt accept flag from CPUn accept usable. 1: To self CPU high speed interrupt accept flag from CPUn accept disable.
31H(49)	To self CPU high speed interrupt accept flag from CPU2	
32H(50)	To self CPU high speed interrupt accept flag from CPU3	
33H(51)	To self CPU high speed interrupt accept flag from CPU4	

(5) System area used by Motion dedicated instruction (204H to 20DH)
The complete status of the each flag is stored in the following address.

Shared CPU memory address	Name	Description
204H(516)	Start accept flag (Axis1 to 16)	The start accept flag is stored by the 1 to 32 axis, each bit. (As for a bit's actually being set Q173HCPU : J1 to J32/ Q172HCPU : J1 to J8.) OFF : Start accept flag usable ON : Start accept flag disable b15 … b1 b0 204H(516) address: J16 •••••••• J2 J1 205H(517) address: J32 •••••••• J17
205H(517)	Start accept flag (Axis17 to 32)	
206H(518)	Speed changing flag (Axis1 to 16)	The speed changing flag is stored by the 1 to 32 axis, each bit. (As for a bit's actually being set Q173HCPU : J1 to J32/ Q172HCPU : J1 to J8.) OFF : Start accept usable ON : Start accept disable b15 … b1 b0 206H(518) address: J16 •••••••• J2 J1 207H(519) address: J32 •••••••• J17
207H(519)	Speed changing flag (Axis17 to 32)	

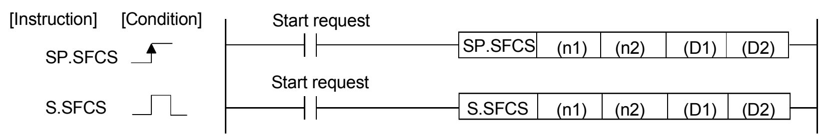
3.2 Motion program (Control program) Start Request from The PLC CPU to The Motion CPU:S(P).SFCS (PLC instruction: S(P).SFCS)

- Motion program (Control program) start request instruction from the PLC CPU to the Motion CPU (S(P).SFCS)

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(n2)		○	○	○	○					○	
(D1)	○	○	○								
(D2)		○	○		○						

○ : Usable △ : Usable partly

(Note) : Setting data (n1) to (D2) : Index qualification possible



[Setting data]

Setting data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(n2)	Motion program (Control program) No. to start.	16-bit binary
(D1)	Complete devices (D1+0) : Device which make turn on for one scan at start accept completion of instruction. (D1+1) : Device which make turn on for one scan at start accept abnormal completion of instruction. ("D1+0" also turns on at the abnormal completion.)	Bit
(D2)	Device to store the complete status.	16-bit binary

(Note-1) : Motion CPU cannot used CPU No.1 in the Multiple CPU configuration.

Set the control program No. to start in (n2). Usable range is shown below.

(1) The control program No. is set
The specified control program No. is started.
In this case, control program is executed from the first block.

(n2) usable range
1 to 1024

(2) The sequence No. (N****) is set in the control program
It can be started in the middle of program.
(a) Indirect setting by data register
D((n2) – 10000 : The control program No. stored in the data register (Motion CPU side) is started.
D((n2) – 10000 + 1) : The sequence No. stored in the data register (Motion CPU side) is started.

(n2) usable range
10000 to 18191

(b) Indirect setting by motion register
#(n2) – 20000 : The control program No. stored in the motion register (Motion CPU side) is started.
#((n2) – 20000 + 1) : The sequence No. stored in the motion register (Motion CPU side) is started.

(n2) usable range
20000 to 28191

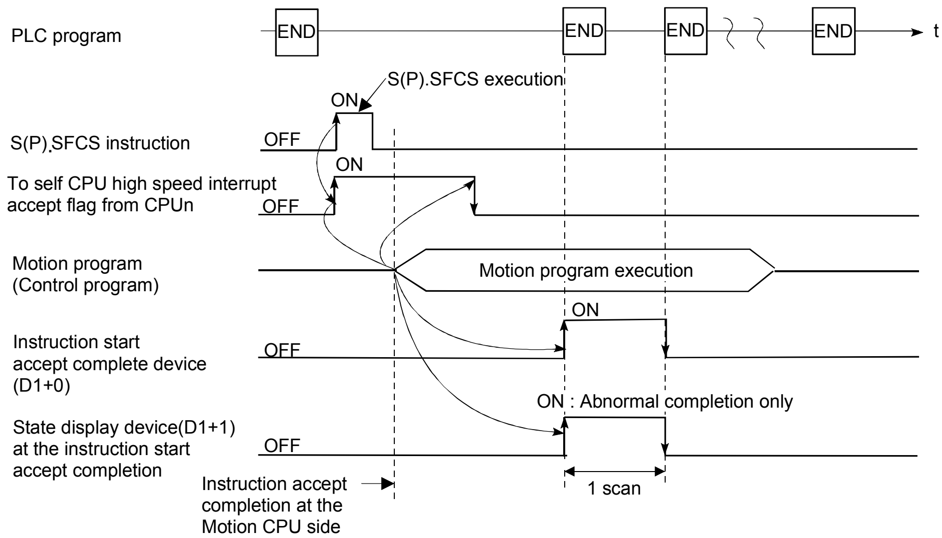
[Description]

(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.

(2) Request to start the Motion program (Control program) specified with (n2).

(3) S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/ S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).SFCS instruction.
When the Motion dedicated PLC instruction is started continuously, it is necessary to execute the next instruction after the complete device of executing instruction turns on.

[Operation of the self CPU at execution of S(P).SFCS instruction]



[Errors]

The abnormal completion in the case shown below, and the error code is stored in the device specified with the complete status storing device (D2).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used ih the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C01	The instruction for the Multiple CPU system which did not be correspond with operating system software of the Motion CPU was executed.	
4C02	The Motion program (Control program) No. to start is outside the following range. • The control program is set 1 to1024 • Indirect setting by data register 10000 to 18191 • Indirect setting by motion register 20000 to 28191	
4C08	There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).SFCS/S(P).SVST and S(P).CHGA sum table simultaneously, and the Motion CPU cannot process them.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

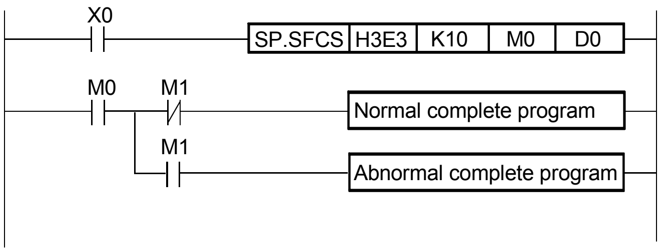
The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4002	Specified instruction is wrong.	
4004	The instruction is composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H is specified by "(First I/O No. of the target CPU)/16" is specified.	

(Note) : 0000H(Normal)

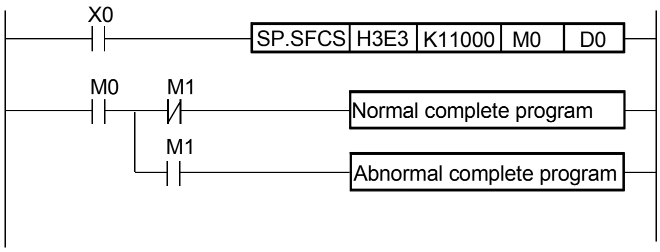
[Program example]

(1) This program starts the Motion program (Control program) No.10 of the Motion CPU No.4.



(2) This program starts the Motion program (Control program) No.30 and sequence No.200 of the Motion CPU No.4 by indirect setting.

PLC program (PLC CPU side)



Motion program (Motion CPU side)

Set the data in the data register of "No. specified with SFCS instruction - 10000".

```
O0010;
D1000 = 30 ; Motion program No.
D1001 = 200 ; Sequence No.
  :
```

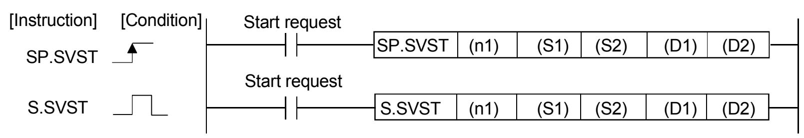
3.3 Motion Program (Axis designation program) Start Request from The PLC CPU to The Motion CPU:S(P).SVST (PLC instruction: S(P).SVST)

• Motion program (Axis designation program) start request instruction from the PLC CPU to the Motion CPU (S(P).SVST)

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(S1)		○	○		○						○
(S2)		○	○	○	○					○	
(D1)	○	○	○								
(D2)		○	○		○						

○ : Usable △ : Usable partly

(Note) : Setting data except (S1) : Index qualification possible



[Setting data]

Setting data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(S1)	Axis No.("Jn") (Note-2) to start. Q173HCPU : J1 to J32/Q172HCPU : J1 to J8	Character sequence
(S2)	Motion program (Axis designation program) No. to start.	16-bit binary
(D1)	Complete devices (D1+0) : Device which make turn on for one scan at start accept completion of instruction. (D1+1) : Device which make turn on for one scan at start accept abnormal completion of instruction. ("D1+0" also turns on at the abnormal completion.)	Bit
(D2)	Device to store the complete status.	16-bit binary

(Note-1) : Motion CPU cannot used CPU No.1 in the Multiple CPU configuration.

(Note-2) : "n" shows the numerical value correspond to axis No..

Q173HCPU : Axis No.1 to No.32 (n=1 to 32) / Q172HCPU : Axis No.1 to No.8 (n=1 to 8)

[Description]

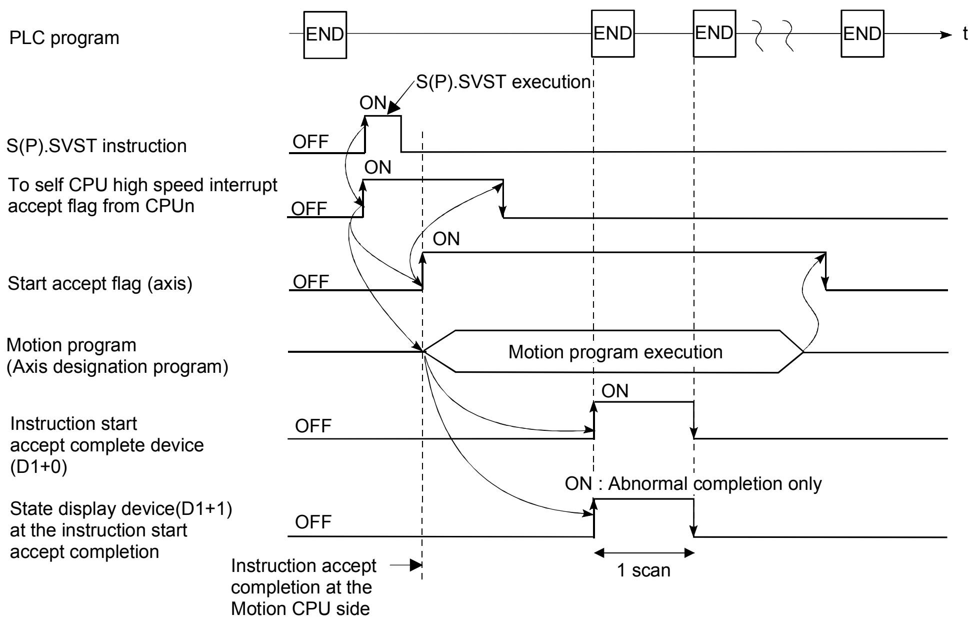
(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.

(2) Request to start the Motion program (Axis designation program) specified with (S2).

(3) S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/ S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).SFCS instruction.
When the Motion dedicated PLC instruction is started continuously, It is necessary to take an inter-lock by the to self CPU high speed interrupt accept flag from CPUn.

(4) It is necessary to take an inter-lock by the start accept flag of the shared CPU memory so that multiple instructions may not be executed toward the same axis of the same Motion CPU No..

[Operation]



(1) The start accept status of each axis can be confirmed with the start accept flag in the shared CPU memory of target CPU.

(2) S(P).SVST instruction accepting and normal/abnormal completion can be confirmed with the complete device(D1) or status display device(D2) at the completion.

(a) Complete device
It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

(b) Status display device at the completion
It is turned on/off according to the status of the instruction completion.
- Normal completion : OFF
- Abnormal completion : It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

[Setting range]

(1) Setting of the starting axis
The starting axis set as (S1) sets J + Axis No. in a character sequence " ".

	(S1) usable range
Q173HCPU	1 to 32
Q172HCPU	1 to 8

Up to 8 axes can be set. If multiple axes are set, it sets without dividing in a space etc,.
The axis No. set in the system setting is used as the axis No. to start.
Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)" for system settings.
And, the axis No. to start does not need to be a order.

Example) When multiple axes (Axis1, Axis2, Axis10, Axis11)are set.
"J1J2J10J11"

(2) Setting of the Motion program (Axis designation program) No.
The usable range of axis designation program No. to set (S2) is checked in the Motion CPU side.

(a) The control program No. is set
The specified axis designation program is started.
In this case, axis designation program is executed from the first block.

(S2) usable range
1 to 1024

(b) The sequence No. (N****) / parameter block No. in the control program is set It can be started in the middle of program.

1) Indirect setting by data register

D((S2) – 10000) : The axis designation program No. stored in the data register (Motion CPU side) is started.

D((S2) – 10000 + 1) : The sequence No. stored in the data register (Motion CPU side) is started.

D((S2) – 10000 + 2) : The parameter block No. stored in the data register (Motion CPU side) is started.

(S2) usable range
10000 to 18191

2) Indirect setting by motion register

#((S2) – 20000) : The axis designation program No. stored in the motion register (Motion CPU side) is started.

#((S2) – 20000 + 1) : The sequence No. stored in the motion register (Motion CPU side) is started.

#((S2) – 20000 + 2) : The parameter block No. stored in the motion register (Motion CPU side) is started.

(S2) usable range
20000 to 28191

[Start accept flag (System area)]

The complete status of the start accept flag is stored in the address of the start accept flag in the shared CPU memory.

<table>
<tr><th>Shared CPU memory address
( ) is decimal address</th><th>Description</th></tr>
<tr><td>204H(516)
205H(517)</td><td>The start accept flag is stored by the 1 to 32 axis, each bit.
(As for a bit's actually being set Q173HCPU : J1 to J32/ Q172HCPU : J1 to J8.)
OFF : Start accept flag usable
ON : Start accept flag disable
<table>
<tr><td></td><td>b15</td><td></td><td>b1</td><td>b0</td></tr>
<tr><td>204H(516) address</td><td>J16</td><td>• • • • • • • •</td><td>J2</td><td>J1</td></tr>
<tr><td>205H(517) address</td><td>J32</td><td>• • • • • • • •</td><td></td><td>J17</td></tr>
</table>
</td></tr>
</table>

[Errors]

The abnormal completion in the case shown below, and the error code is stored in the device specified with the complete status storing device (D2).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C01	The instruction for the Multiple CPU system which did not be correspond with operating system software of the Motion CPU was executed.	
4C03	The Motion program (Axis designation program) No. to start is outside the following range. • The control program is set 1 to 1024 • Indirect setting by data register 10000 to 18191 • Indirect setting by motion register 20000 to 28191	
4C04	Axis No. set by SVST instruction is injustice.	
4C08	There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).SFCS, S(P).SVST and S(P).CHGA sum table simultaneously, and the Motion CPU cannot process them.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

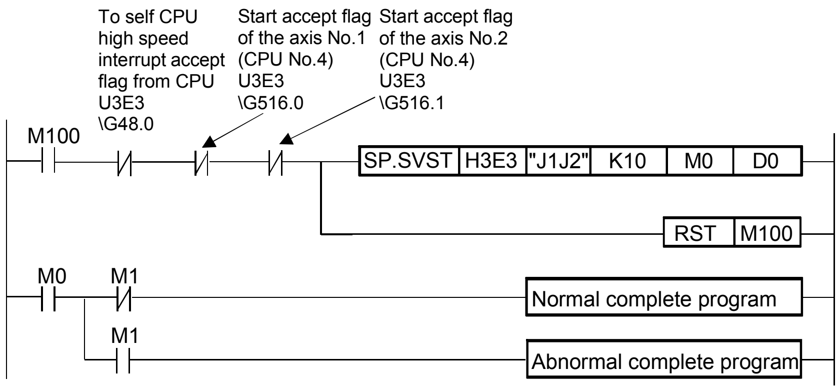
The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU is by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4004	The instruction be composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H is specified by "(First I/O No. of the target CPU)/16" is specified.	

(Note) : 0000H(Normal)

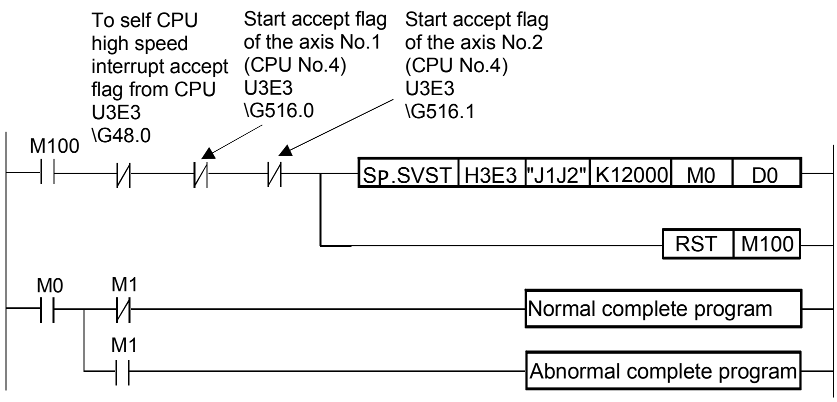
[Program example]

(1) Program which requests to start the Motion program (Axis designation program) No.10 toward axis No.1 and No.2 of the Motion CPU No.4. from the PLC CPU No.1.



(2) Program which requests to start the Motion program (Axis designation program) No.20, sequence No. 100 and parameter block No.30 toward axis No.1 and No.2 of the Motion CPU No.4 by indirect setting from the PLC CPU No.1.

Sequence program (PLC CPU side)



Motion program (Motion CPU side)

Set the data in the data register of "No. specified with SVST instruction - 10000".

```
O0015;
D2000 = 20; Motion program No.
D2001 = 100; Sequence No.
D2002 = 30; Parameter block No.
 ⋮
```

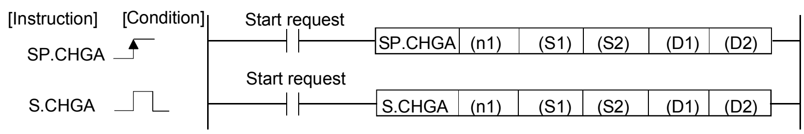
3.4 Home position return instruction from The PLC CPU to The Motion CPU: S(P).CHGA (PLC instruction: S(P).CHGA)

• Home position return instruction from the PLC CPU to the Motion CPU (S(P).CHGA)

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(S1)		○	○		○						○
(S2)		○	○	○	○					○	
(D1)	○	○	○								
(D2)		○	○		○						

○ : Usable △ : Usable partly

(Note) : Setting data except (S1) : Index qualification possible



[Setting data]

Setting data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(S1)	Axis No. ("Jn") (Note-2) to execute the home position return. Q173HCPU : J1 to J32/Q172HCPU : J1 to J8	Character sequence
(S2)	Dummy (Set the any of constant etc.)	32-bit binary
(D1)	Complete devices (D1+0) : Device which make turn on for one scan at start accept completion of instruction. (D1+1) : Device which make turn on for one scan at start accept abnormal completion of instruction. ("D1+0" also turns on at the abnormal completion.)	Bit
(D2)	Device to store the complete status.	16-bit binary

(Note-1) : Motion CPU cannot used CPU No.1 in the Multiple CPU configuration.

(Note-2) : "n" shows the numerical value which correspond to axis No..

Q173HCPU : Axis No.1 to No.32 (n=1 to 32) / Q172HCPU : Axis No.1 to No.8 (n=1 to 8)

[Description]

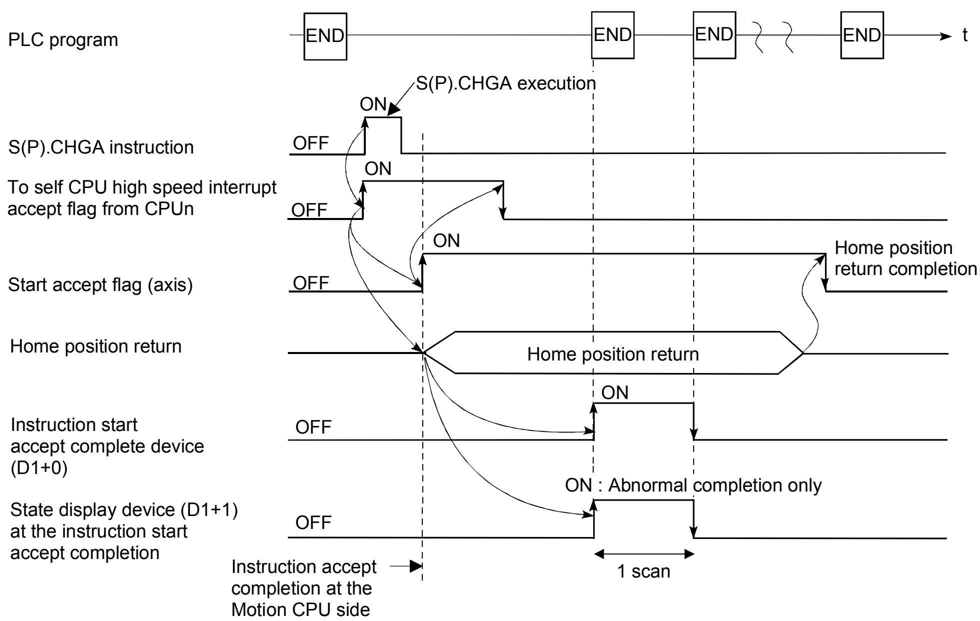
(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.

(2) Execute the home position return of axis (stopped axis) No. specified with (S1) .

(3) S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/ S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).CHGA instruction.
When the Motion dedicated PLC instruction is started continuously, It is necessary to take an inter-lock by the to self CPU high speed interrupt accept flag from CPUn.

(4) It is necessary to take an inter-lock by the start accept flag of the shared CPU memory so that multiple instructions may not be executed toward the same axis of the same Motion CPU No..

[Operation]



(1) The start accept status of each axis can be confirmed with the start accept flag in the shared CPU memory of target CPU.

(2) S(P).CHGA instruction accepting and normal/abnormal completion can be confirmed with the complete device (D1) or status display device (D2) at the completion.

(a) Complete device
It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

(b) Status display device at the completion
It is turned on/off according to the status of the instruction completion.
- Normal completion : OFF
- Abnormal completion : It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

[Setting range]

(1) Setting of axis to execute the home position return.
The starting axis set as (S1) sets J + Axis No. in a character sequence " ".

	(S1) usable range
Q173HCPU	1 to 32
Q172HCPU	1 to 8

The number of axes which can set are only 1 axis.
The axis No. set in the system setting is used as the axis No. to start.
Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)" for system settings.

[Start accept flag (System area)]

The complete status of the start accept flag is stored in the address of the start accept flag in the shared CPU memory.

Shared CPU memory address ( ) is decimal address	Description
204H(516) 205H(517)	The start accept flag is stored by the 1 to 32 axis, each bit. (As for a bit's actually being set Q173HCPU : J1 to J32/ Q172HCPU : J1 to J8.) OFF : Start accept flag usable ON : Start accept flag disable b15 b1 b0 204H(516) address J16 • • • • • • • • • J2 J1 205H(517) address J32 • • • • • • • • • J17

[Errors]

The abnormal completion in the case shown below, and the error code is stored in the device specified with the complete status storing device (D2).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C01	The instruction for the Multiple CPU system which did not be correspond with operating system software of the Motion CPU was executed.	
4C05	Axis No. set by CHGA instruction is injustice.	
4C08	There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).SFCS, S(P).SVST and S(P).CHGA sum table simultaneously, and the Motion CPU cannot process them.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

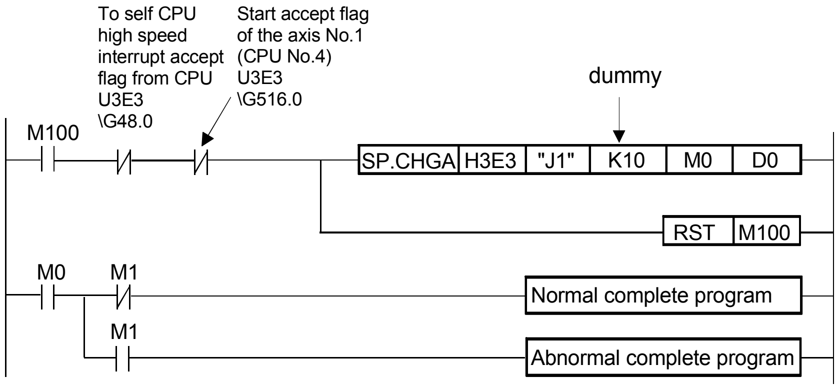
The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4004	The instruction is composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H by "(First I/O No. of the target CPU)/16" is specified.	

(Note) : 0000H(Normal)

[Program example]

Program which execute the home position return of the axis No.1 of the Motion CPU (CPU No.4) from PLC CPU (CPU No.1).



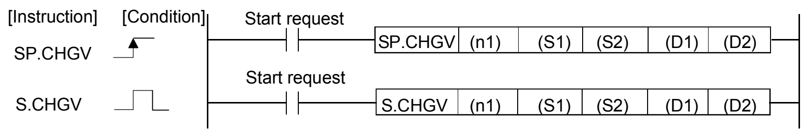
3.5 Speed Change Instruction from The PLC CPU to The Motion CPU: S(P).CHGV (PLC instruction: S(P).CHGV)

• Speed change instruction (S(P).CHGV)

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(S1)		○	○		○						○
(S2)		○	○	○	○					○	
(D1)	○	○	○								
(D2)		○	○		○						

○ : Usable △ : Usable partly

(Note) : Setting data except (S1) : Index qualification possible



[Setting data]

Setting data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(S1)	Axis No.("Jn") (Note-2) to execute the speed change. Q173HCPU : J1 to J32/Q172HCPU : J1 to J8	Character sequence
(S2)	Setting of the current value to change.	32-bit binary
(D1)	Complete devices (D1+0) : Device which make turn on for one scan at start accept completion of instruction. (D1+1) : Device which make turn on for one scan at start accept abnormal completion of instruction. ("D1+0" also turns on at the abnormal completion.)	Bit
(D2)	Device to store the complete status.	16-bit binary

(Note-1) : Motion CPU cannot used CPU No.1 in the Multiple CPU configuration.

(Note-2) : "n" shows the numerical value which correspond to axis No..

Q173HCPU : Axis No.1 to No.32 (n=1 to 32) / Q172HCPU : Axis No.1 to No.8 (n=1 to 8)

[Description]

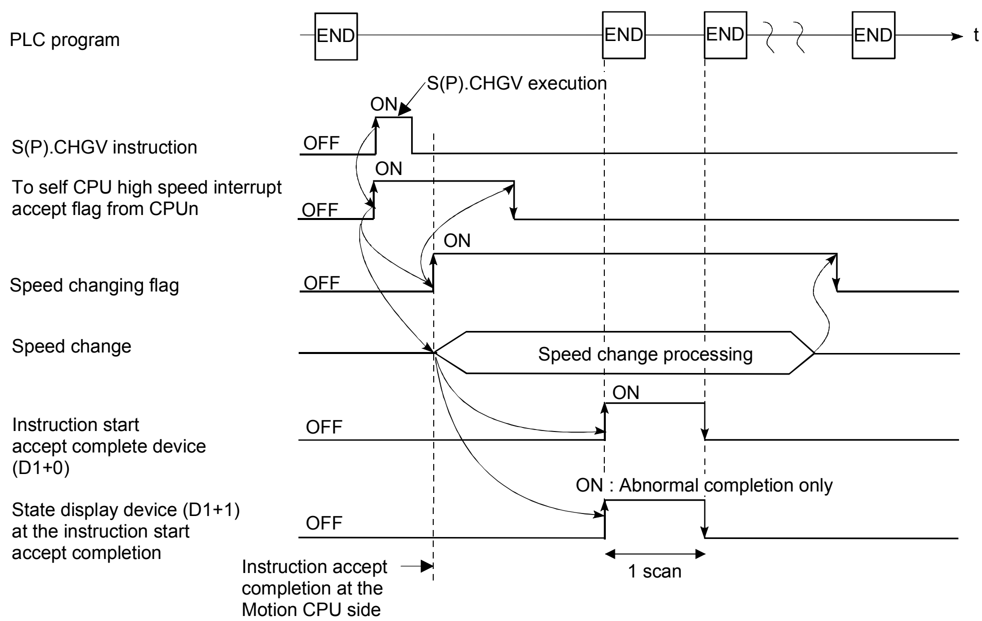
(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.

(2) The speed change is executed of the axis specified with (S1) during positioning or JOG operating.

(3) S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).CHGV instruction.
When the Motion dedicated PLC instruction is started continuously, It is necessary to take an inter-lock by the to self CPU high speed interrupt accept flag from CPUn.

(4) It is necessary to take an inter-lock by the speed changing flag of the shared CPU memory so that multiple instructions may not be executed toward the same axis of the same Motion CPU No..

[Operation]



[Setting range]

(1) Setting of axis to execute the speed change.
The axis to execute the speed change set as (S1) sets J + axis No. in a character sequence " ".

	(S1) usable range
Q173HCPU	1 to 32
Q172HCPU	1 to 8

The number of axes which can set are only 1 axis.
The axis No. set in the system setting is used as the axis No. to start.
Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)" for system settings.

(2) Setting of the speed to change.
mm : -6000000 to 6000000 $\times 10^{-2}$ [mm/min]
inch : -6000000 to 6000000 $\times 10^{-3}$ [inch/min]
degree(Note) : -2147483648 to 2147483647 $\times 10^{-3}$ [degree/min]
(Note) : When the "speed control 10 $\times$ multiplier setting for degree axis" is set to "valid", the setting range is "-2147483648 to 2147483647".

[Speed changing flag (System area)]

The complete status of the start accept flag is stored in the address of the start accept flag in the shared CPU memory.

Shared CPU memory address ( ) is decimal address	Description
206H(518) 207H(519)	The start accept flag is stored by the 1 to 32 axis, each bit. (As for a bit's actually being set Q173HCPU : J1 to J32/ Q172HCPU : J1 to J8.) OFF : Start accept usable ON : Start accept disable b15 ········· b1 b0 206H(518) address: J16 ········· J2 J1 207H(519) address: J32 ········· J17

[Errors]

The abnormal completion in the case shown below, and the error code is stored in the device specified with the complete status storing device (D2).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C01	The instruction for the Multiple CPU system which did not be correspond with operating system software of the Motion CPU was executed.	
4C06	Axis No. set by CHGV instruction is injustice.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4004	The instruction is composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H by "(First I/O No. of the target CPU)/16" is specified.	

(Note) : 0000H(Normal)

In this following case, the minor error (control change error) occurs, speed change is not execute. At this time, the error detection flag (M2047 + 20n) of Motion CPU turns on, an error code is stored in the minor error code area of the applicable axis.

- When the axis specified with (S1) is executing the home position return at the speed change.
- When the axis specified with (S1) is executing the deceleration at the speed change.
- When the speed specified with (S2) is outside the range of 0 to speed limit value.

Moving Backward during Positioning

When a speed change is made to a negative speed by the CHGV instruction, the travel direction can be changed to the direction opposite to the intended positioning direction. Operation for each instruction is as follows.

<table>
<tr><th>G-code Instruction</th><th colspan="2">Operation</th></tr>
<tr><td>G00
G28 (High-speed home position return)
G30
G53</td><td colspan="2" rowspan="2">The axis is reversed in travel direction, returns to the positioning start point at the specified speed, and stops (stands by) there.</td></tr>
<tr><td>G02
G03</td></tr>
<tr><td>G01
G32</td><td colspan="2">The axis is reversed in travel direction, returns to the preceding point at the specified speed, and stops (waits) there.</td></tr>
<tr><td>G25</td><td rowspan="2">Speed change cannot be made.</td><td>Minor error (Error code : 310) (Note) occurs.</td></tr>
<tr><td>G28 (Proximity dog, count, data set, dog cradle, stopper and limit switch combined type home position return)</td><td>Minor error (Error code : 301) (Note) occurs.</td></tr>
<tr><td>JOG operation</td><td>Speed change to negative speed is not made.
Speed is controlled at speed limit value.</td><td>Minor error (Error code : 305) (Note) occurs.</td></tr>
</table>

(Note) : Minor error (Error code : 301) : Speed change was made during home position return.
Minor error (Error code : 305) : Preset speed is outside the range of 0 to speed limit value.
Minor error (Error code : 310) : Speed change was made during high-speed oscillation.

[Description]

(1) When a speed change is made to negative speed, speed is controlled as listed above according to the G-code in execution.

(2) The backing command speed is the absolute value of the new speed. If it exceeds the speed limit value, a minor error (Error code : 305) occurs and the speed is controlled at the speed limit value.

(3) When the axis is standing by at the return position

(a) Signal states

• Start accept (M2001 + 20n)	ON (Remains unchanged from before execution of CHGV)
• Positioning start completion (M2400 + 20n)	ON (Remains unchanged from before execution of CHGV)
• Positioning completion (M2401 + 20n)	OFF
• In-position (M2402 + 20n)	ON
• Command in-position (M2403 + 20n)	OFF
• Speed change "0" accepting flag (M2240 + n)	ON

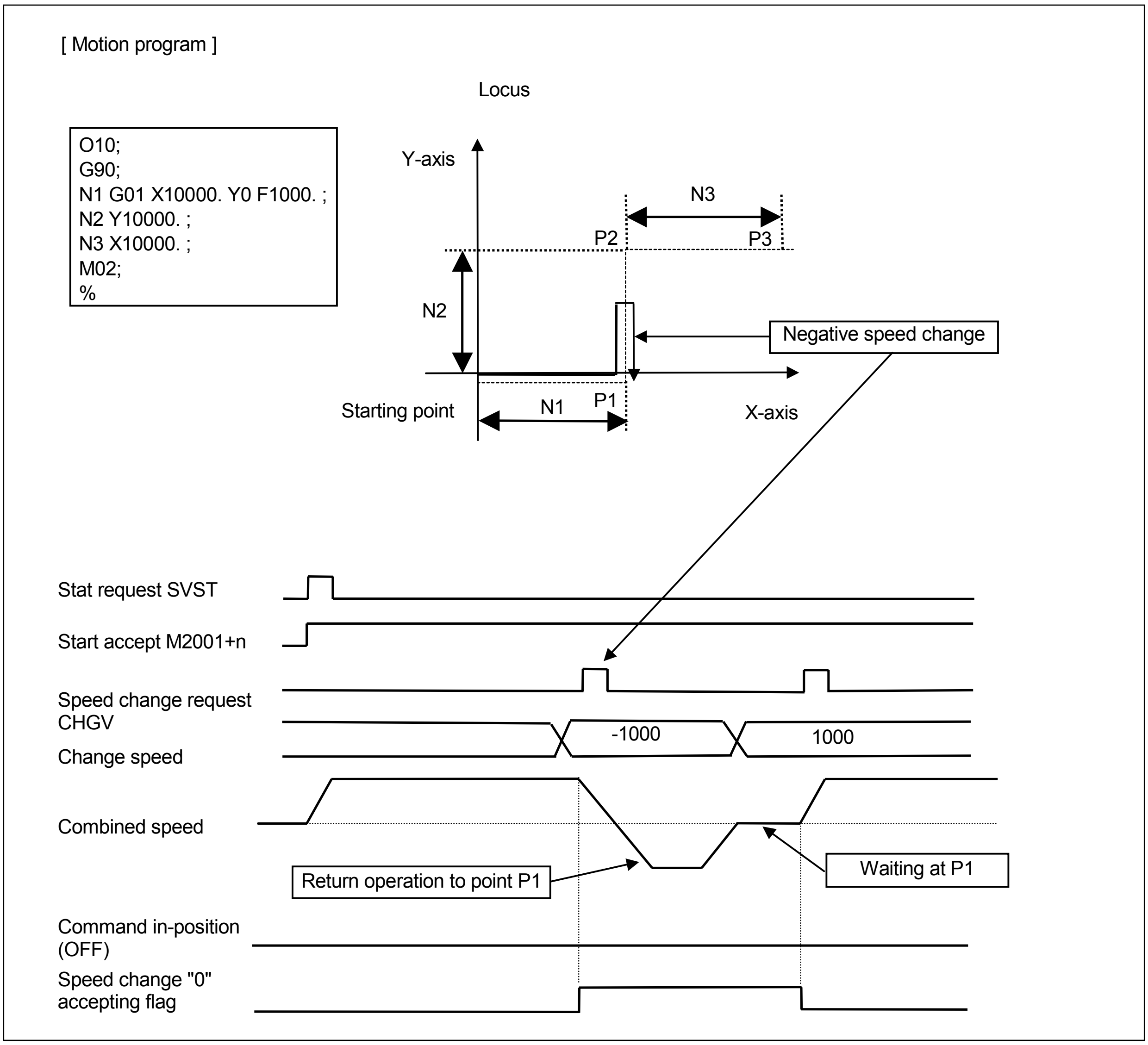
(b) When re-starting, make a speed change to positive speed.

(c) When positioning is end, turn on the stop command.

(d) When a negative speed change is executed again after negative speed completion, CHGV instruction is ignored.

(4) When the complete round is set in G02, G03, do not execute the negative speed change by CHGV instruction.

[Operation Example under G01]



When a speed change is made to negative speed during positioning to P2 in the N2 block as shown above, the axis returns to P1 along the track specified in the program and stands by at P1.

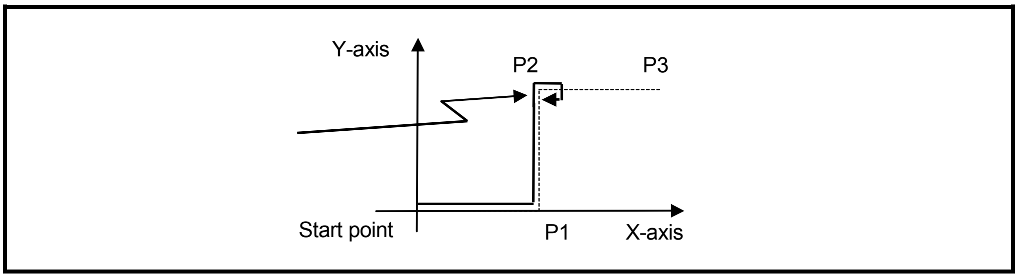
(1) A speed change to negative speed is invalid (ignored), even if it is made again during the standby after returning to P1.

.

(2) The start accept flag (M2001+n) remains ON during the standby in P1.Turn on the stop command to end the positioning at this point.

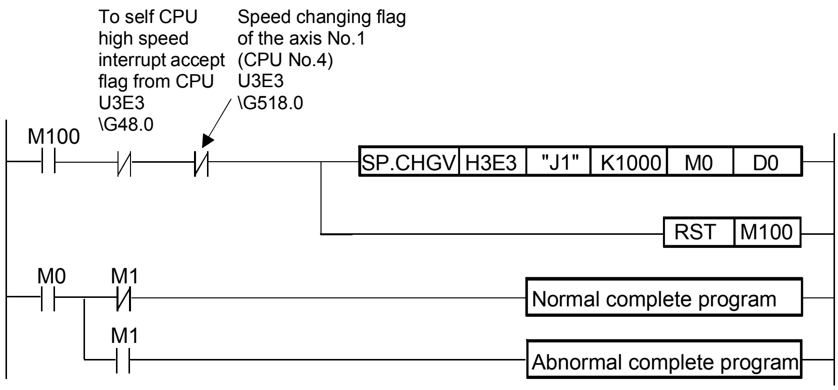
(3) A speed change to negative speed is ignored if it is made during stop by the waiting for FIN using the M-code FIN signal waiting function in the constant-speed control.

(4) In the above example, the axis returns to P2 even if the axis passes through P2 during a speed change made to negative speed immediately before P2.



[Program example]

Program which changes the positioning speed of the axis No.1 of the Motion CPU (CPU No.4) from PLC CPU (CPU No.1) to 1000.



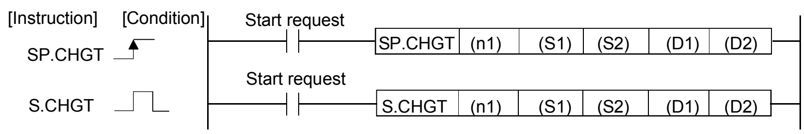
3.6 Torque Limit Value Change Request Instruction from The PLC CPU to The Motion CPU: S(P).CHGT (PLC instruction: S(P).CHGT)

- Torque limit value change request instruction from the PLC CPU to the Motion CPU (S(P).CHGT)

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(S1)		○	○		○						○
(S2)		○	○	○	○					○	
(D1)	○	○	○								
(D2)		○	○		○						

○ : Usable △ : Usable partly

(Note) : Setting data except (S1) : Index qualification possible



[Setting data]

Setting data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(S1)	Axis No.("Jn") (Note-2) to execute the torque limit value change. Q173HCPU : J1 to J32/Q172HCPU : J1 to J8	Character sequence
(S2)	Setting of the torque limit value change to change.	16-bit binary
(D1)	Complete devices (D1+0) : Device which make turn on for one scan at start accept completion of instruction. (D1+1) : Device which make turn on for one scan at start accept abnormal completion of instruction. ("D1+0" also turns on at the abnormal completion.)	Bit
(D2)	Device to store the complete status.	16-bit binary

(Note-1) : Motion CPU cannot used CPU No.1 in the Multiple CPU configuration.

(Note-2) : "n" shows the numerical value which correspond to axis No..
Q173HCPU : Axis No.1 to No.32 (n=1 to 32) / Q172HCPU : Axis No.1 to No.8 (n=1 to 8)

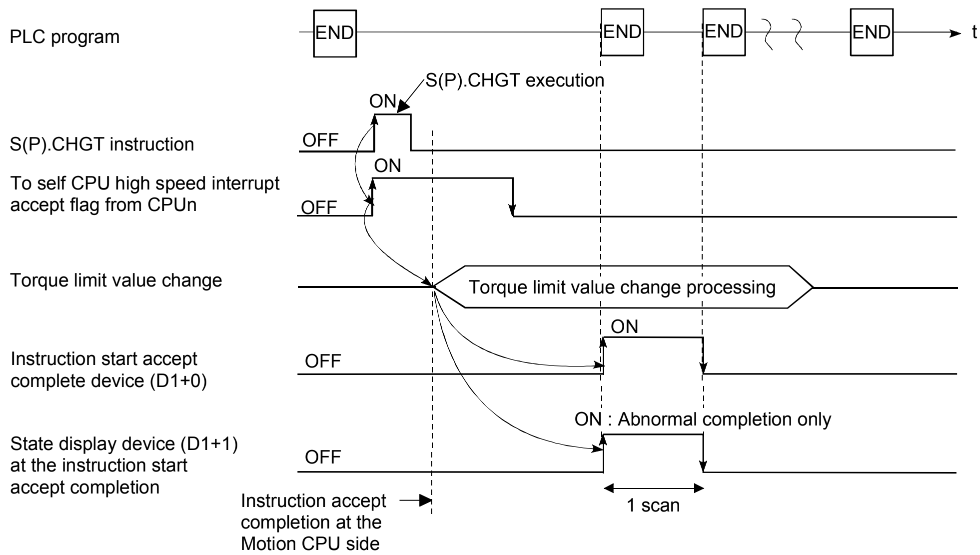
[Description]

(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.

(2) The torque limit value of the axis specified with (S1) is changed to the value of (S2) regardless of the state of during operating or stopping.

(3) S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/ S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).CHGT instruction.
When the Motion dedicated PLC instruction is started continuously, It is necessary to take an inter-lock by the to self CPU high speed interrupt accept flag from CPUn.

[Operation]



[Setting range]

(1) Setting of the axis to execute the torque limit value change.
The axis to execute the torque limit change set as (S1) sets J + axis No. in a character sequence " ".

	(S1) usable range
Q173HCPU	1 to 32
Q172HCPU	1 to 8

The number of axes which can set are only 1 axis.
The axis No. set in the system setting is used as the axis No. to start.
Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)" for system settings.

(2) Setting of the torque limit value to change.

(S2) usable range
1 to 1000

[Errors]

The abnormal completion in the case shown below, and the error code is stored in the device specified with the complete status storing device (D2).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C01	The instruction for the Multiple CPU system which did not be correspond with operating system software of the Motion CPU was executed.	
4C07	Axis No. set by CHGT instruction is injustice.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

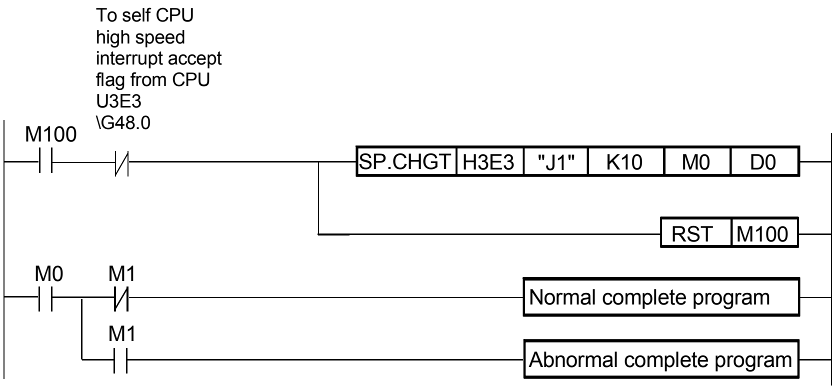
The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4004	The instruction is composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H by "(First I/O No. of the target CPU)/16" is specified.	

(Note) : 0000H(Normal)

[Program example]

Program which changes the torque limit value of the axis No.1 of the Motion CPU (CPU No.4) from PLC CPU (CPU No.1) to 10[%].



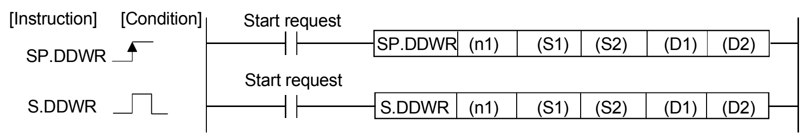
3.7 Write from The PLC CPU to The Motion CPU: S(P).DDWR (PLC instruction: S(P).DDWR)

• Write instruction from the PLC CPU to the Motion CPU (S(P).DDWR)

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(S1)		○	○		○						
(S2)		○	○	△	○						
(D1)		○		△	○						
(D2)	○	○	○								

○ : Usable △ : Usable partly

(Note) : Setting data (n1) to (D2) : Index qualification possible



[Data to be set]

Set data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.1 : 3E0H, CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(S1)	First device of the self CPU in which control data is stored.	16-bit binary
(S2)	First device of the self CPU in which writing data is stored.	
(D1)	First device of the target Motion CPU which stores the writing data.	
(D2)	Bit device which make turn on for one scan at completion of instruction.	Bit

(Note-1) : Motion CPU cannot used CPU No.1 at the Multiple CPU configuration.

[Control data]

Device	Item	Setting data	Setting range	Set by
S1+0	Complete status	The condition result at the completion of the instruction is stored. 0 : No error (Normal completion) Except 0 : Error code	—	System
S1+1	Number of writing data	Set the number of writing data	1 to 16	User

[Controls]

(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.
A part for the number of writing data of the control data specified with (S1) of data since the device specified with (S2) of the self CPU are stored to since the word device specified with (D1) of the target CPU (n1) in the Multiple CPU system.

(2) Figure specification of the bit device is possible for (S2) and (D1). However, figure specification is 4 figures and a start bit device number is only the multiple of 16. It becomes INSTRCT CODE ERROR [4004] when other values are specified.

(3) If the target CPU is not instruction acceptable condition, even if the S(P).DDWR instruction is executed, it may not be processed. In this case, it is necessary to execute the S(P).DDWR instruction again.
(S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/ S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).DDWR instruction.). It can be confirmed by data in the shared CPU memory of the target CPU (Motion CPU) whether the instruction is acceptable or not.
When the Motion dedicated PLC instruction is started continuously, it is must be design to execute next instruction after executing instruction complete device on.

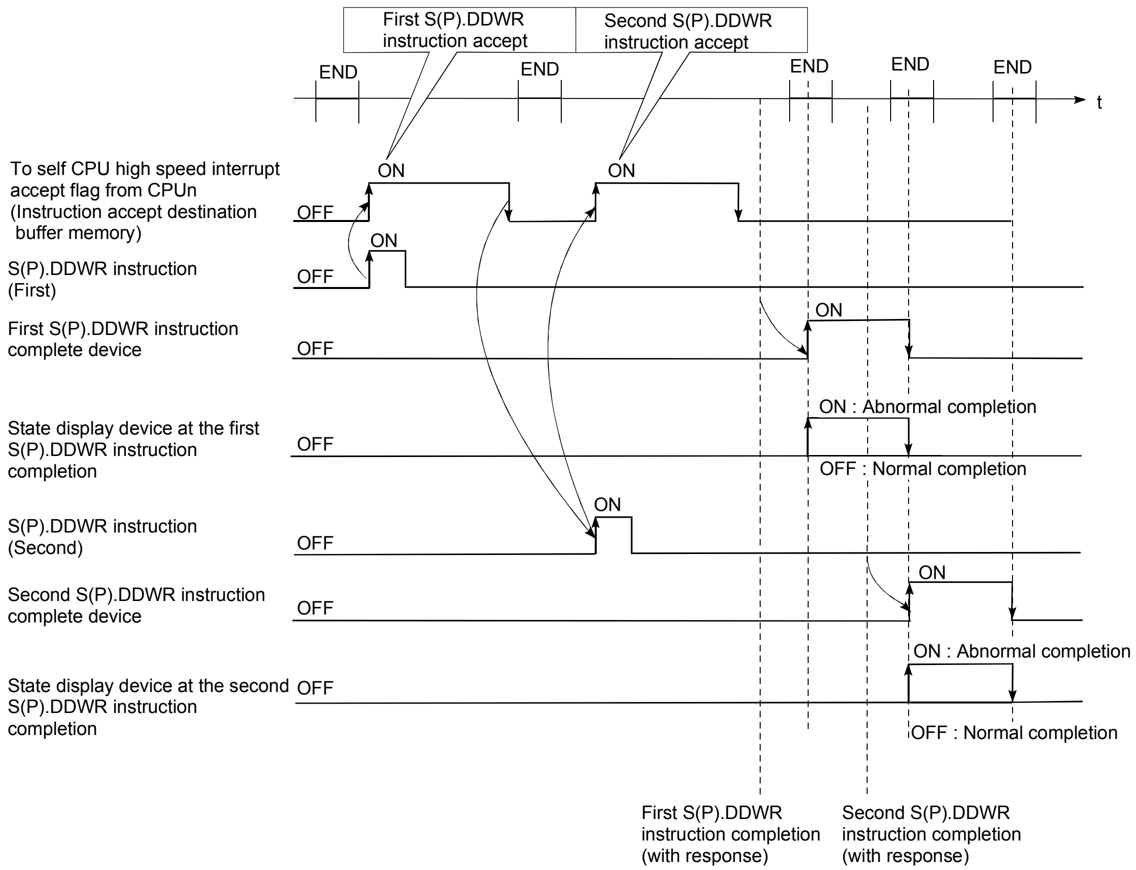
(4) The target CPU device range check is not executed with self CPU at the S(P).DDWR instruction execution, but it checks by the target CPU side, and it becomes abnormal completion at the device range over.

(5) S(P).DDWR instruction accepting and normal/abnormal completion can be confirmed with the complete device (D1) or status display device (D2) at the completion.
   (a) Complete device
   It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

   (b) Status display device at the completion
   It is turned on/off according to the status of the instruction completion.
   - Normal completion : OFF
   - Abnormal completion : It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

(6) SM390 turns on when the target CPU specified with (n1) complete to accept.
SM390 turns off when the target CPU specified with (n1) cannot be write correctly by the reset status or error factor (5000 to 5999).

[Operation of the self CPU at execution of S(P).DDWR instruction]



[Errors]

The abnormal completion in the case shown below, and the error code is stored in the control data (S1+ 0 : Complete status).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C08	There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).DDRD and S(P).DDWR sum table simultaneously, and the Motion CPU cannot process them.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

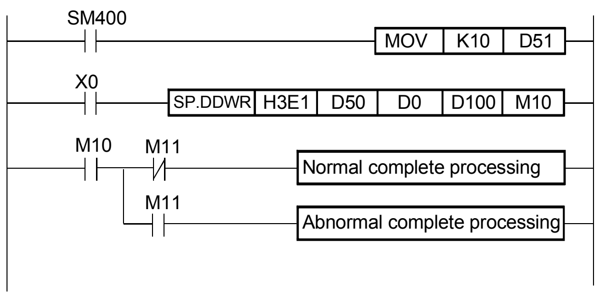
Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4002	Specified instruction is wrong.	
4004	The instruction is composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H is specified by "(First I/O No. of the target CPU)/16" is specified.	
4101	Number of the writing data is except 1 to 16.	
	Number of writing data exceeds range of the storage device of the written data.	

(Note) : 0000H(Normal)

[Program example]

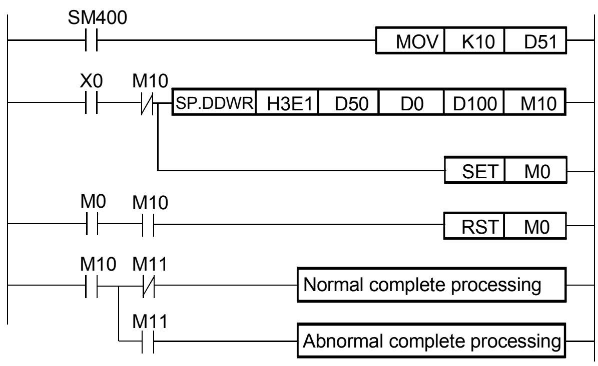
<Example 1>

Program which stores 10 points worth of the data from D0 of the self CPU (CPU No.1) since D100 of CPU No.2., when X0 is turned on.



<Example 2>

Program which stores 10 points worth of the data from D0 of the self CPU (CPU No.1) since D100 of CPU No.2. during turn on X0.



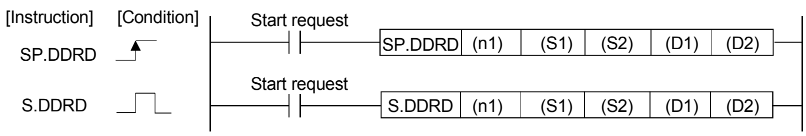
3.8 Read from The Devices of The Motion CPU: S(P).DDRD (PLC instruction: S(P).DDRD)

• Read instruction from the devices of the Motion CPU : S(P).DDRD

Setting data (Note)	Usable devices										
	Internal devices (System, User)		File register	Bit digit specified	Indirectly specified device	MELSECNET/10 direct J□\□		Special function module U□\G□	Index register Z□	Constant K, H	Other
	Bit	Word				Bit	Word				
(n1)		○	○	○	○					○	
(S1)		○	○		○						
(S2)		○		△	○						
(D1)		○	○	△	○						
(D2)	○	○	○								

○ : Usable　　△ : Usable partly

(Note) : Setting data (n1) to (D2) : Index qualification possible



[Setting data]

Set data	Description	Data type
(n1)	(First I/O No. of the target CPU)/16 Value to specify actually is the following. (Note-1) CPU No.1 : 3E0H, CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H	16-bit binary
(S1)	First device of the self CPU in which control data is stored.	
(S2)	First device of the target CPU in which reading data is stored.	
(D1)	First device of the self CPU which stores the reading data.	
(D2)	Bit device which make turn on for one scan at completion of instruction.	Bit

(Note-1) : Motion CPU cannot used CPU No.1 in the Multiple CPU configuration.

[Control data]

Device	Item	Setting data	Setting range	Set by
S1+0	Complete status	The condition result at the completion of the instruction is stored. 0 : Not error (Normal completion) Except 0 : Error code	—	System
S1+1	Number of reading data	Set the number of reading data.	1 to 16	User

[Control]

(1) This instruction is dedicated instruction toward the Motion CPU in the Multiple CPU system. Errors occurs when it was executed toward the CPU except the Motion CPU.
A part for the number of reading data of the control data specified with (S1) of data since the device specified with (S2) in the target CPU (n1) is stored to since the word device specified with (D1) of the self CPU in the Multiple CPU system.

(2) Figure specification of the bit device is possible for (S2) and (D1). However, figure specification is 4 figures and a start bit device number is only the multiple of 16. It becomes INSTRCT CODE ERROR [4004] when other values are specified.

(3) If the target CPU is not instruction acceptable condition, even if the S(P).DDWR instruction is executed, it may not be processed. In this case, it is necessary to execute the S(P).DDWR instruction again.
(S(P).SFCS/S(P).SVST/S(P).CHGA/S(P).CHGV/S(P).CHGT/S(P).DDRD/ S(P).DDWR cannot be executed simultaneously toward the CPU executing S(P).DDWR instruction.). It can be confirmed by data in the shared CPU memory of the target CPU (Motion CPU) whether the instruction is acceptable or not.
When the Motion dedicated PLC instruction is started continuously, it is must be design to execute next instruction after executing instruction complete device on.

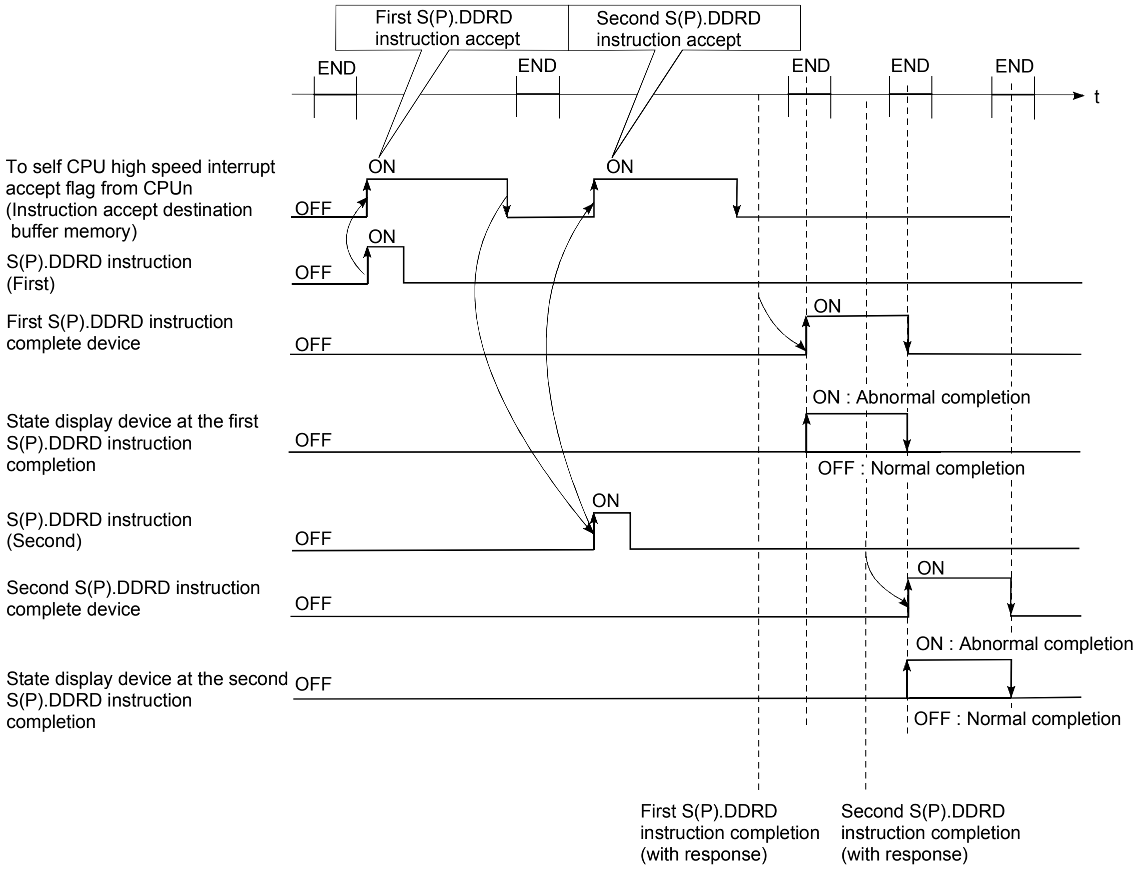
(4) The target CPU device range check is not executed with self CPU at the S(P).DDRD instruction execution, but it checks by the target CPU side, and it becomes abnormal completion at the device range over.

(5) S(P).DDRD instruction accepting and normal/abnormal completion can be confirmed with the complete device (D1) or status display device (D2) at the completion.
   (a) Complete device
   It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

   (b) Status display device at the completion
   It is turned on/off according to the status of the instruction completion.
   - Normal completion : OFF
   - Abnormal completion : It is turned on by the END processing of scan which the instruction completed, and turned off by the next END processing.

(6) SM390 turns on when the target CPU specified with (n1) complete to accept.
SM390 turns off when the target CPU specified with (n1) cannot be write correctly by the reset status or error factor (5000 to 5999).

[Operation of the self CPU at execution of S(P).DDRD instruction]



[Errors]

The abnormal completion in the case shown below, and the error code is stored in the control data (S1+ 0 : Complete status).

Complete status (Note) (Error code)(H)	Error factor	Corrective action
4C00	The specified device cannot be used in the Motion CPU. Or, it is outside the device range.	Confirm a program, and correct it to a correct PLC program.
4C08	There are 33 or more instruction requests to the Motion CPU from the PLC CPU in S(P).DDRD and S(P).DDWR sum table simultaneously, and the Motion CPU cannot process them.	
4C09	CPU No. of the instruction cause is injustice.	

(Note) : 0000H(Normal)

The error flag (SM0) is turned on an operation error in the case shown below, and an error code is stored in SD0.

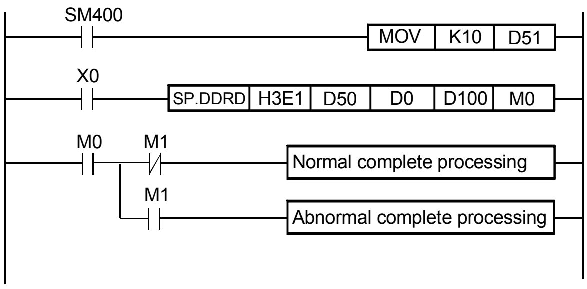
Error code (Note)	Error factor	Corrective action
2110	The CPU No. to be set by "(First I/O NO. of the target CPU)/16" is specified.	Confirm a program, and correct it to a correct PLC program.
2114	The self CPU by "(First I/O No. of the target CPU)/16" is specified.	
2117	The CPU except the Motion CPU by "(First I/O No. of the target CPU)/16" is specified.	
4002	Specified instruction is wrong.	
4004	The instruction is composed of devices except usable devices.	
4100	Since 0 to 3DFH, 3E4H is specified by "(First I/O No. of the target CPU)/16" is specified.	
4101	Number of the writing data is except 1 to 16.	
	Number of writing data exceeds range of the storage device of the written data.	

(Note) : 0000H(Normal)

[Program example]

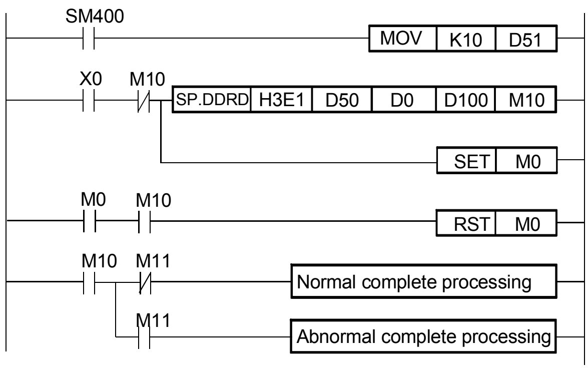
<Example 1>

Program which stores 10 points worth of the data from D0 of the CPU since D100 of self CPU (CPU No.1), when X0 is turned on.



<Example 2>

Program stores 10 points worth of the data from D0 of the CPU No.2 since D100 of self CPU (CPU No.1) during turn on X0.



MEMO

4. POSITIONING SIGNALS

The internal signals of the Motion CPU and the external signals to the Motion CPU are used as positioning signals.

(1) Internal signals

The following five devices of the Motion CPU are used as the internal signals of the Motion CPU.

- Internal relay (M) .... M2000 to M3839 (1840 points)
  M4000 to M4719 (720 points)
- Special relay (SP.M) .... M9073 to M9079 (7 points)
- Data register (D) .... D0 to D1631 (1632 points)
  D1650 to D1679 (30 points)
- Motion register (#) .... #8000 to #8191 (192 points)
- Special register (SP.D) .... D9112 and D9180 to D9201 (23 points)

(2) External signals

The external input signals to the Motion CPU are shown below.

- Upper/lower limit switch input .... The upper/lower limit of the positioning range is controlled.
- Stop signal .... Stop signal for speed control
- Proximity dog signal .... ON/OFF signal from the proximity dog
- Manual pulse generator input .... Signal from the manual pulse generator

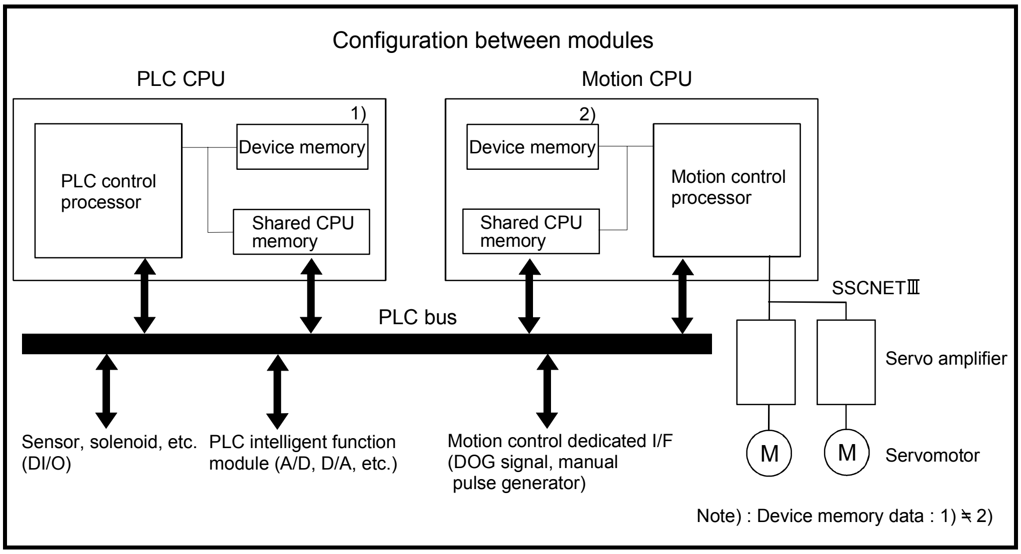


Fig.4.1 Flow of the internal signals/external signals

The positioning dedicated devices are shown below.
It indicates the device refresh cycle of the Motion CPU for status signal with the positioning control, and the device fetch cycle of the Motion CPU for command signal with the positioning control.
The operation cycle of the Motion CPU is shown below.

Item		Q173HCPU	Q172HCPU
Number of control axes		Up to 32 axes	Up to 8 axes
Operation cycle (Default)	SV43	0.88[ms] / 1 to 5 axes 1.77[ms] / 6 to 14 axes 3.55[ms] / 15 to 28 axes 7.11[ms] / 29 to 32 axes	0.88[ms] / 1 to 5 axes 1.77[ms] / 6 to 8 axes

4.1 Internal Relays

(1) Internal relay list

Device No.	Purpose	Device No.	Purpose
M0 to	User device (2000 points)	M3840 to	User device (160 points)
M2000 to	Common device (Status) (320 points)	M4000 to	Axis I/O signal (Axis status 2) (10 points × 32 axes)
M2320 to	Special relay allocated device (Status) (80 points)	M4320 to	Unusable (80 points)
M2400 to	Axis status (20 points × 32 axes)	M4400 to	Axis I/O siganal (Axis command signal 2) (10 points × 32 axes)
M3040 to	Unusable (32 points)	M4720 to M8191	User device (3472 points)
M3072 to	Common device (Command signal) (64 points)		
M3136 to	Special relay allocated device (Command signal) (64 points)		
M3200 to M3839	Axis command signal (20 points × 32 axes)		

☐ It can be used as a user device.

POINT

• Total number of user device points
5632points

(2) Axis status list

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

	Signal name		Refresh cycle	Fetch cycle	Signal direction
0	Positioning start complete		Operation cycle		Status signal
1	Positioning complete				
2	In-position				
3	Command in-position				
4	Unusable		—	—	—
5					
6	Zero pass		Operation cycle		Status signal
7	Error detection		Immediate		
8	Servo error detection		Operation cycle		
9	Home position return request		Main cycle		
10	Home position return complete		Operation cycle		
11	External signals	FLS	Main cycle		
12		RLS			
13		STOP			
14		DOG/CHANGE			
15	Servo ready		Operation cycle		
16	Torque limiting				
17	Unusable		—	—	—
18					
19	M-code outputting signal		Operation cycle		Status signal

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(3) Axis command signal list

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

Signal name

	Signal name	Refresh cycle	Fetch cycle	Signal direction
0	Stop command		Operation cycle	Command signal
1	Rapid stop command			
2	Forward rotation JOG start command		Main cycle	
3	Reverse rotation JOG start command			
4	Complete signal OFF command			
5	Unusable	—	—	—
6				
7	Error reset command		Main cycle	Command signal
8	Servo error reset command			
9	External stop input disable at start command		At start	
10	Unusable	—	—	—
11				
12				
13				
14				
15	Servo OFF command		Operation cycle	Command signal
16	Gain changing command		Operation cycle(Note-3)	
17	Unusable	—	—	—
18				
19	FIN signal		Operation cycle	Command signal

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.
(Note-3): Operation cycle 7.1[ms] or more: Every 3.5[ms]

(4) Axis status 2 list

Axis No.	Device No.
1	M4000 to M4009
2	M4010 to M4019
3	M4020 to M4029
4	M4030 to M4039
5	M4040 to M4049
6	M4050 to M4059
7	M4060 to M4069
8	M4070 to M4079
9	M4080 to M4089
10	M4090 to M4099
11	M4100 to M4109
12	M4110 to M4119
13	M4120 to M4129
14	M4130 to M4139
15	M4140 to M4149
16	M4150 to M4159
17	M4160 to M4169
18	M4170 to M4179
19	M4180 to M4189
20	M4190 to M4199
21	M4200 to M4209
22	M4210 to M4219
23	M4220 to M4229
24	M4230 to M4239
25	M4240 to M4249
26	M4250 to M4259
27	M4260 to M4269
28	M4270 to M4279
29	M4280 to M4289
30	M4290 to M4299
31	M4300 to M4309
32	M4310 to M4319

Signal name

	Signal name	Refresh cycle	Fetch cycle	Signal direction
0	Unusable	—	—	—
1				
2	Automatic start	Operation cycle		Status signal
3	Temporary stop			
4	Unusable	—	—	—
5				
6				
7				
8				
9	Unusable (note-1)	—	—	—

M4009 : Single block processing signal

(Note-1): At single block mode, only M4009 is used single block processing signal.
(Note-2): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-3): Device area of 9 axes or more is unusable in the Q172HCPU.

(5) Axis command signal 2 list

Axis No.	Device No.
1	M4400 to M4409
2	M4410 to M4419
3	M4420 to M4429
4	M4430 to M4439
5	M4440 to M4449
6	M4450 to M4459
7	M4460 to M4469
8	M4470 to M4479
9	M4480 to M4489
10	M4490 to M4499
11	M4500 to M4509
12	M4510 to M4519
13	M4520 to M4529
14	M4530 to M4539
15	M4540 to M4549
16	M4550 to M4559
17	M4560 to M4569
18	M4570 to M4579
19	M4580 to M4589
20	M4590 to M4599
21	M4600 to M4609
22	M4610 to M4619
23	M4620 to M4629
24	M4630 to M4639
25	M4640 to M4649
26	M4650 to M4659
27	M4660 to M4669
28	M4670 to M4679
29	M4680 to M4689
30	M4690 to M4699
31	M4700 to M4709
32	M4710 to M4719

Signal name

	Signal name	Refresh cycle	Fetch cycle	Signal direction
0	Temporary stop command		Operation cycle	Command signal
1	Optional program stop command			
2	Optional block skip command			
3	Single block command			
4	Re-start command			
5	Override ratio valid/invalid			
6	Axis interlock (Forward)			
7	Axis interlock (Reverse)			
8	Unusable (Note-1)	—	—	—
9				

M4408 : Single block mode signal

M4409 : Single block start signal

M4418 : Axis interlock valid/invalid

(Note-1): M4408 (single block mode signal) and M4409 (single block start signal) are used in the single block operation. M4418 (axis interlock valid/invalid) is used in the axis interlock (forward)/(reverse).

(Note-2): The range of axis No.1 to 8 is valid in the Q172HCPU.

(Note-3): Device area of 9 axes or more is unusable in the Q172HCPU.

(6) Common device list

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2000	PLC ready flag		Main cycle	Command signal (Note-1)	M3072
M2001	Axis 1 Start accept flag	Operation cycle		Status signal (Note-1), (Note-2)	
M2002	Axis 2				
M2003	Axis 3				
M2004	Axis 4				
M2005	Axis 5				
M2006	Axis 6				
M2007	Axis 7				
M2008	Axis 8				
M2009	Axis 9				
M2010	Axis 10				
M2011	Axis 11				
M2012	Axis 12				
M2013	Axis 13				
M2014	Axis 14				
M2015	Axis 15				
M2016	Axis 16				
M2017	Axis 17				
M2018	Axis 18				
M2019	Axis 19				
M2020	Axis 20				
M2021	Axis 21				
M2022	Axis 22				
M2023	Axis 23				
M2024	Axis 24				
M2025	Axis 25				
M2026	Axis 26				
M2027	Axis 27				
M2028	Axis 28				
M2029	Axis 29				
M2030	Axis 30				
M2031	Axis 31				
M2032	Axis 32				
M2033	Unusable	—	—	—	—
M2034	Personal computer link communication error flag	Operation cycle		Status signal	
M2035	Unusable (6 points)	—	—	—	—
M2036					
M2037					
M2038					
M2039					
M2040					
M2041	System setting error flag	Operation cycle		Status signal	
M2042	All axes servo ON command		Operation cycle	Command Signal (Note-1)	M3074
M2043	Unusable (4 points)	—	—	—	—
M2044					
M2045					
M2046					
M2047	Motion slot fault detection flag	Operation cycle		Status signal	
M2048	JOG operation simultaneous start command		Main cycle	Command signal (Note-1)	M3076
M2049	All axes servo ON accept flag	Operation cycle		Status signal	
M2050	Start buffer full				
M2051	Manual pulse generator 1 enable flag		Main cycle	Command signal (Note-1)	M3077
M2052	Manual pulse generator 2 enable flag				M3078
M2053	Manual pulse generator 3 enable flag				M3079

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2054	Operation cycle over flag	Operation cycle		Status signal	
M2055	Unusable (6 points)	—	—	—	—
M2056					
M2057					
M2058					
M2059					
M2060					
M2061	Axis 1 Speed changing flag	Operation cycle		Status signal (Note-2)	
M2062	Axis 2				
M2063	Axis 3				
M2064	Axis 4				
M2065	Axis 5				
M2066	Axis 6				
M2067	Axis 7				
M2068	Axis 8				
M2069	Axis 9				
M2070	Axis 10				
M2071	Axis 11				
M2072	Axis 12				
M2073	Axis 13				
M2074	Axis 14				
M2075	Axis 15				
M2076	Axis 16				
M2077	Axis 17				
M2078	Axis 18				
M2079	Axis 19				
M2080	Axis 20				
M2081	Axis 21				
M2082	Axis 22				
M2083	Axis 23				
M2084	Axis 24				
M2085	Axis 25				
M2086	Axis 26				
M2087	Axis 27				
M2088	Axis 28				
M2089	Axis 29				
M2090	Axis 30				
M2091	Axis 31				
M2092	Axis 32				
M2093	Unusable (26 points)	—	—	—	—
M2094					
M2095					
M2096					
M2097					
M2098					
M2099					
M2100					
M2101					
M2102					
M2103					
M2104					
M2105					
M2106					
M2107					
M2108					
M2109					
M2110					
M2111					
M2112					
M2113					
M2114					
M2115					
M2116					
M2117					
M2118					

Common device list (Continued)

Device No.	Signal name		Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2119	Unusable (9 points)		—	—	—	—
M2120						
M2121						
M2122						
M2123						
M2124						
M2125						
M2126						
M2127						
M2128	Axis 1	Automatic deceleration flag	Operation cycle		Status signal (Note-2)	
M2129	Axis 2					
M2130	Axis 3					
M2131	Axis 4					
M2132	Axis 5					
M2133	Axis 6					
M2134	Axis 7					
M2135	Axis 8					
M2136	Axis 9					
M2137	Axis 10					
M2138	Axis 11					
M2139	Axis 12					
M2140	Axis 13					
M2141	Axis 14					
M2142	Axis 15					
M2143	Axis 16					
M2144	Axis 17					
M2145	Axis 18					
M2146	Axis 19					
M2147	Axis 20					
M2148	Axis 21					
M2149	Axis 22					
M2150	Axis 23					
M2151	Axis 24					
M2152	Axis 25					
M2153	Axis 26					
M2154	Axis 27					
M2155	Axis 28					
M2156	Axis 29					
M2157	Axis 30					
M2158	Axis 31					
M2159	Axis 32					
M2160	Unusable (20 points)		—	—	—	—
M2161						
M2162						
M2163						
M2164						
M2165						
M2166						
M2167						
M2168						
M2169						
M2170						
M2171						
M2172						
M2173						
M2174						
M2175						
M2176						
M2177						
M2178						
M2179						

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2180	Unusable (60 points)	—	—	—	—
M2181					
M2182					
M2183					
M2184					
M2185					
M2186					
M2187					
M2188					
M2189					
M2190					
M2191					
M2192					
M2193					
M2194					
M2195					
M2196					
M2197					
M2198					
M2199					
M2200					
M2201					
M2202					
M2203					
M2204					
M2205					
M2206					
M2207					
M2208					
M2209					
M2210					
M2211					
M2212					
M2213					
M2214					
M2215					
M2216					
M2217					
M2218					
M2219					
M2220					
M2221					
M2222					
M2223					
M2224					
M2225					
M2226					
M2227					
M2228					
M2229					
M2230					
M2231					
M2232					
M2233					
M2234					
M2235					
M2236					
M2237					
M2238					
M2239					

Common device list (Continued)

Device No.		Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2240	Axis 1	Speed change "0" accepting flag	Operation cycle		Status signal (Note-2)	
M2241	Axis 2					
M2242	Axis 3					
M2243	Axis 4					
M2244	Axis 5					
M2245	Axis 6					
M2246	Axis 7					
M2247	Axis 8					
M2248	Axis 9					
M2249	Axis 10					
M2250	Axis 11					
M2251	Axis 12					
M2252	Axis 13					
M2253	Axis 14					
M2254	Axis 15					
M2255	Axis 16					
M2256	Axis 17					
M2257	Axis 18					
M2258	Axis 19					
M2259	Axis 20					
M2260	Axis 21					
M2261	Axis 22					
M2262	Axis 23					
M2263	Axis 24					
M2264	Axis 25					
M2265	Axis 26					
M2266	Axis 27					
M2267	Axis 28					
M2268	Axis 29					
M2269	Axis 30					
M2270	Axis 31					
M2271	Axis 32					
M2272	Unusable (8 points)		—	—	—	—
M2273						
M2274						
M2275						
M2276						
M2277						
M2278						
M2279						

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2280	Unusable (40 points)	—	—	—	—
M2281					
M2282					
M2283					
M2284					
M2285					
M2286					
M2287					
M2288					
M2289					
M2290					
M2291					
M2292					
M2293					
M2294					
M2295					
M2296					
M2297					
M2298					
M2299					
M2300					
M2301					
M2302					
M2303					
M2304					
M2305					
M2306					
M2307					
M2308					
M2309					
M2310					
M2311					
M2312					
M2313					
M2314					
M2315					
M2316					
M2317					
M2318					
M2319					

Explanation of the request register

No.	Function	Bit device	Request register
1	PLC ready flag	M2000	D704
2	All axes servo ON command	M2042	D706
3	JOG operation simultaneous start command	M2048	D708
4	Manual pulse generator 1 enable flag	M2051	D755
5	Manual pulse generator 2 enable flag	M2052	D756
6	Manual pulse generator 3 enable flag	M2053	D757

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.
(Note-3): Handling of D704 to D708 and D755 to D757 registers
Because cannot be turn on/off for every bit from the PLC CPU, the above bit devices are assigned to D register, and each bit device becomes on with the lowest rank bit 0 → 1 of each register, and each bit device becomes off with 1 → 0.
Use it when the above functions are requested from the PLC CPU using the S(P).DDRD and S(P).DDWR instruction.
(Note-4): It can also be ordered the device of a remark column.

⚠CAUTION

- The data executed later becomes effective when the same device is executed in the Motion program and PLC program.

(7) Special relay allocated device list (Status)

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note)
M2320	Fuse blown detection	Error occurrence		Status signal	M9000
M2321	AC/DC DOWN detection				M9005
M2322	Battery low				M9006
M2323	Battery low latch				M9007
M2324	Self-diagnostic error				M9008
M2325	Diagnostic error				M9010
M2326	Always ON	Main operation			M9036
M2327	Always OFF				M9037
M2328	Clock data error	Error occurrence			M9026
M2329	PCPU WDT error flag				M9073
M2330	PCPU READY complete flag	At request			M9074
M2331	Test mode ON flag				M9075
M2332	External forced stop input flag	Operation cycle			M9076
M2333	Manual pulse generator axis setting error flag	Error occurrence			M9077
M2334	TEST mode request error flag				M9078
M2335	Motion program setting error flag				M9079
M2336	CPU No.1 reset flag	At status change			M9240
M2337	CPU No.2 reset flag				M9241
M2338	CPU No.3 reset flag				M9242
M2339	CPU No.4 reset flag				M9243
M2340	CPU No.1 error flag				M9244
M2341	CPU No.2 error flag				M9245
M2342	CPU No.3 error flag				M9246
M2343	CPU No.4 error flag				M9247
M2344	Unusable	—	—	—	—
M2345	CPU No.1 MULTR complete flag	At instruction completion		Status signal	M9216
M2346	CPU No.2 MULTR complete flag				M9217
M2347	CPU No.3 MULTR complete flag				M9218
M2348	CPU No.4 MULTR complete flag				M9219
M2349 to M2399	Unusable	—	—	—	—

(Note) : The same status as a remark column is output.

(8) Common device list (Command signal)

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-1) , (Note-2)
M3072	PLC ready flag		Main cycle	Command signal	M2000
M3073	Unusable	—	—	—	—
M3074	All axes servo ON command		Operation cycle	Command signal	M2042
M3076	JOG operation simultaneous start command		Main cycle		M2048
M3077	Manual pulse generator 1 enable flag				M2051
M3078	Manual pulse generator 2 enable flag				M2052
M3079	Manual pulse generator 3 enable flag				M2053
M3080 to M3135	Unusable	—	—	—	—

(Note-1) : The device of a remarks column turns ON by OFF to ON of the above device, and the device of a remarks column turns OFF by ON to OFF of the above device. The state of a device is not in agreement when the device of a remarks column is turned on directly. In addition, when the request from a data register and the request from the above device are performed simultaneously, the request from the above device becomes effective.

(Note-2) : It can also be ordered the device of a remark column.

(9) Special relay allocated device list (Command signal)

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-1), (Note-2)
M3136	Clock data set request		Main cycle	Command signal	M9025
M3137	Clock data read request				M9028
M3138	Error reset				M9060
M3139 to M3199	Unusable	—	—	—	—

(Note-1) : The device of a remarks column turns ON by OFF to ON of the above device, and the device of a remarks column turns OFF by ON to OFF of the above device. The state of a device is not in agreement when the device of a remarks column is turned on directly.

(Note-2) : It can also be ordered the device of a remark column.

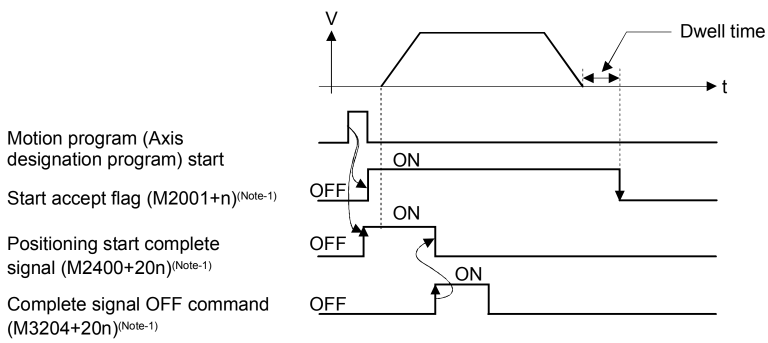
4.1.1 Axis statuses

(1) Positioning start complete signal (M2400+20n)

(a) This signal turns on with the start completion for the positioning control of the axis specified with the Motion program (Axis designation program).
The Motion program (Axis designation program) is started by the following instructions.
1) SVST instruction of the PLC program
2) CALL, GOSUB/GOSUBE instruction in the Motion program (Control program)
It does not turn on at the starting using home position return, JOG operation or manual pulse generator operation.

(b) This signal turns off at turning the complete signal OFF command (M3204+20n) off to on or positioning completion.

When the complete signal OFF command (M3204+20n) turns off to on.



When the positioning is completed.

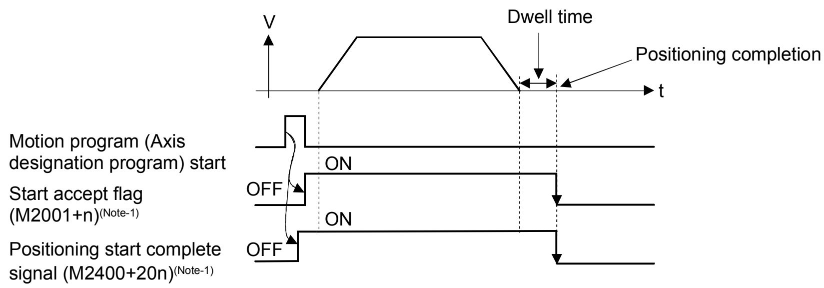


Fig.4.2 ON/OFF timing of the positioning start complete signal

REMARK

(Note-1): In the above descriptions, "n" in"M3204+20n", etc. indicates a value corresponding to axis No. such as the following tables.

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

• Calculate as follows for the device No. corresponding to each axis.

(Example) M3200+20n (Stop command)=M3200+20×31=M3820

M3215+20n (Servo OFF) =M3215+20×31=M3835

• The range (n=0 to 7) of axis No.1 to 8 is valid in the Q172HCPU.

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

(a) This signal turns on with the completion for the positioning control of the axis specified with the Motion program (Axis designation program).
The Motion program (Axis designation program) is started by the following instructions.
1) SVST instruction of the PLC program
2) CALL, GOSUB/GOSUBE instruction in the Motion program (Contorl program)
It does not turn on at the start or stop on the way using home position return, JOG operation, manual pulse generator operation or speed control.
It does not turn on at the stop on the way during positioning.

(b) This signal turns off at turning the complete signal OFF command (M3204+20n) off to on or positioning start completion.

[Motion program exapmle]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
X200. ;	PTP positioning (X200.)
G00 X300 G04 P500;	PTP positioning (X300.), Dwell (500ms)
M02;	Reset
%	

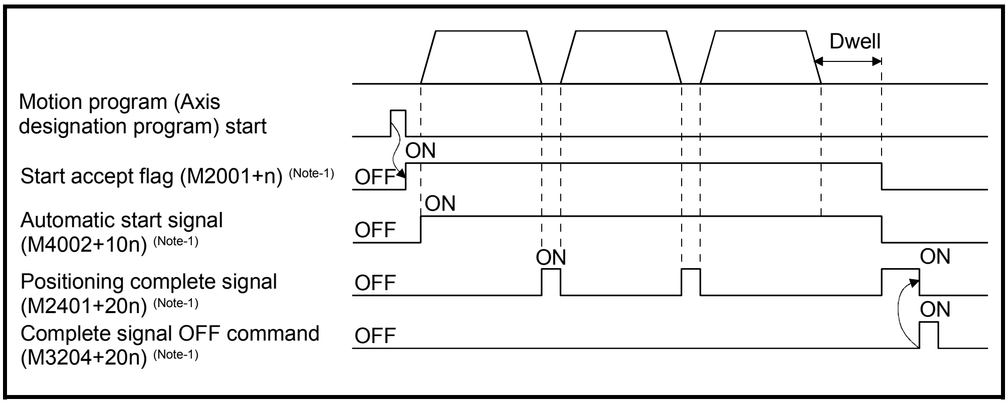


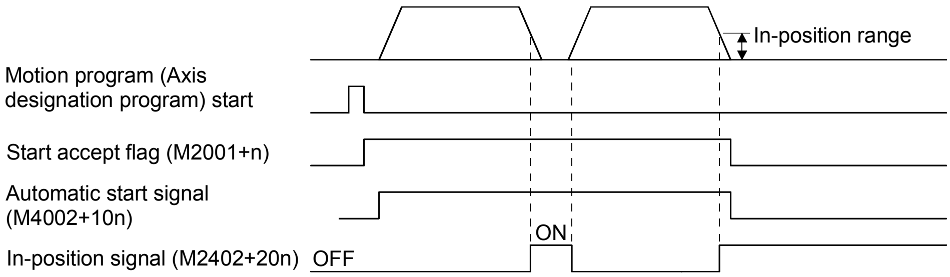
Fig.4.3 ON/OFF timing of the positioning complete signal

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

(a) This signal turns on when the number of droop pulses in the deviation counter becomes below the "in-position range" set in the servo parameters. It turns off at the start.

[Motion program exapmle]

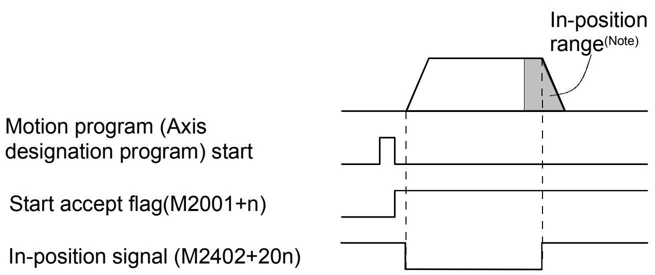
O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
X200. ;	PTP positioning (X200.)
M02;	Reset
%	



(b) An in-position check is performed in the following cases.
- When the servo power supply is turned on.
- After the automatic deceleration is started during positioning control.
- After the deceleration is started with the JOG start signal OFF.
- During the manual pulse generator operation.
- After the proximity dog ON during a home position return.
- After the deceleration is started with the stop command.
- When the speed change to a speed "0" is executed.
- After the deceleration is started with the temporary stop command.

POINT

- If in-position range is longer than the deceleration distance, refer to the following case.



(Note) : If in-position range is longer than the deceleration distance, in-position signal turns on after deceleration start.

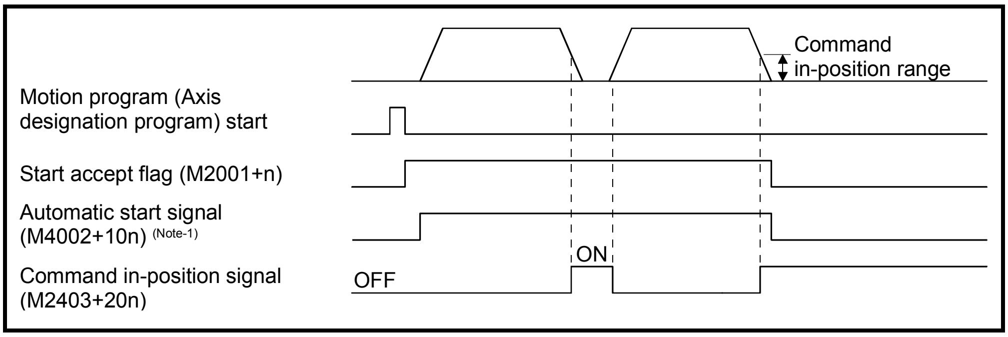
(4) Command in-position signal (M2403+20n)

(a) This signal turns on when the absolute value of difference between the command position and machine value becomes below the "command in-position range" set in the fixed parameters.
This signal turns off in the following cases.
• Positioning control start
• Home position return
• JOG operation
• Manual pulse generator operation

(b) Command in-position check is continually performed during positioning control.

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
X200. ;	PTP positioning (X200.)
M02;	Reset
%	

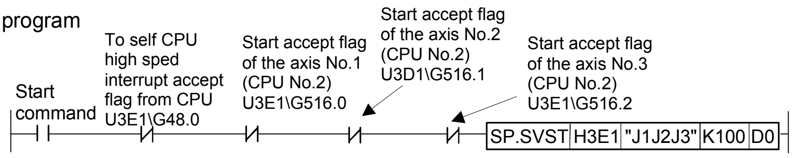


POINTS

Example 1, 2 are shown below about in-position signal and command in-position signal of the interpolation axis.

[Example1]

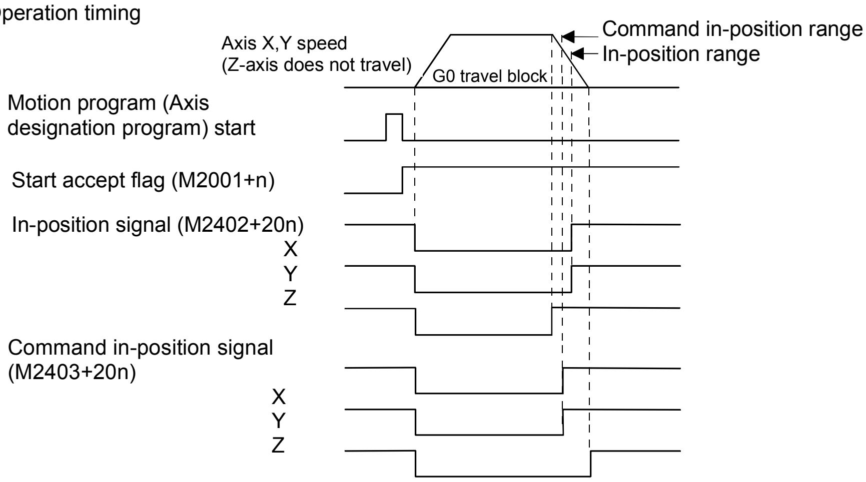
・PLC program



・Motion program

```
O100;
  :
G91;
G00 X100. Y100.;
  :
M02;
%
```

・Operation timing



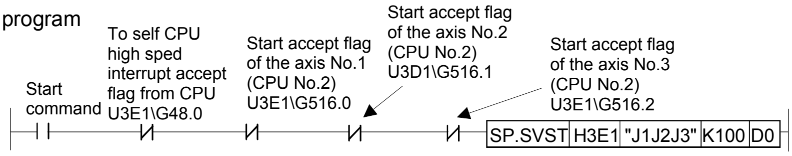
(1) The in-position signal turns ON by reaching the in-position range of servo parameter after deceleration start.
Since the Z-axis is stopped in this case, it always turns on immediately after deceleration start.
Even if the only 2 axes (X,Y) is commanded in the G00 command of Motion program, when the 3 axes is started by SVST instruction in the PLC program, the in-position signal turns ON after deceleration start in the Z-axis as X,Y-axis.

(2) The command in-position signal turns ON when the difference between the command position of Motion program and the absolute position of machine value is less than the command in-position range set in the fixed parameter.
Since the command of Z-axis is not described in this program, the command in-position check is not executed during travel of Z-axis and it remains OFF from start to stop of travel.

POINTS

[Example2]

・PLC program

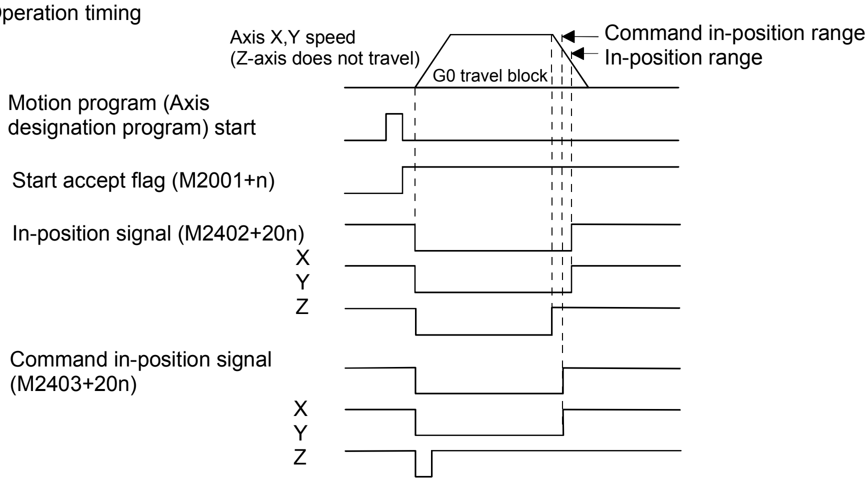


・Motion program

```
O100;
 :
G91;
G00 X100. Y100. Z0;
 :
M02;
%
```

Add the travel value "0" of Z-axis in the Motion program.

・Operation timing



(1) In-position signal is the same as the example 1.

(2) The command in-position check of Z-axis is also executed during axis travel by addition of the travel value "0" of Z-axis in the Motion program. Therefore, the command in-position signal of Z-axis turns OFF moment at the travel start, however it is immediately judged as within the range, and turns ON by processing of command-in-position check.

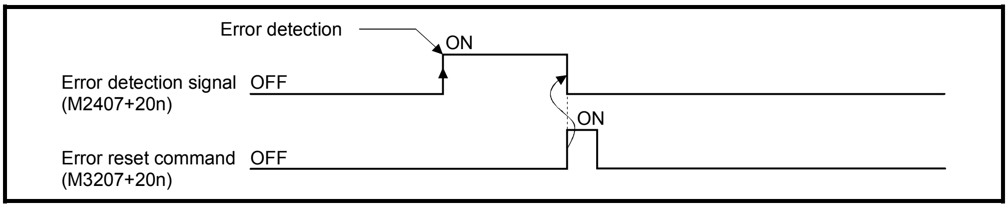
(5) Zero pass signal (M2406+20n)

This signal turns on when the zero point is passed after the power supply on of the servo amplifier.
Once the zero point has been passed, it remains on state until the CPU has been reset.
However, in the home position return method of proximity dog, count, dog cradle or limit switch combined type, this signal turns off once at the home position return start and turns on again at the next zero point passage.

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

(a) This signal turns on with detection of a minor error or major error, and it is used as judgement of the error available/not available.
The applicable error code (Note-1) is stored in the minor error code storage register with detection of a minor error. (Refer to Section 4.2.1)
The applicable error code (Note-2) is stored in the major error code storage register with detection of a major error. (Refer to Section 4.2.1)

(b) This signal turns off when the error reset command (M3207+20n) turns on.



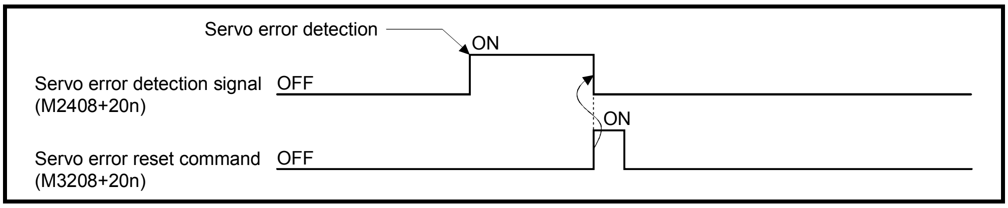
REMARK

(Note-1): Refer to APPENDIX 1.2 for the error codes with detection of minor errors.
(Note-2): Refer to APPENDIX 1.3 for the error codes with detection of major errors.

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

(a) This signal turns on when an error occurs at the servo amplifier side (except for errors cause of alarms and emergency stops) (Note-1), and it is used as judgement of the servo error available/not available.
When an error is detected at the servo amplifier side, the applicable error code (Note-1) is stored in the servo error code storage register (Refer to Section 4.2.1).

(b) This signal turns off when the servo error reset command (M3208+20n) turns on or the servo power supply turns on again.



REMARK

(Note-1): Refer to APPENDIX 1.4 for the error codes on errors detected at the servo amplifier side.

(8) Home position return request signal (M2409+20n)

This signal turns on when it is necessary to confirm the home position address.

(a) When not using an absolute position system

1) This signal turns on in the following cases:
   - Motion CPU power supply on or reset
   - Servo amplifier power supply on
   - Home position return start
     (Unless a home position return is completed normally, the home position return request signal does not turn off.)

2) This signal turns off by the completion of home position return.

(b) When using an absolute position system

1) This signal turns on in the following cases:
   - When not executing a home position return once after system start.
   - Home position return start
     (Unless a home position return is completed normally, the home position return request signal does not turn off.)
   - Erase of an absolute data in Motion CPU according to causes, such as battery error
   - Servo error [2025] (absolute position erase) occurrence
   - Servo error [2143] (absolute position counter warning) occurrence
   - Major error [1203] or [1204] occurrence
   - When the "rotation direction selection" of servo parameter is changed.

2) This signal turns off by the completion of the home position return.
   Operation in G28 of the Motion program changes by the ON/OFF of the home position return request signal.

When home position return request signal is OFF	The axis starts from the current position, passes through the specified mid point, and returns to the home position at high-speed feed rate.
When home position return request signal is ON	Proximity dog, count, data set, dog cradle, stopper or limit switch combined type home position return is executed in accordance with the home position returun data.

⚠ CAUTION

- When using the absolute position system function, on starting up, and when the Motion controller or absolute value motor has been replaced, always perform a home position return.
  In the case of the absolute position system, use the PLC program to check the home position return request before performing the positioning operation.
  Failure to observe this could lead to an accident such as a collision.

(9) Home position return complete signal (M2410+20n)

(a) This signal turns on when the home position return operation has been completed normally.

(b) This signal turns off at the positioning start, JOG operation start and manual pulse generator operation start.

(c) If the home position return of proximity dog, count, dog cradle, stopper or limit switch cpmbined type is executed using the CHGA instruction during this signal on, the "continuous home position return start error" (minor error: 115) occurs and it cannot be start the home position return.

(10) FLS signal (M2411+20n)

(a) This signal is controlled by the ON/OFF state for the upper stroke limit switch input (FLS) of the Q172LX/Servo amplifier.
- Upper stroke limit switch input OFF ...... FLS signal: ON
- Upper stroke limit switch input ON .... FLS signal: OFF

(b) The state for the upper stroke limit switch input (FLS) when the FLS signal is ON/OFF is shown below.

1) Q172LX use(Note-1)

2) Servo amplifier input use (Note-2)

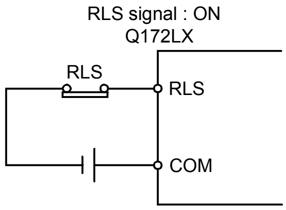
(Note-1): Refer to the "Q173HCPU/Q172HCPU User's Manual".
(Note-2): Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)".

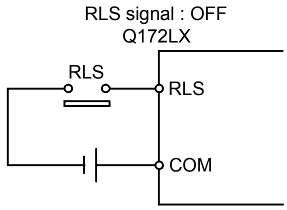
(11) RLS signal (M2412+20n)

(a) This signal is controlled by the ON/OFF state for the lower stroke limit switch input (FLS) of the Q172LX/Servo amplifier.
- Lower stroke limit switch input OFF ...... RLS signal: ON
- Lower stroke limit switch input ON .... RLS signal: OFF

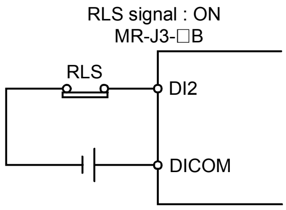
(b) The state of the lower stroke limit switch input (RLS) when the RLS signal is ON/OFF is shown below.

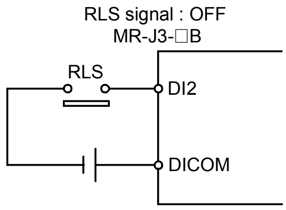
1) Q172LX use (Note-1)





2) Servo amplifier input use (Note-2)





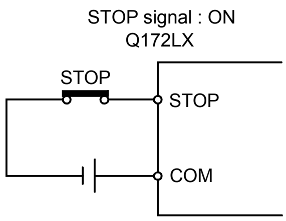
(Note-1): Refer to the "Q173HCPU/Q172HCPU User's Manual".

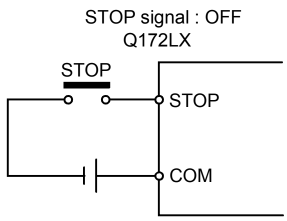
(Note-2): Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)".

(12) STOP signal (M2413+20n)

(a) This signal is controlled by the ON/OFF state for the stop signal input (STOP) of the Q172LX.
- Stop signal of the Q172LX OFF ..... STOP signal: OFF
- Stop signal of the Q172LX ON .... STOP signal: ON

(b) The state of the stop signal input (STOP) of the Q172LX when the STOP signal input is ON/OFF is shown below.





(13) DOG/CHANGE signal (M2414+20n)

(a) This signal turns on/off by the proximity dog input (DOG) of the Q172LX/ Servo amplifier at the home position return.

(b) "Normally open contact input" and "Normally closed contact input" of the system setting can be selected.

1) Q172LX use (Note-1)

2) Servo amplifier input use (Note-2)

(Note-1): Refer to the "Q173HCPU/Q172HCPU User’s Manual".

(Note-2): Refer to the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)".

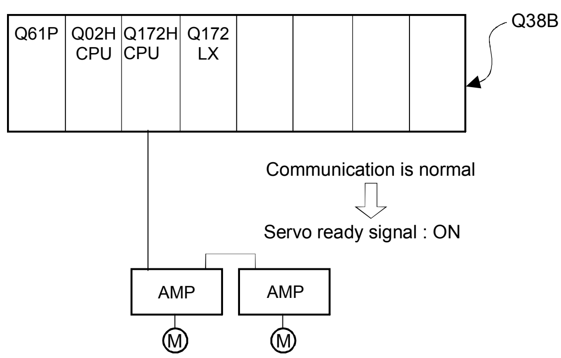
(14) Servo ready signal (M2415+20n)

(a) This signal turns on when the servo amplifiers connected to each axis are in the READY state.

(b) This signal turns off in the following cases.

- M2042 is off
- Servo amplifier is not installed
- Servo parameter is not set
- It is received the forced stop input from an external source
- Servo OFF by the servo OFF command (M3215+20n) on
- Servo error occurs

Refer to APPENDIX 1.4 "Servo errors" for details.



> **POINT**
>
> When the part of multiple servo amplifiers connected to the SSCNETⅢ becomes a servo error, only an applicable axis becomes the servo OFF state.

(15) Torque limiting signal (M2416+20n)

This signal turns on while torque limit is executed.
The signal toward the torque limiting axis turns on.

(16) M-code outputting signal (M2419+20n)

(a) This signal turns on when M** in the Motion program is exexuted.
This signal turns off when FIN signal (M3219+20n) turns on.
Read the M-code when M-code outputting signal is turning on.

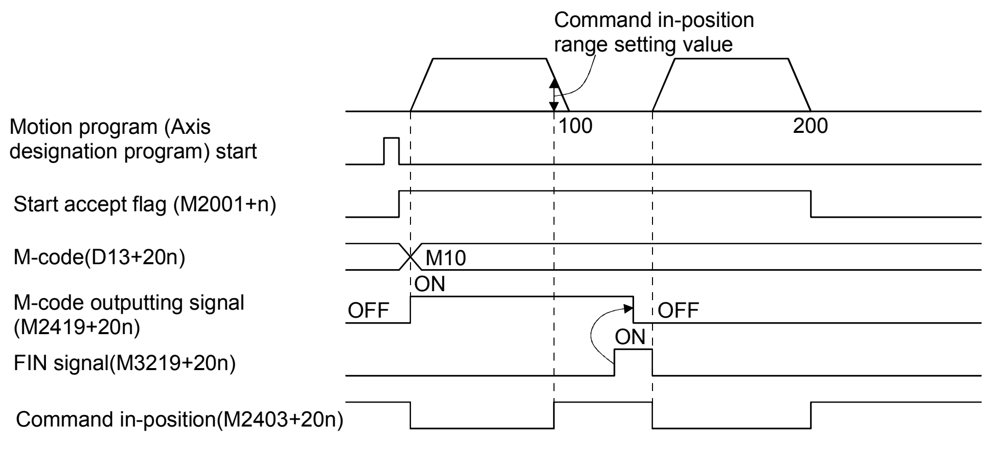
(b) If the G-code and M-code are described in the same block, the M-code outputting signal turns on at the start of G-code processing.

(c) If the miscellaneous function M is executed after completion of position control, describe the M-code independently.

(d) For M00, M01, M02, M30, M98, M99 and M100, the M-code outputting signal does not turn on.(Internal processing only)

[Motion program example]

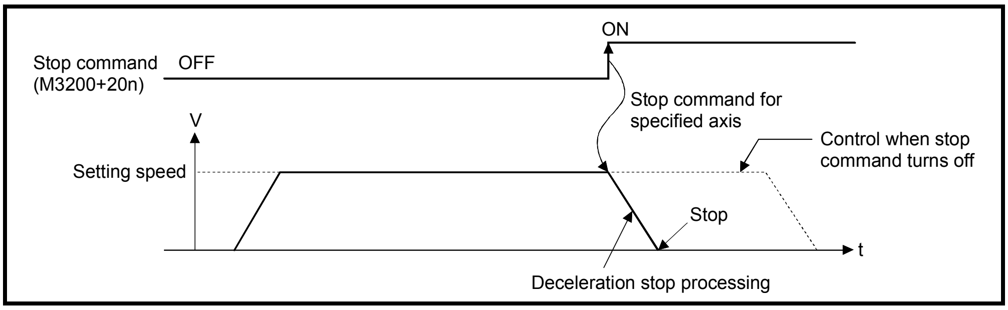
O0001;	Program No.
G90 G00 X100. M10;	Absolute value command PTP positioning (X100.) M10
X200. ;	PTP positioning (X200.)
M02;	Reset
%	



4.1.2 Axis command signals

(1) Stop command (M3200+20n)

(a) This command stops a starting axis from an external source and becomes effective at the turning signal off to on. (An axis for which the stop command is turning on cannot be started.)



(b) The program is ended by the stop command at the automatic start by the SVST instruction. (The Motion program is stopped if any of the stop commands for the axis No. specified with the SVST instruction turns on.)

(c) The re-start command (M4404+10n) is valid only after the temporary stop command (M4400+10n).

(d) The details of stop processing when the stop command turns on are shown below.

Control details during execution	Processing at the turning stop command on	
	During control	During deceleration stop processing
Positioning control during the Motion program start	The axis decelerates to a stop in the deceleration time set in the parameter block or Motion program. (Note-1)	The stop command is ignored and deceleration stop processing is continued. (Note-1)
JOG operation		
Manual pulse generator operation	An immediate stop is executed without deceleration processing.	—
Home position return	(1) The axis decelerates to a stop in the deceleration time set in the parameter block. (2) A "stop error during home position return" occurs and the error code [202] is stored in the minor error storage register for each axis.	

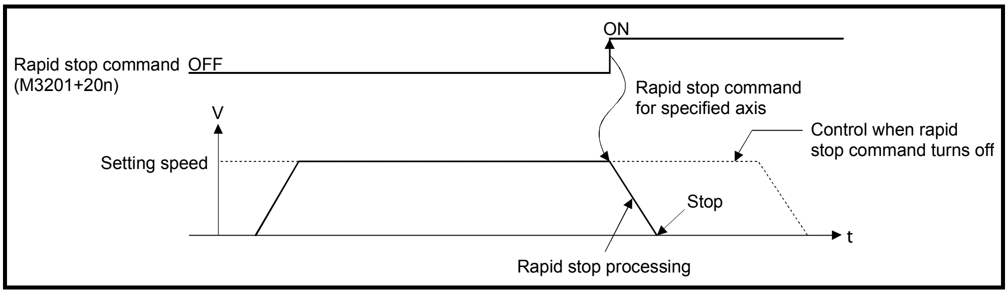
(Note-1) : The deceleration time under G00, G01, G02, G03, G12, G13 or G32 including M-code is equivalent to the acceleration time set in the parameter block.

POINT

If it is made to stop by turning on the stop command (M3200+20n) during a home position return, execute the home position return again.
If the stop command is turned on after the proximity dog ON in the proximity dog type, execute the home position return after move to before the proximity dog ON by the JOG operation or positioning.

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

(a) This command is a signal which stop a starting axis rapidly from an external source and becomes effective when the signal turns off to on. (An axis for which the rapid stop command turns on cannot be started.)



(b) The program is ended by the rapid stop command at the automatic start by the SVST instruction.
(The Motion program is stopped if any of the rapid stop commands for the axis No. specified with the SVST instruction turns on.)

(c) The re-start command (M4404+10n) is valid only after the temporary stop command (M4400+10n).

(d) The details of stop processing when the rapid stop command turns on are shown below.

Control details during execution	Processing at the turning rapid stop command on	
	During control	During deceleration stop processing
Position control during the Motion program start	The axis decelerates to a deceleration time set in the parameter block or Motion program.	Deceleration processing is canceled and rapid stop processing executed instead. (Note-1)
JOG operation		
Manual pulse generator operation	An immediate stop is executed without deceleration processing.	—
Home position return	(1) The axis decelerates to a stop in the rapid stop deceleration time set in the parameter block. (2) A "stop error during home position return" occurs and the error code [203] is stored in the minor error storage register for each axis.	

(Note-1) : The rapid stop deceleration time under G00, G01, G02, G03, G12, G13 or G32 including M-code is equivalent to the acceleration time set in the parameter block.

POINT

If it is made to stop by turning on the rapid stop command (M3201+20n) during a home position return, execute the home position return again.
If the rapid stop command turned on after the proximity dog ON in the proximity dog type, execute the home position return after move to before the proximity dog ON by the JOG operation or positioning.

(3) Forward rotation JOG start command (M3202+20n)/Reverse rotation JOG start command (M3203+20n)

(a) JOG operation to the address increase direction is executed while forward rotation JOG start command (M3202+20n) is turning on.
When M3202+20n is turned off, a deceleration stop is executed in the deceleration time set in the parameter block.

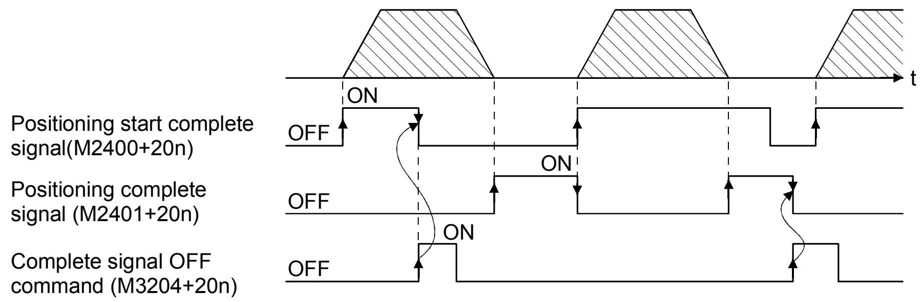
(b) JOG operation to the address decrease direction is executed while reverse rotation JOG start command (M3203+20n) is turinig on.
When M3203+20n is turned off, a deceleration stop is executed in the deceleration time set in the parameter block.

POINT

Take an interlock so that the forward rotation JOG start command (M3202+20n) and reverse rotation JOG start command (M3203+20n) may not turn on simultaneously.

(4) Complete signal OFF command (M3204+20n)

(a) This command is used to turn off the positioning start complete signal (M2400+20n) and positioning complete signal (M2401+20n).

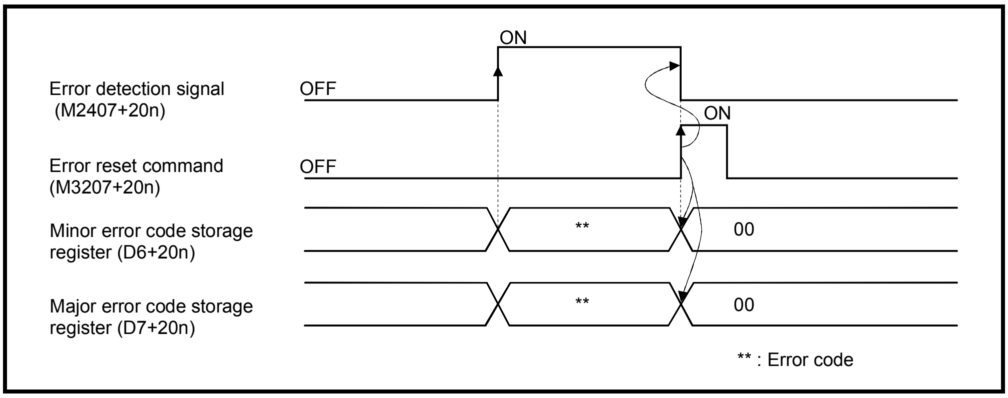


POINT

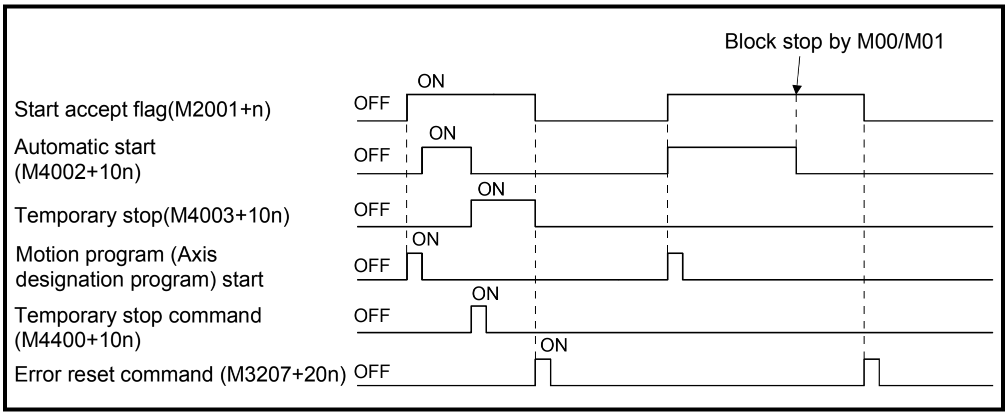
Do not turn the complete signal OFF command on with a PLS instruction.
If it is turned on with a PLS instruction, it cannot be turned off the positioning start complete signal (M2400+20n) and the positioning complete signal (M2401+20n).

(5) Error reset command (M3207+20n)

(a) This command is used to clear the minor error code or major error code storage register of an axis for which the error detection signal has turn on (M2407+20n: ON), and reset the error detection signal (M2407+20n).



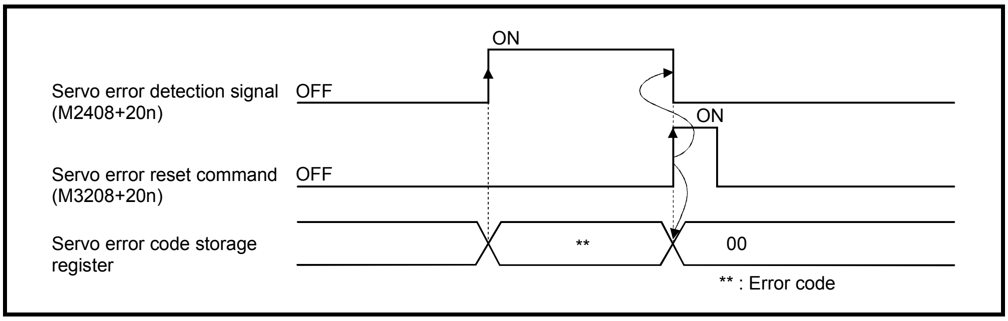
(b) If an error reset is executed during the temporary stop (M4003+10n) by the temporary stop command (M4400+10n) at the automatic start or if an error reset is executed during a block stop by M00/M01, the Motion program operation state is reset.
The SVST instruction must be executed in the next strat. (Re-start is not possible.)



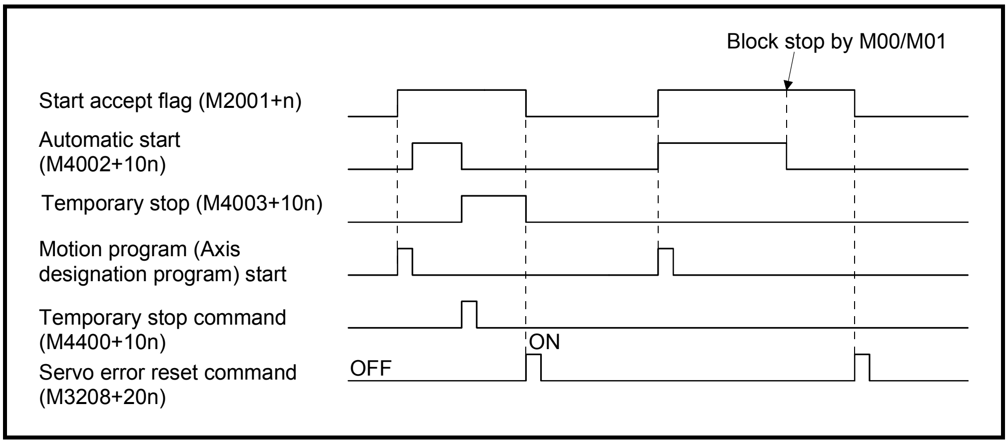
(c) When the error reset command is turned on at the automatic start (M4002+10n: ON), the above reset processing is executed after the stop processing by temporaty stop command (M4400+10n).

(6) Servo error reset command (M3208+20n)

(a) This command is used to clear the servo error code storage register of an axis for which the servo error detection signal has turn on (M2408+20n: ON), and reset the servo error detection signal (M2408+20n).



(b) If an error reset is executed during the temporary stop (M4003+10n) by the temporary stop command (M4400+10n) at the automatic start or if an error reset is executed during a block stop by M00/M01, the Motion program operation state is reset.
The SVST instruction must be executed in the next strat. (Re-start is not possible.)



(c) When the error reset command is turned on at the automatic start (M4002+10n: ON), the above reset processing is executed after the stop processing by temporaty stop command (M4400+10n).

REMARK

Refer to APPENDIX 1 for details on the minor error code, major error code and servo error code storage registers.

(7) External stop input disable at start command (M3209+20n)

This signal is used to set the external STOP signal input valid or invalid.

- ON .... External stop input is set as invalid, and even axes which stop input is turning on can be started.
- OFF .... External stop input is set as valid, and axes which stop input is turning on cannot be started.

POINTS

(1) When it stops an axis with the external stop input after it starts by turning on the external stop input disable at start command (M3209+20n), switch the external stop input from OFF → ON (if external stop input is turning on at the starting, switch it from ON → OFF → ON).

(2) External STOP input causes a block stop at the automatic start (M4002+10n: ON).

(8) Servo OFF command (M3215+20n)

This command is used to execute the servo OFF state (free run state).

- M3215+20n: OFF ..... Servo ON
- M3215+20n: ON .... Servo OFF (free run state)

This command becomes invalid during positioning, and should therefore be executed after completion of positioning.

⚠ CAUTION

- Turn the power supply of the servo amplifier side off before touching a servomotor, such as machine adjustment.

(9) Gain changing command (M3216+20n)

This signal is used to change gain of servo amplifier in the Motion controller by gain changing command ON/OFF.

- ON .... Gain changing command ON
- OFF .... Gain changing command OFF

Refer to the "MR-J3-□B Servo Amplifier Instruction Manual" for details of gain changing function.
Instruction Manual list is shown below.

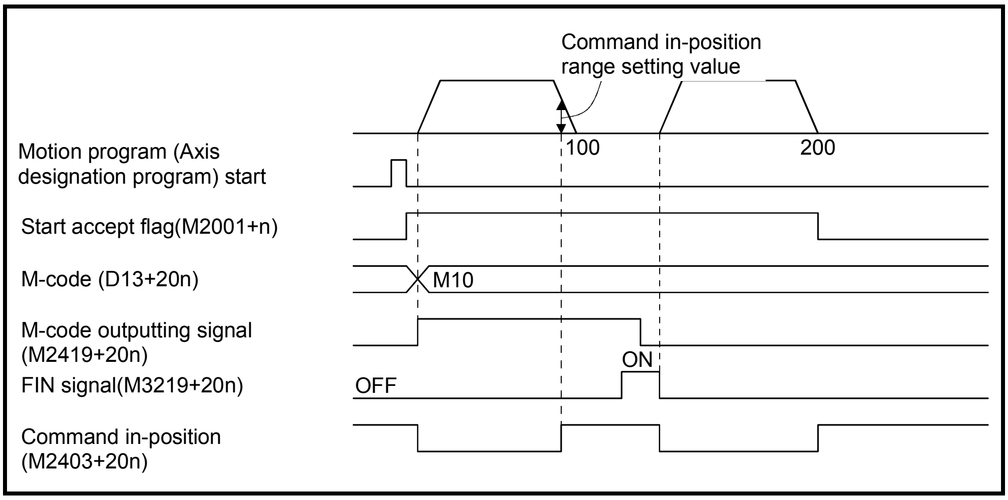
Servo amplifier type	Instruction manual name
MR-J3-□B	MR-J3-□B Servo Amplifier Instruction Manual (SH-030051)

(10) FIN signal (M3219+20n)

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

[Motion program example]

O0001;	Program No.
G90 G00 X100. M10;	Absolute value command PTP positioning (X100.) M10
X200. ;	PTP positioning (X200.)
M02;	Reset
%	



4.1.3 Axis statuses 2

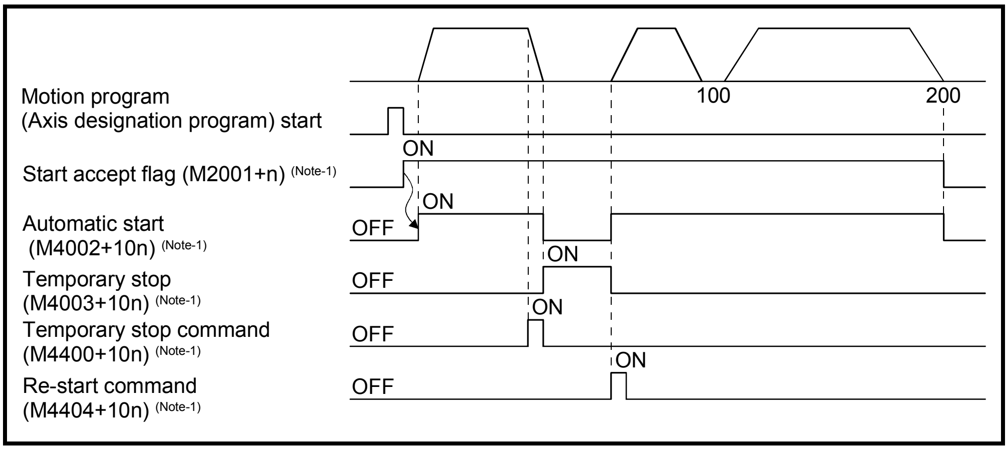
(1) Automatic start signal (M4002+10n)

When the axis used is specified in the SVST instruction, this signal turns on while the block of the specified Motion program is being executed. This signal turns off in the following cases.

- M02/M30 is executed.
- The temporary stop command turned on. (M4400+10n)
- The external STOP signal turned on.
- Error reset
- Emergency stop
- When one block execution is ended by M00, M01 or single block mode.
- The stop or rapid stop command turned on.

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
X200. ;	PTP positioning (X200.)
M02;	Reset
%	



REMARK

(Note-1): "n" indicates a value corresponding to axis No. such as the following tables.

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

(2) Temporary stop signal (M4003+10n)

(a) This signal turns on by the temporary stop command when the automatic start signal (M4002+10n) is turning on.
When the re-start command (M4404+10n) is turned on during a temporary stop, it is resumed from the block where it had stopped.
There is the following temporary stop command.
• Temporary stop command (M4400+10n)

(b) This signal turns off in the following cases.
• The re-start command (M4404+10n) turned on.
• The error reset command (M3207+20n) turned on.
• The servo error reset command (M3208+20n) turned on.
• Error occurrence
• Emergency stop

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
X200. ;	PTP positioning (X200.)
M02;	Reset
%	

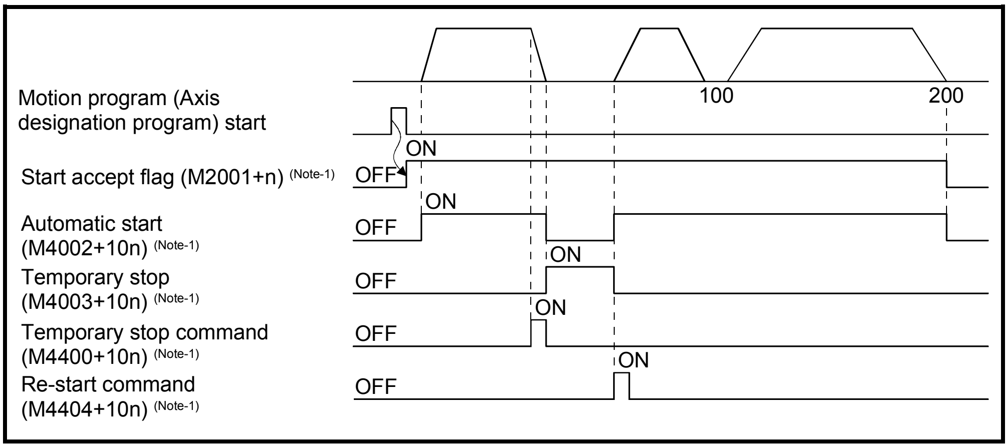


Fig.4.4 ON/OFF timing of the temporary stop signal

(3) Single block processing signal (M4009)

(a) The single block is available in two modes: a mode where a single block is specified before a program start, and a mode where a single block is executed at any point during program execution.
The single block processing signal indicates that a single block can be executed in the mode where a single block is executed at any point during program execution.

(b) A single block is executed when the single block processing signal is ON. When the single block processing is OFF, make an SVST start or turn single block start from OFF to ON to perform continuous operation.

(c) This signal turns on in the following case.
- When the single block mode signal (M4408) is turned on.

(d) This signal turns off in the following case.
- When the single block start signal (M4409) is turned from off to on after the single block mode signal (M4408) is turned off.

[Motion program example]

O0001;	Program No.
N1 G90 G00 X100. F1000. ;	Absolute value command constant-speed positioning (X100.)
N2 X200. ;	Constant-speed positioning (X200.)
N3 X300. ;	Constant-speed positioning (X300.)
N4 X400. ;	Constant-speed positioning (X400.)
M02;	Reset
%	

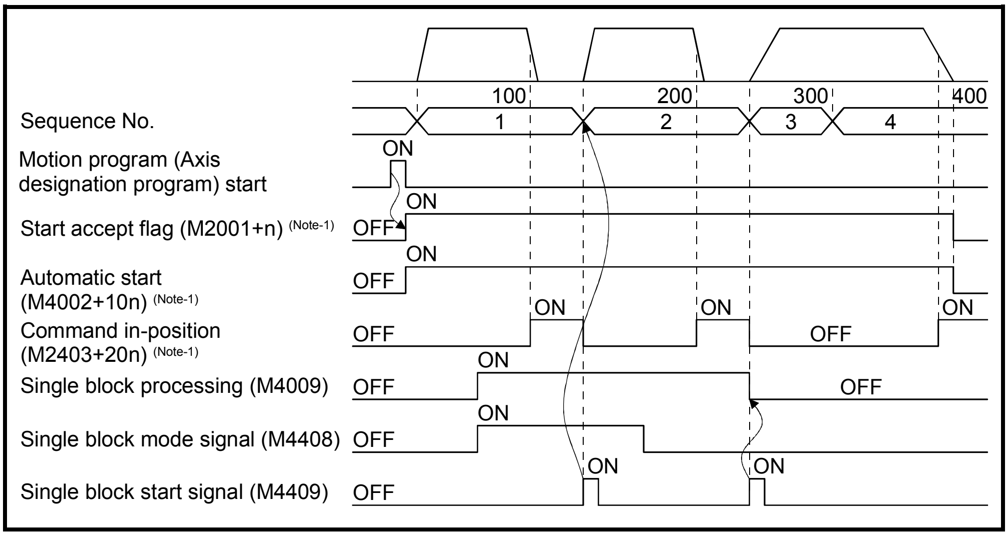


Fig.4.5 Single block signal timings

4.1.4 Axis command signals 2

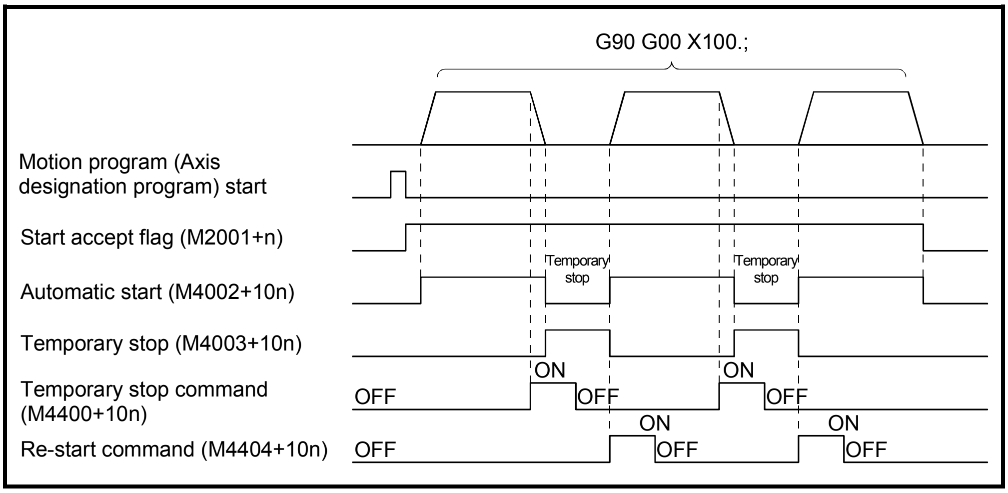
(1) Temporary stop command (M4400+10n)

(a) The Motion program at the positioning start (G00, G01, etc.) with the SVST instruction is stopped temporarily by the temporary stop command.
(The Motion program is stopped temporarily if any of the temporary stop commands for the axis No. specified with the SVST instruction turns on.)

(b) Turn on M4404+10n to re-start.

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
M02;	Reset
%	



(c) Note the following instructions among the positioning start instructions.

1) A program is stopped by the temporary stop command at the proximity dog, count, data set, dog cradle, stopper or limit switch combined type home position return by G28. After that, re-start (M4404+10n) is invalid. Start the Motion program with the SVST instruction to execute G28 again.

2) The temporary stop command is ignored in the axis executing G25 (high-speed oscillation).

POINT

The temporary stop command is ignored at the home position return by JOG operation, manual pulse generator operation or CHGA instruction.

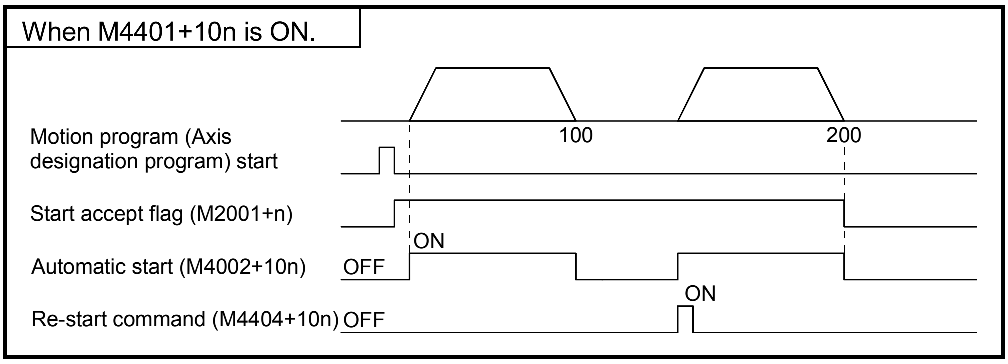
(2) Optional program stop command (M4401+10n)

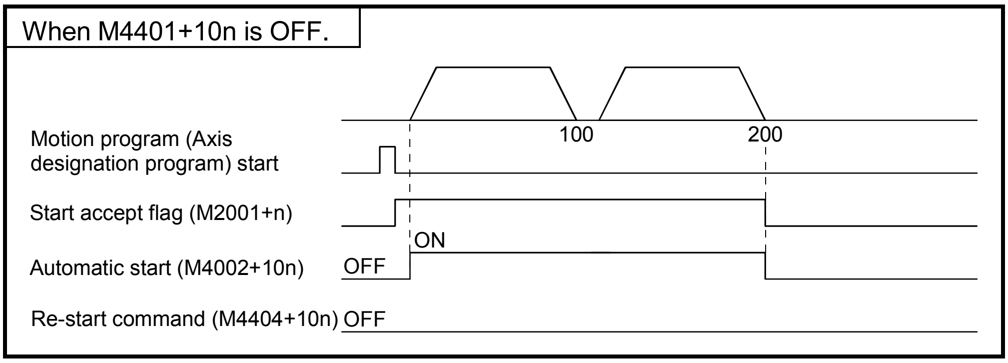
This signal is used to select whether a block stop is made in a block where "M01" exists.

• ON......... The block stop is made as the end of that block.
• OFF.........The next block is executed.

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
M01;	Optional program stop command
X200. ;	PTP positioning (X200.)
M02;	Reset
%	





(3) Optional block skip command (M4402+10n)

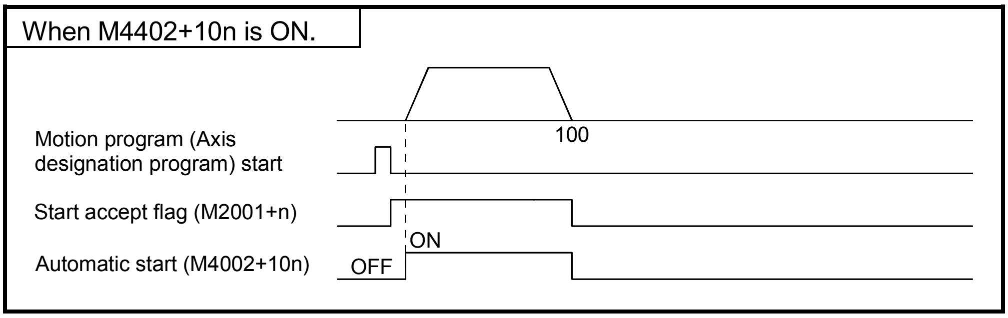
This signal is used to select whether a block is executed or not in the first of block where "/" exists.

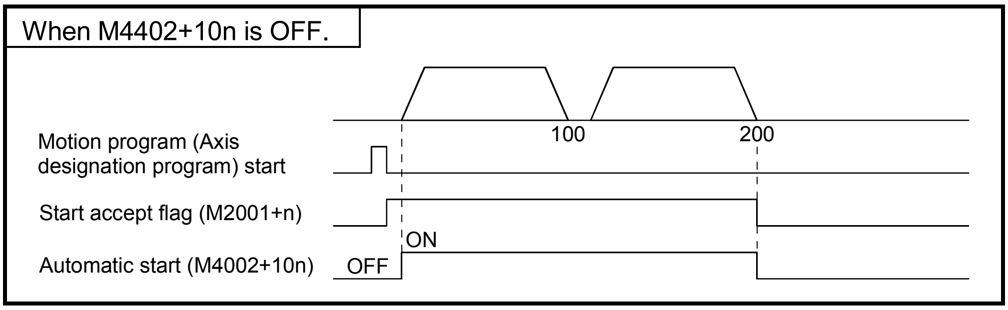
• ON.......... The block is not executed and execution shifts to the next block.

• OFF........ The block is executed.

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
/X200. ;	PTP positioning (X200.)
M02;	Reset
%	





(4) Single block command (M4403+10n)

This single block is ;used to set a single block before a program start. Refer to the single block mode signal (M4408) for the mode which executes a single block at any point during execution of program.

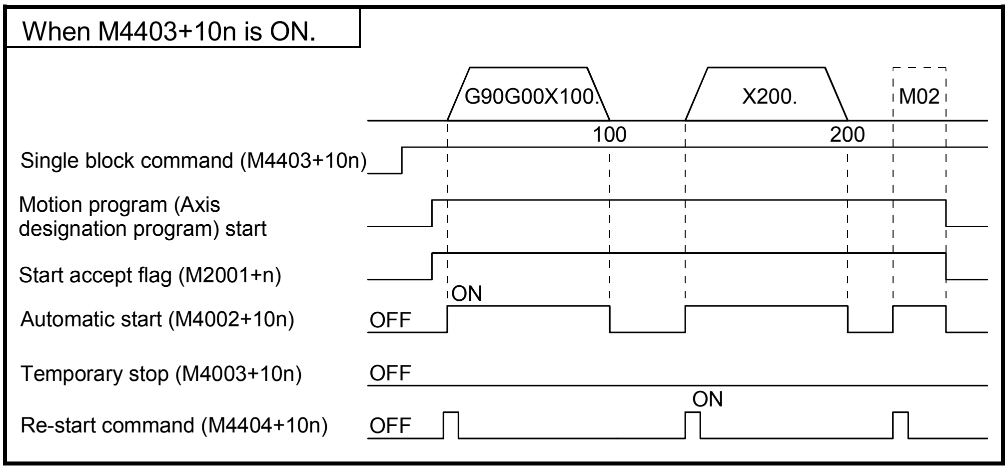
By turning on the single block command before a program start, commands in program operation can be executed block by block.

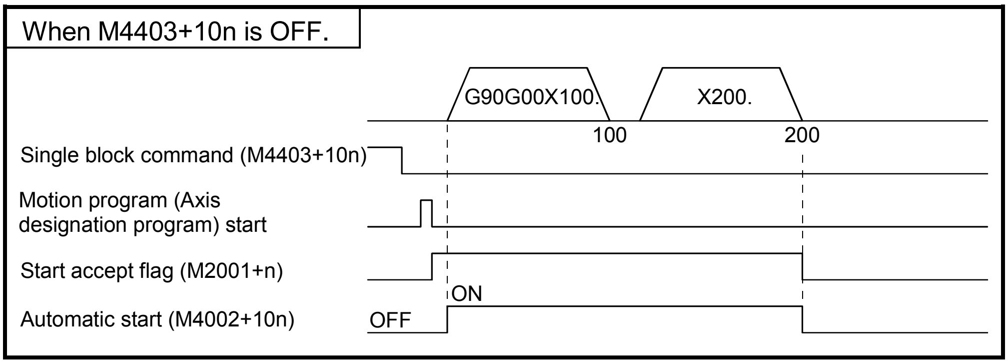
The single block signal is checked only at the Motion program start and is not checked during operation. Therefore, the single block signal is not made valid if it is turned on during operation.

- ON.......... Program is executed block by block.
  The first start is made by turning on the re-start command (M4404+10n) after execution of the SVST instruction.
  After that, a start is made by turning on the re-start command (M4404+10n).
- OFF........ All blocks are executed continuously using the SVST instruction.

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
X200. ;	PTP positioning (X200.)
M02;	Reset
%	



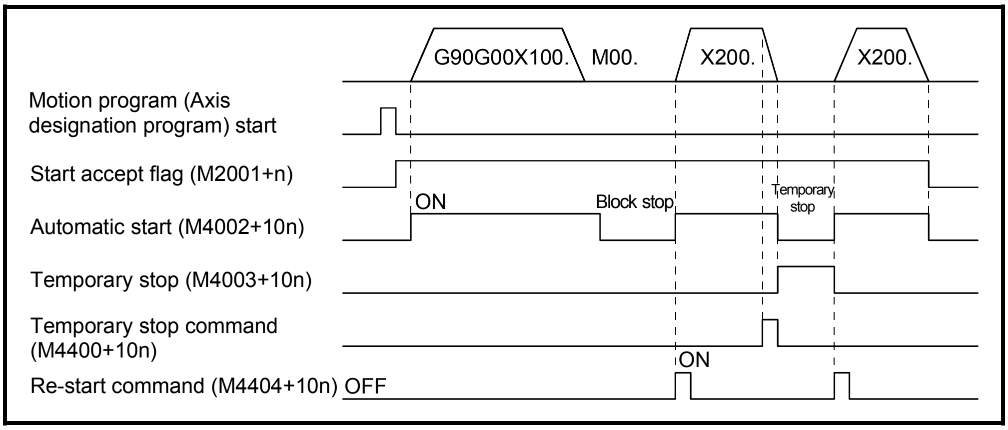


(5) Re-start command (M4404+10n)

This command resumes block execution when it is turned on during a block stop by the M00, M01 or single block command or during a temporary stop during the temporary stop command. (This signal is valid for the Motion program only. It is invalid for a home position return, etc.)

[Motion program example]

O0001;	Program No.
G90 G00 X100. ;	Absolute value command PTP positioning (X100.)
M00	Block stop
X200. ;	PTP positioning (X200.)
M02;	Reset
%	



(6) Override ratio valid/invalid (M4405+10n)

This signal is used to set whether the override ratio is valid or invalid.

• ON.......... Valid : If M4405+10n turns on during execution Motion program, positioning is executed at the specified speed multiplied by the value [%] stored in the override ratio setting register.(Note-1)

• OFF........ Invalid : Positioning is controlled at the override ratio of 100[%].

REMARK

(Note-1) : Positioning is controlled at the override ratio of 100[%] at the G25 (high-speed oscillation), G28 (proximity dog, count, data set, dog cradle, stopper or limit switch combined type home position return) in the Motion program or the home position returun by JOG operation, manual pulse generator or CHGA instruction, etc. (The override ratio is made invalid.)

(7) Axis interlock (Forward)/(Reverse) (M4406+10n/M4407+10n)

This signal is used to select whether an axis is made deceleration stop during positioning control.

(a) The axis interlock (forward)/(reverse) command turns on while the axis interlock valid/invalid (M4418+10n) is turning on, a deceleration stop is executed in the applicable axis.
- ON.......... Valid: If the axis interlock (forward)/(reverse) command turns on during execution of the Motion program, a deceleration stop is executed in the applicable axis.
- OFF........ Invalid: A deceleration stop is not executed in the applicable axis.

(b) The interlock is valid in the following cases.
- Positioning control using the Motion program (Except for hige speed oscillate (G25))
- Home position return
- Manual pulse operation

(c) The interlock is invalid at the "home position return" and "hige speed oscillate".

(d) Deceleration stop is executed follows "deceleration stop time" by the parameter block. However, a deceleration stop at the manual pulse operation only is "a stop without deceleration processing".

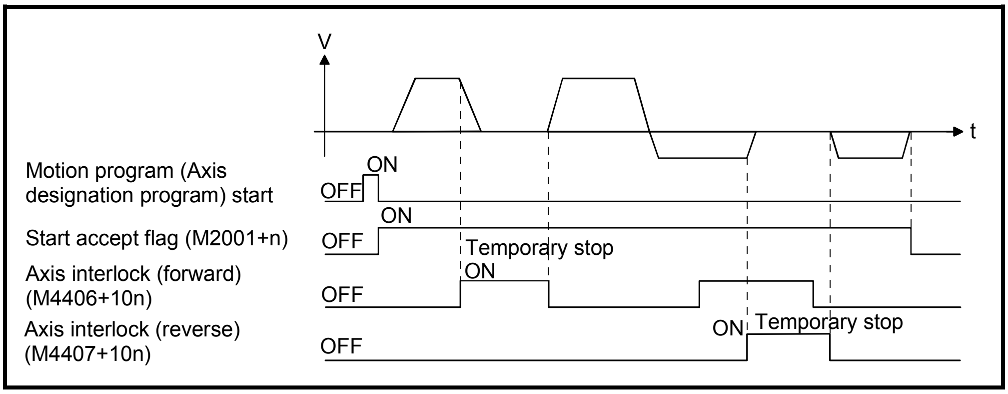
(e) If the axis interlock of travel direction turns on with at least one axis,during interpolation control, a deceleration stop is executed in all interpolation axes.

(f) When the travel of axis stops by the axis interlock, a minor error "axis interlock" (error code: 292) will occur.
In this case, since the program is not ended, the start accept flag (M2001 to M2032) of applicable axis does not turn off.
Therefore, when the Motion program is started by the specification of applicable axis, a minor error "the start accept flag (M2001 to M2032) for applicable axis is ON." (error code: 101) will occur.

(g) When the axis interlock signal turns on at a Motion program start, after the servomotor travels minutely, a minor error "axis interlock" (error code: 292) will occur and a deceleration stop is made. (The servomotor does not travel during JOG operation or manual pulse operation, and a minor error "axis interlock" (error code: 292) will occur.)

[Motion program example]

O0001;	Program No.
G90 G00 X200. ;	Absolute value command PTP positioning (X200.)
G01 X300. F-100. ;	Constant-speed positioning (X300.)
M02;	Reset
%	

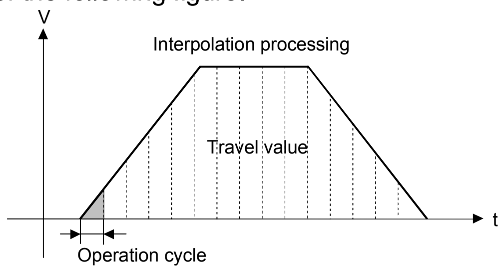


POINTS

[The reasons for the servomotor travels minutely when the axis interlock signal turns on at a Motion program start.]

Since the travel direction is judged at the positioning control in the Motion CPU, only the first interpolation processing is executed. Therefore, the servomotor travels minutely. This travel value is different in the acceleration-fixed acceleration/decerelation (G101) and time-fixed acceleration/decerelation (G100).

(1) Acceleration-fixed acceleration/decerelation (G101)
- The travel value of operation cycle (a part for 1 time of the beginning) is the slash portion of the following figure.

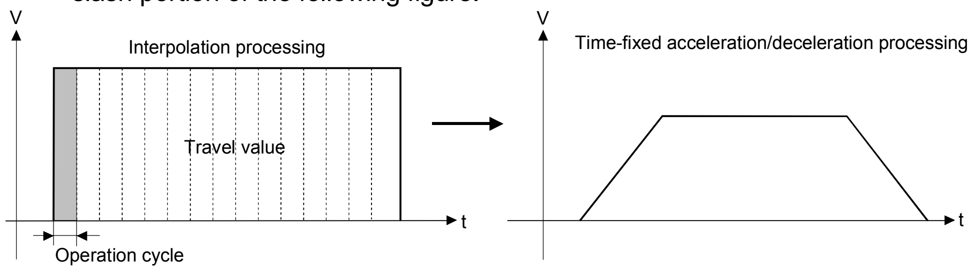


[Command speed 50m/min, Operation cycle 3.5ms]

Travel value for error detection = 50 × 0.0035/2/60

= 0.001mm

(2) Time-fixed acceleration/decerelation (G100)
- The travel value shown in a rectangle of following figure is divided into the travel value for every operation cycle. Therefore, the travel value of operation cycle (a part for 1 time of the beginning) for interpolation processing is the slash portion of the following figure.



[Command speed 10m/min, Operation cycle 3.5ms]

Travel value for error detection = 50 × 0.0035/60

= 0.58mm

(8) Single block mode signal (M4408)

(a) This signal validates a single block valid in the mode which executes a single block during execution of program.

(b) The single block processing (M4009) turns on by turning on the single block mode.

(9) Single block start signal (M4409)

(a) This signal re-starts a single block in the mode which executes a single block during execution of program.

(b) The single brock start is made valid by turning it from OFF to ON. However, the single block start during axis travel is not accepeted.

(c) When the single block processing signal (M4409) and the single block mode signal (M4408) are ON, making a single block start continues single block operation.

(d) When the single block processing signal (M4409) is ON and the single block mode signal (M4408) is OFF, making a single block start stops single block operation and starts continuous operation. At this time, the single block processing (M4409) turns off.

(10) Axis interlock valid/invalid (M4418)

This command is used to validate the axis interlock (forward)/(reverse).

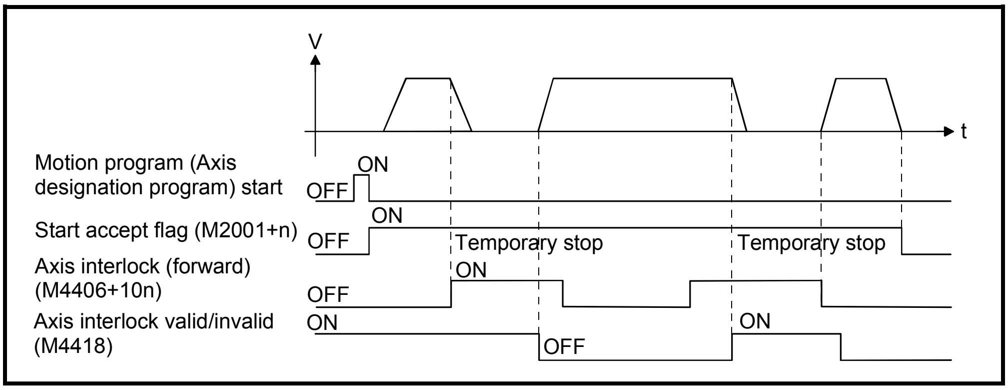
• ON.......... Valid: If the axis interlock (forward)/(reverse) command turns on, a deceleration stop is executed.

• OFF........ Invalid: Even if the axis interlock (forward)/(reverse) command turns on, a deceleration stop is not.

Defaut value is invalid (OFF).

[Motion program example]

O0001;	Program No.
G90 G00 X1000. ;	Absolute value command PTP positioning (X1000.)
G00 X300. ;	PTP positioning (X300.)
M02;	Reset
%	



4.1.5 Common devices

POINTS
(1) Internal relays for positioning control are not latched even within the latch range. In this manual, in order to indicate that internal relays for positioning control are not latched, the expression used in this text is "M2000 to M2319". (2) The range devices allocated as internal relays for positioning control cannot be used by the user even if their applications have not been set.

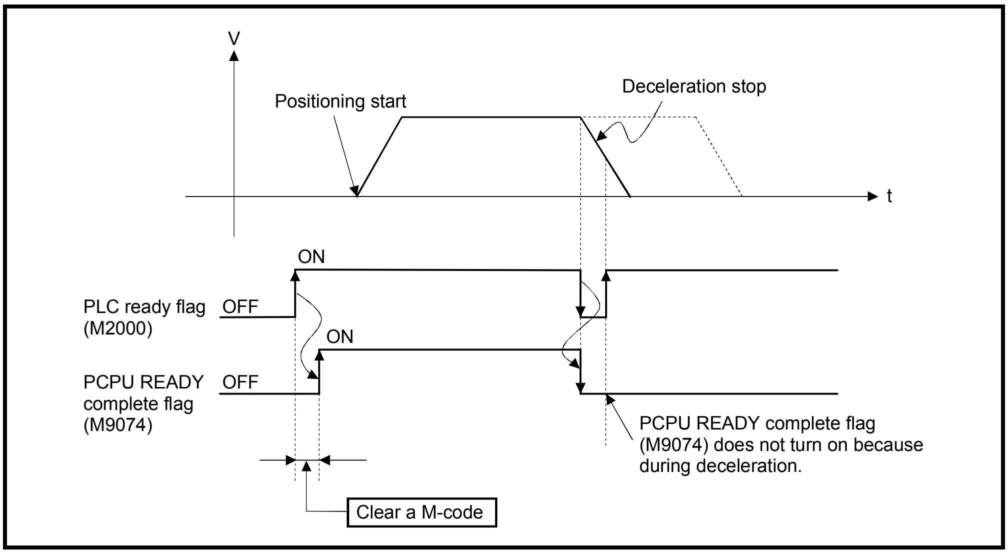
(1) PLC ready flag (M2000) ....………………… Command signal

(a) This signal informs the Motion CPU that the PLC CPU is normal.
   1) The positioning control, home position return, JOG operation or manual pulse generator operation using the Motion program when the M2000 is ON.
   2) The above 1) control is not performed even if the M2000 is turned on during the test mode [TEST mode ON flag (M9075) : ON] using a peripheral device.

(b) The setting data such as the fixed parameters, servo parameters and limit switch output data can be changed using a peripheral device when M2000 is OFF only.
   The above data using a peripheral device cannot be written when the M2000 is ON.

(c) The following processings are performed when the M2000 turns OFF to ON.
   1) Processing details
      • Clear the M-code storage area of all axes.
      • Turn the PCPU READY complete flag (M9074) on.
      • Execute the Motion program (Control program) of automatic start from the first.
   2) If there is a starting axis, an error occurs, and the processing in above (c) 1) is not executed.

3) The processing in above (c) 1) is not executed during the test mode.
It is executed when the test mode is cancelled and M2000 is ON.



(d) The following processings are performed when the M2000 turns ON to OFF.

1) Processing details
- Turn the PCPU READY complete flag (M9074) off.
- Deceleration stop of the starting axis.
- Stop to execute the Motion program.
- Turn all points of the real output PY off.

(e) Operation setting at STOP → RUN
The condition which the PLC ready flag (M2000) turns on is set in the sysytem setting. Select the following either.

1) M2000 turns on by the switch (STOP → RUN). (Default)
The condition which M2000 turns OFF to ON.
- Move the RUN/STOP switch from STOP to RUN.
- Turn the power supply on or release to reset where the RUN/STOP switch is moved to RUN.

The condition which M2000 turns ON to OFF.
- Move the RUN/STOP switch from RUN to STOP.

2) M2000 turns on by set "1" to the switch (STOP → RUN) + setting register.
(M2000 is turned on by set "1" to the switch RUN ∧ setting register.)
The condition which M2000 is turned ON to OFF.
- Set "1" to the setting register D704 of the PLC ready flag where the RUN/STOP switch is moved to RUN. (The Motion CPU detects the change of the lowest rank bit 0 → 1 in D704.)

The condition which M2000 is turned on to off.

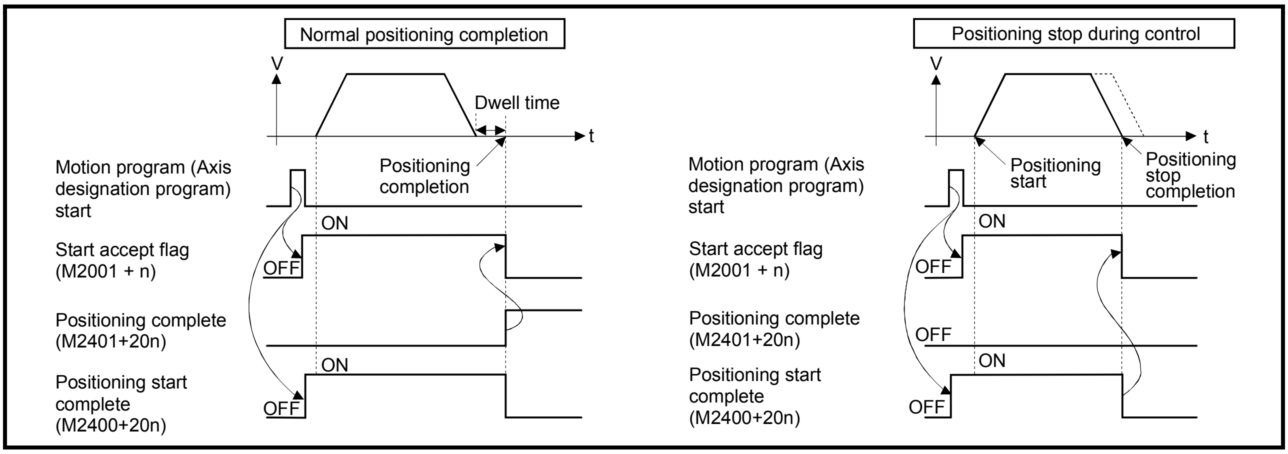
- Set "0" to the setting register D704 of the PLC ready flag where the RUN/STOP switch is moved to RUN. (The Motion CPU detects the change of the lowest rank bit 1 → 0 in D704.)
- Move the RUN/STOP switch from RUN to STOP.

(2) Start accept flag (M2001 to M2032) .... Status signal

(a) This flag turns on when the positioning start (S(P).SVST) instruction is executed. The start accept flag corresponding to an axis specified with the Motion dedicated PLC instruction (S(P).SVST) turns on.

(b) The ON/OFF processing of the start accept flag is shown below.

1) The start accept flag corresponding to an axis specified with the Motion dedicated PLC instruction (S(P).SVST) turns on and it turns off at the positioning completion. This flag also turns off when it is made to stopping on the way.
(When it is made to stop on the way by the speed change to speed "0", this flag remain on.)



2) This flag turns on at the positioning control by turning on the JOG start command (M3202+20n or M3203+20n), and turns off at the positioning stop by turning off the JOG start command.

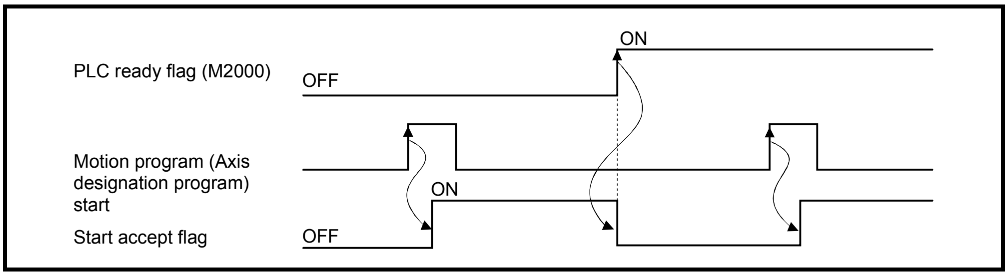
3) This flag turns on during the manual pulse generator enable (M2051 to M2053: ON), and turns off at the manual pulse generator disable (M2051 to M2053: OFF).

⚠CAUTION

● Do not turn the start accept flags ON/OFF in the user side.

- If the start accept flag is turned off using the Motion program or peripheral devices while this flag is on, no error will occur but the positioning operation will not be reliable. Depending on the type of machine, it might operate in an unanticipated operation.
- If the start accept flag is turned on using the Motion program or peripheral devices while this flag is off, no error will occur but the "start accept on error" will occur at the next starting and cannot be started.

(c) When M2000 is OFF, the start accept flag turns on by the Motion dedicated PLC instruction (S(P).SVST), and the start accept flag turns off by turning the M2000 ON.



(3) Personal computer link communication error flag (M2034) ....………. Status signal

This flag turns on when the communication error occurs in the personal computer link communication.

• ON : Personal computer link communication error occurs
• OFF: No personal computer link communication error
(It turns off if normal communication is resumed.)

Refer to APPENDIX 1.5 for details on the PC link communication error.

(4) System setting error flag (M2041)................................ Status signal

This flag set the "system setting data" and performs an adjustment check with a real installation state (CPU base unit/extension base units) at the power supply on or resetting of the Motion CPU.

• ON .... Error
• OFF .... Normal

(a) When an error occurs, the ERR. LED at the front of the CPU turns on. The error contents can be confirmed using the error list monitor of a peripheral device started by SW6RN-GSV43P.

(b) When M2041 is on, positioning cannot be started. Remove an error factor, and turn the power supply on again or reset the Multiple CPU system.

REMARK

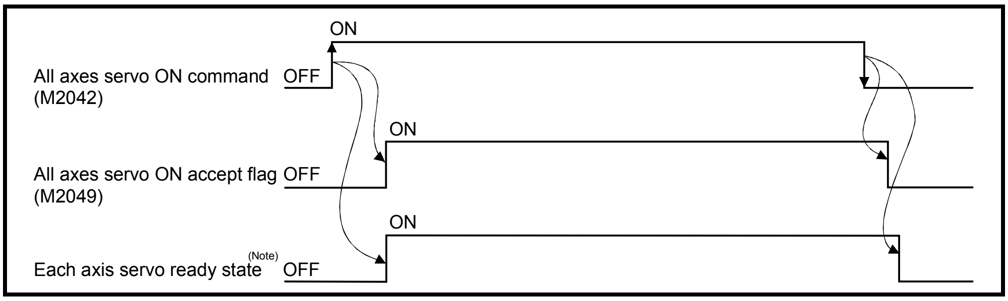
Even if the module which is not set as the system setting with the peripheral device is installed in the slot, it is not set as the object of an adjustment check. And, the module which is not set as the system setting cannot be used in the Motion CPU.

(5) All axes servo ON command (M2042) .... Command signal

This command is used to enable servo operation.

(a) Servo operation enabled … M2042 turns on while the servo OFF command (M3215+20n) is off and there is no servo error.

(b) Servo operation disable ...... • M2042 is off
• The servo OFF command (M3215+20n) is on
• Servo error state



(Note): Refer to "4.1.1 Axis statuses "Servo ready signal"" for details.

POINT
When M2042 turns on, it is not turned off even if the CPU is set in the STOP state.

(6) Motion slot fault detection flag (M2047) .... Status signal

This flag is used as judgement which modules installed in the motion slot of the CPU base unit is "normal" or "abnormal".

• ON .... Installing module is abnormal
• OFF .... Installing module is normal

The module information at the power supply on and after the power supply injection are always checked, and errors are detected.

(a) Perform the disposal (stop the starting axis, servo OFF, etc.) of error detection using the Motion program.

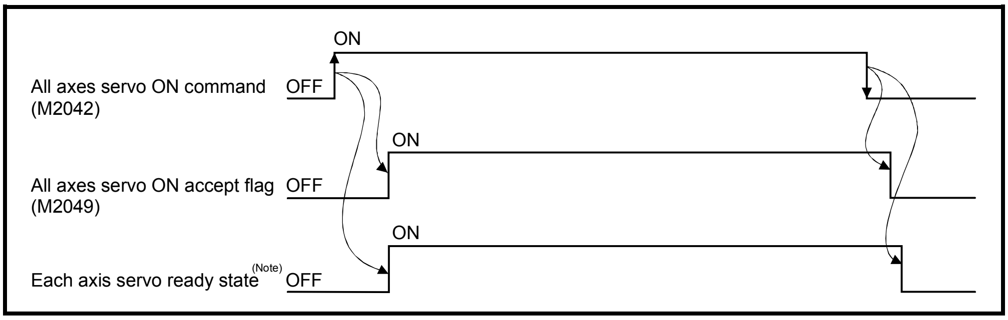
(7) JOG operation simultaneous start command (M2048) …..... Command signal

(a) When M2048 turns on, JOG operation simultaneous start based on the JOG operation execution axis set in the JOG operation simultaneous start axis setting register (D710 to D713).

(b) When M2048 turns off, the axis during operation decelerates to a stop.

(8) All axes servo ON accept flag (M2049) .... Status signal

This flag turns on when the Motion CPU accepts the all axes servo ON command (M2042).
Since the servo ready state of each axis is not checked, confirm it in the servo ready signal (M2415+20n).



(Note): Refer to "4.1.1 Axis statuses "Servo ready signal"" for details.

(9) Start buffer full (M2050).. Status signal

(a) This signal turns on when 64 or more requests is executed simultaneously by the SVST instruction and it cannot be started.

(b) Reset M2050 by the user side.

(10) Manual pulse generator enable flag (M2051 to M2053) .... Command signal

This flag set the enabled or disabled state for positioning with the pulse input from the manual pulse generators connected to P1 to P3 (Note) of the Q173PX.

- ON .... Positioning control is executed by the input from the manual pulse generators.
- OFF .... Positioning control cannot be executed by the manual pulse generators because of the input from the manual pulse generators is ignored.

Defalut value is invalid(OFF).

REMARK

(Note): Refer to the "Q173HCPU/Q172HCPU User's Manual" for P1 to P3 connector of the Q173PX.

(11) Operation cycle over flag (M2054) .... Status signal

This flag turns on when the time concerning motion operation exceeds the operation cycle of the Motion CPU setting. Perform the following operation, in making it turn off.

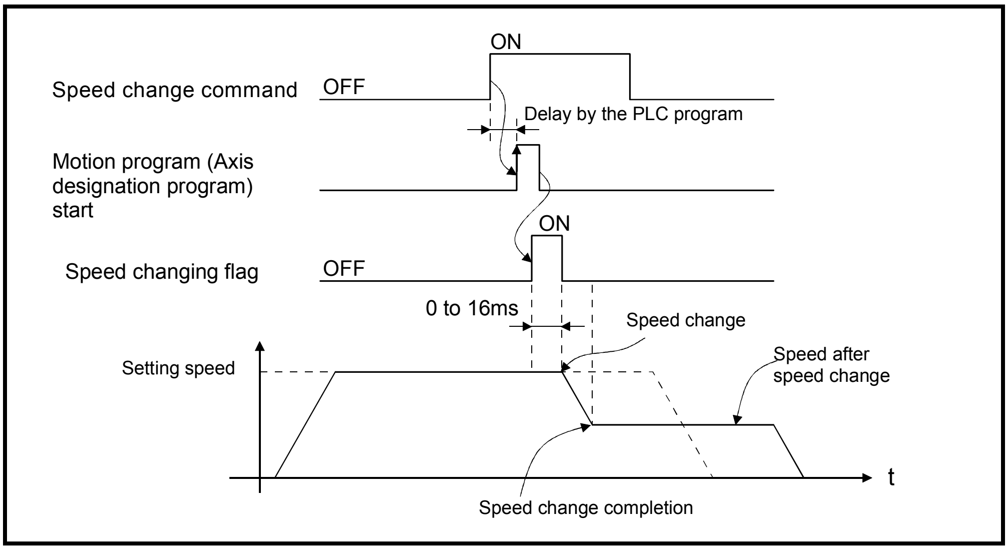
- Turn the power supply of the Multiple CPU system on to off
- Reset the Multiple CPU system
- Reset using the user program

[Error measures]

- Change the operation cycle into a large value in the system setting.

(12) Speed changing flag (M2061 to M2092) .... Status signal

This flag turns on during speed change by the control change (CHGV) instruction of the Motion program or Motion dedicated PLC instruction (S(P).CHGV).



The speed changing flag list is shown below.

Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2061	9	M2069	17	M2077	25	M2085
2	M2062	10	M2070	18	M2078	26	M2086
3	M2063	11	M2071	19	M2079	27	M2087
4	M2064	12	M2072	20	M2080	28	M2088
5	M2065	13	M2073	21	M2081	29	M2089
6	M2066	14	M2074	22	M2082	30	M2090
7	M2067	15	M2075	23	M2083	31	M2091
8	M2068	16	M2076	24	M2084	32	M2092

(Note): The range of axis No.1 to 8 is valid in the Q172HCPU.

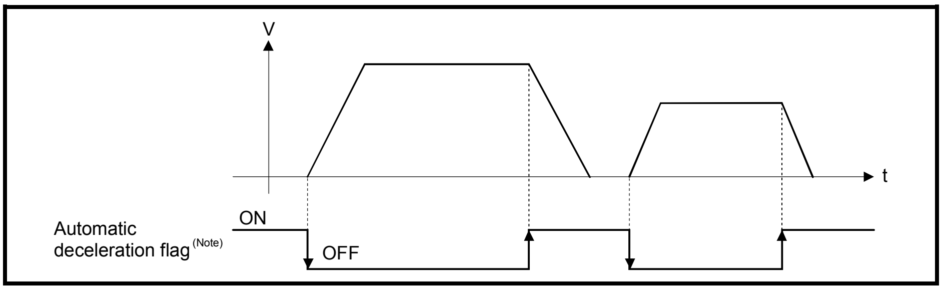
(13) Automatic decelerating flag (M2128 to M2159) .... Status signal

This signal turns on while automatic deceleration processing is performed at the positioning control or position follow-up control.

(a) This flag turns on during automatic deceleration processing to the command address at the position follow-up control, but it turns off if the command address is changed.

(b) When the normal start is completed at the control in all control system, it turns off.

(c) In any of the following cases, this flag does not turn off.
- During deceleration by the JOG signal off
- During manual pulse generator operation
- At deceleration on the way due to stop command or stop cause occurrence
- When travel value is "0"



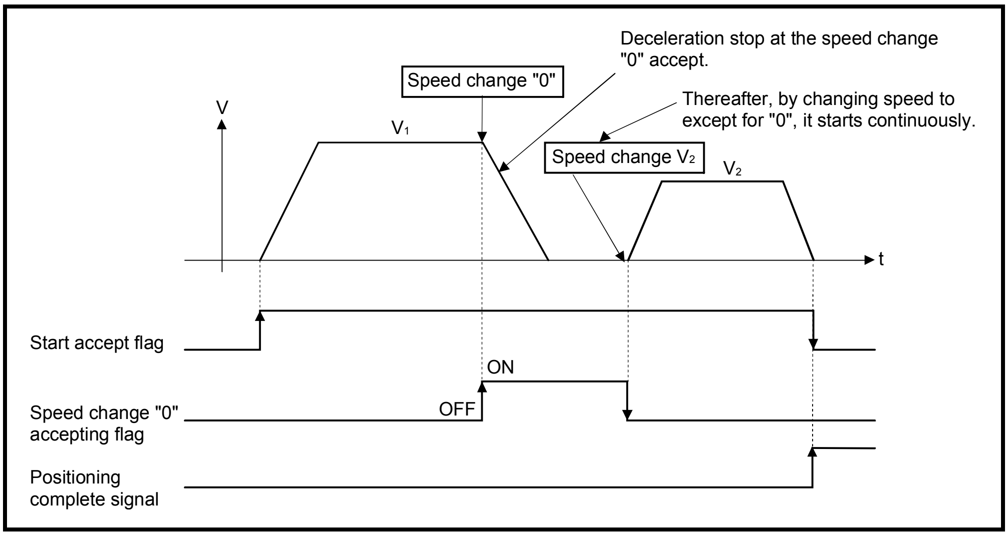
The automatic deceleration flag list is shown below.

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

(Note): The range of axis No.1 to 8 is valid in the Q172HCPU.

(14) Speed change "0" accepting flag (M2240 to M2271)
....………. Status signal

This flag turns on while a speed change request to speed "0" or negative speed change is being accepted.
It turns on when the speed change request to speed "0" or negative speed change is accepted during a start. After that, this signal turns off when a speed change is accepted or on completion of a stop due to a stop cause.



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

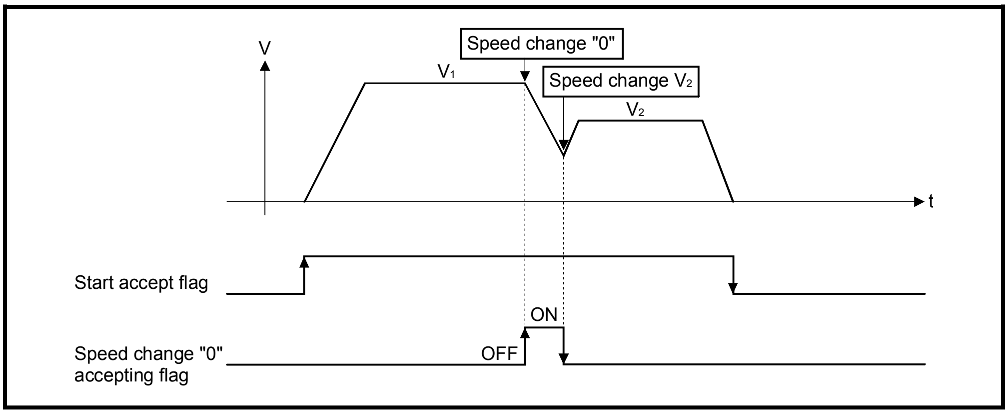
Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2240	9	M2248	17	M2256	25	M2264
2	M2241	10	M2249	18	M2257	26	M2265
3	M2242	11	M2250	19	M2258	27	M2266
4	M2243	12	M2251	20	M2259	28	M2267
5	M2244	13	M2252	21	M2260	29	M2268
6	M2245	14	M2253	22	M2261	30	M2269
7	M2246	15	M2254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

(Note): The range of axis No.1 to 8 is valid in the Q172HCPU.

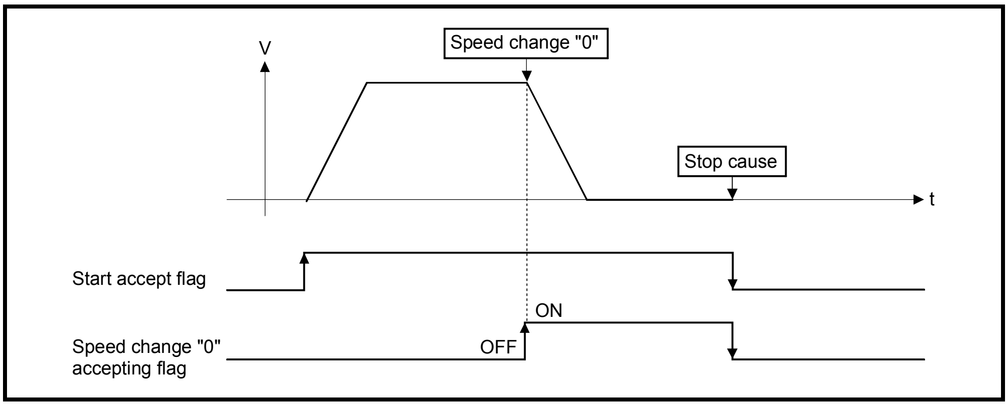
REMARK

(1) Even if it has stopped, when the start accept flag (M2001 to M2032) is ON state, the state where the request of speed change "0" is accepted is indicated. Confirm by this speed change "0" accepting flag.
(2) During interpolation, the flags corresponding to the interpolation axes are set.
(3) In any of the following cases, the speed change "0" request is invalid.
   - After deceleration by the JOG signal off
   - During manual pulse generator operation
   - After positioning automatic deceleration start
   - After deceleration due to stop cause
(4) The temporary stop is executed during travel or dwell (G04) execution, the speed change "0" accepting flag turns on.
(5) Speed change "0" accepting flag turns on in the following cases.
   - The temporary stop command (M4400+10n) is input during travel to the specified block by pre-read enable (G99) or execution of dwell (G04).
   - Travel to the specified block by pre-read enable (G99) or execution of dwell (G04) is executed after the temporary stop command (M4400+10n) input.

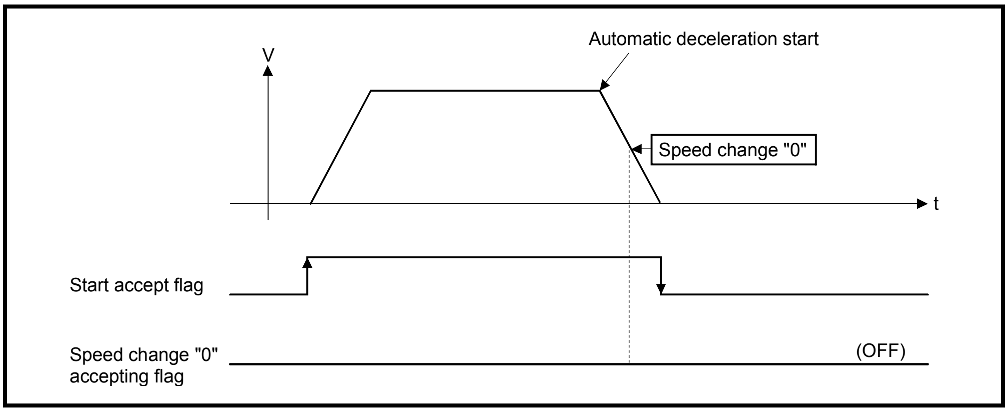
(a) The flag turns off if a speed change request occurs during deceleration to a stop due to speed change "0".



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



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



4.2 Data Registers

(1) Data register list

Device No.	Application
D0 to	Axis monitor device (20 points × 32 axes)
D640 to	Control change register (2 points × 32 axes)
D704 to	Common device (Command signal) (54 points)
D758 to	Common device (Monitor) (42 points)
D800 to	Axis monitor device 2 (20 points × 32 axes)
D1440 to	Control program monitor device (6 points × 16 programs)
D1536 to	Control change register 2 (Override ratio) (3 points × 32 axes)
D1632 to	User device (18 points)
D1650 to	Tool length offset data setting register (2 points × 20)
D1690 to D8191	User device (6502 points)

☐ Usable in the user device.

POINT

- Total number of user device points

6520points

(2) Axis monitor device list

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

Signal name

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0, 1	Machine value	Operation cycle		Command unit	Monitor device
2, 3	Real machine value	Operation cycle		Command unit	Monitor device
4, 5	Deviation counter value	Operation cycle		PLS	Monitor device
6	Minor error code	Immediate		—	Monitor device
7	Major error code	Immediate		—	Monitor device
8	Servo error code	Main cycle		—	Monitor device
9	Home position return re-travel value	Operation cycle		PLS	Monitor device
10, 11	Travel value after proximity dog ON	Operation cycle		Command unit	Monitor device
12	Execute program No.	At start		—	Monitor device
13	M-code	Operation cycle		—	Monitor device
14	Torque limit value	Operation cycle		%	Monitor device
15, 16, 17	Unusable	—	—	—	—
18, 19	Real current value at stop input	Operation cycle		Command unit	Monitor device

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(3) Control change register list

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

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0 1	JOG speed setting		At start	Command unit	Command device

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(4) Axis monitor device 2 list

Axis No.	Device No.
1	D800 to D819
2	D820 to D839
3	D840 to D859
4	D860 to D879
5	D880 to D899
6	D900 to D919
7	D920 to D939
8	D940 to D959
9	D960 to D979
10	D980 to D999
11	D1000 to D1019
12	D1020 to D1039
13	D1040 to D1059
14	D1060 to D1079
15	D1080 to D1099
16	D1100 to D1119
17	D1120 to D1139
18	D1140 to D1159
19	D1160 to D1179
20	D1180 to D1199
21	D1200 to D1219
22	D1220 to D1239
23	D1240 to D1259
24	D1260 to D1279
25	D1280 to D1299
26	D1300 to D1319
27	D1320 to D1339
28	D1340 to D1359
29	D1360 to D1379
30	D1380 to D1399
31	D1400 to D1419
32	D1420 to D1439

Signal name

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0 1	Current value	Operation cycle		Command unit	Monitor device
2	Execute sequence No. (main)	Immediate		—	Monitor device
3	Execute block No. (main)	Immediate		—	Monitor device
4	Execute program No. (sub)	Immediate		—	Monitor device
5	Execute sequence No. (sub)	Immediate		—	Monitor device
6	Execute block No. (sub)	Immediate		—	Monitor device
7	Unusable	—	—	—	—
8	G43/G44 command	Immediate		—	Monitor device
9	Tool length offset data No.	Immediate		—	Monitor device
10 11	Tool length offset data	Immediate		Command unit	Monitor device
12 13 14 15 16 17 18 19	Unusable	—	—	—	—

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(5) Control program monitor device list

Device No.	Signal name
D1440 to D1445	
D1446 to D1451	
D1452 to D1457	
D1458 to D1463	
D1464 to D1469	
D1470 to D1475	
D1476 to D1481	
D1482 to D1487	
D1488 to D1493	
D1494 to D1499	
D1500to D1505	
D1506 to D1511	
D1512 to D1517	
D1518 to D1523	
D1524 to D1529	
D1530 to D1535	

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0	Program No.	Immediate			Monitor device
1	Sequence No.				
2	Block No.				
3	Error code (Minor error code)				
4	Execute status				
5	Unusable (Note-1)	—	—	—	—

D1445 : CLEAR request status storage register

(Note-1): D1445 (CLEAR request status storage register) is used in the "control program stop function from the PLC CPU".

(6) Control change register 2 list

Axis No.	Device No.	Signal name
1	D1536 to D1538	
2	D1539 to D1541	
3	D1542 to D1544	
4	D1545 to D1547	
5	D1548 to D1550	
6	D1551 to D1553	
7	D1554 to D1556	
8	D1557 to D1559	
9	D1560 to D1562	
10	D1563 to D1565	
11	D1566 to D1568	
12	D1569 to D1571	
13	D1572 to D1574	
14	D1575 to D1577	
15	D1578 to D1580	
16	D1581 to D1583	
17	D1584 to D1586	
18	D1587 to D1589	
19	D1590 to D1592	
20	D1593 to D1595	
21	D1596 to D1598	
22	D1599 to D1601	
23	D1602 to D1604	
24	D1605 to D1607	
25	D1608 to D1610	
26	D1611 to D1613	
27	D1614 to D1616	
28	D1617 to D1619	
29	D1620 to D1622	
30	D1623 to D1625	
31	D1626 to D1628	
32	D1629 to D1631	

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0	Override ratio setting register (0 to 100)		Operation cycle	%	Command device
1	Unusable	—	—	—	—
2					

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(7) Tool length offset data setting register list (Higher rank, lower rank)

Device No.	Signal name
D1651, D1650	Tool length offset data 1
D1653, D1652	Tool length offset data 2
D1655, D1654	Tool length offset data 3
D1657, D1656	Tool length offset data 4
D1659, D1658	Tool length offset data 5
D1661, D1660	Tool length offset data 6
D1663, D1662	Tool length offset data 7
D1665, D1664	Tool length offset data 8
D1667, D1666	Tool length offset data 9
D1669, D1668	Tool length offset data 10
D1671, D1670	Tool length offset data 11
D1673, D1672	Tool length offset data 12
D1675, D1674	Tool length offset data 13
D1677, D1676	Tool length offset data 14
D1679, D1678	Tool length offset data 15
D1681, D1680	Tool length offset data 16
D1683, D1682	Tool length offset data 17
D1685, D1684	Tool length offset data 18
D1687, D1686	Tool length offset data 19
D1689, D1688	Tool length offset data 20

(8) Common device list

Device No.	Signal name		Refresh cycle	Fetch cycle	Signal direction
D704	PLC ready flag request			Main cycle	Command device
D705	Speed switching point specified flag request				
D706	All axes servo ON command request				
D707	CLEAR request control program No. setting register				
D708	JOG operation simultaneous start command request				
D709	Unusable		—	—	—
D710	JOG operation simultaneous start axis setting register			At start	Command device
D711					
D712					
D713					
D714	Manual pulse generator axis 1 No. setting register			At the manual pulse generator enable flag ↑	
D715					
D716	Manual pulse generator axis 2 No. setting register				
D717					
D718	Manual pulse generator axis 3 No. setting register				
D719					
D720	Axis 1	Manual pulse generators 1-pulse input magnification setting register (Note-1),(Note-2)			
D721	Axis 2				
D722	Axis 3				
D723	Axis 4				
D724	Axis 5				
D725	Axis 6				
D726	Axis 7				
D727	Axis 8				
D728	Axis 9				
D729	Axis 10				
D730	Axis 11				
D731	Axis 12				
D732	Axis 13				
D733	Axis 14				
D734	Axis 15				
D735	Axis 16				
D736	Axis 17				
D737	Axis 18				
D738	Axis 19				
D739	Axis 20				
D740	Axis 21				
D741	Axis 22				
D742	Axis 23				
D743	Axis 24				
D744	Axis 25				
D745	Axis 26				
D746	Axis 27				
D747	Axis 28				
D748	Axis 29				
D749	Axis 30				
D750	Axis 31				
D751	Axis 32				

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction
D752	Manual pulse generator 1 smoothing magnification setting register		At the manual pulse generator enable flag ↑	Command device
D753	Manual pulse generator 2 smoothing magnification setting register			
D754	Manual pulse generator 3 smoothing magnification setting register			
D755	Manual pulse generator 1 enable flag request		Main cycle	
D756	Manual pulse generator 2 enable flag request			
D757	Manual pulse generator 3 enable flag request			
D758	Unusable	—	—	—
D759	PCPU ready complete flag status	Main cycle		Monitor device
D760	Unusable (40 points)	—	—	—
D761				
D762				
D763				
D764				
D765				
D766				
D767				
D768				
D769				
D770				
D771				
D772				
D773				
D774				
D775				
D776				
D777				
D778				
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D782				
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D784				
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D787				
D788				
D789				
D790				
D791				
D792				
D793				
D794				
D795				
D796				
D797				
D798				
D799				

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

4.2.1 Axis monitor devices

The monitoring data area is used by the Motion CPU to store data such as the machine value during positioning control, the real machine value and the number of droop pulses in the deviation counter.
It can be used to check the positioning control state using the Motion program.
The user cannot write data to the monitoring data area (except the travel value change register).

(1) Machine value storage register (D0+20n, D1+20n) ....…….. Monitor device

The machine value represents the address in the mechanical coodinate system determined by a home position returun.
This value does not change if "G92" and work coordinate system (G54 to G59) are executed.
This value is used to process the stroke limit range and limit switch output.

(2) Real machine value storage register (D2+20n, D3+20n) ....…….. Monitor device

(a) This register stores the actual motor position (machine value – deviation counter value).

(b) The "machine value" is equal to the "real machine value" in the stopped state. (Some real machine values are changed by the servo lock force at a motor stop.

(3) Deviation counter value (droop pulses) storage register (D4+20n, D5+20n)....…….. Monitor device

This register stores the difference between the machine value and real machine value.

(4) Minor error code storage register (D6+20n) .... Monitor device

(a) This register stores the corresponding error code (Refer to APPENDIX 1.2) at the minor error occurrence. If another minor error occurs after error code storing, the previous error code is overwritten by the new error code.

(b) Minor error codes can be cleared by an error reset command (M3207+20n).

(5) Major error code storage register (D7+20n) .... Monitor device

(a) This register stores the corresponding error code (Refer to APPENDIX 1.3) at the major error occurrence. If another major error occurs after error code storing, the previous error code is overwritten by the new error code.

(b) Major error codes can be cleared by an error reset command (M3207+20n).

(6) Servo error code storage register (D8+20n) .... Monitor device

(a) This register stores the corresponding error code (Refer to APPENDIX 1.4) at the servo error occurrence. If another servo error occurs after error code storing, the previous error code is overwritten by the new error code.

(b) Servo error codes can be cleared by an error reset command (M3208+20n).

(7) Home position return re-travel value storage register (D9+20n) .... Monitor device

If the position stopped in the position specified with the travel value setting after the proximity dog ON (refer to 7.3.1) by a peripheral device is not zero point, it made to travel to zero point by re-travel in the Motion CPU.
(Data does not change with the last value in the data setting type.)
The following value is stored according to the number of feedback pulses of the motor connected.

Number of feedback pulses	Storage data
Less than 131072[PLS]	Feedback pulses
131072[PLS] or more, 262144[PLS] or less	1/10 of feedback pulses
More than 262144[PLS]	1/10000 of feedback pulses

(8) Travel value after proximity dog ON storage register (D10+20n, D11+20n) .... Monitor device

This register stores the travel value (unsigned) from the proximity dog ON to home position return completion after the home position return starting.

(9) Execute program No. (main) storage register (D12+20n) .... Monitor device

(a) The register stores the starting program No. (Motion program No.) at the SVST instruction start.
The O No. of subprogram started by "M98" (subprogram call) is stored to another register.

(b) The following value is stored in the following cases.
- JOG operation..................................... FFFFH
- Manual pulse generator operation ...... FFFEH
- Home position return operation .... FFFCH
- Power supply on.................................. FF00H

(c) When either of the following is being executed using a peripheral device in the test mode, FFFD is stored in this register.
- Home position return.

(10) M-code storage register (D13+20n) .... Monitor device

(a) This register stores the M-code set to the Motion program at the block execute start.
If M-code is not set in the Motion program, the value "0" is stored.

(b) The preceding value remains until the M-code is executed next.

(11) Torque limit value storage register (D14+20n) ...... Monitor device

This register stores the torque limit value imposed on the servo amplifier.
The default value 300[%] is stored at the power supply of servo amplifier ON.

(12) Real current value at STOP input storage register (D18+20n, D19+20n) .... Monitor device

This register stores the real current value at the STOP signal (STOP) input of the Q172LX.

4.2.2 Control change registers

This area stores the JOG operation speed data.

Control change register list (Higher rank, lower rank)

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

(Note): The range of axis No.1 to 8 is valid in the Q172HCPU.

(1) JOG speed setting registers (D640+2n) .... Command device

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

(b) Setting range of the JOG speed is shown below.

Item \ Unit	mm		inch		degree	
	Setting range	Unit	Setting range	Unit	Setting range	Unit(Note)
JOG speed	1 to 600000000	$\times 10^{-2}$ [mm/min]	1 to 600000000	$\times 10^{-3}$ [inch/min]	1 to 2147483647	$\times 10^{-3}$ [degree/min]

(Note) : When the "speed control 10× multiplier setting for degree axis" is set to "valid" in the fixed parameter, the unit is "$\times 10^{-2}$[degree/min]".

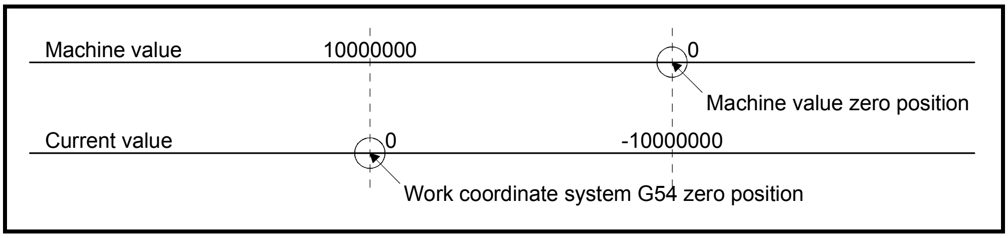
(c) The JOG speed is the value stored in the JOG speed setting registers when the JOG start signal turns off to on.
Even if data is changed during JOG operation, JOG speed cannot be changed.

(d) Refer to Section 7.5 for details of JOG operation.

4.2.3 Axis monitor devices 2

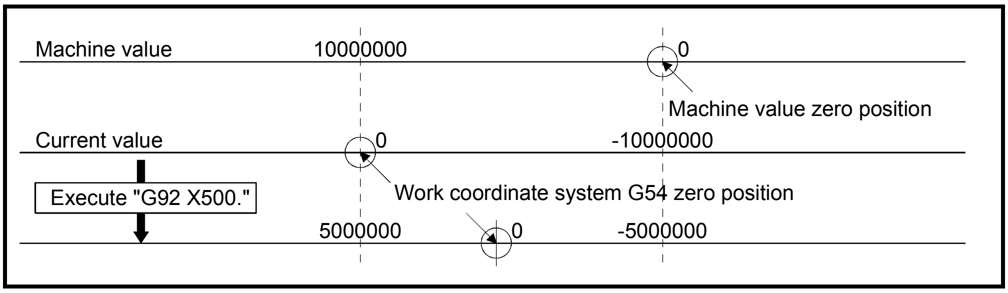
(1) Current value (D800+20n, D801+20n) ....………….. Monitor device

(a) This register stores the address in the work coordinate system (G54 to G59) specified with the Motion program.
This value is stored on the assumption that 0.0001mm is equal to 1. (1mm=10000)
Example that the setting using the peripheral device is G54=1000 is shown below.



At the 10000000 position of the machine value, the current value is "0".

(b) The current value is shift depending on the work coordinate system selection (G54 to G59) and G92 (coordinate system setting).
When "G90 G00 X0. ; " (G54 selected) and "G92 X500." are executed in the above state, the current value is as follows.



The 0 position of the current value is re-set to 500. , which results in the current value of 5000000.

(2) Execute sequence No. (main) storage register (D802+20n)
....……….... Monitor device

This register stores the N No. (sequence No.) of the executing main sequence.
This number changes to "0" using the Motion dedicated PLC instruction (S(P).SVST) at the Motion program start.
The changes of the execute Motion program No., execute sequence No. and execute block No. are shown below.

Program		Execute Motion program No.	Execute sequence No.	Execute block No.
O0001 ;		1	0	0
	G00 X100. ;	1	0	1
	X200. ;	1	0	2
N100	Y100. ;	1	100	0
	Z100. ;	1	100	1
	X300. ;	1	100	2
N200	G01 X350. F100. ;	1	200	0
	Y200. Z200. ;	1	200	1
	M10 ;	1	200	2
	M02 ;	1	200	3
	%	1	200	3

(3) Execute block No. (main) storage register (D803+20n)
....………….. Monitor device

This register stores the block No. during operation.
This number changes to "0" using the Motion dedicated instruction (S(P).SVST) at the Motion program start.
When the sequence No. (N****) described in the Motion program is executed, this number changes to "0", and it is incremented every time a single block is executed. (Be careful when executing the IF-THEN-ELSE-END or WHILE-DO instruction. Refer to Sections 6.16.2 and 6.16.3 for details.)

(4) Execute program No. (sub) storage register (D804+20n)
......……….. Monitor device

(a) This register stores the O No. of the subprogram started by "M98" (subprogram call).

(b) When a subprogram is called from a subprogram, this number changes to the O No. of the subprogram called.
When the subprogram is ended by "M99", this number changes to the O No. of the call source subprogram.

(c) This number changes to "0" using the Motion dedicated PLC instruction (S(P).SVST) at the Motion program start.

(5) Execute sequence No. (sub) storage register (D805+20n)
..........…….. Monitor device

(a) This register sotres the N No. of the subprogram started by "M98" (subprogram call).

(b) When a subprogram is called from a subprogram, this number changes to the N No. of the subprogram called.
When the subprogram is ended by "M99", this number changes to the N No. of the subprogram which called.

(c) This number changes to "0" using the Motion dedicated instruction (S(P).SVST) at the Motion program start.

(6) Execute block No. (sub) storage register (D806+20n)
..........…….. Monitor device

(a) This register stores the block No. of the subprogram started by "M98" (subprogram call).

(b) When a subprogram is called from a subprogram, this number changes to the block No. of the subprogram called.
When the subprogram is ended by "M99", this number changes to the block No. of the subprogram which called.

(c) This number changes to "0" using the Motion dedicated instruction (S(P).SVST) at the Motion program start.

(7) G43/G44 command storage register (D808+20n)
....…….. Monitor device

(a) This register stores the following values when the tool length offset (G43, G44) or tool length offset cancel (G49) set in the Motion program is executed.
• For G43....…….43
• For G44....…….44
• For G49....…….0

(b) The default value is "0".

(8) Tool length offset data No. storage register (D809+20n)
....…….. Monitor device

(a) This register stores the setting tool length offset data No. at the tool length offset (G43, G44) command.

[Example] When the X axis is assigned to axis 3

Execute "G43 X100. H20 ;".

↓

20 is stored in D849.

(b) The default value is "0".

(9) Tool length offset data storage register (D810+20n, D811+20n) ....…………….. Monitor device

(a) This register stores the offset value specified in the tool length offset data No..
Tool length offset data storage register is shown bellow.

	Applicable registers	
	Higher rank	Lower rank
Offset value	D811+20n	D810+20n

(b) The contents of the data registers (D1650 to D1689 : offset value) corresponding to the setting tool length offset data No. is stored in the tool length offset area at the tool length offset (G43, G44) command.

[Example] When the X axis is assigned to axis 3

D1650,D1651=50000(H1=5.0000mm)

Execute "G43 X50. H1 ;".

↓

50000 is stored into D850 and D851.

Execute "G49 X50. ;".

↓

0 is stored into D850 and D851.

4.2.4 Control program monitor devices

Up to 16 control programs can be executed simultaneously. When new control program is executed in this monitor area, the vacant area is secured suitably and the monitor information on the executed program.

(1) Program No. storage register (D1440+6n) ....…….. Monitor device

(a) The O No. of executing control program is stored.

(b) When a subprogram is called from a subprogram, this number changes to the O No. of the subprogram called.

(c) This number changes to "0" using the Motion dedicated PLC instruction (S(P).SFCS) at the Motion program start.

(2) Sequence No. storage register (D1441+6n) ....….. Monitor device

This register stores the N No. (sequence No.) of the executing main sequence. This number changes to "0" using the SFCS instruction at the Motion program start.

(3) Block No. storage register (D1442+6n) ....…….. Monitor device

The block No. of executing control program is stored.
This number changes to "0" using the Motion dedicated PLC instruction (S(P).SFCS) at the Motion program start.
When the sequence No. (N****) described in the Motion program is executed, this number changes to "0", and it is incremented every time a single block is executed. (Be careful when executing the IF-THEN-ELSE-END or WHILE-DO instruction. Refer to Sections 6.16.2 and 6.16.3 for details.)

(4) Error code storage register (D1443+6n) ....……….. Monitor device

(a) This register stores the corresponding error code at the minor error occurrence. If another minor error occurs after error code storing, the previous error code is overwritten by the new error code.

(5) Execute status storage register (D1444+6n) ...…….. Monitor device

This register stores the execute status.

Name	Contents
Execute status storoge register	0 : End 1 : Executing

When the control program is ended normally or by error, the stored monitor information is not cleared, "0" is stored in the execute status storage register. After that, the monitor information is not cleared until the new control program is started and the monitor area is assigned.

(6) CLEAR request status storage register (D1445) ... Monitor device

(a) When the control program specified in the CLEAR request control program No. setting register (D707) is cleared normally, "1" is set.

(b) If an error occurs in CLEAR of the clear control program specified in the CLEAR request control program No. setting register (D707).

1) A minor error "the program number ended by CLEAR is outside the range of 1 to 1024". (Error code: 619)
2) A minor error "the program number ended by CLEAR is nor registered. Or, the axis designation program is cleared". (Error code: 620)

(c) "0" is set in the CLEAR request control program No. setting register (D707), "0" is also set in the CLEAR request status storage register.

4.2.5 Control change registers 2

This area stores the override ratio setting data.

Table 4.1 Control change register 2 list

Name	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Override ratio setting register	D1536	D1539	D1542	D1545	D1548	D1551	D1554	D1557
Unusable	D1537 to D1538	D1540 to D1541	D1543 to D15344	D1546 to D1547	D1549 to D1550	D1552 to D1553	D1555 to D1556	D1558 to D1559

Name	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16
Override ratio setting register	D1560	D1563	D1566	D1569	D1572	D1575	D1578	D1581
Unusable	D1561 to D1562	D1564 to D1565	D1567 to D1568	D1570 to D1571	D1573 to D1574	D1576 to D1577	D1579 to D1580	D1582 to D1583

Name	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
Override ratio setting register	D1584	D1587	D1590	D1593	D1596	D1599	D1602	D1605
Unusable	D1585 to D1586	D1588 to D1589	D1591 to D1592	D1594 to D1595	D1597 to D1598	D1600 to D1601	D15603to D1604	D1606 to D1607

Name	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32
Override ratio setting register	D1608	D1611	D1614	D1617	D1620	D1623	D1626	D1629
Unusable	D1609 to D1610	D1612 to D1613	D1615 to D1616	D1618 to D1619	D1621 to D1622	D1624 to D1625	D1627 to D1628	D1630 to D1631

(1) Override ratio setting register (D1536+3n) ....….. Command device

(a) This register is used to set the override ratio of 0 to 100[%] in 1[%] increments to the command speed in the Motion program.

(b) The actual feed rate is the result of multiplying the command speed in the Motion program by the override ratio.

(c) Refer to Section 7.7 for details of override ratio setting.

4.2.6 Tool length offset data setting registers

(1) Tool length offset data setting registers (D1650+2n)
..........Command device

(a) This register is used to set the tool length offset values.

(b) The tool length offset data No. can be set within the range of H1 to H20.
Tool length offset data setting registers are shown below.

Tool length offset data No.	Applicable registers	
	Higher rank	Lower rank
H1	D1651	D1650
H2	D1653	D1652
H3	D1655	D1654
H4	D1657	D1656
H5	D1659	D1658
H6	D1661	D1660
H7	D1663	D1662
H8	D1665	D1664
H9	D1667	D1666
H10	D1669	D1668
H11	D1671	D1670
H12	D1673	D1672
H13	D1675	D1674
H14	D1677	D1676
H15	D1679	D1678
H16	D1681	D1680
H17	D1683	D1682
H18	D1685	D1684
H19	D1687	D1686
H20	D1689	D1688

(c) The setting ranges of the tool length offset data are shown below.

Unit / Item	mm		degree	
	Setting range	Unit	Setting range	Unit
Tool compensation amount (H1 to H20)	-999.9999 to 999.9999	mm	-359.99999 to 359.99999	degree

(d) Refer to Section 6.13.20 and 6.13.21 for details of the tool length offset.

4.2.7 Common devices

(1) CLEAR request status storage (D1445) .... Monitor device

(a) 0 No. of the conrol program which executes the CLEAR instruction or equivalent of Motion program for the positioning control is executed. When the control program No. is set, the Motion CPU judsges that the CLEAR request was made and ends the specified control program.

(b) The default value is "0".

(c) When CLEAR instruction or equivalent is executed for one program, "1 to 1024" of control program 0 No. is set.

(d) When CLEAR instruction or equivalent is executed for all control programs, "65535" is set in the setting register.

(2) JOG simultaneous start axis setting registers (D710 to D713) .... Command device

(a) These registers set the axis No. and direction which start simultaneously the JOG operation.

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

(Note-1) : Make JOG simultaneous start axis setting with 1/0.
1 : Simultaneous start execution
0 : Simultaneous start not execution
(Note-2) : The range of axis No.1 to 8 is valid in the Q172HCPU.

(b) Refer to Section 7.5.3 for details of the JOG operation simultaneous start.

(3) Manual pulse generator axis No. setting registers (D714 to D719) ....…….. Command device

(a) These registers stores the axis No. controlled with the manual pulse generator.

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

(Note-1) : Make the axis No. controlled with the manual pulse generator setting with 1/0.
1 : Specified axis
0 : Unspecified axis

(Note-2) : The range of axis No.1 to 8 is valid in the Q172HCPU.

(b) Refer to Section 7.6 for details of the manual pulse generator operation.

(4) Manual pulse generator 1-pulse input magnification setting registers (D720 to D751) .... Command device

(a) These register set the magnification (1 to 10000) per pulse of number of the input pulses from anual pulse generator at the pulse generator operation.

1-pulse input magnification setting register	Axis No.	Setting range	1-pulse input magnification setting register	Axis No.	Setting range
D720	Axis 1	1 to 10000	D736	Axis 17	1 to 10000
D721	Axis 2		D737	Axis 18	
D722	Axis 3		D738	Axis 19	
D723	Axis 4		D739	Axis 20	
D724	Axis 5		D740	Axis 21	
D725	Axis 6		D741	Axis 22	
D726	Axis 7		D742	Axis 23	
D727	Axis 8		D743	Axis 24	
D728	Axis 9		D744	Axis 25	
D729	Axis 10		D745	Axis 26	
D730	Axis 11		D746	Axis 27	
D731	Axis 12		D747	Axis 28	
D732	Axis 13		D748	Axis 29	
D733	Axis 14		D749	Axis 30	
D734	Axis 15		D750	Axis 31	
D735	Axis 16		D751	Axis 32	

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.

(b) Refer to Section 7.6 for details of the manual pulse generator operation.

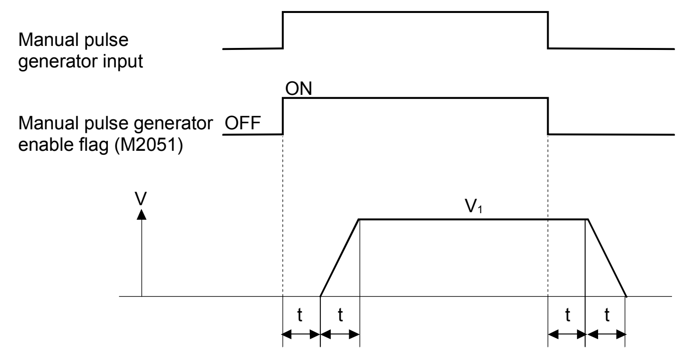
(5) Manual pulse generator smoothing magnification setting registers (D752 to D754) .... Command device

(a) These registers set the smoothing time constants of manual pulse generators.

Manual pulse generator smoothing magnification setting register	Setting range
Manual pulse generator 1 (P1): D752	0 to 59
Manual pulse generator 2 (P1): D753	
Manual pulse generator 3 (P1): D754	

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

(c) Operation



Output speed (V1) [PLS/s] = (Number of input pulses/s) × (Manual pulse generator 1-pulse input magnification setting)

Travel value (L) = (Travel value per pulse) × Number of input pulses (Manual pulse generator 1-pulse input magnification setting)

REMARK

(1) The travel value per pulse of the manual pulse generator is shown below.

- Setting unit
  - mm :0.0001[mm]
  - inch :0.00001[inch]
  - degree :0.00001[degree]

(2) The smoothing time constant is 56.8[ms] to 3408[ms].

4.3 Motion Registers (#)

There are motion registers (#0 to #8191) in the Motion CPU. #8000 to #8063 are used as SV43 dedicated device and #8064 to #8191 are used as the servo monitor device.

(1) SV43 dedicated device (#8000 to #8063)

These devices are reserved by the system. Do not use them by user side.

(2) Servo monitor devices (#8064 to #8191) .... Monitor device

Information about "servo amplifier type", "motor current" and "motor speed" for each axis is stored the servo monitor devices.
The details of the storage data are shown below.

Axis No.	Device No.	Signal name
1	#8064 to #8067	
2	#8068 to #8071	
3	#8072 to #8075	
4	#8076 to #8079	
5	#8080 to #8083	
6	#8084 to #8087	
7	#8088 to #8091	
8	#8092 to #8095	
9	#8096 to #8099	
10	#8100 to #8103	
11	#8104 to #8107	
12	#8108 to #8111	
13	#8112 to #8115	
14	#8116 to #8119	
15	#8120 to #8123	
16	#8124 to #8127	
17	#8128 to #8131	
18	#8132 to #8135	
19	#8136 to #8139	
20	#8140 to #8143	
21	#8144 to #8147	
22	#8148 to #8151	
23	#8152 to #8155	
24	#8156 to #8159	
25	#8160 to #8163	
26	#8164 to #8167	
27	#8168 to #8171	
28	#8172 to #8175	
29	#8176 to #8179	
30	#8180 to #8183	
31	#8184 to #8187	
32	#8188 to #8191	

	Signal name (Note-1)	Signal description	Refresh cycle	Signal direction
+0	Servo amplifier type	0 : Unused 256 : MR-J3-B	When the servo amplifier power-on	Monitor device
+1	Motor current	×0.1[%]	Operation cycle 1.7[ms] or less: Operation cycle Operation cycle 3.5[ms] or more: 3.5[ms]	
+2 +3	Motor speed	×0.1[r/min]		

(Note-1) : The value that the lowest servo monitor device No. was added "+0, +1 ···" on each axis is shown.

4.4 Special Relays (SP.M)

There are 256 special relay points of M9000 to M9255 in the Motion CPU.
Of these, 7 points of the M9073 to M9079 are used for the positioning control, and their applications are indicated in Table 4.2. (Refer to APPENDIX 2.4 "Special Relays" for the applications of the special relays except for M9073 to M9079.)

Table 4.2 Special relay list

Device No.	Signal name	Refresh cycle	Signal type
M9073	PCPU WDT error flag	Main cycle	Status signal
M9074	PCPU REDAY complete flag		
M9075	TEST mode ON flag		
M9076	External forced stop input flag		
M9077	Manual pulse generator axis setting error flag		
M9078	TEST mode request error flag		
M9079	Motion program setting error flag		

(1) PCPU WDT error flag (M9073) .... Status signal

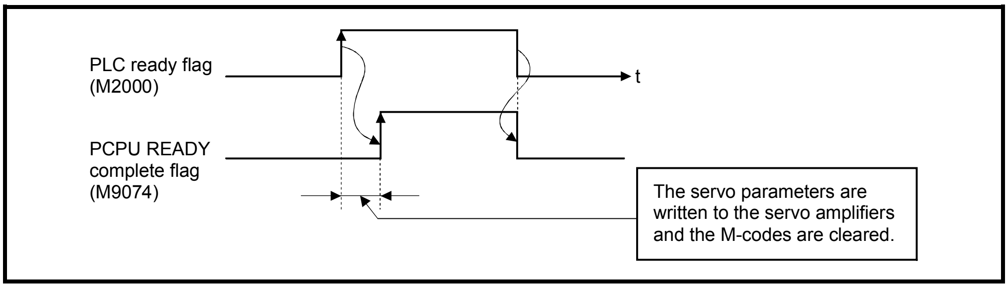
This flag turns on when a "watchdog timer error" is detected of the Motion CPU self-diagnosis function.
When the Motion CPU detects a WDT error, it executes an immediate stop without deceleration of the operating axes.
If the Motion CPU WDT error flag has turn on, reset the Motion CPU.
If M9073 remains on after resetting, there is a fault at the Motion CPU side.
The error cause is stored in the "Motion CPU WDT error cause (D9184)".
(Refer to Section 4.5).

(2) PCPU REDAY complete flag (M9074) ……….......... Status signal

This flag is used as judgement of the normal or abnormal in the Motion CPU side using the PLC program.

(a) When the PLC ready flag (M2000) turns off to on, the fixed parameters, servo parameters and limit switch output data are checked, and if error is not detected, this flag turns on.
The servo parameters are written to the servo amplifiers and the M-codes are cleared.

(b) This flag turns off when the PLC ready flag (M2000) turns off.



(3) TEST mode ON flag (M9075) ....…….................... Status signal

(a) This flag is used as judgement of during the test mode or not using a peripheral.
Use it for an interlock, etc. at the starting of the Motion program using the SVST instruction of the PLC program.
• OFF .... Except for the test mode
• ON .... During the test mode

(b) If the test mode request is executed in the test mode request from the peripheral device, the TEST mode request error flag (M9078) turns on.

(4) External forced stop input flag (M9076) ....…………… Status signal

This flag checks the external forced stop input signal ON/OFF.
• OFF .... During the external forced stop input on
• ON .... During the external forced stop input off

POINTS

(1) If the forced stop signal is input during positioning, the machine value is advanced within the rapid stop deceleration time (Note) set in the parameter block. At the same time, the servo OFF state is established because the all axes servo ON command (M2042) turns off.
When the rapid stop deceleration time (Note) has elapsed after input of the forced stop signal, the machine value returns to the value at the point when the emergency stop was initiated.

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

(Note) : It is not the rapid stop deceleration time but acceleration time at the G100 execution (fixed acceleration/deceleration time).

(5) Manual pulse generator axis setting error flag (M9077)
……….…..... Status signal

(a) This flag is use as judgement of normal or abnormal setting of the manual pulse generator axis No. setting registers (D714 to D719).
• OFF .... D714 to D719 is normal
• ON .... D714 to D719 is abnormal

(b) When M9077 turns on, the error contents are stored in the manual pulse generator axis setting error information (D9185 to D9187).

(6) TEST mode request error flag (M9078) ....………. Status signal

(a) This flag turns on when the test mode is not executed in the test mode request using a peripheral device.

(b) When M9078 turns on, the error contents are stored in the test mode request error information (D9182, D9183).

(7) Motion program setting error flag (M9079) ....….. Status signal

This flag is used as judgement of normal or abnormal for the Motion program positioning data.

• OFF ...... Normal
• ON ...... Abnormal

4.5 Special Registers (SP.D)

There are 256 special register points of D9000 to D9255 in the Motion CPU.
Of these, 23 points of the D9112 and D9180 to D9201 are used for the positioning control.
The special registers used for positioning are shown below. (Refer to APPENDIX 2.5 "Special Registers" for applications of special registers except for D9112 and D9180 to D9201.)

Table 4.3 Special register list

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction
D9112	Connect/disconnect	Main cycle	Main cycle	Command device/ Monitor device
D9180	Unusable	—	—	—
D9181				
D9182	Test mode request error information	At test mode request		Monitor device
D9183				
D9184	Motion CPU WDT error cause	At Motion CPU WDT error occurrence		
D9185	Manual pulse generator axis setting error information	At the manual pulse generator enable flag ↑		
D9186				
D9187				
D9188	Motion operation cycle	Operation cycle		
D9189	Error program No.	At start		
D9190	Error item information			
D9191	Servo amplifier loading information	At power supply on/ operation cycle		
D9192				
D9193	Unusable	—	—	—
D9194				
D9195				
D9196	PC link communication error codes	Operation cycle		Monitor device
D9197	Operation cycle of the Motion CPU setting	At power supply on		
D9198	Unusable	—	—	—
D9199				
D9200	State of switch	Main cycle		Monitor device
D9201	State of LED	Immediate		

(1) Connect/disconnect (D9112)
.... Command device/Monitor device

This function is used to connect/disconnect the SSCNET communication temporarily, when the servo amplifiers or SSCNETⅢ cables on the SSCNET system are exchanged during power supply on of the Motion CPU. The user side requires to connect/disconnect for a system, and the system side stores the states of connect/disconnect command accept waiting or connect/disconnect execute waiting. Moreover, also connect the servo amplifiers disconnected with the connect/disconnect device using this device. When turning the power supply OFF/ON for the axis 1 of SSCNET system, there is no necessity for connect/disconnect processing.

- 0 ………… Connect/disconnect command accept waiting
- -1 ……….. Connect/disconnect execute waiting
- 1 to 32 ….. Disconnect command
- -10 ………. Re-connection command
- -2 ………... Connect/disconnect execute command

(2) Test mode request error information (D9182, D9183)
.... Monitor device

If there are operating axis at a test mode request from a peripheral device, a test mode request error occurs, the test mode request error flag (M9078) turns on, and the during operation/stop data of the each axis are stored.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9182	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D9183	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

Stores the during operation/stop data of each axis
- 0 : During stop
- 1 : During operation

(Note) : The range of axis No.1 to 8 is valid in the Q172HCPU.

(3) Motion CPU WDT error cause (D9184) ……….......... Monitor device

This register is used as judgement of the error contents in the Motion CPU.

Error code	Error cause	Operation when error occurs	Action to take
1	S/W falut 1	All axes stop immediately, after which operation cannot be started.	• Reset with the reset key. • If the error reoccurs after resetting, change the operation cycle into a large value in the system setting.
2	Operation cycle time over		
3	Q bus WDT error		• 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.
4	WDT error		• Reset with the reset key. • If the error reoccurs after resetting, explain the error symptom and get advice from our sales representative.
30	Information processor H/W error		
201 to 215	Q bus H/W fault 201 Error contents 01 : Q bus error 1 02 : Q bus error 2 04 : Q bus error 4 08 : Q bus error 8 Error code = Total of the error contents + 200		• Reset with the reset key. • If the error reoccurs after resetting, the relevant module or the relevant slot (base unit) is probably faulty: replace the module/base unit.
250 to 253	Servo amplifier interface H/W fault 250 Faulty SSCNETⅢ No. 0 : SSCNETⅢ1 1 : SSCENTⅢ2 Error code = Total of the faulty SSCNETⅢ No. + 250		
300	S/W fault3		• Reset with the reset key.
301	8 or more points of CPSTART instruction were used to start programs in excess of simultaneously startable program. Number of simultaneous startable programs: 14		• Reset with the reset key. • Use 8 or more points of CPSTART instruction to start programs within the number of simultaneously startable programs.

(4) Manual pulse generator axis setting error information (D9185 to D9187) .... Monitor device

The setting information is checked when the manual pulse generator enable signal turns off to on, if an error is found, the following error information is stored into D9185 to D9187 and the manual pulse generator axis setting error flag (M9077) turns on.

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

b2 to b0: Store the axis setting errors of the manual pulse generators connected to P1 to P3 of Q173PX.
- 0 : Normal
- 1 : Setting error

(Axis setting in each digit is except for 1 to 32)

b5 to b3: Store the smoothing magnification setting errors of the manual pulse generators connected to P1 to P3 of Q173PX.
- 0 : Normal
- 1 : Setting error

(Axis setting in each digit is except for 0 to 59)

b15 to b6: All turn to 0.

D9186	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D9187	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

Store the 1-pulse input magnification setting errors of the axes.
- 0 : Normal
- 1 : Setting error

(Input magnification of each axis is except for 1 to 10000)

(Note) : The range of axis No.1 to 8 is valid in the Q172HCPU.

(5) Motion operation cycle (D9188) ……….……………. Monitor device

The time which motion operation took for every motion operation cycle is stored in [μs] unit.

(6) Error program No. (D9189) ....……….......... Monitor device

(a) When the Motion program error occurs at the Motion program operation, the program setting error flag (M9079) turns on and the error Motion program No. (0 to 4095).

(b) If an error occurs in another Motion program when error program No. has been stored, the program No. of the new error is stored.

(7) Error item information (D9190) ....………........... Monitor device

When the Motion program error occurs at the Motion program operation, the program setting error flag (M9079) turns on and the error code corresponds to the error setting item is stored.

Refer to APPENDIX 1.1 for details of Motion program setting errors.

(8) Servo amplifier loading information (D9191 to D9192) .... Monitor device

The installation state of the servo amplifier is checked at the power supply on or resetting of the Motion CPU and its results are stored in this device.
If communication with servo amplifier stops, it is reset.
Installation state is stored also about the axis which from non-installation to installation or from installation to non-installation after power supply on.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9191	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D9192	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

Servo amplifier installation state
• Installation. 1
• Non-installation 0

(Note) : The range of axis No.1 to 8 is valid in the Q172HCPU.

(a) Servo amplifier installation state
1) Installation/non-installation state
• "Installation" state .... The servo amplifier is normal. (Communication with the servo amplifier is normal.)
• "Non-installation" state ... No servo amplifier is installed. The servo amplifier power is off. Normal communication with the servo amplifier is not possible due to a connecting cable fault, etc.

2) The system settings and servo amplifier installation states are shown below.

System Settings	Servo amplifier	
	Installation	Non-installation
Used (axis No. setting)	1 is stored	0 is stored
Unused	0 is stored	

(9) PC link communication error codes (D9196) .... Monitor device

When an error occurs during the PC link communication, the error code 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: Received frame error 05: Communication task start error (Each error code is reset to "00" when normal communication is restarted.)

Refer to APPENDIX 1.5 for details of the PC link communication errors.

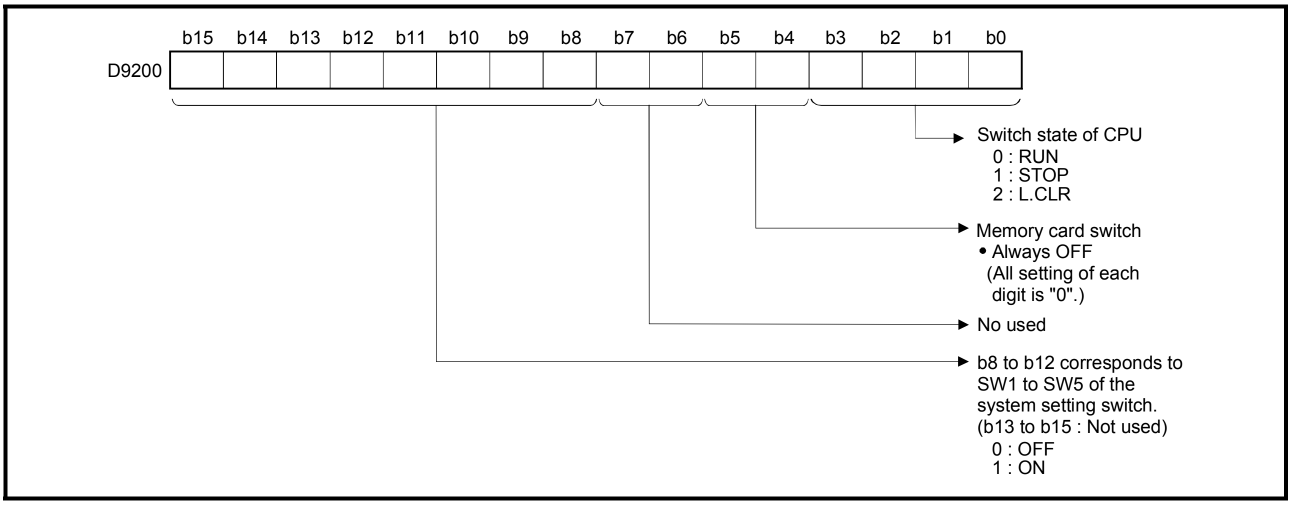
(10) Operation cycle of the Motion CPU setting (D9197) .... Monitor device

The setting operation cycle is stored in [μs] unit.

When the "Automatic setting" is set in the system setting, the operation cycle corresponding to the number of setting axes. When "0.8[ms] / 1.7[ms] / 3.5[ms] / 7.1[ms] / 14.2[ms]" is set in the system setting, the operation cycle corresponding to each setting.

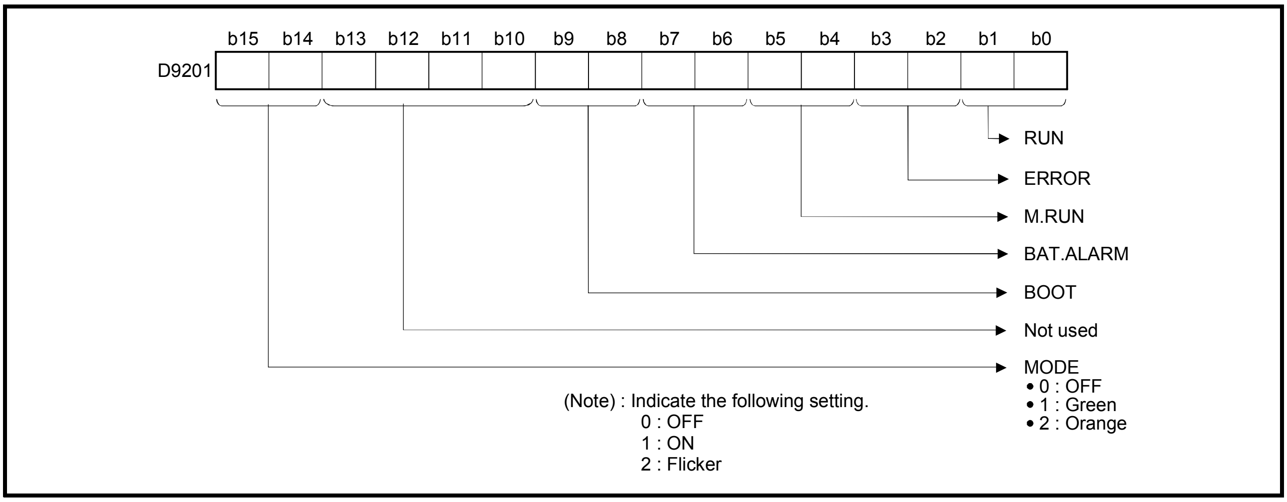
(11) State of switch (D9200) ………………………….. Monitor device

The switch state of CPU is stored in the form of the following.



(12) State of LED (D9201)……………………………..…… Monitor device

It stores whether the LED of CPU is in which state in next by the following bit patterns. 0 is OFF, 1 is ON and 2 is Flicker.)



5. PARAMETERS FOR POSITIONING CONTROL

5.1 System Settings

In the Multiple CPU system, the common system parameters and individual parameters are set for each CPU and written to each CPU.

(1) The base settings, Multiple CPU settings and Motion slot settings are set in the common system parameter setting.

(2) The basic system settings, self CPU installation position setting, servo amplifier/motor setting, high-speed read setting and battery setting are set in the individual parameter setting.

(3) The data setting and correction can be performed in dialog form using a peripheral device.
(Refer to Section 3.1 of the "Q173HCPU/Q172HCPU Motion controller Programming Manual (COMMON)" for details of the setting contents.)

5.2 Fixed Parameters

(1) The fixed parameters are set for each axis and their data is fixed based on the mechanical system, etc.

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

(3) The fixed parameters to be set are shown in Table 5.1.

Table 5.1 Fixed parameter list

No.	Item	Setting range						Initial value	Units	Remarks	Section
		mm		inch		degree					
		Setting range	Units	Setting range	Units	Setting range	Units				
1	Unit setting	0	—	1	—	2	—	0	—	• Set the command value for each axis at the positioning control.	—
2	Travel value per pulse (A): Number of pulses per rotation (AP)	1 to 2147483647[PLS]						20000	PLS	• Set the number of feedback pulses per motor rotation based on the mechanical system.	5.2.1
3	Travel value per pulse (A): Travel value per rotation (AL)	0.0001 to 214748.3647		0.00001 to 21474.83647		0.00001 to 21474.83647		2		• Set the travel value per motor based on the mechanical system.	
4	Backlash compensation amount (Note-1)	0 to 6.5535		0 to 0.65535		0 to 0.65535		0		• Set the backlash amount of the machine. • Every time of the positioning direction changes at the positioning, compensation by the backlash compensation amount is executed. The expression below shows the setting range. 0 ≦ (backlash compensation amount) × AP/AL ≦ 65535	5.2.2
5	Upper stroke limit (Note-1)	-214748.3648 to 214748.3647	mm	-21474.83648 to 21474.83647	inch	0 to 359.99999	degree	214748.3647	mm	• Set the upper limit for the machine travel range. The expression below shows the setting range. -2147483648 ≦ (upper stroke limit value) × AP/AL ≦ 2147483647	5.2.3
6	Lower stroke limit (Note-1)	-214748.3648 to 214748.3647		-21474.83648 to 21474.83647		0 to 359.99999		0		• Set the lower limit for the machine travel range. The expression below shows the setting range. -2147483648 ≦ (lower stroke limit value) × AP/AL ≦ 2147483647	
7	Command in-position range (Note-1)	0.0001 to 3.2767		0.00001 to 0.32767		0.00001 to 0.32767		0.01		• Set the position at which the command in-position signal (M2403+20n) turns on [(positioning address) - (current value)]. The expression below shows the setting range. 1 ≦ (command in-position range) × AP/AL ≦ 32767	5.2.4
8	High-speed feed rate	0.01 to 6000000.00	mm/min	0.001 to 600000.00	inch/min	0.01 to 2147483.647 (Note-2)	degree/min	2000.00	mm/min	• Set the positioning speed by G00. • Set the speed at the home position return by G28.	5.2.5
9	Speed control 10×multiplier setting for degree axis	—	—	—	—	Invalid/Valid	—	Invalid	—	• Set whether the positioning control is executed with a value 10×multiplier the speed of a command speed setting, when a control unit is degree axis.	5.2.6

(Note-1) : The display of the possible setting range changes according to the electronic gear value.
(Note-2) : When the "speed control 10 × multiplier setting for degree axis" is set to "valid", the setting range for high-speed feed rate is 0.01 to 21474836.47[degree/min].

5.2.1 Number of pulses/travel value per rotation

The "Electronic gear function" adjusts the pulse calculated and output by the parameter set in the Q173HCPU/Q172HCPU and the real travel value of machine.
It is defined by the "Number of pulses per rotation" and "Travel value per revolution".

POINTS

(1) The mechanical system error of the command travel value and real travel value is rectified by adjustment the "electronic gear".

(2) The value of less than 1 pulse that cannot be execute a pulse output when the machine travels is incremented in the Q173HCPU/Q172HCPU, and a total incremented pulse output is performed when the total incremented value becomes more than 1 pulse.

(3) The total incremented value of less than 1 pulse that cannot be execute a pulse output is cleared and it is referred to as "0" at the home position return completion, current value change completion and start. (When the total incremented value is cleared, the error occurs to the feed machine value only a part to have been cleared.)

"Number of pulses/travel value per rotation" are shown below.

(1) Number of pulses/travel value per rotation

Number of pulses(AP)/travel value(AL) per rotation is an item which determines how many rotations (number of pulses per rotation) of the servomotor in order to make it a machine as the travel value ordered by the program.
The position control toward the servomotor is controlled with the number of feedback pulses of the encoder connected to the servomotor in the servo amplifier.
The control content of the Motion CPU is shown below.

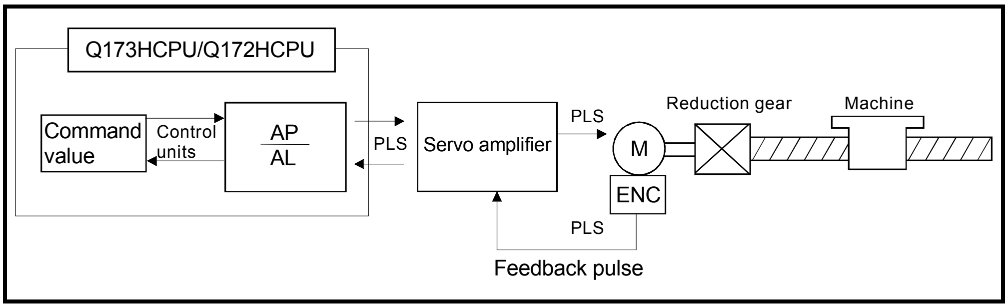


Fig. 5.1 Control content of the Motion CPU

For example, suppose that the servomotor was connected to the ball screw. Because the travel value (⊿S) of machine per motor rotation is [mm] / [inch] unit, the travel value (positioning address) set in the program is commanded in [mm] / [inch] unit. However, the servomotor is positioning controlled by the servo amplifier in pulse unit.

Therefore, AP/AL is set so that the following expression of relations may be materialized in order to convert the travel value of [mm] / [inch] unit set in the program into a pulse.

Number of pulses per motor rotation = AP
Travel value of machine per motor rotation = AL

$$\text{Electronic gear} = \frac{AP}{AL} \quad \ldots\ldots (1)$$

(There is a range which can be set in the numerical value set as AP/AL, so it is necessary to make the setting range of AP/AL the value calculated from the above expression (reduced) of relations.)

Example of the real setting is shown below.

(a) For ball screw
When the ball screw pitch is 20 [mm], the servomotor is HF-KP (262144[PLS/rev]) and direct connection (No reduction gear) is set.

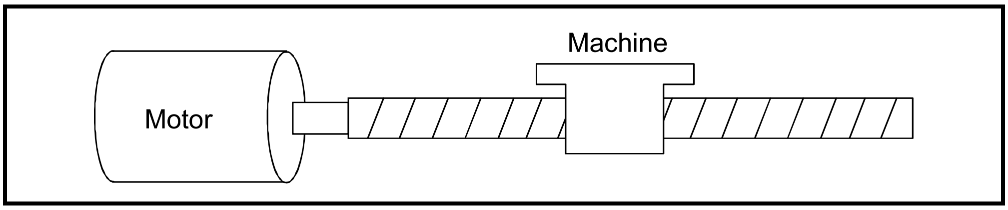


Fig. 5.2 For ball screw

First, find how many millimeters the load (machine) will travel (AL) when the servomotor runs for one rotation (AP).

AP (Number of pulses per motor rotation) = 262144 [PLS]
AL (Travel value of machine per rotation)
= Ball screw pitch × Reduction ratio
= 20 [mm]

Substitute this for the above expression (1).

$$\frac{AP}{AL} = \frac{262144\ [PLS]}{20\ [mm]}$$

The travel value per motor rotation in this example is 0.000076 [mm].
For example, when ordering the travel value of 19 [mm], it becomes 249036.8 [PLS] and the fraction of 0.8 [PLS]. At this time, the Motion CPU orders the travel value of 249036 [PLS] to the servomotor and the fraction is memorized in the Motion CPU.
Positioning is performed by seasoning the travel value with this fraction at the next positioning.

5.2.2 Backlash compensation amount

(1) Backlash compensation amount can be set within the following range.
(Refer to Section "7.1 Backlash Compensation Function" for details.)

$$0 \leqq \frac{\text{Backlash compensation amount}}{\text{Travel value per rotation}} (=A) \leqq 65535[\text{PLS}]$$

(2) The servo error may occur depending on the type of the servo amplifier (servomotor) or operation cycle even if the backlash compensation amount which fulfill the above condition. Set the backlash compensation amount within the following range in order for servo error may not occur.

$$A \leqq \frac{\text{Maximum motor speed [r/min]} \times 1.2 \times \text{operation cycle [ms]}}{60[\text{s}] \times 1000[\text{ms}]} \ [\text{PLS}]$$

5.2.3 Upper/lower stroke limit value

The upper/lower limit value for the travel range of the mechanical system is set.

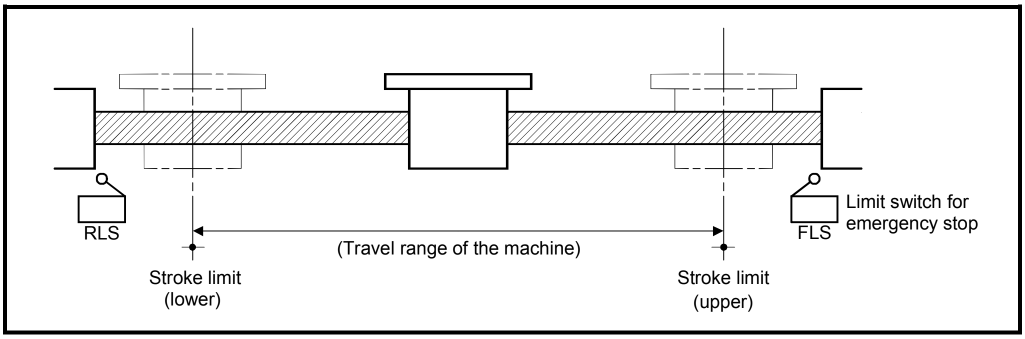


Fig. 5.3 Travel range at the upper/lower stroke limit value setting

(1) Stroke limit range check

The stroke limit range is checked at the following start or during operation.

Operation start	Check	Remarks
• Positioning control (PTP, Constant-speed)	Check	• It is checked whether the positioning address is within the stroke limit range or not at the positioning start. If it outside the range, an error occurs (error code: 580) and positioning is not executed. • If the interpolation path exceeds the stroke limit range during circular interpolation start, an error occurs (error codes: 207, 208) and deceleration stop is executed.
• JOG operation		• When the current value is executed a deceleration stop from current command speed, if the current value exceeds the stroke limit range, a deceleration stop is made before a stroke limit. (Error code: 207) Travel to the direction that returns the axis into the stroke range is possible.
• Manual pulse generator operation		• If the current value exceeds the stroke limit range, it stops at stroke limit. (Error code: 207) In this case, a deceleration stop is not made. Travel to the direction that returns the axis into the stroke range is possible.

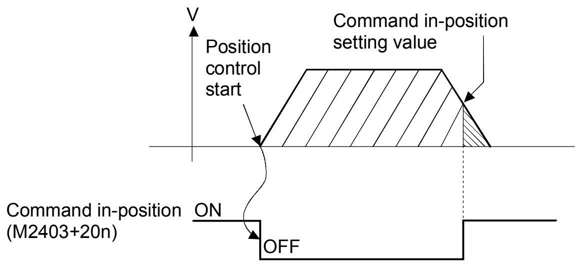
POINTS

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

(2) Positioning from outside the stroke limit range cannot be executed. After returning the axis to within the stroke limit range by the JOG operation or manual pulse generator operation, execute the positioning control.

5.2.4 Command in-position range

The command in-position is the difference between the positioning address (command position) and current value.
Once the value for the command in-position has been set, the command in-position signal (M2403 + 20n) turns on when the difference between the command position and the current value enters the set range [(command position - current value) ≦ (command in-position range)].
The command in-position range check is executed continuously during position control.



5.2.5 High-speed feed rate setting

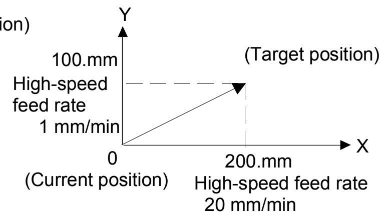
The high-speed feed rate is the positioning speed used to perform positioning with G00 or to make a home position return with G28, and this data is needed to execute G00 or G28.
When executing interpolation control with G00, change the speed of each axis based on the axis whose time to reach the target position is the longer, and find the combined-speed.
The high-speed feed rate setting example for interpolation control with G00.
[Example] Interpolation control from the current position (X=0, Y=0) to the target position (X=200, Y=100)

High-speed feed rate	X-axis	20[mm/min]
	Y-axis	1[mm/min]

G00 X200.Y100.;(Interpolation control execution)

Find the combined travel value

$\sqrt{200^2 + 100^2} \fallingdotseq 223.6067$ [mm]



After the above program execution, the reaching time of each axis is as follows.

X-axis: 200.[mm]/20[mm/min] = 10[min]

Y-axis: 100.[mm]/1[mm/min] = 100[min]

Since the reaching time of the Y-axis is longer, use the Y-axis as the reference axis for the feed rate and find the combined-speed.

$$\underset{\text{(Reference axis feed rate)}}{1[\text{mm/min}]} \times \frac{\overset{\text{(Combined travel value)}}{223.6067[\text{mm}]}}{\underset{\text{(Reference axis travel value)}}{100[\text{mm}]}} \fallingdotseq \underset{\text{(Combined speed)}}{2.23[\text{mm/min}]}$$

POINTS

(1) The high-speed feed rate of each axis is clamped at the speed limit value of parameter block. The clamped value is also used to determine the axis whose time to reach the target position is the longest.
(2) In the above calculation, the travel value and feed rate used are calculated without units. Care must be taken when their units differ.
(Example)
- Travel value
  10000 for the travel of 1 [mm], 100000 for 1 [inch], 100000 for 1 [degree]
- Feed rate
  100 for the feed rate of 1 [mm/min], 1000 for 1 [inch/min], 1000 for 1 [degree/min]

5.2.6 Speed control 10×multiplier setting for degree axis

The setting range of command speed is 0.001 to 2147483.647[degree/min] normally in the axis of control unit [degree]. However, when the "speed control 10×multiplier setting for degree axis" is set to "valid" in the fixed parameter, the speed setting range increases 10×multiplier "0.01 to 21474836.47[degree/min]".

(1) When the "speed control 10×multiplier setting for degree axis" is set to "valid", the speed setting range for high-speed feed rate setting of fixed parameter and JOG speed limit value of JOG operation data increases 10×multiplier "0.01 to 21474836.47[degree/min]".

(2) When the "speed control 10×multiplier setting for degree axis" is set to "valid", the speed setting range for feed rate (F) specified with the Motion program increases 10×multiplier "0.01 to 21474836.47[degree/min]". When the feed rate (F) is indirectly set, it is the same.

(3) Speed setting range in the interpolation operation is shown below.
If the "speed control 10×multiplier setting for degree axis" is set to "valid" even by one axis among axes specified at the Motion program start, the speed setting range for all degree axes specified at the start increase 10×multiplier "0.01 to 21474836.47[degree/min]".
When it is considered that the axis set as degree axis speed control 10×multiplier setting "invalid" is "valid" by the interpolation control, the high-speed feed rate of fixed parameter is controlled by 10 multiplied values.
(Note) : The specified axis at the start is an axis name described by SVST, CALL and GOSUB/GOSUBE instruction at the axis specified program start.

(4) In the interpolation control for the axis of "control unit [degree] and [except degree]", if the "speed control 10×multiplier setting for degree axis" is set to "valid" even by one axis among axes specified at the Motion program start, and the interpolation control unit of parameter block is set as [degree], the feed rate setting range increases 10×multiplier "0.01 to 21474836.47[degree/min]".

(5) The parameter block cannot be set for every axis. Therefore, when the control unit is set as [degree], the setting range of speed limit value is fixed by "0.001 to 2147483.647[degree/min]".
However, the positioning control is executed as setting range of speed limit value "0.01 to 21474836.47[degree/min]" in the axis set to "speed control 10×multiplier setting for degree axis is valid".

Example 1

An example for positioning control is shown below when the fixed parameter and parameter block are set as follows.

• Fixed parameter

Setting axis	Unit	High-speed feed rate	Speed control 10 × multiplier setting for degree axis
Axis 1(X)	degree	2147483.647[degree/min]	Invalid
Axis 2(Y)	degree	21474836.47[degree/min]	Valid

• Parameter block

	Block 1
Interpolation control unit	degree
Speed limit value	2147483.647[degree/min]

(1) 1-axis linear positioning

(a) Axis set to "speed control 10 × multiplier setting for degree axis is invalid" (X-axis)

Motion program	Operation
G91;	
G01 X1000. F2147483.647;	Operation with feed rate 2147483.647[degree/min]
G01 X1000. F2147483647;	Operation with feed rate 2147483.647[degree/min] (When the decimal point is not specified, the feed rate is set as 3 digits below the decimal point.)
#@0:L= 2147483647;	
G01 X1000. F#@0:L	Operation with feed rate 2147483.647[degree/min] (The feed rate is set as 3 digits below the decimal point for indirect setting.)
G01 X1000. F21474836.47;	Deceleration stop with the minor error[502] (Command value exceeds the setting range.)

(b) Axis set to "speed control 10 × multiplier setting for degree axis is valid" (Y-axis)

Motion program	Operation
G91;	
G01 Y1000. F2147483.647;	Operation with feed rate 21474836.47[degree/min] (2 digits are valid below the decimal point.)
G01 Y 1000. F2147483647;	Operation with feed rate 21474836.47[degree/min] (When the decimal point is not specified, the feed rate is set as 2 digits below the decimal point.)
#@0:L= 2147483647;	
G01 Y1000. F#@0:L	Operation with feed rate 21474836.47[degree/min] (The feed rate is set as 2 digits below the decimal point for indirect setting.)
G01 Y1000. F21474836.47;	Operation with feed rate 21474836.47[degree/min]

POINTS

(1) Axis set to "speed control 10 × multiplier setting for degree axis is invalid".
 (a) Setting range of feed-rate is 0.001 to 2147483.647[degree/min].
 (b) When the feed rate is set as indirect setting or without decimal point setting in the Motion program, the feed rate is set as 3 digits below the decimal point.).

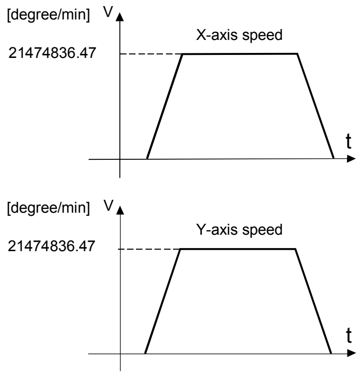
(2) Axis set to "speed control 10 × multiplier setting for degree axis is valid".
 (a) Setting range of feed-rate is 0.01 to 21474836.47[degree/min].
 (b) When the feed rate is set as indirect setting or without decimal point setting in the Motion program, the feed rate is set as 2 digits below the decimal point.)

Example 1

(2) 2-axes interpolation positioning

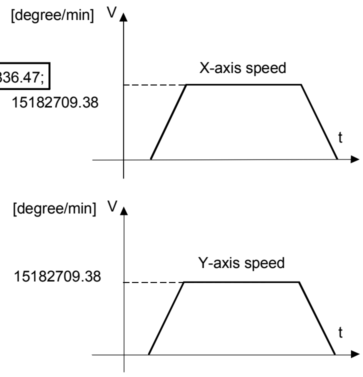
(a) G00

G91 G00 X1000. Y1000. ;



(b) G01

G91 G01 X100. Y100. F21474836.47;



POINTS

If the "speed control 10 × multiplier setting for degree axis" is set to "valid" even by one axis among axes specified at the Motion program start in the interpolation operation, the "speed control 10 × multiplier setting for degree axis" is considered as "valid" for all degree axes specified at the start.
Therefore, in the above example, "speed control 10 × multiplier setting for degree axis" is set to "valid" in also X-axis, the high-speed feed rate is controlled as ten times 21474836.47[degree/min].

Example 2

• An example for positioning control is shown below when the fixed parameter and parameter block are set as follows.

• Fixed parameter

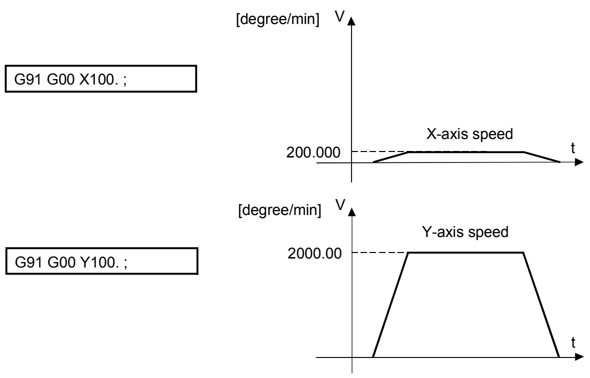
Setting axis	Unit	High-speed feed rate	Speed control 10 × multiplier setting for degree axis
Axis 1(X)	degree	200.000[degree/min]	Invalid
Axis 2(Y)	degree	2000.00[degree/min]	Valid

• Parameter block

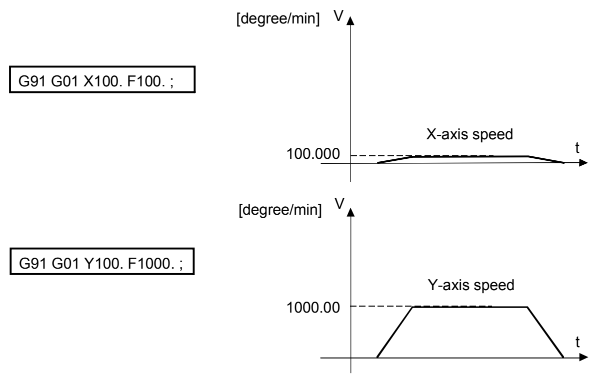
	Block 1
Interpolation control unit	degree
Speed limit value	200.000[degree/min]

(1) 1-axis linear positioning

(a) G00

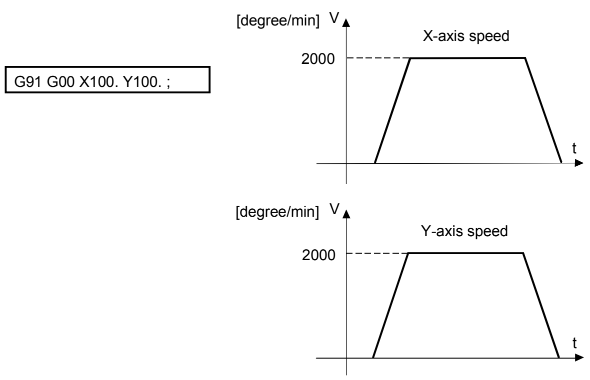


(b) G01

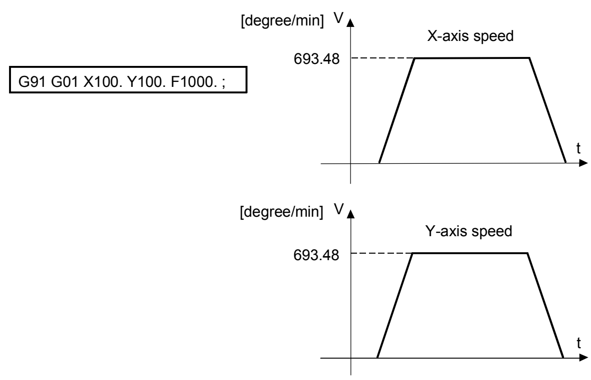


(2) 2-axes interpolation positioning

(a) G00



(b) G01



POINTS

After the "speed control 10 × multiplier setting for degree axis" is set to "valid", when the speed change is executed by Motion dedicated PLC instruction (S(P).CHGV) or Motion program (CHGV instruction), the positioning control is executed by ten times the command speed (set value).

5.3 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 64 blocks can be set as parameter blocks.

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

(4) Parameter block to be set are shown in Table 5.2.

Table 5.2 Parameter Block list

No.	Item	Setting range: mm – Setting range	mm – Units	inch – Setting range	inch – Units	degree – Setting range	degree – Units	Initial value	Units	Remarks	Section
1	Interpolation control unit	0	—	1	—	2	—	0	—	• Set the units for compensation control. • It can be also used as the units for the command speed and allowable error range for circular interpolation set in the Motion program.	6.11.6
2	Speed limit value	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647 (Note-1)	degree/min	200.000	mm/min	• Set the maximum speed for positioning/home position return. • If the positioning speed or home position return speed setting exceeds the speed limit value, control is executed at the speed limit value.	5.3.1
3	Acceleration time	Acceleration-fixed acceleration/deceleration method : 1 to 65535[ms]						1000	ms	• Set the time taken to reach the speed limit value from the start of motion.	5.3.1
		Time-fixed acceleration/deceleration method : 1 to 5000[ms]								• Always acceleration/deceleration time is the setting value.	
4	Deceleration time	Acceleration-fixed acceleration/deceleration method : 1 to 65535[ms]						1000	ms	• Set the time taken to stop from the speed limit value.	5.3.1
		Time-fixed acceleration/deceleration method : Invalid								• Setting is ignored.	
5	Rapid stop deceleration time	Acceleration-fixed acceleration/deceleration method : 1 to 65535[ms]						1000	ms	• Set the time taken to stop from the speed limit value when a rapid stop is executed.	5.3.1
		Time-fixed acceleration/deceleration method : Invalid								• Setting is ignored.	
6	S-curve ratio	Acceleration-fixed acceleration/deceleration method : 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.	5.3.2
		Time-fixed acceleration/deceleration/ method : Invalid								• Always 0%..	
7	Torque limit value	1 to 1000[%]						300	%	• Set the torque limit value in the Motion program.	—
8	Deceleration processing on STOP input	0 : Deceleration stop is executed based on the deceleration time. 1 : Deceleration stop is 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 10.0000	mm	0 to 1.00000	inch	0 to 1.00000	degree	0.0100	mm	• Set the permissible range for the locus of the arc and the set end point coordinates.	5.3.3

(Note-1): When the "speed control 10×multiplier setting for degree axis" set to "valid", the setting range of is 0.01 to 21474836.47[degree/min].
However, setting range of 0.001 to 2147483.647[degree/min] is displayed in the parameter block setting screen of programming software.

POINTS

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

(2) Speed limit value is within the feed speed setting range of feed speed (F) set in the Motion program.

POINTS

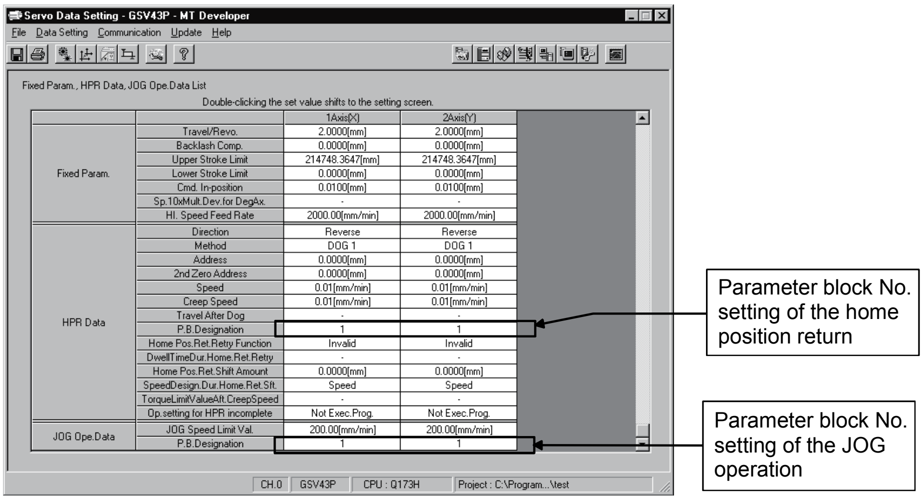
The data set in the parameter block is used in the positioning control, home position return and JOG operation.

(1) The parameter block No. used in the positioning control is set indirectly in the following case.
   (a) Start by the SVST instruction from the PLC (Refer to Section 3.3)
   (b) Start by the CALL, GOSUB/GOSUBE instruction from the Motion program (Refer to Section 6.16.21, 6.16.22 and 6.16.23)

   And the parameter block can be changed by the PB instruction in the Motion program. Refer to Section 6.16.14 for details.

(2) The parameter block No. used in the home position return or JOG operation is set at the setting of the "home position return data" or " JOG operation data" using a peripheral device. (Refer to Section "7.3.1 Home position return data", "7.5.1 JOG operation data" for details.)

   [Home position return data, Jog operation data setting screen]



		1Axis[X]	2Axis[Y]
Fixed Param.	Travel/Revo.	2.0000[mm]	2.0000[mm]
	Backlash Comp.	0.0000[mm]	0.0000[mm]
	Upper Stroke Limit	214748.3647[mm]	214748.3647[mm]
	Lower Stroke Limit	0.0000[mm]	0.0000[mm]
	Cmd. In-position	0.0100[mm]	0.0100[mm]
	Sp.10xMult.Dev.for DegAx.	-	-
	Hl. Speed Feed Rate	2000.00[mm/min]	2000.00[mm/min]
HPR Data	Direction	Reverse	Reverse
	Method	DOG 1	DOG 1
	Address	0.0000[mm]	0.0000[mm]
	2nd Zero Address	0.0000[mm]	0.0000[mm]
	Speed	0.01[mm/min]	0.01[mm/min]
	Creep Speed	0.01[mm/min]	0.01[mm/min]
	Travel After Dog	-	-
	P.B.Designation	1	1
	Home Pos.Ret.Retry Function	Invalid	Invalid
	DwellTimeDur.Home.Ret.Retry	-	-
	Home Pos.Ret.Shift Amount	0.0000[mm]	0.0000[mm]
	SpeedDesign.Dur.Home.Ret.Sft.	Speed	Speed
	TorqueLimitValueAft.CreepSpeed	-	-
	Op.setting for HPR incomplete	Not Exec.Prog.	Not Exec.Prog.
JOG Ope.Data	JOG Speed Limit Val.	200.00[mm/min]	200.00[mm/min]
	P.B.Designation	1	1

5.3.1 Relationships between the speed limit value, acceleration time, deceleration time and rapid stop deceleration time

According to the G-code instructions, there are two different acceleration/deceleration modes, acceleration-fixed acceleration/deceleration and time-fixed acceleration/deceleration.

(1) Acceleration-fixed acceleration/deceleration system

(a) G01, G02, G03, G12, G13 or G32 during G101 execution

The acceleration/deceleration mode of acceleration-fixed acceleration/deceleration is used.
The actual acceleration time, deceleration time and rapid stop deceleration time are shorter than their settings as the positioning speed is lower than the speed limit value.
The setting ranges of acceleration time, deceleration time and rapid stop deceleration time is 1 to 65535[ms].

(b) G00 (without M-code), G28 (high-speed home position return), G30, G53 or G00 including M-code during G101 execution

The acceleration/deceleration mode of acceleration-fixed acceleration/deceleration is used.
The calculation of acceleration for acceleration/deceleration is based on the lower speed among the feed speed (Refer to Section 5.2.5) from high-speed feed rate of fixed parameter and the speed limit value of parameter block.
At the override of 100[%], the real acceleration time, real rapid stop deceleration time and real deceleration time are equal to their settings.
The setting ranges of the acceleration time, deceleration time and rapid stop deceleration time are 1 to 65535[ms].

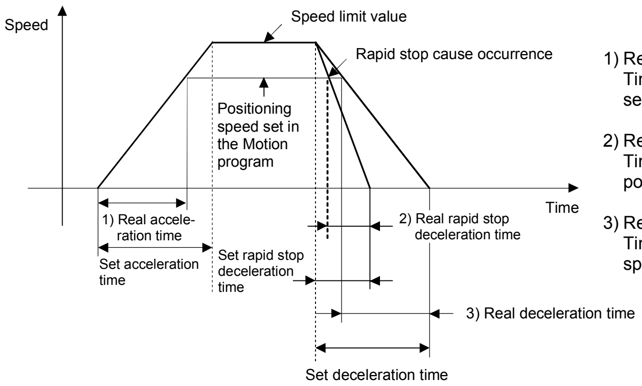
(2) Time-fixed acceleration/deceleration system

(a) G00 including M-code during G100 execution (default), G01, G02, G03, G12, G13 or G32

The acceleration/deceleration mode of time-fixed acceleration/deceleration is used.
The preset acceleration time is used to perform acceleration, deceleration or rapid stop deceleration processing.
The setting range of the acceleration time is 1 to 5000[ms].
If the setting exceeds 5000[ms], the acceleration time is clamped at 5000[ms].
At this time, an error does not occur.

(1) Acceleration-fixed acceleration/deceleration system

(a) G01, G02, G03, G12, G13 or G32 during G101 execution

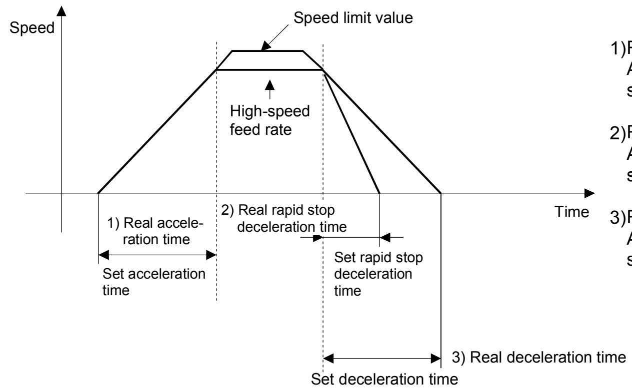


1) Real acceleration time
Time take to reach the positioning speed set in the Motion program.

2) Real rapid stop deceleration time
Time taken to effect a rapid stop from the positioning speed set in the Motion program.

3) Real deceleration time
Time taken to stop from the positioning speed set in the Motion program.

(b) G00 (without M-code), G28 (high-speed home position return), G30, G53 or G00 including M-code during G101 execution



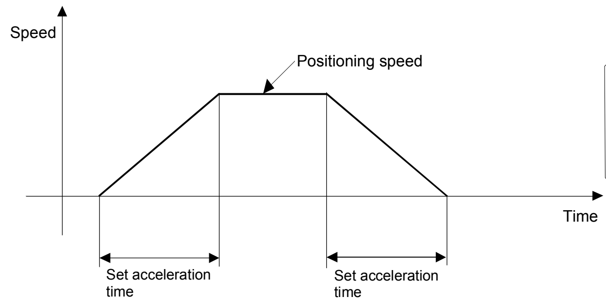
1)Real acceleration time
At the override of 100[%], it is equal to the setting acceleration time.

2)Real rapid stop deceleration time
At the override of 100[%], it is equal to the setting rapid stop deceleration time.

3)Real deceleration time
At the override of 100[%], it is equal to the setting deceleration time.

(2) Time-fixed acceleration/deceleration system

(a) G00 including M-code during G100 execution (default), G01, G02, G03, G12, G13 or G32

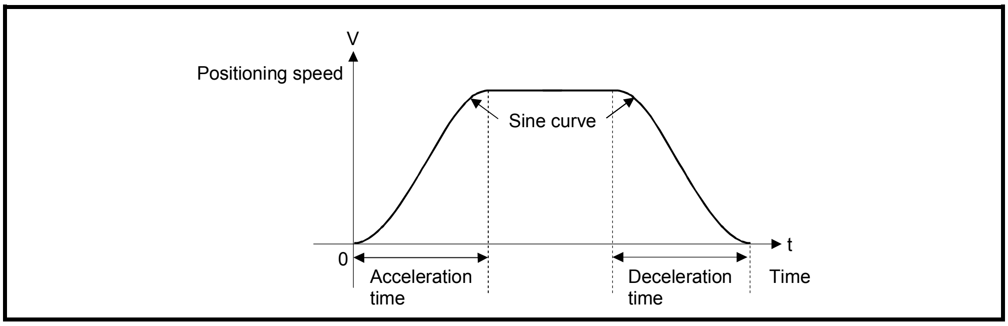


Acceleration/deceleration time is constant regardless of positioning speed.
(Always acceleration time)
Deceleration time and rapid stop time are ignored.

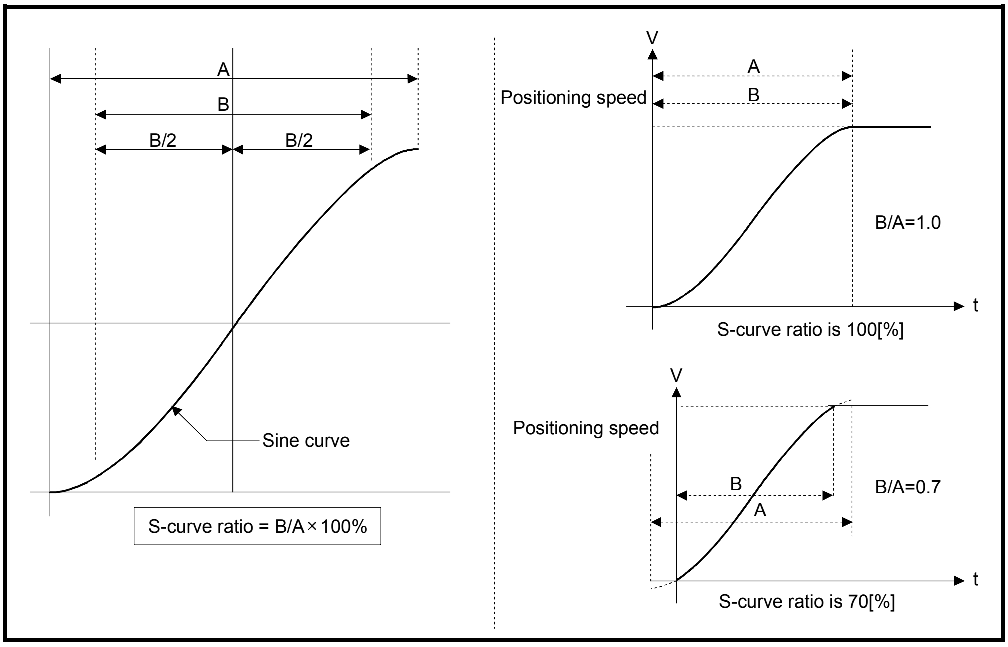
Fig. 5.4 Relationships between the speed limit value, acceleration time, deceleration time and rapid stop deceleration time

5.3.2 S-curve ratio

S-curve ratio can be set as the acceleration and deceleration processing method for S-pattern processing.
Setting range of the S-curve ratio is 0 to 100[%].
If it is set outside the range, an error occurs at the start and control is executed with the S-curve ratio set as 100[%].
Errors are set in the servo program setting error area (D9190).
Setting of the S-curve ratio enables acceleration/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/deceleration curve.



(Note) : When the G00, G01, G02, G03, G12, G13 or G32 including M-code is used, S-curve ratio is ignored and control is executed as always 0[%].

5.3.3 Allowable error range for circular interpolation

The locus of the arc calculated from the start point address and central point address may not coincide with the set end point address for the central-specified control.
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 it exceeds the setting range, an error occurs at the start and positioning does not start. Such an error are set the applicable axis or minor error code area.

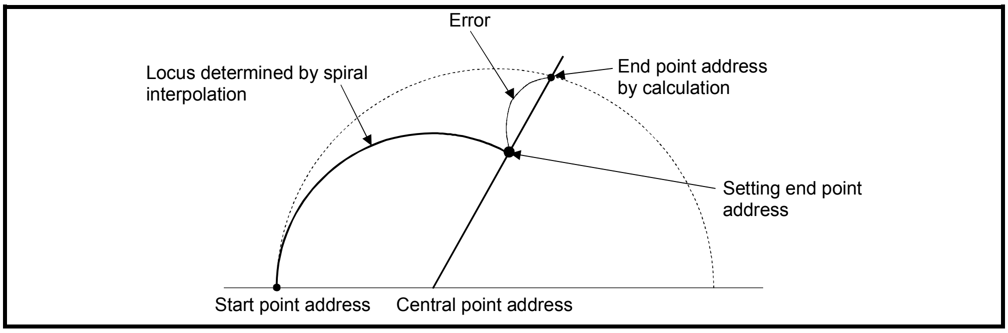


Fig. 5.5 Spiral Interpolation

5.4 Work Coordinate Data

(1) The work coordinate data is used to set the work coordinates and six different work coordinates can be set (G54 to G59) for every axis. (Refer to Section 6.12 for details.)

(2) The position is set with the offset from the mechanical coordinate system home position for the work coordinate system. The offset setting value is the distance from the mechanical coordinate system home position (0).

(3) The work coordinate data is set using the peripheral devices.

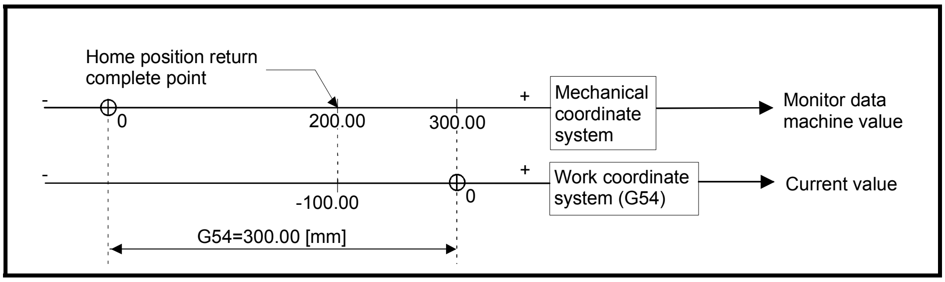
(4) The work coordinate data to be set are shown in Table 5.3.

Table 5.3 Work Coordinate Data List

No.	Item	Setting range						Initial value	Units	Remarks	Section
		mm		inch		degree					
		Setting range	Units	Setting range	Units	Setting range	Units				
1	G54	-214748.3648 to 214748.3647	mm	-21474.83648 to 21474.83647	inch	-359.99999 to 359.99999	degree	0	mm	Set the work coordinate system 1 to 6.	6.12
2	G55										
3	G56										
4	G57										
5	G58										
6	G59										

(5) When a home position return is made based on the home position return setting data, the mechanical coordinate system and work coordinate system are as shown below.

[Example] The X-axis home position address of home position return data is set to 200.00[mm] and the X-axis: G54 of the work coordinate data is set to 300.00[mm] to make a home position return.



On completion of a home position return, the machine value is equal to 200.00[mm] and the current value is equal to -100.00[mm].
When the work coordinate data is set to 0, the current value is equal to the machine value.

6. MOTION PROGRAMS FOR POSITIONING CONTROL

Motion program in the EIA language format is used as a programming language in the Motion controller (SV43).
A Motion program is used to specify the positioning control type and positioning data required to execute the positioning control in the Motion CPU.
This chapter describes the Motion program composition and setting method of the Motion program.

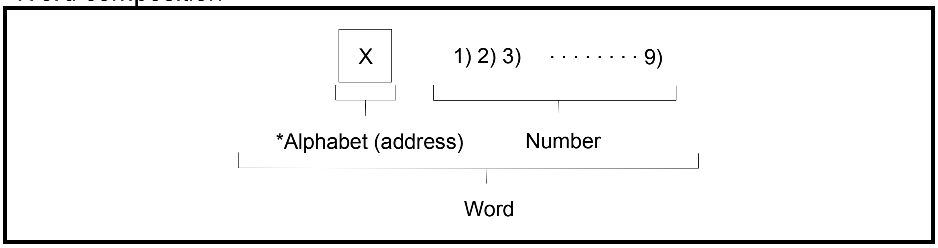
6.1 Motion Program Composition

This section describes the format and composition of the Motion program.
A Motion program is called a word address format (word), and it is combination of a single alphabet (address) and numbers.

(1) Word address format (word)

A word is a collection of characters arranged in certain order, and this is used as a unit to process that information to perform a specific operation.
A word is composed of a single alphabet (address) and subsequent several-digit number in the Motion controller. (The number may be headed by a "+" or "-" sign.)

<Word composition>



(Note) : The first alphabet of word is called an address and defines the meaning of subsequent numeric information.

(2) Block

A block is a collection of several words. It includes information necessary to perform a single specific operation of a machine and acts as a complete command on a block basis.
A block is ended by the EOB (End of Block) code to indicate separation.

<Block composition>

1)	2)	3)	4)	5)	6)
N100	G01	X250.	Y-123.4	F1500.	;
Word	Word	Word	Word	Word	E0B
Block					

1) N100 ·········· Sequence No. : It is used to identify a program block, and it is indicated by a number (up to 4 digits) after alphabet N.

2) G01 ············ Preparatory code : The basic instruction which commands the movement of motion control is indicated. (G-code)

3) X250. ·········· Coordinate position data (Note) : The command for coordinate position of X-axis is indicated. This word commands 250[mm] of X-axis.

4) Y-123.4 ······· Coordinate position data (Note) : The command for coordinate position of Y-axis is indicated. This word commands -123.4[mm] of Y-axis.

5) F1500. ········· Feed speed : The command of feed speed in linear or circular interpolation is indicated. (F-code) This word indicates the speed of 1500[mm] per minute.

6) ; ····················EOB (End of Block) : The end (separation) of program block is indicated.

(Note) : There are following two methods in the coordinate position data.

Absolute value command ········· G90: Method to travel the specified coordinate position regardless of the current position.

Incremental value command ···· G91: Method to command the next target position based on the current position.

(3) Motion program

A machine operation is commanded by several collection of blocks in the Motion program.

<Motion program composition>

```
00001 O100;                          1) Motion program No.
00002 N10 G91 G00;
00003       G28 X0. Y0. ;
00004       X250. ;
00005 N20 M20;
00006       X-50. Y120. ;
00007 N30 G01 X25. F500. ;           2) Program block
  •     •
  •     •
  •     •
00020 N80 M21;
00021       M02;
00022       %                        Indicates a program end.
                                     3) Line number
```

1) Motion program No. ··············· Number specified in a PLC program. It can be set alphabet "O" and any number of 1 to 1024.

2) Program block ······················· Consists of multiple program blocks necessary for motion operations in control order.

3) Line number ·························· Automatically displayed in serial number when a Motion program is created by the peripheral device.

POINT

Up to 1024 Motion programs are stored in a memory in Motion controller (SV43). These Motion programs are managed in a Motion program No..

6.2 Type of The Motion Program

There are following two types in the Motion program.
Type of Motion program is set for every program by the motion parameter.

Type of the Motion program

Name	Description
Control program	This program is described by the control instructions only. Axis travel instructions are not included. Pre-read does not done at the program execution.
Axis designation program	This program is described by the "control instructions and axis travel instructions" or "only the either".

(1) Refer to Section 6.3 to 6.5 for details of the instruction which can be described in each program.

(2) The total number of the control programs and axis designation programs is 1024.

(3) The method to start and end of the control program differs from the and the axis designation program. Refer to Section 6.6 for details.

(4) The Motion program during execution cannot be re-written. Confirm that the PLC ready flag (M2000) is OFF, and write the Motion program.

6.3 G-code List

G-codes used in the Motion program are shown below.

G-code List

Type	Instruction	(Group)	Description	Control program	Axis designation program	Remark
G-code	G00 (Note)	01	Point-to-point positioning at the high-speed feed-rate	×	○	
	G01	01	Constant-speed positioning at the speed specified in F	×	○	
	G02	01	Circular interpolation (CW)	×	○	
	G03	01	Circular interpolation (CCW)	×	○	
	G04	00	Dwell	×	○	
	G09	00	Exact stop check	×	○	
	G12	01	Helical interpolation (CW)	×	○	
	G13	01	Helical interpolation (CCW)	×	○	
	G23 (Note)	02	Cancel, cancel/start invalid	×	○	
	G24	02	Cancel, cancel/start	×	○	
	G25	00	High-speed oscillation	×	○	
	G26	00	High-speed oscillation stop	×	○	
	G28	00	Home position return	×	○	
	G30	00	Second home position return	×	○	
	G32	00	Skip	×	○	
	G43	08	Tool length offset (+)	×	○	
	G44	08	Tool length offset (-)	×	○	
	G49 (Note)	08	Tool length offset cancel	×	○	
	G53	00	Mechanical coordinate system selection	×	○	
	G54 (Note), G55, G56, G57, G58, G59	12	Work coordinate system selection	×	○	
	G61	13	Exact stop check mode	×	○	
	G64 (Note)	13	Cutting mode	×	○	
	G90 (Note)	03	Absolute value command	×	○	
	G91	03	Incremental value command	×	○	
	G92	00	Coordinate system setting	×	○	
	G98	21	Pre-read disable	×	○	
	G99 (Note)	21	Pre-read enable	×	○	
	G100 (Note)	20	Time-fixed acceleration/deceleration switching command	×	○	
	G101	20	Acceleration-fixed acceleration/deceleration switching command	×	○	

(Note) : Indicates the G-code selected at the power-on.

Class and group of G-code are shown below.

Class	Description
Modal G-codes (Groups 01, 02, 03, 08, 12, 13, 20, 21)	Once any G-code is commanded, it is valid until another G-code in the same group is commanded. Initial status (at the power-on) is as follows. Group 01 ·········· G00 Point-to-point positioning at the high-speed feed rate Group 02 ·········· G23 Cancel, cancel/start invalid Group 03 ·········· G90 Absolute value command Group 08 ·········· G49 Tool length offset cancel Group 12 ·········· G54 Word coordinate system 1 selection Group 13 ·········· G64 Cutting mode Group 20 ·········· G100 Time-fixed acceleration/deceleration switching command Group 21 ·········· G99 Pre-read enable
Unmodal G-codes (Group 00)	Valid only for the block in which any G-code has been commanded.

6.4 M-code List

M-codes used in the Motion program are shown below.

M-code List

Type	Instruction	Description	Control program	Axis designation program	Remark
Special M-code	M00	Program stop	×	○	
	M01	Optional program stop	×	○	
	M02	Program end	○	○	
	M30	Program end	○	○	
	M98, M99	Subprogram call, end	×	○	
	M100	Preread disable	×	○	
General M-code	Other M-codes	—	×	○	

The special M-codes are not output to the device (M-code outputting signal : M2419+20n).

Use the GOSUB/GOSUBE instruction for the subprogram call in the control program. A general M-code cannot be used in the control program. Use the EXEON/EXEOFF for the signal wait from external source.
(Because there is no axis designation in the control program, it is not made to correspond to the FIN signal which is the signal of every axis.)

6.5 Control Instruction List

Control instructions used in the Motion program are shown below.

Control instruction list

Type	Instruction	Description	Control program	Axis designation program
Control function	IF, GOTO	Program control function	○	○
	IF, THEN, ELSE, END	Program control function	○	○
	WHILE, DO	Program control function	○	○
	WAITON, WAITOFF	Travel block wait function	×	○
	EXEON, EXEOFF	Block wait function	○	○
	ON, OFF	Conditional branch using bit device	○	○
Binary operation	+, -, *, /, MOD, =	Four fundamental operator, assignment statement	○	○
Standard function	SIN, COS, TAN, ASIN, ACOS, ATAN	Trigonometric function	○	○
	INT	Numerical conversion (real number to integer)	○	○
	FLT	Numerical conversion (integer to real number)	○	○
	DFLT	32-bit real number data to 64-bit real number data conversion	○	○
	SFLT	64-bit real number data to 32-bit real number data conversion	○	○
	SQRT, ABS, BIN, BCD, LN, EXP, RSD, FIX, FLP	Function	○	○
Logical operation	AND, OR, XOR, NOT, <<, >>	Logical operator	○	○
Bit operation	BSET, BRST	Bit set and reset for word devices	○	○
Motion dedicated function	PB	Parameter block change	× (Note-1)	○
	TL	Torque limit value change	×	○
	CHGA	Home position return	○	×
	CHGV	Speed change	○	○
	CHGT	Torque limit value change	○	○
Bit device operation	SET, RST	Bit device set, reset functions	○	○
	IF, THEN, SET/RST/OUT	Bit device operation on condition	○	○
Program start, end	CALL	Program start	○	× (Note-2)
	GOSUB	Program call 1	○	× (Note-2)
	GOSUBE	Program call 2	○	× (Note-2)
	CLEAR	Control program end	○ (Note-3)	×
Others	TIME	Time to wait	○	× (Note-4)
	BMOV	Block move (16 bit unit)	○	○
	BDMOV	Block move (32 bit unit)	○	○
	FMOV	Identical data block move (16 bit unit)	○	○

Control instruction list (Continued)

Type	Instruction	Instruction description	Control program	Axis designation program
Multiple CPU instruction	MULTW	Write device data to shared CPU memory	○	○
	MULTR	Read device data from shared CPU memory of the other CPU	○	○
	TO	Write words data to intelligent function module/special function module	○	○
	FROM	Read words data from intelligent function module/special function module	○	○

(Note-1) : Because the axis travel instruction cannot be executed in the control program, the change of PB (parameter block) is unnecessary. Therefore, PB cannot be used.

(Note-2) : Do a subprogram call in the axis designation program with M98.

(Note-3) : Control such as a start and end of the control program can be executed from the other control program.

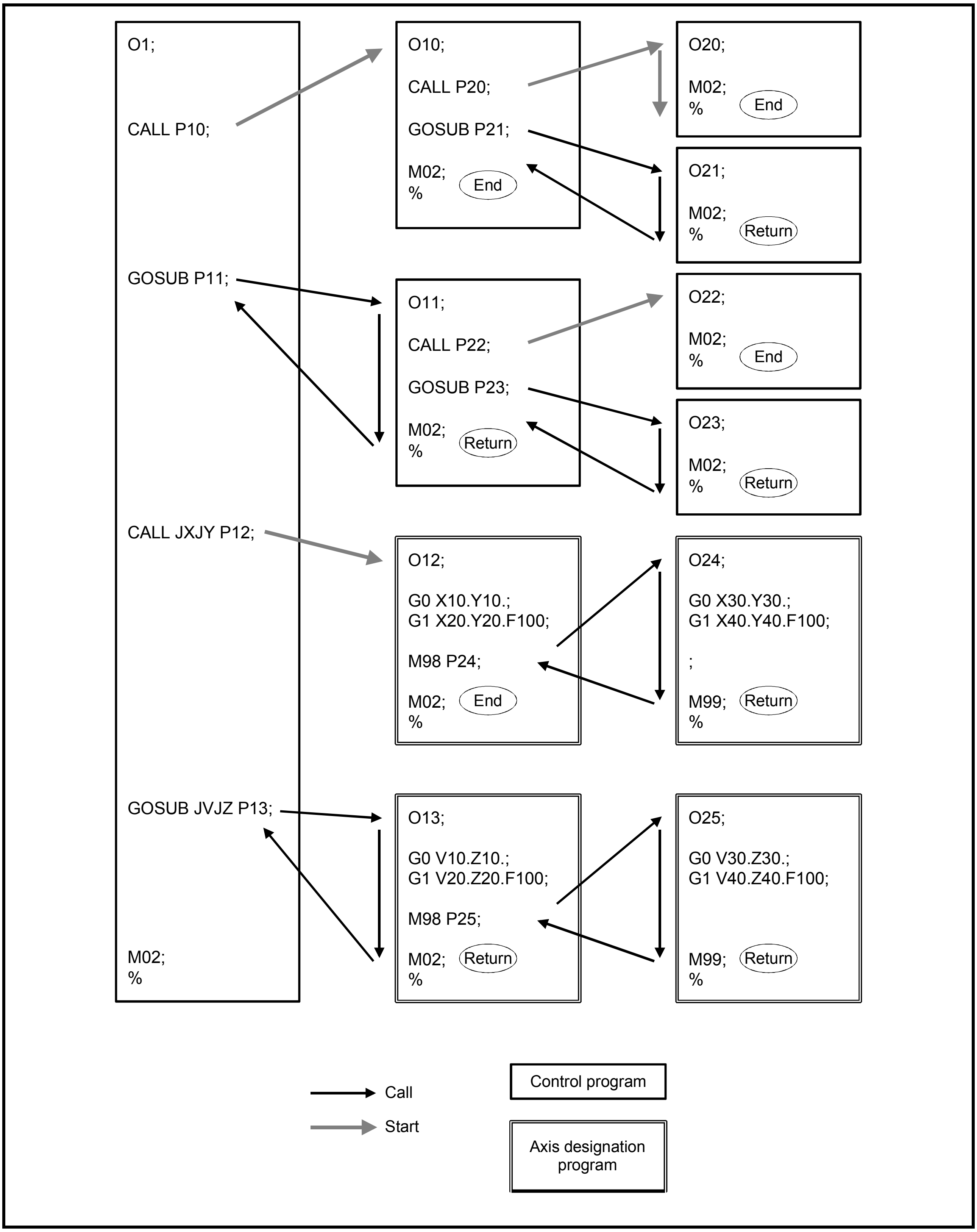
(Note-4) : G04 (Dwell) is used in the axis designation program for time to wait.

6.6 Start/End Method

Start/end methods of the Motion program are shown below.

<table>
<tr><th>Type</th><th>Start/end method</th></tr>
<tr><td rowspan="3">Control program</td><td>Start method
(1) Start by the SFCS instruction from the PLC CPU.
(2) Start by the CALL instruction (start) or the GOSUB/GOSUBE instruction (call) in the control program.
(3) Start by the program parameter automatically.
(Note) : Call/start of the control program from the axis designation program cannot be executed. The program starts from the first by turning the PLC ready flag (M2000) OFF to ON in the automatic start.</td></tr>
<tr><td>End method
(1) The program ends to execute with the "M02/M30;" in the following cases.
(a) Started by the SFCS instruction from the PLC CPU.
(b) Started by the CALL instruction (start) in the control program.
(c) Started by the program parameter automatically.
(2) The program returns to the call source program with the "M02/M30;" in the following cases.
(a) Started by the GOSUB/GOSUBE instruction (call) in the control program.</td></tr>
<tr><td>Forced end from other program
The program can be ended by executing the CLEAR instruction from other programs.</td></tr>
<tr><td rowspan="2">Axis designation program</td><td>Start method
(1) Start by the SVST instruction from the PLC CPU.
(2) Start by the CALL instruction (start) or the GOSUB/GOSUBE instruction (call) in the control program.
(3) Start with M98 in the axis designation program.</td></tr>
<tr><td>End method
(1) The program ends to execute with the "M02/M30;" in the following cases.
(a) Started by the SVST instruction from the PLC CPU.
(b) Started by the CALL instruction (start) in the control program.
(2) The program returns to the call source program with the "M02/M30;" in the following cases.
(a) Started by the GOSUB/GOSUBE instruction (call) in the control program.
(3) The program returns to the call source program with the "M99;" in the following cases.
(a) Started with the M98 in the axis designation program.</td></tr>
</table>

Example for structure of program start/end



6.7 Number of Maximum Nesting for Program Call and Multi Startable Program

(1) The number of maximum nesting of the GOSUB/GOSUBE is 8 levels in the control program.

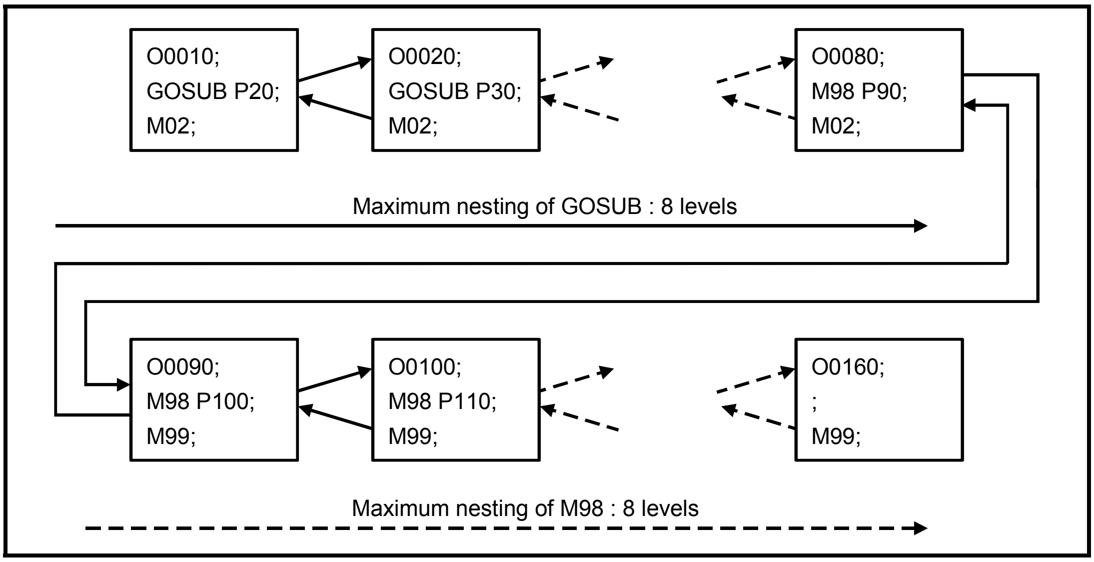
(2) The number of maximum nesting of M98 is 8 levels in the designation program.

(3) The program started by the CALL in the control program operates as a program different from starting source, so there are no restrictions for nesting of the starting source and program started.

(4) The number of maximum multi startable programs of the control program is 16.
However, when it was called by the GOSUB/GOSUBE, the number of multi executed programs is counted as 2 programs in the call source program and program called.

(5) The number of maximum multi startable programs of the axis designation program is 32.
However, when it was called by the M98, the number of multi executed programs is counted as 1 program in the call source program and program called.

(6) Number of maximum nesting for the both of GOSUB/GOSUBE and M98 is 8 levels.
Maximum nesting is 16 levels in the following combinations.



6.8 Motion parameter

Set the following parameters for every Motion program.

<table>
<tr><th>No.</th><th>Item</th><th>Setting range</th><th>Initial value</th><th>Remark</th></tr>
<tr><td>1</td><td>Program type</td><td>1. Control program
2. Axis designation program</td><td>Control program</td><td rowspan="2">This parameter is input at the turning M2000 off to on after that it is controlled.
Turn M2000 off at the changing of this parameter.</td></tr>
<tr><td>2</td><td>Start setting</td><td>Select the automatic start.
(When the control program is selected.)
1. Automatic start
2. Not automatic start</td><td>Not automatic start</td></tr>
</table>

6.9 Caution at The Axis Designation Program Creation

(1) A subprogram call from another subprogram (nesting) is maximum 8 levels.

(2) In one block, one G-code can be selected from each modal group. Up to two G-codes can be commanded. Refer to following table for G-code combinations,.

G-code Combination List

		Second G-codes																							
		G00	G01	G02	G03	G04	G09	G12	G13	G28	G43	G44	G49	G53	G54	G55	G56	G57	G58	G59	G61	G64	G90	G91	G92
First G-codes	G00					○					○	○	○												
	G01					○					○	○	○												
	G02					○																			
	G03					○																			
	G04																								
	G09		○	○	○			○	○																
	G12					○																			
	G13					○																			
	G23																								
	G24																								
	G25																								
	G26																								
	G28													○											
	G30													○											
	G32																								
	G43																								
	G44																								
	G49									○															
	G53									○															
	G54	○	○	○	○			○	○																○
	G55	○	○	○	○			○	○																○
	G56	○	○	○	○			○	○																○
	G57	○	○	○	○			○	○																○
	G58	○	○	○	○			○	○																○
	G59	○	○	○	○			○	○																○
	G61	○	○	○	○			○	○																
	G64	○	○	○	○			○	○																
	G90	○	○	○	○			○	○																
	G91	○	○	○	○			○	○																
	G92	○	○	○	○			○	○																
	G98																								
	G99																								
	G100																								
	G101																								

○ : G-code combination is possible.

How to use the above table

(a) When the G09 is specified as the first G-code, G01, G02, G03, G12 or G13 can be specified as the second code.

(b) When the G90 is specified as the first G-code, G00, G01, G02, G03, G12 or G13 can be specified as the second code.
G90 G61; and G90 G64; result in a format error.

(c) Specify the G23, G24, G25, G26, G32, G98, G99, G100 or G101 individually.

IMPORTANT
The Motion program which an axis overlapped cannot be started simultaneously. If it is executed, we cannot guarantee their operations.

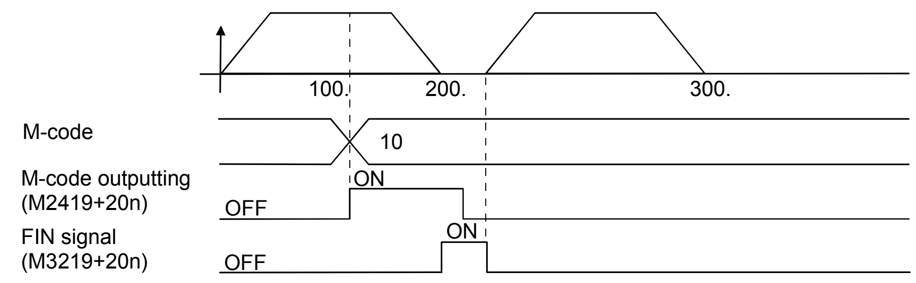
(3) The M-codes except the M00, M01, M02, M30, M98, M99 and M100 can be specified in the same block with another command. However, if they are specified together in the same block with the travel command (G00 to G03, G32), the M function is executed by the start of the travel command (G00 to G03, G32).

(4) If the multiple M-codes except the M00, M01, M02, M30, M98, M99 and M100 are specified in one block, only the last one is valid.

(5) When the auxiliary function (M) is set in continuous G01 blocks .
If an auxiliary function (M) is set at any point in continuous G01 blocks, operation is performed in either of the following two ways.

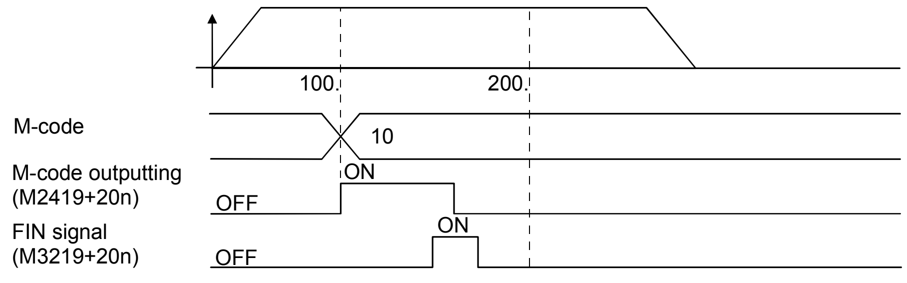
O0100;	
1) G90 G01 X100. F1000. ;	Constant-speed positioning of X
2) X200. M10;	Constant-speed positioning of X, M-code
3) X300. ;	Constant-speed positioning of X

(a) Deceleration stop



When the FIN signal (M3219+20n) is not turned from OFF to ON to OFF during positioning in block 2), a decelerates stop is made once in the block of M-code.

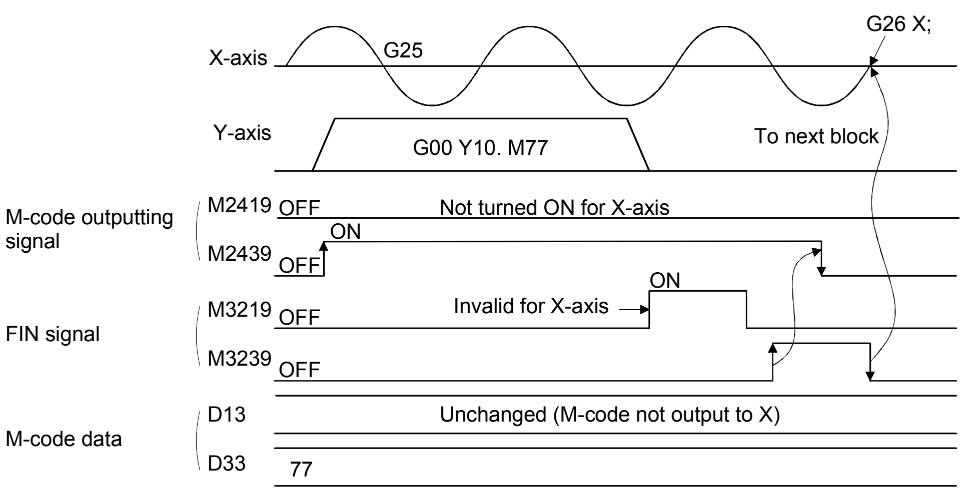
(b) Constant-speed operation



When the FIN signal (M3219+20n) is turned from OFF to ON to OFF during positioning in block 2), the axis performs constant-speed operation without decelerating stop in the block of M-code.

(6) The M-codes except the M00, M01, M02, M30, M98, M99 and M100 are output to the M-code storage registers (D13+20n) of all axes specified at the program start. However, the M-code storage register is not output to the axis in execution of high-speed oscillation. Also, if the FIN signal (M3219+20n) is set to the axis in execution of high-speed oscillation is invalid.
(Program No. 1 is started with X (axis 1) and Y (axis 2) specified SVST J1J2 K1)

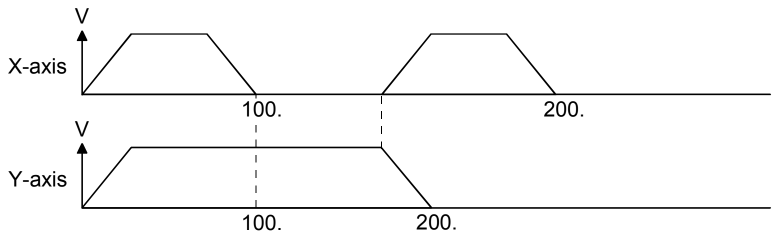
```
O0001;
N1 G25 X START90. STRK10. F30;      X-axis high-speed oscillation start
N2 G00 Y10. M77;                    PTP positioning of Y-axis
N3 G26 X;                           X-axis high-speed oscillation stop
   M02;
   %
```



(7) Acceleration/deceleration processing for G01

G91 G01 X100. Y100. F100. ;	Constant-speed positioning of X, Y.........Block 1
Y100. ;	Constant-speed positioning of Y ....Block 2
X100. ;	Constant-speed positioning of X ....Block 3

The acceleration/deceleration processing of the X-axis and Y-axis in the above program are as follows.



- Both the acceleration and deceleration times are equal to the acceleration time of parameter block.
- When the M-code is commanded in G00, the acceleration and deceleration times are also equal to the acceleration time of parameter block as in G01. (Example : G00 X□ M□;)
- In G02, G03 and G32, the acceleration and deceleration times are also equal to the acceleration time of parameter block as in G01.

(8) Operation of G09 (exact stop check)

Since a shift by command in-position cannot be made, it shifts to the next block after command.

(9) Operation of G28 (home position return)

Home position return of the proximity dog, count, data set, dog cradle, stopper and limit switch combined-type is executed in the axis whose home position return request signal (M2409+20n) is ON.

A high-speed feed home position return is executed in the axis whose home position return request signal (M2409+20n) is OFF.

(10) Checking for the axis used at the program start

(a) If an axis used in the already started program is started by another program, a program cannot be executed because a minor error (error code : 101) occurs at the execution of the SVST instruction.

(b) If the axis not specified in the axis number setting of the SVST instruction in the program waiting to be started is described in the Motion program, it stops because a minor error (error code : 594) at the positioning processing of the applicable axis in the program.

(11) Variable preread

Variables in up to eight blocks including the one currently executed are preread. Set variables before starting of the program.

(12) Motion program including the high-speed oscillation

Be careful the following when the high-speed oscillation (G25) is performed for all axes specified in the SVST.
(Program No. 1 is started with X (axis 1) and Y (axis 2) specified "SVST J1J2 K1")

```
O0001;
N1 G25 X START90. STRK10. F30; X-axis high-speed oscillation start
N2 G25 Y START90. STRK20. F10; Y-axis high-speed oscillation start
N3  <-----------------------  Be careful to program N3 after.
      :
```

(a) The G-code instructions except G26 (high-speed oscillation stop) and G04 (dwell) should not be executed.

(b) The M-codes except M00, M01, M02, M30, M98 and M99 should not be executed.

6.10 Instruction Symbols/Characters List

Instruction symbols and characters used in Motion programs are shown below.

Table 6.1 Instruction Symbol/Character List

Symbol/character	Function	Description
A	Coordinate position data	These symbols are used to specify the travel axis at the positioning command. Set the axis No. and axis name in the system settings.
B	Coordinate position data	
C	Coordinate position data	
U	Coordinate position data	
V	Coordinate position data	
W	Coordinate position data	
X	Coordinate position data	
Y	Coordinate position data	
Z	Coordinate position data	
CA	Coordinate position data	
CB	Coordinate position data	
CU	Coordinate position data	
CV	Coordinate position data	
CW	Coordinate position data	
CX	Coordinate position data	
CY	Coordinate position data	
CZ	Coordinate position data	
DA	Coordinate position data	
DB	Coordinate position data	
DU	Coordinate position data	
DV	Coordinate position data	
DW	Coordinate position data	
DX	Coordinate position data	
DY	Coordinate position data	
DZ	Coordinate position data	
EA	Coordinate position data	
EB	Coordinate position data	
EU	Coordinate position data	
EV	Coordinate position data	
EW	Coordinate position data	
EX	Coordinate position data	
EY	Coordinate position data	
EZ	Coordinate position data	
I	Circular arc central coordinate 1	Used in G02, G03, G12 or G13 (arc central coordinate specification).
J	Circular arc central coordinate 2	
R	Radius of R point-specified circular arc	Used in G02, G03, G12 or G13 (R specification).
F	Interpolation feed combined-speed	Used in G01, G02, G03, G12 or G13.

• Multiple operators cannot be used in one block.

• Refer to Section 6.11.4 for the setting range of instruction symbols.

Table 6.1 Instruction Symbol/Character List (Continued)

Symbol/character	Function	Description
G	Preparatory function (G-code)	Refer to Section "6.3 G-code List".
L	Subprogram repeat count	Used in M98
M	Auxiliary function (M-code)	Refer to Section "6.4 M-code List".
N	Sequence No.	Indicates a sequence No.
O	Program No.	Indicates a Motion program No.
P	Dwell timer	Used in G04.
	Start program No.	Used in G24.
	Subprogram call number	Used in M98, GOSUB/GOSUBE or CALL instruction.
	Waiting time	Used in TIME instruction.
PB	Parameter block No.	Change the parameter block.
TL	Torque limit value	Change the torque limit value.
+	Addition	Used in arithmetic operation commands.
-	Subtraction	
*	Multiplication	
/	Division	
	Optional block skip	Optional block skip is specified for a block which is headed by this symbol. (Refer to Section 4.1.4 (3).)
MOD	Remainder	Used in arithmetic operation commands.
(,)	Comment	Gives comment in the inside of parentheses.
[,]	Brackets	Used in conditional expressions.
#	Variable	Symbols used for indirect designation.
	Device designation	
%	Program end	Indicates the end of a program.
;	Block separation	Indicates separation of blocks.
IF	Condition	Used in conditional branch instructions.
THEN		
ELSE		
GOTO	Jump	
WHILE	Repeat	
DO		
END		
EQ	Comparison instruction (=)	Used in comparison instructions.
NE	Comparison instruction (!=)	
GT	Comparison instruction (>)	
LT	Comparison instruction (<)	
GE	Comparison instruction (>=)	
LE	Comparison instruction (<=)	
OR	Logical operation instruction (OR)	Used in arithmetic operation commands.
XOR	Logical operation instruction (Exclusive OR)	
AND	Logical operation instruction (AND)	

- Multiple operators cannot be used in one block.
- Refer to Section 6.11.4 for the setting range of instruction symbols.

Table 6.1 Instruction Symbol/Characters List (Continued)

Symbol/character	Function	Description
SIN	Trigonometric function (sine)	Used in arithmetic operation commands.
COS	Trigonometric function (cosine)	
TAN	Trigonometric function (tangent)	
ASIN	Trigonometric function (arcsine)	
ACOS	Trigonometric function (arccosine)	
ATAN	Trigonometric function (arctangent)	
INT	Numerical conversion (real number to integer)	
FLT	Numerical conversion (integer to real number)	
SET	Bit device set	Used in control instructions.
RST	Bit device reset	
CAN	Cancel device specification	Used in G24.
START	Starting angle specification	Used in G25.
STRK	Amplitude specification	
SKIP	Skip device specification	Used in G32.
DFLT	32-bit real number data to 64-bit real number data conversion	Control instruction
SFLT	64-bit real number data to 32-bit real number data conversion	
CHGA	Home position return	
CHGV	Speed change	
CHGT	Torque limit value change	
IF, THEN, SET/RST/OUT	Bit device operation on condition	
CALL	Program start	
GOSUB	Program call 1	
GOSUBE	Program call 2	
CLEAR	Control program end	
BMOV	Block traverse (16 bit unit)	
BDMOV	Block traverse (32 bit unit)	
FMOV	Identical data block transfers (16 bit unit)	
MULTW	Write device data to shared CPU memory	
MULTR	Read device data from shared CPU memory of the other CPU	
TO	Write words data to intelligent function module/special function module	
FROM	Read words data from intelligent function module/special function module	

- Multiple operators cannot be used in one block.
- Refer to Section 6.11.4 for the setting range of instruction symbols.

Table 6.1 Instruction Symbol/Characters List (Continued)

Symbol/character	Function	Description
H	Subprogram call sequence No.	Used in M98.
	Tool length offset data No.	Used in G43, G44.
	Indicates hexadecimal number constant.	Used in BMOV, BDMOV, MULTW, MULTR, TO or FROM.

- Multiple operators cannot be used in one block.
- Refer to Section 6.11.4 for the setting range of instruction symbols.

6.11 Setting Method for Command Data

This section describes the setting method for command data (addresses, speeds, operational expressions) used in the Motion programs.
There are following two setting method for command data.

- Direct setting (using numerical values entering)
  .... Refer to Section 6.11.1.
- Indirect setting (using variable : #＊＊＊＊ or device : #W＊＊＊＊)
  .... Refer to Section 6.11.2.

"Direct setting" and "indirect setting" can be used together in one Motion program.

6.11.1 Direct setting (numerical value)

Direct setting is a way to set each positioning data using a numerical value, and these data are fixed data. Data setting and correction can be made using the peripheral device only.

<Example of positioning data setting by direct setting>

```
O0200;
N99 G90 G00 X100. Y110.;
   G01 X200.Y202.F204.;
   G91 G00 Z300.;
M02;
%
```

Numerical setting for positioning data

6.11.2 Indirect setting

(1) Variable representation

The 16-bit integer type, 32-bit integer type and 64-bit double precision real number can be used as variables.

	Data registers	Link registers	Motion registers	Coasting timer
16-bit integer type	#n, #Dn, #nS, #DnS, #n:S, #Dn:S	#Wn:S	#@n, #@nS, #@n:S	—
32-bit integer type	#nL, #DnL, #n:L, #Dn:L	#Wn:L	#@nL, #@n:L	#FT (Read only)
64-bit double precision real number	#nF, #DnF, #n:F, #Dn:F	#Wn:F	#@nF, #@n:F	—

n : Variable or device number

(2) Usable device range

(a) Word device

Item	Q173HCPU/Q172HCPU		
	Points	Accessibility	
		Read	Write
Data register (D)	8192 points	○	○
Link register (W)	8192 points	○	○
Special register (D)	256 points	○	○
Motion register (#)	8192 points	○	○
Coasting timer (FT)	1 point (888μs)	○	×

○ : Usable × : Unusable

(b) Bit device

Item		Q173HCPU/Q172HCPU		
		Points	Accessibility	
			Read	Write
Input/output	Input module non-installation range (X)	8192 points	○	○
	Output module non-installation range (Y)		○	○
Real input/ output	Input module installation range (PX)	Up to 256 points	○	×
	Output module installation range (PY)		○	○
Internal relay (M/L total)		8192 points	○	○
Special relay (M)		256 points	○	○
Link relay (B)		8192 points	○	○
Annunciator (F)		2048 points	○	○

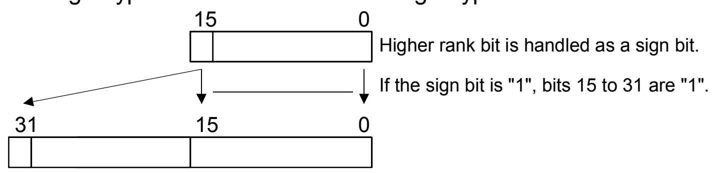
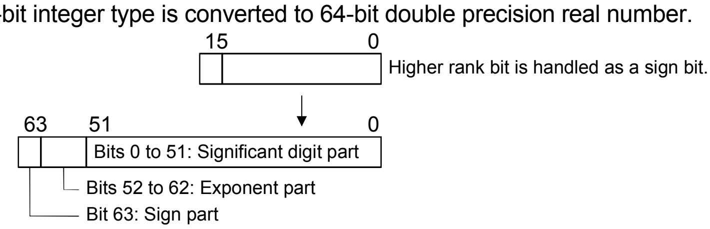
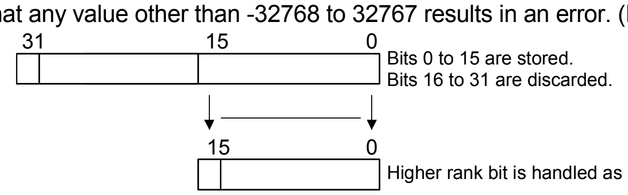
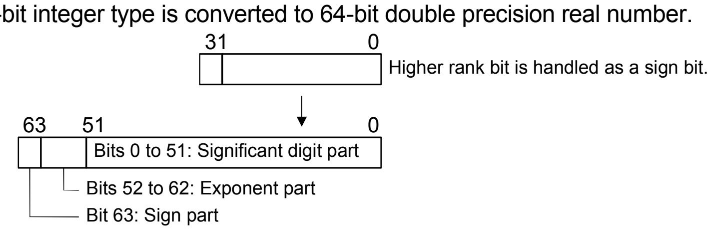
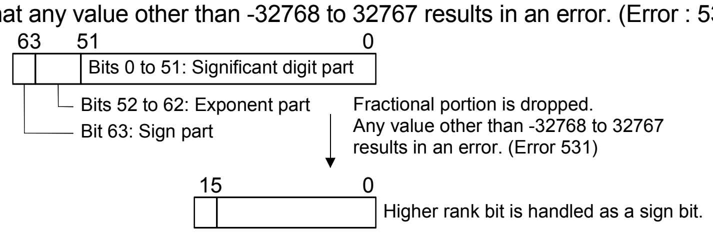
○ : Usable × : Unusable

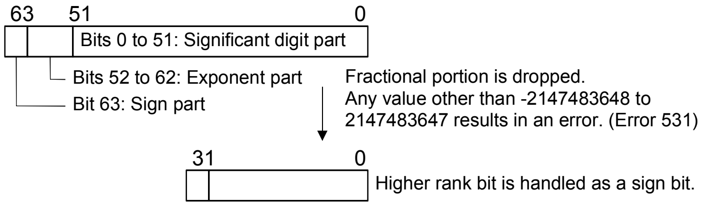
POINT

(1) The data register is shown as "#D" or "#" in the Motion program.
Describe it as "#@" to indicate a motion register.
(2) The mark of the I/O modules is X and Y in the Motion program regardless of installation/non-installation. Do not use PX and PY.

(3) Variable conversion

When variables of different types are used for operation, the types are matched by internal operation.
Type conversion is made by internal operation as follows.

Conversion format	Description
16 bit to 32 bit	The 16-bit integer type is extended to 32-bit integer type. 
16 bit to 64 bit	The 16-bit integer type is converted to 64-bit double precision real number. 
32 bit to 16 bit	The 32-bit integer type is converted to 16-bit integer type. Note that any value other than -32768 to 32767 results in an error. (Error : 531) 
32 bit to 64 bit	The 32-bit integer type is converted to 64-bit double precision real number. 
64 bit to 16 bit	The 64-bit double precision real number is converted to 16-bit integer type. Note that any value other than -32768 to 32767 results in an error. (Error : 531) 

Conversion format	Description
64 bit to 32 bit	The 64-bit double precision real number is converted to 32-bit integer type. Note that any value other than -2147483648 to 2147483647 results in an error. (Error : 531) 

(4) Variable setting (#n : n = integer)

(a) How to handle variable as 16-bit integer

When a #n variable is followed by "S" or ": S", it is handled as a 16-bit integer. (-32768 to 32767)

[Example]

```
#0   : [D0]
#1S  : [D1]
#2:S : [D2]
```

Odd numbers may be used as 16-bit specified variables.

(b) How to handle variable as 32-bit integer

Variables are handled as 32 bits. (-2147483648 to 2147483647)

[Example]

```
           Upper  Lower                Upper  Lower
#100:L : [D101, D100] #102:L : [D103, D102]
```

• When a variable is specified as 2 words (32 bits), only an even number can be used. The data size of a variable is 4 bytes.

<Example of positioning data setting by variable setting>

```
O0200;
N99 G90 G00 X#100 Y#110;
  G01 X#200 Y#202 F#204;
  #300 = #302 - #304;
  G91 G00 Z300.;
  IF [#310 EQ 1000] GOTO99;
M02;
%
```

Motion program No. (O) cannot be set indirectly.

Indirect setting (address, speed, operational expression)

Direct setting

(c) How to handle variable as 64-bit double precision real number

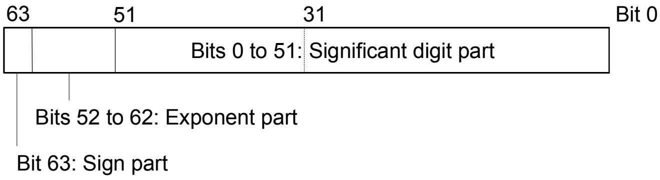
By handling a variable as a 64-bit double precision real number, arithmetic operation spanning multiple blocks can be performed without reduction in precision.

Describe a capital letter ":F" after a #n variable.

#nF : Four variables of #n to #n+3 are used and handled as a 64-bit double precision real number.

63	31		Bit 0
#n+3	#n+2	#n+1	#n

The data format of a 64-bit double precision real number conforms to the binary floating-point type double precision (64 bits) of IEEE Standard.



[Example]

#@10:F=#@20:L/#@22:L;

The division result of 32-bit integers, [#@21, #@20] and [#@23, #@22], is stored to a 64-bit real number, [#@13, #@12, #@11, #@10].

#@10:F=#@20:L;

A 32-bit integer, [#@21, #@20], is expanded in sign to a 64-bit real number, [#@13, #@12, #@11, #@10].

#@40:L=#@30:F;

A 64-bit integer, [#@33, #@32, #@31, #@30], is expanded in sign to a 32-bit integer, [#@41, #@40].

<Restrictions>

64-bit double precision real numbers cannot be used in the function INT and FTL.

(5) Assignment of variable

When a decimal point is added for assignment of a value to a variable, the value is assigned as shown below.

#@10:L=1.; →¨10000 enters in #@10, #@11.

#@10:F=1.; →¨10000 (64-bit double precision real number) enters in #@10, #@11, #@12, #@13.

"1." is converted into a value of four decimal places.

(Converted to a value of four decimal places regardless of the unit (mm, inch, degree).)

[Example]

<Command address 1>

```
G91;
#@10:L=1.;
G0 X#@10:L ; ←The travel value of X is any of the following values.
```

mm	inch	degree
1 mm	0.1 inch	0.1 degree

<Command address 2>

```
G91;
#@10:F=1.;
G0 X#@10:F ; ←The travel value of X is equivalent to any of the following
               values if it is "#@10F=1.;" (64-bit double precision real
               number).
```

mm	inch	degree
1 mm	0.1 inch	0.1 degree

<Feed speed (F) 1>

```
G91;
#@10:L=1.;
G01 X10.F#@10:L ; ←The feed speed (F) of X-axis is any of the following
                   values.
```

mm	inch	degree
100 mm/min	10 inch/min	10 degree/min

<Feed speed (F) 2>

```
G91;
#@10F=1.;
G01 X10.F#@10F ; ←The feed speed (F) of X-axis is equivalent to any of
                  the following values if it is "#@10F=1.;" (64-bit
                  double precision real number).
```

mm	inch	degree
100 mm/min	10 inch/min	10 degree/min

(6) Device setting (#Xx : Xx is device)

The word device (D, W, #) and bit device (X, Y, M, B, F) can be referred to by device setting.
Because the word device (D, W, #) is handled as 32 bits (2 word data), only an even number can be used.
The four fundamental operations of bit devices cannot be performed.
[Example]
#X180 : X180
#M2000 : M2000
#D100:L : [D101, D100] ([upper, lower])
• The word device can be used only an even number. The data size of a variable is 4 bytes.

POINT
For two-word setting, set an even-numbered device.

(7) Inputting device data

The device data for indirect setting is input by the Motion CPU at the Motion program start.
Therefore, execute the pre-read disable of M100 for the indirect setting.
The procedure by start method for setting data to devices and cautions are shown below.

Starting methods	Setting procedure	Cautions
Start by the Motion program	Set the data in indirect setting devices. ↓ Start the Motion program.	Do not change the indirect setting device before the "positioning start complete signal" of the starting axis turns ON.
Automatic start by the cancel/start	Set the data to the indirect setting devices set in the start program. ↓ Turn the cancel command device ON.	
After program start	Set the command data to the indirect setting devices. ↓ Execute the M100 pre-read disable. ↓ Refer to the values set to the indirect setting devices until the M100 is executed.	Example O0010; N1 G00 X0 F1000. ; N2 M100; N3 G01 X100. F1500. ; N4 G01 X#D2000L F1500. ; M02; % Set "D2000, D2001" before execution of N2. They may not be reflected after execution of N2.

POINTS

(1) The Motion program No. (O) cannot be set indirectly.
(2) When the Motion program is executed in the Motion CPU, the data of specified devices (2-word or 4-word) are input in the variable setting or device setting using word devices.
Take an interlocks with the start accept flag (M2001 to M2032) not to change until the specified axes accept a start for the device data specified for indirect setting.
When performing positioning control, execute the start request of Motion program after setting the data to indirect setting devices. If the data is changed before the acceptance of start, positioning control may not be executed with normal values.
(3) Set a variable latch using the peripheral devices.
(4) Variable setting "#＊＊＊＊" is the same in value as device setting "#D＊＊＊＊" which uses data registers.
Example) #2000=1;
#D2000=2; ←The value of #2000 is also 2.
Therefore, the motion device is described as "#@".

6.11.3 Operational data

(1) Four fundamental operations (+, -, *, /, MOD)

The data type combinations and conversion methods for four fundamental operations (+, -, *, /, MOD) are shown below.

Operation result = [Data 1] operator [Data 2]

Operator indicates +, -, *, / or MOD

Internal operation is performed after conversion into the type of the operation result. If there is no operation result such as a conditional expression, internal operation is performed with 32-bit data. For MOD, however, if the operation result type is 64-bit data with floating point, internal operation is performed with 32-bit data, which is then converted into the operation result type and stored.

No.	Operation result	Data 1	Data 2
1	#n (16 bit) No conversion Error occurs if conversion result exceeds 16-bit range. (Error: 531)	#n (16 bit) No conversion	#n (16 bit) No conversion
2			#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)
3			#nF, #n:F (64 bit) 64-bit data is converted into 16-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 16-bit range. (Error : 531)
4		#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)	#n (16 bit) No conversion
5			#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)
6			#nF, #n:F (64 bit) 64-bit data is converted into 16-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 16-bit range. (Error : 531)
7		#nF, #n:F (64 bit) 64-bit data is converted into 16-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 16-bit range. (Error : 531)	#n (16 bit) No conversion
8			#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)
9			#nF, #n:F (64 bit) 64-bit data is converted into 16-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 16-bit range. (Error : 531)

n : Indicates variable number or device number

No.	Operation result	Data 1	Data 2
10	#nL, #n:L (32 bit) (32 bit) No conversion Error occurs if conversion result exceeds 32-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 32-bit data.	#n (16 bit) 16-bit data is converted into 32-bit data.
11			#nL, #n:L (32 bit) No conversion
12			#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)
13		#nL, #n:L (32 bit) No conversion	#n (16 bit) 16-bit data is converted into 32-bit data.
14			#nL, #n:L (32 bit) No conversion
15			#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)
16		#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 32-bit data.
17			#nL, #n: L (32 bit) No conversion
18			#nF, #n: F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)

n : Indicates variable number or device number

- For +, -, *, / (except MOD)

No.	Operation result	Data 1	Data 2
19	#nF, #n:F (64 bit) (64 bit) No conversion	#n (16 bit) 16-bit data is converted into 64-bit data.	#n (16 bit) 16-bit data is converted into 64-bit data.
20			#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
21			#nF, #n:F (64 bit) No conversion
22		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.	#n (16 bit) 16-bit data is converted into 64-bit data.
23			#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
24			#nF, #n:F (64 bit) No conversion
25		#nF, #n:F (64 bit) No conversion	#n (16 bit) 16-bit data is converted into 64-bit data.
26			#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
27			#nF, #n:F (64 bit) No conversion

n : Indicates variable number or device number

- For MOD

No.	Operation result	Data 1	Data 2
28	#nF, #n:F (64 bit) (64 bit) Internal operation result (32 bit) is converted into 64-bit data.	#n (16 bit) 16-bit data is converted into 32-bit data.	#n (16 bit) 16-bit data is converted into 32-bit data.
29			#nL, #n:L (32 bit) No conversion
30			#nF, #n: F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)
31		#nL, #n:L (32 bit) No conversion	#n (16 bit) 16-bit data is converted into 32-bit data.
32			#nL, #n:L (32 bit) No conversion
33			#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)
34		#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 32-bit data.
35			#nL, #n:L (32 bit) No conversion
36			#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if conversion result exceeds 32-bit range. (Error : 531)

n : Indicates variable number or device number

(2) Logical operations (AND, OR, XOR, NOT), shift operators (<<, >>)

- For AND, OR, XOR, <<, >>

The data type combinations and conversion methods for logical operations (AND, OR, XOR) and shift operators (<<, >>) are shown below.

Operation result = [Data 1] operator [Data 2]

Operator indicates AND, OR, XOR, << or >>

For logical and shift operations, operation including the 64-bit floating-point type cannot be performed. (Error "560 : format error")

No.	Operation result	Data 1	Data 2	Remarks
1	#n (16 bit) No conversion	#n (16 bit) No conversion	#n (16 bit) No conversion	
2			#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)	
3			#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled
4		#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)	#n (16 bit) No conversion	
5			#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)	
6			#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled
7		#nF, #n:F (64 bit) Operation cannot be performed.	#n (16 bit) Operation cannot be performed.	Operation disabled
8			#nL, #n:L (32 bit) Operation cannot be performed.	Operation disabled
9			#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled
10	#nL, #n:L (32 bit) (32 bit) No conversion	#n (16 bit) 16-bit data is converted into 32-bit data.	#n (16 bit) 16-bit data is converted into 32-bit data.	
11			#nL, #n:L (32 bit) No conversion	
12			#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled
13		#nL, #n:L (32 bit) No conversion	#n (16 bit) 16-bit data is converted into 32-bit data.	
14			#nL, #n:L (32 bit) No conversion	
15			#nF, #n: F (64 bit) Operation cannot be performed.	Operation disabled
16		#nF, #n:F (64 bit) Operation cannot be performed.	#n (16 bit) Operation cannot be performed.	Operation disabled
17			#nL, #n:L (32 bit) Operation cannot be performed.	Operation disabled
18			#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled

n : Indicates variable number or device number

• For NOT

The following table indicates the data type combinations and conversion methods for NOT.

Operation result = operator [Data 1]

Operator denotes NOT.

For logical and shift operations, operation including the 64-bit floating-point type cannot be performed. (Error "560 : format error")

No.	Operation result	Data 1	Remarks
1	#n (16 bit) No conversion	#n (16 bit) No conversion	
2		#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data. Error occurs if conversion result exceeds 16-bit range. (Error : 531)	
3		#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled
4	#nL, #n:L (32 bit) (32 bit) No conversion	#n (16 bit) 16-bit data is converted into 32-bit data.	
5		#nL, #n:L (32 bit) No conversion	
6		#nF, #n:F (64 bit) Operation cannot be performed.	Operation disabled

n : Indicates variable number or device number

(3) Trigonometric functions (SIN, COS, TAN, ASIN, ACOS, ATAN)

The data type combinations and conversion methods for trigonometric functions (SIN, COS, TAN, ASIN, ACOS, ATAN) are shown below.

Operation result = trigonometric function [Data 1]

Trigonometric function indicates SIN, COS, TAN, ASIN, ACOS or ATAN

Internal operation is performed with the 64-bit floating-point type.

When there is operation in Data 1, operation is performed after conversion into 64-bit data.

No.	Operation result	Data 1
1	#n (16 bit) Internal operation result (64 bit) is multiplied by 10000 and result of multiplication is converted into16-bit data. Fractional portion is dropped during conversion. Error occurs if operation result exceeds 16-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 64-bit data. Data is divided by 10000 during conversion.
2		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data. Data is divided by 10000 during conversion.
3		#nF, #n:F (64 bit) Data is divided by 10000 during conversion.
4	#nL, #n:L (32 bit) Internal operation result (64 bit) is multiplied by 10000 and result of multiplication is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if operation result exceeds 32-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 64-bit data. Data is divided by 10000 during conversion.
5		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data. Data is divided by 10000 during conversion.
6		#nF, #n:F (64 bit) Data is divided by 10000 during conversion.
7	#nF, #n:F (64 bit) Internal operation result (64 bit) is stored as it is.	#n (16 bit) 16-bit data is converted into 64-bit data.
8		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
9		#nF, #n:F (64 bit) No conversion

n : Indicates variable number or device number

(4) Floating-point type real number processing instructions (INT, FLT)

The data type combination and conversion method for floating-point type real number processing instructions (INT, FLT)are shown below.

Operation result = function [Data 1]

Function indivates INT or FLT.

The floating-point type real number processing instructions (INT, FLT) can operate the 32-bit type only.

The floating-point type real number processing instructions cannot operate data other than the 32-bit type. (Error "560 : Format error")

INT and FLT cannot be used with other operations. (Error "560 : Format error")

No.	Operation result	Data 1
1	#nL, #n:L (32 bit) <INT> 32-bit floating-point type is converted into 32-bit type. Fractional portion is dropped during conversion. Error occurs if operation result exceeds 32-bit range. (Error : 531) <FLT> 32-bit type is converted into 32-bit floating-point type.	#nL, #n:L (32 bit) No conversion

n : Indicates variable number or device number

(5) Functions (SQRT, ABS, LN, EXP)

The data type combinations and conversion methods for functions (SQRT, ABS, LN, EXP) are shown below.

Operation result = function [Data 1]

Function indicates SQRT, ABS, LN or EXP

Internal operation of SQRT, LN or EXP is performed with the 64-bit floating-point type.

Internal operation of ABS is performed by making conversion into the operation result type.

When there is operation in Data 1 for SQRT, operation is performed after conversion into 64-bit data.

• For SQRT, LN, EXP

No.	Operation result	Data 1
1	#n (16 bit) Internal operation result (64 bit) is converted into 16-bit data. Fractional portion is dropped during conversion. Error occurs if operation result exceeds 16-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 64-bit data.
2		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
3		#nF, #n:F (64 bit) No conversion
4	#nL, #n:L (32 bit) Internal operation result (64 bit) is converted into 32-bit data. Fractional portion is dropped during conversion. Error occurs if operation result exceeds 32-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 64-bit data.
5		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
6		#nF, #n:F (64 bit) No conversion
7	#nF, #n:F (64 bit) No conversion	#n (16 bit) 16-bit data is converted into 64-bit data.
8		#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
9		#nF, #n:F (64 bit) No conversion

n : Indicates variable number or device number

• For ABS

No.	Operation result	Data 1
1		#n (16 bit) No conversion
2	#n (16 bit) No conversion	#nL, #n:L (32 bit) 32-bit data is converted into 16-bit data.
3		#nF, #n:F (64 bit) 64-bit data is converted into 16-bit data.
4		#n (16 bit) 16-bit data is converted into 32-bit data.
5	#nL, #n:L (32 bit) No conversion	#nL, #n:L (32 bit) No conversion
6		#nF, #n:F (64 bit) 64-bit data is converted into 32-bit data.
7		#n (16 bit) 16-bit data is converted into 64-bit data.
8	#nF, #n:F (64 bit) No conversion	#nL, #n:L (32 bit) 32-bit data is converted into 64-bit data.
9		#nF, #n:F (64 bit) No conversion

n : Indicates variable number or device number

(6) Functions (BIN, BCD)

The data type combinations and conversion methods for functions (BIN, BCD) are shown below.

Operation result = function [Data 1]

Function indicates BIN or BCD

Internal operation is performed by making conversion into the 32-bit type.

Operation including the 64-bit floating-point type cannot be performed.

(Error "560 : format error")

BIN and BCD cannot be used with other operations.

(Error "560 : format error")

No.	Operation result	Data 1
1	#n (16 bit) Internal operation result (64 bit) is converted into 16-bit data. Error occurs if operation result exceeds 16-bit range. (Error : 531)	#n (16 bit) 16-bit data is converted into 32-bit data.
2		#nL, #n:L (32 bit) No type conversion
3		#nF, #n:F (64 bit) Operation cannot be performed.
4		#n (16 bit) 16-bit data is converted into 32-bit data.
5	#nL, #n:L (32 bit) No type conversion	#nL, #n:L (32 bit) No type conversion
6		#nF, #n:F (64 bit) Operation cannot be performed.

n : Indicates variable number or device number

(7) Functions (round-off (RND), round-down (FIX), round-up (FUP))

The data type combinations and conversion methods for round-off (RND), round-down (FIX) and round-up (FUP) are shown below.

Operation result = function [Data 1]

Function denotes RND, FIX or FUP.

Round-off (RND), round-down (FIX) and round-up (FUP) cannot perform operation of other than the 64-bit floating-point type.
(Error "560 : format error")

No.	Operation result	Data 1
1	#nF, #n:F (64 bit) No type conversion <RND> Rounds off data 1 to one decimal place. <FIX> Rounds down data 1 to the units. <FUP> Rounds up data 1 to the units.	#nF, #n:F (64 bit) No type conversion

n : Indicates variable number or device number

6.11.4 Setting range of instruction symbols list

Setting range of instruction symbols used in the Motion programs are shown below.

Table 6.2 Setting Range of Instruction Symbol List

	Symbol	Function	Setting range: Motion program description	Setting range: Indirect setting value by variable
Address	A	Coordinate position data	-214748.3648 to 214748.3647 [mm] -21474.83648 to 21474.83647 [inch] 0 to 359.99999 [degree]	-2147483648 to 2147483647 0 to 35999999
	B	Coordinate position data		
	C	Coordinate position data		
	U	Coordinate position data		
	V	Coordinate position data		
	W	Coordinate position data		
	X	Coordinate position data		
	Y	Coordinate position data		
	Z	Coordinate position data		
	CA	Coordinate position data		
	CB	Coordinate position data		
	CU	Coordinate position data		
	CV	Coordinate position data		
	CW	Coordinate position data		
	CX	Coordinate position data		
	CY	Coordinate position data		
	CZ	Coordinate position data		
	DA	Coordinate position data		
	DB	Coordinate position data		
	DU	Coordinate position data		
	DV	Coordinate position data		
	DW	Coordinate position data		
	DX	Coordinate position data		
	DY	Coordinate position data		
	DZ	Coordinate position data		
	EA	Coordinate position data		
	EB	Coordinate position data		
	EU	Coordinate position data		
	EV	Coordinate position data		
	EW	Coordinate position data		
	EX	Coordinate position data		
	EY	Coordinate position data		
	EZ	Coordinate position data		
	I	Circular arc central coordinate 1		
	J	Circular arc central coordinate 2		

Table 6.2 Setting Range of Instruction Symbol List (Continued)

	Symbol	Function	Setting range	
			Motion program description	Indirect setting value by variable
Address	R	Radius of R point specified circular arc	0 to 214748.3647 [mm] 0 to 21474.83647 [inch] 0 to 359.99999 [degree]	0 to 2147483647 0 to 35999999
Speed	F	Interpolation feed combined speed	0.01 to 6000000.00 [mm/min] 0.001 to 600000.000 [inch/min] 0.001 to 2147483.647 [degree/min](Note-1)	1 to 600000000 1 to 2147483647
Others	G	Preparatory function (G-code)	00, 01, 02, 03, 04, 09, 12, 13, 23, 24, 25, 26, 28, 30, 32, 43, 44, 49, 53, 54, 55, 56, 57, 58, 59, 61, 64, 90, 91, 92, 98, 99, 100, 101	–
	H	Subprogram call sequence No.	1 to 9999	1 to 9999
		Tool length offset data No.	1 to 20	1 to 20
	L	Subprogram repeat count	0 to 9999	0 to 9999
	M	Auxiliary function (M-code)	0 to 9999	0 to 9999
	N	Sequence No.	1 to 9999	–
	O	Motion program No.	1 to 1024	–
	P	Dwell time	1 to 65535	1 to 65535
		Start program No.	1 to 1024	1 to 1024
		Subprogram call No.	1 to 1024	1 to 1024
	PB	Parameter block No.	1 to 16	1 to 16
	TL	Torque limit value	1 to 1000	1 to 1000
Operational expression	+	Addition	-2147483648 to 2147483647	-2147483648 to 2147483647
	-	Subtraction		
	*	Multiplication		
	/	Division		
	MOD	Remainder		

(Note-1) : When the "speed control 10× multiplier setting for degree axis" set to "valid", the setting range is 0.01 to 21474836.47[degree/min].

REMARK

(1) Command unit

A decimal point can be entered in the Motion program input information which defines the command address or speed, etc.

[Example] 123456.7890

A decimal point may also be omitted.

When a decimal point is omitted, a command address is represented in 0.0001[mm], 0.00001[inch] or 0.00001[degree] increments, for example.

<For command address> <For feed speed (F)>

○○○○○○.○○○○ ○○○○○○○○.○○

[Example] 10. ······ 10mm [Example] 10. ······ 10mm/min

10 ······· 0.001mm (unit: mm) 10 ······· 0.1mm/min (unit: mm)

Any value may be specified up to 10 digits. (Decimal point not included) Specifying more than 10 digits will result in an error.

Number of effective digits below decimal point are listed below. After effective digits are ignored. Note that specifying 10 or more digits will result in an error.

Unit / Command	mm	inch	degree
Command address	4	5	5
Command speed	2	3	3 (Note)

(Note) : When the "speed control 10× multiplier setting for degree axis" set to "valid", the number of effective digits below decimal point is 2.

6.11.5 Positioning control unit for 1 axis

For one axis, positioning control is executed in the control unit specified in the fixed parameter.

(The control unit specified in the parameter block is ignored.)

6.11.6 Control units for interpolation control

(1) The interpolation control units specified with the parameter block and the control units of the fixed parameter are checked.
If the interpolation control units specified with the parameter block differ from the control units of the each axis fixed parameter for the interpolation control, it shown below.

	Interpolation control units in the parameter block			Starting method
	mm	inch	degree	
Condition for normal start	There are axes whose control unit set in the fixed parameter is [mm] /[inch].		There are axes whose control unit set in the fixed parameter is [degree].	Control starts by the interpolation control unit of parameter block.
Condition for unit mismatch error (error code : 40)	Control units of the fixed parameter for all axes differ from the interpolation control units specified with parameter block.			• If the control units of axes to be interpolation-controlled are the same, control starts in the preset control unit. • If the control units of axes to be interpolation-controlled are different, control starts in the unit of highest priority as indicated below. Priority degree>inch>mm

(2) The combinations of each axis control units for interpolation control are shown in the table indicated below.

	mm	inch	degree
mm	1)	2)	2)
inch	2)	1)	2)
degree	2)	2)	1)

1) : Same unit 2) : Unit mismatch

(a) Same unit (1))
The position command value is calculated according to the setting address/travel value, positioning speed and electronic gear.

(b) Unit mismatch (2))
- The travel value and positioning speed are calculated for each axis.
  a) The travel value is converted into the [PLS] unit using the electronic gear of its own axis.
  b) The positioning speed is converted into the [PLS/s] unit using the electronic gear of the axis whose control unit matches the interpolation control unit.
     The travel value converted into [PLS], the speed converted into [PLS/s], and the electronic gear are used to calculate the position command value for positioning.
- If there are two or more axes whose control units are the same as the interpolation control unit in the linear interpolation of three or more axes, the electronic gear of the lowest axis No. is used to calculate the positioning speed.

POINT

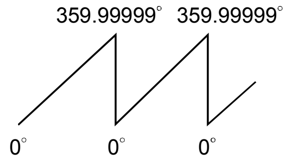
When a "degree" is used as the control unit of one axis, a "degree" should also be used with the other axis.

6.11.7 Control in the control unit "degree"

If the control units are "degree", the following items differ from other control units.

(1) Current value address

The current addresses in the control units "degree" are ring addresses from 0° to 360°.

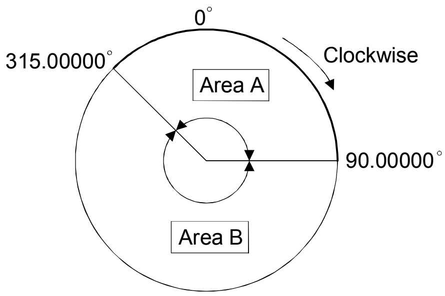


(2) Stroke limit valid/invalid setting

The upper/lower limit value of the stroke limit in the control unit "degree" is within the range of 0° to 359.99999°

(a) Stroke limit is valid

Set the "lower limit value to upper limit value of the stroke limit" in a clockwise direction to validate the stroke limit value.



1) If travel range in area A is set, the limit values are as follows :
   - Lower stroke limit value : 315.00000°
   - Upper stroke limit value : 90.00000°
2) If travel range in area B is set, the limit values are as follows :
   - Lower stroke limit value : 90.00000°
   - Upper stroke limit value : 315.00000°

(b) Stroke limit is invalid

Set the "upper stroke limit value" equal to "lower stroke limit value" to invalidate the stroke limit value.

It can be controlled regardless the stroke limit settings.

POINTS

(1) Circular interpolation including the axis which set the stroke limit as invalid cannot be executed.

(2) When the upper/lower limit value of the axis which set the stroke limit as valid are changed, perform the home position return after that.

(3) When the stroke limit is set as valid in the incremental data system, perform the home position return after power supply on.

(3) Positioning control

Positioning control method in the control unit "degree" is shown below.

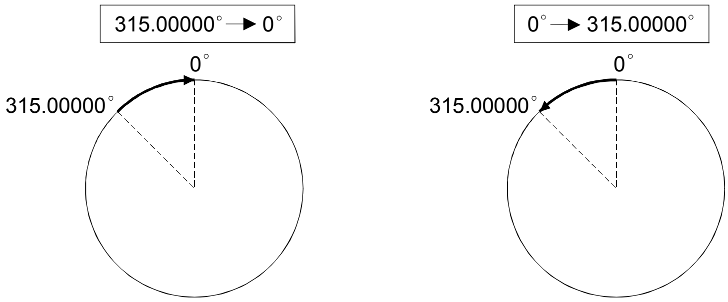
(a) Absolute data method

Positioning in a near direction to the specified address is performed based on the current value.

Examples

(1) Positioning is executed in a clockwise direction to travel from the current value of 315.00000° to 0°.

(2) Positioning is executed in a counter clockwise direction to travel from the current value of 0° to 315.00000°.

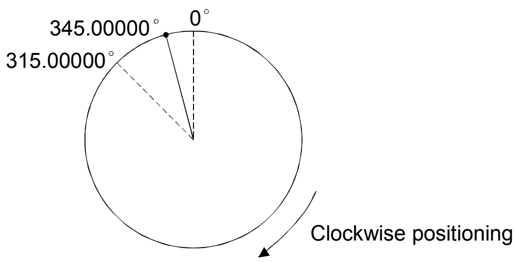


POINTS

(1) The positioning direction of absolute data method is set a clockwise/counter clockwise direction by the setting method of stroke limit range, positioning in the shortest direction may not be possible.

Example

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



(2) Set the positioning address within the range of 0° to 360°.
Use the incremental data method for positioning of one revolution or more.

(b) Incremental data method

Positioning by the specified travel value to the specified direction.

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

1) Positive travel value ....Clockwise rotation

2) Negative travel value...............Counter clockwise rotation

POINT

Positioning of 360° or more can be executed in the incremental data method.

6.12 About Coordinate Systems

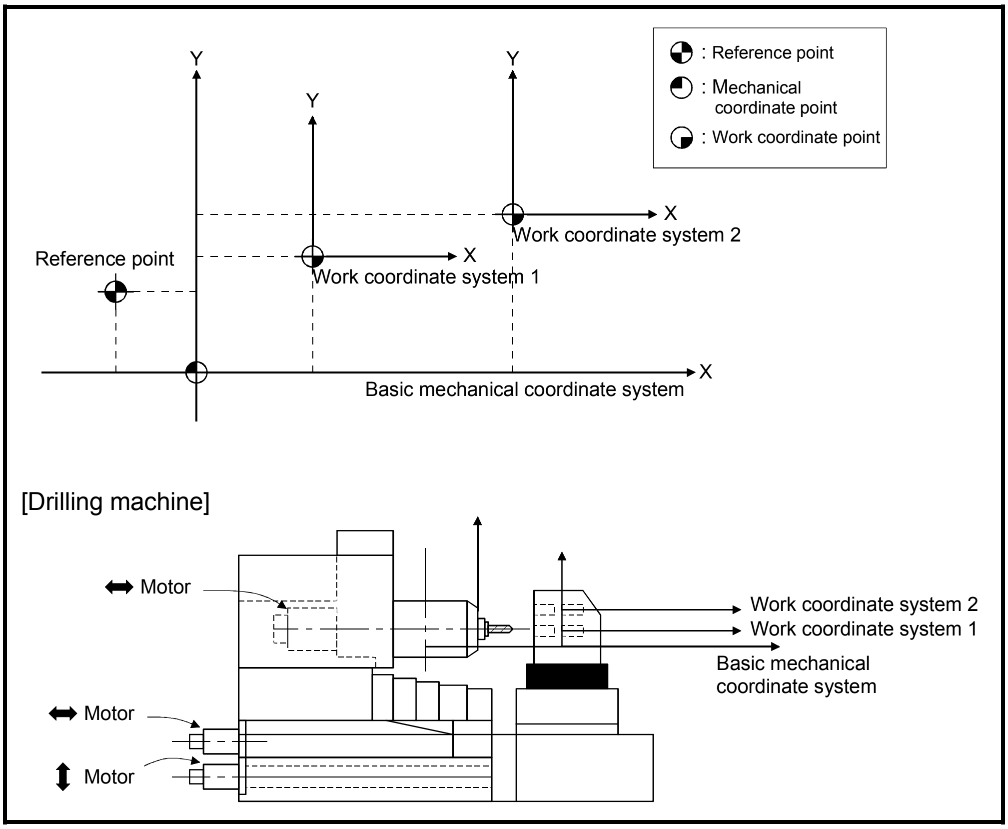
This section describes coordinate systems.
There are two coordinate systems : basic mechanical coordinate system and work coordinate system.

(1) Basic mechanical coordinate system

.... A coordinate system specific to a machine and indicates the position determined specifically for the machine.

(2) Work coordinate system

.... A coordinate system used by a programmer for programming to set the reference point on a work as a coordinate home position.
In the work coordinate system, a position is specified with an offset value from the basic mechanical coordinate system. The offset value is set with a distance from the mechanical coordinate system origin (0).
You can specify up to six work coordinate systems (work coordinates 1 to 6). Set them by parameter setting or work coordinate system selection (G54 to G59). (Refer to Section 5.4 and 6.13.24.)
By setting multiple work coordinates, you can easily perform multiple positioning operations with one Motion program.



6.13 G-code

This section describes instruction codes to use in the Motion program.
Each instruction is described in the following format.

1) →

2) →

Code	G00	
Function	Point-to-point positioning at high-speed feedrate	Positions the specified axes. (PTP)

← Functional outline of instruction explained easily.

Format	G00␣X x␣Y y␣Z z ; Positioning addresses Axis names

← The method of the input and description are shown.
"␣" shows that space should be put when the program is input.

3)

[Explanation]

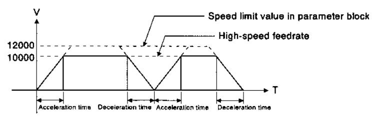
(1) This command is executed linearly positioning of the specified all axes from the current value to the specified coordinate position at the fixed speed.

(2) Being a modal instruction, this command is valid until another G code in the same modal group is used. Hence, if the next command is the same G code, it may be enabled by specifying only the axis name. (Modal group (01) is made up of G00, G01, G02, G03, G12 and G13.)

(3) This command always increases or decreases speed at the starting or end point of a block and proceeds to the next block.

(4) The positioning speed is not more than the high-speed feedrate of each axis.

[Example] G00 X100. ;
X150. ;
(When high-speed feedrate is 10000[mm/min] and speed limit value in parameter block is 12000[mm/min])



(5) Acceleration-fixed acceleration/deceleration is made.
Acceleration is calculated from the lower speed of the high-speed feedrate and speed limit value and the acceleration time and deceleration time in the parameter block.

(6) The positioning data can be set by direct designation(numerical value) or indirect designation(variable : #****).

(7) Commanding the M code in G00 also causes acceleration/deceleration to be made in the acceleration time of the parameter block as in G01. (Example G00 X□ M□ ;)

4)

[Related Parameters]

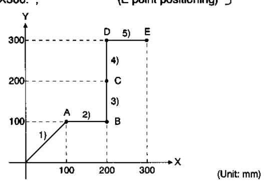
High-speed feedrate: Set the maximum feedrate of each axis.
(Refer to section 5.2.5 for the high-speed feedrate setting in the fixed parameter.)
When G00 is executed, positioning takes place in the shortest path which connects the starting point and end point.
The positioning speed is within the high-speed feedrate of each axis.

5)

[Program Example]

Program used to position the axes at points A, B, C, D and E. (Under absolute value command)

1) G00 X100. Y100. ; (A point positioning)
2) X200. ; (B point positioning)
3) Y200. ; (C point positioning) } Travel under G00
4) G01 Y300. F100. ; (D point positioning)
5) X300. ; (E point positioning) } Travel under G01



6)

REMARK

(1) To execute the feedrate of G00, the axis whose time to reach the target position is the longest in the travel/high-speed feedrate(fixed parameter) of the each axes is used as the reference axis, and interpolation is made in the reference axis speed interpolation mode phase or the like. (Refer to section 5.2.5.)

(2) The high-speed feedrate of each axis is clamped at the speed limit value if it is larger than the speed limit value of the parameter block. The calculation of the reference axis is also made using the clamped value.

No.	Description	No.	Description
1)	Name of the instruction code.	4)	Indicates the parameters related to this instruction.
2)	Indicates the model name.	5)	Indicates a program example which uses this instruction.
3)	Indicates the detailed explanation or precautions.	6)	Indicates supplementary explanation or instructions related to this instruction.

The arguments of G-code are shown in Table 6.3.

Table 6.3 G-code arguments

	Axis command (Note-2)	Radius command (R)	Central point command	Skip command (SKIP)	Cancel command (CAN)	Starting angle (START)	Amplitude (STRK)	M-code (Note-3)	G-code	Feed (F)	H	L	N	O	P	PB	Remarks
G00	○							○	○								Only G-codes of G04, G43, G44 and G49 are available. (Note-1)
G01	○							○	○	○							Only G-codes of G04, G43, G44 and G49 are available. (Note-1)
G02	◎		◎					○	○	○							Only G-codes of G04 is available. Central point command and axis command may be specified up to 2 axes.
G02	◎	◎						○	○	○							Only G-codes of G04 is available. Radius command and axis command may be specified up to 2 axes.
G03	◎		◎					○	○	○							Only G-codes of G04 is available. Central point command and axis command may be specified up to 2 axes.
G03	◎	◎						○	○	○							Only G-codes of G04 is available. Radius command and axis command may be specified up to 2 axes.
G04															◎		Dwell
G09									○								Only G-codes of G01, G02, G03, G12 and G13 are available. (Note-1)
G12	◎		◎					○	○	○							Only G-codes of G04 is available. Central point command and axis command may be specified up to 3 axes.
G12	◎	◎						○	○	○							Only G-codes of G04 is available. Radius command and axis command may be specified up to 3 axes.
G13	◎		◎					○	○	○							Only G-codes of G04 is available. Central point command and axis command may be specified up to 3 axes.
G13	◎	◎						○	○	○							Only G-codes of G04 is available. Radius command and axis command may be specified up to 3 axes.
G23																	
G24					◎										○	○	P : Start program No. PB : Parameter block No.
G25	◎					○	◎				◎						Specify only axis name for axis command and frequency for F.
G26	◎																Specify only axis name for axis command.
G28	○								○								Only G-codes of G53 is available.
G30	○								○								Only G-codes of G53 is available.
G32	○			◎				○	○	○					○		P must not be specified for axis command and M-code simultaneously.
G43	○										◎						
G44	○										◎						
G49	○								○								Only G-codes of G28 is available.
G53	○								○								Only G-codes of G28 is available.
G54	○								○								Only G-codes of G00, G01, G02, G03, G12, G13 and G92 are available. (Note-1)

Table 6.3 G-code arguments (Continued)

	Axis command (Note-2)	Radius command (R)	Central point command (I,J)	Skip command (SKIP)	Cancel command (CAN)	Starting angle (START)	Amplitude (STRK)	M-code (Note-3)	G-code	Feed (F)	H	L	N	O	P	PB	Remarks
G55	○								○								Only G-codes of G00, G01, G02, G03, G12, G13 and G92 are available. (Note-1)
G56	○								○								Only G-codes of G00, G01, G02, G03, G12, G13 and G92 are available. (Note-1)
G57	○								○								Only G-codes of G00, G01, G02, G03, G12, G13 and G92 are available. (Note-1)
G58	○								○								Only G-codes of G00, G01, G02, G03, G12, G13 and G92 are available. (Note-1)
G59	○								○								Only G-codes of G00, G01, G02, G03, G12, G13 and G92 are available. (Note-1)
G61									○								Only G-codes of G00, G01, G02, G03, G12 and G13 are available. (Note-1)
G64									○								Only G-codes of G00, G01, G02, G03, G12 and G13 are available. (Note-1)
G90	○								○								Only G-codes of G00, G01, G02, G03, G12 and G13 are available. (Note-1)
G91	○								○								Only G-codes of G00, G01, G02, G03, G12 and G13 are available. (Note-1)
G92	○								○								Only G-codes of G00, G01, G02, G03, G12 and G13 are available. (Note-1)
G98																	
G99																	
G100																	
G101																	

◎ : Must be specified ○ : May be specified Blank : Must not be specified

For G43, G44, G49, G54 to G59, G90 and G91, use the currently selected modal group 01 to set the specifiable arguments.

(Note-1) : The G-code may be set in the first parameter only.

(Note-2) : The axis commands are X, Y, Z, U, V, W, A, B, CX, CY, CZ, CU, CV, CW, CA, CB, DX, DY, DZ, DU, DV, DW, DA, DB, EX, EY, EZ, EU, EV, EW, EA and EB.

(Note-3) : The M-codes are except M00, M01, M02, M30, M98, M99 and M100.

6.13.1 G00 Point-to-point positioning at the high-speed feed rate

Code	G00	The positions of the specified axes are executed. (PTP)
Function	Point-to-point positioning at the high-speed feed rate	

Format	G00␣X x␣Y y␣Z z ; x, y, z: Positioning address X, Y, Z: Axis name

[Explanation]

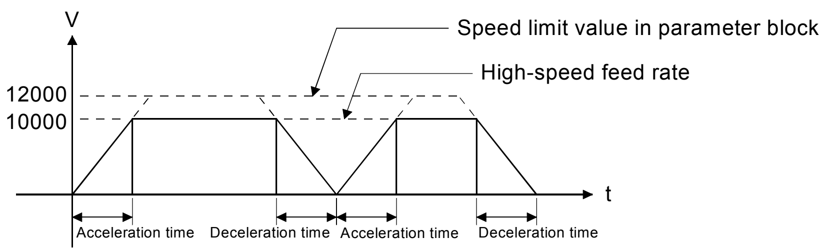
(1) The linearly positioning of the specified axes from the current value to specified coordinate position at the fixed speed for all axes.

(2) Since this command is a modal instruction, it is valid until another G-code in the same modal group is used. Therefore, when the next command is the same G-code, it is possible by specifying only the axis name. (G00, G01, G02, G03, G12 and G13 are contained in a modal group (01).)

(3) Acceleration or deceleration is always executed at the start or end point of a block, and it proceeds to the next block in this command.

(4) The positioning speed is the high-speed feed rate of each axis or less.

[Example] G00 X100. ;
X150. ;
(High-speed feed rate : 10000[mm/min], speed limit value in parameter block : 12000[mm/min])



(5) This command executes the acceleration-fixed acceleration/deceleration. Acceleration is calculated from the lower speed among the high-speed feed rate or speed limit value and the acceleration/deceleration time in the parameter block.

(6) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

(7) When a M-code is commanded, G00 executes the acceleration/deceleration in the same way as G01 at the acceleration time of the parameter block. (Example G00 X□ M□ ;)

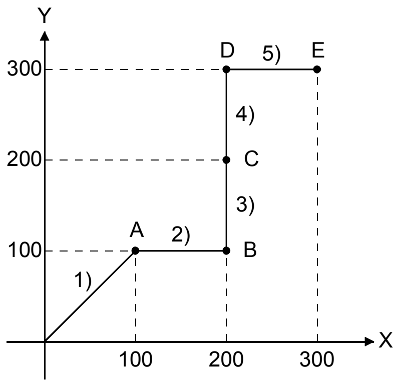
[Related Parameters]

High-speed feed rate: The maximum feed rate of each axis is set.
(Refer to Section 5.2.5 for the high-speed feed rate setting of the fixed parameter.)
The positioning is executed in the shortest path which connects the start and end point at the execution of G00.
The positioning speed is the high-speed feed rate of each axis or less.

[Program Example]

Program to execute positioning of A, B, C, D and E points. (Absolute value command)

```
1) G00  X100.  Y100.  ;    (A point positioning) ┐
2) X200.  ;                (B point positioning) ├Travel with G00
3) Y200.  ;                (C point positioning) ┘
4) G01  Y300.  F100.  ;    (D point positioning) ┐
5) X300.  ;                (E point positioning) ┘Travel with G01
```



(Unit: mm)

REMARK

(1) To execute the feed rate of G00, the axis whose time to reach the target position is the longest in the travel/high-speed federate (fixed parameter) of the each axes is used as the reference axis, and interpolation is made in the reference axis speed interpolation mode phase or the like. (Refer to Section 5.2.5.)

(2) The high-speed feed rate of each axis is clamped at the speed limit value if it is larger than the speed limit value of the parameter block. The calculation of the reference axis is also made using the clamped value.

6.13.2 G01 Constant-speed positioning at the speed specified in F

Code	G01	Linear interpolation is executed from the current position to the specified end point at the specified feed rate. (Constant-speed) The feed rate is specified at the linear speed (combined-speed) to the advance direction.
Function	Constant-speed positioning at the speed specified in F	

Format	G01␣X x␣Y y␣Z z␣F f ; f: Feed rate F: Feed rate command x, y, z: Positioning address X, Y, Z: Axis name

[Explanation]

(1) Since this command is a modal instruction, it is valid until another G-code in the same group is used. Therefore, when the next command is G01, if the feed rate is not changed, it is possible by specifying only the axis name.

(2) The command unit of feed rate is specified in the interpolation control unit of parameter block.

(3) The maximum command value of feed rate is the speed limit value set in the parameter block.

(4) If the F command is not set in the first G01 command, a program error will (error code : 501) occur.

(5) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

[Example] G01 X100. F200. ;
X150. ;

(6) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

(7) Specify G61 when making acceleration/deceleration at block switching.

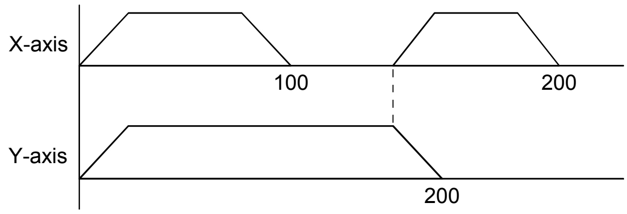
(8) If the G02 or G03 command is executed during the G01 command (Constant-speed positioning), a deceleration stop is not made.

[Example]
```
G01 X100. Y100. Z100. ;
G02 X0. Y0. I0. J50. F500. ;   } Constant-speed control is
G03 X0. Y0. I0. J50. F500. ;   } executed in this area.
G01 X100. ;
```

(9) Acceleration/deceleration processing of G01 command

G91 G01 X100. Y100. F100. ;	Constant-speed positioning of X, Y..... Block 1
Y100. ;	Constant-speed positioning of Y.......... Block 2
X100. ;	Constant-speed positioning of X..........Block 3

When the above program is executed, the acceleration/deceleration processing of the X and Y-axis is shown below.



(Note) : 1) Both the acceleration and deceleration times are the acceleration time of the parameter block.
2) When a M-code is commanded, G00 executes the acceleration/ deceleration in the same way as G01 at the acceleration time of the parameter block.

[Related Parameters]

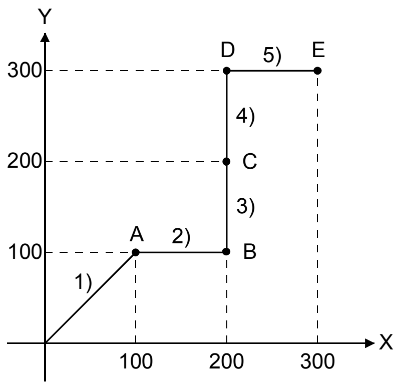
Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

[Program Example]

Program to execute positioning of A, B, C, D and E points. (Absolute value command)

1) G01 X100. Y100. F100. ; (A point positioning)
2) X200. ; (B point positioning)
3) Y200. ; (C point positioning)
4) G00 Y300. ; (D point positioning)
5) X300. ; (E point positioning)

2) to 4): Travel with G01 (Travel at feed rate of 100[mm/min])
5): Travel with G00



(Unit: mm)

6.13.3 G02 Circular interpolation CW (Central coordinates-specified)

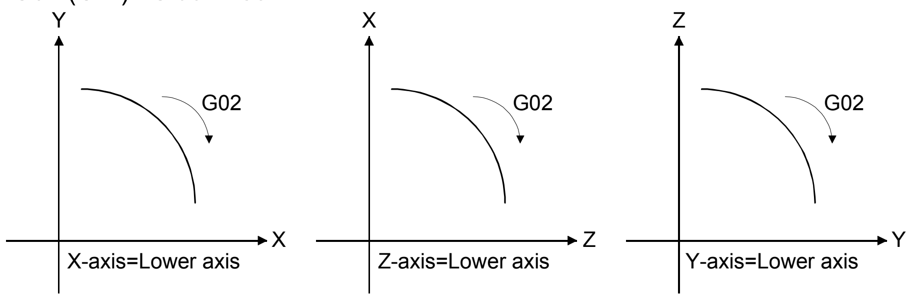
Code	G02	The axes travel from the current position (start point) to the specified coordinate position (end point) with a circular arc (CW). The travel speed is the specified feed rate.
Function	Circular interpolation (CW) Circular arc central coordinates-specified	

Format	G02␣X x␣Y y␣I i␣J j␣F f ; f: Feed rate F: Feed rate command I i␣J j: Circular arc center coordinates 1, 2 X x␣Y y: End point X, Y coordinates

[Explanation]

(1) The incremental values (always use incremental values) from the current position (start point) is used to command the circular arc center coordinates.
For G02 (CW), give the end point coordinates of the circular arc with the address (must be specified for 2 axes) and specify the central coordinates of circular arc with I and J.
The central coordinates 1, 2 are I and J in order of lower axis No.s.
[When X=Axis 1, Y=Axis 2, I=1(X), J=2(Y)
When X=Axis 2, Y=Axis 1, I=1(Y), J=2(X)]

(2) Always specify the end point coordinates for 2 axes as they cannot be omitted.
G02 (CW) : Clockwise



(3) If the end point is in the same position as the start point, the circular arc is 360° (complete round).

(4) If they cannot be linked by a circular arc,
Within the allowable error range for circular interpolation : The start and end points are connected by helical interpolation.
Beyond the allowable error range for circular interpolation : An error occurs at the circular arc start point.

(5) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(6) When the circular arc central coordinates and radius are specified simultaneously for G02 (CW), the central coordinates-specified circular interpolation has priority.

(7) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

[Related Parameters]

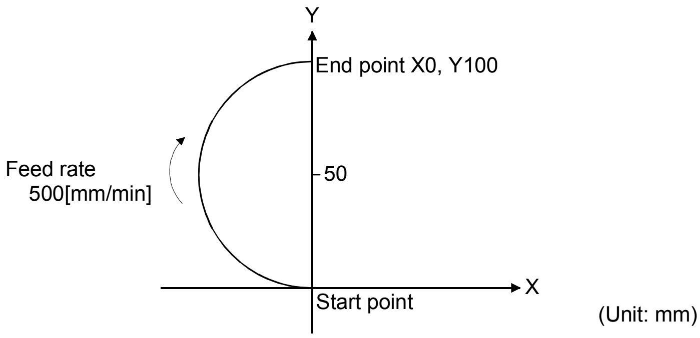
Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

Circular interpolation arc error : The permissible circular arc error range is set.
(Refer to Section 5.3.3 for the allowable error range for circular interpolation of the parameter block.)

[Program Example]

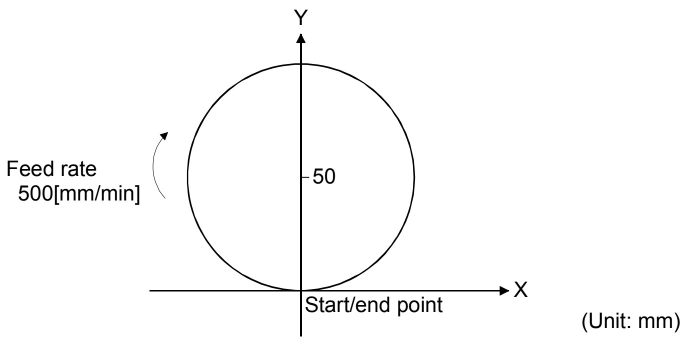
(1) The program which performs circular interpolation from the current position to draw a half circle.

G91 G02 X0. Y100. I0. J50. F500. ;



(2) The program which performs circular interpolation from the current value to draw a complete round.

G02 X0. Y0. I0. J50. F500. ; (Command for the complete round)



REMARK

(1) The end point and circular arc central coordinates cannot be omitted.
Always specify them for two axes.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation cannot be executed the combination of [mm] and [degree] or [inch] and [degree].

6.13.4 G03 Circular interpolation CCW (Central coordinates-specified)

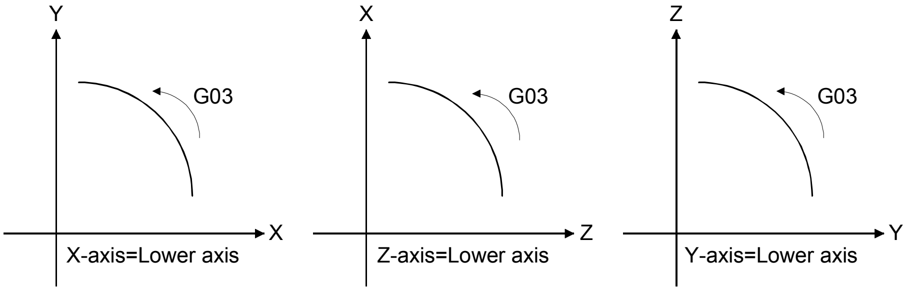
Code	G03	The axes travel from the current position (start point) to the specified coordinate position (end point) with a circular arc (CCW). The travel speed is the specified feed rate.
Function	Circular interpolation (CCW) Circular arc central coordinates-specified	

Format	G03␣X x␣Y y␣I i␣J j␣F f ; f: Feed rate F: Feed rate command I i␣J j: Circular arc center coordinates 1, 2 X x␣Y y: End point X, Y coordinates

[Explanation]

(1) The incremental values (always use incremental values) from the current position (start point) is used to command the circular arc center coordinates.
For G03 (CCW), give the end point coordinates of the circular arc with the address (must be specified for 2 axes) and specify the central coordinates of circular arc with I and J.
The central coordinates 1, 2 are I and J in order of lower axis No.s.
[When X=Axis 1, Y=Axis 2, I=1(X), J=2(Y)
When X=Axis 2, Y=Axis 1, I=1(Y), J=2(X)]

(2) Always specify the end point coordinates for 2 axes as they cannot be omitted.
G03 (CCW) : Counterclockwise



(3) If the end point is in the same position as the start point, the circular arc is 360° (complete round).

(4) If they cannot be linked by a circular arc,
Within the allowable error range for circular interpolation : The start and end points are connected by helical interpolation.
Beyond the allowable error range for circular interpolation : An error occurs at the circular arc start point.

(5) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(6) When the circular arc central coordinates and radius are specified simultaneously for G03 (CCW), the radius-specified circular interpolation has priority.

(7) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

[Related Parameters]

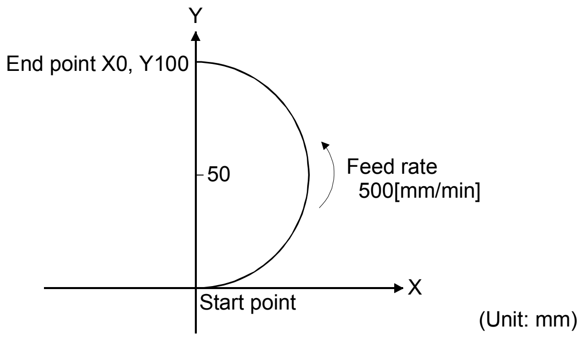
Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

Circular interpolation arc error : The allowable error range for circular interpolation is set.
(Refer to Section 5.3.3 for the allowable error range for circular interpolation of the parameter block.)

[Program Example]

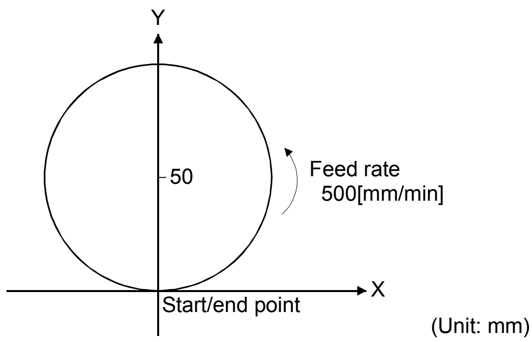
(1) The program which performs circular interpolation from the current position to draw a half circle.

G91 G03 X0. Y100. I0. J50. F500. ;



(2) The program which performs circular interpolation from the current value to draw a complete round.

G03 X0. Y0. I0. J50. F500. ; (Command for the complete round)



REMARK

(1) The end point and circular arc central coordinates cannot be omitted.
Always specify them for two axes.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.

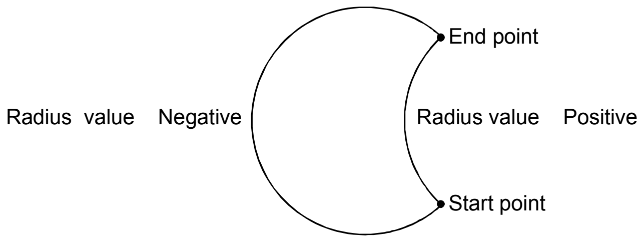
6.13.5 G02 Circular interpolation CW (Radius-specified)

Code	G02	The axes travel from the current position (start point) to the specified coordinate position (end point) with a circular arc of the specified radius (CW). The travel speed is the specified feed rate.
Function	Circular interpolation (CW) Radius-specified circular interpolation	

Format	G02␣X x␣Y y␣R r␣F f ; F f : Feed rate F : Feed rate command R r : Circular arc radius X x␣Y y : End point X, Y coordinates

[Explanation]

(1) A circular arc of more than 180° is drawn at a negative circular arc radius (R) value, or a circular arc of 180° or less is drawn at a positive R value.
Always use an incremental value to command the R value.



An error will occur if "the distance between start and end points" - radius × 2 > "circular arc error".

(2) If a complete round command (the start point is the same as the end point) is specified in R-specified circular interpolation, an error (error code : 108) will occur and no operation is performed. Therefore, specify the circular arc central coordinates-specified for the complete round command.

(3) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(4) When the circular arc central coordinates and radius are specified simultaneously for G02 (CW), the radius-specified circular interpolation has priority.

(5) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

[Related Parameters]

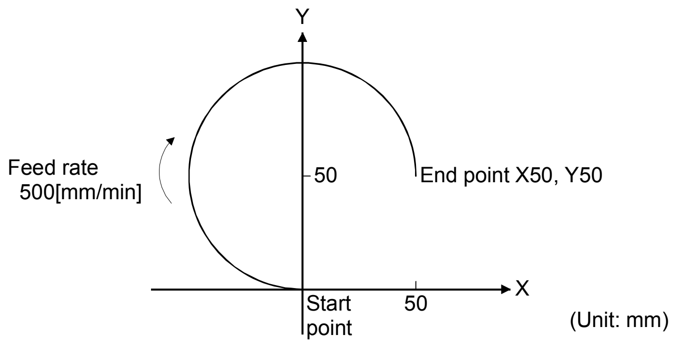
Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

Circular interpolation arc error : The allowable error range for circular interpolation is set.
(Refer to Section 5.3.3 for the allowable error range for circular interpolation of the parameter block.)

[Program Example]

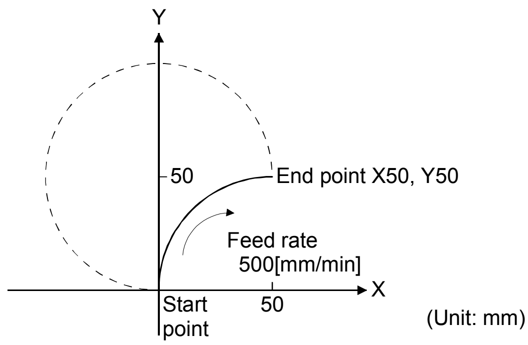
(1) The program which draws a circular arc of more than 180° at a negative circular arc radius (R) value.

G91 G02 X50. Y50. R-50. F500. ;



(2) The program which draws a circular arc of 180° or less at a positive circular arc radius (R) value.

G91 G02 X50. Y50. R50. F500. ;



REMARK

(1) The end point coordinates and circular arc radius cannot be omitted. Always specify the end point coordinates and circular arc radius.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.

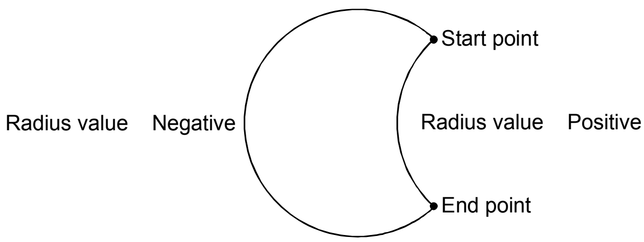
6.13.6 G03 Circular interpolation CCW (Radius-specified)

Code	G03	The axes travel from the current position (start point) to the specified coordinate position (end point) with a circular arc of the specified radius (CCW). The travel speed is the specified feed rate.
Function	Circular interpolation (CCW) Radius specified circular interpolation	

Format	G03␣X x␣Y y␣R r␣F f ; Feed rate Feed rate command Circular arc radius End point X, Y coordinates

[Explanation]

(1) A circular arc of more than 180° is drawn at a negative circular arc radius (R) value, or a circular arc of 180° or less is drawn at a positive R value.
Always use an incremental value to command the R value.



An error will occur if "the distance between start and end points" - radius × 2 > "circular arc error".

(2) If a complete round command (the start point is the same as the end point) is specified in R-specified circular interpolation, an error (error code : 108) will occur and no operation is performed. Therefore, specify the circular arc central coordinates for the complete round command.

(3) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(4) When the circular arc central coordinates and radius are specified simultaneously for G03 (CCW), the radius-specified circular interpolation has priority.

(5) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

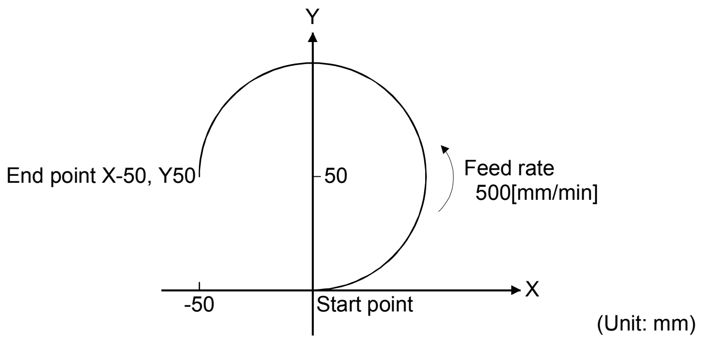
[Related Parameters]

Speed limit value	: The maximum feed rate of each axis is set. (Refer to Section 5.3.1 for the speed limit value of the parameter block.)
Circular interpolation arc error	: The allowable error range for circular interpolation is set. (Refer to Section 5.3.3 for the allowable error range for circular interpolation of the parameter block.)

[Program Example]

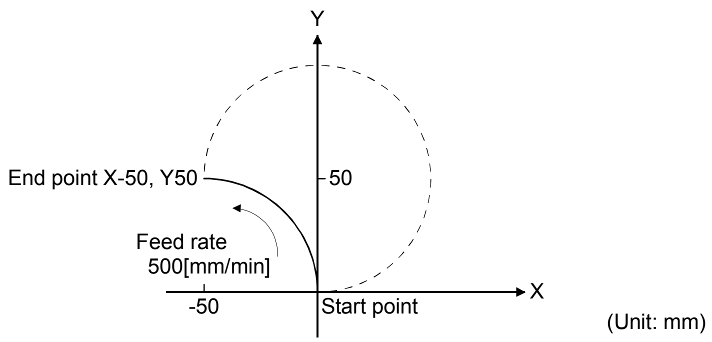
(1) The program which draws a circular arc of more than 180° at a negative circular arc radius (R) value.

G91 G03 X-50. Y50. R-50. F500. ;



(2) The program which draws a circular arc of 180° or less at a positive circular arc radius (R) value.

G91 G03 X-50. Y50. R50. F500. ;



REMARK

(1) The end point coordinates and circular arc radius cannot be omitted.
Always specify the end point coordinates and circular arc radius.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.

6.13.7 G04 Dwell

Code	G04	Execution of next block is waited for the specified period of time.
Function	Dwell	

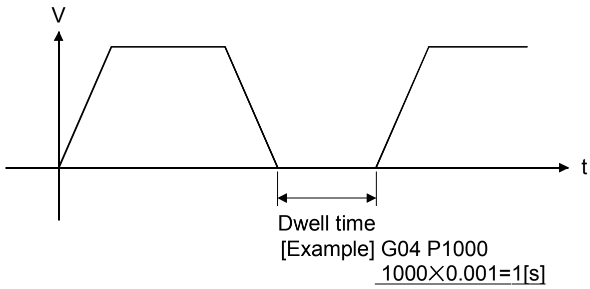
Format	G04␣P p;
	p: Dwell time (1 to 65535)

[Explanation]

(1) The time from after deceleration stop of the preceding travel command until the next block start is specified.

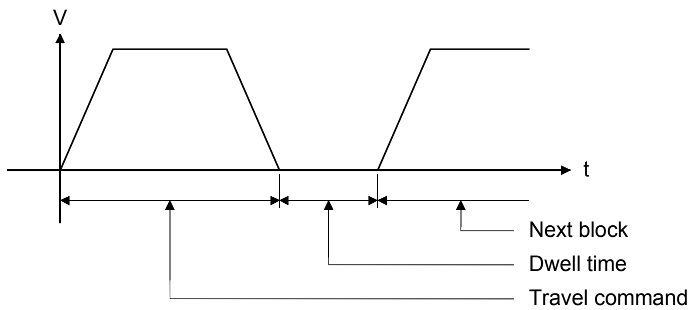
(2) The symbol indicating the dwell time is "P".

(3) The dwell time is specified within the range of 1 to 65535 in increments of 0.001[s].
Therefore, setting of G04 P1000 indicates a wait time of 1[s].



(4) The dwell time can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

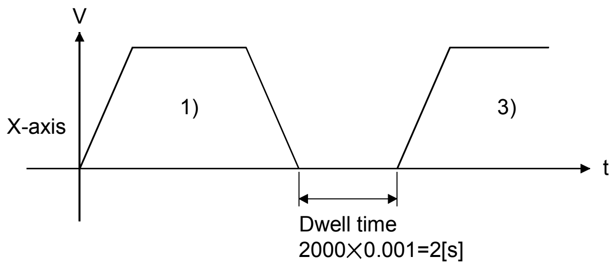
(5) When specifying dwell in the same block as the travel block, describe dwell after the travel command.
Also, describe the dwell time (P) after G04.
[Example]
G00 X100 Y100 G04 P2000;
- G04 P2000: Dwell command
- G00 X100 Y100: Travel command (G00, G01, G02, G03, G12 or G13 can be specified.)



[Program Example]

The program in which dwell time is placed between positioning operation instructions.

1) G01 X100. F10. ; (Positioning)
2) G04 P2000 ; (Dwell time set to 2[s])
3) G01 X200. ; (Positioning)



The X-axis is positioned to "100.", stops there for 2[s], and starts positioning operation to "200." again.

REMARK

(1) A decimal point cannot be specified for the dwell time.

(2) When an operation cycle (refer to Section 1.2.1) is 0.88[ms], the longest of dwell time is 58.253[s]. (Even if P58254 to P65535 is specified, it is clamped by 58.253[s].)
When an operation cycle is 0.44[ms], the longest of dwell time is 29.127[s].

6.13.8 G09 Exact stop check

Code	G09	The axes travel in the specified block point-to-point positioning.
Function	Exact stop check	

Format	G09␣G01␣X x␣F f ; May be used only in the G01, G02, G03, G12 or G13 program

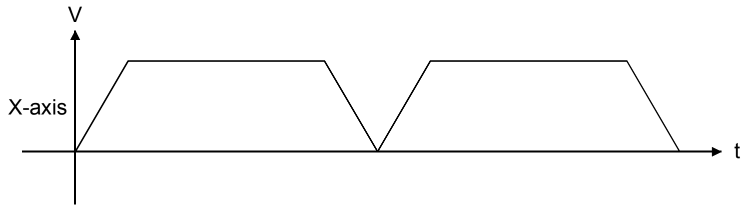
[Explanation]

(1) This command is used with the interpolation command. Executing this command travels point-to-point positioning in only the specified block.
The interpolation command codes usable with this command are G01, G02, G03, G12 and G13 only.

(2) In this system, the next block is executed after making a deceleration stop in the specified coordinate position.

(3) Not being a modal instruction, this command is valid for the specified block only.

<When an exact stop check is used>
G09 G01 X100. F300. ;
X200. ;



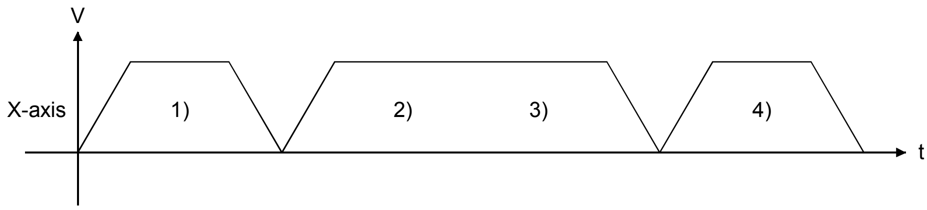
<When an exact stop check is not used>
G01 X100. F300. ;
X200. ;

(4) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #＊＊＊＊).

[Program Example]

The program which uses the exact stop check for positioning.

1) G09 G01 X100. F500. ; (Positioning by an exact stop check)
2) X200. ; (Positioning)
3) X300. ; (Positioning)
4) G09 G01 X400. ; (Positioning by an exact stop check)



6.13.9 G12 Helical interpolation CW (Helical central coordinates-specified)

Code	G12	The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular end address or linear axis end point address, and the helical interpolation (CW) is executed so that it may become a spiral course. The travel speed is the specified combined-speed for 2 axes circular interpolation axis.
Function	Helical interpolation (CW) Helical central coordinates-specified	

Format	G12␣X x␣Y y␣Z z␣I i␣J j␣P p␣F f ; f: Feed rate F: Feed rate command p: Number of pitches (0 to 999) P: Pitch command I i␣J j: Circular arc central coordinates 1, 2 (Relative address) Z z: Linear axis end point Z coordinates X x␣Y y: Circular interpolation axis end point X, Y coordinates

[Explanation]

(1) The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current value (start point) to circular interpolation axis end point address (X,Y) or linear axis end point address (Z), and the helical interpolation is executed so that it may become a spiral course.

(2) Always use the incremental values (relative address) from the current position (start point) to command the circular arc central coordinates.
An absolute values or incremental values of the circular interpolation axis end point (X,Y) and linear axis end point (Z) depends in the modal status (G90/G91) when executing the Motion program.

(3) Always specify the end point coordinates for 3 axes as they cannot be omitted.

(4) Only the number of times specified by the number of pitches around on the specified circle, and it is executed positioning to end point at the specified circular interpolation.

(5) The center coordinates-specified circle specifies circular interpolation method connected start point and end point at the seeing on the plane for which performs circular interpolation.

(6) The central coordinates 1, 2 are I and J in order of lower axis No.s by system setting.
[Example]
When X=Axis 1, Y=Axis 2, I=1(X), J=2(Y)
When X=Axis 2, Y=Axis 1, I=1(Y), J=2(X)

(7) The travel speed is the specified combined-speed for 2 axes circular interpolation axis.

(8) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(9) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #✻✻✻✻).

(10) If start point = end point, number of pitches = 1 and travel value of linear axis = 0, at the only central coordinates-specified helical interpolation, complete round can be drawn.

[Related Parameters]

Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

[Program Example]

```
G90  G00  X0.  Y0.  ;
G12  X100.  Y100.  Z100.  I50.  J50.  P2  F1000.  ;
```

REMARK

(1) The end point coordinates and circular arc central coordinates cannot be omitted.
Always specify the end point coordinates for 3 axes and the circular arc central coordinates for 2 axes.

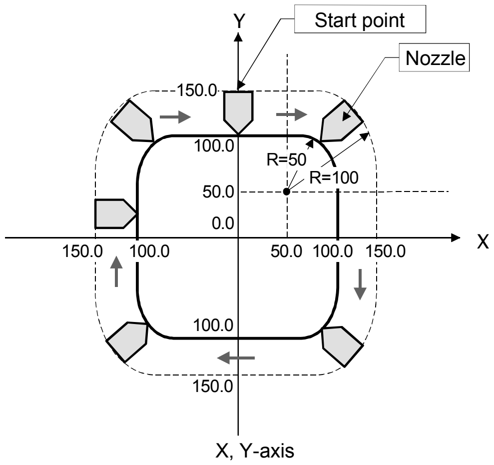
(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

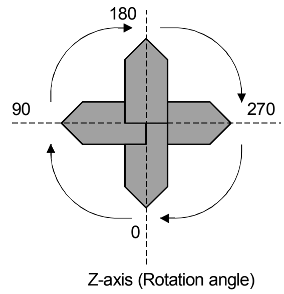
(3) Circular interpolation axis in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.
There is no restriction of the unit of the linear axis.

(4) When number of pitches is omitted, it is executed "number of pitches = 0".

(5) The error allowable range for circular interpolation cannot be setting.
(Invalid the error allowable range for circular interpolation of the parameter blocks. Therefore, the spiral interpolation cannot be executed in the error allowable range for circular interpolation.)

The example of the direction of the nozzle of controlling the normal for circular arc curve.





The program to start as the upper figure from start point and witch keeps a nozzle at right angles toward the contour of line and that it goes around the contour and witch is returned to start point. It is the following program when a helical interpolation function is used.

[Program Example]

```
G90  G00  X0.  Y150.  Z0. ;      ←  Travel to start point
G01  X50.  F1000. ;
G12  X150.  Y50.  Z90.  I0.  J-100.  P0  ;
G01  Y-50.  ;
G12  X50.  Y-150.  Z180.  I-100.  J0.  P0  ;
G01  X-50.  ;
G12  X-150.  Y-50.  Z270.  I0.  J100.  P0  ;
G01  Y50.  ;
G12  X-50.  Y150.  Z0.  I100.  J0.  P0  ;
G01  X0  ;
M02  ;
%
```

6.13.10 G13 Helical interpolation CCW (Helical central coordinates-specified)

Code	G13	The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular interpolation axis end point address or linear axis end point address, and the helical interpolation (CCW) is executed so that it may become a spiral course. The travel speed is the specified combined-speed for 2 axes circular interpolation axis.
Function	Helical interpolation (CCW) Helical central coordinates-specified	

Format	G13␣X x␣Y y␣Z z␣I i␣J j␣P p␣F f ; f: Feed rate F: Feed rate command p: Number of pitches (0 to 999) P: Pitch command I i, J j: Circular arc central coordinates 1, 2 (Relative address) Z z: Linear axis end point Z coordinates X x, Y y: Circular interpolation axis end point X, Y coordinates

[Explanation]

(1) The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular interpolation axis end point address (X,Y) or linear axis end point address (Z), and the helical interpolation control is executed so that it may become a spiral course.

(2) Always use the incremental values (relative address) from the current position (start point) to command the circular arc central coordinates.
An absolute values or incremental values of the circular interpolation axis end point (X,Y) and linear axis end point (Z) depends in the modal status (G90/G91) when executing the Motion program.

(3) Always specify the end point coordinates for 3 axes as they cannot be omitted.

(4) Only the number of times specified by the number of pitches around on the specified circle, and it is executed positioning to end point at the specified circular interpolation.

(5) The central coordinates-specified circle specifies circular interpolation method connected start point and end point at the seeing on the plane for which performs circular interpolation.

(6) The central coordinates 1, 2 are I and J in order of lower axis No.s by system setting.
[Example] When X=Axis 1, Y=Axis 2, I=1(X), J=2(Y)
When X=Axis 2, Y=Axis 1, I=1(Y), J=2(X)

(7) The travel speed is the specified combined-speed for 2 axes circular interpolation axis.

(8) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(9) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

(10) If start point = end point, number of pitches = 1 and travel value of linear axis = 0, at the only central coordinates-specified helical interpolation, complete round can be drawn.

[Related Parameters]

Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

[Program Example]

```
G90  G00  X0.  Y0.  ;
G13  X100.  Y100.  Z100.  I50.  J50.  P2  F1000.  ;
```

REMARK

(1) The end point coordinates and circular arc central coordinates cannot be omitted.
Always specify the end point coordinates for 3 axes and the circular arc central coordinates for 2 axes.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation axis in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.
There is no restriction of the unit of the linear axis.

(4) When number of pitches is omitted, it is executed "number of pitches = 0".

(5) The error allowable range for circular interpolation cannot be setting.
(Invalid the error allowable range for circular interpolation of the parameter blocks. Therefore, the spiral interpolation cannot be executed in the error allowable range for circular interpolation.)

6.13.11 G12 Helical interpolation CW (Helical radius-specified)

Code	G12	The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular interpolation axis end point address or linear axis end point address, and the helical interpolation (CW) is executed so that it may become a spiral course. The travel speed is the specified combined-speed for 2 axes circular interpolation axis.
Function	Helical interpolation (CW) Radius-specified helical interpolation	

Format	G12␣X x␣Y y␣Z z␣R r␣P p␣F f ; f: Feed rate F: Feed rate command p: Number of pitches (0 to 999) P: Pitch command R r: Circular arc radius Z z: Linear axis end point Z coordinates X x Y y: Circular interpolation axis end point X, Y coordinates

[Explanation]

(1) The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular interpolation axis end point address (X,Y) or linear axis end point address (Z), and the helical interpolation is executed so that it may become a spiral course.
An absolute values or incremental values of the circular interpolation axis end point (X,Y) and linear axis end point (Z) depends in the modal status (G90/G91) when executing the Motion program.

(2) Only the number of times specified by the number of pitches around on the specified circle, and it is executed positioning to end point at the specified circular interpolation.

(3) The radius-specified circle specifies circular interpolation method connected start point and end point at the seeing on the plane for which performs circular interpolation.

(4) A less than half-circle circular arc command is given at a positive R (circular arc radius) value, or a more than half-circle circular arc command is given at a negative R value. Always use an incremental value to command the R value.

(5) The travel speed is the specified combined-speed for 2 axes circular interpolation axis.

(6) If a complete round command (the start point is the same as the end point) is specified in R-specified helical interpolation, a minor error will (error code : 108) occur and no operation is performed. Therefore, specify the helical circular arc central coordinates for the complete round command.

(7) When this command is executed continuously, the acceleration or deceleration is not made at the start or end point of a block because the status is not the exact stop check mode.

(8) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #＊＊＊＊).

(9) If start point = end point, number of pitches = 1 and travel value of linear axis = 0, at the only center coordinates-specified helical interpolation, complete round can be drawn.

[Related Parameters]

Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

[Program Example]

```
G90  G00  X0.  Y0.  ;
G12  X100.  Y100.  Z100.  R100.  P2  F1000.  ;
```

REMARK

(1) The end point coordinates and circular radius cannot be omitted.
Always specify the end point coordinates for 3 axes and the circular radius.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation axis in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.
There is no restriction of the unit of the linear axis.

(4) When number of pitches is omitted, it is executed "number of pitches = 0".

(5) The allowable error range for circular interpolation cannot be setting.
(Invalid the allowable error range for circular interpolation of the parameter blocks. Therefore, the spiral interpolation cannot be executed in the allowable error range for circular interpolation.)

6.13.12 G13 Helical interpolation CCW (Helical radius-specified)

Code	G13	The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular interpolation axis end point address or linear axis end point address, and the helical interpolation (CW) is executed so that it may become a spiral course. The travel speed is the specified combined-speed for 2 axes circular interpolation axis.
Function	Helical interpolation (CCW) Radius-specified helical interpolation	

Format	G13␣X x␣Y y␣Z z␣R r␣P p␣F f ; f: Feed rate F: Feed rate command p: Number of pitches (0 to 999) P: Pitch command R r: Circular arc radius Z z: Linear axis end point Z coordinates X x␣Y y: Circular interpolation axis end point X, Y coordinates

[Explanation]

(1) The linear interpolation to other linear axis is executed performing 2 axes circular interpolation from the current position (start point) to circular interpolation axis end point address (X,Y) or linear axis end point address (Z), and the helical interpolation is executed so that it may become a spiral course.
An absolute values or incremental values of the circular interpolation axis end point (X,Y) and linear axis end point (Z) depends in the modal status (G90/G91) when executing the Motion program.

(2) Only the number of times specified by the number of pitches around on the specified circle, and it is executed positioning to end point at the specified circular interpolation.

(3) The radius-specified circle specifies circular interpolation method connected start point and end point at the seeing on the plane for which performs circular interpolation.

(4) A less than half-circle circular arc command is given at a positive R (circular arc radius) value, or a more than half-circle circular arc command is given at a negative R value. Always use an incremental value to command the R value.

(5) The travel speed is the specified combined-speed for 2 axes circular interpolation axis.

(6) If a complete round command (the starting point is the same as the end point) is specified in R-specified helical interpolation, a minor error will (error code : 108) occur and no operation is performed. Therefore, specify the helical circular arc central coordinates for the complete round command.

(7) When this command is executed continuously, the feed rate is not increased or decreased at the start or end point of a block since the status is not the exact stop check mode.

(8) The positioning data can be set by direct setting (numerical value) or indirect setting (variable : #＊＊＊＊).

(9) If start point = end point, number of pitches = 1 and travel value of linear axis = 0, at the only central coordinates-specified helical interpolation, complete round can be drawn.

[Related Parameters]

Speed limit value : The maximum feed rate of each axis is set.
(Refer to Section 5.3.1 for the speed limit value of the parameter block.)

[Program Example]

```
G90  G00  X0.  Y0.  ;
G13  X100.  Y100.  Z100.  R100.  P2  F1000.  ;
```

REMARK

(1) The end point coordinates and circular radius cannot be omitted.
Always specify the end point coordinates for 3 axes and the circular radius.

(2) Circular interpolation includes the [degree] axis whose stroke limit is set to be invalid cannot be executed.

(3) Circular interpolation axis in the unit combination of [mm] and [degree] or [inch] and [degree] cannot be executed.
There is no restriction of the unit of the linear axis.

(4) When number of pitches is omitted, it is executed "number of pitches = 0".

(5) The error allowable range for circular interpolation cannot be setting.
(Invalid the error allowable range for circular interpolation of the parameter blocks. Therefore, the spiral interpolation cannot be executed in the error allowable range for circular interpolation.)

6.13.13 G23 Cancel, cancel start invalid

Code	G23	G24 (cancel function, cancel start function) which has already been made valid is invalidated. Valid until G24 (cancel function, cancel start function) is executed.
Function	Cancel, cancel start invalid	

Format	G23 ;

[Explanation]

(1) This command makes invalid the cancel or cancel start function which has already been made valid.

(2) This function is also made valid for the high-speed oscillation axis.

```
N1 G24 CAN #X100 ;
N2 G01 X200. F200. ;                    Cancel function is valid for N2 and N3.
N3 G25 Y START90. STRK1. F10 ;
N4 G23 ; ----------------------------→ Cancel function is invalid
                                        (Cancel function is invalid for the high-
                                        speed oscillation axis.)
```

[Program Example]

The program which makes the cancel start function valid/invalid during execution of "O0010" program.

```
O0010
G24 CAN #X100 P100 PB1 ;   Execution of cancel start function
G90 G01 X200. F1000. ;
G23 ;                      Cancel start function invalid
```

6.13.14 G24 Cancel, cancel start

Code	G24	The executing program is cancel and the specified start program automatically starts. This function is valid until cancel or cancel start function invalid (G23) is executed.
Function	Cancel, cancel start	

Format	G24␣CAN␣#X x␣P n␣PBn ; PBn: Parameter block No. (Indirect setting is possible) P n: Start program No. (Indirect setting is possible) #X x: Cancel device (X, Y, M, B, F) CAN: Cancel designation

[Explanation]

(1) If the cancel device signal is turned ON during execution of this command, a deceleration stop is made and the executing program is cancel (cancel function). When the start program No. "Pn" has been set, after a deceleration stop by turning ON the cancel signal, the specified program automatically starts (cancel start function).

(2) This command cannot be used with the home position return (G28) instruction.

(3) In a waiting status for a restart (single block, M00, M01) during macro processing, this command is made valid after completion of processing.

(4) If the cancel device turns ON during travel block switching, a cancel start is made valid at the next travel block processing when there are no operating axes (no high-speed oscillation axes).

(5) The device "X, Y, M, B and F" can be used for cancel. By assigning the input signal for high-speed read function to the cancel device, response is made faster than the input from the PLC CPU.

(6) The setting range of program No. "Pn" for a start is 1 to 1024.

(7) The parameter block of start program can be set with "PBn". The setting range of parameter block No. "PBn" is 1 to 64. If the parameter block No. "PBn" is omitted or it is set the outside of setting range, parameter block No. 1 is fixed.

(8) The program No. "Pn" and parameter block No. "PBn" set for a start can be set by indirect setting with a variable, D, W, or # (2-word data).

(9) When G24 exists at any point between continuous constant-speed positioning blocks, a deceleration stop is made once.

```
N1  G24  CAN  #X100  ;              Cancel function for N1 is valid
N2  G01  X200.  F2000.  ;           until G24 or G23 is specified.
N3  X300.  Y200.  ;
N4  G24  CAN  #X101  ; ----------> Cancel function for N1 is invalid and a
                                    deceleration stop is made.
N5  G01  X50.  Y50  F1000.  ;       Cancel function for N4 is valid until G24 or
                                    G23 is specified.
```

(10) When G24 is executed after high-speed oscillation (G25), the high-speed oscillation axis also stops.

```
N1  G25  X  START90.  STRK1.  F10  ;
N2  G24  CAN  #X100  P100  ;         Cancel function for N2 is valid between
N3  G01  Y100.  Z100.  F1000.  ;     N3 and N5. Note that the high-speed
N4  G26  X  ;                        oscillation axis also stops if cancel is
N5  G01  X0.  Y0.  Z0.  F1000.  ;    made invalid in this area.
N6  G23  ;
```

(11) If the start program No. "Pn" is omitted (cancel function), the running program ends when the cancel device turns ON.

(12) When setting the start axes in the SVST instruction, also include the axis No. to be executed in the start program. Making a start turns ON the start acceptance flag of the set axis. The start acceptance flag turns OFF once at a cancel time, but it turns ON again when the axis is started in the original program at a start program run.

[Program Example]

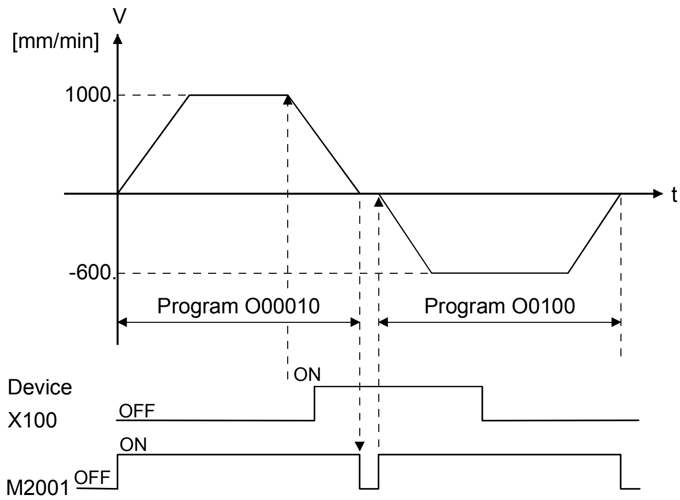
The program which cancels program operation during execution of "O0010" program and starts "O0100" program. (Command unit is [mm].)

O0010 ;

1) G24 CAN #X100 P100 PB1 ;	Execution of cancel start function
2) G90 G01 X200. F1000. ;	Cancel device X100 turns ON midway. After deceleration stop, O0100 starts.

O0100 ;

3) G90 G01 X50. F600. ;	X-axis travels to 50[mm] position at 600[mm/min].



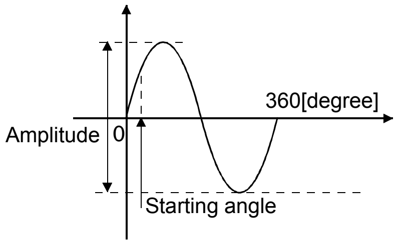
6.13.15 G25 High-speed oscillation

Code	G25	The specified axis oscillates in a Sine curve.
Function	High-speed oscillation	

Format	G25 X START s STRK a F f ; f: Frequency (Indirect setting is possible) F: Frequency designation (Indirect setting is possible) a: Amplitude (Indirect setting is possible) STRK: Amplitude designation s: Starting angle (Indirect setting is possible) START: Starting angle designation X: Axis name

[Explanation]

(1) The specified axis oscillates in a Sine curve.



Amplitude : The oscillating amplitude is specified in the setting unit. It can be specified indirectly with a variable, D, W, or # (2-word data). The setting range is 1 to 2147483647. If the setting is outside the range, a minor error will (error code : 585) occur and it cannot be started.

Starting angle : The start position with the angular position of a Sine curve is specified. It can be specified indirectly with a variable, D, W, or # (2-word data). Set it within the range of 0 to 359.9[degree] in 0.1[degree] increments. If the setting is outside the range, a minor error will (error code : 586) occur and it cannot be started.

Frequency : The number of cycles in which the axis will be operated for 1 minute in a Sine curve is specified. It can be specified indirectly with a variable, D, W, or # (2-word data). The setting range is 1 to 5000[CPM]. If the setting is outside the range, a minor error will (error code : 587) occur and it cannot be started.

(2) This command is valid for the specified block only (modal group (00)).

(3) After a start, operation continues until G26 high-speed oscillation stop is executed or the stop command is input.

(4) Acceleration/deceleration processing is not performed. When not making it start rapidly, set the starting angle to 90.0[degree] or 270.0[degree].

[Program Example]

The program in which the X-axis oscillates in the Sine curve of 10[mm] amplitude, 90 [degree] starting angle and 30[CPM] frequency.
(Command unit is [mm].)

```
G25 X START 90. STRK 10. F30 ;
```

(Note) : The starting angle (START) is valid to the first decimal place.

[Example] (1) START 90. .... Means 90.0[degree].

(2) START 90 .... Means 9.0[degree].

(3) In START #2010

#2010 = 900 .... Means 90.0[degree].

#2010 = 1 .... Means 0.1 [degree].

6.13.16 G26 High-speed oscillation stop

Code	G26	The high-speed oscillation of the axis which is performing high-speed oscillation is stopped.
Function	High-speed oscillation stop function	

Format	G26␣X; (X: Axis name)

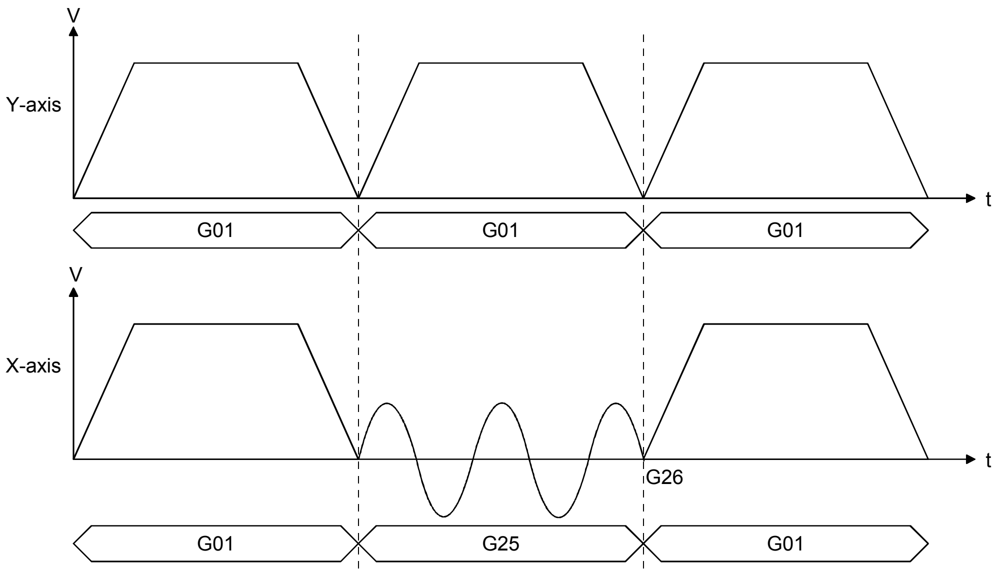
[Explanation]

(1) Stops the high-speed oscillation of the axis which is performing high-speed oscillation.

(2) Use this command in pairs with a high-speed oscillation start.
When the corresponding axis is not stopped up to a program END (M02, M30) after a high-speed oscillation start, high-speed oscillation is kept performed at a program END.
Also, do not set a stop to the axis which has not made a high-speed oscillation start. In that case, a minor error (error code : 582) is displayed and execution proceeds to the next block.

[Program Example]

```
N01 G91 G01 X10. Y10. F100. ;
N02 G25 X START 0. STRK 10. F100 ;
N03 G01 Y10. ;
N04 G26 X ;
N05 G01 X10. Y10. ;
M02 ;
```



If the start command of the X-axis (high-speed oscillation start axis) is described in the N03 block, a minor error (error code : 581) is displayed when this block is executed, and this program is suspended.

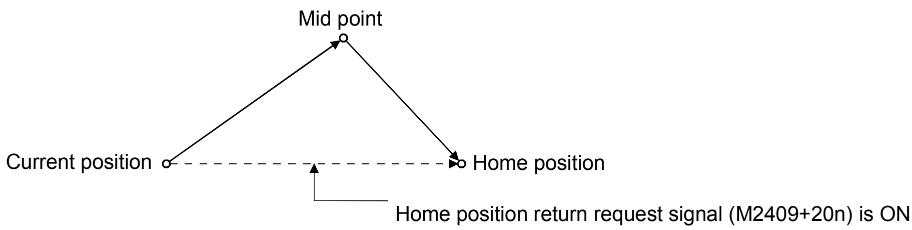
6.13.17 G28 Home position return

Code	G28	When the home position return request is ON, the mid point designation is ignored and a proximity dog, count, data set, dog cradle, stopper or limit switch combined type home position return. When the home position return request is OFF, the axis returns from the current position to the home position through the specified mid point at high-speed feed rate.
Function	Home position return	

Format	G28␣X x␣Y y␣Z z ; (X x␣Y y␣Z z: Mid point coordinates)

[Explanation]

(1) When the home position return request is ON, this command ignores a mid point and returns the specified axis to the home position. When the home position return request signal (M2409+20n) is OFF, this command positions the axis from the current position to the home position through the specified mid point at high-speed feed rate.



(2) The home position return method is determined by the home position return data at the home position return request ON.

(3) Be sure to set the axis which executes the home position return. The home position return is not executed without setting.

(4) Be sure to set the mid point coordinates.

(5) The mid point data setting can be made by direct setting (numerical value) or indirect setting (variable : #∗∗∗∗).

(6) The tool length offset and virtual mechanical coordinates (Refer to Section 6.13.29.) of the axis which executed the home position are cancel.
Mid point designation depends on the position command system (G90, G91) currently selected.

(7) When the control unit is [degree], operation from the mid point to the home position differs between the absolute value command (G90) and incremental value command (G91).
The axis travels in the nearest path under the absolute value command (G90), or in the direction specified in the home position return direction parameter under the incremental value command (G91).

(8) The following parameter blocks are used at the home position return (G28).
(a) Home position return request ON ..... Parameter block specified with home position return parameter.
(b) Home position return request OFF .... Parameter block at the axis specified program start.

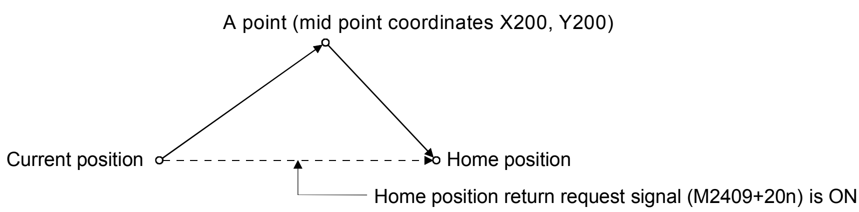
[Related Parameters]

Home position address : The current value of the home position is set.
(Refer to Section 7.3.1 Home position return data.)
High-speed feed rate : The high-speed feed rate of each axis is set.
(Refer to Section 5.2.5 High-speed feed rate setting.)

[Program Example]

The program which executes the home position return from the current position through the A point (mid point).

```
G90  ;
G28  X200.  Y200.  ;  (Home position return)
```



REMARK

When the G28 is commanded, a home position return is made at the high-speed feed rate.

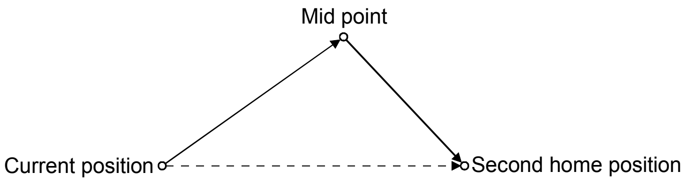
6.13.18 G30 Second home position return

Code	G30	The axis returns from the current position to the second home position through the specified mid point at the high-speed feed rate.
Function	Second home position return	

Format	G30␣X x␣Y y␣Z z ; Mid point coordinates

[Explanation]

(1) This command positions the specified axis from the current position to the second home position through the specified mid point at the rapid feed rate.



(2) Be sure to set the axis which executes the second home position return. The second home position return is not executed without setting.

(3) Be sure to set the mid point coordinates.

(4) The mid point data setting can be made by direct setting (numerical value) or indirect setting (variable : #✻✻✻✻).

(5) The tool length offset and virtual mechanical coordinates (Refer to Section 6.13.29) of the axis which executed the second home position are cancel.
Mid point designation depends on the position command system (G90, G91) currently selected.

(6) When the control unit is [degree], operation from the mid point to the second home position differs between the absolute value command (G90) and incremental value command (G91).
The axis travels in the nearest path under the absolute value command (G90), or in the direction specified in the home position return direction parameter under the incremental value command (G91).

[Related Parameters]

Second home position address : The current value of the second home position is set.
(Refer to Section 7.3.1 Home position return data.)

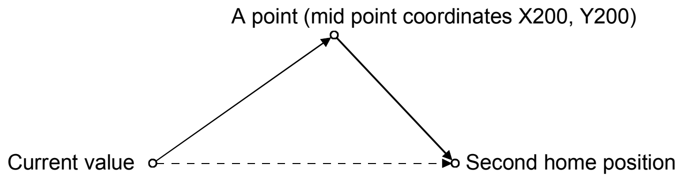
High-speed feed rate : The high-speed feed rate of each axis is set.
(Refer to Section 5.2.5 High-speed feed rate setting.)

[Program Example]

The program which executes the second home position return from the current position through the A point (mid point).

G90 ;

G30 X200. Y200. ; (Second home position return)



REMARK

When the G30 command is given, a second home position return is executed at high-speed feed rate.

6.13.19 G32 Skip

Code	G32	The axis travels at the specified feed rate, the remaining command is suspended at the input of an external signal, and the next block is executed. Dwell is skipped for the dwell command.
Function	Skip	

Format	<When axis specified> G32␣X x␣Y y␣F f␣SKIP␣#Xx ; Skip device (X, Y, M, B, F) Skip command Feed rate (Indirect setting is possible) Feed rate command Positioning address (Indirect setting is possible) Axis name <When dwell is specified> G32␣P p␣SKIP␣#Xx ; Skip device (X, Y, M, B, F) Skip command Dwell time Dwell command

[Explanation]

(1) When the skip signal is entered during execution of G32, the remaining command of that block is suspended and the next block is executed. Dwell may also be skipped by giving the dwell command (P) in the G32 block without specifying the axis.

(2) A format error occurs if the axis command or M-code and the dwell command are described simultaneously.

(3) The setting range of dwell time is 1 to 65535 in increments of 0.001[s].

(4) Specify the skip signal in the program.

(5) The skip function makes a skip at the skip signal ON.

(6) This command is valid for the specified block only (modal group (00)). The interpolation type of this command is the constant-speed positioning command.

(7) When the skip signal is not input until the end point of this command block, the block completes at the end point.

(8) For dwell/skip, the block completes on completion of the dwell processing.

(9) The absolute circular interpolation or the absolute helical interpolation of the next block cannot be executed.

(10) The F command is handled like G01.

(11) The coasting value δ_A between skip signal detection and a stop is represented by the following expression.

$$\delta_A \text{ [mm]} = \frac{F}{60} \left(t1 + \frac{tc1}{2} + Tr \right)$$

F : Command speed [mm/min]
t1 : Signal input delay time = operation cycle + Detection delay time [s]
tc1 : Acceleration/deceleration time [s]
Tr : Position loop time constant [s]
(Reciprocal number of position control gain value set in servo parameter. When position control gain = 25, Tr = 1/25 = 0.04 [s])

(12) Under the following conditions, G32 makes deceleration stop once, then proceeds to the next block.

(a) When the point-to-point positioning command (G00, G25, G28, G30 or the like) is executed after the G32 block

```
N10 G32 X100. F1000. SKIP #X10 ;
N20 G00 X200. ;  ──────────→ Deceleration stop is made before this block.
N30 G32 X300. F1000. SKIP #X11 ;
```

(b) High-speed oscillation stop (G26) is executed after the G32 block

```
N10 G25 Y START 90. STRK 1. F400. ;
N20 G32 X100. F1000. SKIP #X10 ;
N30 G26 Y ;  ──────────→ Deceleration stop is made before this block.
G32 X200. F1000. SKIP #X11 ;
```

(c) When the absolute value command (G90) or incremental value command (G91) is executed after the G32 block

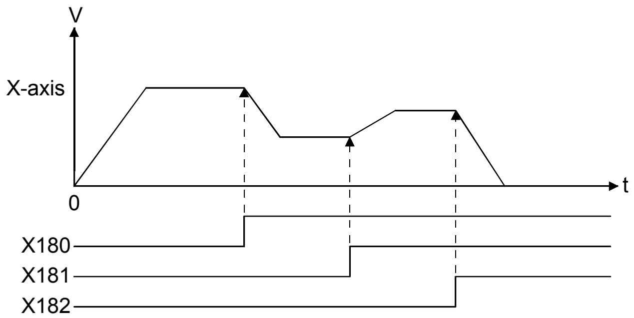
```
N10 G90 ;
N20 G32 X100. F1000. SKIP #X10 ;
N30 G91 ;  ──────────→ Deceleration stop is made before this block.
N40 G32 X200. Y200. F1000. SKIP #X11 ;
```

(d) When the block immediately after G32 is in the constant-speed positioning command but its command axes do not include the specified axis of the G32 block

```
N10 G32 X100. F1000. SKIP #X10 ;
N20 G32 Y100. Z100. F1000. SKIP #X11 ;  ──→ Deceleration stop is made before this block.
```

[Program Example]

(1) The program designed to make multiple skips under the control of external skip signals specified from the program midway through positioning.
(Under incremental value command)
- G91 ;
- G32 X100. F2000 SKIP #X180 ; Turns ON the X180 signal midway.
- G32 X100. F1000 SKIP #X181 ; Turns ON the X181 signal midway.
- G32 X200. F1500 SKIP #X182 ; Turns ON the X182 signal midway.



(2) Under dwell command
If cancel device X100 turns ON during dwell in N01, G0 in N02 where dwell was suspended is executed.
N01 G32 P1000 SKIP #X100 ;
N02 G90 G0 X100. ;

⚠ CAUTION

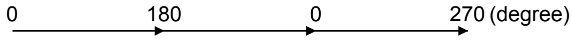
The following operation assumes that a skip (G32) is specified during constant-speed control (G01) and the [degree] axis without a stroke range is included.
When an absolute value command exists after a skip under this condition, the last positioning point and the travel distance in the whole program are the same independently of whether a skip is executed or not. This is indicated by the following example.

(1) When the skip instruction is an incremental value command and subsequent instructions are also incremental value commands

<Program example>

```
G91 ;
G32 X180. SKIP#X100 F10. ;
G01 X180. ;
G01 X270. ;
```

<Motion without a skip>



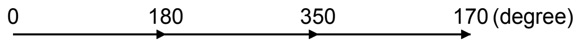
<Motion with a skip>
(When a skip is made at 100 (degree))

(2) When the skip instruction is an absolute value command and subsequent instructions are also absolute value commands

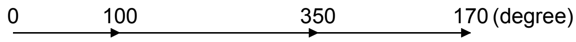
<Program example>

```
G90 ;
G32 X180. SKIP#X100 F10. ;
G01 X350. ;
G01 X170. ;
```

<Motion without a skip>



<Motion with a skip>
(When a skip is made at 100(degree))



Even if a skip is not executed, the last positioning point is the same.

(Note) : The above explanation is valid until a deceleration stop (constant-speed positioning command to point-to-point positioning command, etc.) after skip (G32). After a deceleration stop, operation of the normal [degree] axis is performed. The conditions of deceleration stop after a skip (G32) are shown below. Refer to "6.13.19 G32 Skip" for details.

1) When the point-to-point positioning command (G00, G25, G28, G30 or the like) is executed after the G32 block.
2) When the high-speed oscillation stop (G26) is executed after the G32 block.
3) When the absolute value command (G90) or incremental value command (G91) is executed after the G32 block.
4) When the block immediately after G32 is in the constant-speed positioning command but its command axes do not include the specified axis of the G32 block.

6.13.20 G43 Tool length offset (+)

Code	G43	The axis travels with the preset offset value added to the travel command. By setting a difference between the tool length value and actual tool length as the offset value, a program can be created without being aware of the tool length.
Function	Tool length offset (+)	

Format	G43␣X x␣H h ; H h — Offset data number x — Positioning address X — Axis name

[Explanation]

(1) By executing this command, the axis travels to the position which results from adding the offset value set in the tool length offset data setting registers to the end position of the travel command.

(2) In the following cases, the tool length offset command is cancel.

G49 ; —— Tool length offset cancel command
G43 H0 ;
G44 H0 ; —— Set the offset data No. 0 to cancel the tool length offset.

(3) This command can be set to one axis only. If two or more axes are commanded simultaneously, it is valid for the last specified axis.

G43 X1. Y1. Z1. H1 ; —— Z-axis is valid.
If no axis is specified, the last specified axis is made valid.
G01 Z1 ;
G43 H1 ; —— Z-axis is valid.

(4) As this command is a modal instruction, the offset value is retained until the offset value is cancel (G49).

(5) Tool length offset can be made to only one axis simultaneously. (Both G43 and G44)

•
•
•

G43 X100. H1 ;
G43 Y100. H2 ; ← Cannot be used this way.

[Related Parameters]

Tool length offset value : Set in the tool length offset data setting registers.
(Refer to Section 4.2.6.)

[Program Example]

The program for which executes the positioning added the offset value to the command position. (For absolute value command)
(Data of the tool length offset data setting registers are as follows :
H1 = 5[mm] (D1650, 1651 = 50000), H2 = 10[mm] (D1652, 1653 = 100000))

G90 ;	(Absolute value command)
G00 G43 X50. H1 ;	(With the addition of the offset value of 5[mm], X-axis is positioned to its 55[mm] position)
G01 X25. F500. ;	(X-axis travels to its 30[mm] position at 500[mm/min].)
Y100. ;	(Y-axis travels to its 100[mm] position at 500[mm/min].)
G43 X200. H2 ;	(With the addition of the offset value of 10[mm], X-axis travels to its 210[mm] position (offset value change))

6.13.21 G44 Tool length offset (-)

Code	G44	The axis travels with the preset offset value subtracted from the travel command. By setting a difference between the tool length value and actual tool length as the offset value, a program can be created without being aware of the tool length.
Function	Tool length offset (-)	

Format	G44␣X x␣H h ; H h — Offset data number x — Positioning address X — Axis name

[Explanation]

(1) By executing this command, the axis travels to the position which results from subtracting the offset value set in the tool length offset data setting registers from the end position of the travel command.

(2) In the following cases, the tool length offset command is cancel.

G49 ; ——— Tool length offset cancel command
G43 H0 ;
G44 H0 ; ——— Set the offset data No. 0 to cancel the tool length offset.

(3) This command can be set to one axis only. If two or more axes are commanded simultaneously, it is valid for the last specified axis.

G44 X1. Y1. Z1. H1 ; ——— Z-axis is valid.
If no axis is specified, the last specified axis is made valid.
G01 Z1 ;
G44 H1 ; ——— Z-axis is valid.

(4) As this command is a modal instruction, the offset value is retained until the offset value is cancel (G49).

(5) Tool length offset may be made to only one axis simultaneously. (Both G43 and G44)

•
•
•

G44 X100. H1 ;
G44 Y100. H2 ; ←—— Cannot be used this way.

[Related Parameters]

Tool length offset value : Set in the tool length offset data setting registers.
(Refer to Section 4.2.6.)

[Program Example]

The program for which executes the positioning subtracted the offset value from the command position. (For absolute value command)
(Data of the tool length offset data setting registers are as follows :
H1 = 5[mm] (D1650, 1651 = 50000), H2 = 10[mm] (D1652, 1653 = 100000))

G90 ;	(Absolute value command)
G00 G44 X50. H1 ;	(With the addition of the offset value of 5[mm], X-axis is positioned to its 45[mm] position)
G01 X25. F500. ;	(X-axis travels to its 20[mm] position at 500[mm/min].)
Y100. ;	(Y-axis travels to its 100[mm] position at 500[mm/min].)
G44 X200. H2 ;	(With the addition of the offset value of 10[mm], X-axis travels to its 190[mm] position (offset value change))

6.13.22 G49 Tool length offset cancel

Code	G49	The preset tool length offset value (G43, G44) is cancel.
Function	Tool length offset cancel	

Format	G49␣X x ; x: Positioning address X: Axis name

[Explanation]

(1) This command cancels the preset tool length offset value (G43, G44) and performs the specified positioning.

(2) Be sure to set the positioning address for tool length offset cancel.

[Related Parameters]

Power-on mode : At power-on, the tool length offset cancel mode is established.

[Program Example]

The program designed to cancel the offset value and perform the specified positioning after positioning has been executed by tool length offset. (For absolute value command) (Data of the tool length offset data setting registers are as follows : H1 = 5[mm] (D1650, 1651 = 50000), H2 = 10[mm] (D1652, 1653 = 100000))

G90 ;	(Absolute value command)
G00 G43 X50. H1 ;	(With the addition of the offset value of 5[mm], X-axis is positioned to its 55[mm] position)
G01 X25. F500. ;	(X-axis travels to its 30[mm] position at 500[mm/min].)
Y100. ;	(Y-axis travels to its 100[mm] position at 500[mm/min].)
G43 X200. H2 ;	(With the addition of the offset value of 10[mm], X-axis travels to its 210[mm] position (offset value change))
G49 X100. ;	(With the offset value canceled, X-axis travels to its 100[mm] position at 500[mm/min].)

6.13.23 G53 Mechanical coordinate system selection

Code	G53	The axis travels to the command position of basic mechanical coordinate system at the high speed feed rate.
Function	Mechanical coordinate system selection	

Format	G53␣X x␣Y y␣Z z ; X x␣Y y␣Z z: Coordinates in basic mechanical coordinate system

[Explanation]

(1) The basic mechanical coordinate system represents the position determined for a specific machine (e.g. tool changing position, stroke end position).
It is automatically set relative to the predetermined reference point after a home position return is executed by the CHGA instruction at power-on.

(2) Not being a modal instruction, the specified block only is valid.

(3) When G53 and G28 are specified in the same block, the latter command is valid.
G53 G28 .... ; ——— G28 is valid (home position return command)
G28 G53 .... ; ——— G53 is valid (mechanical coordinate system selection command)

(4) When G53 and G30 are specified in the same block, the latter command is valid.
G53 G30 .... ; ——— G30 is valid (second home position return command)
G30 G53 .... ; ——— G53 is valid (mechanical coordinate system selection command)

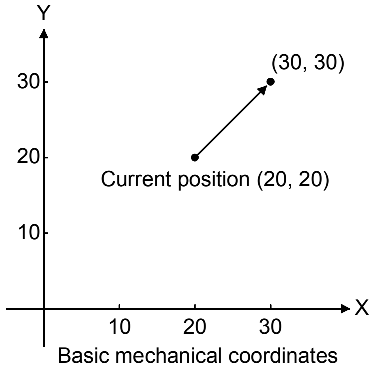
(5) The offset specified in G92 is invalid.

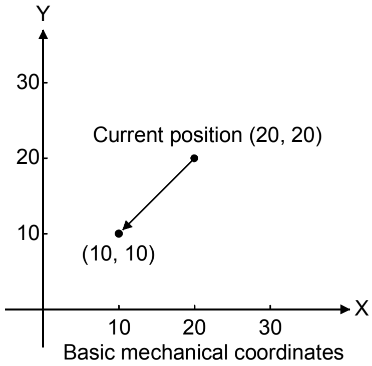
(6) The tool length offset specified in G43 or G44 is invalid.

(7) Under the incremental value command (G91), the axes travel at the incremental value of the mechanical coordinate system, and under the absolute value command (G90), the axes travel at the absolute value of the mechanical coordinate system.

[Example]

G91 ; (Incremental value command)	G90 ; (Absolute value command)
G53 X10. Y10. ;	G53 X10. Y10. ;



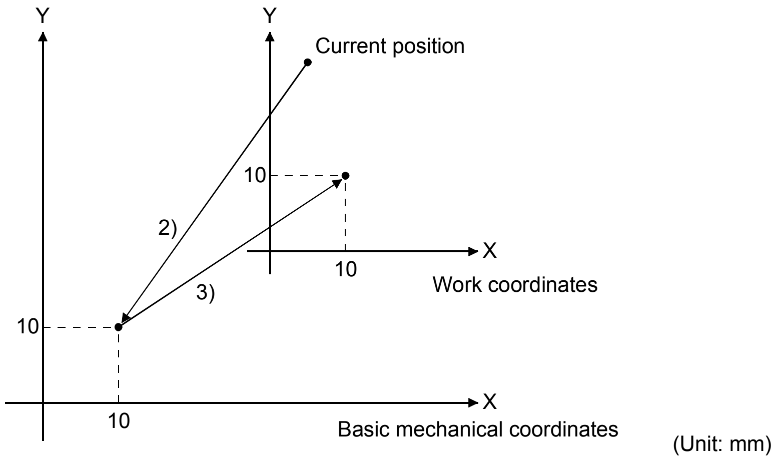


(8) Positioning data can be set by direct setting (numerical value) or indirect setting (variable : #＊＊＊＊).

[Program Example]

The program designed to position the axes to the specified position in the work coordinate system after positioning them to the specified position in the basic mechanical coordinate system in the absolute value mode.

1) G90 ; (Absolute value command)
2) G53 X10. Y10. ; (Axes travel to X10. Y10. in the basic mechanical coordinates)
3) G01 X10. Y10. F20. ; (Axes travel to X10. Y10. in the work coordinates)



REMARK

Travel by G53 is processed by G00. (The modal group (01) is not changed.)

6.13.24 G54 to G59 Work coordinate system selection

Code	G54, G55, G56, G57, G58, G59	The work coordinate system is selected and the axes travel to the specified position in the work coordinates system at the speed specified in the feed rate.
Function	Work coordinate system 1 to 6 selection	

Format	G54␣X x␣Y y␣Z z ; to G59 (X x␣Y y␣Z z: Positioning located in specified work coordinates system)

[Explanation]

(1) Work coordinate systems 1 to 6 are coordinates systems specified in the parameters or work coordinates system setting.
The offset value in the work coordinates system is set using the distance from the basic mechanical coordinates system origin (0).

(2) The coordinates system of G54 is selected at a Motion program start.

(3) As the work coordinates systems 1 to 6 is modal instruction, it is valid until the next work coordinate system 1 to 6 selection is commanded.

(4) If G92 is commanded in any of the G54 to G59 modes, a new work coordinates system can be set.
If G92 is commanded, all work coordinates systems (1 to 6) travel in parallel.

<Work coordinates system selection>
G54 Xx Yy Zz ;

<Work coordinates system change>
G54 G92 Xx Yy Zz ; ....Work coordinates 2 to 6 also travel in parallel similarly.

(5) Positioning data can be set by direct setting (numerical value) and indirect setting (variable : #∗∗∗∗).

[Related Parameters]

Work coordinates system offset value : Specify the offset in the work coordinates system using the distance from the basic mechanical coordinates. (Refer to Section 5.4 for the work coordinate data.)
Up to six work coordinates systems can be set. (Work coordinates systems 1 to 6)

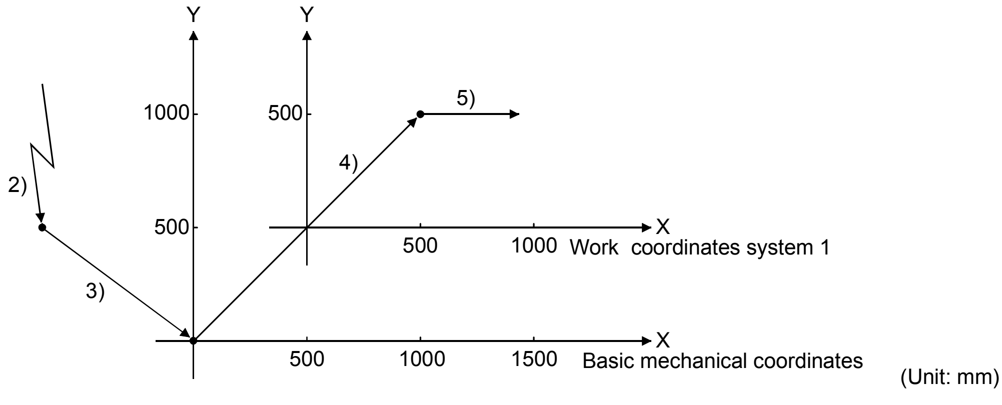
[Program Example]

<Work coordinates system selection>

The program for which executes the positioning to the specified position in the work coordinates system 1.

(The offset of the work coordinates system 1 is X500, Y500)

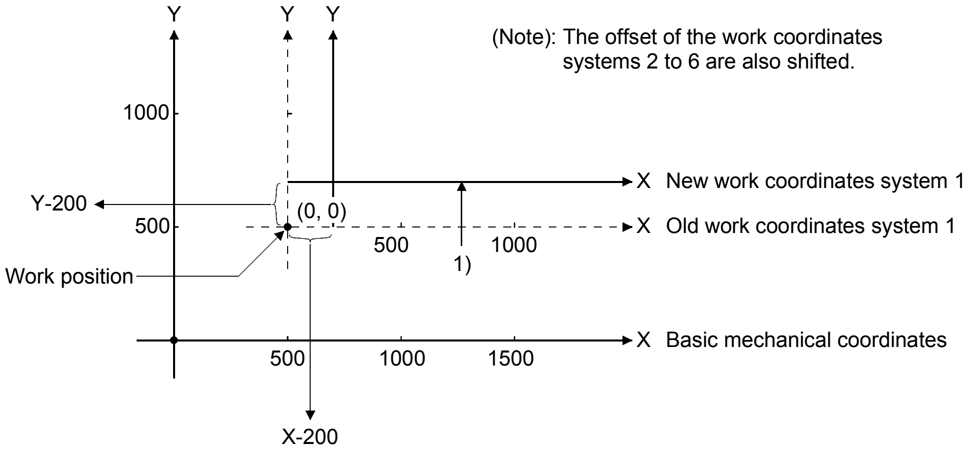
1) G90 ; (Absolute value command)
2) G28 X0. Y0. ; (Home position return)
3) G53 X0. Y0. ; (Axes travel to the basic mechanical coordinates home position)
4) G54 X500. Y500. ; (Axes travel to the specified position in the work coordinates system 1)
5) G91 G01 X500. F10. ; (Incremental value command positioning)



<Work coordinates system change>

The program for which set the offset of the work coordinates system 1 to X500, Y500 in the parameter setting of work coordinates data, then change the work coordinates system to new work coordinates system 1.

1) G54 G92 X-200. Y-200. ; (New work coordinates system 1 setting)
   (After execution of 1), the current value is changed to X-200, Y-200.)



6.13.25 G61 Exact stop check mode

Code	G61	It travels in the point-to-point positioning (PTP).
Function	Exact stop check mode	

Format	G61 ;

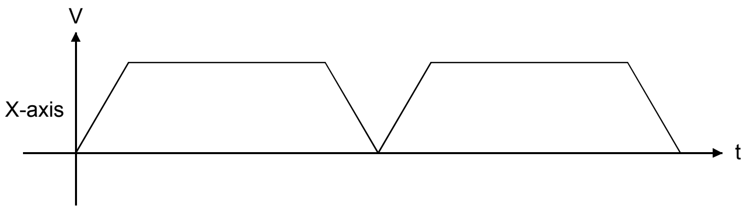
[Explanation]

(1) This command is used with the interpolation command. Executing this command travels in the point-to-point positioning.
The interpolation command codes usable with this command are G01, G02, G03, G12 and G13 only.

(2) In this system, the next block is executed after deceleration stop for every specified coordinates.

(3) As this command is modal command, it is valid until the cutting mode (G64) is commanded.

<In exact stop check mode>
G61 G01 X100. F500. ;
X200. ;

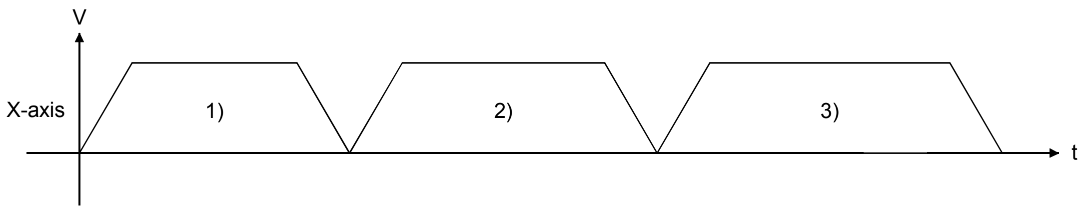


<Not in exact stop check mode>
G01 X100. F500. ;
X200. ;

[Program Example]

The program for which executes the positioning in the exact stop check mode.

1) G61 G01 X100. F500. ; (Positioning in the exact stop check mode)
2) X200. ; (Positioning in the exact stop check mode)
3) X300. ; (Positioning in the exact stop check mode)



REMARK

Only the high-speed feed rate may be the specified speed in G00. To specify the speed every time point-to-point positioning is executed, you can use G61 and G01.

6.13.26 G64 Cutting mode

Code	G64	The next block continuously executes without deceleration stop between cutting feed blocks.
Function	Cutting mode	

Format	G64 ;

[Explanation]

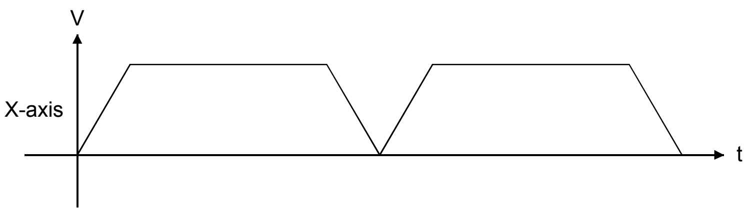
(1) This command is used to execute the positioning to the specified coordinates position approximately. It operates continuously without deceleration stop for every specified coordinates as the exact stop check mode.
Use this command to make a smooth connection with the interpolation command (G01, G02, G03, G12, G13).

(2) The cutting mode is selected at a Motion program start.

(3) As this command is modal instruction, it is valid until the exact stop check mode (G61) is commanded.

<In cutting mode>
G64 G01 X100. F500. ;
X200. ;

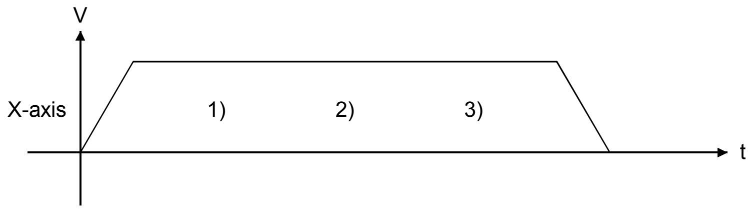
<Not in cutting mode>
G61 G01 X100. F500. ;
X200. ;



[Program Example]

The program for which executes the positioning in the cutting mode.

1) G64 G01 X100. F500. ; (Positioning in the cutting mode)
2) X200. ; (Positioning in the cutting mode)
3) X300. ; (Positioning in the cutting mode)



6.13.27 G90 Absolute value command

Code	G90	The coordinates command is set as an absolute value command.
Function	Absolute value command	

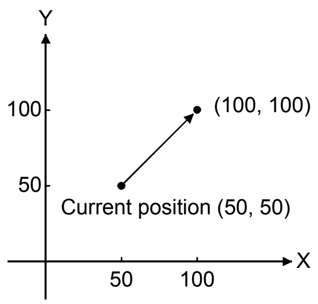
Format	G90␣X x␣Y y␣Z z ; Locating position

[Explanation]

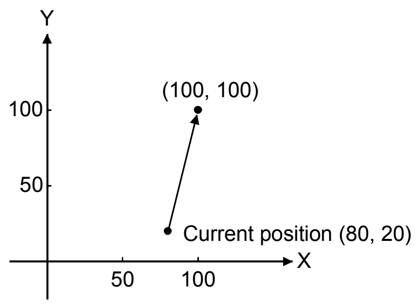
(1) In the absolute value command mode, the axes travel to the specified coordinates position regardless of the current position. The positioning command set after execution of this command operates with the absolute value from the home position coordinates.

(2) As this command is modal instruction, it is valid until the incremental value command mode (G91) is commanded.

(3) The absolute value command mode is selected at a Motion program start.
[Example] G90 X100. Y100. ;



Current position coordinates of X50, Y50



Current position coordinates of X80, Y20

(Unit: mm)

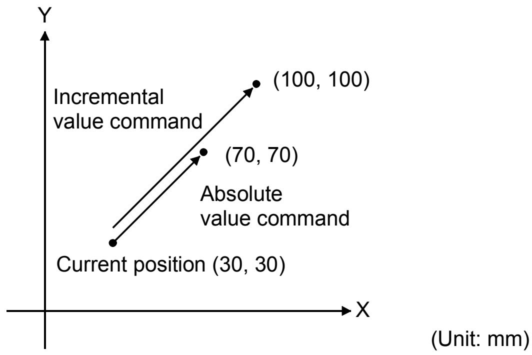
(4) Positioning data can be set by direct setting (numerical value) and indirect setting (variable : #＊＊＊＊).

[Program Example]

Example of comparison between the absolute value command and incremental value command

<Incremental value command>
G91 X70. Y70. ;

<Absolute value command>
G90 X70. Y70. ;



6.13.28 G91 Incremental value command

Code	G91	The coordinates command is set as an incremental value command.
Function	Incremental value command	

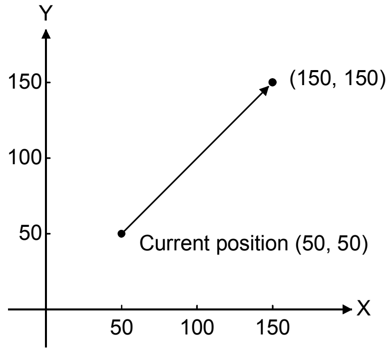
Format	G91␣X x␣Y y␣Z z ; Locating position

[Explanation]

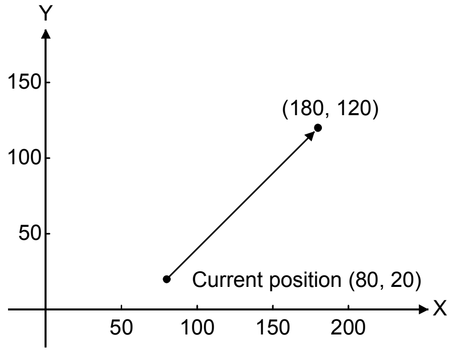
(1) In the incremental value command mode, the axes travel the distance of the specified relative value from the start point (0) of the current position.
The positioning command set after execution of this command operates with the incremental value from the current position.

(2) As this command is modal instruction, it is valid until the absolute value command mode (G90) is commanded.

(3) The absolute value command mode is selected at a Motion program start.
[Example] G91 X100. Y100. ;



Current position coordinates of X50, Y50



Current position coordinates of X80, Y20

(Unit: mm)

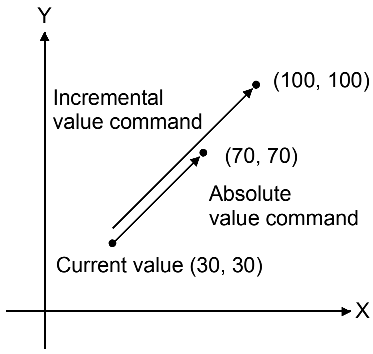
(4) Positioning data can be set by direct setting (numerical value) and indirect setting (variable : #∗∗∗∗).

[Program Example]

Example of comparison between the incremental value command and absolute value command

<Incremental value command>
G91 X70. Y70. ;

<Absolute value command>
G90 X70. Y70. ;



(Unit: mm)

6.13.29 G92 Coordinates system setting

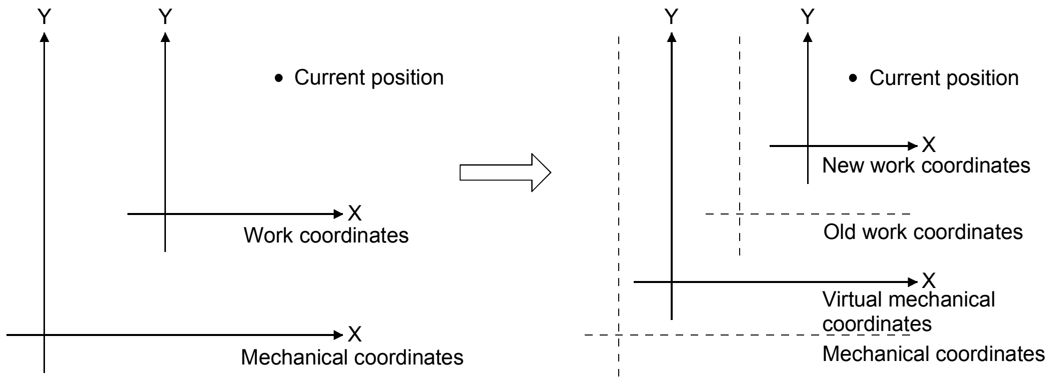
Code	G92	The mechanical coordinates (virtual mechanical coordinates) is set simulatively. Setting the virtual mechanical coordinate system also changes the work coordinates systems 1 to 6.
Function	Coordinates system setting	

Format	G92␣X x␣Y y␣Z z ; Setting coordinate value (Set the offset from the current position)

[Explanation]

(1) The current position in the work coordinate system is changed to the specified coordinates value, a new work coordinates is set. The work coordinates system is set in the specified position (offset from the current position).
By making coordinates system setting, the virtual mechanical coordinates is set and the work coordinate systems 1 to 6 travel in parallel.

[Example] G92 X20. Y30. ;



(2) Positioning data can be set by direct setting (numerical value) and indirect setting (variable : #∗∗∗∗).

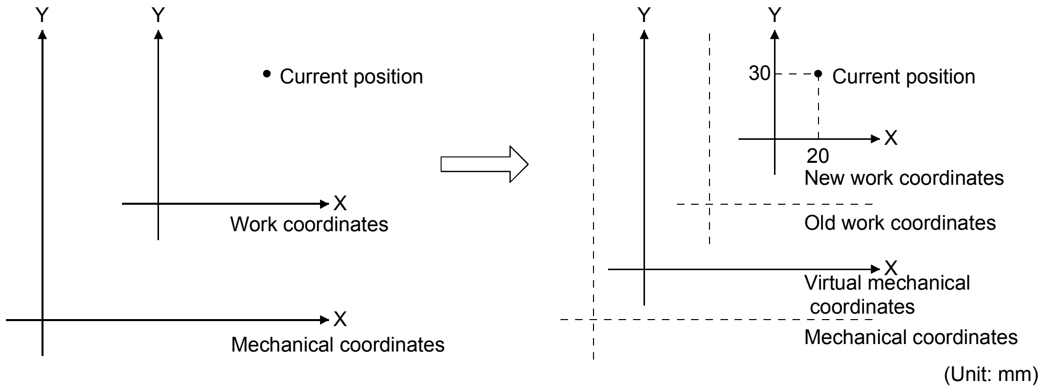
(3) By executing G92 in the constant-speed positioning command (e.g. G01), deceleration stop is made once. When G92 is executed in the single block mode, making a single block start twice in the same block shifts execution to the next block.

POINT
If the current value is changed in G92, the current value data restored after a power failure is based on the status prior to execution of G92.

[Program Example]

The program for which set the work coordinate system to the specified position.

G92 X20. Y30. ;



6.13.30 G98, G99 Preread disable/enable

Code	G98, G99	Preread disable (G98)
Function	Preread disable/enable	Preread enable (G99)

Format	G98 ; G99 ;

[Explanation]

(1) The preread disable mode after that when G98 is executed.
As this command is a modal instruction, it is valid until the preread enable (G99) being commanded.

(2) The preread enable mode after that when G99 is executed.
As this command is a modal instruction, it is valid until the preread disable (G98) being commanded.

(3) It is preread enable (G99) at the axis designation program starts.

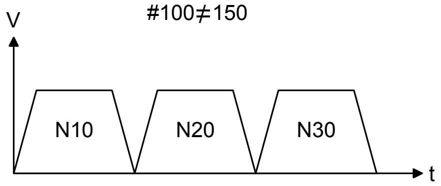
(4) Command G98 and G99 without the argument alone.

[Program Example]

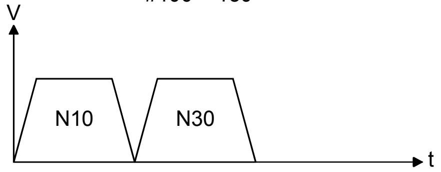
```
G90 ;
G98 ;
N10 G01 X10. F10. ;
N15 IF [#100 EQ150] GOTO30 ;
N20 G01 X20. ;
N30 G01 X30. ;
```

Even if # 100 changes in the preread disable mode while executing this line, it is reflected below IF.

#100≠150



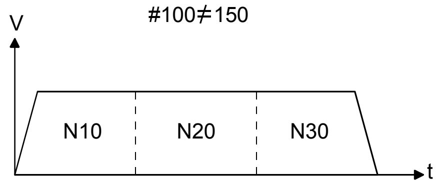
#100 = 150



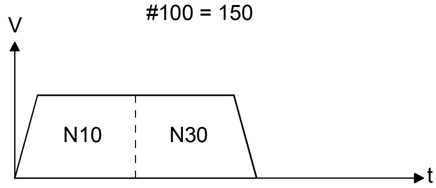
The continuous operation is not executed and a stop once in the preread disable mode as for the G01 continuous block.

```
G90 ;
G99 ;
N10 G01 X10. F10. ;
N20 IF [#100 EQ150] GOTO30 ;
N20 G01 X20. ;
N30 G01 X30. ;
```

#100≠150



#100 = 150



REMARK

(1) Preread is disabled until G99 is executed after it blocks it modal G98, and being specified only though preread is stopped in the block that M100 (preread disable) was not modal, and specified once.

(2) There is no described meaning as a program thought the problem is not in modal G98 even if M100 is executed.

6.13.31 G100, G101 Time-fixed acceleration/deceleration, acceleration-fixed acceleration/ deceleration switching command

Code	G100, G101	
Function	Time-fixed acceleration/ deceleration, acceleration-fixed acceleration/deceleration switching command	The acceleration/deceleration method is switched to time-fixed acceleration/deceleration or acceleration-fixed acceleration/ deceleration.

Format	G100 ; G101 ;

[Explanation]

(1) The acceleration/deceleration method of the travel command G01, G02, G03, G12, G13, G32 or G00 (with M-code) is switched to time-fixed acceleration/deceleration or acceleration-fixed acceleration/deceleration.

(2) The G-code of this command is set independently.

(3) Use G100 to select the time-fixed acceleration/deceleration. The G100 status is selected at a start.

(4) Use G101 to select the acceleration-fixed acceleration/deceleration.

(5) The acceleration-fixed acceleration/deceleration is set in G101, the M-code does not made a FIN waiting. (The M-code is output to the M-code storage register, but the M-code outputting signal does not turn ON.)

(6) Acceleration/deceleration in the acceleration-fixed mode is valid until :

(a) The time-fixed acceleration/deceleration command in G100 is executed ;
(b) The program is ended in M02;
(c) The program is stopped by the rapid stop command, stop command, error reset or emergency stop;
(d) The program is stopped at error occurrence.

(7) When G100 is changed to G101 or G101 to G100, a deceleration stop is made once.

[Program Example]

The program designed to make the acceleration-fixed acceleration/deceleration mode of the acceleration/deceleration system valid, then invalid midway through the program. (Command unit : [mm])

```
O10  ;
G91  ;
N1  G28  X0.  Y0.  ;          ┐ Time-fixed acceleration/deceleration(Operation is
N2  G01  X100. F1000.  ;      │ performed in G100 at a start)
N3  Y100.  ;                  │ Deceleration stop after execution
N4  G101  ;                   ┤
N5  X100.  ;                  │ Acceleration-fixed acceleration/deceleration
N6  Y100.  ;                  │ Deceleration stop after execution
N7  G100  ;                   ┤
N8  X100.  ;                  │ Time-fixed acceleration/deceleration
N9  Y100.  ;                  ┘
M02  ;
%
```

REMARK

About locus of G100/G101

Locus commanded from the Motion controller is different by setting of the G100/G101.

(a) Locus of G100

Time-fixed acceleration/deceleration method is used to enable the smooth operation between positioning points for CP operation. In the case of a continuous point of G01 (CP Linear interpolation), it passes roundly inside in a point during positioning. And in the case of G02/G03 (Circular interpolation), the locus is inside further than a circular arc set in a program. The degree which become inside further than a positioning point changes by the acceleration/deceleration time or speed.

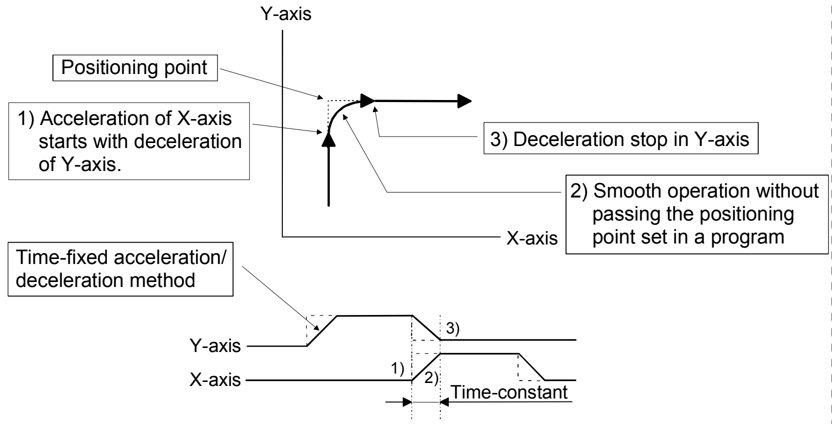
This is indicated by the following example.

Example

1) Linear interpolation

The direction changes to 90° in a point during positioning. The acceleration of X-axis starts near the positioning point with deceleration of Y-axis, it becomes to a rounded locus. X-axis operates with constant-speed after Y-axis stops, and the positioning is executed to the next point.

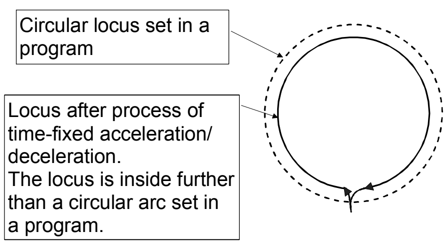
```
O100;
G100;
G91 G01 X0.Y100.F100.;
X100.;
M02;
%
```



2) Circular interpolation

In the case of G02/G03 (Circular interpolation), the locus is inside further than a circular arc set in a program. It becomes to a rounded locus in a start and end points for circular interpolation.

```
O110;
G100;
G90 G02 X0.Y0.I0.J50.F500.;
M02;
%
```



(b) Locus of G101

Acceleration-fixed acceleration/deceleration method is used to enable the correct locus control between positioning points for CP operation. Set a G101 to execute the correct locus control. However, be careful that the speed fluctuation increases at a pass point and the vibration may be occurred in the machine.

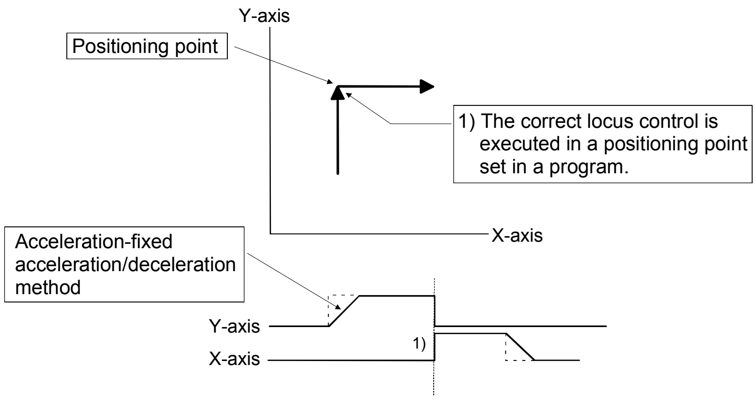
This is indicated by the following example.

Example

1) Linear interpolation

The direction changes to 90° in a point during positioning. The correct locus control in a point during positioning with command speed is executed.

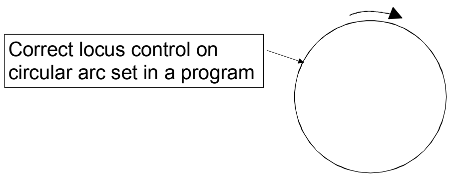
```
O200;
G101;
G91 G01 X0.Y100.F100.;
X100.;
M02;
%
```



2) Circular interpolation

In the case of G02/G03 (Circular interpolation), the correct locus control is executed on circular arc set in a program.

```
O210;
G101;
G90 G02 X0.Y0.I0.J50.F500.;
M02;
%
```



6.14 M-Code

This section explains the M-codes used in the Motion programs.

(1) M-codes

When a Motion program is executed, the 4-digit code data following M is output to the data register (D) in the M command block.

The processing of the next block is not executed until the FIN signal (M3219+20n) is input.

(Refer to Section 7.8 for relationships between the M-codes and FIN signal.).

<Command format>

M∗∗∗∗ Numeral	Setting range : 0 to 9999 (except M00, M01, M02, M30, M98, M99 and M100)

The M-codes usable are 9993 types since M00, M01, M02, M30, M98, M99 and M100 are fixed in functions and they are special M-codes.

(Refer to Section 6.15 for the Special M-Code.)

6.15 Special M-Code

The arguments of the special M-codes are shown in Table 6.4 below.

Table 6.4 Special M-Code argument list.

	Axis command (Note-1)	Radius command (R)	Central Point command (I, J)	M-code (Note-2)	G-code	Feed (F)	H	L	N	O	P	Remark
M00												
M01												
M02												
M30												
M98							○	○			○	
M99												
M100												
Other M-codes				○	○							

○ : May be specified.
Blank : Must not be specified.

(Note-1) : The axis commands are X, Y, Z, U, V, W, A, B, CX, CY, CZ, CU, CV, CW, CA, CB, DX, DZ, DU, DV, DW, DA, DB, EX, EY, EZ, EU, EV, EW, EA and EB.

(Note-2) : M-codes indicate except M00, M01, M02, M30, M98, M99 and M100.

6.15.1 M00 Program stop

Code	M00	Execution of program is stopped.
Function	Program stop	

Format	M00 ;

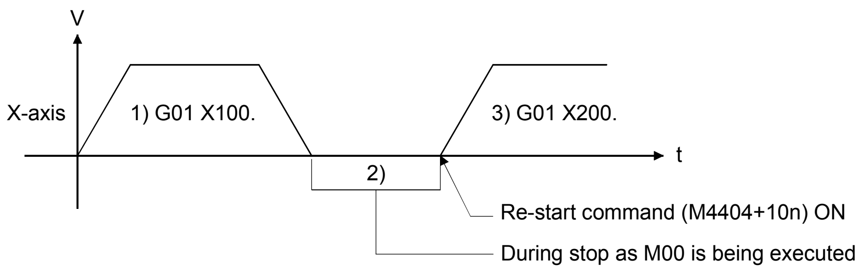
[Explanation]

Executing this command stops the program without execution of the next block.
By turning ON the re-start command (M4404+10n) after a stop, execution resumes from the next block.

[Program Example]

The program for which makes the program stop during positioning operation and restarts positioning.

1) G01 X100. F10. ; (Positioning)
2) M00 ; (Program stop) ← Re-start command (M4404+10n) ON
3) G01 X200. ; (Re-start command resumes positioning)



6.15.2 M01 Optional program stop

Code	M01	When the optional program stop is ON, executing M01 stops an execution of program.
Function	Optional program stop	

Format	M01 ;

[Explanation]

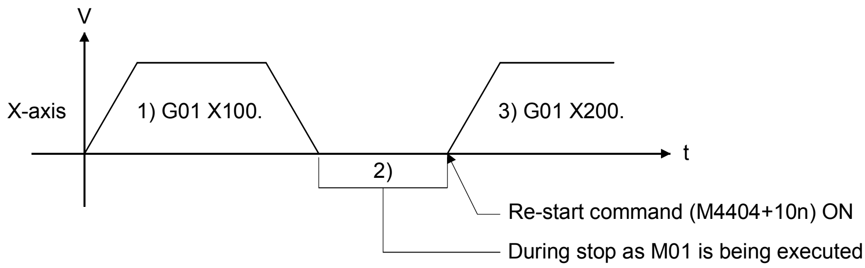
When the optional program stop command (M4401+10n) is ON, executing this command stops the program without execution of the next block.
By turning ON the restart signal command (M4404+10n) after a stop, execution resumes from the next block.
When the optional program stop command (M4401+10n) is OFF, the next block is executed without a program stop.

[Program Example]

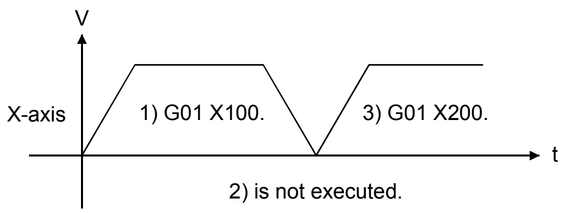
The program which uses the optional program stop (M01).

1) G01 X100. F10. ; (Positioning)
2) M01 ; (Optional program stop)
3) G01 X200. ; (Positioning)

<Optional program stop command (M4401+10n) is ON>



<Optional program stop command (M4401+10n) is OFF>



REMARK

M01 performs the same operation as "M00" when the optional program stop command (M4401+10n) is ON.

6.15.3 M02 Program end

Code	M02	Program is ended.
Function	Program end	

Format	M02 ;

[Explanation]

Executing this command ends an execution of program.
This command is required at the end of a program.

[Program Example]

The program which ends a program after positioning control.

```
G90 ;                          (Absolute value command)
G01 X100. Y200. F100. ;        (Positioning)
X200. Y300. ;                  (Positioning)
G00 X0. Y0. ;                  (Positioning)
M02 ;                          (Program end) ..... Also be enabled by M30.
%
```

REMARK

M02 and M30 have the same function.

6.15.4 M30 Program end

Code	M30	Program is ended.
Function	Program end	

Format	M30 ;

[Explanation]

Executing this command ends an execution of program.
This command is required at the end of a program.

[Program Example]

The program which is ends a program after positioning control.

```
G90 ;                         (Absolute value command)
G01 X100. Y200. F100. ;       (Positioning)
X200. Y300. ;                 (Positioning)
G00 X0. Y0. ;                 (Positioning)
M30 ;                         (Program end) ..... Also be enabled by M02.
%
```

REMARK

M30 and M02 have the same function.

6.15.5 M98, M99 Subprogram call, subprogram end

Code	M98, M99	Subprogram call (M98) and subprogram end (M99) are executed.
Function	Subprogram call, subprogram end	

Format	M98␣Pp␣H h␣L l ; l: Subprogram repetition count (1 to 9999) h: Subprogram call sequence No. (1 to 9999) p: Subprogram call program No. (1 to 512) M99 ;

[Explanation]

(1) The program of the same pattern can be registered as a single subprogram and called as required from the main program.

<Subprogram call> (M98)

Argument program No., sequence No. and repetition count may be omitted.
When omitted, these numbers are as follows.

Program No. : Main program
Sequence No. : First
Repetition count : Once

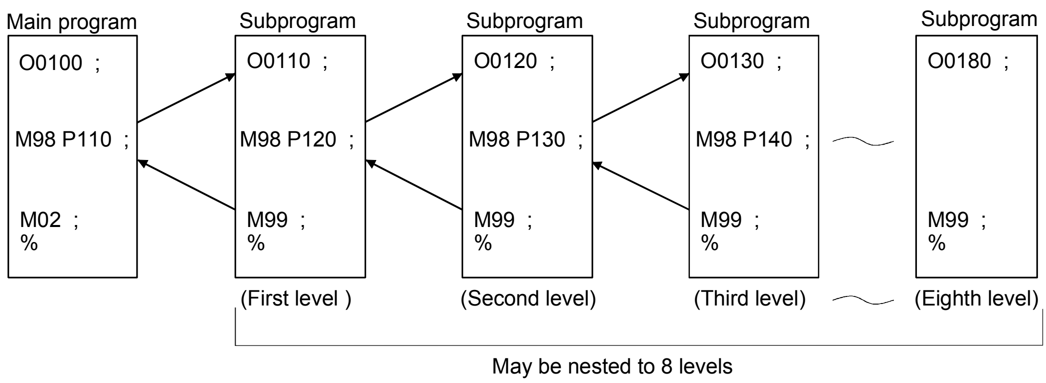
[Example]

:
:
M98 ; Executes once from the beginning of the main program.

<Subprogram end> (M99)

Returns to the block next to the call block.

(2) A subprogram can be called from another subprogram. This is called subprogram nesting. Subprograms may be called (nested) to the depth of eight levels.



(3) When a subprogram ends by error, a main program also ends in the subroutine call by M98/M99 for the axis designation program.

[Program Example]

The program designed to run the specified subprogram twice repeatedly, return to the main program, and complete operation.

Main program

```
O0110 ;
  ⋮
M98 P120 H20 L2 ;
  ⋮
M02 ;
%
```

Subprogram

```
O0120 ;
  ⋮
N20 ;
  ⋮
M99 ;
%
```

The program which calls a subprogram from another subprogram.

Main program

```
O0200 ;
N010 M98 P202 ; ..................... 1)
N020 G90 ;
     G61 ;
N030 G01 X50. Y50. F800. ;
     X60. ;
N040 G00 X10. ;
     G01 Y100. F600. ;
N050 M98 P201 ; ..................... 3)
N060 G0 X30. Y20. ;
     X20. ;
N070 M98 P202 ; ..................... 7)
N080 G91 G01 X100. F700. ;
     X20. ;
     Y30. ;
     M02 ;
     %
```

Subprogram

```
O0201 ;
N200 G91 ;
N210 G01 X100. Y100. F2000. ;
     X200. ;
     Y200.;
N220 G01 Y300. F1500. ;
     X300. ;
N230 G02 X50. Y50. I0. J50. F800. ;
N240 G01 X100. Y500. F2000. ;
N250 M98 P202 ; ..................... 4)
     M99 ; ............................ 6)
     %
```

Subprogram

```
O0202 ;
N300 G91 ;
     G61 ;
N310 G02 X50. Y50. I0. J50. F500. ;
N320 G01 X100. Y100. F1500. ;
N330 G90 ;
     M99 ; .................. 2), 5), 8)
     %
```

6.15.6 M100 Preread disable

Code	M100	Preread is not executed on the G-code (Motion program).
Function	Preread disable	

Format	M100 ;

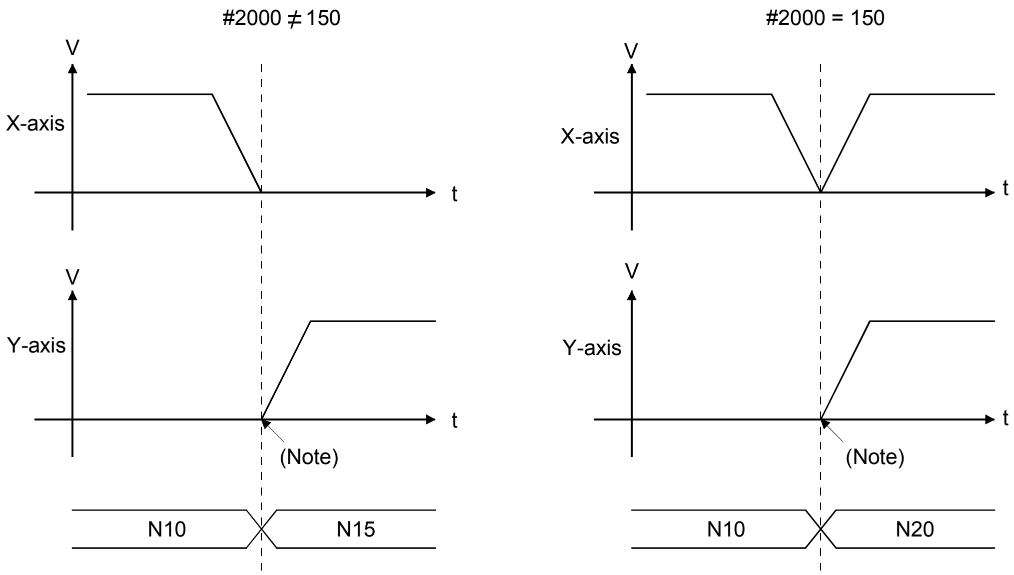
[Explanation]

Executing this command does not execute preread on the G-code (Motion programs). After completion of motion up to the preceding block, the next block is processed.

[Program Example]

```
N10  G01  X10.  F10.  ;
       M100  ;
       IF [#2000 EQ150] GOTO20  ;
N15  G01  Y10.  ;
N20  G01  X0.  Y0.  ;
```

Since M100 exists in the next block, a change in #2000 during execution of the command on this line is reflected on the IF statement below.



(Note) : When M100 is executed, constant-speed positioning does not continue from N10 to N15 or from N10 to N20 and a deceleration stop is made once after execution of N10.

6.16 Miscellaneous

The settable arguments in the first character are shown in Table 6.5 below.

Table 6.5 Argument List

	[ ]	Operator	Logical operator	Assignment (=)	GOTO	G	M	Remarks
#	○	○	○	○				–
IF	◎	○	○		◎			–
GOTO	○	○						–
/						○	○	Depends on the data after "/".
G								Refer to Section 6.13.
M								Refer to Section 6.15 for M00, M01, M02, M30, M98, M99 and M100.
Axis command	○	○						Depends on the G-code in the modal group (01).
Feed	○	○						Depends on the G-code in the modal group (01).
O								–
N								Regards the line number and later as the fist character.
( )								Handles data between "(" and ")" as a comment.
IF	○	○	○					–
ELSE		○						–
END		○						–
WHILE	○	○	○					–
DO		○						–

○ : May be specified.
◎ : Must be specified.
Blank : Must not be specified.

6.16.1 Program control function (IF, GOTO statement)

Code	IF, GOTO	The flow of execution program is controlled based on the condition.
Function	Program control function	

Format	IF␣[expression]␣GOTOn ; n: Sequence No.

[Explanation]

(1) If the specified expression is true (1) (condition is satisfied), execution jumps to the sequence No. specified in GOTO.
If the expression is false (0), the next line is executed.

IF [#@100 EQ1] GOTO100 ;
  If #@100 is 1, execution jumps to N100.
  If it is other than 1, the next line is executed.
IF [#@100] GOTO100 ;
  If #@100 is 1 (true), execution jumps to N100.
  If it is 0 (false), the next line is executed.

(2) The following comparison instructions may be used in the expression.

Code	Meaning
EQ	Equal to (=)
NE	Not equal to (!=)
GT	Greater than (>)
LT	Less than (<)
GE	Greater than or equal to (>=)
LE	Less than or equal to (<=)

(3) The expression must be enclosed in "[", "]".

(4) The line number specified in GOTO must exist in the same program. If it does not exist, an error (error code : 541) occurs.

(5) If only GOTOn is specified, execution jumps to the specified sequence No. unconditionally.

(6) The GOTO statement cannot cause execution to go into or come out of the THEN and ELSE statements.
It is similar for the DO statement.

[Program Example]

The program for which jumps the specified sequence No. if the condition is satisfied.

```
            O00201 ;
            N200 G91 ;
            N210 G01 X100. Y100. F2000. ;
                X200. ;
                Y200. ;
            ┌─ IF [#@100] GOTO230 ;         (If #@100 is true, execution jumps to N230.)
Jump to     │ N220 G01 Y300. F1500. ;
N230        │    X300. ;
            └→ N230 G02 X50. Y50. I0. J50. F800. ;
            N240 G01 X100. Y500. F2000. ;
            ┌─ IF [#@110 EQ 180] GOTO260 ;  (If #@110 is 180, execution jumps to N260.)
Jump to     │ N250 G00 X10. ;
N260        │    Y100. ;
            └→ N260 G28 X0. Y0. ;
                M02 ;
                %
```

REMARK

Only one comparison instruction may be used in one block.

6.16.2 Program control function (IF, THEN, ELSE, END statements)

Code	IF, THEN, ELSE, END	The flow of execution program is controlled based on the condition.
Function	Program control function	

Format	IF␣[expression]␣THENm ; IF identification number (1 to 32) Block U group ELSEm; Block U group ENDm ;

[Explanation]

(1) If the specified expression is true (1) (condition is satisfied), the THEN statement (block group up to ELSE) is executed. If it is false (0) (condition is not satisfied), the ELSE statement (block group up to END) is executed.

```
IF  [#@100 EQ1]  THEN1  ;
     If #@100 is 1, the block group described here is executed.
ELSE1  ;
     If #@100 is not 1, the block group described here is executed.
END1  ;
```

(2) When ELSE is omitted, the block group up to END is executed only if the conditional expression is true.

```
IF [#@100 EQ1] THEN1  ;
    If #@100 is 1, the block group described here is executed.
END1  ;
```

(3) The multiprogramming depth is up to three levels including that of the WHILE statement.

```
IF [  ] THEN1  ;
         IF [  ] THEN2  ;
                  IF [  ] THEN3  ;

                 END3  ;
       END2  ;
END1  ;
```

(4) The GOTO statement cannot cause execution to go into or come out of the THEN and ELSE statements.

[Program Example]

```
     O0001 ;
N1   G91 ;
N2   G01 X100. Y100. F2000 ;
N3   X200. ;
N4   Y200. ;
N5   IF [#@100 EQ0] THEN1 ;       When #@100=0, THEN1 to END1 are executed.
N6   G01 Y300. F1500 ;
N7   X300. ;
N8   END1 ;
N9   G02 X50. Y50. I0. J50. F800 ;
N10  G01 X100. Y500. F2000 ;
N11  IF [#@110] THEN2 ;           When #@110 is true, THEN2 to ELSE2 are executed.
N12  G00 X10. ;
N13  Y100. ;
N14  ELSE2 ;                      When #@110 is false, ELSE2 to END2 are executed.
N15  G28 X0. Y0. ;
N16  END2 ;
N17  M02 ;
     %
```

(Note) : Note that if the sequence No. (N∗∗∗) is omitted in the above program, the block No. changes as indicated below.

Program	Execution block No. (A)	Execution block No. (B)	Execution block No. (C)	Execution block No. (D)
O1 ;	0	0	0	0
G91 ;	1	1	1	1
G01 X100. Y100. F2000 ;	2	2	2	2
X200. ;	3	3	3	3
Y200. ;	4	4	4	4
IF [#@100 EQ0] THEN1 ;	5	5	5	5
G01 Y300. F1500 ;	6	—	6	—
X300. ;	7	—	7	—
END1 ;	8	—	8	—
G02 X50. Y50. I0. J50. F800 ;	9	6	9	6
G01 X100. Y500. F2000 ;	10	7	10	7
IF [#@110] THEN2 ;	11	8	11	8
G00 X10. ;	12	9	—	—
Y100. ;	13	10	—	—
ELSE2 ;	14	11	—	—
G28 X0. Y0. ;	—	—	12	9
END2 ;	—	—	13	10
M02 ;	15	12	14	11
%	—	—	—	—

(A) indicates that #@100 = 0 and #@110 is true. (B) indicates that #@100 ≠ 0 and #@110 is true.
(C) indicates that #@100 = 0 and #@110 is false. (D) indicates that #@100 ≠ 0 and #@110 is false.

6.16.3 Program control function (WHILE, DO, END statements)

Code	WHILE, DO, END	The flow of execution program is controlled based on the condition.
Function	Program control function	

Format	WHILE␣[conditional expression]␣DOm ; ENDm ; m: WHILE identification number (1 to 32)

[Explanation]

(1) While the [conditional expression] holds, blocks between the next block and ENDm block are executed repeatedly, and when it does not hold, execution shifts to the block next to ENDm.

(2) WHILE [conditional expression] DOm and ENDm are used in pairs.
The range of identification No. m is 1 to 32.

(3) The multiprogramming depth of the WHILE statement is up to three levels.
[Example] (1) The identification No. m can be used any number of times as desired.

```
WHILE [ ] D01 ;
  :
END1 ;
  :
WHILE [ ] D05 ;
  :
END5 ;
  :
WHILE [ ] D01 ;
  :
END1 ;
```

(2) The multiprogramming depth is up to three levels.

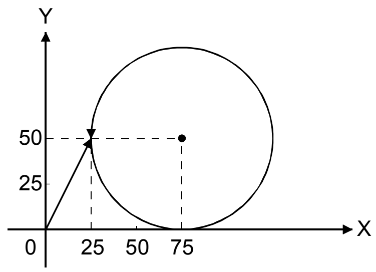
```
WHILE [ ] D01 ;
  :
WHILE [ ] D02 ;
  :
WHILE [ ] D03 ;
  :                 (Third level) (Second level) (First level)
END3 ;
  :
END2 ;
  :
END1 ;
```

(4) The GOTO statement cannot cause execution to go into or come out of the DO statement.

[Program Example]

The program for which jumps to the specified line if the condition is satisfied.

```
   O0110 ;
N1 #@0=0 ;
N2 G91 G00 X25. Y50. ;
N3 WHILE [#@0 LT3] D01 ;
N4 G03 X0. Y0. I25. J0. F100. ;      (Note-1)
N5 #@0=#@0+1 ; ··········· (Note-2)
N6 END1 ;
N7 G28 X0. Y0. ;
N8 M02 ;
   %
```



(Note-1) : N3 to N6 are repeated while variable #@0 < 3 holds.
(Note-2) : Every time this block is executed once, 1 is added to variable #@0.
The above program ends after drawing a circle three times.

(Note) : Note that if the sequence No. (N∗∗∗) is omitted in the above program, the block No. changes as indicated below.

Program	Execution block No.
O0110 ;	0
#@0=0 ;	1
G91 G00 X25. Y50. ;	2
WHILE [#@0 LT3] DO1 ;	3
G03 X0. Y0. I25. J0. F100. ;	4
#@0=#@0+1 ;	5
END1 ;	—
G28 X0. Y0. ;	4
M02 ;	5
%	—

6.16.4 Four fundamental operators, assignment operator (+, -, *, /, MOD, =)

Code	+, -, *, /, MOD, =	Addition (+), subtraction (-), multiplication (*), division (/), remainder (MOD) and assignment (=) are executed.
Function	Four fundamental operators, assignment operator	

Format	n1 Operator n2 ; n2: Numerical value or variable Operator: Operator (+, -, *, /, MOD,=) n1: Numerical value or variable

[Explanation]

(1) Calculation of the specified operator is performed.

(2) The priority of operations is in order of function, multiplication type operation and addition type operation.

#@100 = #@110 + #@120 * SIN [#@130] ;

1) Function
2) Multiplication type operation
3) Addition type operation

(3) The area of operation where you want to give priority can be enclosed in [ ].
[ ] can be five levels deep including [ ] of a function. An operational expression may be described in up to 72 characters. (Up to the maximum number of characters in one block)

#@100 = SQRT [[[#@110 - #@120] * SIN [#@130] + #@140] * #@150] ;

First level
Second level
Third level

(4) For +, -, * and /, the operation result type is used for operation. Operation data 1, 2 are converted into the operation result type. The operation result can be the 16-, 32- or 64-bit type.

Operation result = operation data 1 operator operation data 2

Operation result is stored

Operation is performed after conversion of operation data 1, 2 into operation result type.

(5) For MOD, the 16- or 32-bit type is used for operation. If operation data 1, 2 are the 64-bit type, they are converted into the 32-bit type.
The operation result can be the 16-, 32- or 64-bit type, but if the operation result is the 64-bit type, the result of operation performed with the 32-bit type is converted into the 64-bit type and the result of conversion is stored.

Operation result = operation data 1 operator operation data 2

Operation result is stored
Note that if operation result is 64-bit type, 32-bit type is converted into 64-bit type.

Operation is performed after conversion of operation data 1, 2 into operation result type.
Note that if operation result is 64-bit type, 32-bit type is used to perform operation.

(6) The following operational expressions will result in a "Format error" (error code : 560).

#@10 = ##@20 ; → Possible if #@10 = #[#@20] ;
#@10 = #@20 + - #@30 ; → Possible if #@10 = #@20 + [- #@30] ;

(7) If there is no operation result (if operation exists in the operation result, or for conditional expression such as the IF statement), the 32-bit type is used to perform operation.

[Program Example]

The program for which execute the positioning based on the result of the specified operation.

```
O0200 ;
#@40L = 1000000 ;
#@60L = 767 ;
#@80L = 10000 ;
#@30L = [#@40L + 50000] * 2 ;
#@50L = #@60L  MOD  256 ;
#@70L = #@80L * 2 ;
N060  G00  X#@30L  Y#@50L ;
      X20. ;
N080  G91  G01  X100.  F#@70L ;
      X20. ;
      Y30. ;
M02 ;
%
```

6.16.5 Trigonometric functions (SIN, COS, TAN, ASIN, ACOS, ATAN)

Code	SIN, COS, TAN, ASIN, ACOS, ATAN	Operations of SIN (sine), COS (cosine), TAN (tangent), ASIN (arcsine), ACOS (arccosine) and ATAN (arctangent) are executed.
Function	Trigonometric functions	

Format	function␣[n] ; [n]: Numerical value (can be specified indirectly) function: Trigonometric function (SIN, COS, TAN, ASIN, ACOS, ATAN)

[Explanation]

(1) The operation of the specified trigonometric function is performed.

(2) The operation result is a 32-bit integer (BIN value) including four decimal places.

(3) When the argument of the trigonometric function has no decimal point, the operation result is similarly a BIN value including four decimal places.

[Program Example]

```
#2010 : L = SIN [60.] ;          #2010 : L = 8660
#2016 : L = SIN [600000] ;       #2016 : L = 8660
#2020 : L = COS [45.] ;          #2020 : L = 7071
#2026 : L = COS [450000] ;       #2026 : L = 7071
#2030 : L = TAN [30.] ;          #2030 : L = 5773
#2036 : L = TAN [300000] ;       #2036 : L = 5773
#2040 : L = ASIN [0.8660] ;      #2040 : L = 599970
#2046 : L = ASIN [8660] ;        #2046 : L = 599970
#2050 : L = ACOS [0.7071] ;      #2050 : L = 450005
#2056 : L = ACOS [7071] ;        #2056 : L = 450005
#2060 : L = ATAN [1.] ;          #2060 : L = 450000
#2066 : L = ATAN [10000] ;       #2066 : L = 450000
```

6.16.6 Real number to BIN value conversion (INT)

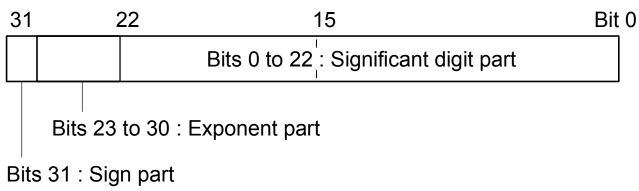
Code	INT	A floating-point type real number is converted into a 32-bit integer (BIN value) including four decimal places.
Function	Floating-point type real number processing instruction Real number to BIN value	

Format	INT␣[n] ; [n] — Indirect setting only INT — Real number to 32-bit integer (BIN value) conversion command

[Explanation]

(1) A floating-point type real number is converted into a 32-bit integer (BIN value) including four decimal places.

(2) A floating-point type real number is processed as single precision (32-bit) in the binary floating-point format of the IEEE Standard.
Sign part .... 1 bit
Exponent part .... 8 bits
Significant digit part...... 23 bits



(3) The following values can be handled as floating-point type real numbers.
$-1.0 \times 2^{128} <$ value $\leqq -1.0 \times 2^{-126}$, 0, $1.0 \times 2^{-126} \leqq$ value $< 1.0 \times 2^{128}$

[Program Example]

```
#2002 : L = 10000  ;
#2004 : L = FLT [#2002 : L]  ;      #2004 : L = (461C4000) 16
                                    (D2004, D2005 = (461C4000) 16)
#2006 : L = INT [#2004 : L]  ;      #2006 : L = 10000
```

6.16.7 BIN value to real number conversion (FLT)

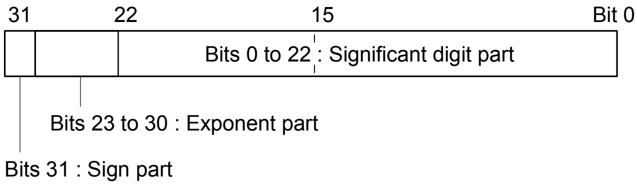
Code	FLT	
Function	Floating-point type real number processing instruction BIN value to real number conversion	A 32-bit integer (BIN value) including four decimal places is converted into a floating-point type real number.

Format	FLT␣[n] ; [n] — Indirect setting only FLT — 32-bit integer (BIN value) to real number conversion command

[Explanation]

(1) A 32-bit integer (BIN value) including four decimal places is converted into a floating-point type real number.

(2) A floating-point type real number is processed as single precision (32-bit) in the binary floating-point format of the IEEE Standard.
Sign part .... 1 bit
Exponent part .... 8 bits
Significant digit part...... 23 bits



(3) The following values can be handled as floating-point type real numbers.
$-1.0 \times 2^{128} <$ value $\leqq -1.0 \times 2^{-126}$, 0, $1.0 \times 2^{-126} \leqq$ value $< 1.0 \times 2^{128}$

[Program Example]

```
#2002 : L = 10000  ;
#2004 : L = FLT [#2002 : L]  ;       #2004 : L = (461C4000) 16
                                     (D2004, D2005 = (461C4000) 16)
#2006 : L = INT [#2004 : L]  ;       #2006 : L = 10000
```

6.16.8 32-bit real number and 64-bit real number data conversion (DFLT, SFLT)

Code	DFLT, SFLT	The DFLT instruction converts the data from 32-bit real number to 64-bit real number. The SFLT instruction converts the data from 64-bit real number to 32-bit real number.
Function	32-bit real number and 64-bit real number data conversion	

Format	DFLT␣[n] ; [n]: Indirect setting only DFLT: 32bit real number→64bit real number data conversion command SFLT␣[n] ; [n]: Indirect setting only SFLT: 64bit real number→32bit real number data conversion command

[Explanation]

(1) DFLT : 32-bit real number data (a floating-point type) is converted 64-bit real number data (a floating-point type).

(2) SFLT : 64-bit real number data (a floating-point type) is converted 32-bit real number data (a floating-point type).

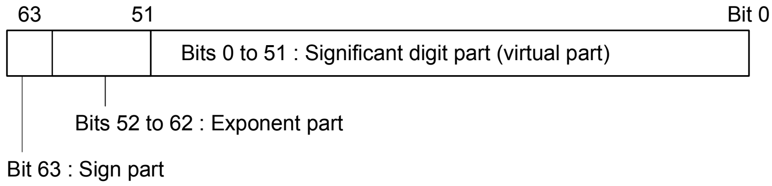
[Program Example]

```
#2004F = DFLT [#2002L]  ;
#2010L = SFLT [#2012F]  ;
```

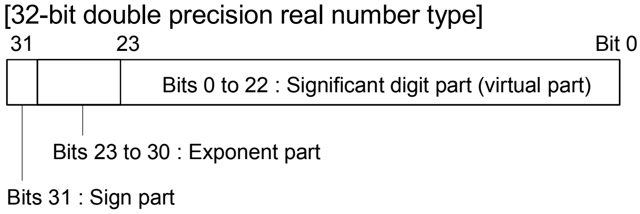
REMARK

32-bit real number data is used in QCPU, and the data conversion between Motion CPU and PLC CPU must use this instruction.

[64-bit double precision real number type]



[32-bit double precision real number type]



6.16.9 Functions (SQRT, ABS, BIN, BCD, LN, EXP, RND, FIX, FUP)

Code	SQRT, ABS, BIN, BCD, LN, EXP, RND, FIX, FUP	Operations of SQRT (square root), ABS (absolute value), BIN (BCD to BINARY conversion), BCD (BINARY to BCD conversion), LN (natural logarithm), EXP (base e exponent), RND (round off), FIX (round down) and FUP (round up) are executed.
Function	Functions	

Format	function ␣ [n] ; [n]: Numerical value (Indirect setting is possible) function: Function (SQRT, ABS, BIN, BCD, LN, EXP, RND, FIX, FUP)

[Explanation]

(1) Operation of the specified function is executed.

(2) Refer to Items (5), (6), (7) in Section 6.11.3 for the operation result.

[Program Example]

#2010L = SQRT [100]	10 enters [D2011, D2010].
#2020L = ABS [-25]	25 enters [D2021, D2020].
#2030L = BIN [100]	64 enters [D2031, D2030].
#2040L = BCD [100]	256 enters [D2041, D2040].
#2050L = LN [1000000]	13 enters [D2051, D2050].
#2060L = EXP [20]	485165195 enters [D2061, D2060].
#2070F = RND [14/3]	5 enters [D2073, D2072, D2071, D2070] (64-bit floating-point type).
#2080F = FIX [14/3]	4 enters [D2083, D2082, D2081, D2080] (64-bit floating-point type).
#2090F = FUP [14/3]	5 enters [D2093, D2092, D2091, D2090] (64-bit floating-point type).
#2170F = RND [-14/3]	-5 enters [D2173, D2172, D2171, D2170] (64-bit floating-point type).
#2180F = FIX [-14/3]	-5 enters [D2183, D2182, D2181, D2180] (64-bit floating-point type).
#2190F = FUP [-14/3]	-4 enters [D2193, D2192, D2191, D2190] (64-bit floating-point type).

6.16.10 Logical operators (AND, OR, XOR, NOT, <<, >>)

Code	AND, OR, XOR, NOT, <<, >>	Logical product (AND), logical add (OR), exclusive logical add (XOR), logical NOT (NOT) and shift operations (<<, >>) are executed.
Function	Logical operators	

Format	
	<For AND, OR, XOR, <<, >>> n1 logical operator n2 ; n2: Numerical value or variable logical operator: Logical operator (AND, OR, XOR, <<, >>) n1: Numerical value or variable <For NOT> NOT␣[n1] ; n1: Numerical value or variable

[Explanation]

(1) Operation of the specified logical operator is executed.

(2) Only the integer types (16-bit type, 32-bit type) may be used to perform logical operation. Logical operation including the 64-bit floating-point type cannot be performed. (error 560 : Format error)
The operation result can be 16- or 32-bit type, but it is converted into the operation result type for operation.

(3) The area of operation where you want to give priority can be enclosed in [ ]. [ ] can be five levels deep including [ ] of a function. An operational expression may be described in up to 72 characters. (Up to the maximum number of characters in one block)

<For AND, OR, XOR, <<, >> >

Operation result = operation data 1 operator operation data 2 ;

Operation result is stored

Operation is performed after conversion of operation data 1, 2 into operation result type.
Note that operation including 64-bit floating-point type cannot be performed.

<For NOT>

Operation result = NOT [operation data 1] ;

Each bit of operation data 1 is inverted and result of inversion is stored into operation result.

(4) The logical operators can be used with the conditional expressions of the IF and WHILE statements.

IF [[ON #M1000] AND [OFF #M1100]] GOTO1 ;
  If M1000 is ON and M1100 is OFF, the N1 line is executed.
IF [[#2100 AND #2200] EQ #2300] GOTO2 ;
  If the result of operating AND #2100 and #2200 contents is equal to #2300, the N2 line is executed.

[Program Example]

Operator	Program example	Operation
AND	#2010L = 100 ; #2020L = #2010L AND 15 ;	#2010L = 00000000 00000000 00000000 01100100 15 = 00000000 00000000 00000000 00001111 #2020L = 00000000 00000000 00000000 00000100 = 4
OR	#2010L = 100 ; #2020L = #2010L OR 14 ;	#2010L = 00000000 00000000 00000000 01100100 14 = 00000000 00000000 00000000 00001110 #2020L = 00000000 00000000 00000000 01101110 = 110
XOR	#2010L = 100 ; #2020L = #2010L XOR 14 ;	#2010L = 00000000 00000000 00000000 01100100 14 = 00000000 00000000 00000000 00001110 #2020L = 00000000 00000000 00000000 01101010 = 106
NOT	#2010L = 90 ; #2020L = NOT [#2010L] ;	#2010L = 00000000 00000000 00000000 01011010 #2020L = 11111111 11111111 11111111 10100101 = -91
<<	#2010L = 20 ; #2020L = #2010L << 2 ;	#2010L = 00000000 00000000 00000000 00010100 #2020L = 00000000 00000000 00000000 01010000 = 80
>>	#2010L = 80 ; #2020L = #2010L >> 2 ;	#2010L = 00000000 00000000 00000000 01010000 #2020L = 00000000 00000000 00000000 00010100 = 20

6.16.11 Move block wait functions (WAITON, WAITOFF)

Code	WAITON, WAITOFF	The next travel block is executed at the completion of ON/OFF condition for the specified device.
Function	Move block wait functions	

Format	WAITON #Xx ; (Xx: Device (X, Y, M, B, F)) WAITOFF #Xx ; (Xx: Device (X, Y, M, B, F))

[Explanation]

(1) Execution of the next travel block is waited until the completion of ON/OFF condition for the specified device. However, the operation block is executed.

(2) The response time of WAITON/WAITOFF is the operation cycle time (approx. 0.88 [ms] for 5 or less axes).

(3) The grammar is indicated below.
<WAITON statement> : WAITON #<device>
[Example] WAITON #X10 ;

<WAITOFF statement> : WAITOFF #<device>
[Example] WAITOFF #X11 ;

(4) It takes about 7 to 64[ms] from when a program is started until the program is actually run. Therefore, If WAITON/WAITOFF is used, the Motion program can be started at high speed. By setting a wait for a shift to the next block with WAITON or WAITOFF after a program start has been made by the start instruction of the Motion program, prereading of the next block has been completed, and therefore, the next block can be executed at high speed (approx. 3.5[ms] for 4 or less axes) after the device condition has held, improving the variation or delay in a program start.

[Example]
```
WAITON #X10 ;           ← When X10 turns ON, N1 block is executed.
N1 G01 X100. Y200. F1000. ;
WAITOFF #X11 ;          ← When X11 turns OFF, N2 block is executed.
N2 G01 X200. Y300. F500. ;
      :
      :
M02 ;
%
```

(5) WAITON/WAITOFF cannot be used with the home position return instruction.

[Program Example]

The program which executes the next block at the completion of condition.

```
1)  00001  WAITON  #X10  ;
    00002  N1  G01  X100.  Y200.  F1000.  ;
2)  00003  WAITOFF  #X11  ;
    00004  N2  #2010 = 5  ;
    00005  G00  X0.  Y-10.  ;
3)  00006  WAITON  #X12  ;
    00007  GOTO  10  ;
        :
        :

    00015  N10  G00  X0.  Y0.  ;

        :
        :

    00020  #2000 = 5  ;
4)  00021  WAITOFF  #XFF  ;
    00022  IF  [#2000  EQ  5]  GOTO  20  ;
    00023  N15  G01  X200.  Y200.  F2000.  ;

        :
        :

    00027  N20  G01  X100.  Y100.  F2000.  ;
    00028  M02  ;
    00029  %
```

The above program is executed as described below.

1) Line 1 When device X10 turns ON, line 2 is executed.
2) Line 3 When device X11 turns OFF, line 5 is executed.
   (Line 4 is being executed.)
3) Line 6 When device X12 turns ON, N10 is executed.
4) Line 21 When device XFF turns OFF, #2000=5 to line 27 are executed.
   Because of preread processing, N15 is not executed and execution jumps to N20 if the #2000 (D2000) value is changed from sequence program while execution waits for XFF to turn from ON to OFF in the WAITOFF statement.

6.16.12 Block wait functions (EXEON, EXEOFF)

Code	EXEON, EXEOFF	The next block is executed at the completion of ON/OFF condition for the specified device.
Function	Block wait function	

Format	EXEON #Xx ; Xx: Device (X, Y, M, B, F) EXEOFF #Xx ; Xx: Device (X, Y, M, B, F)

[Explanation]

(1) Execution of the next block is waited until the completion of ON/OFF condition for the specified device.

(2) The response time of EXEON/EXEOFF is an operation cycle.

(3) The grammar is indicated below.
<EXEON statement> : EXEON #<device>
[Example] EXEON #X10 ;

<EXEOFF statement> : EXEOFF #<device>
[Example] EXEOFF #X11 ;

[Program Example]

(1) Control program

```
SET  #M100  ;
RST  #M101  ;
EXEON  #M102  ;    <-- Preread is not executed in the control program.
#D2100=200             When the M102 is ON, the next block is executed.
CALL  JXJY  P100  ;
      :
      :
M02  ;
```

(2) Axis designation program

(a) Next block is travel block.

EXEON/EXEOFF

```
SET  #M100  ;
EXEON  #M102  ;
G01 X100.  F1000.  ;   ←  Preread of next block is not executed.
     :                    When the M102 is ON, the next block is executed.
     :
MO2  ;
%
```

WAITON/WAITOFF

```
SET  #M100  ;
WAITON  #M102  ;
G01 X100.  F1000.  ;   ←  Preread of next block is executed.
     :                    When the M102 is ON, the next block is executed. The next travel
     :                    block is executed at high speed.
MO2  ;
%
```

(b) Next block is not travel block.

EXEON/EXEOFF

```
SET  #M100  ;
EXEON  #M102  ;
RST  #M100  ;          ←  Preread of next block is not executed. The next block is
     :                    executed after waiting for the M102 to turn ON.
     :
MO2  ;
%
```

WAITON/WAITOFF

```
SET  #M100  ;
WAITON  #M102  ;
RST  #M100  ;          ←  When the next block is not the travel block, a waiting by the
     :                    WAITON is not executed.
     :
MO2  ;
%
```

(c) EXEON/EXEOFF is wrote between the travel blocks.

EXEON/EXEOFF

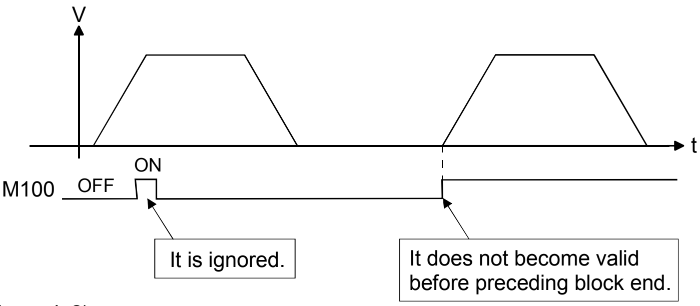
```
G01  X100.  F100.  ;
EXEON  #M100  ;
G01  X200.  F100.  ;
```

EXEON/EXEOFF

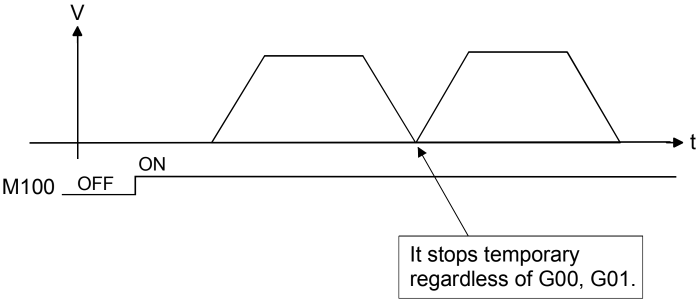
```
G00  X100.  ;
EXEON  #M100  ;
G00  X200.  ;
```

• Above two programs stop temporary between blocks regardress of G00(PTP), G01(CP), and it judges waiting/execution for EXEON/EXEOFF in the state of preceding block end.

(Example1)



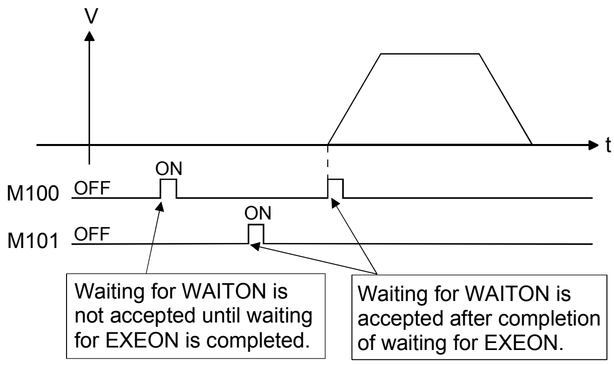
(Example2)



REMARK

Operation which combined EXEON and WAITON.

```
WAITON #M100  ;
EXEON  #M101  ;
G01  X100.  F100  ;
```



When the EXEON is wrote in the next block of WAITON (not travel value), priority is given to waiting condition for EXEON regardless of WAITON state, in this case, since an operation is complicated, it recommends not using it combining WAITON and EXEON.

6.16.13 Bit set and reset for word devices (BSET, BRST)

Code	BSET, BRST	Sets or resets the specifies bit in the word device.
Function	Bit operation of the ward devices	

Format	
	BSET D n ; n: Set bit number (0 to15) D: Word device which operates bit. (#D, #W, #@) BRST D n ; n: Reset bit number (0 to15) D: Word device which operates bit. (#D, #W, #@)

[Explanation]

(1) BSET sets the specifies bit in the word device.

(2) BRST resets the specifies bit in the word device.

[Program Example]

Set the 10th bit of D2000.

```
BSET #D2000 10 ;
```

Reset the 12th bit of #@100.

```
BRST #@100 12 ;
```

6.16.14 Parameter block change (PB)

Code	PB	The parameter block of the specified No. is used.
Function	Parameter block change	

Format	
	PB pb ; pb: Parameter block No. PB: Parameter block change command

[Explanation]

(1) The numerical value following PB is used as a parameter block No..

(2) The parameter block value may also be specified indirectly by a variable, D, W or # (2-word data).

(3) Any of 1 to 64 may be specified as the parameter block value.
Specifying any other value than the above will result in a "Format error". (error code : 560)

(4) Once given, the parameter block change command is valid until the parameter block change command is given again.
However, when a torque limit value change (TL) is executed, the specified torque limit value is used.

(5) When a parameter block change (PB) is executed during a torque limit value change (TL), the torque limit value in the new parameter block is used.

(6) When a parameter block change is executed during a constant-speed motion, the axis decelerates to a stop once and the next constant-speed motion is executed.

```
G01  X100.  F500.  ;  ←  Deceleration to a stop at X100.
PB3  ;  ←  After that, parameter block 3 is used.
G01  X200.  ;
```

(7) The home position return (G28) uses the following parameters.
(a) Home position return request ON............Parameter block is specified home position return parameters.
(b) Home position return request OFF…..……Parameter block at the axis designation program start.

(8) The parameter block change command cannot be described in the same block as another command.

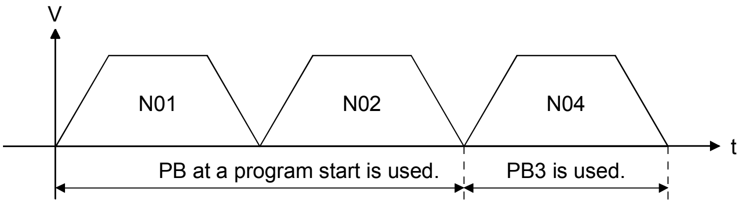
(9) If a cancel start is made during a parameter block change, the start program uses the parameter block for execution of the start program.

(10) A parameter block change (PB) is valid at the next travel.

[Program Example]

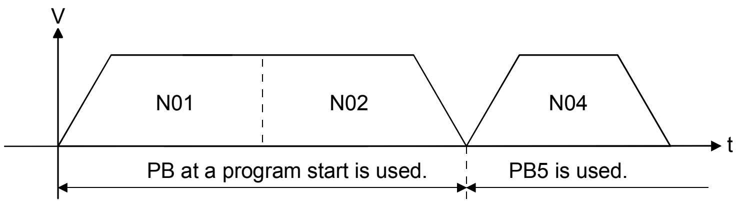
(1) When a parameter block change is executed during point-to-point positioning

```
N01 G00 X0. ;        Uses the parameter block at a program start.
N02 G00 X100. ;
N03 PB3 ;            Changes to parameter block 3.
N04 G00 X300. ;
```



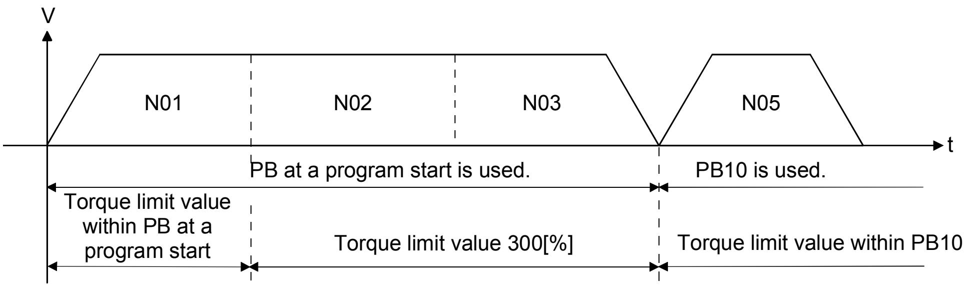
(2) When a parameter block change is executed during constant-speed positioning

```
N01 G01 X0. F200. ;  Uses the parameter block at a program start.
N02 G01 X100. ;
N03 PB5 ;            Changes to parameter block 5.
N04 G01 X200.;
```



(3) When torque limit value is being changed

```
N01 G01 X0. F200. ;
N02 G01 X100. TL300 ;
N03 G01 X200. ;
N04 PB10 ;
N05 G01 X300. ;
```



6.16.15 Torque limit value change (TL)

Code	TL	The torque limit value is changed to the specified value.
Function	Torque limit value change	

Format	
	TL t ; t: Torque limit value TL: Torque limit value change command

[Explanation]

(1) The numerical value following TL is commanded as a torque limit value. The torque limit value may also be specified indirectly by a variable, D, W or # (2-word data).
(After the TL code, the torque limit value in the parameter block is not used.)

(2) Any of 1 to 1000[%] may be specified as the torque limit value.
Specifying any other value than the above will result in a "Format error". (error code : 560)

(3) Once given, the TL command is valid until the TL command is given again or the parameter block or CHGT command is given. However, at a program start, the torque limit value in the specified parameter block or the specified torque limit value is used.

(4) At a home position return (G28), the torque limit value in the parameter block at a program start is used.

(5) If a cancel start is made during a torque limit value change, the start program uses the torque limit value in the parameter block for execution of a start program.

(6) If a torque limit value change (TL) is specified in G32 (skip) and the skip device is already ON before execution of G32, the torque limit value change command (TL) is also skipped and the torque limit value specified previously remains unchanged.

(7) The torque limit value change (TL) is valid for all axes specified in the start instruction of the Motion program. However, if the torque limit value specified in the torque limit value change (TL) for the axis whose torque limit value is specified in the CHGT command is greater than the torque limit value in the CHGT command, torque is clamped at the torque limit value of the CHGT command.

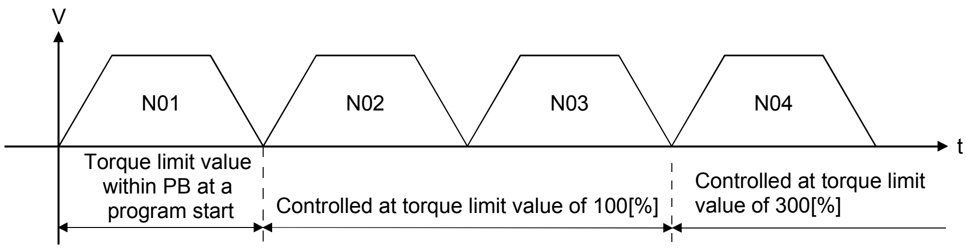
(8) The axis operating under the high-speed oscillation (G25) is not made valid. That axis is made valid from the move command or M-code after the high-speed oscillation stop (G26) is executed.

(9) If specified in a move block, the torque limit value (TL) is made valid from that motion. When the torque limit value is independent (no block motion specified), it is made valid for the next motion.

[Program Example]

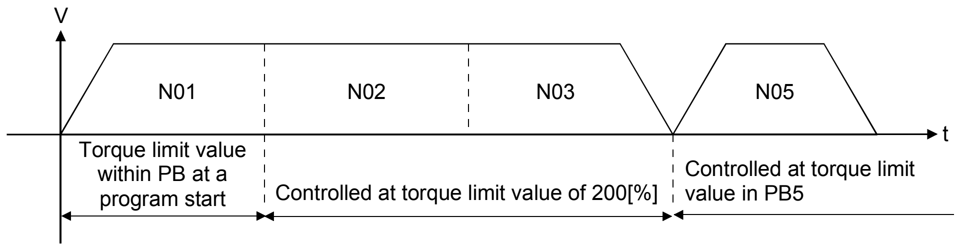
(1) When torque limit value change is made

N01 G00 X0. ;	Controls at the torque limit value in the parameter block at a program start.
N02 G00 X100. TL100 ; N03 G00 X200. ;	Controls at the torque limit value of 100[%].
N04 G00 X300. TL300 ;	Controls at the torque limit value of 300[%].



(2) When parameter block change is made

N01 G01 X0. F200. ;	Controls at the torque limit value in the parameter block at a program start.
N02 G01 X100. TL200 ; N03 G01 X200. ;	Controls at the torque limit value of 200[%]
N04 PB5 ;	Changes to parameter block 5.
N05 G01 X300. ;	Controls at the torque limit value in parameter block 5.



6.16.16 Home position return (CHGA)

Code	CHGA	A home position return of the specified axis is executed.
Function	Home position return	

Format	CHGA JX; JX: The "J + Axis name" to return the home position is set. It is possible to specify it only by an axis.

[Explanation]

(1) The start accept flag (M2001 to M2032) of the specified axis is turned ON.

(2) The start accept flag is turned ON according to the home position return parameters after a home position return.

(3) G28 executes a high-speed home position return when the home position return request is OFF. However, the home position return is executed for CHGA by the home position return method set by the home position return parameter.
CHGA instruction is executed an equal to S(P).CHGA instruction of "3 MOTION DEDICATED PLC INSTRUCTION" in the Motion program.

6.16.17 Speed change (CHGV)

Code	CHGV	A speed change of the specified axis is executed.
Function	Speed change	

Format	CHGV JX n ; n: Speed change value (Indirect setting is possible) JX: The "J + Axis name" to change the speed value is set. It is possible to specify it only by an axis.

[Explanation]

(1) The speed changing flag (M2061 to M2092) of the specified axis is turned ON.

(2) The speed changing flag is turned OFF after changing speed to "n".

(3) CHGV can be changed in the range of the speed limit value though override is a speed change which specifies the ratio from 0 to 100[%].
CHGV instruction is executed an equal to S(P).CHGV instruction of "3 MOTION DEDICATED PLC INSTRUCTION" in the Motion program.

REMARK

```
G90 ;
G00 X0. ;
G00 X1000. ;
CHGV JX 100. ;
```

```
G90 ;
G00 X0. ;
G00 X1000. ;
N1 ;
IF [ON #M2402] GOTO1 ;
CHGV JX 100. ;
```

(1) When the block of CHGV is preread by programming the above left program, CHGV is executed while executing the block (example : G00 block) before CHGV.
Make the program like a above right program to execute CHGV after the block of "G00 X1000. ; " ends.

(2) Set the speed change value specified with the CHGV instruction without the decimal point.
If the speed change value with decimal point is set, an effective digit below the decimal point is distinguished as follows, and it converts it into the value without the decimal point .

Fixed parameter of specified axis		Number of effective digits below the decimal point	Ex.) "CHGV JX 12345.6789;" is set.
Units	Speed control 10× multiplier setting for degree axis		
mm	—	2 digits	CHGV JX 1234567
inch	—	3 digits	CHGV JX 12345678
degree	Valid	2 digits	CHGV JX 1234567
	Invalid	3 digits	CHGV JX 12345678

6.16.18 Torque limit value change (CHGT)

Code	CHGT	A torque limit value change of the specified axis is executed.
Function	Torque limit value change	

Format	CHGT JX n ; n: Torque limit change value (Indirect setting is possible) (1 to 1000[%]) JX: The "J + Axis name" to change the torque limit value is set. It is possible to specify it only by an axis.

[Explanation]

CHGT is an instruction which executes an equal to S(P).CHGT instruction of "3 MOTION DEDICATED PLC INSTRUCTION" in the Motion program.

REMARK

```
G90 ;
G00 X0. ;
TL50 ;
G00 X1000. ;
CHGT JX 50. ;
```

When the block of CHGT is preread by programming the above program, CHGT is executed while executing the block (example : G00 block) before CHGT.
Torque limit value is changed after the movement of the pre-block completes a TL instruction.
When a TL instruction was used, the timing of the torque limit value is clear with the axis designation program.

6.16.19 Bit device set, reset functions (SET, RST)

Code	SET, RST	The specified device is turned ON/OFF.
Function	Bit device set, reset functions	

Format	SET #Yy ; #Yy: ON device (Y, M) SET: Device ON command RST #Yy ; #Yy: OFF device (Y, M) RST: Device OFF command

[Explanation]

(1) The specified device in the G-code program can be turned ON/OFF.

(2) Refer to Section 6.11.2 (2) for the usable device ranges.

[Program Example]

```
1) SET #M0 ;     Turns ON device M0.
2) RST #M0 ;     Turns OFF device M0.
3) SET #Y10 ;    Turns ON device Y10.
```

6.16.20 Bit device operation on condition (IF, THEN, SET/RST/OUT)

Code	IF, THEN, SET/RST/OUT	When the condition consists, a specified device is turned on.
Function	Bit device operation on condition	

Format	IF [conditional expression] THEN SET #Yy ; #Yy: ON device (Y, M, B, F, special M) IF [conditional expression] THEN RST #Yy ; #Yy: OFF device (Y, M, B, F, special M) IF [conditional expression] THEN OUT #Yy ; #Yy: Device turn ON and OFF on condition. (Y, M, B, F, special M)

[Explanation]

(1) When the condition consists, "IF [conditional expression] THEN SET" turns ON a specified device.

(2) When the condition consists, "IF [conditional expression] THEN RST" turns OFF a specified device.

(3) When a specified device is turned ON when the condition consists, and the condition does not consist, "IF [conditional expression] THEN OUT" turns OFF a specified device.

[Program Example]

```
IF [#100 EQ0] THEN SET #Y0 ;

IF [#100 EQ0] THEN RST #Y0 ;

IF [#100 EQ0] THEN OUT #Y0 ;
```

REMARK

(1) The mark of the I/O modules is X and Y in SV43 regardless of installation/non-installation. PX and PY is not used in the Motion program.

(2) Writing in the device X is possible only for the range of the input modules non-installation.

(3) The start accept flag (M2001 to M2032) must not use IF, THEN and SET/RST/OUT.

(4) Do not write it in special relay (M9000 to M9255) excluding the user setting device.

(Note) : The device range which can be used by "IF, THEN, SET/RST/OUT" and "SET/RST" is the same.

6.16.21 Program start (CALL)

Code	CALL	The specified control program or axis designation program is started.
Function	Program start	

Format	CALL JXJYJZJUJVJWJAJB ␣ Pp ; Pp: Motion program No. (1 to 1024) (Indirect setting is possible) JXJYJZJUJVJWJAJB: J+starting axis name. Eight or less can be specified.

[Explanation]

(1) Other control programs or axis designation programs are started from the control program.

(2) Do not set the axis and parameter block No. to start the control programs.

(3) Set the axis name used by the axis designation program to start the axis designation program.

(4) As for set program No."Pn" and parameter block No."PBn", indirect setting by #@ or D (word data) is also possible. In this case, sequence No. can be specified as follows.

[Control program start]
CALL P#D2010 ;
D2010 : Program No.
D2011 : Sequence No.

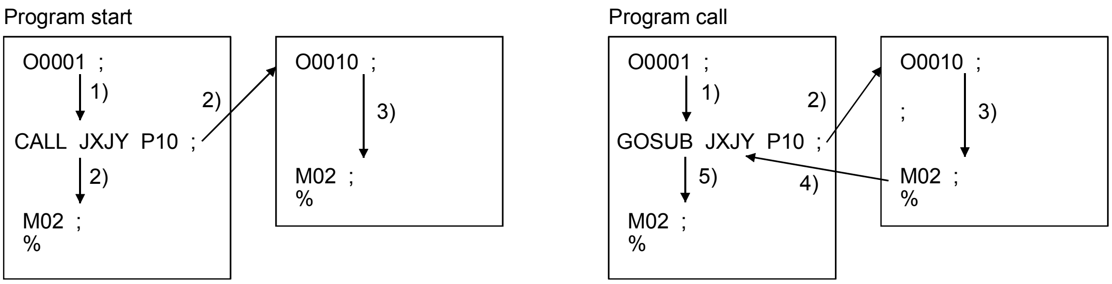
[Axis designation program start]
CALL JXJY P#D2010 ;
D2010 : Program No.
D2011 : Sequence No.
D2012 : Parameter block No.

(5) This instruction cannot be used in the axis designation program.

(6) When the program No. of axis designation program is specified directly, the parameter block No. is started as the default value (PB1).

(7) After the control program and axis designation program are started, the next block is executed without waiting the end of started program.

Difference point of the program call and program start



This program is executed in parallel the started program and following the next block of CALL.

The following next block of GOSUB is executed after waiting the end of called program.
(GOSUBE also is same.)

6.16.22 Program call 1 (GOSUB)

Code	GOSUB	The specified control program or axis designation program is called.
Function	Program call 1	

Format	GOSUB JXJYJZJUJVJWJAJB ␣ Pp ; Pp: Motion program No. (1 to 1024) (Indirect setting is possible) JXJYJZJUJVJWJAJB: J+starting axis name. Eight or less can be specified.

[Explanation]

(1) Other control programs or axis designation programs are called from the control program.

(2) Do not set the axis and parameter block No. to call the control program.

(3) Set the axis name used by the axis designation program to call the axis designation program.

(4) This instruction cannot be used in the axis designation program.

(5) As for set Motion program No."Pn" and parameter block No."PBn", indirect setting by #@ or D (word data) is also possible. In this case, sequence No. can be specified as follows.

[Control program call]
GOSUB P#D2010 ;
D2010 : Motion program No.
D2011 : Sequence No.

[Axis designation program call]
GOSUB JXJY P#D2010 ;
D2010 : Motion program No.
D2011 : Sequence No.
D2012 : Parameter block No.

(6) When the program No. of the axis designation program is specified directly, the parameter block No. is called as the default value (PB1).

(7) After the control program and axis designation program are called, the next block is executed after waiting the end of called program.

Refer to the explanation of "Program start" for the difference between the program start and program call.

6.16.23 Program call 2 (GOSUBE)

Code	GOSUBE	The specified control program or axis designation program is called. The call source program is ended at the error occurrence.
Function	Program call 2	

Format	GOSUBE JXJYJZJUJVJWJAJB ␣ Pp ; Pp: Motion program No. (1 to 1024) (Indirect setting is possible) JXJYJZJUJVJWJAJB: J+starting axis name. Eight or less can be specified.

[Explanation]

(1) Other control programs or axis designation programs are called from the control program.

(2) Do not set the axis and parameter block No. to call the control program.

(3) Set the axis name used by the axis designation program to call the axis designation program.

(4) This instruction cannot be used in the axis designation program.

(5) As for set Motion program No."Pn" and parameter block No."PBn", indirect setting by #@ or D (word data) is also possible. In this case, sequence No. can be specified as follows.

[Control program call]
GOSUBE P#D2010 ;
D2010 : Motion program No.
D2011 : Sequence No.

[Axis designation program call]
GOSUBE JXJY P#D2010 ;
D2010 : Motion program No.
D2011 : Sequence No.
D2012 : Parameter block No.

(5) When the program No. of the axis designation program is specified directly, the parameter block No. is called as the default value (PB1)

(7) After the control program and axis designation program are called, the next block is executed after waiting the end of called program.

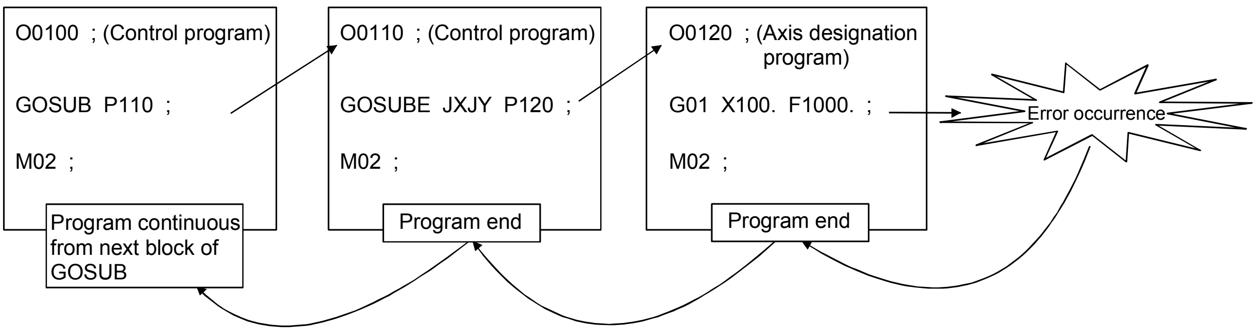
(8) Call source program is ended at the error occurrence. After the control program and the axis designation program are called, the next block is executed after waiting the end of called program.

(9) The end of rol program by CLEAR instruction in the control program or the CLEAR request control program No. setting register (D707) are normal. Call source program is not ended.

Refer to the explanation of "Program start" for the difference between the program start and program call.

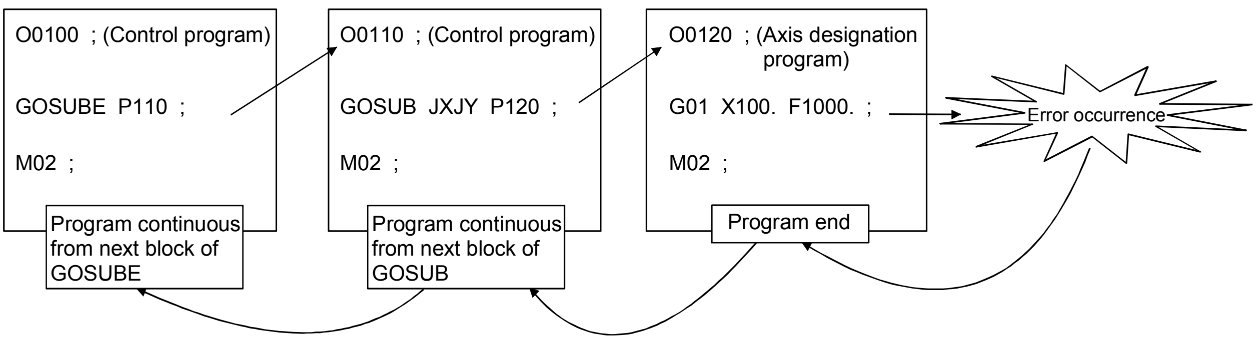
[Program Example]

(1) GOSUB+GOSUBE



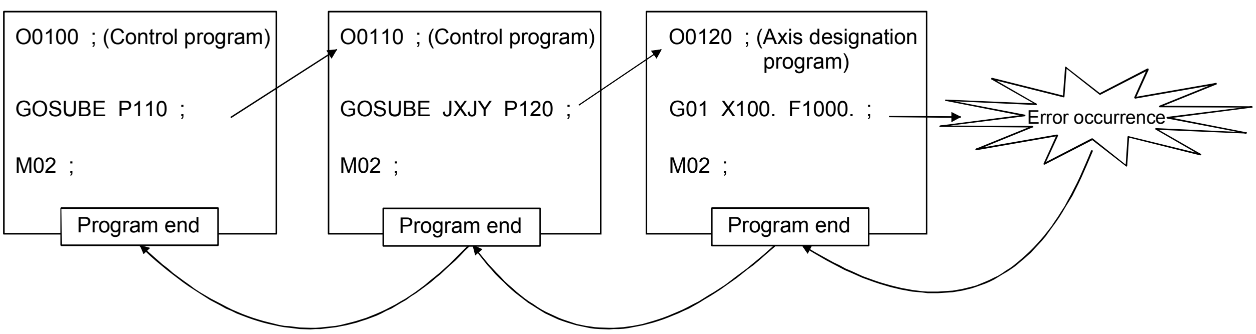
If an error which program ends will occur in the program No.120, program "O0110" ends but program "O0100" executes continuously.

(2) GOSUBE+GOSUB



If an error which program ends will occur in the program No.120, program "O0100" and "O0110" execute continuously.

(3) GOSUBE+GOSUBE



If an error which program ends will occur in the program No.120, program "O0100" and "O0110" end.

REMARK

Error list which the main program ends by an error occurrence is shown below.

Error type			Error code
Positioning error	Minor error	Starting errors	100, 101, 103, 104, 106, 107, 108, 109, 110, 115, 140, 142, 145, 160, 161
		Positioning control errors	200, 201, 202, 203, 206,207, 208, 209, 211
		Motion program executing errors	500, 501, 502, 504, 510, 513, 525, 530, 531, 532, 533, 534, 535, 536, 537, 538, 541, 542, 543, 544, 545, 546, 547, 555, 560, 562, 570, 571, 580, 581, 582, 584, 585, 586, 587, 591, 592, 593, 594 600, 610, 611, 612, 613, 614, 615, 617, 618, 619, 620, 630, 631, 632, 633, 634, 635, 636, 637, 650, 651, 652, 653, 660, 661, 662, 663, 680
	Major error	Starting errors	1000, 1001, 1002, 1003, 1004, 1005
		Positioning control errors	1101, 1102, 1103, 1104, 1105
	Servo amplifier error		2000 to 2099, 2146, 2147

6.16.24 Control program end (CLEAR)

Code	CLEAR	The specified control program is ended.
Function	Control program end	

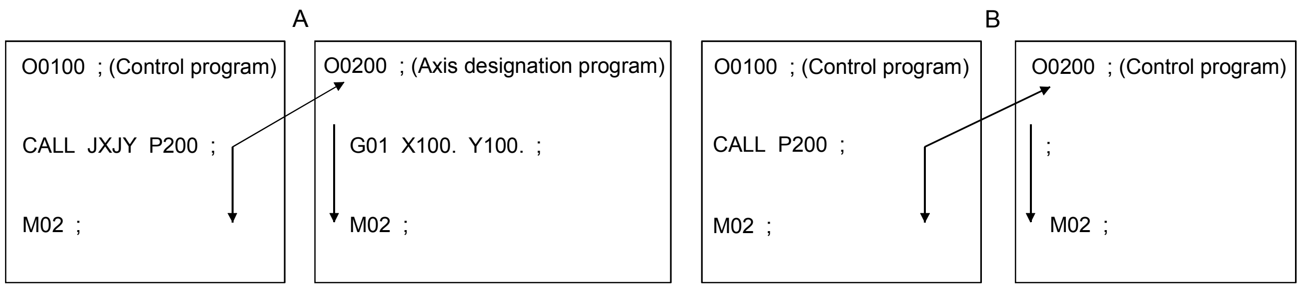
Format	CLEAR Pp; Pp: Motion program No. (1 to 1024) (Indirect setting is possible)

[Explanation]

(1) The CLEAR is ended if it is executing it specifying the number of the control program from the control program.

(2) The axis designation program cannot be stopped.

(3) The CLEAR at a program start is as following operation.

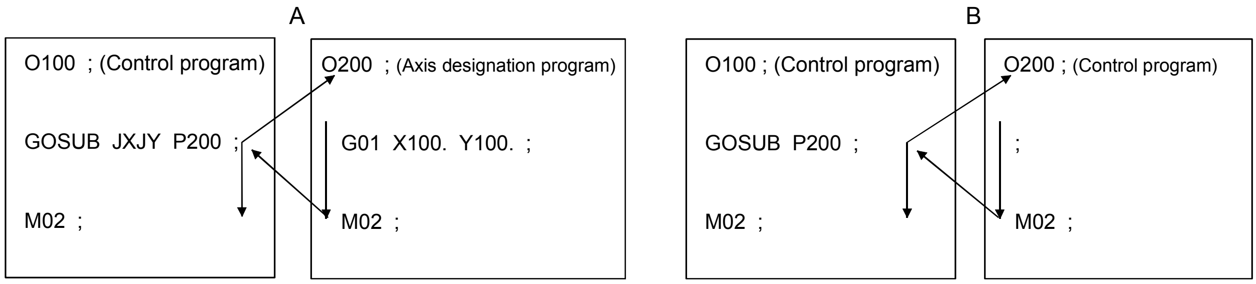


(a) If the main program (O0100) ends regardless of the started program or subprogram (O0200), the main program (O0100) ends and the subprogram (O0200) does not end. (Figure A, B)

(b) When the started program is the control program, if the subprogram (O0200) ends, the subprogram (O0200) ends and the main program (O0100) does not end. (Figure B)

(c) When the started program is the axis designation program, turn the stop command or rapid stop command of applicable axis ON to stop the subprogram (O0200).
In this case, the subprogram (O0200) ends and the main program (O0100) does not end. (Figure A)

(4) The CLEAR at the program call as the following operation.



(a) When the started program is a control program, if the main program (O0100) is cleared, the both of the main program (O0100) and subprogram (O0200) end. (Figure B)

(b) When the started program is a control program, if the subprogram (O0200) is cleared, the execution ends and the control returns to the main program (O0100). (Figure B)

(c) When the started program is a designation program, if the main program (O0100) is cleared, only main program (O0100) ends and the subprogram (O200) does not end. (Figure A)

(d) When the started program is a designation program, if the subprogram ends by the stop command or rapid stop command, etc. of the applicable, the control returns to the main program (O0100). (Figure A)

[Program Example]

The control program of Motion program No. 10 is ended.
CLEAR P10 ;

REMARK

Even if the control program is stopped with the CLEAR instruction, a signal during the set keep a set.

6.16.25 Time to wait (TIME)

Code	TIME	Time from the end of the block to the next block beginning is specified at waiting time.
Function	Time to wait	

Format	TIME␣Pp; Pp: Waiting time (1 to 65535)

[Explanation]

(1) Time from the end of the block to the next block beginning is specified at waiting time.

(2) The specified range of waiting time is 1 to 65535.
The command unit is 0.001[s].
TIME P1000 ; is waiting at 1[s].

(3) Waiting time can be set by direct setting (numerical value) and indirect setting (constant : #∗∗∗∗).

(4) TIME instruction can be used only the control program.
Use the G04 (Dwell) as the time to wait in the axis designation program.

(5) The command unit is 0.001[s] (1[ms]). However, note that about dozens maximum error (dispersion) will occur by the main cycle.

[Program Example]

M10 is turned ON for 100[ms].

```
SET  #M10  ;
TIME  P100  ;
RST  #M10  ;
```

Waiting time of 65535[ms] (65.535[s]) or more is as follows.

Example 100[s] waiting

```
#@0 = 0  ;
WHILE  [#@0  LE  10]  D01  ;
TIME  P10000  ;
#@0 = #@0 + 1  ;
END1  ;
```

6.16.26 Block transfers (BMOV : 16-bit unit)

Code	BMOV	The data of n words from the specified device are batch-transferred to the specified transfer destination. (16-bit unit)
Function	Block transfers (16-bit unit)	

Format	
	BMOV D S n ; n: Number of transmission words (Constant or indirect setting (1 to 65535)) S: First devices of transfer source data or absolute address. D: First devices of transfer destination data or absolute address.

[Explanation]

(1) The contents for n words from device specified with (S) are batch-transferred to the n words from device specified with (D). (Transferred with a word [16-bit] unit.)

(2) Data can be transferred if the word devices of the transfer source and destination overlap. Data are transferred from devices, starting with the one at (S), for transfer of data from devices of larger numbers to those of smaller numbers, or starting with the one at (S)+(n-1) for transfer of data from devices of smaller numbers to those of larger numbers.

(3) When the H+32-bit hexadecimal constant for (D) or (S) is specified, it is meant to specify the absolute address of the Motion CPU. The absolute address specifies the even number.
When the absolute address is specified, the content of the address is understood. When a wrong operation is executed, operation which crashes the system, and is abnormal might be executed.

(4) An operation error will occur if :
(a) (S) to (S)+(n-1) is outside the device range. } When (n) specifies word device
(b) (D) to (D)+(n-1) is outside the device range. }
(c) (n) is 0 or a negative number.
(d) The absolute address is outside the range of the RAM.

[Program Example]

(1) Program which batch-transfers a contents for 5 words from D0 to all data for 5 words from #@10.

```
BMOV #@10 #D0
```

		Batch transfer (16-bit unit)		
#@10	12	←	D0	12
#@11	34		D1	34
#@12	56		D2	56
#@13	78		D3	78
#@14	90		D4	90

(2) Program which batch-transfers a contents for 5 words from absolute address (0x06000000) of Motion CPU to all data for 5 words from D2000.

```
BMOV #D2000 H06000000 5
```

D2000	12	Batch transfer (16-bit unit) ←	0x06000000	12
D2001	34		0x06000002	34
D2002	56		0x06000004	56
D2003	78		0x06000006	78
D2004	90		0x06000008	90

6.16.27 Block transfer (BDMOV : 32-bit unit)

Code	BDMOV	The data of n words from the specified word device are batch-transferred to the specified transfer destination. (32-bit unit)
Function	Block transfer (32-bit unit)	

Format	BDMOV D S n ; n: Number of transmission words (Constant or indirect setting (1 to 65535)) S: First devices of transfer source data or absolute address. D: First devices of transfer destination data or absolute address.

[Explanation]

(1) The contents of n words from the word device specified with (S) are batch-transferred, to the n words from the word device specified with (D). (Transferred with 2-word [32-bit] unit.)

(2) Data can be transferred if the word devices of the transfer source and destination overlap. Data are transferred from the devices, starting with the one at (S), for transfer of data from devices of larger numbers to those of smaller numbers, or starting with the one at (S)+(n-1) for transfer of data from devices of smaller numbers to those of larger numbers.

(3) When the H+32-bit hexadecimal constant for (D) or (S) is specified, it is meant to specify the absolute address of the Motion CPU.
The absolute address specifies the multiple of four.

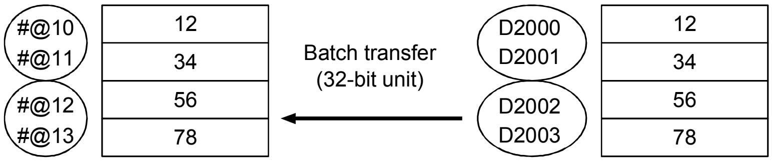
(4) An operation error will occur if :

(a) (S) to (S)+(n-1) is outside the device range.
(b) (D) to (D)+(n-1) is outside the device range.
(c) The device number of (D) or (S) is not even number.
When (n) specifies word device.
(d) (n) is 0,negative number or odd number.
(e) The absolute number is not multiple of four.
(f) The absolute address is outside the range of the RAM.

[Program Example]

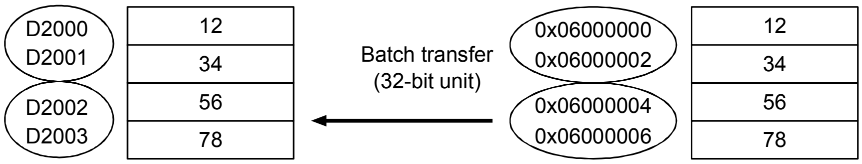
(1) Program which batch-transfers a contents for 4 words from D2000 to all data for 4 words from #@10.

```
BDMOV #@10 #D2000 4
```



(2) Program which batch-transfers a contents for 4 words from absolute address (0x06000000) of Motion CPU to all data for 4 words from D2000.

```
BDMOV #D2000 H06000000 4
```



6.16.28 Identical data block transfers (FMOV)

Code	FMOV	The data of n words from the specified device are batch-transferred to the specified transfer destination. (a word [16-bit] unit)
Function	Identical data block transfers	

Format	FMOV D S n ;
	n: Number of transmission words (Constant or indirect setting (1 to 65535))
	S: Transfer source data constant or indirect setting (0 to 65535)
	D: First devices of transfer destination data or absolute address.

[Explanation]

(1) The constant or contents for device specified with (S) are batch-transferred to the n words from the device specified with (D). (Transferred with 1-word [16-bit] unit.)

(2) Data can be transferred if the word devices of the transfer source and destination overlap.

(3) When the H+32-bit hexadecimal constant for (D) is specified, it is meant to specify the absolute address of the Motion CPU. The absolute address specifies the even number.
When the absolute address is specified, the content of the address is understood. When a wrong operation is executed, operation which crashes the system, and is abnormal might be executed.

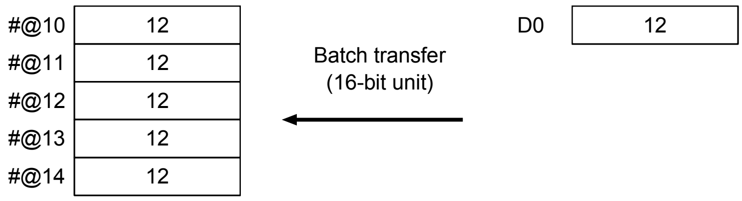
(4) When a wrong operation is executed, operation which crashes the system, and is abnormal might be executed.

(a) (S) is outside the range -32768 to 65535. (When constant specified)
(b) When (S) is outside the range of the device. (When indirectly specified device)
(c) When from (D) to (D)+(n-1) is outside the range of the device.
(d) (n) is outside the range 1 to 65535. (When constant specified)
(e) When (n) is outside the range of the device. (When indirectly specified device)
(f) When the absolute address is outside the range of RAM.

[Program Example]

(1) Program which batch-transfers a contents for from D0 to all data for 5 words from #@10.

```
FMOV #@10 #D0 5
```

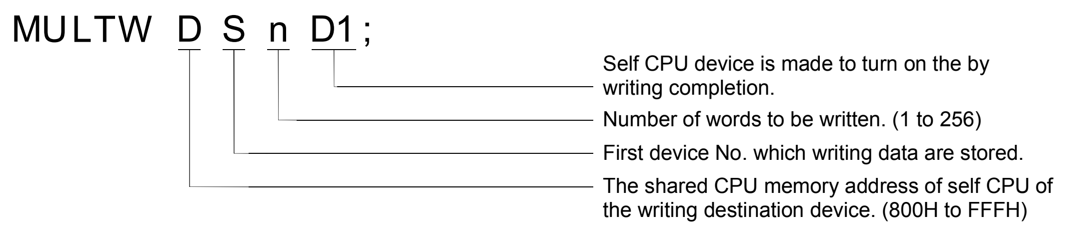


The motion device is not initialized (0 set) at the power on.
Please use it after initializing data by this instruction when it is necessary.

6.16.29 Write device data to shared CPU memory (MULTW)

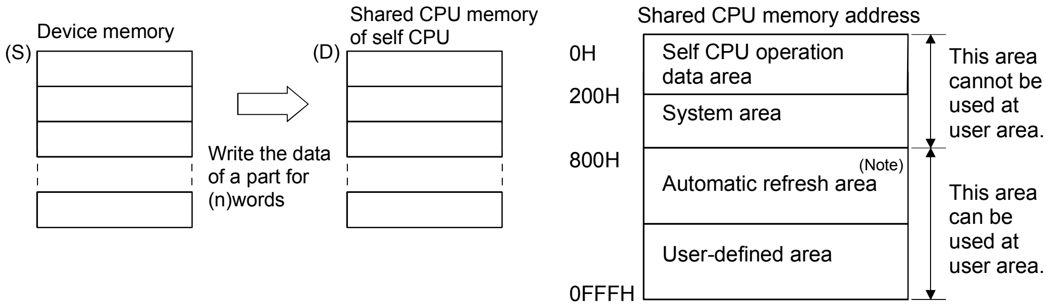
Code	MULTW	A part for (n) words of data since the device specified with (S) of the self CPU module are written to since the shared CPU memory address specified with (D) of the self CPU module.
Function	Write device data to shared CPU memory	

Format



[Explanation]

(1) A part for (n) words of data since the device specified with (S) of the self CPU module are written to since the shared CPU memory address specified with (D) of the self CPU module. After writing completion of the device data, the complete bit device specified with (D1) turns on.



(Note) : When automatic refresh is not set, it can be used as a user defined area.
And, when automatic refresh is set up, since the automatic refresh transmitting range becomes a user defined area.

(2) Do resetting of the complete bit device by the user program.

(3) Another MULTW instruction cannot be processed until MULTW instruction is executed and a complete bit device is turned ON. When MULTW instruction was executed again before MULTW instruction is executed and complete bit device is turned ON, the MULTW instruction executed later becomes no processing.

(4) The devices that may be set at (D), (S) (n) and (D1) are shown below.

Setting data	Word devices (Note) (16-bit integer type)			Bit devices (Note)					Constant
	D	W	#@	M	B	F	X	Y	
(D)	○	○	○	—	—	—	—	—	○
(S)	○	○	○	—	—	—	—	—	—
(n)	○	○	○	—	—	—	—	—	○
(D1)	—	—	—	○	○	○	○	○	—

(Note) : The device No. cannot be specified indirectly.

An operation error will occur if :

(a) Number of words (n) to be written is outside the range of 1 to 256.

(b) The shared CPU memory address (D) of self CPU of the writing destination device is outside the range (800H to FFFH) of the shared CPU memory address.

(c) The shared CPU memory address (D) of self CPU of the writing destination device + number of words (n) to be written is outside the range (800H to FFFH) of the shared CPU memory address.

(d) First device No. (S) which writing data are stored + number of words (n) to be written is outside the device range.

(e) MULTW instruction was executed again before MULTW instruction is executed and complete bit device is turned on.

[Program Example]

2-word from D0 is written in the shared CPU memory to since A00H.

```
RST  #M0  ;
MULTW  HA00  #D0  2  #M0  ;
```

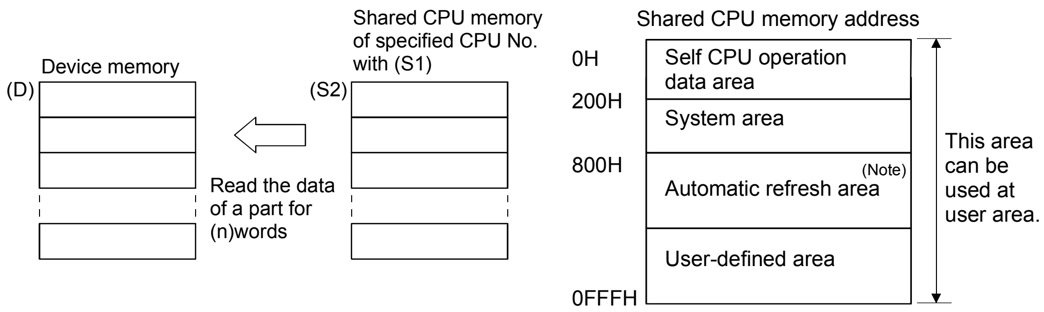
6.16.30 Read device data from shared CPU memory of the other CPU (MULTR)

Code	MULTR	A part for (n) words of data of the other CPU specified with (S1) are read from the address specified with (S2) of the shared CPU memory, and it is stored since the device specified with (D).
Function	Read device data from shared CPU memory of the other CPU	

Format	MULTR D S1 S2 n;
	n: Number of words to be read. (1 to 256) S2: The shared CPU memory first address of the data which it will be read. (0H to FFFH) S1: First I/O No. of the PLC CPU/Motion CPU which it will be read.(CPU No.1 : 3E0H, CPU No.2 : 3E1H, CPU No.3 : 3E2H, CPU No.4 : 3E3H) D: First device No. which stores the reading data.

[Explanation]

(1) A part for (n) words of data of the other CPU specified with (S1) are read from the address specified with (S2) of the shared CPU memory, and are stored since the device specified with (D).



(Note) : When automatic refresh is not set, it can be used as a user defined area.
And, when automatic refresh is set up, since the automatic refresh transmitting range becomes a user defined area.

(2) The devices that may be set at (D), (S1), (S2) and (n) are shown below.

Setting data	Word devices (Note) (16-bit integer type)			Bit devices (Note)					Constant
	D	W	#@	M	B	F	X	Y	
(D)	○	○	○	—	—	—	—	—	—
(S1)	○	○	○	—	—	—	—	—	○
(S2)	○	○	○	—	—	—	—	—	○
(n)	○	○	○	—	—	—	—	—	○

(Note) : The device No. cannot be specified indirectly.

(3) When data are read normally from the target CPU specified with (S1), the reading complete flag M9216 to M9219 (CPU No.1:M9216, CPU No.2:M9217, CPU No.3:M9218, CPU No.4:M9219) corresponding to the target CPU turns on. If data cannot be read normally, the reading complete flag of the target CPU does not turn on.

(4) When multiple MULTR instructions are executed to the same CPU simultaneously, the reading complete flag of target CPU number M9216 to M9219 turns on/off as a result of MULTR that it is executed at the end.

(5) Reset the reading complete flag (M9216 to M9219) using the user program.

(6) An operation error will occur if :
  (a) Number of words (n) to be read is outside the range of 1 to 256.

  (b) The shared CPU memory first address (S2) of the data which it will be read is outside the range (000H to FFFH) of the shared CPU memory address.

  (c) The shared CPU memory first address (S2) of the data which it will be read + number of words (n) to be read is outside the range (000H to FFFH) of the shared CPU memory address.

  (d) First device No. (D) which stores the reading data + number of words (n) to be read is outside the device range.

  (e) Except 3E0H/3E1H/3E2H/3E3H is set at (S1).

  (f) The self CPU is specified with (S1).

  (g) The CPU which reads is resetting.

  (h) The errors are detected in the CPU which read.

[Program Example]

2-word is read to since #@0 from the shared CPU memory C00H of CPU No.1.

```
MULTR  #@0  H3E0  HC00  2 ;
```

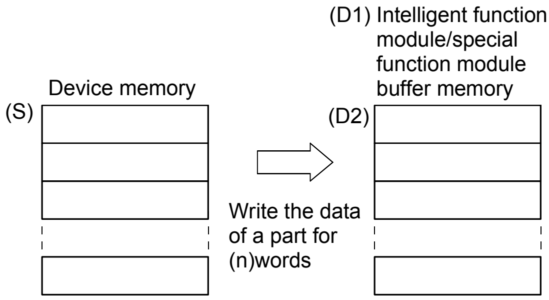
6.16.31 Write words data to intelligent function module/special function module (TO)

Code	TO	A part for (n) words of data from device specified with (S) are written to since address specified with (D2) of the buffer memory in the intelligent function module/special function module controlled by the self CPU specified with (D1).
Function	Write words data to intelligent function module/special function module	

Format	TO D1 D2 S n ;
	n: Number of words to be written. (1 to 256) S: First device No. which writing data are stored. D2: First address of the buffer memory which writes data. D1: First I/O No. of the intelligent function module/special function module. (000H to FF0H)

[Explanation]

(1) A part for (n) words of data from device specified with (S) are written to since address specified with (D2) of the buffer memory in the intelligent function module/special function module controlled by the self CPU specified with (D1).



(2) First I/O No. of the module set by system setting is specified by (D1).

Power supply module	Q02H CPU	Q173H CPU	QX40 First I/O No. : 00H	Q64AD First I/O No. : 10H	Q64DA First I/O No. : 20H	

(D1) sets 20H by the system setting when a TO instruction is executed in the D/A conversion module (Q64DA).

(3) The devices that may be set at (D1), (D2), (S) and (n) are shown below.

Setting data	Word devices (Note) (16-bit integer type)			Bit devices (Note)					Constant
	D	W	#@	M	B	F	X	Y	
(D1)	○	○	○	—	—	—	—	—	○
(D2)	○	○	○	—	—	—	—	—	○
(S)	○	○	○	—	—	—	—	—	—
(n)	○	○	○	—	—	—	—	—	○

(Note) : The device No. cannot be specified indirectly.

(4) The following analogue modules can be used as the control module of Motion CPU.
- Q62DA
- Q64DA
- Q68DAV
- Q68DAI
- Q64AD
- Q68ADV
- Q68ADI

(5) An operation error will occur if :
(a) Number of words (n) to be written is outside the range of 1 to 256.
(b) Motion CPU cannot communicate with intelligent function module/special function module at the instruction execution.
(c) Abnormalities of the intelligent function module/special function module were detected at the instruction execution.
(d) I/O No.s specified with (D1) differ from the intelligent function module/special function module controlled by the self CPU.
(e) The address specified with (D2) is outside the buffer memory range.
(f) First device No. (S) which writing data are stored + number of words (n) to be written is outside the device range.

[Program Example]

2-word from #0 is written to since buffer memory address (0H) of the Intelligent function module/special function module (First I/O No. : 010H).

```
T0  H010  H0  #0  2  ;
```

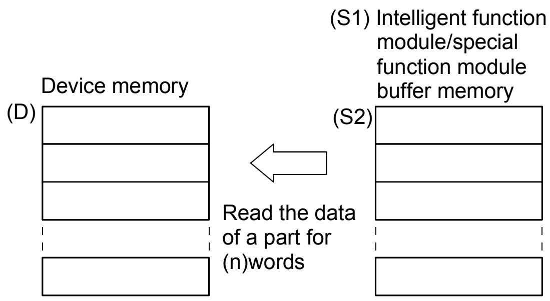
6.16.32 Read words data from intelligent function module/special function module (FROM)

Code	FROM	A part for (n) words of data are read from the address specified with (S2) of the buffer memory in the intelligent function module/special function module controlled by the self CPU specified with (S1), and are stored since the device specified with (D).
Function	Read words data from intelligent function module/special function module	

Format	FROM D S1 S2 n ; n: Number of words to be read (1 to 256) S2: First address No. of the buffer memory which it will be read. S1: First I/O No. of the intelligent function module/special function module. (000H to FF0H) D: First device No. which stores the reading data.

[Explanation]

(1) A part for (n) words of data are read from the address specified with (S2) of the buffer memory in the intelligent function module/special function module controlled by the self CPU specified with (S1), and are stored since the device specified with (D).



(2) First I/O No. of the module set by system setting is specified by (D1).

Power supply module	Q02H CPU	Q173H CPU	QX40 First I/O No. : 00H	Q64AD First I/O No. : 10H	Q64DA First I/O No. : 20H	

(S1) sets 20H by the system setting when a FROM instruction is executed in the D/A conversion module (Q64DA).

(3) The devices that may be set at (D), (S1), (S2) and (n) are shown below.

Setting data	Word devices (Note) (16-bit integer type)			Bit devices (Note)					Constant
	D	W	#@	M	B	F	X	Y	
(D)	○	○	○	—	—	—	—	—	—
(S1)	○	○	○	—	—	—	—	—	○
(S2)	○	○	○	—	—	—	—	—	○
(n)	○	○	○	—	—	—	—	—	○

(Note) : The device No. cannot be specified indirectly.

(4) The following analogue modules can be used as the control module of Motion CPU.
- Q62DA
- Q64DA
- Q68DAV
- Q68DAI
- Q64AD
- Q68ADV
- Q68ADI

(5) An operation error will occur if :
(a) Number of words (n) to be read is outside the range of 1 to 256.
(b) Motion CPU cannot communicate with intelligent function module/special function module at the instruction execution.
(c) Abnormalities of the intelligent function module/special function module were detected at the instruction execution.
(d) I/O No.s specified with (S1) differ from the intelligent function module/special function module controlled by the self CPU.
(e) The address specified with (S2) is outside the buffer memory range.
(f) First device No. (D) which stores the reading data + number of words (n) to be read is outside the device range.

[Program Example]

A word is read from the buffer memory address 10H of the intelligent function module/special function module (First I/O No. : 020H), and is stored in W0.

```
FROM #W0 H020 H10 1 ;
```

6.16.33 Conditional branch using bit device (ON, OFF)

Code	ON, OFF	By describing this command in the conditional expression of IF or WHILE, branches processing according to the ON/OFF status of the specified bit device.
Function	Bit device conditional branch	

Format	IF␣[ON␣#M100]␣GOTO1 ;
	ON/OFF device (X, Y, M, B, F) ON/OFF command (describe OFF for OFF) *Conditional expression of IF THEN or WHILE can also be described similarly.

[Explanation]

(1) The ON/OFF status of the specified bit device is judged by the ON/OFF command to see if it is true (1) or false (0).
By using this command in the conditional expression of IF or WHILE, a conditional branch can be made with a bit device.
When used with a logical operator, this command enables a conditional branch with multiple bit devices.

(2) [ ] of the conditional expression can be five levels deep including [ ] of a function.
An operational expression may be described in up to 72 characters in all. (Up to the maximum number of characters in one block)

<When "ON" is specified>

```
IF [ON #M100] GOTO1 ;
```

When M100 is ON, the result is true (1) and a branch to N01 is taken.
When M100 is OFF, the result is false (0) and the next block is executed.

<When "OFF" is specified>

```
IF [OFF #M100] GOTO1 ;
```

When M100 is ON, the result is false (0) and the next block is executed.
When M100 is OFF, the result is true (1) and a branch to N01 is taken.

<When used with logical operator>

```
IF [[ON #M100] AND [ON #M110]] GOTO1 ;
```

When M100 is ON and M110 is ON, a branch to N01 is taken.
If either of them is OFF, the next line is executed.

(3) The device that may be specified after the ON/OFF command is the bit device only.
If a word device is specified, a "Format error" (error code : 560) occurs.

(4) The bit devices usable in the ON/OFF command are X, Y, M, B and F.

(5) The ON/OFF command is available for the conditional expressions of the program control functions (IF GOTO, IF THEN, WHILE).

[Program Example]

(1) When M100 is ON, a branch to line N03 is taken.

```
N01  IF  [ON  #M100]  GOTO3  ;  ← Branches to line N03 if M100 is ON.
N02  G01  X100.  F200.  ;          Executes the next line (N02) if M100 is OFF.
N03  G00  X0.  ;
```

(2) Execution starts from the next line (THEN1 and later) if M200 is ON, or from ELSE1 if it is OFF.

```
N01  IF  [ON  #M200]  THEN1  ;
N02  G01  X100.  F200.  ;  ← Executed when M200 is ON.
N03  ELSE1  ;
N04  G00  X200.  ;  ← Executed when M200 is OFF.
N05  END1  ;
```

(3) While M300 is OFF, the blocks within WHILE (N02, N03, N04) are executed repeatedly.

```
N01  WHILE  [OFF  #M300]  D02  ;  ← Executes blocks within WHILE while M300 is OFF.
N02  G91  G01  X10.  F100.  ;
N03  #2010 = #2010 + 1  ;
N04  END2  ;  ← Executed when M300 turns ON.
N05  G90  G00  X0.  ;
```

MEMO

7. AUXILIARY AND APPLIED FUNCTIONS

7.1 Backlash Compensation Function

This function compensates for the backlash amount in the machine system. When the backlash compensation amount is set, extra feed pulses equivalent to the backlash compensation amount set up whenever the travel direction is generated at the positioning control, JOG operation or manual pulse generator operation.

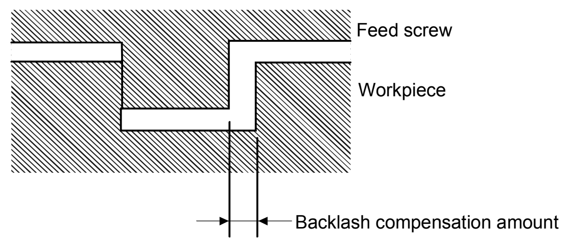


Fig.7.1 Backlash compensation amount

(1) Setting of 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] or [degree] units are used as shown below.

(a) [mm] units

- 0 to 6.5535
- $0 \leqq \dfrac{\text{(Backlash compensation amount)}}{\text{(Travel value per PLS)}} \leqq 65535\text{[PLS]}$

(Decimal fraction rounded down)

(b) [inch] or [degree] units

- 0 to 0.65535
- $0 \leqq \dfrac{\text{(Backlash compensation amount)}}{\text{(Travel value per PLS)}} \leqq 65535\text{[PLS]}$

(Decimal fraction rounded down)

7

(2) Backlash compensation processing

Details of backlash compensation processing are shown below.

Table 7.1 Details of backlash compensation processing

Condition	Processing
First start after power on	• If travel direction is equal to home position return direction, the backlash compensation is not executed. • If travel direction is not equal to home position return direction, the backlash compensation is executed.
JOG operation start	• If travel direction is changed at the JOG operation start, the backlash compensation is executed.
Positioning start	• If travel direction is changed, the backlash compensation is executed.
Manual pulse generator operation	• If travel direction is changed, the backlash compensation is executed.
Home position return completion	• The backlash compensation is executed after home position return completion.
Absolute position system	• Status stored at power off and applied to absolute position system.

POINTS

(1) The feed pulses of backlash compensation amount are added to the machine value.

(2) When the backlash compensation amount is changed, the home position return is required.
When the home position return is not executed, the original backlash compensation amount is not changed.

7.2 Torque Limit Function

This function restricts the generating torque of the servomotor within the setting range. If the torque required for control exceeds the torque limit value during positioning control, it restricts with the setting torque limit value.

(1) Setting range of the torque limit value
It can be set within the range of 1 to 1000[%] of the rated torque.

(2) Torque limit value change
Torque limit value can be changed in the Motion program or PLC program, etc. at a program start or JOG operation start.
(a) Torque limit value is changed to the torque limit value specified with parameter block at a program start or JOG operation start.

(b) TL instruction (Refer to Section 6.16.15), PB instruction (Refer to Section 6.16.14) or CHGT instruction (Refer to Section 6.16.18) is used to change the torque limit value in the Motion program.
PB instruction changes it to the torque limit value specified with parameter block. TL or PB instruction commands to all start axes of Motion program. CHGT instruction commands to only specified axis.

(c) S(P).CHGT instruction (Refer to Section 3.6) is used to change in the PLC program.

[Control Details]

(1) Torque limit value at a Motion program start or JOG operation start is changed to the value specified with parameter block.

(2) When the TL or PB instruction is used to change the torque limit value, the new value is valid until the next TL or PB instruction is executed. However, it is clamped at the torque limit value of CHGT/S(P).CHGT instruction.

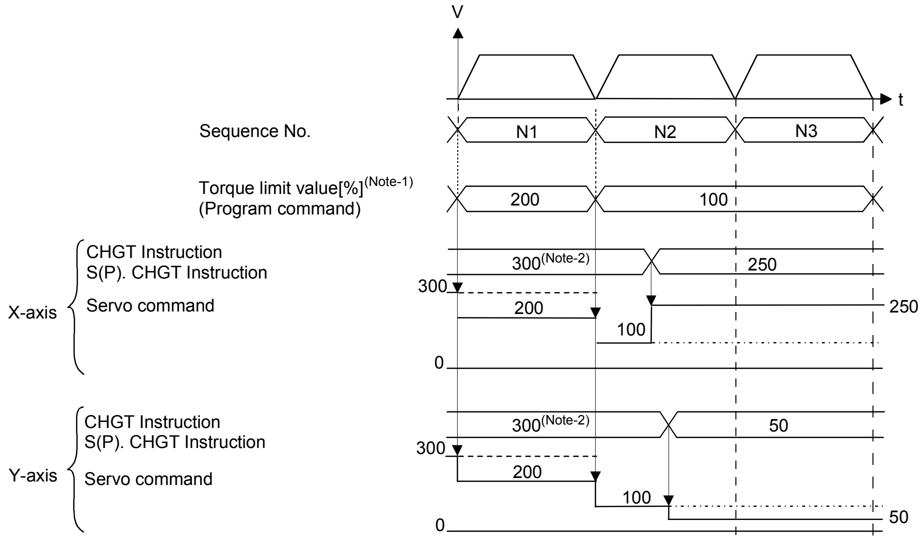
[Program Example]

(1) It is supported that the torque limit value has been set to 300[%] for each axis by the CHGT/S(P).CHGT instruction before a program start.

(2) 200[%] is set as the torque limit value of parameter block to execute a program.

(3) Motion program

```
O10;
G90;
N1 G00 X100. Y100. ;
TL100;
N2 G00 X200. Y200. ;
N3 G00 X300. Y300. ;
M02;
%
```



(Note-1) : Indicates the torque limit value change by a program or CHGT/S(P).CHGT instruction, and the resultant command to servo amplifier. Unit is [%].

1) Torque limit value changed by CHGT/S(P).CHGT instruction. Given to the change target axes.

2) The servo command indicates the torque limit value given actually to the servo amplifier.

(Note-2) : When the CHGT/S(P).CHGT instruction is not executed after power-on, the torque limit value is 300[%].

(4) Explanation

(a) In comparison with the torque limit value of parameter block specified with the S(P).SVST and the value specified with last CHGT/S(P).CHGT instruction, the lower torque limit value at a program start is commanded. In this case, the value is 200[%] every each axis.

(b) The torque limit value of TL instruction at N2 execution is 100[%] every each axis.

(c) During N2 execution, the torque limit value is changed to 250[%] in the X-axis and to 50[%] in the Y-axis by the CHGT/S(P).CHGT instruction.

7.3 Home Position Return

(1) Use the home position return at the power supply ON and other times where confirmation of axis is at the machine home position is required.

(2) The following six methods for home position return are shown below.
- Proximity dog type
- Count type
- Data set type
- Dog cradle type
- Stopper type
- Limit switch combined type

(3) The home position return data must be set for each axis to execute the home position return.

(4) Select the optimal home position return method for the system configuration and applications with reference to the following.

Home position return methods		Contents	Applications
Proximity dog type	Proximity dog type 1	• Home position is zero point of servomotor. • When the proximity dog is ON, it cannot be started.	• It is used in the system which can surely pass a zero point from the home position return start to proximity dog ON → OFF.
	Proximity dog type 2	• Home position is zero point of servomotor. • When the proximity dog is ON, it can be started.	• This method is valid when the stroke range is short and "proximity dog type 1" cannot be used.
Count type(Note-1)	Count type 1	• Home position is zero point of servomotor.	• It is used in the system which can surely pass a zero point from the home position return start to point of travel distance set as "travel value after proximity dog ON".
	Count type 2	• Zero point is not used in the home position return.	• This method is used when the proximity dog is near the stroke end and the stroke range is narrow.
	Count type 3	• Home position is zero point of servomotor.	• This method is valid when the stroke range is short and "count type 1" cannot be used.
Data set type	Data set type 1	• Home position is command position of Motion CPU.	• External input signals such as dog signal are not set in this absolute position system. • This method is valid for the data set independent of a deviation counter value.
	Data set type 2	• Home position is real position of servomotor.	• External input signals such as dog signal are not set in this absolute position system.
Dog cradle type		• Home position is zero point of servomotor immediately after the proximity dog signal ON.	• It is easy to set the position of proximity dog, because the proximity dog is set near the position made to the home position.
Stopper type	Stopper type 1	• Home position is position which stopped the machine by the stopper. • Proximity dog is used.	• This method is valid to improve home position accuracy in order to make the home position for the position which stopped the machine by the stopper.
	Stopper type 2	• Home position is position which stopped the machine by the stopper. • Proximity dog is not used.	
Limit switch combined type		• Home position is zero point of servomotor. • Proximity dog is not used. • External limit switch is surely used.	• It is used in the system that the proximity dog signal cannot be used and only external limit switch can be used.

(Note-1) : If the proximity dog signal of servo amplifier is used, the count type home position return can not be executed.

7.3.1 Home position return data

This data is used to execute the home position return.
Set this data using a peripheral device.

Table 7.2 Home position return data list

No.	Item	Setting range						Initial value	Units	Indirect setting	
		mm		inch		degree					
		Setting range	Units	Setting range	Units	Setting range	Units			Valid/ invalid	Number of words
1	Home position return direction	0: Reverse direction (Address decrease direction) 1: Forward direction (Address increase direction)						0	–	–	–
2	Home position return method	0: Proximity dog type 1 4: Proximity dog type 2 1: Count type 1 5: Count type 2 6: Count type 3 2: Data set type 1 3: Data set type 2 7: Dog cradle type 8: Stopper type 1 9: Stopper type 2 10: Limit switch combined type						0	–	–	–
3	Home position address	-214748.3648 to 214748.3647	mm	-21474.83648 to 21474.83647	inch	0 to 359.99999	degree	0	mm	○	2
4	Second home position address	-214748.3648 to 214748.3647	mm	-21474.83648 to 21474.83647	inch	0 to 359.99999	degree	0	mm	○	2
5	Home position return speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647 (Note-1)	degree/min	0.01	mm/min	○	2
6	Creep speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647 (Note-1)	degree/min	0.01	mm/min	○	2
7	Travel value after proximity dog ON	0.0000 to 214748.3647	mm	0.00000 to 21474.83647	inch	0.00000 to 21474.83647	degree	0	mm	○	2
8	Parameter Block setting	1 to 64						1	–	–	–
9	Home position return retry function	0: Invalid (Do not execute the home position return retry by limit switch.) 1: Valid (Execute the home position return retry by limit switch.)						0	–	–	–
10	Dwell time at the home position return retry	0 to 5000 [ms]						0	ms	○	1
11	Home position shift amount	-214748.3648 to 214748.3647	mm	-21474.83648 to 21474.83647	inch	-21474.83648 to 21474.83647	degree	0	mm	○	2
12	Speed set at the home position shift	0: Home position return speed 1: Creep speed						0	–	–	–
13	Torque limit value at the creep speed	1 to 1000 [%]						300	%	○	1
14	Operation setting for incompletion of home position return	0: Execute Motion program 1: Not execute G-code of Motion program except G28						1	–	–	–

	Remarks	Explanatory section
	• The home position return direction is set.	—
	• The home position return method is set. • The proximity dog type or count type are recommended for the servo amplifier which does not support absolute value.	—
	• The current value of home position after the home position return is set. • It is recommended that the home position address is set in the upper stroke limit value or lower stroke limit value.	—
	• The current value of second home position after the second home position return is set. • It is recommended that the second home position address is set in the upper stroke limit value or lower stroke limit value.	—
	• The home position return speed is set.	—
	• The creep speed (low speed immediately before stopping after deceleration from home position return speed) after the proximity dog ON is set.	—
	• The travel value after the proximity dog ON for the count type is set. • More than the deceleration distance at the home position return speed is set.	7.3.1 (1)
	• The parameter block (Refer to Section 5.3) No. to use for home position return is set.	—
	• Valid/invalid of home position return retry is set.	7.3.1 (2)
	• The stop time at the deceleration stop during the home position return retry is set.	
	• The shift amount at the home position shift is set.	7.3.1 (3)
	• The operation speed which set the home position shift amount except "0" is set.	
	• The torque limit value with creep speed at the stopper type home position return is set.	7.3.1 (4)
	• When the home position return request signal is ON, it set whether a travel instruction except G28 can be executed or not in the Motion program.	7.3.1 (5)

(Note-1): When the "speed control 10×multiplier setting for degree axis" is set to "valid"in the fixed parameter, the setting range is "0.01 to 21474836.47"[degree/min].

(1) Travel value after proximity dog ON

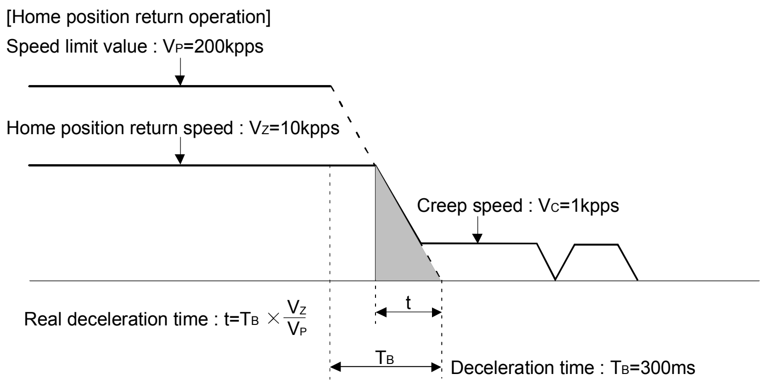
(a) The travel value after proximity dog ON is set to execute the count type home position return.

(b) After the proximity dog ON, the home position is the first zero-point after travel by the setting travel value.

(c) Set the travel value after proximity dog ON more than the deceleration distance from the home position return speed.

Example

The deceleration distance is calculated from the speed limit value, home position return speed, creep speed and deceleration time as shown below.



[Deceleration distance (shaded area under graph)]

$= \frac{1}{2} \times \frac{V_Z}{1000} \times t$

Converts in speed per millisecond

$= \frac{V_Z}{2000} \times \frac{T_B \times V_Z}{V_P}$

$= \frac{10 \times 10^3}{2000} \times \frac{300 \times 10 \times 10^3}{200 \times 10^3}$

$= 75$ . . . . . . Set 75 or more

POINT

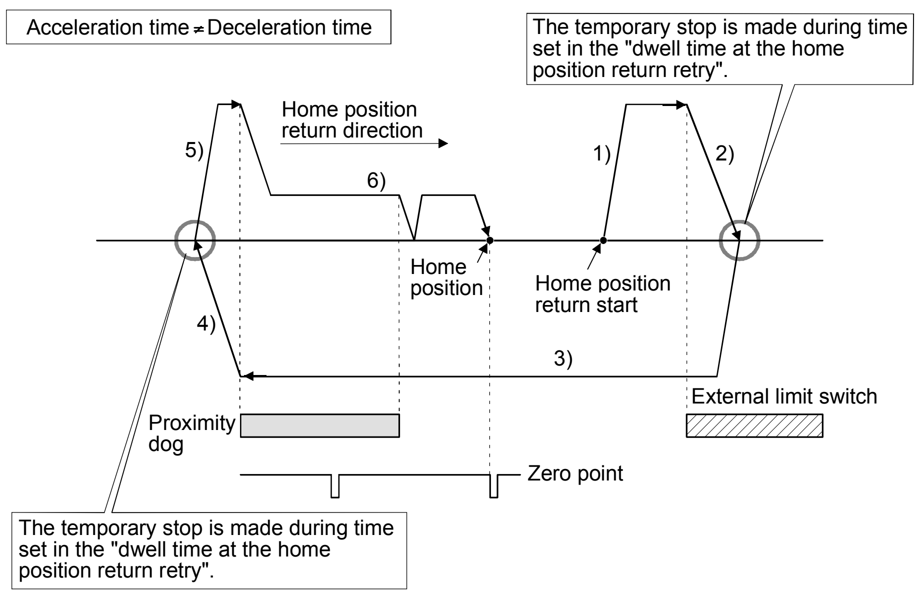
A home position return must be made after the servomotor has been rotated more than one revolution to pass the axis through the Z-phase (motor reference position signal).
For a proximity dog type or count type home position return, the distance between the point where the home position return program is started and the deceleration stop point before re-travel must be such that the servomotor is rotated more than one revolution to pass the axis through the Z-phase.
When a data set type home position return is made in an ABS (absolute position) system, the servomotor must also have been rotated more than one revolution by JOG operation or the like to pass the axis through the Z-phase.
(Note) : When "1 : No servomotor Z-phase pass after power ON" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), even if it does not pass zero point, the home position return can be executed and restrictions are lost.

(2) Home position return retry function/dwell time at the home position return retry

(a) Valid/invalid of home position return retry is set.

(b) When the valid of home position return retry function is set, the time to stop at return of travel direction is set with dwell time at the home position return retry.

(c) Operation for the proximity dog type home position return by setting "valid" for home position return retry function is shown below.



1) It travels to preset direction of home position return.
2) If the external upper/lower limit switch turns OFF before the detection of proximity dog, a deceleration stop is made.
3) After a deceleration stop, the temporary stop is made during time set in the "dwell time at the home position return retry" and it travels to reverse direction of home position return with the home position return speed.
4) A deceleration stop is made by the proximity dog OFF.
5) After a deceleration stop, the temporary stop is made during time set in the "dwell time at the home position return retry" and it travels to direction of home position return.
6) Home position return ends.

Fig. 7.2 Operation for home position return retry function

(d) Possible/not possible of home position return retry function by the home position return method is shown below.

Home position return methods	Possible/not possible of home position return retry function
Proximity dog type	○
Count type	○
Data set type	×
Dog cradle type	○
Stopper type	×
Limit switch combined type	×

○ : Possible, × : Not possible

(3) Home position shift amount/speed set at the home position shift

(a) The shift (travel) amount from position stopped by home position return is set.

(b) If the home position shift amount is positive value, it shifts from detected zero point signal to address increase direction. If it is negative value, it shifts from detected zero point signal to address decrease direction.

(c) Operation speed which set the home position shift amount except "0" is set in the speed set at the home position shift. Select one of the "home position return speed" or "creep speed".

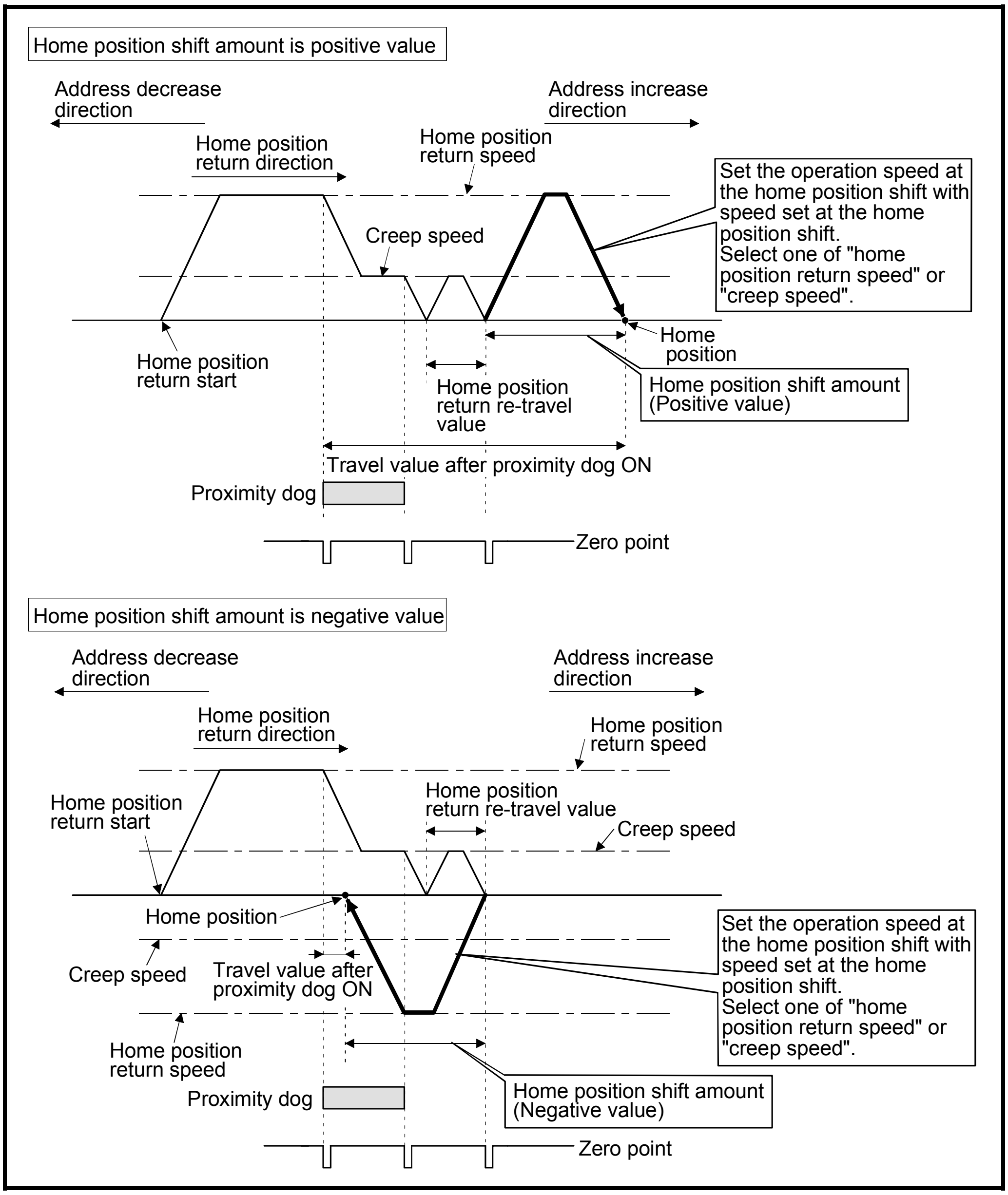


Fig. 7.3 Home position shift amount/speed set at the home position shift

(d) Valid/invalid of the setting value for home position shift amount by the home position return method is shown below.

Home position return methods	Valid/invalid of home position shift amount
Proximity dog type	○
Count type	○
Data set type	×
Dog cradle type	○
Stopper type	×
Limit switch combined type	○

○ : Valid, × : Invalid

POINT

(1) Home position shift function is used to rectify a home position stopped by the home position return. When there are physical restrictions in the home position by the relation of a proximity dog installation position, the home position is rectified to the optimal position. Also, by using the home position shift function, it is not necessary to care the zero point for an installation of servomotor.

(2) After proximity dog ON, if the travel value including home position shift amount exceeds the range of "-2147483648 to 2147483647" [$\times 10^{-4}$mm, $\times 10^{-5}$inch, $\times 10^{-5}$degree], "travel value after proximity dog ON" of monitor register is not set correctly.

(4) Torque limit value at the creep speed

(a) Torque limit value at the creep speed (on press) is set in the case of using the pressed position as, the home position by the home position return of stopper type 1, 2.

(b) Valid/invalid of the torque limit value at the creep speed by the home position return method is shown below.

Home position return methods	Valid/invalid of torque limit value at the creep speed
Proximity dog type	×
Count type	×
Data set type	×
Dog cradle type	×
Stopper type	○
Limit switch combined type	×

○ : Valid, × : Invalid

(5) Operation setting for incompletion of home position return

(a) Operation in selecting "0: Execute Motion program"

1) When "0: Execute Motion program" is set in all axes among axes(Note) specified at Motion program start, the Motion program can be executed regardless of ON/OFF of the home position return request signal (M2409+20n).

(Note): Axis name described in axis designation program start by the SVST, CALL or GOSUB/GOSUBE instruction.

(b) Operation in selecting "1: Not execute G-code of Motion program except G28".

1) When "1: Not execute G-code of Motion program except G28" is set even by one axis among axes specified at Motion program start, and the home position return request signals (M2409+20n) are turned ON for all axes specified at Motion program start, the practicable instructions in started Motion program are shown below.

Practicable instructions	G28 (Home position return)
	All controlled instructions

2) In case of above 1), when the travel instruction by the G-code except G28 is executed to all axes specified at Motion program start, a minor error [error code: 680] occurs and Motion program ends.

3) In case of above 1), G28 is executed in the beginning of Motion program, and if the home position return request signals (M2409+20n) are turned OFF for all axes specified at Motion program start, after that, normal travel instruction can be executed.

4) JOG operation and manual pulse generator operation can be executed regardless of the home position return request signal (M2409+20n) ON/OFF.

5) Same operation is executed regardless of absolute position system or not. When "1: Not execute G-code of Motion program except G28" is selected in the case of not absolute position system, the home position return request signal (M2409+20n) turns ON at power supply ON or reset of Motion CPU and power supply ON of servo amplifier. Therefore, it must be executed any of the followings.
- Home position return by CHGA instruction before Motion program start.
- Home position return by G28

6) Same operation is executed in also TEST mode.

POINT

If the all axes specified at Motion program start are not condition of home position return completion in the Motion program execution, it can be set using this function, as the Motion program operation except home position return is not possible.
Therefore, when it interferes with another axis for incompletion of home position return even if it is an axis for completion of home position return, the travel instruction cannot be executed until it becomes the home position return completion for all axes specified at Motion program start.

Example 1

Operation example in starting the Motion program in the condition that the fixed parameter and home position return request signal were set as the following is shown below.

Setting axis	Operation setting for incompletion of home position return	Home position return request signal (M2409+20n)
Axis 1 (X)	1: Not execute G-code of Motion program except G28	ON
Axis 2 (Y)	0: Execute Motion program	OFF

```
O100 ;
SET #M3000 ;        Controlled instruction is executed.
G0 Y100. ;          Since the home position return request signal of X-axis is ON and
                    it is not home position return completion for all axes, a minor error
                    [error code: 680] occurs and the Motion program ends even if it is
                    travel instruction to Y-axis.
G1 X100.  F1000. ;
•
•
•
```

Example 2

Operation example in starting the Motion program in the condition that the fixed parameter and home position return request signal were set as the following is shown below.

Setting axis	Operation setting for incompletion of home position return	Home position return request signal (M2409+20n)
Axis 1 (X)	1: Not execute G-code of Motion program except G28	ON
Axis 2 (Y)	1: Not execute G-code of Motion program except G28	OFF

```
O100 ;
G28  X Y ;          Home position return is executed according to the home position
                    return method of home position return data for X-axis.
                    High-speed home position return is executed for Y-axis.
G1 X100.  F1000. ;  Home position return request signal turned OFF for all axes in the
•                   last block, and next travel instruction can be executed.
•
•
```

(6) Indirect setting of home position return data

A part of home position return data can be executed the indirect setting by the word devices (D, W, #) of Motion CPU.

(a) Data devices for indirect setting

There are data registers (D), link registers (W) and Motion registers (#) as data devices for indirect setting. (Word devices except data registers, link registers and Motion registers cannot be used.) Usable devices are shown below. (Set the number of words for 2 words as even number.)

Word devices	Usable devices
D	1690 to 8191
W	0 to 1FFF
#	0 to 7999

(b) Read home position return data

In the indirect setting by the word devices, the specified word device data are read at Motion program execution by Motion CPU.
Set data to devices for indirect setting and then execute the start request of Motion program at home position return.

(c) Read a home position address/second home position address

1) G28

When the home position return request signal (M2409+20n) is ON, it is executed in the home position return method specified with the home position return data. The home position return data read in the starting are current value. And simultaneously, the home position return data are saved to memory backed up electrically.
When the home position return request signal (M2409+20n) is OFF, the high-speed home position return is executed the backed up home position return data as a home position. The home position address specified with the home position return data is not newly read.

POINT

The home position data backed up in the first home position return are used. Therefore, even if the home position return data at first home position return and at high-speed home position return is different, certainly the high-speed home position return is executed to the home position with the peculiar machine set at first. There is a case in which the home position return data differs with the first home position return by changing the programming software or contents of register for indirect setting, etc.

2) CHGA

It is executed in the home position return method specified with the home position return data. The home position return data read in the starting are current value. And simultaneously, the home position return data are saved to memory backed up electrically.

3) G30

The second home position return address specified with the home position return data is read every time, and the positioning is executed with high-speed feed rate.

POINT
Take an interlock not to change the device data specified for indirect setting until the home position return is completed. If the device data is changed before completion of home position return, it may not execute the home position return at the normal value.

(7) Setting items for home position return data

Items		Home position return methods										
		Proximity dog type 1	Proximity dog type 2	Count type 1	Count type 2	Count type 3	Data set type 1	Data set type 2	Dog cradle type	Stopper type 1	Stopper type 2	Limit switch combined type
Home position return data	Home position return direction	○	○	○	○	○	○	○	○	○	○	○
	Home position address	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	Second home position address	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	Home position return speed	◎	◎	◎	◎	◎	–	–	◎	◎	–	◎
	Creep speed	◎	◎	◎	◎	◎	–	–	◎	◎	◎	◎
	Travel value after proximity dog ON	–	–	◎	◎	◎	–	–	–	–	–	–
	Parameter block setting	○	○	○	○	○	–	–	○	○	○	○
	Home position return retry function	○	○	○	○	○	–	–	○	–	–	–
	Dwell time at the home position return retry	◎	◎	◎	◎	◎	–	–	◎	–	–	–
	Home position shift amount	◎	◎	◎	◎	◎	–	–	◎	–	–	◎
	Speed set at the home position shift	○	○	○	○	○	–	–	○	–	–	○
	Torque limit value at the creep speed	–	–	–	–	–	–	–	–	◎	◎	–
	Operation setting for incompletion of home position return	○	○	○	○	○	○	○	○	○	○	○
Parameter blocks	Interpolation control unit	–	–	–	–	–	–	–	–	–	–	–
	Speed limit value	–	–	–	–	–	–	–	–	–	–	–
	Acceleration time	○	○	○	○	○	–	–	○	○	○	○
	Deceleration time	○	○	○	○	○	–	–	○	○	○	○
	Rapid stop deceleration time	○	○	○	○	○	–	–	○	○	○	○
	S-curve ratio	○	○	○	○	○	–	–	○	○	○	○
	Torque limit value	○	○	○	○	○	–	–	○	○	○	○
	Deceleration processing at the stop time	○	○	○	○	○	–	–	○	○	○	○
	Allowable error range for circular interpolation	–	–	–	–	–	–	–	–	–	–	–

◎: Must be set (Indirect setting)
○: Must be set
—: Must be not set

7.3.2 Home position return by the proximity dog type 1

[Control details]

(1) Proximity dog type 1

Zero point position after proximity dog ON to OFF is home position in this method.

When it does not pass (zero pass signal: M2406+20n OFF) the zero point from home position return start to deceleration stop by proximity dog ON to OFF, an error will occur and home position return is not executed. However, when "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), if it does not pass zero point from home position return start to deceleration stop by proximity dog ON to OFF, the home position return can be executed.

(2) Home position return by the proximity dog type 1

Operation of home position return by proximity dog type 1 for passing (zero pass signal: M2406+20n ON) the zero point from home position return start to deceleration stop by proximity dog ON to OFF is shown below.

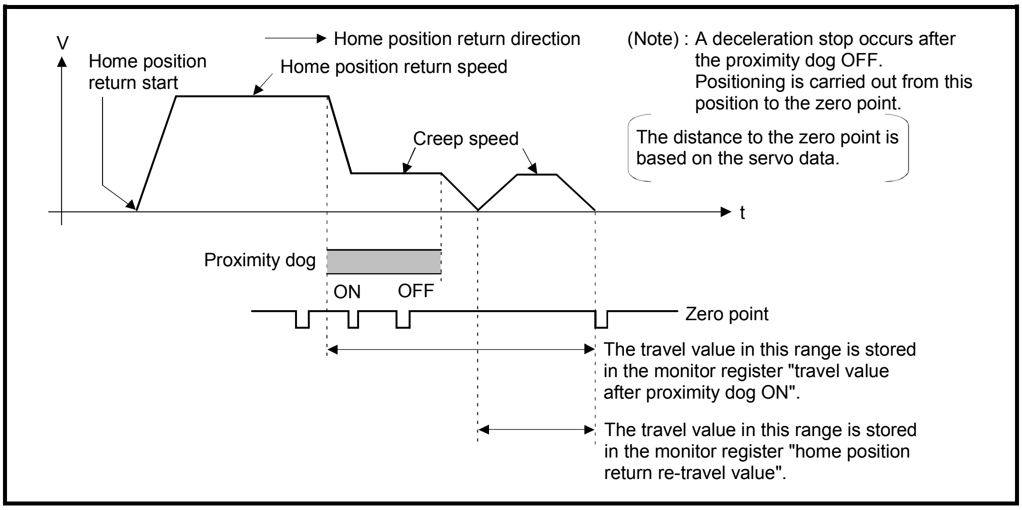


Fig. 7.4 Home position return operation by the proximity dog type 1

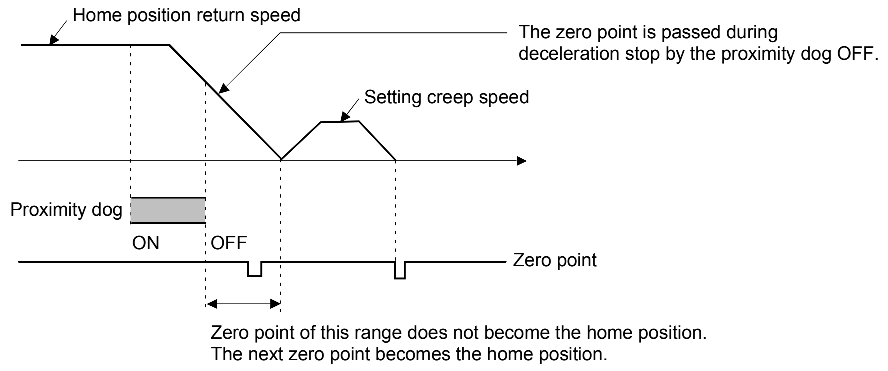
(3) Home position return execution

Home position return by the proximity dog type 1 is executed using the CHGA instruction in Section 7.3.16.

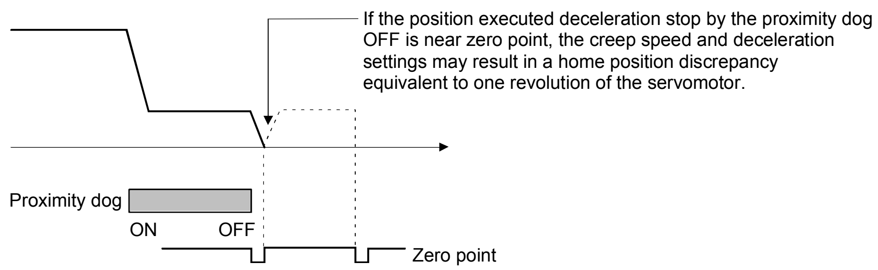
When the home position return request is ON, the proximity dog type 1 home position return is also made even G28 of the Motion program.

[Cautions]

(1) Keep the proximity dog ON during deceleration from the home position return speed to the creep speed.
If the proximity dog turns OFF before deceleration to the creep speed, a deceleration stop is made and the next zero point is set as the home position.



(2) The position executed deceleration stop by proximity dog OFF is near zero point, a home position discrepancy equivalent to one revolution of the servomotor may occur. Adjust the position of proximity dog OFF, such that the home position return re-travel value becomes half the travel value for one revolution of the servomotor.



POINT

When the home position return retry function is not set in the following cases, execute the home position return, after return the axis once to position before the proximity dog ON by the JOG operation, etc.
Home position return cannot be executed without returning to position before the proximity dog ON.
(1) Home position return with a position after the proximity dog ON to OFF.
(2) When the power supply turned OFF to ON after home position return end.

(3) When it does not pass (zero pass signal: M2406+20n ON) the zero point from home position return start to deceleration stop by proximity dog ON to OFF, a minor error "ZCT not set" (error code: 120) will occur, a deceleration stop is made and home position return does not end normally. When a distance between home position return start position and home position is near and a zero point is not passed, select the proximity dog type 2.

(4) If home position return is executed in the proximity dog ON, a major error "proximity dog signal is turning ON at the home position return start" (error code: 1003) will occur, the home position return is not executed. Use the proximity dog type 2 in this case.

(5) When home position return retry function is not set, if home position return is executed again after home position return end, a minor error "home position return completion signal is turning ON at the proximity dog type home position return start" (error code: 115)" will occur, the home position return is not executed.

(6) If in-position signal (M2402+20n) does not turn ON, home position return is not ended.

7.3.3 Home position return by the proximity dog type 2

[Control details]

(1) Proximity dog type 2

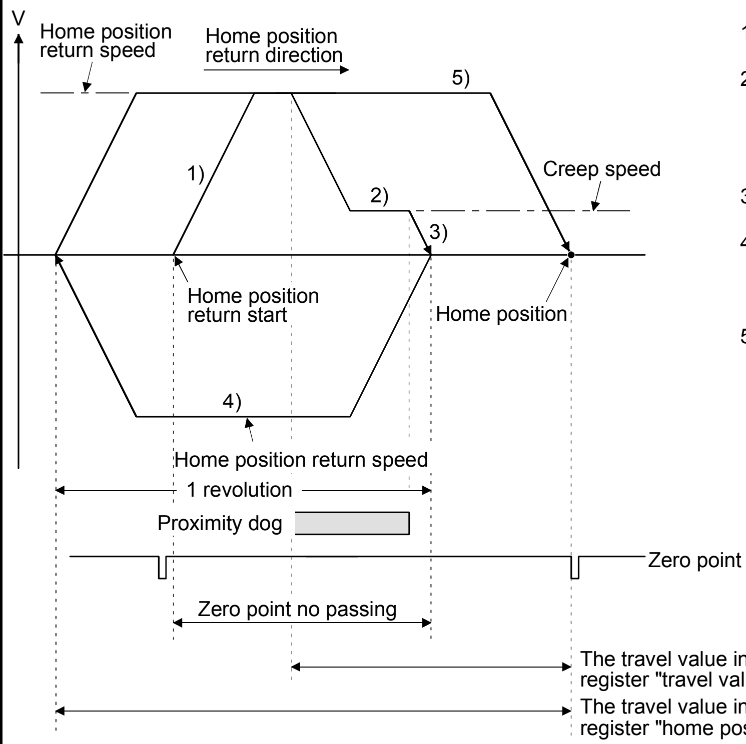
Zero point position after proximity dog ON to OFF is home position in this method.

When it passed (zero pass signal: M2406+20n ON) the zero point from home position return start to deceleration stop by proximity dog ON to OFF, operation for "proximity dog type 2" is the same as "proximity dog type 1". (Refer to Section 7.3.2)

When it does not pass (zero pass signal: M2406+20n OFF) the zero point from home position return start to deceleration stop by proximity dog ON to OFF, it moves to home position return direction after the servomotor is rotated one revolution to reverse direction and it passed the zero point, and the first zero point position is set as home position after proximity dog ON to OFF.

(2) Home position return by the proximity dog type 2

Operation of home position return by proximity dog type 2 for not passing the zero point from home position return start to deceleration stop by proximity dog ON to OFF is shown below.



1) It travels to preset direction of home position return with the home position return speed.
2) A deceleration is made to the creep speed by the proximity dog ON, after that, it travels with the creep speed. (If the proximity dog turns OFF during a deceleration, a deceleration stop is made and the operation for 4) starts.)
3) A deceleration stop is made by the proximity dog OFF.
4) After a deceleration stop, it travels for one revolution of servomotor to reverse direction of home position return with the home position return speed.
5) It travels to direction of home position return with the home position return speed, the home position return ends with first zero point after the proximity dog ON to OFF. (At this time, a deceleration to the creep speed is not made with the proximity dog OFF to ON . And if the zero point is not passed because of droop pulses for processing of 4) and 5), a minor error "ZCT not set" (error code: 120) will occur, a deceleration stop is made and the home position return does not end normally. In this case, adjust a position of proximity dog OFF.)

Fig. 7.5 Home position return operation by the proximity dog type 2 (zero point no passing)

(3) Home position return execution
Home position return by the proximity dog type 2 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the proximity dog type 2 home position is also made even G28 of the Motion program.

[Cautions]

(1) A system which the servomotor can rotate one time or more is required.

(2) When a servomotor stops with specified condition enables and rotates one time after proximity dog ON, make a system for which does not turn OFF the external upper/lower stroke limit.

(3) Keep the proximity dog ON during deceleration from the home position return speed to the creep speed.
If the proximity dog turns OFF before deceleration to the creep speed, a deceleration stop is made and the next zero point is set as the home position.

(4) If home position return is executed in the proximity dog ON, it starts with the creep speed.

(5) When home position return retry function is not set, if home position return is executed again after home position return completion, a minor error "home position return completion signal is turning ON at the proximity dog type home position return start" (error code: 115) will occur, the home position return is not executed.

(6) When "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), even if it does not pass zero at the servo amplifier power ON, the zero pass signal (M2406+20n) turns ON. This operation is the same as proximity dog type 1.

(7) If in-position signal (M2402+20n) does not turn ON, home position return is not ended.

7.3.4 Home position return by the count type 1

[Control details]

(1) Count type 1

After the proximity dog ON, the zero point after the specified distance (travel value after proximity dog ON) is home position in this method.
(If the proximity dog signal of servo amplifier is used, the count type 1 home position return cannot be executed.)
When the zero point is not passed (zero pass signal: M2406+20n OFF) until it travels the distance set in the "travel value after proximity dog ON" from home position return start, an error will occur and home position return is not executed.
However, when "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), if the zero point is not passed until it travels the distance set in the "travel value after proximity dog ON" from home position return start, the home position return can be executed.
The travel value after proximity dog ON is set in the home position return data (Refer to Section 7.3.1).

(2) Home position return by the count type 1

Operation of home position return by count type 1 for passing the distance set in the "travel value after proximity dog ON" from the home position return start is shown below.

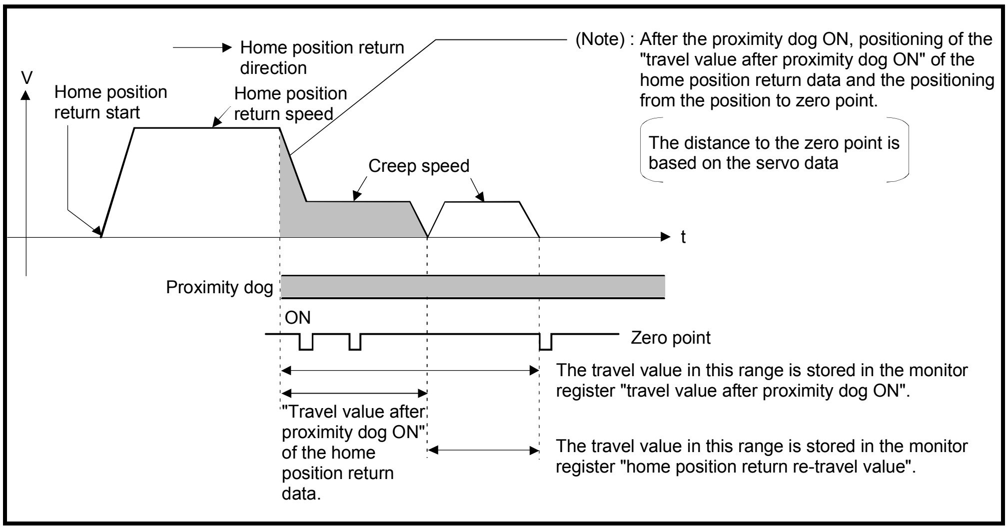


Fig. 7.6 Home position return operation by the count type 1

(3) Home position return execution

Home position return by the count type 1 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the count type 1 home position is also made even G28 of the Motion program.

[Cautions]

(1) Home position return and continuously start of home position return are also possible in the proximity dog ON in the count type 1.
When the home position return or continuously start of home position return are executed in the proximity dog ON, the home position return is executed after return the axis once to position of the proximity dog OFF.

(2) When the zero point is not passed (zero pass signal: M2406+20n ON) until it travels the distance set in the "travel value after proximity dog ON" from home position return start, a minor error "ZCT not set" (error code: 120) will occur, a deceleration stop is made and home position return does not end normally. When a distance between home position return start position and home position is near and a zero point is not passed, select the count type 3.

(3) When the "travel value after proximity dog ON" is less than the deceleration distance from "home position return speed" to "creep speed", a minor error "an overrun occurred because the setting travel value is less than the deceleration distance at the proximity dog signal input during home position return of count type" (error code: 209) will occur and deceleration stop is made.

(4) If in-position signal (M2402+20n) does not turn ON, home position return is not ended.

7.3.5 Home position return by the count type 2

[Control details]

(1) Count type 2

After the proximity dog ON, the position which traveled the specified distance (travel value after proximity dog ON) is home position in this method.
(If the proximity dog signal of servo amplifier is used, the count type 2 home position return cannot be executed.)
It is not related for zero point pass or not pass.
A count type 2 is effective method when a zero point signal cannot be taken.
(However, dispersions will occur to the stop position at the home position return compared with the count type 1.)
The travel value after proximity dog ON is set in the home position return data (Refer to Section 7.3.1).

(2) Home position return by the count type 2

Operation of home position return by count type 2 is shown below.

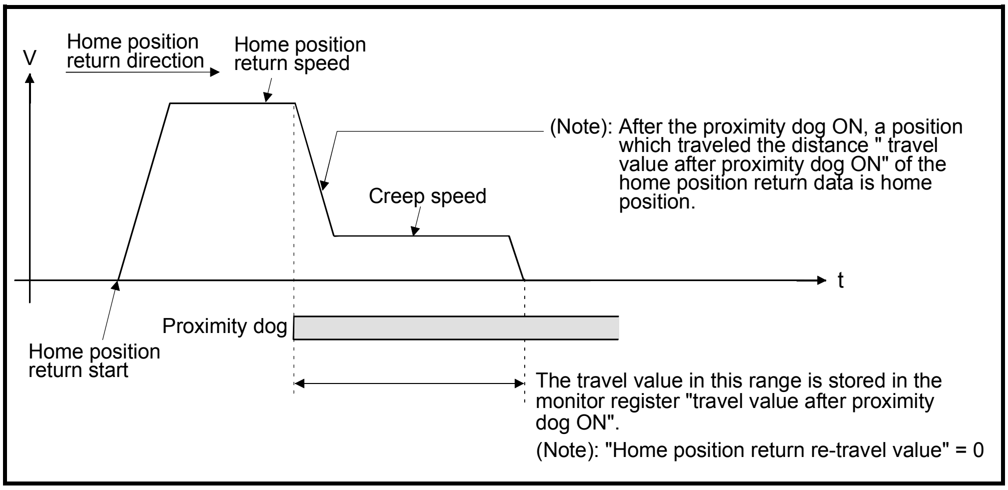


Fig. 7.7 Home position return operation by the count type 2

(3) Home position return execution

Home position return by the count type 2 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the count type 2 home position return is also made even G28 of the Motion program.

[Cautions]

(1) Home position return and continuously start of home position return are also possible in the proximity dog ON in the count type 2.
When the home position return and continuously start of home position return are executed in the proximity dog ON, the home position return is executed after return the axis once to position of the proximity dog OFF.

(2) When the "travel value after proximity dog ON" is less than the deceleration distance from "home position return speed" to "creep speed", a minor error "an overrun occurred because the setting travel value is less than the deceleration distance at the proximity dog signal input during home position return of count type" (error code: 209) will occur and deceleration stop is made.

(3) Command position is the home position.

(4) If in-position signal (M2402+20n) does not turn ON, home position return is not ended.

7.3.6 Home position return by the count type 3

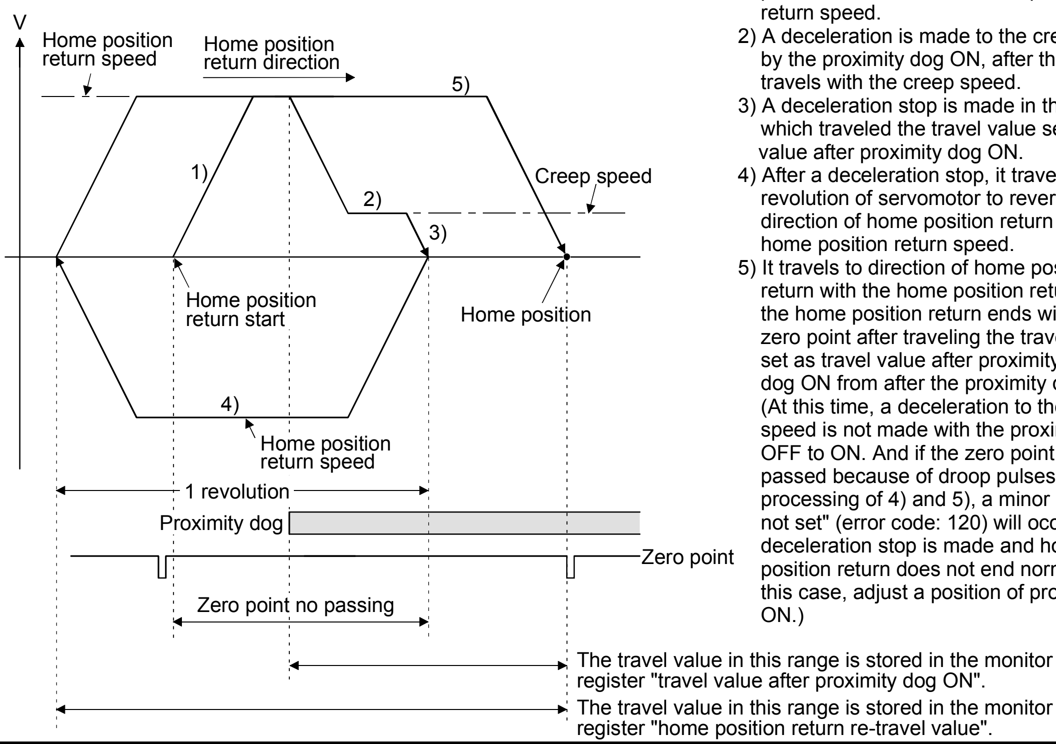
[Control details]

(1) Count type 3

After the proximity dog ON, the zero point after the specified distance (travel value after proximity dog ON) is home position in this method.
(If the proximity dog signal of servo amplifier is used, the count type 3 home position return cannot be executed.)
When the zero point is passed (zero pass signal: M2406+20n ON) during travel of specified distance set in the "travel value after proximity dog ON" from the home position return start, home position return operation is the same as "count type 1". (Refer to Section 7.3.4)
When a zero point is not passed (zero pass signal: M2406+20n OFF) during travel of specified distance set in the "travel value after proximity dog ON" from the home position return start, it rotates one time to reverse direction and passes the zero point, re-travels to home position return direction, and then the first zero point after the specified distance (travel value after proximity dog ON) after proximity dog ON is set as home position.
The travel value after proximity dog ON is set in the home position return data (Refer to Section 7.3.1).

(2) Home position return by the count type 3

Operation of home position return by count type 3 for not passing the zero point during travel of specified distance set in the "travel value after proximity dog ON" from home position return start is shown below.



1) It travels to preset direction of home position return with the home position return speed.
2) A deceleration is made to the creep speed by the proximity dog ON, after that, it travels with the creep speed.
3) A deceleration stop is made in the position which traveled the travel value set as travel value after proximity dog ON.
4) After a deceleration stop, it travels for one revolution of servomotor to reverse direction of home position return with the home position return speed.
5) It travels to direction of home position return with the home position return speed, the home position return ends with first zero point after traveling the travel value set as travel value after proximity dog ON from after the proximity dog ON. (At this time, a deceleration to the creep speed is not made with the proximity dog OFF to ON. And if the zero point is not passed because of droop pulses for processing of 4) and 5), a minor error "ZCT not set" (error code: 120) will occur, a deceleration stop is made and home position return does not end normally. In this case, adjust a position of proximity dog ON.)

Fig. 7.8 Home position return operation by the count type 3 (zero point no passing)

(3) Home position return execution

Home position return by the count type 3 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the count type 3 home position return is also made even G28 of the Motion program.

[Cautions]

(1) A system which the servomotor can rotate one time or more is required.

(2) After the proximity dog ON, when a servomotor rotates one time to reverse direction after stop with travel value set in the "travel value after proximity dog ON", make a system which does not turn OFF the external upper/lower stroke limit.

(3) Home position return and continuously start of home position return are also possible in the proximity dog ON in the count type 3.
When the home position return and continuously start of home position return are executed in the proximity dog ON, the home position return is executed after return the axis once to position of the proximity dog OFF.

(4) When the "travel value setting after proximity dog ON" is less than the deceleration distance from "home position return speed" to "creep speed", a minor error "an overrun occurred because the setting travel value is less than the deceleration distance at the proximity dog signal input during home position return of count type" (error code: 209) will occur and deceleration stop is made.

.

(5) When "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), even if it does not pass zero point at the servo amplifier power ON, the zero pass signal (M2406+20n) turns ON. This operation is the same as count type 1.

(6) If in-position signal (M2402+20n) does not turn ON, home position return is not ended.

7.3.7 Home position return by the data set type 1

[Control details]

(1) Data set type 1

The proximity dog is not used in this method for the absolute position system.

(2) Home position return by the data set type 1

Home position is the command position at the home position return operation.

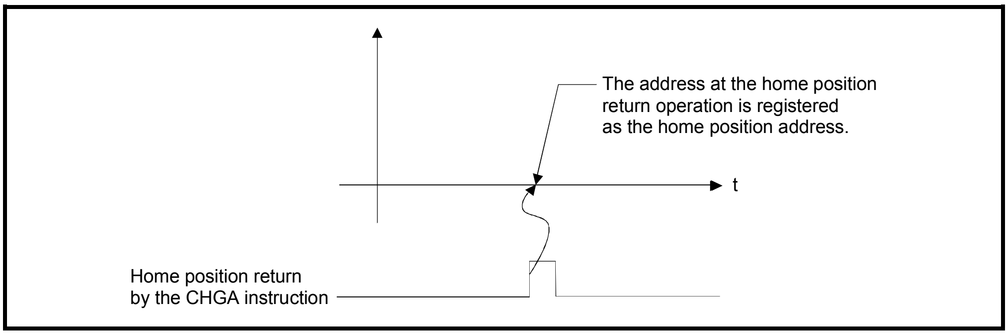


Fig. 7.9 Home position return operation by the date set type 1

(3) Home position return execution

Home position return by the data set type 1 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the data set type 1 home position return is also made even G28 of the Motion program.

[Cautions]

(1) A zero point must be passed (zero pass signal: M2406+20n ON) between turning ON the power supply and executing home position return.
If home position return is executed without passing a zero point once, "no zero point passed error" occurs. If "no zero point passed error" occurred, perform the home position return again, after reset the error and turn the servomotor at least one revolution by the JOG operation.
The zero point passing can be confirmed with the zero pass signal (M2406+20n).
However, when "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), even if it does not pass zero point at the servo amplifier power ON, the home position return is possible because the zero pass signal (M2406+20n) turns ON.

(2) Home position return is started by the data set type 1 when the absolute position system does not support, it becomes same function as the current value change command.

(3) The home position return data required for the data set type 1 are the home position return direction and home position address.

(4) If in-position signal (M2402+20n) does not turn ON, home position return is not ended.

7.3.8 Home position return by the data set type 2

[Control details]

(1) Data set type 2

The proximity dog is not used in this method for the absolute position system.

(2) Home position return by the data set type 2

Home position is the real position of servomotor at the home position return operation.

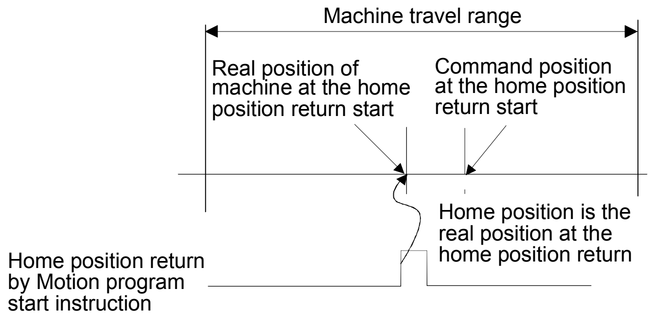


Fig. 7.10 Home position return operation by the date set type 2

(3) Home position return execution

Home position return by the data set type 2 is executed using the CHGA instruction in Section 7.3.16.

When the home position return request is ON, the data set type 2 home position return is also made even G28 of the Motion program.

[Cautions]

(1) A zero point must be passed (zero pass signal: M2406+20n ON) between turning ON the power supply and executing home position return.
If home position return is executed without passing a zero point once, "no zero point passed error" occurs. If "no zero point passed error" occurred, perform the home position return again, after reset the error and turn the servomotor at least one revolution by the JOG operation.
The zero point passing can be confirmed with the zero pass signal (M2406+20n).
However, when "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), even if it does not pass zero point at the servo amplifier power ON, the home position return is possible because the zero pass signal (M2406+20n) turns ON.

(2) The home position return data required for the data set type 2 are the home position return direction and home position address.

7.3.9 Home position return by the dog cradle type

[Control details]

(1) Dog cradle type

After deceleration stop by the proximity dog ON, if the zero point is passed after traveling to reverse direction and turning the proximity dog OFF, the deceleration stop is made. And it moves to direction of home position return again with creep speed and the first zero point after proximity dog ON is home position in this method.

(2) Home position return by the dog cradle type

Operation of home position return by the dog cradle type for setting the proximity dog in the home position return direction is shown below.

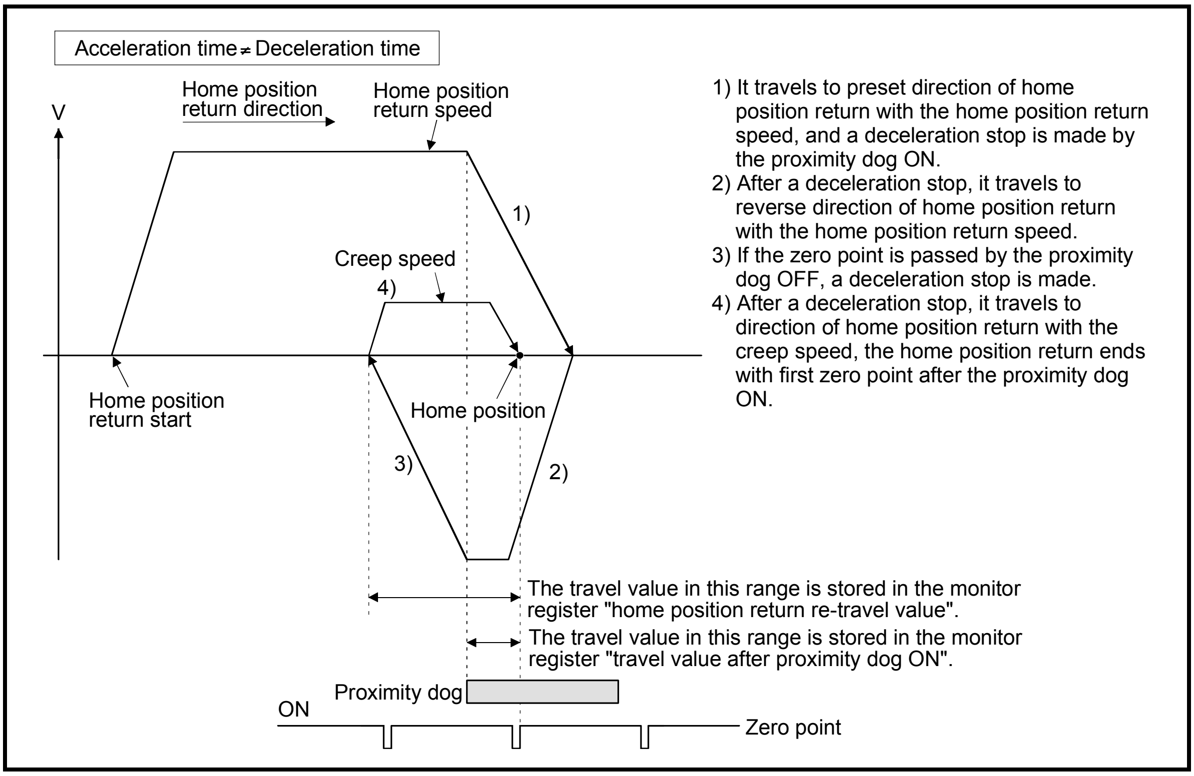


Fig. 7.11 Home position return operation by the dog cradle type

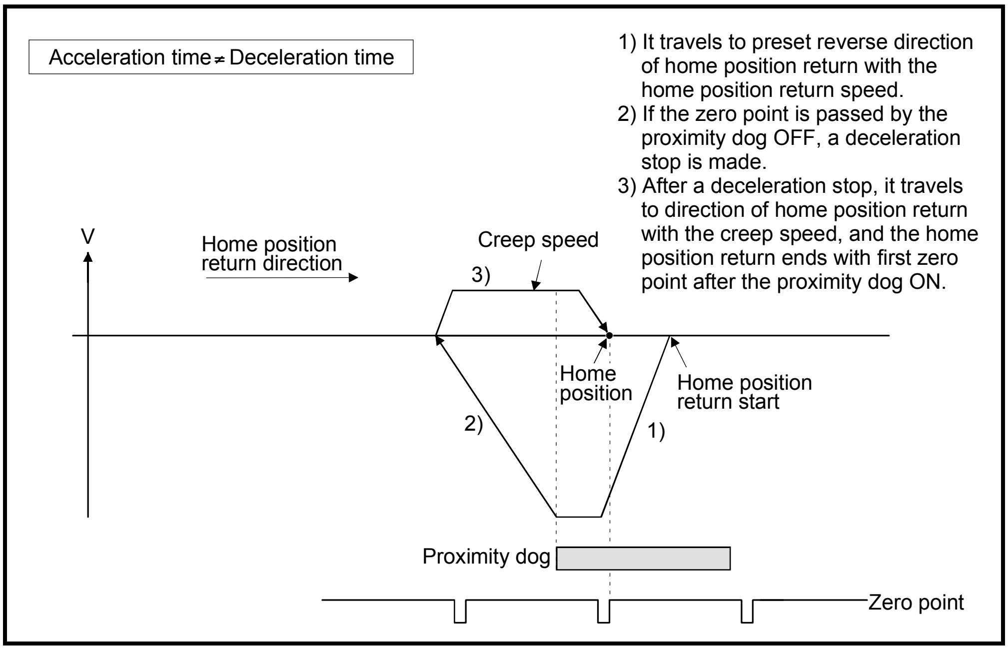
(3) Home position return execution

Home position return by the dog cradle type is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the dog cradle type home position return is also made even G28 of the Motion program.

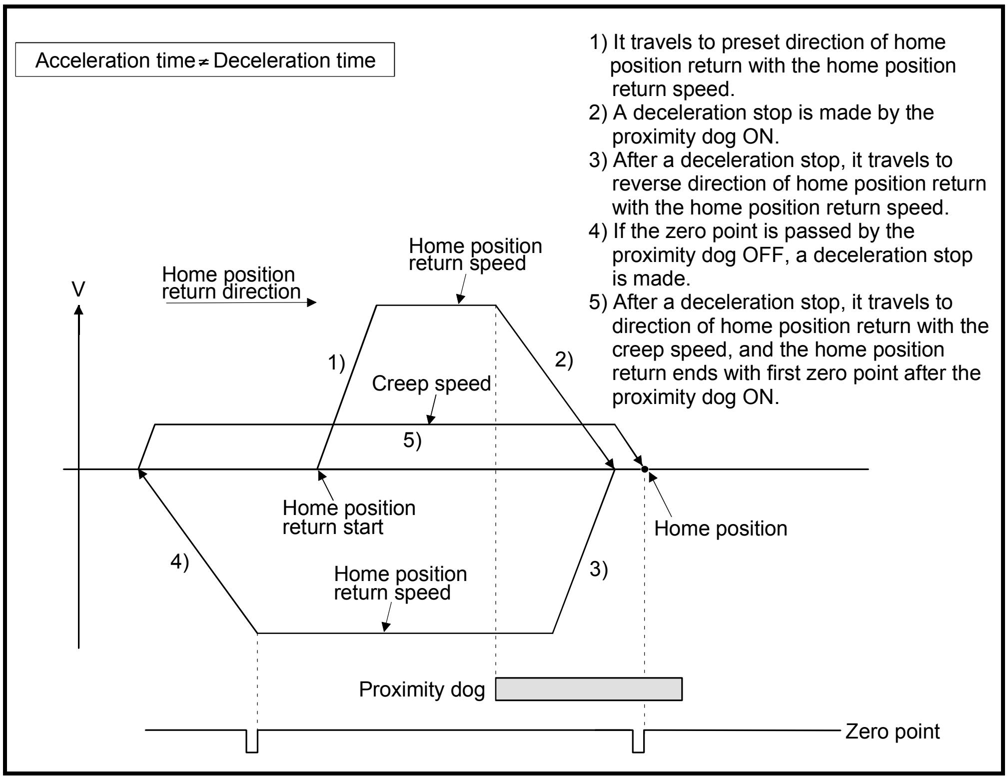
[Cautions]

(1) When home position return retry function is not set, if home position return is executed again after home position return end, a minor error "home position return complete signal is turning ON at the dog cradle type home position return start" (error code: 115) will occur, the home position return is not executed.

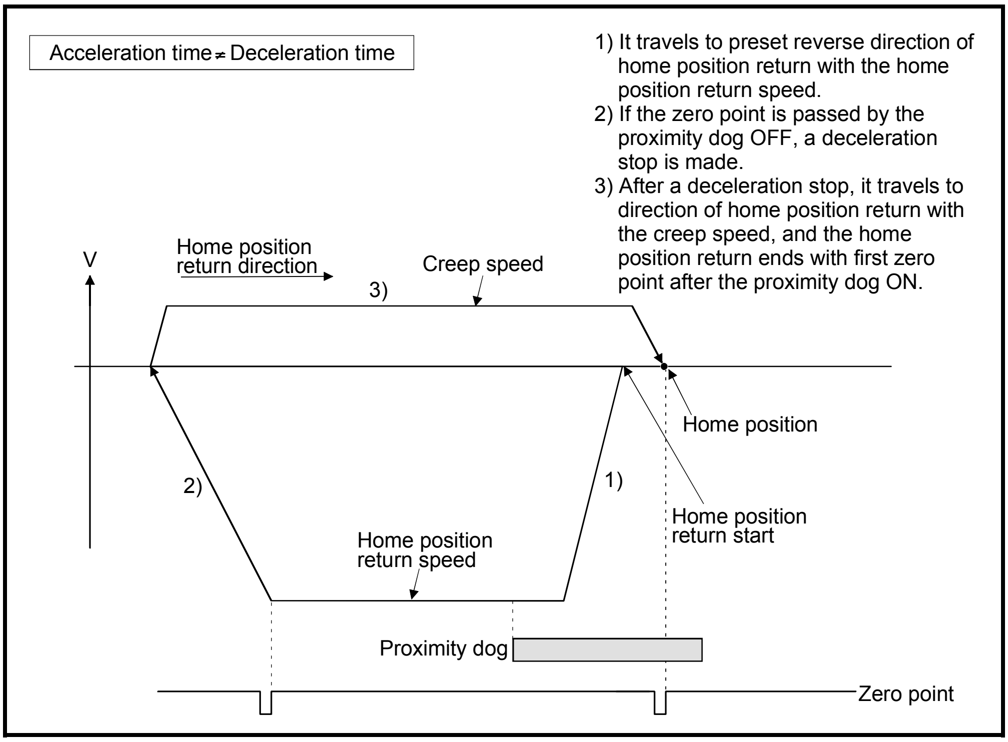
(2) If the home position return is executed in the proximity dog, it travels to reverse direction of home position return. If proximity dog turns OFF, a deceleration stop is made, it travels to direction of home position return again with the creep speed and the first zero point after proximity dog ON is home position.



(3) When the proximity dog is set in the home position return direction, the proximity dog is turned OFF during travel to reverse direction of home position return, and the zero point is not passed, it continues to travel in the reverse direction of home position return with home position return speed until the zero point is passed. The zero point is passed again during deceleration by zero point pass, the home position becomes this side compared with the case to pass zero point at the time of the proximity dog OFF.



(4) When it starts in the proximity dog, the zero point is not passed at the time of the proximity dog is turned OFF during travel to reverse direction of home position return, it continues to travel with home position return speed until the zero point is passed. The zero point is passed again during deceleration by zero point pass, the home position becomes this side compared with the case to pass zero point at the time of the proximity dog OFF.



7.3.10 Home position return by the stopper type 1

[Control details]

(1) Stopper type 1

Position of stopper is home position in this method.
It travels to the direction set in the "home position return direction" with the "home position return speed", after a deceleration starts by proximity dog OFF to ON and it presses against the stopper and makes to stop with the torque limit value set in the "torque limit value at the creep speed" and "creep speed" of home position return data. Real position of servomotor at the time of detection for turning the torque limiting signal OFF to ON is home position.
Torque limit value after reaching creep speed is set in the "torque limit value at the creep speed" of home position return data.

(2) Home position return by the stopper type 1

Operation of home position return by the stopper type 1 is shown below.

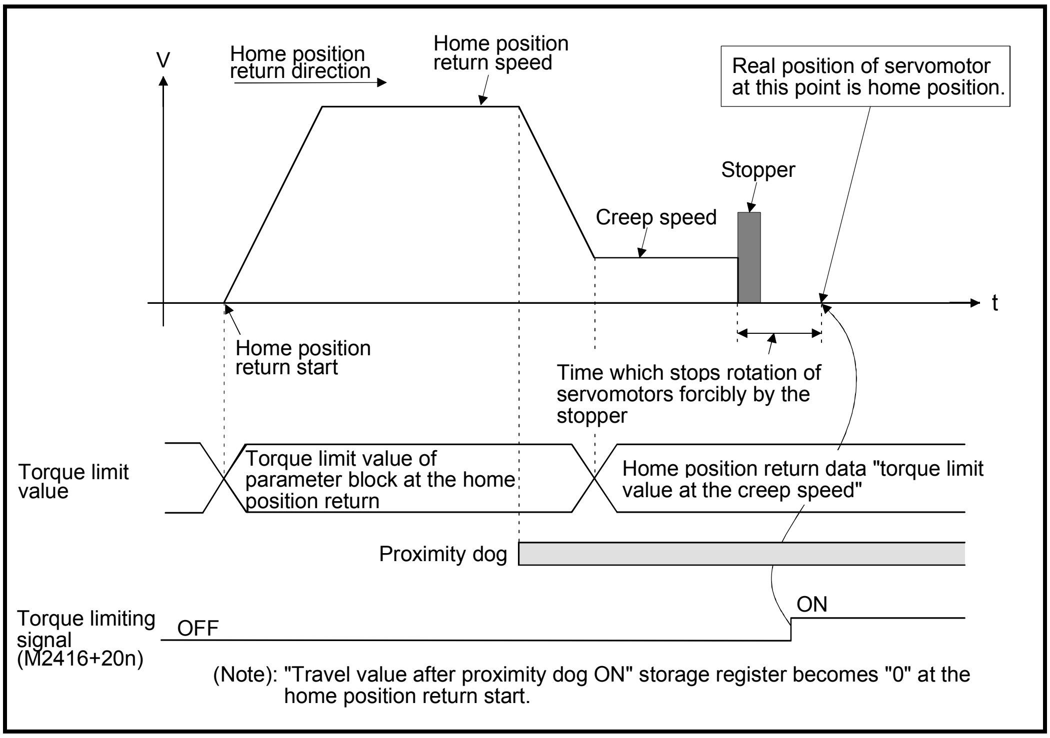


Fig. 7.12 Home position return operation by the stopper type 1

(3) Home position return execution

Home position return by the stopper type 1 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the stopper type 1 home position return is also made even G28 of the Motion program.

[Cautions]

(1) A zero point does not must be passed (zero pass signal: M2406+20n ON) between turning on the power supply and executing home position return.

(2) Home position return retry function cannot be used in the stopper type 1.

(3) Set the torque limit value after reaching the creep speed for system.
When the torque limit value is too large, servomotors or machines may be damaged after pressing the stopper. Also, when the torque limit value is too small, it becomes the torque limiting before pressing the stopper and ends the home position return.

(4) If the home position return is executed again after home position return completion, a minor error "home position return completion signal is turning ON at the stopper type home position return start (error code: 115)" will occur, the home position return is not executed.

(5) Home position return is started during the proximity dog ON, it is started from the "creep speed".

7.3.11 Home position return by the stopper type 2

[Control details]

(1) Stopper type 2

Position of stopper is home position in this method.
It travels the direction set in the "home position return direction" with the "creep speed", and it presses against the stopper and makes to stop with the "creep speed". (The torque limit value is valid set in the "torque limit value at the creep speed" of the home position return data from the home position return start.)
Real position of servomotor at the time of detection for turning the torque limiting signal OFF to ON is home position.
Torque limit value after reaching creep speed is set in the "torque limit value at the creep speed" of home position return data.

(2) Home position return by the stopper type 2

Operation of home position return by the stopper type 2 is shown below.

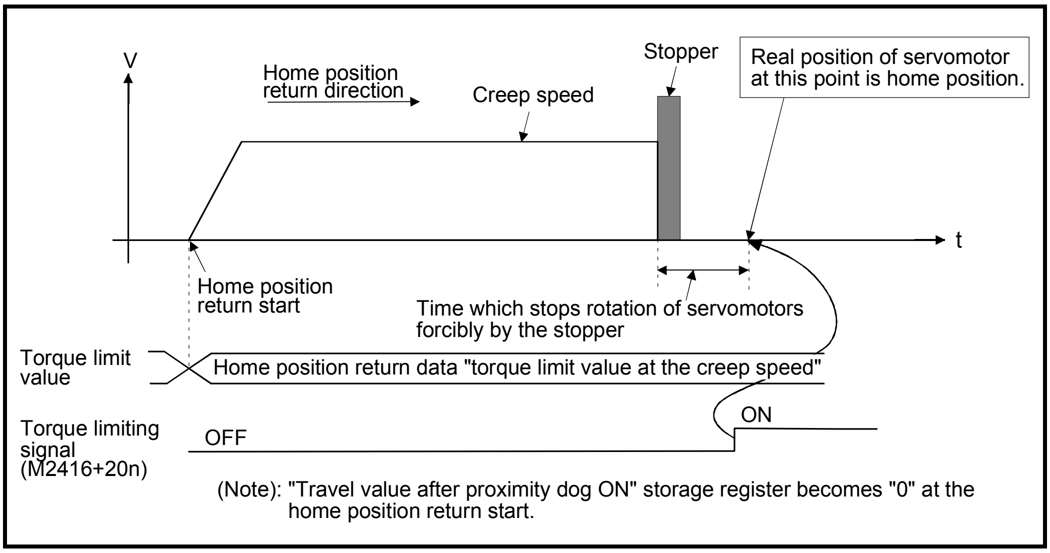


Fig. 7.13 Home position return operation by the stopper type 2

(3) Home position return execution

Home position return by the stopper type 2 is executed using the CHGA instruction in Section 7.3.16.
When the home position return request is ON, the stopper type 2 home position return is also made even G28 of the Motion program.

[Cautions]

(1) A zero point does not must be passed (zero pass signal: M2406+20n ON) between turning on the power supply and executing home position return.

(2) Home position return retry function cannot be used in the stopper type 2.

(3) Set the torque limit value at the reaching creep speed for system.
When the torque limit value is too large, servomotors or machines may be damaged after pressing the stopper. Also, when the torque limit value is too small, it becomes the torque limiting before pressing the stopper and ends the home position return.

(4) If the home position return is executed again after home position return completion, a minor error "home position return completion signal is turning ON at the stopper type home position return start" (error code: 115) will occur, the home position return is not executed.

7.3.12 Home position return by the limit switch combined type

[Control details]

(1) Limit switch combined type

The proximity dog is not used in this method. Home position return can be executed by using the external upper/lower limit switch.

When the home position return is started, it travels to direction of home position return with "home position return speed". Deceleration is made by turning the limit switch of home position return direction ON to OFF, it travels to reverse direction of home position return with creep speed, and the zero point just before limit switch is home position.

(2) Home position return by the limit switch combined type

Operation of home position return by limit switch combined type for setting the limit switch in the home position return direction is shown below.

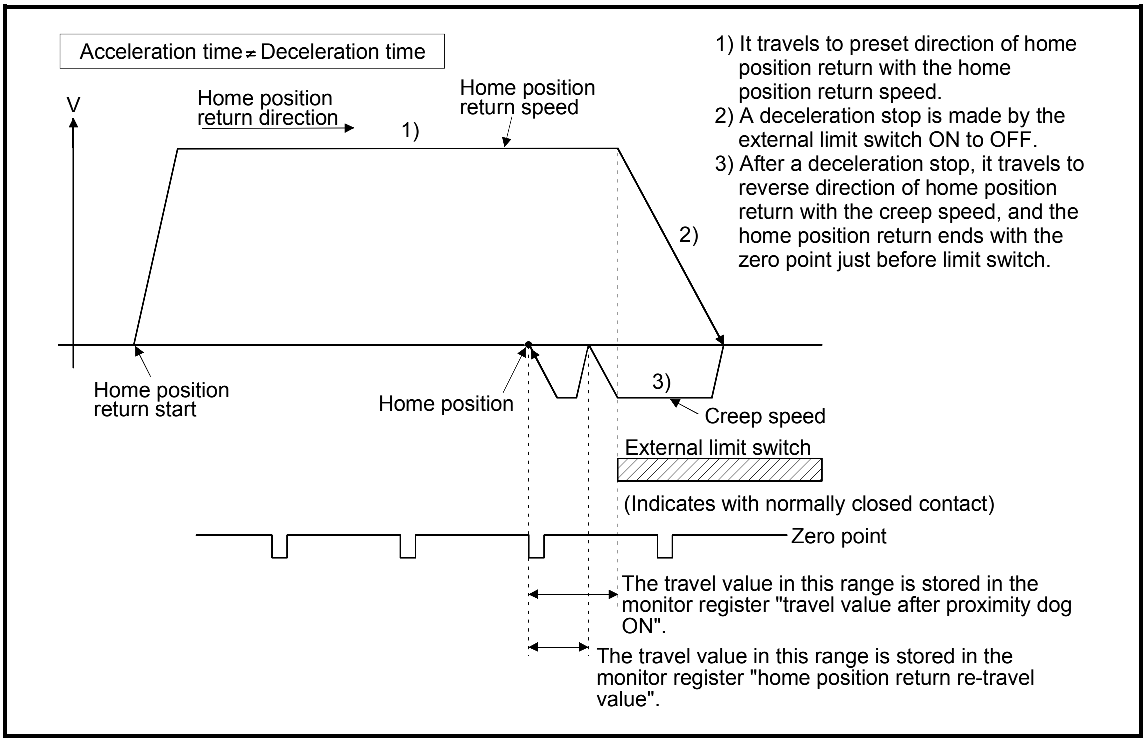


Fig. 7.14 Home position return operation by the limit switch combined type

(3) Home position return execution

Home position return by the limit switch combined type is executed using the CHGA instruction in Section 7.3.16.

When the home position return request is ON, the limit switch combined type home position return is also made even G28 of the Motion program.

[Cautions]

(1) For the axis which executes the home position return by the limit switch combined type, if the external input signal has not set in the system settings, a minor error "the positioning control which use the external input signal was executed for the axis which has not set the external input signal in the system settings" (error code: 142) will occur and home position return is not executed.

(2) When the limit switch reverse to home position return direction is turned ON to OFF, deceleration stop is made, home position return is not completed and a major error "external limit switch detection error" (error code: 1101, 1102) will occur.

(3) Home position return retry function cannot be used in the limit switch combined type.

(4) If the home position return is executed with the limit switch OFF, it is started to reverse direction of home position return with creep speed.

(5) When it does not pass (zero pass signal: M2406+20n ON) the zero point from home position return start to deceleration stop by limit switch OFF, a minor error "ZCT not set" (error code:120) will occur, a deceleration stop is made and home position return does not complete normally. However, when "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), if the zero point is not passed until from home position return start to deceleration stop by limit switch OFF, the home position can be executed.

(6) Deceleration stop is executed after the limit switch OFF. Set the limit switch in expectation of deceleration distance.

(7) If the in-position signal (M2402+20n) is turned ON, home position return is not ended.

(8) When the width is in a zero point, the home position differs from the home position return by the proximity dog type 1, proximity dog type 2, count type 1, count type 3 and dog cradle type.

7.3.13 Home position return retry function

When a work has been exceeded home position during positioning control, etc., even if it executes the home position return, depending on the position of work, a work may not travel to home position direction. In this case, a work is normally travelled before the proximity dog by the JOG operation, etc, and the home position return is started again. However, by using the home position return retry function, even if a work is where, the home position return can be executed.
Refer to Section 7.3.1(7) for home position return method by using the home position return retry function.

[Data Setting]

When the "home position return retry function" is used, set the following "home position return data" using a peripheral devices.
Set the "dwell time at the home position return retry" as required.
Set the parameters for every axis.

Table 7.3 Home position return data

Items	Setting details	Setting value	Initial value
Home position return retry function	0 : Invalid (Do not execute the home position return retry by limit switch.) 1 : Valid (Execute the home position return retry by limit switch.)	0, 1	0
Dwell time at the home position return retry	The stop time at the deceleration stop during the home position return retry is set	0 to 5000 [ms]	0

[Control details]

Operation for the home position return retry function is shown below.

(1) Home position return retry operation setting a work within the range of external limit switch

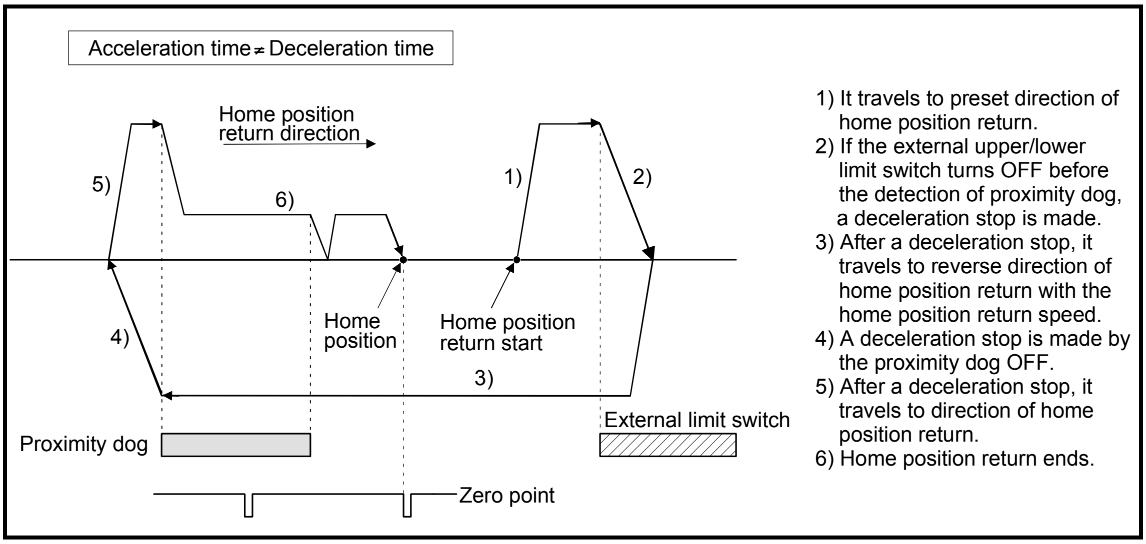
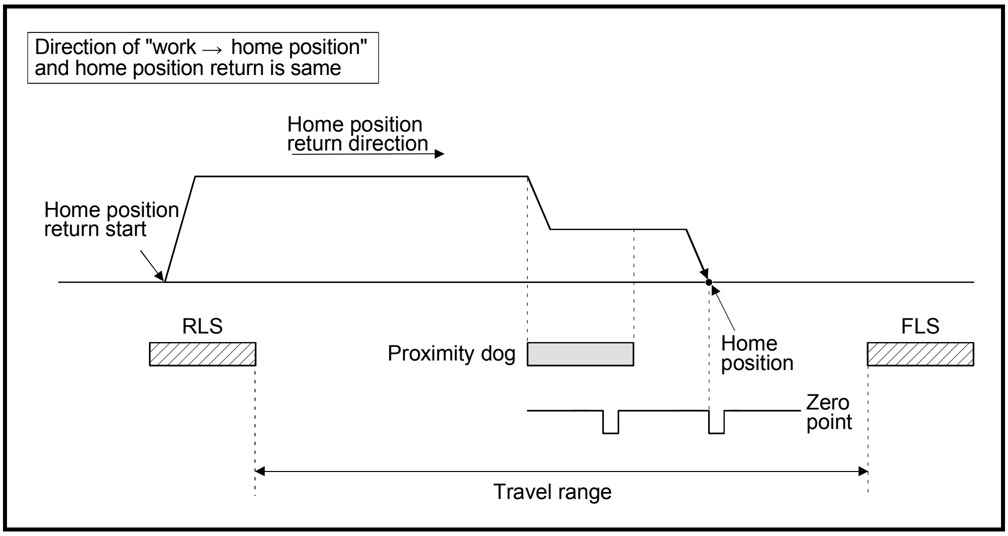


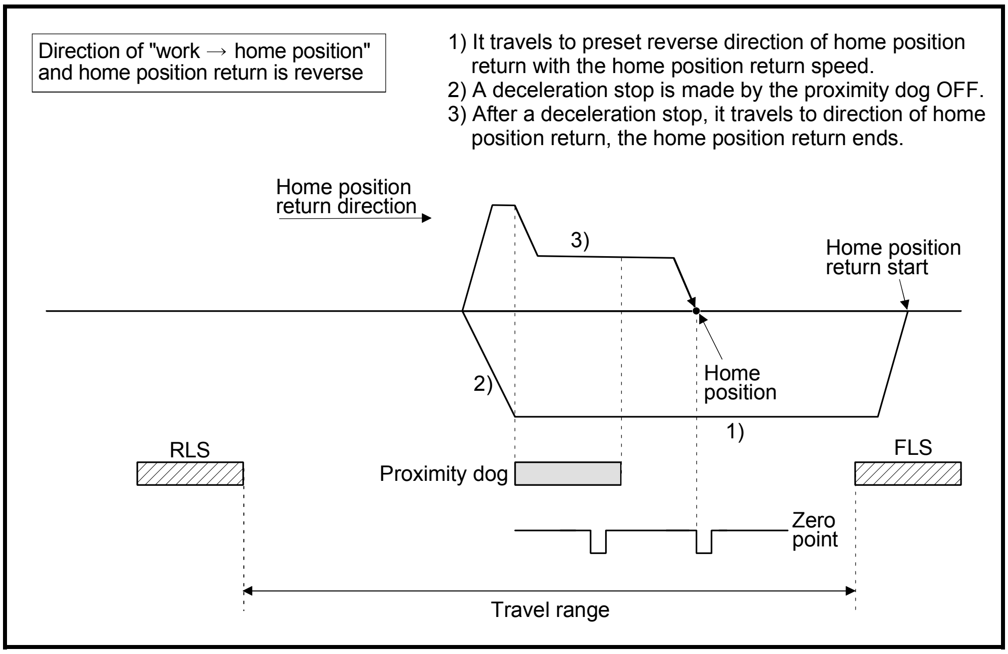
Fig. 7.15 Operation for home position return retry (proximity dog type)

(2) Home position return retry operation setting a work outside the range of external limit switch

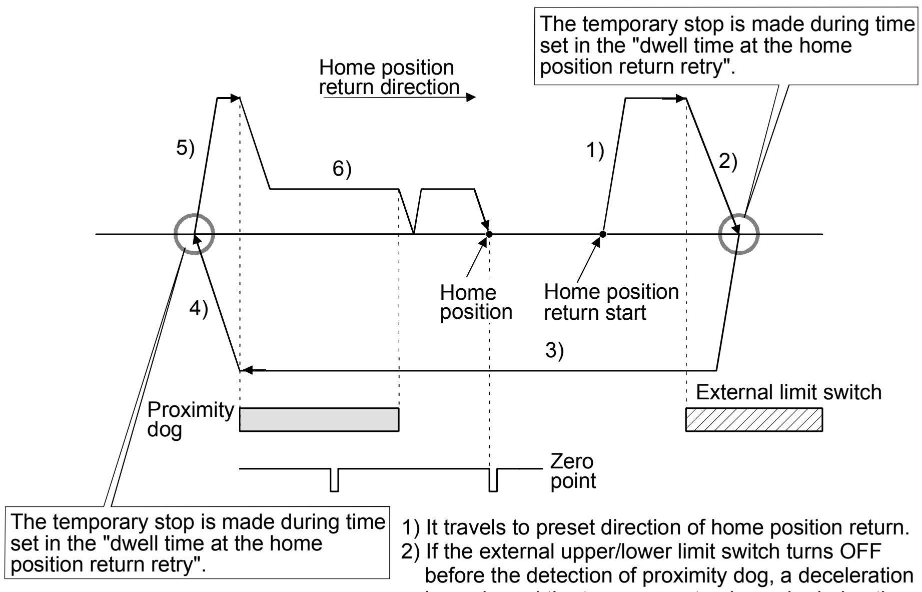
(a) When the direction of "work → home position" and home position return is same, normal home position return is operated.



(b) When the direction of "work → home position" and home position return is reverse, deceleration stop is made with the proximity dog OFF and home position return is operated to preset direction of home position return.



(3) Dwell time setting at the home position return retry
Reverse operation by detection of the external upper/lower limit switch and dwell time function at the home position return start after stop by proximity dog OFF are possible with the dwell time at the home position return retry in the home position return retry function.
Dwell time at the home position return retry becomes valid at the time of deceleration stop of the following 2) and 4). (Dwell time operates with the same value.)



1) It travels to preset direction of home position return.
2) If the external upper/lower limit switch turns OFF before the detection of proximity dog, a deceleration is made and the temporary stop is made during time set in the "dwell time at the home position return retry".
3) After a stop, it travels to reverse direction of home position return with the home position return speed.
4) A deceleration is made by the proximity dog OFF and the temporary stop is made during time set in the "dwell time at the home position return retry".
5) After a stop, it travels to direction of home position return.
6) Home position return ends. At this time, the "dwell time at the home position return retry" is invalid.

Fig. 7.16 Dwell time setting at the home position return retry

[Cautions]

(1) Possible/not possible of home position return retry function by the home position return method is shown below.

Home position return methods	Possible/not possible of home position return retry function
Proximity dog type	○
Count type	○
Data set type	×
Dog cradle type	○
Stopper type	×
Limit switch combined type	×

○ : Possible, × : Not possible

(2) Make a system for which does not execute the servo amplifier power off or servo OFF by the external upper/lower limit switch. Home position return retry cannot be executed only in the state of servo ON.

(3) Deceleration is made by detection of the external limit switch and travel to reverse direction of home position return is started. In this case, a major error "external limit switch detection error" (error codes: 1001, 1002, 1101, 1102) will not occur.

⚠CAUTION

- Be sure to set the external limit switch (FLS, RLS) in the upper/lower position of machines. If the home position return retry function is used without external limit switch, servomotors continue rotating.

7.3.14 Home position shift function

Normally, when the machine home position return is executed, a position of home position is set by using the proximity dog or zero point signal. However, by using the home position shift function, the position to which only the specified travel value was travelled from the position which detected the zero point signal can be regarded as home position.
Refer to Section 7.3.1(7) for home position return method by using the home position shift function.

[Data Setting]

Set the following "home position return data" using a peripheral devices to use the "home position shift function".
Set the parameters for every axis.

Table 7.4 Home position return data

Items	Setting details	Setting value	Initial value
Home position shift amount	The shift amount at the home position shift is set.	-2147483648 to 2147483647 [$\times 10^{-4}$ mm, $\times 10^{-5}$ inch, 10^{-5} degree]	0
Speed set at the home position shift	The speed at the home position shift is set.	0 : Home position return speed 1 : Creep speed	0

[Control details]

(1) Home position shift operation

Operation for the home position shift function is shown below.

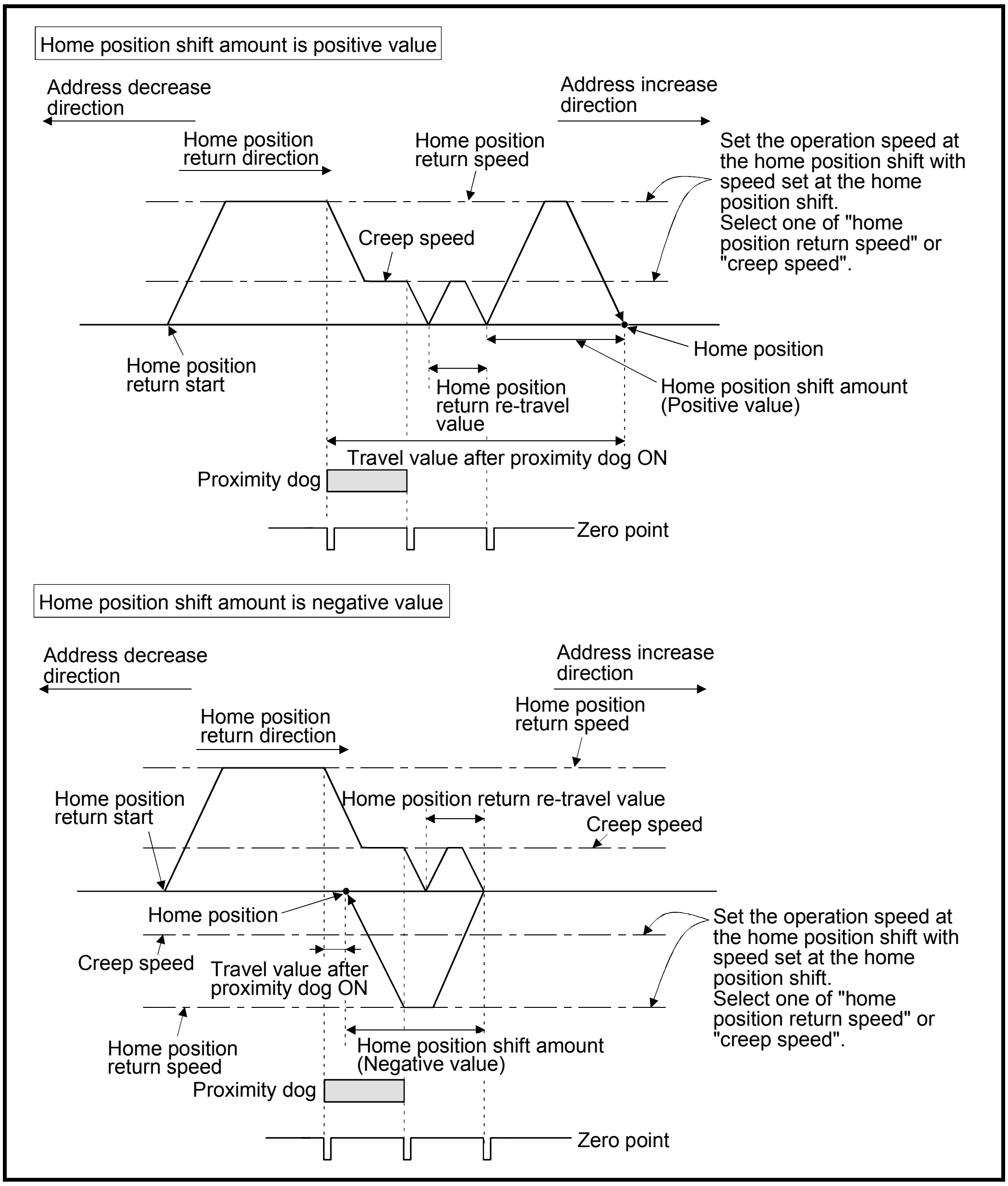


Fig. 7.17 Operation for home position shift

(2) Setting range of home position shift amount
Set the home position shift amount within the range of from the detected zero signal to external upper/lower limit switch (FLS/RLS). If the range of external upper/lower limit switch is exceeded, a major error "external limit switch detection error" (error codes: 1102, 1103) will occur at that time and the home position return is not ended.

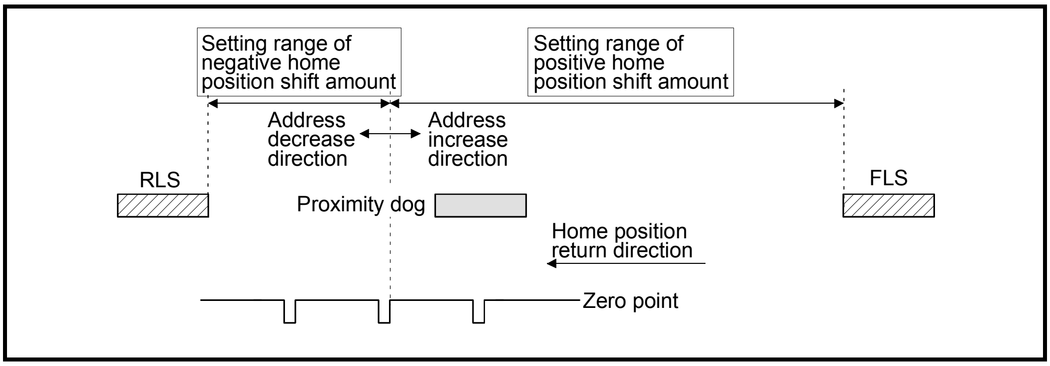


Fig. 7.18 Setting range of home position shift amount

(3) Travel speed at the home position shift
When the home position shift function is used, set the travel speed at the home position shift as the speed set at the home position shift. Either the home position return speed or creep speed is selected as the travel speed at the home position shift.
The travel speed at the home position shift for the home position return by proximity dog type is shown below.
(a) Home position shift operation with the "home position return speed"

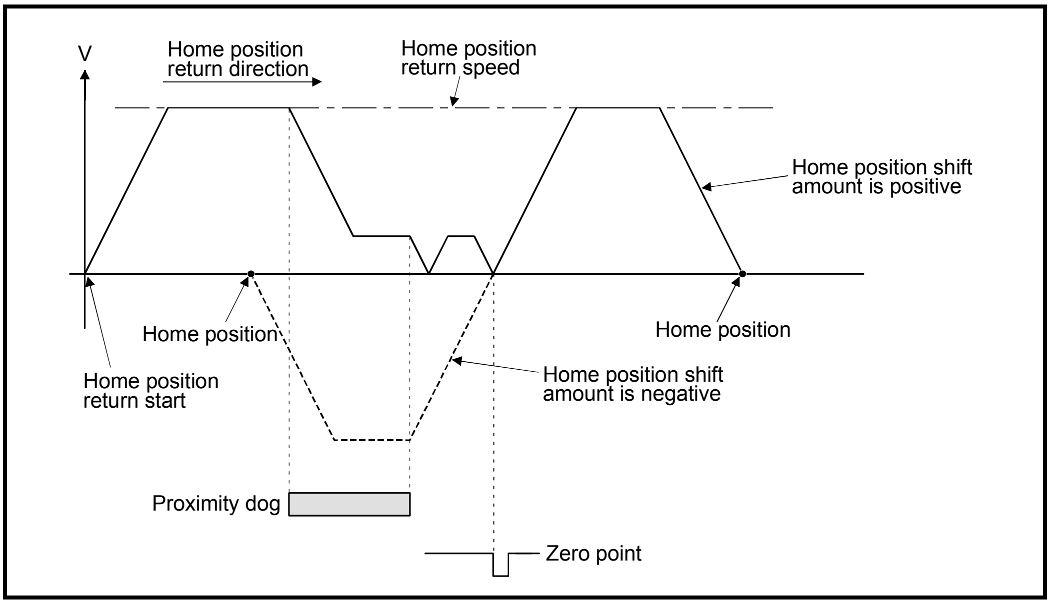


Fig. 7.19 Operation for home position shift with the home position return speed

(b) Home position shift operation with the "creep speed"

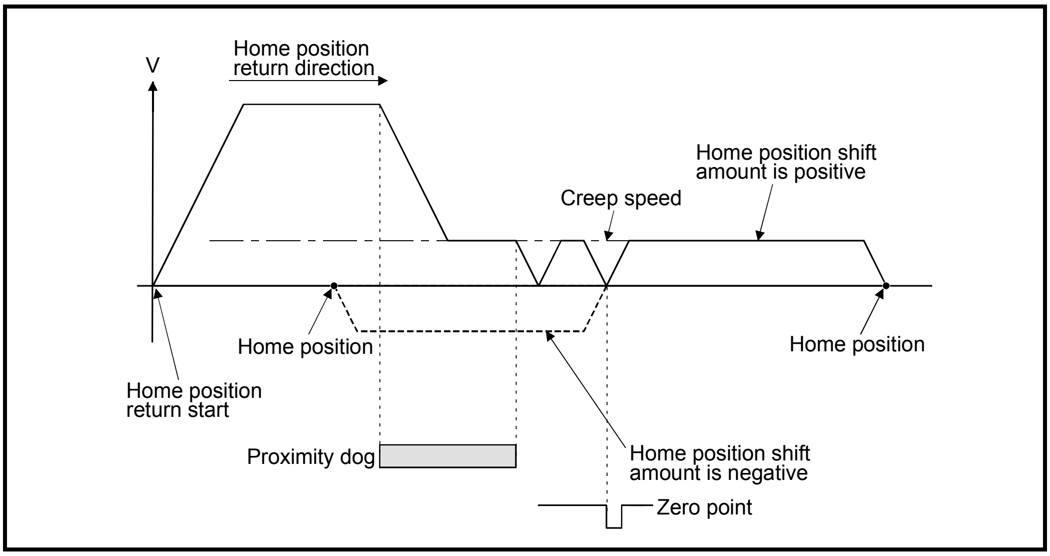


Fig. 7.20 Operation for home position shift with the creep speed

[Cautions]

(1) Valid/invalid of home position shift amount setting value by the home position return method is shown below.

Home position return methods	Valid/invalid of home position shift amount
Proximity dog type	○
Count type	○
Data set type	×
Dog cradle type	○
Stopper type	×
Limit switch combined type	○

○ : Valid, × : Invalid

(2) Axis monitor devices and axis statuses are set after completion of home position shift.

(3) When the home position return by proximity dog type, set the travel value after proximity dog ON and home position shift amount within the range of "-2147483648 to 2147483647" [$\times 10^{-4}$ mm, $\times 10^{-5}$ inch, 10^{-5} degree].

7.3.15 Condition selection of home position set

A home position return must be made after the servomotor has been rotated more than one revolution to pass the axis through the Z-phase (motor reference position signal) and the zero pass signal (M2406+20n) has been turned ON.
When "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4, (PC17) Condition selection of home position set" of servo parameter (expansion setting parameter), if it does not pass zero point with the motor rotation after turning the servo amplifier power ON, the zero pass signal (M2406+20n) can be turned ON.

[Data Setting]

Set the following "servo parameters" using a peripheral devices to select the "function selection C-4".
Set the servo parameters for every axis.

Table 7.5 Servo parameter (expansion setting parameter)

Items	Setting details	Setting value	Initial value
Function selection C-4 (PC17) Condition selection of home position set	• Set the condition selection of home position set in the absolute position system.	0: Need to pass motor Z phase after the power supply is switched on 1: Not need to pass motor Z phase after the power supply is switched on	0

[Cautions]

(1) When "1 : Not need to pass motor Z phase after the power supply is switched on" is set as the above servo parameter, a restrictions such as "make the home position return after the servomotor is rotated more than one revolution to pass the axis through the Z-phase (motor reference position signal)" is lost.

(2) When "1 : Not need to pass motor Z phase after the power supply is switched on" is selected in the "function selection C-4" of servo parameter (expansion setting parameter), if it does not pass zero point at the servo amplifier power ON, the zero pass signal (M2406+20n) turns ON.

(3) When the above parameter is changed, turn the servo amplifier power OFF to ON after resetting or turning power OFF to ON of Multiple CPU system.

⚠ CAUTION

- Do not set the "1 : Not need to pass motor Z phase after the power supply is switched on" for axis which executes the home position return again after it continues traveling the same direction infinitely.

7.3.16 Execution of home position return

The home position return is executed using the CHGA instruction.

[Control details]

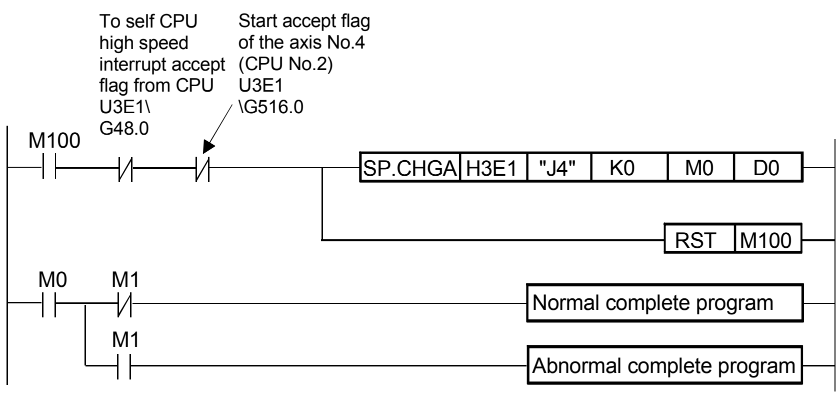
(1) Home position return is executed by the home position return method specified with the home position return data (Refer to Section 7.3.1).
Refer to the following sections for details of the home position return methods :
- Proximity dog type 1.................. Section 7.3.2
- Proximity dog type 2.................. Section 7.3.3
- Count type 1.............................. Section 7.3.4
- Count type 2.............................. Section 7.3.5
- Count type 3.............................. Section 7.3.6
- Data set type 1........................... Section 7.3.7
- Data set type 2........................... Section 7.3.8
- Dog cradle type.......................... Section 7.3.9
- Stopper type 1............................ Section 7.3.10
- Stopper type 2............................ Section 7.3.11
- Limit switch combined type........ Section 7.3.12

[Program]

A program which executes a home position return using the CHGA instruction is shown below.

• Program example

Program which execute the home position return of the axis No.4 of the Motion CPU (CPU No.2) from PLC CPU(CPU No.1).



[Cautions]

If the home position is not within the in-position range of servo parameter, it does not mean having reached the home position data and the home position return does not end in the proximity dog type, count type, data set type 1, dog cradle type, or limit switch combined type
home position return. In this case, adjusts the in-position range of servo parameter or position control gain.

7.4 Speed Change (CHGV instruction)

The speed change is executed at the positioning control or JOG operation.
S(P).CHGV instruction of PLC program or CHGV instruction of Motion program is used for the speed change.

[Control details]

(1) A speed of operating axis is forcibly changed to the speed specified with the speed change registers.

(2) Refer to Section 3.5 for details of the S(P).CHGV instruction of PLC program.
Refer to Section 6.16.17 for details of the CHGV instruction of Motion program.

(3) A speed change should be set within the range of "-speed limit value to + speed limit value". If it is outside the range, a minor error "305" will occur.

(4) When a speed change is executed during positioning control of program operation, make the override invalid. When the override is valid, a speed change is not executed.

(5) During a temporary stop, a speed change is not executed.

(6) A speed change during constant-speed control (when the axis travels through mid points continuously during execution of G01, G02, G03, G12, G13 or G32) should be set within the range of "-F command to +F command". If it is outside the range, the speed is controlled by F command.

(7) The F command after a speed change during constant-speed control is made valid within the range of the change speed or less.

(8) If a speed change is executed during positioning control for program operation, it operates at the speed changed to the command of the next travel block.
It changes whether the speed change value is continued or the speed changes command speed value in the program depending on the next type of travel block mode as the table "command speed after execution of speed change" of next page.

(9) A speed change for the high-speed oscillation axis is invalid.

Command Speed after Execution of Speed Change

No.	Travel mode at speed change (Note-1)	Travel mode after speed change (Note-1)	Command speed at execution of travel instruction after speed change
1	PTP (Note-2)	PTP/OSC (Note-2)	Program command speed (Note-6)
2		Constant speed (Note-3)	
3	Constant speed (Note-3)	PTP/OSC (Note-2)	Program command speed (Note-6)
4		Constant speed (Note-3) with F command	Program command speed (Note-7)
5		Constant speed (Note-3) without F command and without special M-code (Note-4)	New speed is continued
6		Constant speed (Note-3) without F command and with special M-code (Note-5)	Program command speed (Note-6)

(Note-1): A speed change is valid only at the execution of travel mode in the PTP or constant speed.

(Note-2): This mode is executed by G00, G28, G30 or G53. OSC mode is the travel mode executed by G25.

(Note-3): This mode is executed by G01, G2, G3, G12, G13 or G32. The independent M-code is also handled as the constant speed mode.

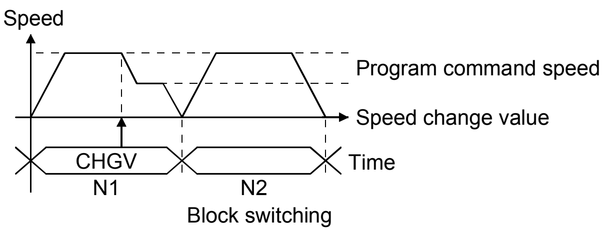
(Note-4): When a special M-code (M00, M01, M02, M30, M98, M99, M100) is not executed during the constant speed mode after speed change.

(Note-5): When a special M-code (M00, M01, M02, M30, M98, M99, M100) is executed during the constant speed mode after speed change.
The decelerates stop is made at the execution of the special M-code.

(Note-6): PTP mode: High-speed feed rate. OSC mode: F (frequency) command. Constant speed mode: F (speed) command.

Example (CHGV is executed during N1)

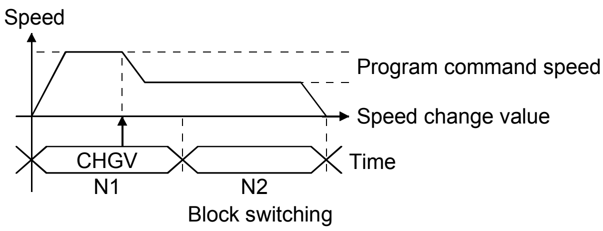
```
010   ;
N1  G00  X100.  ;
N2  G00  X200.  ;
M02  ;
%
```



(Note-7): F (speed) command. Note that it is clamped at the speed change value.

Example (CHGV is executed during N1)

```
011   ;
N1  G01  X100.  F1000.  ;
N2  G01  X200.  F1000.  ;
M02  ;
%
```



[Data setting]

(1) The setting ranges to speed change registers are shown below.

Item \ Units	mm		inch		degree	
	Setting range	Units	Setting range	Units	Setting range	Units(Note)
Speed change value	0 to 600000000	$\times 10^{-2}$ mm/min	0 to 600000000	$\times 10^{-3}$ inch/min	0 to 2147483.647	$\times 10^{-3}$ degree/min

(Note) : When the "speed control 10 × multiplier setting for degree axis" is set to "valid" in the fixed parameter, the setting range is " $\times 10^{-2}$ [degree/min]".

POINT

When the speed is set in the PLC program, stores a value which is 100 times (unit: mm)/1000 times (unit: inch, degree) the real speed in the speed change registers.

Example

To change the speed to 10000.00mm/min, stores "1000000" to the speed change registers.

(Note): Store a value which is 100 times the real speed in the speed change register for the axis "speed control 10 × multiplier setting for degree axis is valid".

[Cautions]

A speed change is not executed with the following errors.
(It is checked at the execution of CHGV instruction.)

Error code	Error factor		Error Processing	Corrective action
301	Speed change error	Home position return is executed by the specified axis.	• Error detection flag (M2407+20n) turns ON. • Error code 301 is stored in the minor error code storage register of each axis.	Do not execute the speed change during the home position return.
305	Data setting error	Speed is set outside the range of "0" to speed limit value.	• Error detection flag (M2407+20n) turns ON. • Error code 305 is stored in the minor error code storage register of each axis.	Set the speed within the range of "0" to speed limit value.
$4C06_H$ (Note) (Complete status)		Axis No. is set is except for 1 to 32.	• Error code is stored in the complete status storage device.	Confirm a program and correct it to a correct PLC program.
		Axis No. is set indirectly by index qualification.		

(Note) : Refer to Section 3.5 for error details.

(1) If a speed change is executed, the setting speed is ignored in the following cases. (An error will not occur.)
   (a) During motion program execution
   (b) During deceleration by the stop command
   (c) During a stop
   (d) During manual pulse generator operation

[Operation Timing]

The operation timing for a speed change is shown in Fig. 7.21.

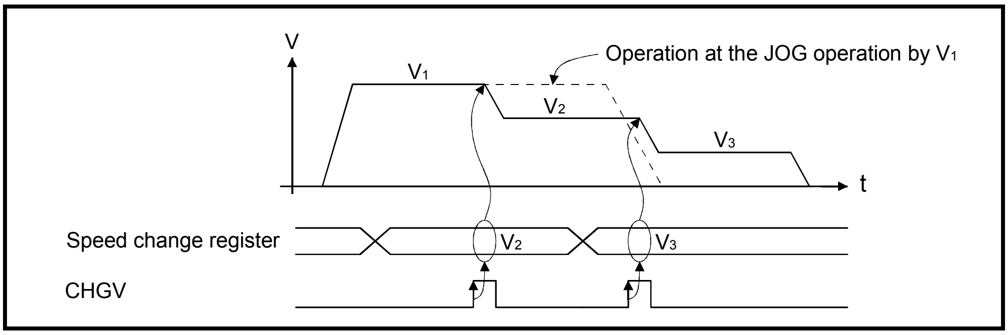


Fig. 7.21 Operation timing for speed change

[Program Example]

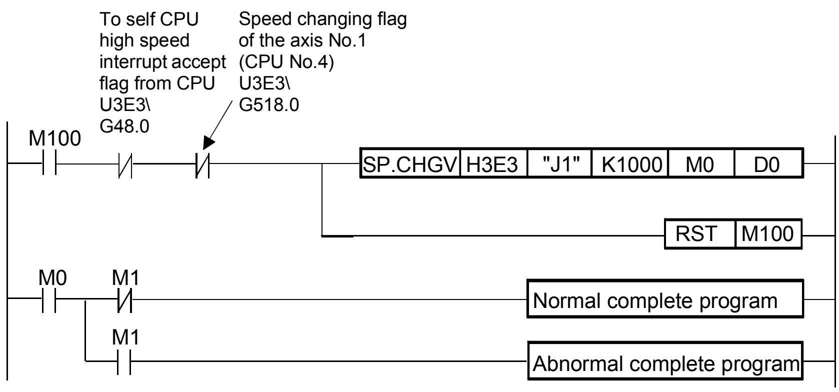
A program example for speed change is shown as the following conditions.

(1) Conditions for speed change

(a) Axis No. for speed change............................ Axis 1
(b) New speed.. 1000
(c) Speed change command.............................. M100

(2) PLC program

Program which changes the positioning speed of the axis No.1 of the Motion CPU (CPU No.4) from PLC CPU(CPU No.1) to 1000.



7.5 JOG Operation

The setting JOG operation is executed.
Individual start or simultaneous start can be used in the JOG operation.
JOG operation can be executed using the PLC program, control program or test mode of peripheral device.
(Refer to the help of each software for JOG operation method by the test mode of peripheral device.)
JOG operation data must be set for each axis for JOG operation. (Refer to Section 7.5.1)

7.5.1 JOG operation data

JOG operation data is the data required to execute JOG operation.
Set the JOG operation data using a peripheral device.

Table 7.6 JOG operation data list

No.	Item	Setting range						Initial value	Units	Remarks	Explan-atory section
		mm		inch		degree					
		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 (Note-1)	degree/ min	200.00	mm/s	• Sets the maximum speed at the JOG operation. • If JOG speed setting exceeds the JOG speed limit value, it is controlled with JOG speed limit value.	—
2	Parameter block setting	1 to 64						1	—	• Sets the parameter block No. to be used at the JOG operation.	5.3

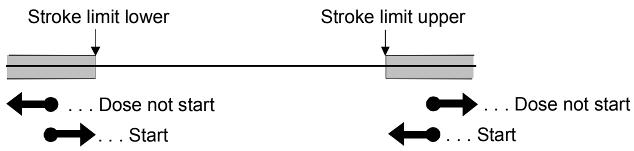
(Note-1) : When the "speed control 10 × multiplier setting for degree axis" is set to "valid", the setting range is 0.01 to 21474836.47[degree/min].

(1) JOG operation data check
A relative check of the JOG operation data is executed at the following timing:
- JOG operation individual start
- JOG operation simultaneous start
- JOG operation request

(2) Data error processing
- Only data for which detected errors is controlled as default value.
- The error code corresponding to each data for erroneous axis is stored in the data register.

POINT

Start to outside the range of stroke limit of fixed parameter cannot be executed.
However, JOG operation is possible in the direction from outside the stroke limit range to back inside the stroke limit range.



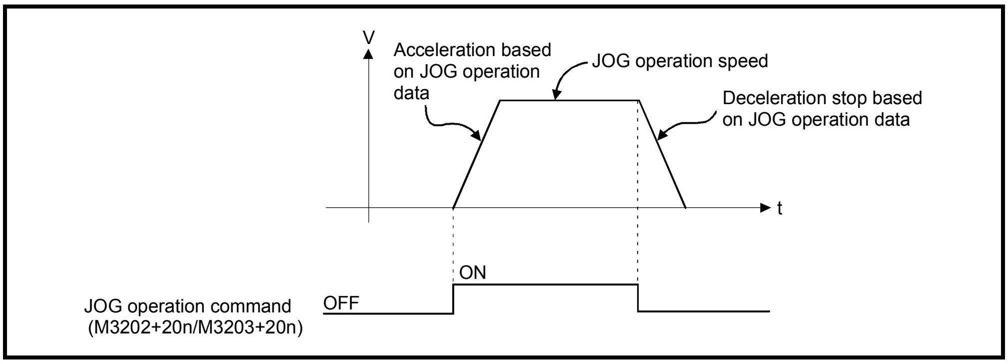
7.5.2 Individual start

JOG operation for the specified axes is started.
JOG operation is executed by the following JOG operation commands :

- Forward JOG start command........... M3202+20n
- Reverse JOG start command........... M3203+20n

[Control details]

(1) JOG operation continues at the JOG speed setting register value while the JOG operation signal turns on, and a deceleration stop is made by the JOG operation signal OFF.
Control of acceleration/deceleration is based on the data set in the JOG operation data.



JOG operation for axis for which JOG operation command is turning on is executed.

(2) The setting range for JOG speed setting registers are shown below.

No. (Note)	JOG operation		JOG speed setting register		Setting range					
					mm		inch		degree	
	Forward JOG	Reverse JOG	Most significant	Setting range	Setting range	Units	Setting range	Units	Setting range	Units
1	M3202	M3203	D641	D640	1 to 600000000	$\times 10^{-2}$ mm /min	1 to 600000000	$\times 10^{-3}$ inch /min	1 to 2147483647	$\times 10^{-3}$ degree /min (Note-1)
2	M3222	M3223	D643	D642						
3	M3242	M3243	D645	D644						
4	M3262	M3263	D647	D646						
5	M3282	M3283	D649	D648						
6	M3302	M3303	D651	D650						
7	M3322	M3323	D653	D652						
8	M3342	M3343	D655	D654						
9	M3362	M3363	D657	D656						
10	M3382	M3383	D659	D658						
11	M3402	M3403	D661	D660						
12	M3422	M3423	D663	D662						
13	M3442	M3443	D665	D664						
14	M3462	M3463	D667	D666						
15	M3482	M3483	D669	D668						
16	M3502	M3503	D671	D670						
17	M3522	M3523	D673	D672						
18	M3542	M3543	D675	D674						
19	M3562	M3563	D677	D676						
20	M3582	M3583	D679	D678						
21	M3602	M3603	D681	D680						
22	M3622	M3623	D683	D682						
23	M3642	M3643	D685	D684						
24	M3662	M3663	D687	D686						
25	M3682	M3683	D689	D688						
26	M3702	M3703	D691	D690						
27	M3722	M3723	D693	D692						
28	M3742	M3743	D695	D694						
29	M3762	M3763	D697	D696						
30	M3782	M3783	D699	D698						
31	M3802	M3803	D701	D700						
32	M3822	M3823	D703	D702						

(Note-1) : When the "speed control 10 $\times$ multiplier setting for degree axis" is set to "valid" in the fixed parameter, the unit is " $\times 10^{-2}$ [degree/min]".

(Note-2) : The range of axis No.1 to 8 is valid in the Q172HCPU.

POINT

When the JOG operation speed is set in the PLC program or control program, stores a value which is 100 times the real speed in units of [mm] or 1000 times the speed in units of [inch] or [degree] in the JOG speed setting register.

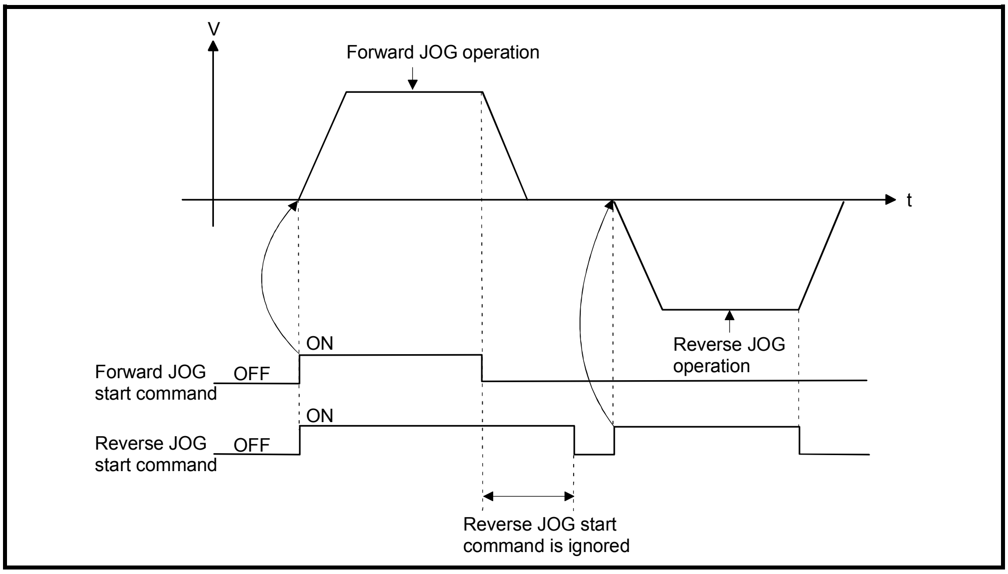
Example

If JOG operation speed of 6000.00 [mm/min] is set, stores the value "600000" in the JOG speed setting register.

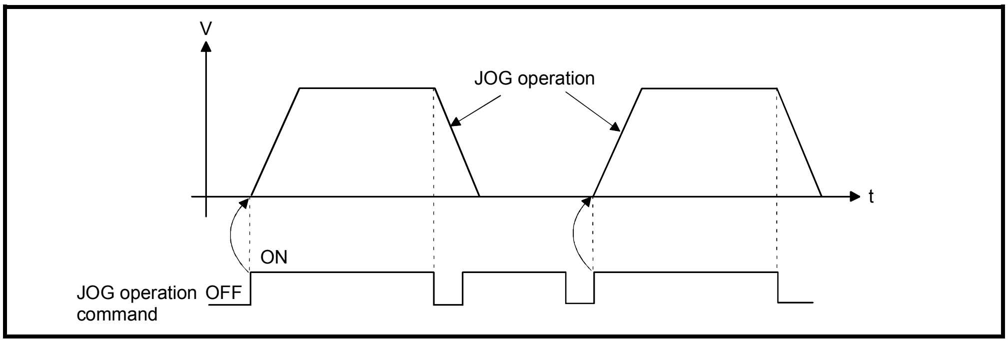
(Note): Store a value which is 100 times the real speed in the JOG speed setting register for the axis "speed control 10 $\times$ multiplier setting for degree axis is valid".

[Cautions]

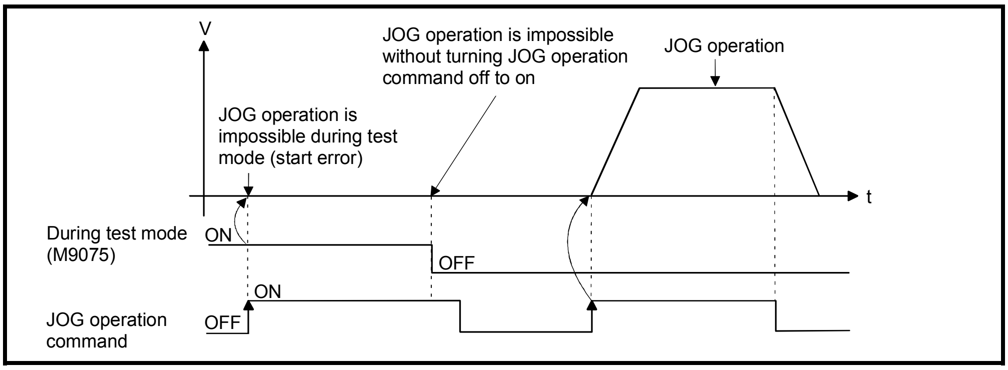
(1) If the forward JOG start command (M3202+20n) and reverse JOG start command (M3203+20n) turn on simultaneously for a single axis, the forward JOG operation is executed.
When a deceleration stop is made by the forward JOG start command OFF, the reverse JOG operation is not executed even if the reverse JOG start command is ON. After that, when the reverse JOG start command turns off to on, the reverse JOG operation is executed.



(2) If the JOG operation command (M3202+20n/M3203+20n) turns on during deceleration by the JOG operation command OFF, after deceleration stop, JOG operation is not executed.
After that, the JOG operation is executed by the JOG operation command OFF to ON.



(3) JOG operation by the JOG operation command (M3202+20n/M3203+20n) is not executed during the test mode using a peripheral devices.
After release of test mode, the JOG operation is executed by turning the JOG operation command OFF to ON.

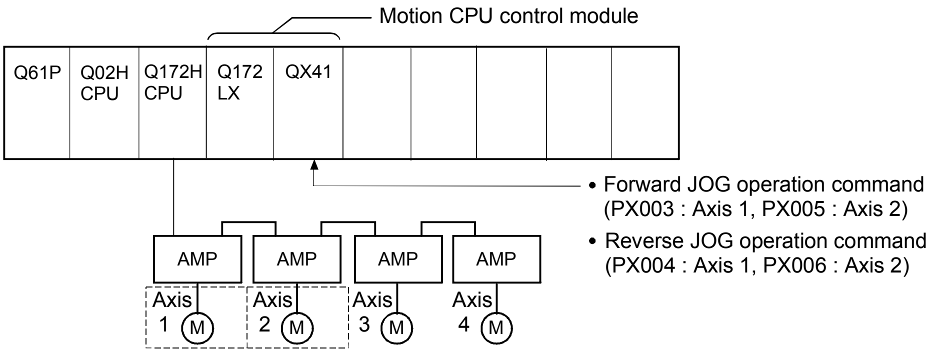


[Program Example]

Program for JOG operation is shown as the following conditions.

(1) System configuration

JOG operation for Axis 1 and Axis 2.



(2) JOG operation conditions

(a) Axis No. .... Axis 1, Axis 2
(b) JOG operation speed 100000
(c) JOG operation commands
1) Forward JOG operation .... Axis 1 : PX003 ON, Axis 2 : PX005 ON
2) Reverse JOG operation ...... Axis 1 : PX004 ON, Axis 2 : PX006 ON

(3) Motion program (Control program)

```
O0100
SET #M2042; All axes servo ON command turns on.
N10 IF[[ON #M2415] AND [ON #M2435]] GOTO 20; Wait until axis 1 and axis 2 servo ON.
GOTO 10;
N20 #D640L = 100000; Transfer the JOG operation speed to D640L and D642L.
#D642L = 100000;
IF [[ON #X003] AND [OFF #M3203]] THEN 1;
SET #M3202;
ELSE 1;                                      One axis forward rotation command
RST #M3202;                                  SET/RST
END 1;
IF [[ON #X004] AND [OFF #M3202]] THEN 2;
SET #M3203;
ELSE 2;                                      One axis reverse rotation command
RST #M3203;                                  SET/RST
END 2;
IF [[ON #X005] AND [OFF #M3223]] THEN 3;
SET #M3222;
ELSE 3;                                      Two axes forward rotation command
RST #M3222;                                  SET/RST
END 3;
IF [[ON #X006] AND [OFF #M3222]] THEN 4;
SET #M3223;
ELSE 4;                                      Two axes reverse rotation command
RST #M3223;                                  SET/RST
END 4;
GOTO 20;
M02;
%
```

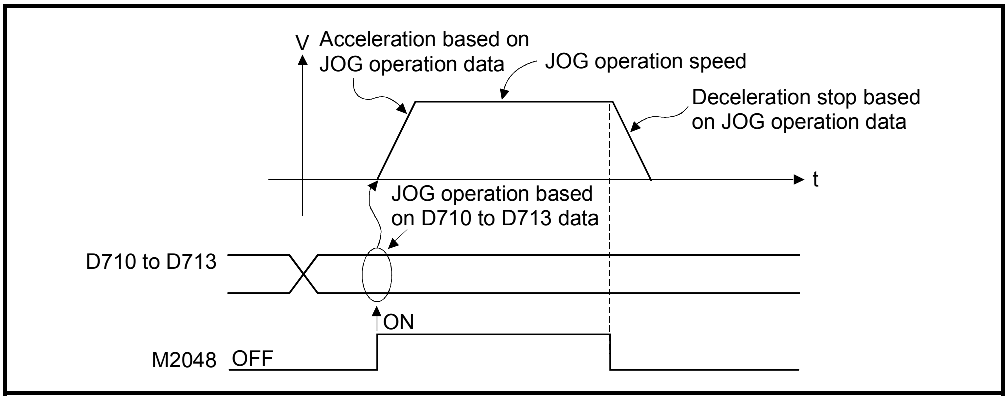
(Note) : Control program O0100 is started by automatically start, CALL, GOSUB, GOSUBE or SFCS instruction of the PLC program.

7.5.3 Simultaneous start

Simultaneous start JOG operation for specified multiple axes.

[Control details]

(1) JOG operation continues at the JOG speed setting register value for each axis while the JOG operation simultaneous start command (M2048) turns on, and a deceleration stop is made by the M2048 OFF.
Control of acceleration/deceleration is based on the data set in the JOG operation data.



(2) JOG operation axis is set in the JOG operation simultaneous start axis setting register (D710 to D713).

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

(Note-1) Set the JOG operation simultaneous start axis with 1/0.
1:Simultaneous start is executed
0:Simultaneous start is not executed
(Note-2) The range of the axis No.1 to 8 is valid in the Q172HCPU.

(3) The setting range for JOG speed setting registers are shown below.

No. (Note)	JOG operation		JOG speed setting register		Setting range					
					mm		inch		degree	
	Forward JOG	Reverse JOG	Most significant	Setting range	Setting range	Units	Setting range	Units	Setting range	Units
1	M3202	M3203	D641	D640	1 to 600000000	$\times 10^{-2}$ mm/min	1 to 600000000	$\times 10^{-3}$ inch/min	1 to 2147483647	$\times 10^{-3}$ degree/min (Note-1)
2	M3222	M3223	D643	D642						
3	M3242	M3243	D645	D644						
4	M3262	M3263	D647	D646						
5	M3282	M3283	D649	D648						
6	M3302	M3303	D651	D650						
7	M3322	M3323	D653	D652						
8	M3342	M3343	D655	D654						
9	M3362	M3363	D657	D656						
10	M3382	M3383	D659	D658						
11	M3402	M3403	D661	D660						
12	M3422	M3423	D663	D662						
13	M3442	M3443	D665	D664						
14	M3462	M3463	D667	D666						
15	M3482	M3483	D669	D668						
16	M3502	M3503	D671	D670						
17	M3522	M3523	D673	D672						
18	M3542	M3543	D675	D674						
19	M3562	M3563	D677	D676						
20	M3582	M3583	D679	D678						
21	M3602	M3603	D681	D680						
22	M3622	M3623	D683	D682						
23	M3642	M3643	D685	D684						
24	M3662	M3663	D687	D686						
25	M3682	M3683	D689	D688						
26	M3702	M3703	D691	D690						
27	M3722	M3723	D693	D692						
28	M3742	M3743	D695	D694						
29	M3762	M3763	D697	D696						
30	M3782	M3783	D699	D698						
31	M3802	M3803	D701	D700						
32	M3822	M3823	D703	D702						

(Note-1) : When the "speed control 10 × multiplier setting for degree axis" is set to "valid" in the fixed parameter, the unit is " $\times 10^{-2}$ [degree/min]".

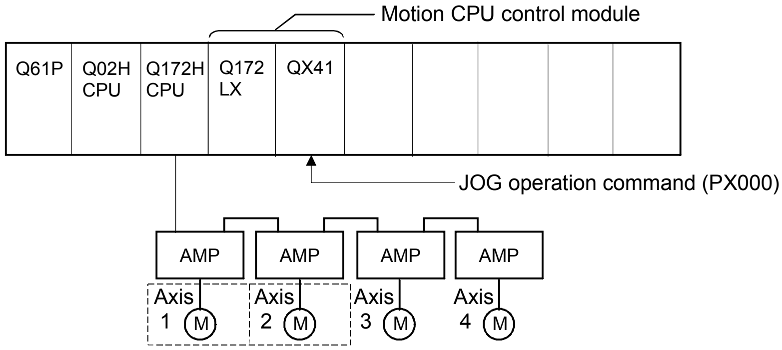
(Note-2) : The range of axis No.1 to 8 is valid in the Q172HCPU.

[Program Example]

Program for simultaneous start of JOG operations are shown as the following conditions.

(1) System configuration

JOG operation for Axis 1 and Axis 2.



(2) JOG operation conditions

(a) JOG operation conditions are shown below.

Item	JOG operation conditions	
Axis No.	Axis 1	Axis 2
JOG operation speed	150000	150000

(b) JOG operation command ...... During PX000 ON

(3) Motion program

```
O0100
SET #M2042; All axes servo ON command turns on.
N10 IF[[ON #M2415] AND [ON #M2435]] GOTO 20; Wait until axis 1 and axis 2 servo ON.
GOTO 10;
N20 IF[ON #X000] THEN 1
#D710 = 2;
#D712 = 1;
#D640L = 150000;
#D642L = 150000;
SET #M2048;
ELSE 1;
RST #M2048;
END 1;
GOTO 20;
M02;
%
```

(Note) : Control program O0100 is started by automatically start, CALL, GOSUB, GOSUBE or SFCS instruction of the PLC program.

7.6 Manual Pulse Generator Operation

Positioning control based on the number of pulses inputted from the manual pulse generator is executed.
Simultaneous operation for 1 to 3 axes is possible with one manual pulse generator, the number of connectable modules are shown below.

Number of connectable to the manual pulse generator
3

POINT

• When two or more Q173PXs are installed, connect the manual pulse generator to first (It counts from 0 slot of the CPU base) Q173PX.
(When the manual pulse generator is used, only first Q173PX is valid.)

[Control details]

(1) Positioning of the axis set in the manual pulse generator axis setting register based on the pulse input from the manual pulse generator.
Manual pulse generator operation is only valid while the manual pulse generator enable flag turn ON.

Manual pulse generator connecting position	Manual pulse generator axis No. setting register	Manual pulse generator enable flag
P1	D714, D715	M2051
P2	D716, D717	M2052
P3	D718, D719	M2053

(2) The travel value and output speed for positioning control based on the pulse input from manual pulse generator are shown below.

(a) Travel value
The travel value based on the pulse input from a manual pulse generator is calculated using the following formula.

[Travel value] = [Travel value per pulse] × [Number of input pulses] × [Manual pulse generator 1-pulse input magnification setting]

The travel value per pulse for manual pulse generator operation is shown below.

Unit	Travel value
mm	0.1 [μm]
inch	0.00001 [inch]
degree	0.00001 [degree]

If units is [mm], the command travel value for input of one pulse is :
(0.1 [μm]) × (1 [PLS]) × (Manual pulse generator 1- pulse 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] = [Number of input pulses per 1 ms] × [Manual pulse generator 1-pulse input magnification setting]

(3) Setting of the axis operated by the manual pulse generator
The axis operated by the manual pulse generator is set in the axis setting register (D714 to D719) by the manual pulse generator.
The bit corresponding to the axis controlled (1 to 32) is set.

(4) Manual pulse generator 1- pulse input magnification setting
Make magnification setting for 1- pulse input from the manual pulse generator for each axis.

1- pulse input magnification setting register	Applicable axis No. (Note-1)	Setting range
D720	Axis 1	1 to 10000
D721	Axis 2	
D722	Axis 3	
D723	Axis 4	
D724	Axis 5	
D725	Axis 6	
D726	Axis 7	
D727	Axis 8	
D728	Axis 9	
D729	Axis 10	
D730	Axis 11	
D731	Axis 12	
D732	Axis 13	
D733	Axis 14	
D734	Axis 15	
D735	Axis 16	
D736	Axis 17	
D737	Axis 18	
D738	Axis 19	
D739	Axis 20	
D740	Axis 21	
D741	Axis 22	
D742	Axis 23	
D743	Axis 24	
D744	Axis 25	
D745	Axis 26	
D746	Axis 27	
D747	Axis 28	
D748	Axis 29	
D749	Axis 30	
D750	Axis 31	
D751	Axis 32	

(Note-1) : The range of axis No.1 to 8 is valid in the Q172HCPU.

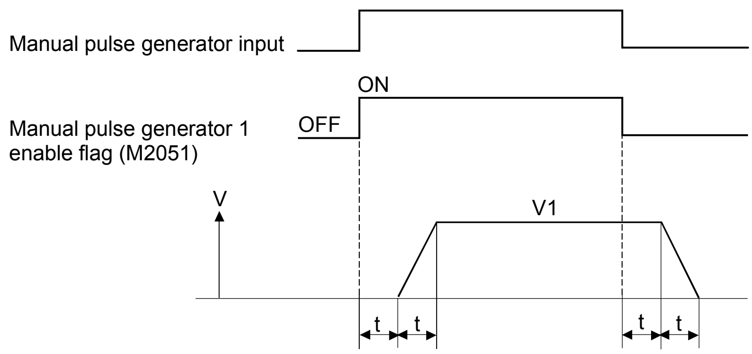
(Note): The manual pulse generator does not have the speed limit value, so they set the magnification setting within the rated speed of servomotor.

(5) The setting manual pulse generator 1-pulse input magnification checks the "1-pulse input magnification setting registers of the manual pulse generator" of the applicable axis at the turning manual pulse generator enable flag turns off to on. If the value is outside of range, the manual pulse generator axis setting error register (D9185 to D9187) and manual pulse generator axis setting error flag (M9077) are set and a value of "1" is used for the magnification.

(6) Manual pulse generator smoothing magnification setting
A magnification to smooth the turning the manual pulse generator operation off to on or on to off is set.

Manual pulse generator smoothing magnification setting register	Setting range
Manual pulse generator 1 (P1) : D752	0 to 59
Manual pulse generator 2 (P2) : D753	
Manual pulse generator 3 (P3) : D754	

(a) Operation



Output speed (V1) = [Number of input pulses/ms] × [Manual pulse generator 1-pluse input magnification setting]

Travel value (L) = [Travel value per pulse] × [Number of input pulses] × [Manual pulse generator 1-pluse input magnification setting]

(b) When the smoothing magnification is set, the smoothing time constant is as following formula.
Smoothing time constant (t) = (Smoothing magnification + 1) × 56.8 [ms]

REMARK

The smoothing time constant is within the range of 56.8 to 3408[ms].

(7) Errors details at the data setting for manual pulse generator operation are shown below.

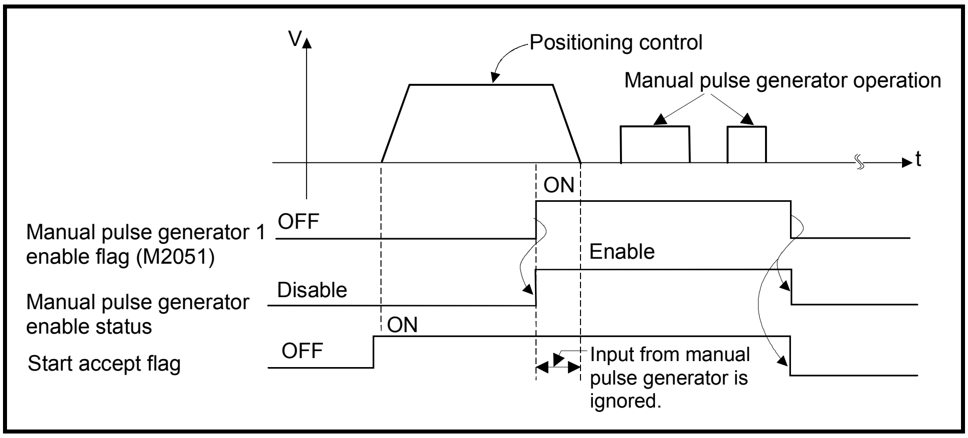
Error details	Error processing
Axis set to manual pulse generator operation is specified.	• Duplicated specified axis is ignored. • First setting manual pulse generator operation is executed.
Axis setting is 4 axes or more	• Manual pulse generator operation is executed according to valid for 3 axes from the lowest manual pulse generator axis setting register.
All of bit is "0" for the effective axis No. of manual pulse generator axis No. setting register.	• Manual pulse generator operation is not executed.

[Cautions]

(1) The start accept flag turns on for axis during manual pulse generator operation. Positioning control or home position return cannot be started using the Motion CPU or a peripheral device.
Turn off the manual pulse generator enable flag after the manual pulse generator operation end.

(2) The torque limit value is fixed at 300[%] during manual pulse generator operation.

(3) If the manual pulse generator enable flag turns on for the starting axis by positioning control or JOG operation, an error [214] is set to the applicable axis and manual pulse generator input is not enabled. After the axis has been stopped, the turning OFF to ON of the manual pulse generator enable flag becomes valid, the start accept flag turns on by the manual pulse generator input enabled status, and input from the manual pulse generator is input.



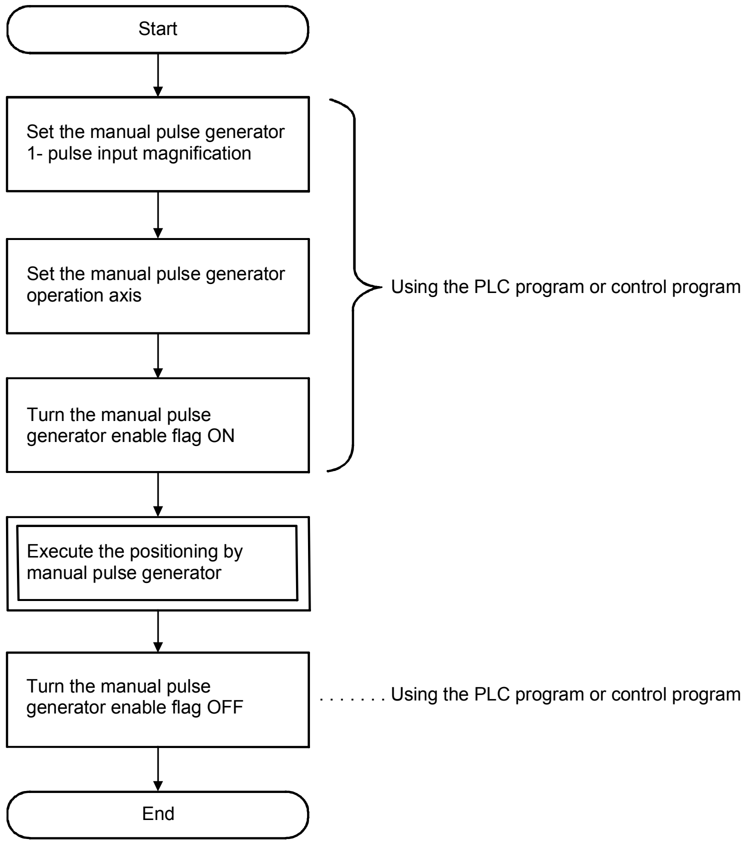
(4) If the manual pulse generator enable flag of another manual pulse generator No. turns on for axis during manual pulse generator operation, an error [214] is set to the applicable axis and the input of that manual pulse generator is not enabled. Turn the manual pulse generator enable flag on again after stopping the manual pulse generator operation which had become input enable previously.

(5) If the same manual pulse generator enable flag turns on again for axis during smoothing deceleration after manual pulse generator enable flag turns off, an error [214] is set and manual pulse generator input is not enabled. Turn the manual pulse generator enable flag on after smoothing deceleration stop (after the start accept flag OFF).

(6) If another axis is set and the same manual pulse generator enable flag turns on again during smoothing deceleration after manual pulse generator enable flag turns off, the manual pulse generator input is not enabled.
At this time, the manual pulse generator axis setting error bit of the manual pulse generator axis setting error storage register (D9185 to D9187) turns on, and the manual pulse generator axis setting error flag (M9077) turns on.
Include the start accept flag OFF for specified axis in interlocks as the conditions which turn on the manual pulse generator enable flag.

[Procedure for manual pulse generator operation]

Procedure for manual pulse generator operation is shown below.

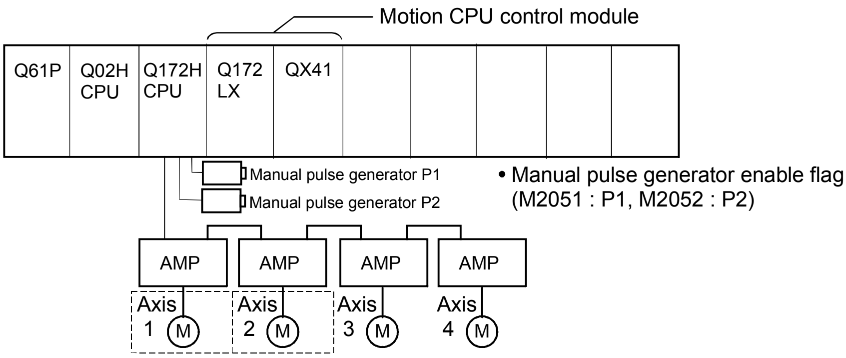


[Program Example]

Program executes manual pulse generator operation is shown as the following conditions.

(1) System configuration

Manual pulse generator operation of Axis 1.



(2) Manual pulse generator operation conditions

(a) Manual pulse generator operation axis........... Axis 1, Axis 2
(b) Manual pulse generator 1-pluse input magnification............ 100
(c) Manual pulse generator operation enable ...... M2051(Axis 1)/M2052(Axis 2) ON
(d) Manual pulse generator operation end ……… M2051(Axis 1)/M2052(Axis 2) OFF

(3) Motion program (Control program)

```
O0100
SET #M2042; All axes servo ON command turns on.
N10 IF [[ON #M2415] AND [ON #M2435]] GOTO 20; Wait until axis 1 and axis 2 servo ON.
GOTO 10;
N20 IF [ON #X000] GOTO 30; Wait until manual pulse generator operation start.
GOTO 20;
N30 #D720 = 100;  } Set "axis 1" and "axis 2" 1-pluse input magnification.
#D721 = 100;      }
#D714L = 1; Control axis 1 by P1.
#D716L = 2; Control axis 2 by P2.
SET #M2051; } Axis 1 and axis 2 manual pulse generator enable flag turn on.
SET #M2052; }
N40 IF [OFF #X000] GOTO 50; Wait until manual pulse generator operation end.
GOTO 40;
N50 RST #M2051; } Axis 1 and axis 2 manual pulse generator enable flag turn off.
RST #M2052;     } (Note) : Turn off the P1 and P2 manual pulse generator enable flag for
M02;                       safety not to continue the manual pulse generator operation at
%                          the manual pulse generator operation end.
```

(Note) : Control program O0100 is started by automatically start, CALL, GOSUB, GOSUBE or SFCS instruction of the PLC program.

7.7 Override Ratio Setting Function

The speed change can be executed by setting the override ratio to the command speed of the Motion program in this function.

[Control details]

(1) The override ratio is set in the range of 0 to 100[%] in 1[%] units to the command speed in the Motion program. The value obtained by multiplying the command speed by the override value is the real feed speed.

(2) The override ratio is set to each axis.
The default value is 100[%] in all axes.

[Data Setting]

(1) The speed change by the override ratio setting function is used the override ratio setting register.
The override ratio setting register of each axis are shown below.

Axis No.	Override Ratio Setting Register	Axis No.	Override Ratio Setting Register	Axis No.	Override Ratio Setting Register	Axis No.	Override Ratio Setting Register
1	D1536	9	D1560	17	D1584	25	D1608
2	D1539	10	D1563	18	D1587	26	D1611
3	D1542	11	D1566	19	D1590	27	D1614
4	D1545	12	D1569	20	D1593	28	D1617
5	D1548	13	D1572	21	D1596	29	D1620
6	D1551	14	D1575	22	D1599	30	D1623
7	D1554	15	D1578	23	D1602	31	D1626
8	D1557	16	D1581	24	D1605	32	D1629

(2) The ratio is set to the override ratio setting register within the range of 0 to 100[%].

(3) When the override ratio enable/disable (M4405+10n) is ON, the content of override ratio setting register is valid. When the M4405+10n is OFF, it is controlled at the override ratio of 100[%].

[Cautions]

(1) When the SVST instruction is executed, the content of override ratio setting register for the lowest starting axis valid.
[Example]
Axis 2, 3, 4 start instruction

SP.SVST	H3E3	"J2J3J44"	K100	M0	D0

• When the above SVST instruction is executed, the data of axis 2 is valid. (The data of axis 3, 4 are invalid.)

(2) When the speed is changed by the override ratio setting function, acceleration/deceleration processing is executed according to the "acceleration time" and "deceleration time" in the parameter block.

(3) The override ratio setting is valid for Motion program operation only. (Invalid for JOG operation and so on.)

(4) The error contents for override ratio data setting are shown below.

Error code	Error factor	Error Processing	Corrective action
190	At a start, the value set in the override ratio setting register is except 0 to 100[%].	• Operation is performed at 100[%]. (Operation is executed at command speed in the Motion program.)	Sets the override ratio within the range of 0 to 100 [%].
290	During operation, the value set in the override ratio setting register is except 0 to 100[%].		

[Operation Timing]

The speed change timing by override ratio setting function is shown in Fig. 7.22.

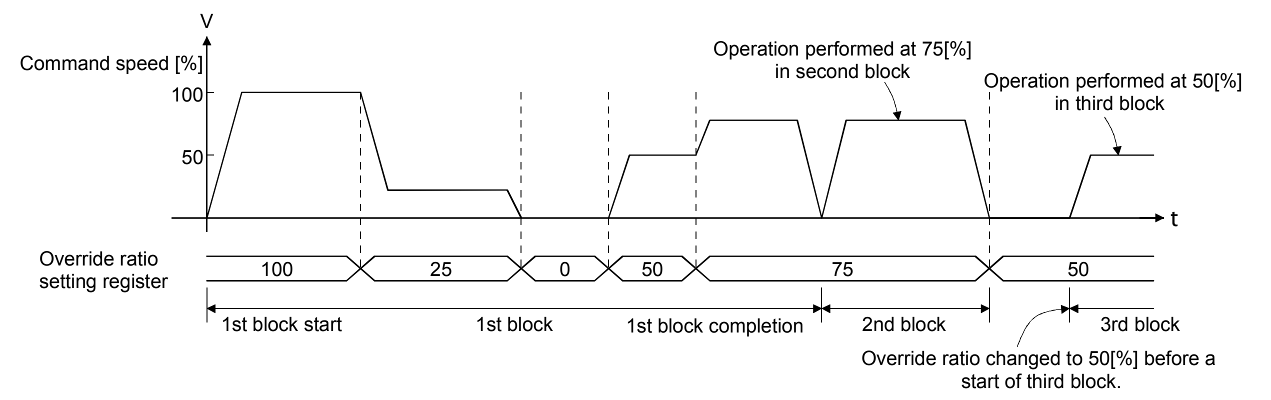


Fig. 7.22 Speed change timing for override ratio setting

7.8 FIN signal wait function

By selecting the FIN signal wait function and setting a M-code at each executing point, a process end of each executing point is synchronized with the FIN signal, the FIN signal turns ON to OFF and then the next positioning is executed.
Turn the FIN signal on/off using the Motion program or PLC program.

[Data Setting]

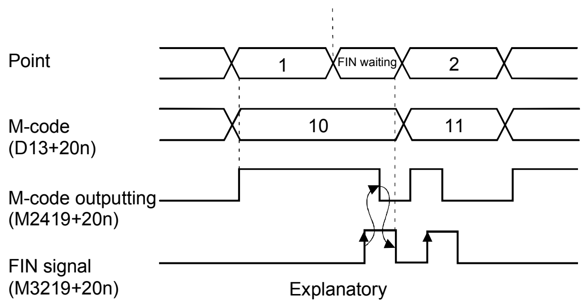
(1) The FIN signal and M-code outputting signal correspond to the following devices of each axis.

Signal name \ Axis No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FIN signal	M3219	M3239	M3259	M3279	M3299	M3319	M3339	M3359	M3379	M3399	M3419	M3439	M3459	M3479	M3499	M3519
M-code outputting signal	M2419	M2439	M2459	M2479	M2499	M2519	M2539	M2559	M2579	M2599	M2619	M2639	M2659	M2679	M2699	M2719
Signal name \ Axis No.	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**2 9**	**30**	**31**	**32**
FIN signal	M3539	M3559	M3579	M3599	M3619	M3639	M3659	M3679	M3699	M3719	M3739	M3759	M3779	M3799	M3819	M3839
M-code outputting signal	M2739	M2759	M2779	M2799	M2819	M2839	M2859	M2879	M2899	M2919	M2939	M2959	M2979	M2999	M3019	M3039

(2) The acceleration/deceleration method is the fixed acceleration/deceleration time method.
The acceleration/deceleration time of selected parameter block is used as the acceleration time.

[Program Example]

```
O0001
01 ;
G01  X20.  Y20.  F100.  M10 ;  (Point1)
X30.  Y25.  M11  ;             (Point2)
X35.  Y30.  M12  ;             (Point3)
X40.  Y40.  ;                  (Point4)
M02  ;
%
```



Explanatory

1. When the positioning of point 1 starts, M-code10 is output and M-code outputting signal turns on.
2. FIN signal turns on after performing required processing in the Motion program.
   Transition to the next point does not execute until the FIN signal turns on.
3. When the FIN signal turns on, M-code outputting signal turns off.
4. When the FIN signal turns off after the M-code outputting signal turns off, the positioning to the next point 2 starts.

[Cautions]

(1) When the stop command (external, M3200+20n, M3201+20n), cancel signal or skip signal is input, the M-code outputting signal turns OFF.

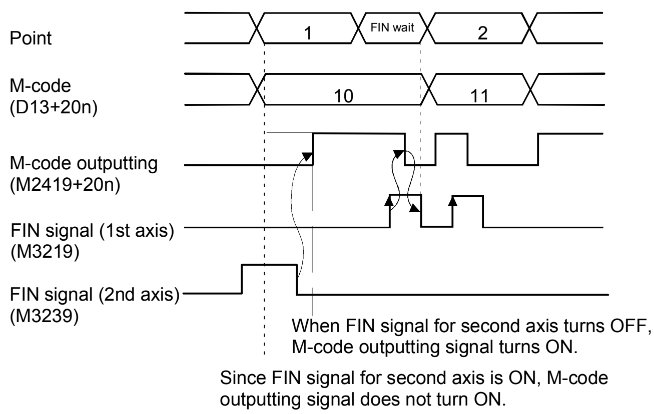
(2) When M-code is set at the end point, positioning ends after the FIN signal has turn OFF to ON to OFF.

(3) Transition of point for the FIN signal wait function is executed with the command before acceleration/deceleration. (Refer to Fig in (6) (b).)

(4) M-code outputting signal is output to all interpolation axes at the interpolation control. In this case, turn on the signal for one of the interpolation axes. However, the FIN signal for the high-speed oscillation execution axis is ignored.

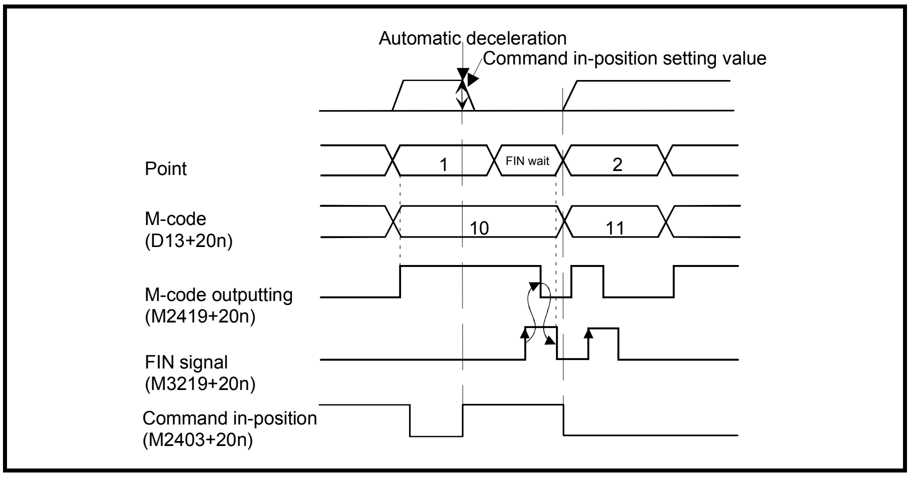
(5) When the FIN signal for any one of the interpolation axes is ON, the M-code outputting signal is not output if the FIN wait function is executed.

Example: When the FIN waiting function for point 1 is executed while the second axis turns on.

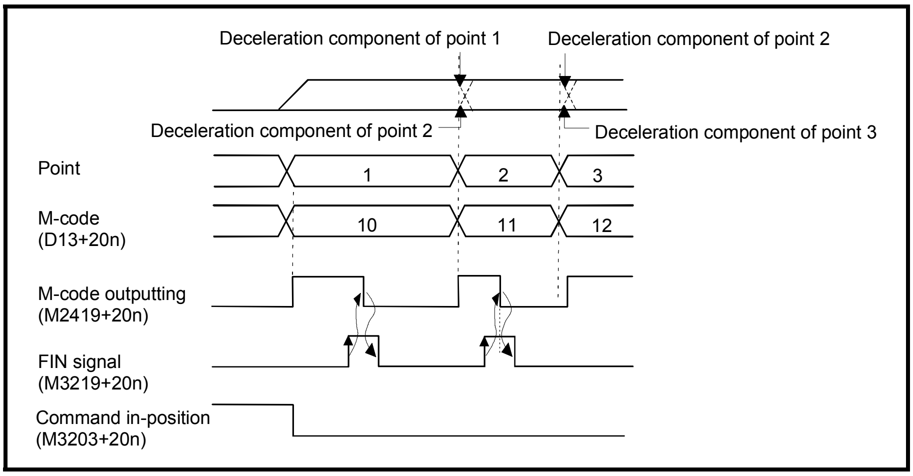


(6) The command in-position signal for FIN signal wait function is output as below.

(a) When the automatic deceleration is started by positioning to the executed point (including the last point) during FIN signal wait.
If the difference between the positioning address (command position) of executing point and the machine value reaches within the command in-position range during FIN signal wait deceleration, the command in-position signal (M2403+20n) turns on.
When the axis transits to the next point, the command in-position signal turns off.

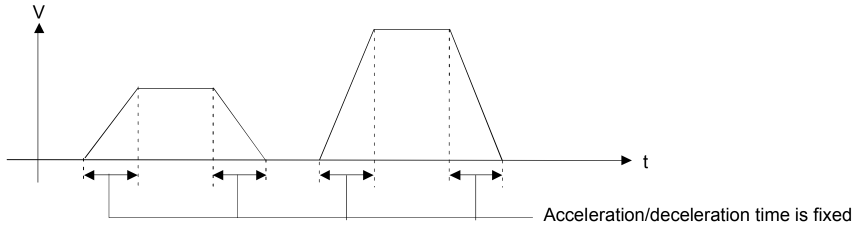


(b) When the axis transits to the next point without automatic deceleration by positioning to the executing point during FIN signal wait.
If the axis transits to the next point without automatic deceleration, the command in-position signal does not turn on.



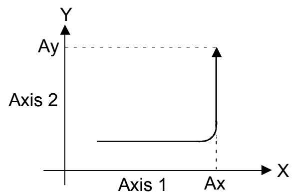
POINTS

(1) The fixed acceleration/deceleration time method is acceleration/deceleration processing that the time which acceleration/deceleration takes is fixed, even if the command differs.

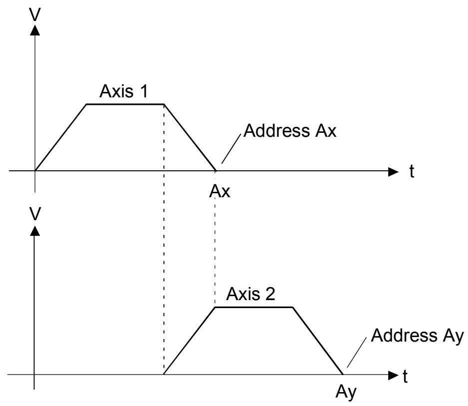


(a) The following processing and parameters are invalid in the fixed acceleration/deceleration time method.
- Rapid stop acceleration/deceleration time in parameter block
- S-curve acceleration/deceleration

(b) The speed processing for each axis is as shown below in positioning operation (constant-speed) as shown in the following figure.



Positioning operation

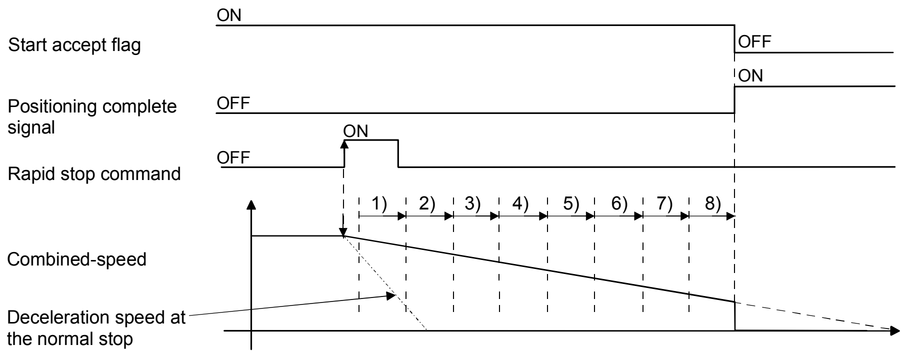


Constant-speed control processing of each axis

(2) When the rapid stop command is executed by the setting "deceleration time < rapid stop deceleration time" during constant-speed control, the point data currently executed in the middle of deceleration, and the positioning may be completed suddenly as a speed "0".
In the case of, "deceleration time ≧ rapid stop deceleration time", the above operation is not executed.

Travel value by the point data currently executed at the rapid stop command (Up to 9 points) < Speed at rapid stop command input × Rapid stop deceleration time/2

[Operation pattern]



7.9 Single Block Operation

This function is used to execute the program operation block-by-block and check the operation of Motion program.
The single block is available in two modes: a mode where a single block is specified before a program start, and a mode where a single block is executed at any point during program execution.

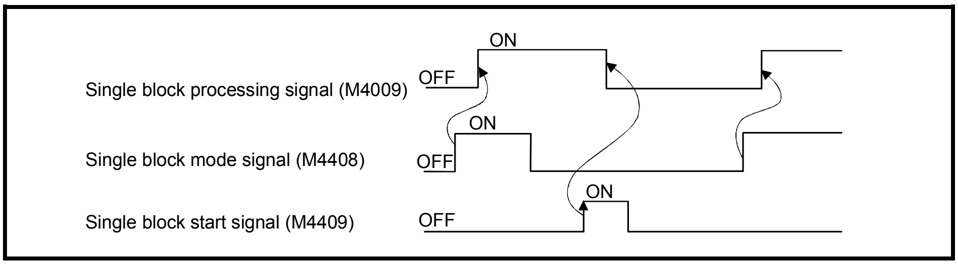
The single block operation can be executed at any point during operation by turning the single block mode signal (M4408) ON during continuous operation, and by turning the single block start signal (M4409) from OFF to ON.

[Control details]

(1) Single block signal devices

The single block related signals are shown below.

Signal Name	Device No.	Signal direction
Single block processing	M4009	Monitor device
Single block mode	M4408	Command device
Single block start	M4409	



These signals are valid for all program operations executed concurrently.

(a) Single block in progress (M4009)

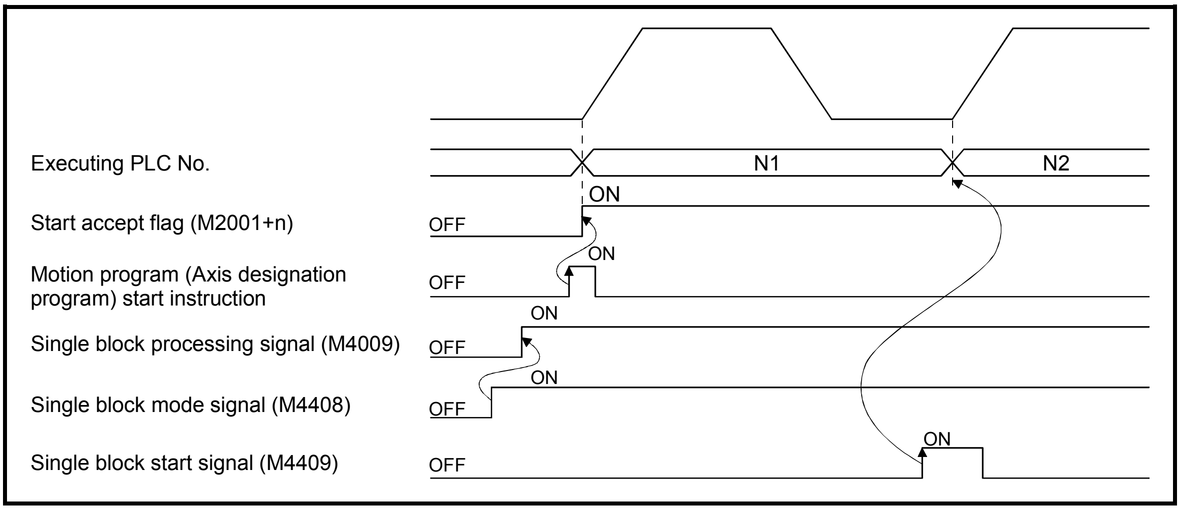
This signal indicates that the single block function can be executed. A single block is executed when the single block processing signal is ON. When the single block processing is OFF, make a Motion program (axis designation program) start or turn single block start from OFF to ON to perform continuous operation. When the single block mode signal (M4408) turns ON, the single block processing signal turns ON.
When the single block start signal (M4409) turns from OFF to ON after the single block mode signal (M4408) turns OFF, this signal turns OFF.

(b) Single block mode (M4408)
This signal makes a single block valid.

(c) Single block start (M4409)
This single starts a program in a single block waiting status.

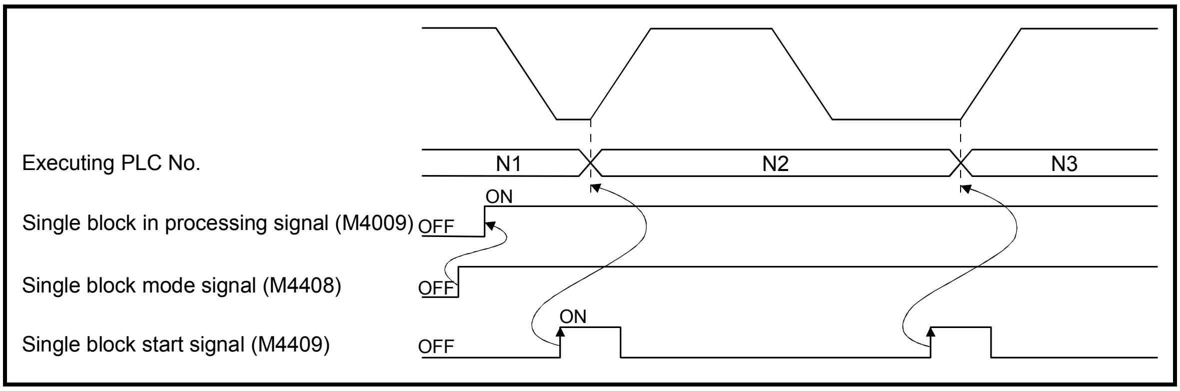
(2) How to execute single block from a start

When the single block mode signal (M4408) turns ON, the single block processing signal (M4009) turns ON. In this status, turn ON the Motion program (Axis designation program).
After the first block is executed, execution waits for the single block start signal (M4409) to turn from OFF to ON.



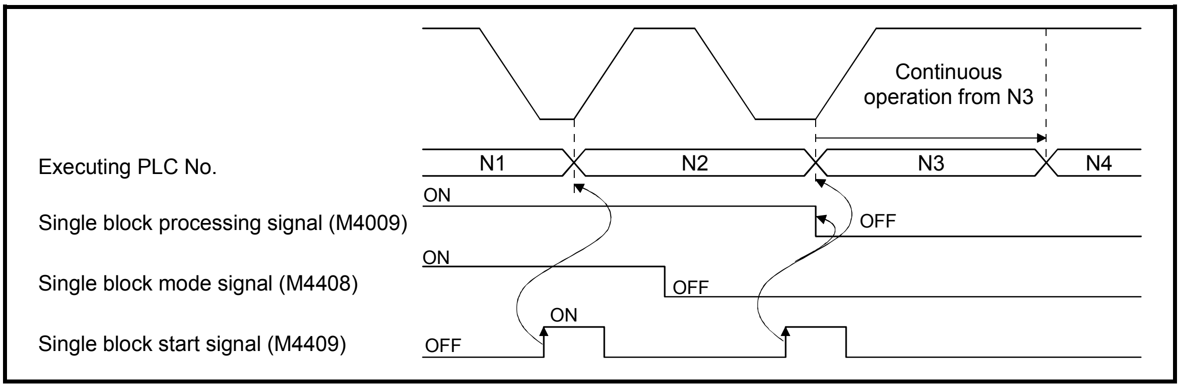
(3) How to continue single block

Turn the single block start signal (M4409) from OFF to ON while the single block processing signal (M4009) is ON.
After one block program is executed, execution waits for the single block start signal to turn ON.



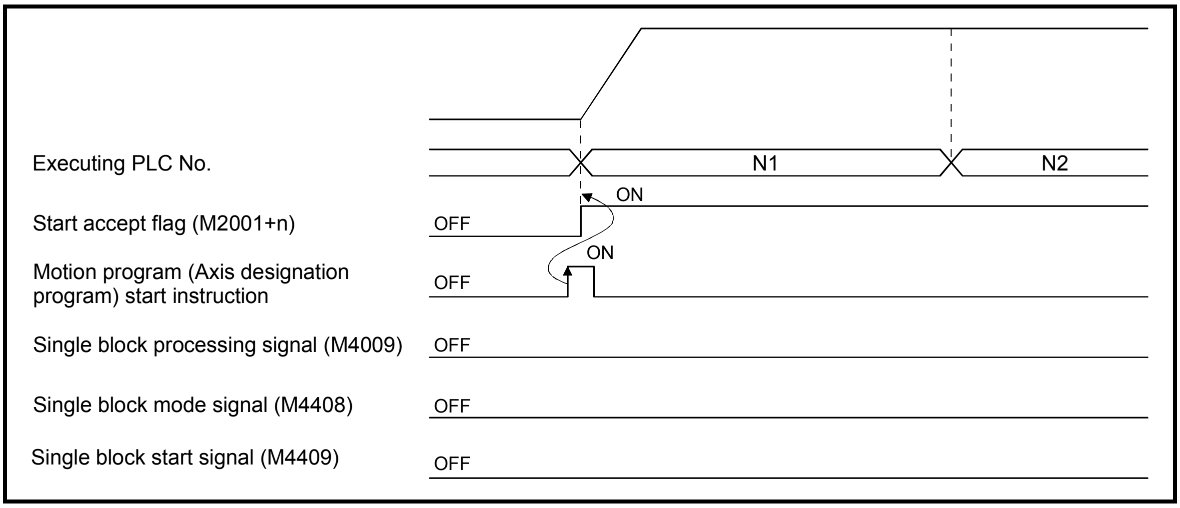
(4) How to start operation continuously during execution of single block

Turn the single block mode signal (M4408) from ON to OFF. When the single block start signal (M4409) turns OFF to ON in this state, the single block processing signal (M4409) turns OFF and the program makes continuous operation.



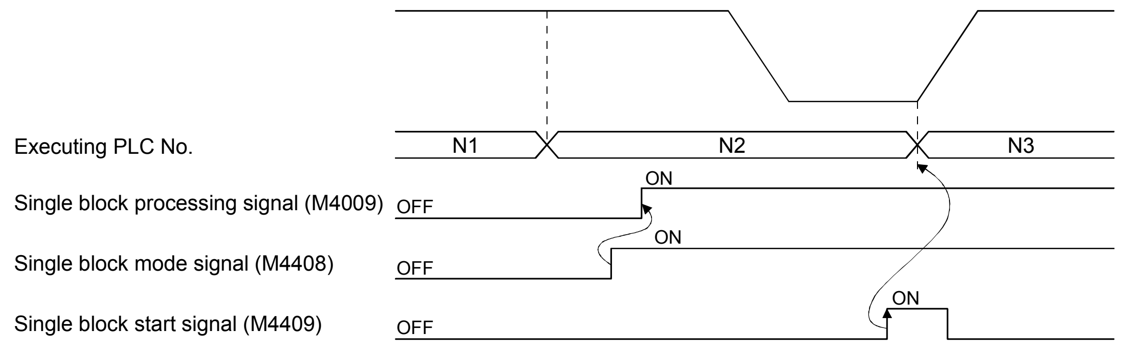
(5) How to perform continuous operation from a start (Normal operation)

The Motion program (Axis designation program) turns ON while the single block processing signal (M4009) is OFF, the program makes continuous operation.



(6) How to execute single block during continuous operation

Turn the single block mode signal (M4408) ON during program operation. During move block execution, the program is stopped after termination of that block and execution waits for the single block start signal (M4409) to turn from OFF to ON.

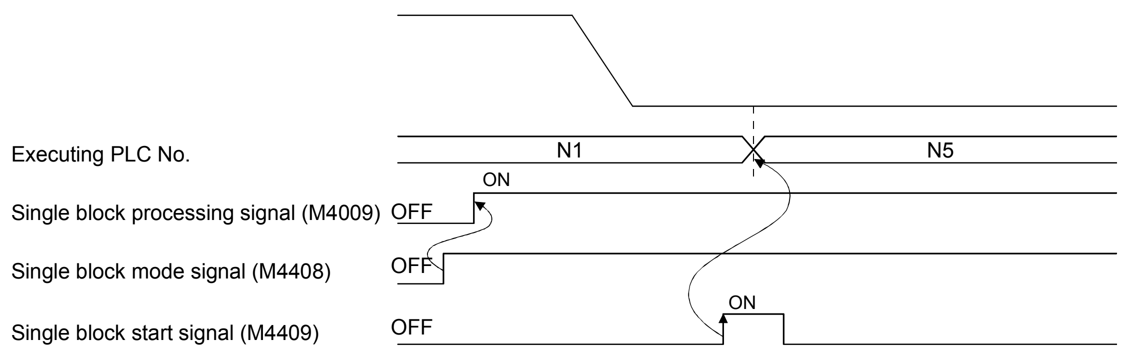


A macro instruction block, e.g. arithmetic operation, is pre-read during execution of the move instruction for PTP (e.g. G00) or CP (e.g. G01). Therefore, if the single block function is executed while the macro instructions are pre-read during motion, the executing block number and executing PLC No. displayed are those in the pre-read area.

[Motion program example]

```
O0010 ;
N1 G01 X100. F100. ; (Single block processing signal is ON)
N2 #D0 = 0 ;
N3 #D2 = 1 ;
N4 #D3 = 2 ;
N5 #D4 = 3 ; (Pre-read complete block)
M02 ;
%
```

During N1 execution, the single block processing signal is turned ON. If the macro instructions in up to N5 have been pre-read at this time, making a single block start for one block changes the executed PLC No. from N1 to N5.



[Cautions]

(1) Single block mode signal (M4408) and single block command (M4403+10n)
If the single block by single block mode signal (M4408) and the single block by single block command (M4403+10n) are executed simultaneously, the operation by the single block command (M4403+10n) is made invalid.

(2) Emergency stop, stop command, rapid stop command and error when single block in progress signal (M4009) is ON
When the single block processing signal (M4009) is ON, it does not turn OFF if an emergency stop, stop command or rapid stop command is executed, or an error occurs.
The single block processing signal (M4009) turns OFF by turning OFF the single block mode signal (M4408) and then turning the single block start signal (M4409) from OFF to ON.

(3) Status at termination of one block execution when single block in progress is ON
If one block execution ends when the single block processing signal (M4009) is ON, the automatic start signal (M4002+10n) does not turn OFF. At this time, the command in-position signal (M2403+20n) turns ON.

(4) Single block start during move instruction execution
The single block start is not accepted during axis travel (except high-speed oscillation). Make a single block start after the axis has been stopped by single block.

7.10 Control Program Stop Function from The PLC CPU

The No. of control program during execution is specified to end a program from the PLC CPU. (This function is equivalent to a Motion program (CLEAR) for positioning control.)

(1) The control program set as the CLEAR request control program No. setting register (D707) is ended. The values except for "0" is set in D707, the CLEAR processing is executed.

(2) When an equivalent for CLEAR instruction is executed toward the all control programs during execution, "65535" is stored in the CLEAR request control program No. setting register (D707).

(3) When the control program set as the CLEAR request control program No. setting register (D707) is cleared normally, "1" is stored in the CLEAR request status storage register (D1445).

(4) When an error will occur by clearing the control program set as the CLEAR request control program No. setting register (D707), the following error codes are stored.
   (a) A minor error "the program number ended by CLEAR is outside the range of 1 to 1024". (Error code: 619)
   (b) A minor error "the program number ended by CLEAR is nor registered. Or, the axis designation program is cleared." (Error code: 620)

(5) When "0" is stored in the CLEAR request control program No. setting register (D707), "1" is also stored in the CLEAR request status storage register (D1445).

[Operation Timing]

Operation timing for the CLEAR request status storage register by control program stop function from the PLC CPU is shown in Fig. 7.23.

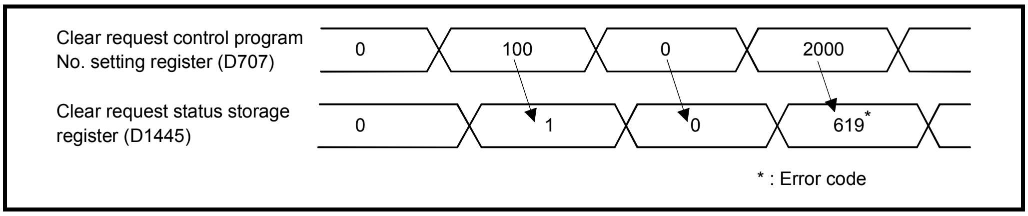


Fig. 7.23 Operation timing for the CLEAR request status storage register

MEMO

8. USER FILES

A user file list and directory structure are shown below

8.1 Projects

User files are managed on a "project" basis.
When you set a "project name", a "project name" folder is created as indicated on the next page, and under that, an editing folder (temp) are created.

POINT

(1) Set the "project name" on the project management screen.

(2) The "project name" is restricted to 230 characters in length.

(3) The "project path name" + "project name" are restricted to 230 characters in length.
((Example) "C:\Usr\.........\project name\")

8

8.2 User File List

A user file list is shown below.

(Note-1) : Indicates the file (data) stored in CPU memory.

Project name folder ··· Folder of user-set "project name"

Sub folders (fixed)

Sfc

(1)		Project file	Project name.prj	··· Information file of the project
(2)		Motion program file	svgcode.bin	··· Motion program file
(3)		PC type file	gsvp.cnf	··· CPU type information file
(4)	(Note-1)	System setting data file	svsystemH.bin	··· System setting data information file
		High speed read setting file	svlatch.bin	··· High speed read setting information file
		Optional data monitor setting file	svsysmon.bin	··· Optional data monitor information file
(5)	(Note-1)	Servo data file	svdataH.bin	··· Parameter information file
			svparaH.bin	··· Servo parameter information file
			svls.bin	··· Limit switch setting data information file
			svdatag.bin	··· Parameter information file for SV43
(6)	(Note-1)	Motion parameter file	motionpara.bin	··· Motion parameter information file
(7)		Backup data file	svbackup.bin	··· Information file 1 for backup and load
			svbackup2.bin	··· Information file 2 for backup and load
			svbackup6.bin	··· Information file 6 for backup and load
(8)	(Note-1)	Motion register file	modevice.bin	··· Reading file of the motion register (#0 to #8191). For write, only user device range (#0 to #7999) is written.
		Device memory file	devmen.bin	··· Reading file of the device excluding # (X, Y, M/L, B, F, D, W, special M, special D)
(9)		Device setting screen information file	devset.inf	··· Device setting information file of device setting screen
(10)	(Note-1)	Q series PLC common parameter file	param.wpa	··· Data file of Multiple CPU setting, I/O assignment, etc.
(11)		Communication setting information file	communi.inf	··· Communication setting information file

temp ··· Program editing temporary directory

APPENDICES

APPENDIX 1 Error Codes Stored Using The Motion CPU

The Motion program setting errors and positioning errors are detected in the Motion CPU side.

(1) Motion program setting errors

These are positioning data errors set in the Motion program, at it checks the parameter block No. and axis No. at the execution of SVST instruction.
The operations at the error occurrence are shown below.

- The Motion program setting error flag (M9079) turns on.
- The erroneous Motion program is stored in the error program No. storage register (D9189).
- The error code is stored in the error item information register (D9190).

(2) Positioning error

(a) Positioning errors occurs at the positioning start or during positioning control. There are minor errors, major errors and servo errors.

1) Minor errors…… These errors occur in the PLC program or Motion program, and the error codes 1 to 999 are used. Remove the error cause by correcting the PLC program or Motion program.
2) Major errors…… These errors occur in the external input signals or control commands from the Motion CPU, and the error codes 1000 to 1999 are used. Check the error code, and remove the error cause of the external input signal state or PLC program.
3) Servo errors ..….These errors detected in the servo amplifier, and the error codes 2000 to 2999 are used. Check the error code, and remove the error cause of the servo amplifier side.

(b) The error detection signal of the erroneous axis turns on at the error occurrence, and the error codes are stored in the minor error code, major error code or servo error code storage register.

Table 1.1 Error code storage registers, error detection signals

Error class \ Device	Error code storage register Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	Error detection signal
Minor error	D6	D26	D46	D66	D86	D106	D126	D146	D166	D186	D206	D226	D246	D266	D286	D306	M2407+20n
Major error	D7	D27	D47	D67	D87	D107	D127	D147	D167	D187	D207	D227	D247	D267	D287	D307	
Servo error	D8	D28	D48	D68	D88	D108	D128	D148	D168	D188	D208	D228	D248	D268	D288	D308	M2408+20n

Error class \ Device	Error code storage register Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	Error detection signal
Minor error	D326	D346	D366	D386	D406	D426	D446	D466	D486	D506	D526	D546	D566	D586	D606	D626	M2407+20n
Major error	D327	D347	D367	D387	D407	D427	D447	D467	D487	D507	D527	D547	D567	D587	D607	D627	
Servo error	D328	D348	D368	D388	D408	D428	D448	D468	D488	D508	D528	D548	D568	D588	D608	D628	M2408+20n

(Note): The range of axis No.1 to 8 is valid in the Q172HCPU.

(c) If another error occurs after an error code has been stored, the existing error code is overwritten, deleting it.
However, the error history can be checked using a peripheral device started with the SW6RN-GSV43P software.

(d) Error detection signals and error codes are held until the error code reset command (M3207+20n) or servo error reset command (M3208+20n) turns on.

POINTS

(1) Even if the servo error reset (M3208+20n) turns on at the servo error occurrence, the same error code might be stored again.
(2) Reset the servo error after removing the error cause of the servo amplifier side at the servo error occurrence.

APPENDIX 1.1 Motion program setting errors (Stored in D9190)

The error codes, error contents and corrective actions for Motion program setting errors are shown in Table 1.2.

Table 1.2 Motion program setting error list

Error code stored in D9190	Error name	Error contents	Error processing	Corrective action
1	Parameter block No. setting error	The parameter block No. is outside the range of 1 to 64.	Execute the Motion program with the default value "1" of parameter block.	Set the parameter block No. within the range of 1 to 64.
906	Axis No. setting error	An unused axis of the system setting is set to the Motion program set in the SVST instruction.	Positioning control does not start.	Set the axis No. used in the system settings.
3300	Number of control program starts over error	33 or more axis designation programs are started simultaneously.	Positioning control does not start.	Set up to 32 programs as the simultaneous execution program.
3301	Number of designation program starts over error	17 or more control programs are started simultaneously.	Positioning control does not start.	Set up to 16 programs as the simultaneous execution program.

APPENDIX 1.2 Minor errors

These errors are detected in the PLC program or Motion program, and the error codes of 1 to 999 are used.
Minor errors include the setting data errors, starting errors, positioning control errors, speed change/torque control value change errors and Motion program execution errors.

(1) Setting 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 1.3.

Table 1.3 Setting data error (1 to 99) list

Error code	Erroneous data	Check timing	Error cause	Error processing	Corrective action
21	Home position return data	Home position return start of the count, proximity dog, data set, dog cradle, stopper and limit switch combined type	The home position address is outside the range of 0 to 35999999 ($\times 10^{-5}$[degree]) with degree axis.	Home position return is not started.	Set the home position address within the setting range using a peripheral device.
22		Home position return start of the count, proximity dog, dog cradle, stopper and limit switch combined type	The home position return speed is outside the range of 1 to speed limit value.		Set the home position return speed or less to the speed limit value using a peripheral device.
23			The creep speed is outside the range of 1 to home position return speed.		Set the creep speed below to the home position return speed or less using a peripheral device.
24		Home position return start of the count type	The travel value after the proximity dog ON is outside the range of 0 to (2^{31}-1) ($\times$unit).		Set the travel value after the proximity dog ON within the setting range using a peripheral device.
25		Home position return start of the count, proximity dog, dog cradle, stopper and limit switch combined type	The parameter block No. is outside the range of 1 to 64.		Set the parameter block No. within the setting range using a peripheral device.
26		Home position return start of the stopper type	Torque limit value at the creep speed is outside the range of 1 to 1000[%].		Set the torque limit value at the creep speed within the setting range using a peripheral device.
27		Home position return start of the usable retry function	Dwell time at the home position return is outside the range of 0 to 500[ms].		Set the dwell time at the home position return retry within the setting range using a peripheral device.

Table 1.3 Setting data error (1 to 99) list (Continued)

Error code	Erroneous data	Check timing	Error cause	Error processing	Corrective action
40	Parameter block	Interpolation control start	The interpolation control unit of the parameter block is different from the control unit of the fixed parameters.	Control with the control unit of the fixed parameters.	Set the same control unit of the fixed parameters and servo parameters.

POINT

When the interpolation control unit of parameter block is different from the control unit of the fixed parameters, an error code may not be stored with the combination of units.
Refer to Section 6.11.6 for details.

(2) Positioning control start errors (100 to 199)

These errors are detected at the positioning control start.
The error codes, causes, processing, and corrective actions are shown in Table 1.4 below.

Table 1.4 Positioning control start error (100 to 199) list

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
100	○	○	○	○	○	○	The PLC ready flag (M2000) or PCPU ready flag (M9074) is OFF.	Positioning control does not start.	• Set the Motion CPU to RUN. • Turn the PLC ready flag (M2000) on.
101		○	○	○	○	○	The start accept flag (M2001 to M2032) for applicable axis is ON.		• Take an interlock in the program not to start the starting axis. (Use the start accept flag OFF of the applicable axis as the starting condition).
103		○	○	○	○	○	The stop command (M3200+20n) for applicable axis is ON.		• Turn the stop command (M3200+20n) off and start.
104		○	○	○	○	○	The rapid stop command (M3201+20n) for applicable axis is ON.		• Turn the rapid stop command (M3201+20n) off and start.
105 (Note)		○					The feed current value is outside the range of stroke limit at the start.		• Set within the stroke limit range by the JOG operation. • Set within the stroke limit range by the home position return or current value change.
106 (Note)		○				○	Positioning is outside the range of the stroke limit.		• Perform the positioning within the range of stroke limit.
107		○					The address that does not generate an arc is set at the auxiliary point-specified circular interpolation or auxiliary point-specified helical interpolation. (Relationship between the start point, auxiliary point and end point.)		• Correct the addresses of the Motion program.
108 (Note)		○					The address that does not generate an arc is set at the R (radius) specified circular interpolation or R (radius) specified helical interpolation. (Relationship between the start point, radius and end point.)		

(Note): These errors are stored the error codes of the all applicable interpolation axes at the interpolation operation.

Table 1.4 Positioning control start error (100 to 199) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode				Error cause	Error processing	Corrective action
			JOG	Manual pulse generator	Home position return	OSC			
109		○					The address that does not generate an arc is set at the central point-specified circular interpolation or central point-specified helical interpolation. (Relationship between the start point, central point and end point.)	Positioning control does not start.	• Correct the addresses of the Motion program.
110 (Note)		○					The difference between the end point address and ideal end point is outside the allowable error range for circular interpolation at the circular interpolation.		
115					○		The home position return complete signal (M2410+20n) turned on at the home position return of proximity dog, dog cradle and stopper type.		• Do not start continuously for the home position return. Return to a point before the proximity dog signal ON by JOG operation or positioning operation, etc., and perform the home position return.
116			○				The setting JOG speed is "0".		• Set the correct speed (within the setting range).
							The setting JOG speed exceeded the JOG speed limit value.	Control with the JOG speed limit value.	
							The setting JOG speed limit value exceeded the setting range.	Control with the maximum setting range of each control unit.	• Set the correct JOG speed limit value (within the setting range).
117			○				Both of forward and reverse rotation were set at the simultaneous start for the JOG operation.	Only the applicable axis set to the forward direction starts.	• Set a correct data.
120					○		ZCT not set The zero pass signal (M2406+20n) turned off at the re-travel at the home position return for proximity dog, count and limit switch combined type or start in the home position return for data set type.	Home position return is not completed correctly.	• Execute the home position return after the zero point passed.

(Note): These errors are stored the error codes of the all applicable interpolation axes at the interpolation operation.

Table 1.4 Positioning control start error (100 to 199) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
140		○					The travel value of the reference axis is set at "0" in the linear interpolation for reference axis specification.	Positioning control does not start.	• Do not set axis of travel value "0" as the reference axis.
142					○		The positioning control which use the external input signal was executed for the axis which has not set the external input signal in the system settings.		• Set the external input signal in the system setting.
145					○		Unusable instructions were started in the external input signal setting via servo amplifier.		• Do not start count type home position return in the external input signal setting via servo amplifier.
160		○					The operating axis is specified in the SVST instruction.		• Start after the operating signal has turned OFF. Provide a SVST instruction operating interlock.
161	○	○					Program No. to be started is outside the range of 1 to 1024.		• Correct the start instruction.
163		○					The sequence No. specified in the SVST is outside the range of 0 to 9999.	Positioning control starts from the beginning the program.	• Set the sequence No. within the range of 0 to 9999.
190		○					At a start, the override ratio is outside the range of 0 to 100[%].	Operation is performed at 100[%].	• Set the override ratio within the range of 0 to 100[%].

(3) Positioning control errors (200 to 299)

These are errors detected during the positioning control.

The error codes, causes, processing and corrective actions are shown in Table 1.5 below.

Table 1.5 Positioning control error (200 to 299) list

Error code	Control program	Axis designation program (positioning)	Control mode				Error cause	Error processing	Corrective action
			JOG	Manual pulse generator	Home position return	OSC			
200	○	○	○	○		○	The PLC ready flag (M2000) turned off during the control by the start request of Motion program.	Decelera-tion stop Control program ends.	• Turn the PLC ready flag (M2000) on after all axes have stopped.
201					○		The PLC ready flag (M2000) turned off during the home position return.		• Perform the home position return again after turning the PLC ready flag (M2000) on or turning the stop command (M3200+20n) or rapid stop command (M3201+20n) off.
202					○		The stop command (M3200+20n) turned on during the home position return.		(Return to a point before the proximity dog signal ON using JOG operation or positioning operation, and perform the home position return again in the proximity dog type.)
203					○		The rapid stop command (M3201+20n) turned on during the home position return.	Rapid stop	
204		○	○	○	○	○	The PLC ready flag (M2000) turned off to on again during deceleration by turning off the PLC ready flag (M2000).	No operation	• Turn the PLC ready flag (M2000) OFF to ON after all axes have stopped. (Turn the PLC ready flag (M2000) OFF to ON during deceleration is "no operation".)

Table 1.5 Positioning control error (200 to 299) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
206					○		All axes rapid stop ([Back Space] key input) is executed using the test mode of a peripheral device during the home position return.	Rapid stop	• Return to a point before the proximity dog signal ON using JOG operation or positioning operation, and perform the home position return again in the proximity dog type. • Return to a point before the proximity dog signal ON using JOG operation or positioning operation, and perform the home position return again, when the proximity dog signal turns off in the count type. (Perform the home position return operation again, when the proximity dog signal turns on in the count type.)
207		○	○				The feed current value exceeded the stroke limit range during the control. Only the axis exceed the stroke limit range is stored at the circular/helical interpolation. All interpolation axes are stored in the linear interpolation.	Decelera-tion stop	• Correct the stroke limit range or travel value setting so that positioning address control is within the range of the stroke limit.
208		○		○			The feed current value of another axis exceeded the stroke limit value during the circular/helical interpolation control or simultaneous manual pulse generator operation. (For detection of other axis errors).		
209					○		An overrun occurred because the travel value after the dog ON is less than the deceleration distance at the proximity dog signal input during home position return of count type.		• Set the speed setting so that overrun does not occur. • Set the travel value so that overrun does not occur.
211		○					During control, an overrun occurred because the deceleration distance for the output speed is not attained at the point where the final positioning address was detected.		

Table 1.5 Positioning control error (200 to 299) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
214				○			The manual pulse generator was enabled during the start of the applicable axis, the manual pulse generator operation was executed.	Manual pulse generator input is ignored until the axis stops.	• Execute the manual pulse generator operation after the applicable axis stopped.
230		○					When the skip is executed in the constant-speed control, the next interpolation instruction is an absolute circular interpolation or absolute helical interpolation.	Immediate stop	• Execute the absolute linear interpolation after a point which make a skip.
290		○					The override ratio is outside the range of 0 to 100[%] during the control.	Operation is performed at 100[%].	• Set the override ratio within the range of 0 to 100[%].
292		○					Axis interlock (M4406+10n/M4407+10n) turned on during the control.	Decelera-tion stop	• Turn the axis interlock (M4406+10n/M4407+10n) OFF in order to resume an axis travel.

(4) Speed change/torque limit value change errors (300 to 399)

These are errors detected at speed change or torque limit value change.
The error codes, causes, processing and corrective actions are shown in Table 1.6 below.

Table 1.6 Speed change/torque limit value change error (300 to 399) list

Error code	Control program	Axis designation program (positioning)	Control mode				Error cause	Error processing	Corrective action
			JOG	Manual pulse generator	Home position return	OSC			
301	○				○		The speed was changed for the axis during home position return.	Speed is not changed.	• Do not change speed during home position return.
305	○		○				The speed after speed change is set outside the range of 0 to speed limit value.	Control with the speed limit value.	• Set the speed after speed change within the range of 0 to speed limit value.
	○	○					The absolute value of speed after speed change is set outside the range of 0 to speed limit value.		• Set the absolute value of speed after speed change within the range of 0 to speed limit value.
310	○						The speed was changed during high-speed oscillation.	Speed is not changed.	• Do not change speed during high-speed oscillation.
							The speed change to "0" was requested during high-speed oscillation.		
311	○						The value outside the range of 1 to 1000[%] was set in the torque limit value change request (CHGT).	Torque limit value is not changed.	• Set the change request within the range of 1 to 1000[%].
312	○						The torque limit value change request (CHGT) was made for the axis that had not been started.		• Request the change for the starting axis.

(5) Motion program running errors (500 to 699)

These errors are detected during Motion program execution.
Check the execute Motion program No., execute sequence No. and execute block No., and correct the Motion program.
Table 1.7 lists the processings and corrective actions for Motion program running errors.

Table 1.7 Motion program running error (500 to 699) list

Error code	Control program	Axis designation program (positioning)	Control mode				Error cause	Error processing	Corrective action
			JOG	Manual pulse generator	Home position return	OSC			
500		○					0 is specified as the N No.	Decelera-tion stop. Control program ends.	• Set the N No. of sequence program within the range of 1 to 9999.
501		○					There is no F command. Speed is "0".		• Set the F before and during execution of G01, G02, G03. • Set the speed of "1" or higher.
502		○					The command value exceeded the setting range.		• Set the address, speed, dwell time, etc. within the setting range.
503		○					The specified speed command exceeded the speed limit value of the parameter block.	Speed is clamped at speed limit value for operation.	• Set the correct speed (within the range).
504		○					5 or more axes were specified in 1 block.	Decelera-tion stop. Control program ends.	• 5 or more axes cannot be interpolated. • Set the number of interpolation axes up to 4 axes.
510		○					Unauthorized G-code was specified.		• Set the correct G-code.
513		○					The interpolation length exceeded the setting range.		• Set the axis address within the setting range.
525		○					Subprogram level excess. Subprogram calling depth exceeded 8 levels. Or, the wrong program No. was called as a subprogram.		• Set the calling depth within 8 levels. • Call the correct program No. (O) as a subprogram.
530	○	○					Arithmetic expression is not correct. Device setting is not correct. There is wrong data among home position return data for indirect setting.		• Use a correct arithmetic expression. • Set the correct device.
531	○	○					Integer value overflow. The integer value exceeded the setting range during arithmetic operation.		• Correct the variable value and arithmetic expression.
532	○	○					The numbers of "[" and "]" specified in one block differ.		• Set the numbers of "[" and "]" in pairs.
533	○	○					The denominator of division is 0.		• Set the denominator to other than 0.

Table 1.7 Motion program running error (500 to 699) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
534	○	○					[,] exceeded 5 levels.	Decelera-tion stop. Control program ends.	• Correct the Motion program.
535	○	○					The IF [condition] GOTO statement is in error.		• Correct the IF statement.
536	○	○					The variable number exceeded the range.		• Set the variable within the setting range.
537	○	○					The variable definition statement does not have "=".		• Add "=".
538	○	○					Impossible operation is executed.		• Execute a possible operation.
541		○					The sequence No. specified with subprogram call, return from subprogram or GOTO is not set.		• Set the sequence No..
542	○	○					In the specified Motion program, the WHILE [ ] DOm-ENDm statement is in error.		• Correct the Motion program.
543	○	○					In the specified Motion program, the nesting of the DOm-ENDm statement exceeded the limit.		
544	○	○					In the specified Motion program, DOm-ENDm are not in pairs.		
545	○	○					In the specified Motion program, the IF [ ] THENm-ENDm statement is in error.		
546	○	○					In the specified Motion program, the nesting of the IF [ ] THENm-ENDm statement exceeded the limit.		
547	○	○					In the specified Motion program, IF [ ] THENm, ELSEm and ENDm are not in pairs.		
555		○					At a subprogram call, the specified subprogram is not registered.		• Create the specified subprogram. • Change the call No..
560	○	○					The command format in the Motion program is not correct.		• Correct the Motion program. Correct the argument following G**.
562	○	○					There is no M02/M30 at the end of the Motion program. There is no M99 at the end of the subprogram.		• Put M02, M30 or M99 before %.
570		○					At a tool length offset (G43, G44) command, the offset data number is not specified. The offset data number is not correct.		• Correct the offset data number.
571		○					At a tool length offset (G43, G44) or tool offset cancel (G49) command, the axis corresponding to compensation is not specified.		• Specify the axis corresponding to compensation.
580		○					The command beyond the preset stroke range was executed.		• Specify the command within the preset stroke range.
581		○					The travel command was given to the high-speed oscillation operation axis.		• Do not give the travel command to the high-speed oscillation operation axis.
582		○					High-speed oscillation cancel was given to the axis which was not operating in high-speed oscillation.	No operation	• High-speed oscillation cancel is invalid.

Table 1.7 Motion program running error (500 to 699) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
584		○					Cancel start (G24) program No. error	Decelera-tion stop. Control program ends.	• Correct the Motion program No..
585		○					High-speed oscillation (G25) amplitude range error		• Correct the high-speed oscillation (G25) amplitude range.
586		○					High-speed oscillation (G25) starting angle range error		• Correct the high-speed oscillation (G25) starting angle range.
587		○					High-speed oscillation (G25) frequency range error		• Correct the high-speed oscillation (G25) frequency range.
591	○	○					A fault occurred in the system.		• Explain the error symptom and get advice from our sales representative.
592		○					The axis name is not correct.		• Match the axis name with the one in the system settings.
593	○	○					O No. designated in the specified Motion program is not correct. O No. specified with CALL, GOSUB/GOSUBE is not registered. O No. specified with G24 (cancel start) is not correct.		• Correct the O***; part. • Correct O No. specified with CALL, GOSUB/GOSUBE. • Set the correct O No..
594		○					The axis not specified with SVST is specified in the Motion program.		• Correct the SVST instruction. • Correct the Motion program.
600		○					<u>Number of helical interpolation pitches error</u> Number of helical interpolation pitches is outside the range of 1 to 999.		• Set the number of helical interpolation pitches within the range of 0 to 999.
610	○	○					IF [condition] THEN SET/RST/OUT statements are in error.		• Correct the instructions.
611	○						There are unusable instructions and incorrect instructions in the control program.	Program ends.	• Correct the instructions.
612	○						The program of number set as automatic starts not registered. Or, the axis designation program is started automatically.		• Correct the parameters.
613	○						The operating axis is specified with CALL, GOSUB/GOSUBE.		• Correct the CALL, GOSUB/GOSUBE instruction.
614	○						The program number started by CALL, GOSUB/GOSUBE is outside the range of 1 to 1024.		
615	○						The program started by CALL, GOSUB/GOSUBE is not registered.		

Table 1.7 Motion program running error (500 to 699) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode				Error cause	Error processing	Corrective action
			JOG	Manual pulse generator	Home position return	OSC			
616	○						The sequence No. started by CALL, GOSUB/GOSUBE is outside the range of 1 to 9999.	Positioning control starts from the beginning of the program.	• Correct the sequence No..
617	○						The program started by CALL, GOSUB/GOSUBE is already executed. (Double start error)	Program ends.	• Correct the CALL, GOSUB/GOSUBE instruction.
618	○						The depth of nest for control program started by GOSUB/GOSUBE is 9 levels or more.		• Set the depth of nest within 8 levels.
619	○						The program number ended by CLEAR is outside the range of 1 to 1024.		• Correct the CLEAR instruction.
620	○						The program number ended by CLEAR is not registered. Or, the axis designation program is cleared.		• Correct the CLEAR instruction.
630	○						Number of axis designation program starts over error 33 or more axis designation programs are started simultaneously.		• Set the simultaneous execute program up to 32 programs.
631	○						Number of control program starts over error 17 or more control programs are started simultaneously.	Decelera-tion stop, control program ends	• Set the simultaneous execute program up to 16 programs.
632	○	○					BMOV, BDMOV, FMOV execution error The Motion CPU memory address set in the (D), (S) is outside the range of SRAM. (S) to (S) + (n-1) is outside the device range. (D) to (D) + (n-1) is outside the device range. (n) is 0 or outside the setting range.		• Correct the program to set the Motion CPU memory address with even number. • Change (n) within the range of device range for block transmitting range. • Set (n) within the setting range.
633	○						TIME execution error The device number of indirect setting is not correct. The data is outside the range of 1 to 65535.		• Correct the device number of indirect setting. • Set the data within the range of 1 to 65535.
634	○						Axis designation program incorrect start The axis designation program is started without an axis setting. (SFCS, CALL, GOSUB/GOSUBE)		• Set an axis.
635	○						Control program incorrect start The axis designation program is started with an axis setting. (SVST, CALL, GOSUB/GOSUBE)		• Do not set an axis.
636	○	○					Incorrect access to PX, PY SET, RST or OUT is operated to the real I/O device (PX, PY) in the Motion program.		• Correct the program.
637	○						Control program multiple start error The already started control program is started.		• Correct the program.

Table 1.7 Motion program running error (500 to 699) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
650	○	○					Write device data to shared CPU memory (MULTW) execution error • Number of words (n) to be written is outside the range of 1 to 256. • The shared CPU memory address (D) of self CPU of the writing destination device is outside the range (800H to FFFH) of the shared CPU memory address. • The shared CPU memory address (D) of self CPU of the writing destination device + number of words (n) to be written is outside the range (800H to FFFH) of the shared CPU memory address. • First device No. (S) which writing data are stored + number of words (n) to be written is outside the device range. • MULTW instruction was executed again before MULTW instruction is executed and complete bit device is turned on.	Decelera-tion stop, control program ends	• Correct the program so that the number of words (n) to be written is within the range of 1 to 256. • Correct the program so that the shared CPU memory address (D) of self CPU of the writing destination is within the range of shared CPU memory address. • Correct the program so that the shared CPU memory address (D) of self CPU of the writing destination + number of words (n) to be written is within the range of shared CPU memory address. • Correct the program so that first device No. (S) which writing data are stored + number of words (n) to be written is within the device range. • Execute MULTW instruction again after the complete bit device of MULTW instruction is turned on.
651	○	○					Read device data from shared CPU memory of the other CPU (MULTR) execution error • Number of words (n) to be read is outside the range of 1 to 256. • The shared CPU memory first address (S2) of the data which it will be read is outside the range (000H to FFFH) of the shared CPU memory address. • The shared CPU memory first address (S2) of the data which it will be read + number of words (n) to be read is outside the range (000H to FFFH) of the shared CPU memory address. • First device No. (D) which stores the reading data + number of words (n) to be read is outside the device range. • Except 3E0H/3E1H/3E2H/3E3H is set at (S1). • The self CPU is specified with (S1). • The CPU which reads is resetting. • The errors are detected in the CPU which read.		• Correct the program so that the number of words (n) to be read is within the range of 1 to 256. • Correct the program so that the shared CPU memory first address (S2) of the data which it will be read is within the range of shared CPU memory address. • Correct the program so that the shared CPU memory first address (S2) of the data which it will be read + number of words (n) to be read is within the range of shared CPU memory address. • Correct the program so that first device No. (D) which stores the reading data + number of words (n) to be read is within the device range. • Correct the program so that 3E0H/3E1H/3E2H/3E3H is set at (S1). • Correct the program so that the self CPU is not specified with (S1). • Check that the reset flag (M9240 to M9243) is OFF, then correct the program to execute the MULTR instruction. • If the errors are detected in the CPU which read, exchange the CPU.

Table 1.7 Motion program running error (500 to 699) list (Continued)

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Manual pulse generator	Home position return	OSC	Error cause	Error processing	Corrective action
652	○	○					<u>Write device data to intelligent function module/special function module (TO) execution error</u> • Number of words (n) to be written is outside the range of 1 to 256. • Motion CPU cannot communicate with intelligent function module/special function module at the instruction execution. • Abnormalities of the intelligent function module/ special function module were detected at the instruction execution. • I/O No.s specified with (D1) differ from the intelligent function module/special function module controlled by the self CPU. • The address specified with (D2) is outside the buffer memory range. • First device No. (S) which writing data are stored + number of words (n) to be written is outside the device range.	Decelera-tion stop, control program ends	• Correct the program so that the number of words (n) to be written is within the range of 1 to 256. • Replace the intelligent function module/special function module if there is a fault. • Correct the program so that the first I/O No.s specified with (D1) is intelligent function module/special function module controlled by the self CPU. • Correct the program so that the address specified with (D2) is within the buffer memory range. • Correct the program so that first device No. (S) which writing data are stored + number of words (n) to be written is within the device range.
653	○	○					<u>Read device data from intelligent function module/ special function module (FROM) execution error</u> • Number of words (n) to be read is outside the range of 1 to 256. • Motion CPU cannot communicate with intelligent function module/special function module at the instruction execution. • Abnormalities of the intelligent function module/ special function module were detected at the instruction execution. • I/O No.s specified with (S1) differ from the intelligent function module/special function module controlled by the self CPU. • The address specified with (S2) is outside the buffer memory range. • First device No. (D) which stores the reading data + number of words (n) to be read is outside the device range.		• Correct the program so that the number of words (n) to be read is within the range of 1 to 256. • Replace the intelligent function module/special function module if there is a fault. • Correct the program so that I/O No.s specified with (S1) is intelligent function module/special function module controlled by the self CPU. • Correct the program so that the address specified with (S2) is within the buffer memory range. • Correct the program so that first device No. (D) which stores the reading data + number of words (n) to be read is within the device range.
680		○					• When "Not execute G-code of Motion program except G28" is selected to start the Motion program and all axes home position return request signal (M2409+20n) is not turned OFF for incompletion of home position return, the travel instruction by the G-code except for G28 is executed.	Program ends	• Execute a home position return by the CHGA or G28, and executed the travel instruction by except for G28 after the home position return request signals (M2409+20n) are turned OFF for all axes specified at Motion program start. • Set a "Execute Motion program" for incompletion of home position return for all axes specified at Motion program start.

(6) System errors (900 to 999)

Table 1.8 System error (900 to 999) list

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
901							• The motor travel value while the power is off exceeded the "System setting mode-allowable travel value during power off" set in the system settings at the turning on of the servo amplifier.	Further operation is possible.	• Check the position. • Check the battery of encoder.

APPENDIX 1.3 Major errors

These errors occur by control command from the external input signal or Motion program, and the error codes 1000 to 1999 are used.
Major errors include the positioning control start errors, positioning control errors absolute position system errors and system errors.

(1) Positioning control start errors (1000 to 1099)

These errors are detected at the positioning control start.
The error codes, causes, processing and corrective actions are shown in Table 1.9.

Table 1.9 Positioning control start error (1000 to 1099) list

Error code	Control program	Axis designation program (positioning)	Control mode				Error cause	Error processing	Corrective action
			JOG	Manual pulse generator	Home position return	OSC			
1000		○	○	○	○	○	• The external STOP signal of the applicable axis turned on.	Positioning control does not start.	• Turn the STOP signal off.
1001		○	○	○	○	○	• The external signal FLS (upper limit LS) turned off at the forward direction (address increase direction) start.		• Move in the reverse direction by the JOG operation, etc. and set within the external limit range.
1002		○	○	○	○	○	• The external signal RLS (lower limit LS) turned off at the reverse direction (address decrease direction) start.		• Move in the forward direction by the JOG operation, etc. and set within the external limit range.
1003					○		• The external DOG (proximity dog) signal turned on at the home position return start of the proximity dog type.		• Perform the home position return after move to the proximity dog ON by the JOG operation, etc.
1004		○	○	○	○	○	• The applicable axis is not servo READY state. (M2415+20n: OFF). (1) The power supply of the servo amplifier is OFF. (2) During initial processing after turning on the servo amplifier. (3) The servo amplifier is not installed. (4) A servo error is occurred. (5) Cable fault. (6) Servo OFF command (M3215+20n) is ON.		• Wait until the servo READY state (M2415+20n: ON).
1005		○	○	○	○	○	• The servo error detection signal of the applicable axis (M2408+20n) turned on.		• Eliminate the servo error, reset the servo error detection signal (M2408+20n) by the servo error reset command (M3208+20n), then start operation.

(2) Positioning control errors (1100 to 1199)

These errors are detected at the positioning control.

The error codes, causes, processing and corrective actions are shown in Table 1.10.

Table 1.10 Positioning control error (1100 to 1199) list

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
1101 (Note)		○	○	○	○	○	• The external signal FLS (upper limit LS) turned off during the forward direction (address increase direction).	Decelera-tion stop by "Stop processing on STOP input" of the parameter block.	• Travel in the reverse direction by the JOG operation, etc. and set within the external limit range.
1102 (Note)		○	○	○	○	○	• The external signal RLS (lower limit LS) turned off during the reverse direction (address decrease direction).		• Travel in the forward direction by the JOG operation, etc. and set within the external limit range.
1103					○		• The external STOP signal (stop signal) turned on during home position return of proximity dog type.		• Perform the home position return after move to the proximity dog ON by the JOG operation, etc. at the home position return of the proximity dog type.
1143		○	○	○	○	○	• The servo error detection signal turned on during positioning control.	Immediate stop without decelera-ting.	• Start after disposal at the servo error.
1105		○	○	○	○	○	• The power supply of the servo amplifier turned off during positioning control. (Servo not installed status detection, cable fault, etc.) • Home position return did not complete normally without stop within the in-position range of home position at the home position return.	Turn the servo READY (M2415+20n) OFF.	• Turn on the power supply of the servo amplifier. • Check the connecting cable to the servo amplifier. • Make the gain adjustment.

(Note) : This error is output with SV43 at the start.

(3) Absolute position system errors (1200 to 1299)

These errors are detected at the absolute positioning system.

The error codes, causes, processing and corrective actions are shown in Table 1.11.

Table 1.11 Absolute position system error (1200 to 1299) list

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
1201							• A sum check error occurred with the backup data in the controller at the turning on servo amplifier power supply. • Home position return was not performed. • CPU module battery error. • Home position return started but did not complete normally.	Home position return request ON	• Check the battery and execute a home position return.
1202							• A communication error between the servo amplifier and encoder occurred at the turning on servo amplifier power supply.	Home position return request ON, servo error [2016] set.	• Check the motor and encoder cables and execute a home position return again.
1203							• The amount of change in encoder current value is excessive during operation. A continual check is performed (both of servo ON and OFF states) after the servo amplifier power has been turned ON.	Home position return request ON	• Check the motor and encoder cables.
1204							• The following expression holds: "Encoder current value [PLS] ≠ feedback current value [PLS] (encoder effective bit number)" during operation. A continual check is performed (both of servo ON and OFF states) after the servo amplifier power has been turned on.		

(4) System errors (1300 to 1399)

These errors are detected at the power-on.

The error codes, causes, processing and corrective actions are shown in Table 1.12.

Table 1.12 System error (1300 to 1399) list

Error code	Control program	Axis designation program (positioning)	Control mode: JOG	Control mode: Manual pulse generator	Control mode: Home position return	Control mode: OSC	Error cause	Error processing	Corrective action
1310							• Initial communication with the Multiple CPU system did not complete normally. • Motion CPU fault.	Positioning control does not start.	• Replace the Motion CPU.

APPENDIX 1.4 Servo errors

(1) Servo amplifier errors (2000 to 2899)

These errors are detected by the servo amplifier, and the error codes are [2000] to [2899].
The servo error detection signal (M2408+20n) turns on at the servo amplifier error occurrence. Eliminate the error cause, reset the servo amplifier error by turning on the servo error reset command (M3208+20n) and perform re-start.
(The servo error detection signal does not turn on because the codes [2100] to [2599] are for warnings.)

(Note-1): As for the regenerative alarm (error code [2030]) or overload 1 or 2 (error codes [2050], [2051]), the state at the operation is held also for after the protection circuit operation in the servo amplifier. The memory contents are cleared with the external power supply off, but are not cleared by the reset signal.

(Note-2): If resetting by turning off the external power supply is repeated at the occurrence of error code [2030], [2050] or [2051], it may cause devices to be destroyed by overheating. Re-start operation after eliminating the cause of the error certainly.

Details of servo errors are shown in Table 1.13.

⚠CAUTION
● If a controller, servo amplifier self-diagnosis error occurs, check the points stated in this manual and clear the error.

Table 1.13 Servo error (2000 to 2899) list

Error code	Error cause: Name	Error cause: Description	Error check	Error processing	Corrective action
2010	Undervoltage	• Power supply voltage is low. MR-J3-□B: 160VAC or less MR-J3-□B1: 83ACV or less • There was an instantaneous control power failure of 60[ms] or longer. • Shortage of power supply capacity caused the power supply voltage to drop at start, etc. • The bus voltage dropped to the following value or less. MR-J3-□B: 200VDC MR-J3-□B1: 158VDC	Any time during operation	Immediate stop	• Review the power supply.
		• Faulty parts in the servo amplifier [Checking method] Servo error [2010] occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.			• Replace the servo amplifier.
2012	Memory error 1 (RAM)	• Faulty parts in the servo amplifier (RAM memory error) [Checking method] Servo error [2012] occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	• Servo amplifier power on. • Multiple CPU system power on.		• Replace the servo amplifier.
2013	Clock error	• Faulty parts in the servo amplifier (Printed board fault) [Checking method] Servo error [2013] occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Any time during operation		• Replace the servo amplifier.
		• Faulty the controller (Clock error transmitted from the controller) [Checking method] Servo error [2013] occurs if Motion CPU is used in the Multiple CPU system.			• Replace the Motion CPU.
2014	CPU Watchdog	• Faulty hardware of servo amplifier			• Replace the servo amplifier.
2015	Memory error 2 (EEP-ROM)	• Faulty parts in the servo amplifier (EEP-ROM fault) [Checking method] Servo error [2015] occurs if power is switched on after disconnection of all cables but the control circuit power supply cables. • The number of write times to EEP-ROM exceeded 100,000.	• Servo amplifier power on. • Multiple CPU system power on.		

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause: Name	Error cause: Description	Error check	Error processing	Corrective action
2016	Encoder error 1 (At power on)	• Encoder connector (CN2) disconnected. • Encoder fault • Encoder cable faulty (Wire breakage or shorted) • Encoder cable type (2-wire, 4-wire) selection was wrong in parameter setting.	• Servo amplifier power on. • Multiple CPU system power on.	Immediate stop	• Connect correctly. • Replace the servomotor. • Repair or replace the cable. • Set the correct encoder type of servo parameter.
2017	Board error	• Faulty parts in the servo amplifier (CPU/parts fault) [Checking method] Servo error [2017] occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.			• Replace the servo amplifier.
2019	Memory error 3 (Flash ROM)	• Faulty parts in the servo amplifier (ROM memory fault) [Checking method] Servo error [2019] occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.			
2020	Encoder error 2	• Encoder connector (CN2) disconnected. • Encoder fault • Encoder cable faulty (Wire breakage or shorted)	Any time during operation		• Connect correctly. • Replace the servomotor. • Repair or replace the cable.
2024	Main circuit error	• Power input wires and servomotor power wires are in contact. [Checking method] Servo error [2024] occurs if servo is switched on after disconnecting the U, V and W power cables from the servo amplifier. • Sheathes of servomotor power cables deteriorated, resulting in ground fault. • Main circuit of servo amplifier failed.			• Correct the wiring. • Replace the cable. • Replace the servo amplifier.
2025	Absolute position erase	• Voltage drop in encoder (Battery of servo amplifier disconnected.) • Battery voltage low • Battery cable or battery is faulty. • Home position return not set. (Power was switched on for the first time in the absolute position detection system.)	• Servo amplifier power on. • Multiple CPU system power on.	Immediate stop Home position return request ON	• After leaving the servo error [2025] occurring for a few minutes, switch power off, then on again. Always make home position return again. • Replace the battery. Always make home position return again. • After leaving the servo error [2025] occurring for a few minutes, switch power off, then on again. Always make home position return again.

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause		Error check	Error processing	Corrective action
	Name	Description			
2030	Regenerative alarm	• Wrong setting of system setting (regenerative brake)	Any time during operation	Immediate stop	• Check the regenerative brake of system setting and set correctly.
		• Built-in regenerative brake resistor or regenerative brake option is not connected.			• Connect correctly.
		• High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative brake option to be exceeded. [Checking method] Call the servo monitor and check the regenerative level.			• Reduce the frequency of positioning. (Call the regenerative level [%] of servo monitor and reduce the frequency of acceleration/deceleration or feed speed.) • Use the regenerative brake option of larger capacity. • Reduce the load.
		• Power supply voltage is abnormal. MR-J3-□B: 260VAC or more MR-J3-□B1: More than 135VAC			• Review the power supply
		• Built-in regenerative brake resistor or regenerative brake option faulty.			• Replace the servo amplifier or regenerative brake option..
		• Regenerative transistor faulty. [Checking method] • The regenerative brake option has overheated abnormally. • Servo error [2030] occurs even after removal of the built-in regenerative brake resistor or regenerative brake option.			• Replace the servo amplifier.
2031	Overspeed	• Command speed is too high. (Motor speed has exceeded the instantaneous permissible speed.)			• Check the servo program or mechanical system program, and set correctly.
		• Small acceleration/deceleration time constant caused overshoot to be large.			• If an overshoot occurs during acceleration/deceleration, check the acceleration/deceleration time in the fixed parameters.
		• Servo system is instable to cause overshoot.			• Re-set servo gain to proper value. • If servo gain cannot be set to proper value: 1) Reduce load inertia moment ratio; or 2) Reexamine acceleration/ deceleration time constant.
		• Electronic gear ratio is high.			• Set correctly.(Check if the number of pulses per revolution and travel value per revolution in the fixed parameters match the machine system.
		• Encoder faulty.			• Replace the servomotor.

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause: Name	Error cause: Description	Error check	Error processing	Corrective action
2032	Overcurrent	• Short occurred in servomotor power (U, V, W).	Any time during operation	Immediate stop	• Correct the wiring.
		• Transistor (IPM) of the servo amplifier faulty. [Checking method] Servo error [2032] occurs if power is switched on after U, V and W are disconnected.	Any time during operation	Immediate stop	• Replace the servo amplifier.
		• Ground fault occurred in servomotor power (U, V, W).	Any time during operation	Immediate stop	• Correct the wiring.
		• External noise caused the overcurrent detection circuit to misoperate.	Any time during operation	Immediate stop	• Take noise suppression measures.
2033	Overvoltage	• Lead of built-in regenerative brake resistor or regenerative brake option is open or disconnected.	Any time during operation	Immediate stop	• Replace the lead. • Connect correctly.
		• Regenerative transistor faulty.	Any time during operation	Immediate stop	• Replace the servo amplifier.
		• Wire breakage of built-in regenerative brake resistor or regenerative brake option.	Any time during operation	Immediate stop	• For wire breakage of built-in regenerative brake resistor, replace the servo amplifier. • For wire breakage of regenerative brake option, replace the regenerative brake option.
		• Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient.	Any time during operation	Immediate stop	• Add regenerative brake option or increase capacity.
		• Power supply voltage is high.	Any time during operation	Immediate stop	• Review the power supply.
		• Ground fault occurred in servomotor power (U, V, W).	Any time during operation	Immediate stop	• Correct the wiring.
2034	Communica-tions error	• Data received from the Motion CPU faulty.	Any time during operation	Immediate stop	• Check the connection of SSCNETⅢ cable. • Check if there is a disconnection in the SSCNETⅢ cable.
2035	Command frequency error	• There is excessive variation in the position commands and command speed is too high from the Motion CPU.	Any time during operation	Immediate stop	• Check the command speed and the number of pulses per revolution/travel value per revolution of the fixed parameters.
		• Noise entered the commands from the Motion CPU.	Any time during operation	Immediate stop	• Check the connection of SSCNETⅢ cable. • Check if there is a disconnection in the SSCNETⅢ cable. • Check if any relays or solenoids are operating in the vicinity.
		• Motion CPU failure	Any time during operation	Immediate stop	• Replace the Motion CPU.
2036	Transmission error	• Fault in communication with the Motion CPU.	Any time during operation	Immediate stop	• Check the connection of SSCNETⅢ cable. • Check if there is a disconnection in the SSCNETⅢ cable.

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause: Name	Error cause: Description	Error check	Error processing	Corrective action
2045	Main circuit device overheat	• Servo amplifier failure	Any time during operation	Immediate stop	• Replace the servo amplifier.
		• The power supply was turned on and off continuously by overloaded status.			• The drive method is reviewed.
		• Ambient temperature of servo amplifier is over 55[°C] (131[°F]).			• Review environment so that ambient temperature is 0 to 55[°C] (32 to 131[°F]).
		• Used beyond the specifications of close mounting of servo amplifier.			• Use within the range of specifications.
2046	Servomotor overheat	• Ambient temperature of servomotor is over 40[°C] (104[°F]).			• Review environment so that ambient temperature is 0 to 40[°C] (32 to 104[°F]).
		• Servomotor is overloaded.			• Reduce load. • Review operation pattern. • Use servomotor that provides larger output.
		• Thermal sensor in encoder is faulty.			• Replace the servomotor.
2047	Cooling fan alarm	• Cooling fan life expiration			• Replace the cooling fan of the servo amplifier.
		• Foreign matter caught in the fan stopped rotation.			• Remove the foreign matter.
		• The power supply of the cooling fan failed.			• Replace the servo amplifier.
2050	Overload 1	• Servo amplifier is used in excess of its continuous output current.			• Reduce load. • Review operation pattern. • Use servomotor that provides larger output.
		• Servo system is instable and hunting.			• Repeat acceleration/ deceleration to execute auto tuning. • Change auto tuning response setting. • Set auto tuning to OFF and make gain adjustment manually.
		• Machine struck something.			• Review operation pattern. • Install limit switches.
		• Wrong connection of servo motor. (Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.)			• Connect correctly.
		• Encoder faulty. [Checking method] When the servomotor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.			• Replace the servomotor.

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</th><th rowspan="2">Error processing</th><th rowspan="2">Corrective action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td rowspan="4">2051</td><td rowspan="4">Overload 2</td><td>• Machine struck something.</td><td rowspan="10">Any time during operation</td><td rowspan="12">Immediate stop</td><td>• Review operation pattern.
• Install limit switches.</td></tr>
<tr><td>• Wrong connection of servomotor. (Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.)</td><td>• Connect correctly.</td></tr>
<tr><td>• Servo system is instable and hunting.</td><td>`• Repeat acceleration/ deceleration to execute auto tuning.
• Change auto tuning response setting.
• Set auto tuning to OFF and make gain adjustment manually.</td></tr>
<tr><td>• Encoder faulty.
[Checking method]
When the servomotor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.</td><td>• Replace the servomotor.</td></tr>
<tr><td rowspan="6">2052</td><td rowspan="6">Error excessive</td><td>• Acceleration/deceleration time constant is too small.</td><td>• Increase the acceleration/deceleration time.</td></tr>
<tr><td>• Torque limit value is too small.</td><td>• Increase the torque limit value.</td></tr>
<tr><td>• Motor cannot be started due to torque shortage caused by power supply voltage drop.</td><td>• Review the power supply capacity.
• Use servomotor which provides larger output.</td></tr>
<tr><td>• Model loop gain value of servo parameter is small.</td><td>• Increase set value and adjust to ensure proper operation.</td></tr>
<tr><td>• Servomotor shaft was rotated by external force.</td><td>• When torque is limited, increase the limit value.
• Reduce load.
• Use servomotor that provides larger output.</td></tr>
<tr><td>• Machine struck something.
• Encoder faulty
• Wrong connection of servomotor. (Servo amplifier's output terminals U, V, W do not match servomotor's input terminals U, V, W.)</td><td>• Review operation pattern.
• Install limit switches.
• Replace the servomotor.
• Connect correctly.</td></tr>
<tr><td>2060 (AL.1A)</td><td>Motor combination error</td><td>• Fault in combination with the servo amplifier and servomotor.</td><td>• Servo amplifier power on.
• Multiple CPU system power on.</td><td>• Use the correct combination with the servo amplifier and servomotor.</td></tr>
<tr><td>2088 (88)</td><td>Watchdog</td><td>• CPU, parts faulty</td><td>Any time during operation</td><td>• Replace the servo amplifier.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause: Name	Error cause: Description	Error check	Error processing	Corrective action
2102 (AL.92)	Open battery cable warning	• Bttery cable for absolute position detection system is open.	Any time during operation	Operation continues	• Repair the cable or replace the battery.
		• Voltage of battery for absolute position detection system supplied fell to about 3V or less. (Detected with the encoder.)			• Replace the battery.
2106 (AL.96)	Home position setting warning	• After home position return, droop pulses remaining are greater than the in-position range setting.			• Re-try the home position return.
		• Creep speed is high.			• Reduce the creep speed.
2116 (AL.9F)	Battery warning	• Voltage of battery for absolute position detection system installed to servo amplifier fell to 3.2V or less. (Detected with the servo amplifier.)			• Replace the battery.
2140 (AL.E0)	Excessive regenerative warning	• There is a possibility that regenerative alarm [2030] may occur. (Detected 85[%] regenerative level of the maximum load capacity for the regenerative register.)			• Refer to the details on the regenerative alarm [2030].
2141 (AL.E1)	Overload warning 1	• There is a possibility that overload alarm [2050], [2051] may occur. (Detected 85[%] overload level.)			• Refer to the details on the overload alarm [2050], [2051].
2143 (AL.E3)	Absolute position counter warning	• Absolute position encoder pulses faulty.		Operation continues Home position return request ON	• Take noise suppression measures. • Replace the servomotor. • Execute the home position return after measures.
2146 (AL.E6)	Servo forced stop warning	• Servo amplifier are forced stop state. (Servo amplifier input signal EM1 is OFF.)		Immediate stop	• Ensure safety and deactivate forced stop.
2147 (AL.E7)	Controller forced stop warning	• A forced stop (EMG) signal is input from the Motion CPU		Immediate stop	• Ensure safety and deactivate forced stop.
2148 (AL.E8)	Cooling fan speed reduction warning	• Cooling fan life expiration		Operation continues	• Replace the cooling fan of servo amplifier. • Replace the servo amplifier.
		• The power supply of the cooling fan is broken.			• Replace the cooling fan of servo amplifier.
2149 (AL.E9)	Main circuit off warning	• Servo-on signal was turned on with main circuit power off.			• Switch on the main circuit power.
2152 (AL.EC)	Overload warning 2	• During a stop, the status in which a current flew intensively in any of the U, V and W phases of the servomotor occurred repeatedly, exceeding the warning level.			• Reduce the positioning frequency at the specific positioning address. ・Reduce the load. • Replace the servo amplifier/ servomotor with the one of larger capacity.

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause		Error check	Error processing	Corrective action
	Name	Description			
2153 (AL.ED)	Output watt excess warning	• Continuous operation was performed with the output wattage (speed × torque) of the servomotor exceeding 150[%] of the rated output.	Any time during operation	Operation continues	• Reduce the servomotor speed. • Reduce the load.

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</th><th rowspan="2">Error processing</th><th rowspan="2">Corrective action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2599</td><td>Parameter error</td><td>Parameter error
• The servo parameter value is outside the setting range. (Any unauthorized parameter is ignored and the value before setting is held.)
<table>
<tr><th>Error code</th><th>Parameter No.</th><th>Name</th></tr>
<tr><td>2301</td><td>PA01</td><td>For manufacturer setting</td></tr>
<tr><td>2302</td><td>PA02</td><td>Regenerative brake option</td></tr>
<tr><td>2303</td><td>PA03</td><td>Absolute position detection system</td></tr>
<tr><td>2304</td><td>PA04</td><td>Function selection A-1</td></tr>
<tr><td>2305</td><td>PA05</td><td>For manufacturer setting</td></tr>
<tr><td>2306</td><td>PA06</td><td>For manufacturer setting</td></tr>
<tr><td>2307</td><td>PA07</td><td>For manufacturer setting</td></tr>
<tr><td>2308</td><td>PA08</td><td>Auto tuning mode</td></tr>
<tr><td>2309</td><td>PA09</td><td>Auto tuning response</td></tr>
<tr><td>2310</td><td>PA10</td><td>In-position range</td></tr>
<tr><td>2311</td><td>PA11</td><td>For manufacturer setting</td></tr>
<tr><td>2312</td><td>PA12</td><td>For manufacturer setting</td></tr>
<tr><td>2313</td><td>PA13</td><td>For manufacturer setting</td></tr>
<tr><td>2314</td><td>PA14</td><td>Rotation direction selection</td></tr>
<tr><td>2315</td><td>PA15</td><td>Encoder output pulse</td></tr>
<tr><td>2316</td><td>PA16</td><td>For manufacturer setting</td></tr>
<tr><td>2317</td><td>PA17</td><td>For manufacturer setting</td></tr>
<tr><td>2318</td><td>PA18</td><td>For manufacturer setting</td></tr>
<tr><td>2319</td><td>PA19</td><td>Parameter write inhibit</td></tr>
<tr><td>2320</td><td>PB01</td><td>Adaptive tuning mode</td></tr>
<tr><td>2321</td><td>PB02</td><td>Vibration suppression control filter tuning mode</td></tr>
<tr><td>2322</td><td>PB03</td><td>For manufacturer setting</td></tr>
<tr><td>2323</td><td>PB04</td><td>Feed forward gain</td></tr>
<tr><td>2324</td><td>PB05</td><td>For manufacturer setting</td></tr>
<tr><td>2325</td><td>PB06</td><td>Ratio of load inertia moment to servo motor inertia moment</td></tr>
<tr><td>2326</td><td>PB07</td><td>Model loop gain</td></tr>
<tr><td>2327</td><td>PB08</td><td>Position loop gain</td></tr>
<tr><td>2328</td><td>PB09</td><td>Speed loop gain</td></tr>
<tr><td>2329</td><td>PB10</td><td>Speed integral compensation</td></tr>
<tr><td>2330</td><td>PB11</td><td>Speed differential compensation</td></tr>
<tr><td>2331</td><td>PB12</td><td>For manufacturer setting</td></tr>
<tr><td>2332</td><td>PB13</td><td>Machine resonance suppression filter 1</td></tr>
<tr><td>2333</td><td>PB14</td><td>Notch form selection 1</td></tr>
<tr><td>2334</td><td>PB15</td><td>Machine resonance suppression filter 2</td></tr>
<tr><td>2335</td><td>PB16</td><td>Notch form selection 2</td></tr>
</table></td><td>Any time during operation</td><td>Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</th><th rowspan="2">Error processing</th><th rowspan="2">Corrective action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2599</td><td>Parameter error</td><td>
<table>
<tr><th>Error code</th><th>Parameter No.</th><th>Name</th></tr>
<tr><td>2336</td><td>PB17</td><td>For manufacturer setting</td></tr>
<tr><td>2337</td><td>PB18</td><td>Low-pass filter</td></tr>
<tr><td>2338</td><td>PB19</td><td>Vibration suppression control vibration frequency setting</td></tr>
<tr><td>2339</td><td>PB20</td><td>Vibration suppression control resonance frequency setting</td></tr>
<tr><td>2340</td><td>PB21</td><td>For manufacturer setting</td></tr>
<tr><td>2341</td><td>PB22</td><td>For manufacturer setting</td></tr>
<tr><td>2342</td><td>PB23</td><td>Low-pass filter selection</td></tr>
<tr><td>2343</td><td>PB24</td><td>Slight vibration suppression control selection</td></tr>
<tr><td>2344</td><td>PB25</td><td>For manufacturer setting</td></tr>
<tr><td>2345</td><td>PB26</td><td>Gain changing selection</td></tr>
<tr><td>2346</td><td>PB27</td><td>Gain changing condition</td></tr>
<tr><td>2347</td><td>PB28</td><td>Gain changing time constant</td></tr>
<tr><td>2348</td><td>PB29</td><td>Gain changing ratio of load inertia moment to servo motor inertia moment</td></tr>
<tr><td>2349</td><td>PB30</td><td>Gain changing position loop gain</td></tr>
<tr><td>2350</td><td>PB31</td><td>Gain changing speed loop gain</td></tr>
<tr><td>2351</td><td>PB32</td><td>Gain changing speed integral compensation</td></tr>
<tr><td>2352</td><td>PB33</td><td>Gain changing vibration suppression control vibration frequency setting</td></tr>
<tr><td>2353</td><td>PB34</td><td>Gain changing vibration suppression control resonance frequency setting</td></tr>
<tr><td>2354</td><td>PB35</td><td>For manufacturer setting</td></tr>
<tr><td>2355</td><td>PB36</td><td>For manufacturer setting</td></tr>
<tr><td>2356</td><td>PB37</td><td>For manufacturer setting</td></tr>
<tr><td>2357</td><td>PB38</td><td>For manufacturer setting</td></tr>
<tr><td>2358</td><td>PB39</td><td>For manufacturer setting</td></tr>
<tr><td>2359</td><td>PB40</td><td>For manufacturer setting</td></tr>
<tr><td>2360</td><td>PB41</td><td>For manufacturer setting</td></tr>
<tr><td>2361</td><td>PB42</td><td>For manufacturer setting</td></tr>
<tr><td>2362</td><td>PB43</td><td>For manufacturer setting</td></tr>
<tr><td>2363</td><td>PB44</td><td>For manufacturer setting</td></tr>
<tr><td>2364</td><td>PB45</td><td>For manufacturer setting</td></tr>
<tr><td>2365</td><td>PC01</td><td>Error excessive alarm level</td></tr>
<tr><td>2366</td><td>PC02</td><td>Electromagnetic brake sequence output</td></tr>
</table>
</td><td>Any time during operation</td><td>Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</th><th rowspan="2">Error processing</th><th rowspan="2">Corrective action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2599</td><td>Parameter error</td><td>
<table>
<tr><th>Error code</th><th>Parameter No.</th><th>Name</th></tr>
<tr><td>2367</td><td>PC03</td><td>Encoder output pulses selection</td></tr>
<tr><td>2368</td><td>PC04</td><td>Function selection C-1</td></tr>
<tr><td>2369</td><td>PC05</td><td>Function selection C-2</td></tr>
<tr><td>2370</td><td>PC06</td><td>For manufacturer setting</td></tr>
<tr><td>2371</td><td>PC07</td><td>Zero speed</td></tr>
<tr><td>2372</td><td>PC08</td><td>For manufacturer setting</td></tr>
<tr><td>2373</td><td>PC09</td><td>Analog monitor output 1</td></tr>
<tr><td>2374</td><td>PC10</td><td>Analog monitor output 2</td></tr>
<tr><td>2375</td><td>PC11</td><td>Analog monitor 1 offset</td></tr>
<tr><td>2376</td><td>PC12</td><td>Analog monitor 2 offset</td></tr>
<tr><td>2377</td><td>PC13</td><td>For manufacturer setting</td></tr>
<tr><td>2378</td><td>PC14</td><td>For manufacturer setting</td></tr>
<tr><td>2379</td><td>PC15</td><td>For manufacturer setting</td></tr>
<tr><td>2380</td><td>PC16</td><td>For manufacturer setting</td></tr>
<tr><td>2381</td><td>PC17</td><td>Function selection C-4</td></tr>
<tr><td>2382</td><td>PC18</td><td>For manufacturer setting</td></tr>
<tr><td>2383</td><td>PC19</td><td>For manufacturer setting</td></tr>
<tr><td>2384</td><td>PC20</td><td>For manufacturer setting</td></tr>
<tr><td>2385</td><td>PC21</td><td>Alarm history clear</td></tr>
<tr><td>2386</td><td>PC22</td><td>For manufacturer setting</td></tr>
<tr><td>2387</td><td>PC23</td><td>For manufacturer setting</td></tr>
<tr><td>2388</td><td>PC24</td><td>For manufacturer setting</td></tr>
<tr><td>2389</td><td>PC25</td><td>For manufacturer setting</td></tr>
<tr><td>2390</td><td>PC26</td><td>For manufacturer setting</td></tr>
<tr><td>2391</td><td>PC27</td><td>For manufacturer setting</td></tr>
<tr><td>2392</td><td>PC28</td><td>For manufacturer setting</td></tr>
<tr><td>2393</td><td>PC29</td><td>For manufacturer setting</td></tr>
<tr><td>2394</td><td>PC30</td><td>For manufacturer setting</td></tr>
<tr><td>2395</td><td>PC31</td><td>For manufacturer setting</td></tr>
<tr><td>2396</td><td>PC32</td><td>For manufacturer setting</td></tr>
<tr><td>2397</td><td>PD01</td><td>For manufacturer setting</td></tr>
<tr><td>2398</td><td>PD02</td><td>For manufacturer setting</td></tr>
<tr><td>2399</td><td>PD03</td><td>For manufacturer setting</td></tr>
<tr><td>2400</td><td>PD04</td><td>For manufacturer setting</td></tr>
<tr><td>2401</td><td>PD05</td><td>For manufacturer setting</td></tr>
<tr><td>2402</td><td>PD06</td><td>For manufacturer setting</td></tr>
<tr><td>2403</td><td>PD07</td><td>Output signal device selection 1</td></tr>
<tr><td>2404</td><td>PD08</td><td>Output signal device selection 2</td></tr>
<tr><td>2405</td><td>PD09</td><td>Output signal device selection 3</td></tr>
<tr><td>2406</td><td>PD10</td><td>For manufacturer setting</td></tr>
</table>
</td><td>Any time during operation</td><td>Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</th><th rowspan="2">Error processing</th><th rowspan="2">Corrective action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2599</td><td>Parameter error</td><td>
<table>
<tr><th>Error code</th><th>Parameter No.</th><th>Name</th></tr>
<tr><td>2407</td><td>PD11</td><td>For manufacturer setting</td></tr>
<tr><td>2408</td><td>PD12</td><td>For manufacturer setting</td></tr>
<tr><td>2409</td><td>PD13</td><td>For manufacturer setting</td></tr>
<tr><td>2410</td><td>PD14</td><td>Function selection D-3</td></tr>
<tr><td>2411</td><td>PD15</td><td>For manufacturer setting</td></tr>
<tr><td>2412</td><td>PD16</td><td>For manufacturer setting</td></tr>
<tr><td>2413</td><td>PD17</td><td>For manufacturer setting</td></tr>
<tr><td>2414</td><td>PD18</td><td>For manufacturer setting</td></tr>
<tr><td>2415</td><td>PD19</td><td>For manufacturer setting</td></tr>
<tr><td>2416</td><td>PD20</td><td>For manufacturer setting</td></tr>
<tr><td>2417</td><td>PD21</td><td>For manufacturer setting</td></tr>
<tr><td>2418</td><td>PD22</td><td>For manufacturer setting</td></tr>
<tr><td>2419</td><td>PD23</td><td>For manufacturer setting</td></tr>
<tr><td>2420</td><td>PD24</td><td>For manufacturer setting</td></tr>
<tr><td>2421</td><td>PD25</td><td>For manufacturer setting</td></tr>
<tr><td>2422</td><td>PD26</td><td>For manufacturer setting</td></tr>
<tr><td>2423</td><td>PD27</td><td>For manufacturer setting</td></tr>
<tr><td>2424</td><td>PD28</td><td>For manufacturer setting</td></tr>
<tr><td>2425</td><td>PD29</td><td>For manufacturer setting</td></tr>
<tr><td>2426</td><td>PD30</td><td>For manufacturer setting</td></tr>
<tr><td>2427</td><td>PD31</td><td>For manufacturer setting</td></tr>
<tr><td>2428</td><td>PD32</td><td>For manufacturer setting</td></tr>
</table>
</td><td>Any time during operation</td><td>Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</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
2899</td><td>Initial parameter error</td><td>Initial parameter error
• The parameter setting is wrong.
• The parameter data was corrupted.
<table>
<tr><th>Error code</th><th>Parameter No.</th><th>Name</th></tr>
<tr><td>2601</td><td>PA01</td><td>For manufacturer setting</td></tr>
<tr><td>2602</td><td>PA02</td><td>Regenerative brake option</td></tr>
<tr><td>2603</td><td>PA03</td><td>Absolute position detection system</td></tr>
<tr><td>2604</td><td>PA04</td><td>Function selection A-1</td></tr>
<tr><td>2605</td><td>PA05</td><td>For manufacturer setting</td></tr>
<tr><td>2606</td><td>PA06</td><td>For manufacturer setting</td></tr>
<tr><td>2607</td><td>PA07</td><td>For manufacturer setting</td></tr>
<tr><td>2608</td><td>PA08</td><td>Auto tuning mode</td></tr>
<tr><td>2609</td><td>PA09</td><td>Auto tuning response</td></tr>
<tr><td>2610</td><td>PA10</td><td>In-position range</td></tr>
<tr><td>2611</td><td>PA11</td><td>For manufacturer setting</td></tr>
<tr><td>2612</td><td>PA12</td><td>For manufacturer setting</td></tr>
<tr><td>2613</td><td>PA13</td><td>For manufacturer setting</td></tr>
<tr><td>2614</td><td>PA14</td><td>Rotation direction selection</td></tr>
<tr><td>2615</td><td>PA15</td><td>Encoder output pulse</td></tr>
<tr><td>2616</td><td>PA16</td><td>For manufacturer setting</td></tr>
<tr><td>2617</td><td>PA17</td><td>For manufacturer setting</td></tr>
<tr><td>2618</td><td>PA18</td><td>For manufacturer setting</td></tr>
<tr><td>2619</td><td>PA19</td><td>Parameter write inhibit</td></tr>
<tr><td>2620</td><td>PB01</td><td>Adaptive tuning mode</td></tr>
<tr><td>2621</td><td>PB02</td><td>Vibration suppression control filter tuning mode</td></tr>
<tr><td>2622</td><td>PB03</td><td>For manufacturer setting</td></tr>
<tr><td>2623</td><td>PB04</td><td>Feed forward gain</td></tr>
<tr><td>2624</td><td>PB05</td><td>For manufacturer setting</td></tr>
<tr><td>2625</td><td>PB06</td><td>Ratio of load inertia moment to servo motor inertia moment</td></tr>
<tr><td>2626</td><td>PB07</td><td>Model loop gain</td></tr>
<tr><td>2627</td><td>PB08</td><td>Position loop gain</td></tr>
<tr><td>2628</td><td>PB09</td><td>Speed loop gain</td></tr>
<tr><td>2629</td><td>PB10</td><td>Speed integral compensation</td></tr>
<tr><td>2630</td><td>PB11</td><td>Speed differential compensation</td></tr>
<tr><td>2631</td><td>PB12</td><td>For manufacturer setting</td></tr>
<tr><td>2632</td><td>PB13</td><td>Machine resonance suppression filter 1</td></tr>
<tr><td>2633</td><td>PB14</td><td>Notch form selection 1</td></tr>
<tr><td>2634</td><td>PB15</td><td>Machine resonance suppression filter 2</td></tr>
<tr><td>2635</td><td>PB16</td><td>Notch form selection 2</td></tr>
</table></td><td>• Servo amplifier power on.
• Multiple CPU system power on.</td><td>Immediate stop</td><td>• After checking and correcting of the parameter setting, turn off to on or reset the power of Multiple CPU system CPU.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</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
2899</td><td>Initial parameter error</td><td>
<table>
<tr><th>Error code</th><th>Parameter No.</th><th>Name</th></tr>
<tr><td>2636</td><td>PB17</td><td>For manufacturer setting</td></tr>
<tr><td>2637</td><td>PB18</td><td>Low-pass filter</td></tr>
<tr><td>2638</td><td>PB19</td><td>Vibration suppression control vibration frequency setting</td></tr>
<tr><td>2639</td><td>PB20</td><td>Vibration suppression control resonance frequency setting</td></tr>
<tr><td>2640</td><td>PB21</td><td>For manufacturer setting</td></tr>
<tr><td>2641</td><td>PB22</td><td>For manufacturer setting</td></tr>
<tr><td>2642</td><td>PB23</td><td>Low-pass filter selection</td></tr>
<tr><td>2643</td><td>PB24</td><td>Slight vibration suppression control selection</td></tr>
<tr><td>2644</td><td>PB25</td><td>For manufacturer setting</td></tr>
<tr><td>2645</td><td>PB26</td><td>Gain changing selection</td></tr>
<tr><td>2646</td><td>PB27</td><td>Gain changing condition</td></tr>
<tr><td>2647</td><td>PB28</td><td>Gain changing time constant</td></tr>
<tr><td>2648</td><td>PB29</td><td>Gain changing ratio of load inertia moment to servo motor inertia moment</td></tr>
<tr><td>2649</td><td>PB30</td><td>Gain changing position loop gain</td></tr>
<tr><td>2650</td><td>PB31</td><td>Gain changing speed loop gain</td></tr>
<tr><td>2651</td><td>PB32</td><td>Gain changing speed integral compensation</td></tr>
<tr><td>2652</td><td>PB33</td><td>Gain changing vibration suppression control vibration frequency setting</td></tr>
<tr><td>2653</td><td>PB34</td><td>Gain changing vibration suppression control resonance frequency setting</td></tr>
<tr><td>2654</td><td>PB35</td><td>For manufacturer setting</td></tr>
<tr><td>2655</td><td>PB36</td><td>For manufacturer setting</td></tr>
<tr><td>2656</td><td>PB37</td><td>For manufacturer setting</td></tr>
<tr><td>2657</td><td>PB38</td><td>For manufacturer setting</td></tr>
<tr><td>2658</td><td>PB39</td><td>For manufacturer setting</td></tr>
<tr><td>2659</td><td>PB40</td><td>For manufacturer setting</td></tr>
<tr><td>2660</td><td>PB41</td><td>For manufacturer setting</td></tr>
<tr><td>2661</td><td>PB42</td><td>For manufacturer setting</td></tr>
<tr><td>2662</td><td>PB43</td><td>For manufacturer setting</td></tr>
<tr><td>2663</td><td>PB44</td><td>For manufacturer setting</td></tr>
<tr><td>2664</td><td>PB45</td><td>For manufacturer setting</td></tr>
<tr><td>2665</td><td>PC01</td><td>Error excessive alarm level</td></tr>
<tr><td>2666</td><td>PC02</td><td>Electromagnetic brake sequence output</td></tr>
</table>
</td><td>• Servo amplifier power on.
• Multiple CPU system power on.</td><td>Immediate stop</td><td>• After checking and correcting of the parameter setting, turn off to on or reset the power of Multiple CPU system CPU.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

<table>
<tr><th rowspan="2">Error code</th><th colspan="2">Error cause</th><th rowspan="2">Error check</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
2899</td><td>Initial parameter error</td><td>

Error code	Parameter No.	Name
2667	PC03	Encoder output pulses selection
2668	PC04	Function selection C-1
2669	PC05	Function selection C-2
2670	PC06	For manufacturer setting
2671	PC07	Zero speed
2672	PC08	For manufacturer setting
2673	PC09	Analog monitor output 1
2674	PC10	Analog monitor output 2
2675	PC11	Analog monitor 1 offset
2676	PC12	Analog monitor 2 offset
2677	PC13	For manufacturer setting
2678	PC14	For manufacturer setting
2679	PC15	For manufacturer setting
2680	PC16	For manufacturer setting
2681	PC17	Function selection C-4
2682	PC18	For manufacturer setting
2683	PC19	For manufacturer setting
2684	PC20	For manufacturer setting
2685	PC21	Alarm history clear
2686	PC22	For manufacturer setting
2687	PC23	For manufacturer setting
2688	PC24	For manufacturer setting
2689	PC25	For manufacturer setting
2690	PC26	For manufacturer setting
2691	PC27	For manufacturer setting
2692	PC28	For manufacturer setting
2693	PC29	For manufacturer setting
2694	PC30	For manufacturer setting
2695	PC31	For manufacturer setting
2696	PC32	For manufacturer setting
2697	PD01	For manufacturer setting
2698	PD02	For manufacturer setting
2699	PD03	For manufacturer setting
2700	PD04	For manufacturer setting
2701	PD05	For manufacturer setting
2702	PD06	For manufacturer setting
2703	PD07	Output signal device selection 1
2704	PD08	Output signal device selection 2
2705	PD09	Output signal device selection 3
2706	PD10	For manufacturer setting

</td><td>• Servo amplifier power on.
• Multiple CPU system power on.</td><td>Immediate stop</td><td>• After checking and correcting of the parameter setting, turn off to on or reset the power of Multiple CPU system CPU.</td></tr>
</table>

Table 1.13 Servo error (2000 to 2899) list (Continued)

Error code	Error cause: Name	Error cause: Description	Error check	Error processing	Corrective action
2601 to 2899	Initial parameter error	(see table below)	• Servo amplifier power on. • Multiple CPU system power on.	Immediate stop	• After checking and correcting of the parameter setting, turn off to on or reset the power of Multiple CPU system CPU.

Error code	Parameter No.	Name
2707	PD11	For manufacturer setting
2708	PD12	For manufacturer setting
2709	PD13	For manufacturer setting
2710	PD14	Function selection D-3
2711	PD15	For manufacturer setting
2712	PD16	For manufacturer setting
2713	PD17	For manufacturer setting
2714	PD18	For manufacturer setting
2715	PD19	For manufacturer setting
2716	PD20	For manufacturer setting
2717	PD21	For manufacturer setting
2718	PD22	For manufacturer setting
2719	PD23	For manufacturer setting
2720	PD24	For manufacturer setting
2721	PD25	For manufacturer setting
2722	PD26	For manufacturer setting
2723	PD27	For manufacturer setting
2724	PD28	For manufacturer setting
2725	PD29	For manufacturer setting
2726	PD30	For manufacturer setting
2727	PD31	For manufacturer setting
2728	PD32	For manufacturer setting

APPENDIX 1.5 PC link communication errors

Table 1.14 PC link communication error codes list

Error codes stored in D9196	Error description	Corrective action
01	• A receiving packet for PC link communication does not arrive. • The arrival timing of the receiving packet is too late.	• Check whether the power of PC has been turned on. • Check the connection of the communication cable. • Check the communication cable for wire breakage. • Check whether the A□0BD-PCF/ A30CD-PCF has been installed correctly.
02	• A receiving packet CRC code is not right.	• Check whether there is a noise source near the PC. • Check the connection of the communication cable. • Check the communication cable for wire breakage.
03	• A receiving packet data ID is not right.	• Check whether the A□0BD-PCF/ A30CD-PCF has been installed correctly. • Replace the A□0BD-PCF/A30CD-PCF.
04	• The number of received frames is not right.	• Check whether there is a noise source near the PC. • Check the connection of the communication cable. • Check the communication cable for wire breakage.
05	• A PC communication task does not start.	• Start the communication task for PC side.

APPENDIX 2 Motion dedicated signal

APPENDIX 2.1 Internal relay (M)

(1) Axis status list

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

Signal name

	Signal name		Refresh cycle	Fetch cycle	Signal direction
0	Positioning start complete		Operation cycle		Status signal
1	Positioning complete				
2	In-position				
3	Command in-position				
4	Unusable		—	—	—
5					
6	Zero pass		Operation cycle		Status signal
7	Error detection		Immediate		
8	Servo error detection		Operation cycle		
9	Home position return request		Main cycle		
10	Home position return complete		Operation cycle		
11	External signals	FLS	Main cycle		
12		RLS			
13		STOP			
14		DOG/CHANGE			
15	Servo ready		Operation cycle		
16	Torque limiting				
17	Unusable		—	—	—
18					
19	M-code outputting signal		Operation cycle		Status signal

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.

(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(2) Axis command signal list

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

Signal name

	Signal name	Refresh cycle	Fetch cycle	Signal direction
0	Stop command		Operation cycle	Command signal
1	Rapid stop command			
2	Forward rotation JOG start command		Main cycle	
3	Reverse rotation JOG start command			
4	Complete signal OFF command			
5	Unusable	—	—	—
6				
7	Error reset command		Main cycle	Command signal
8	Servo error reset command			
9	External stop input disable at start command		At start	
10	Unusable	—	—	—
11				
12				
13				
14				
15	Servo OFF command		Operation cycle	Command signal
16	Gain changing command		Operation cycle(Note-3)	
17	Unusable	—	—	—
18				
19	FIN signal		Operation cycle	Command signal

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.
(Note-3): Operation cycle 7.1[ms] or more: Every 3.5[ms]

(3) Axis status 2 list

Axis No.	Device No.
1	M4000 to M4009
2	M4010 to M4019
3	M4020 to M4029
4	M4030 to M4039
5	M4040 to M4049
6	M4050 to M4059
7	M4060 to M4069
8	M4070 to M4079
9	M4080 to M4089
10	M4090 to M4099
11	M4100 to M4109
12	M4110 to M4119
13	M4120 to M4129
14	M4130 to M4139
15	M4140 to M4149
16	M4150 to M4159
17	M4160 to M4169
18	M4170 to M4179
19	M4180 to M4189
20	M4190 to M4199
21	M4200 to M4209
22	M4210 to M4219
23	M4220 to M4229
24	M4230 to M4239
25	M4240 to M4249
26	M4250 to M4259
27	M4260 to M4269
28	M4270 to M4279
29	M4280 to M4289
30	M4290 to M4299
31	M4300 to M4309
32	M4310 to M4319

Signal name

	Signal name	Refresh cycle	Fetch cycle	Signal direction
0	Unusable	—	—	—
1				
2	Automatic start	Operation cycle		Status signal
3	Temporary stop			
4	Unusable	—	—	—
5				
6				
7				
8				
9	Unusable (note-1)	—	—	—

M4009 : Single block processing signal

(Note-1): At single block mode, only M4009 is used single block processing signal.
(Note-2): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-3): Device area of 9 axes or more is unusable in the Q172HCPU.

(4) Axis command signal 2 list

Axis No.	Device No.
1	M4400 to M4409
2	M4410 to M4419
3	M4420 to M4429
4	M4430 to M4439
5	M4440 to M4449
6	M4450 to M4459
7	M4460 to M4469
8	M4470 to M4479
9	M4480 to M4489
10	M4490 to M4499
11	M4500 to M4509
12	M4510 to M4519
13	M4520 to M4529
14	M4530 to M4539
15	M4540 to M4549
16	M4550 to M4559
17	M4560 to M4569
18	M4570 to M4579
19	M4580 to M4589
20	M4590 to M4599
21	M4600 to M4609
22	M4610 to M4619
23	M4620 to M4629
24	M4630 to M4639
25	M4640 to M4649
26	M4650 to M4659
27	M4660 to M4669
28	M4670 to M4679
29	M4680 to M4689
30	M4690 to M4699
31	M4700 to M4709
32	M4710 to M4719

Signal name

	Signal name	Refresh cycle	Fetch cycle	Signal direction
0	Temporary stop command		Operation cycle	Command signal
1	Optional program stop command			
2	Optional block skip command			
3	Single block command			
4	Re-start command			
5	Override ratio valid/invalid			
6	Axis interlock (Forward)			
7	Axis interlock (Reverse)			
8	Unusable (Note-1)	—	—	—
9				

M4408 : Single block mode signal

M4409 : Single block start signal

M4418 : Axis interlock valid/invalid

(Note-1): M4408 (single block mode signal) and M4409 (single block start signal) are used in the single block operation.
M4418 (axis interlock valid/invalid) is used in the axis interlock (forward)/(reverse).

(Note-2): The range of axis No.1 to 8 is valid in the Q172HCPU.

(Note-3): Device area of 9 axes or more is unusable in the Q172HCPU.

(5) Common device list

Device No.	Signal name		Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2000	PLC ready flag			Main cycle	Command signal (Note-1)	M3072
M2001	Axis 1	Start accept flag	Operation cycle		Status signal (Note-1), (Note-2)	
M2002	Axis 2					
M2003	Axis 3					
M2004	Axis 4					
M2005	Axis 5					
M2006	Axis 6					
M2007	Axis 7					
M2008	Axis 8					
M2009	Axis 9					
M2010	Axis 10					
M2011	Axis 11					
M2012	Axis 12					
M2013	Axis 13					
M2014	Axis 14					
M2015	Axis 15					
M2016	Axis 16					
M2017	Axis 17					
M2018	Axis 18					
M2019	Axis 19					
M2020	Axis 20					
M2021	Axis 21					
M2022	Axis 22					
M2023	Axis 23					
M2024	Axis 24					
M2025	Axis 25					
M2026	Axis 26					
M2027	Axis 27					
M2028	Axis 28					
M2029	Axis 29					
M2030	Axis 30					
M2031	Axis 31					
M2032	Axis 32					
M2033	Unusable		—	—	—	—
M2034	Personal computer link communication error flag		Operation cycle		Status signal	
M2035 to M2040	Unusable (6 points)		—	—	—	—
M2041	System setting error flag		Operation cycle		Status signal	
M2042	All axes servo ON command			Operation cycle	Command Signal (Note-1)	M3074
M2043 to M2046	Unusable (4 points)		—	—	—	—
M2047	Motion slot fault detection flag		Operation cycle		Status signal	
M2048	JOG operation simultaneous start command			Main cycle	Command signal (Note-1)	M3076
M2049	All axes servo ON accept flag		Operation cycle		Status signal	
M2050	Start buffer full					
M2051	Manual pulse generator 1 enable flag			Main cycle	Command signal (Note-1)	M3077
M2052	Manual pulse generator 2 enable flag					M3078
M2053	Manual pulse generator 3 enable flag					M3079

Device No.	Signal name		Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2054	Operation cycle over flag		Operation cycle		Status signal	
M2055 to M2060	Unusable (6 points)		—	—	—	—
M2061	Axis 1	Speed changing flag	Operation cycle		Status signal (Note-2)	
M2062	Axis 2					
M2063	Axis 3					
M2064	Axis 4					
M2065	Axis 5					
M2066	Axis 6					
M2067	Axis 7					
M2068	Axis 8					
M2069	Axis 9					
M2070	Axis 10					
M2071	Axis 11					
M2072	Axis 12					
M2073	Axis 13					
M2074	Axis 14					
M2075	Axis 15					
M2076	Axis 16					
M2077	Axis 17					
M2078	Axis 18					
M2079	Axis 19					
M2080	Axis 20					
M2081	Axis 21					
M2082	Axis 22					
M2083	Axis 23					
M2084	Axis 24					
M2085	Axis 25					
M2086	Axis 26					
M2087	Axis 27					
M2088	Axis 28					
M2089	Axis 29					
M2090	Axis 30					
M2091	Axis 31					
M2092	Axis 32					
M2093 to M2118	Unusable (26 points)		—	—	—	—

Common device list (Continued)

Device No.	Signal name		Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2119	Unusable (9 points)		—	—	—	—
M2120						
M2121						
M2122						
M2123						
M2124						
M2125						
M2126						
M2127						
M2128	Axis 1	Automatic deceleration flag	Operation cycle		Status signal (Note-2)	
M2129	Axis 2					
M2130	Axis 3					
M2131	Axis 4					
M2132	Axis 5					
M2133	Axis 6					
M2134	Axis 7					
M2135	Axis 8					
M2136	Axis 9					
M2137	Axis 10					
M2138	Axis 11					
M2139	Axis 12					
M2140	Axis 13					
M2141	Axis 14					
M2142	Axis 15					
M2143	Axis 16					
M2144	Axis 17					
M2145	Axis 18					
M2146	Axis 19					
M2147	Axis 20					
M2148	Axis 21					
M2149	Axis 22					
M2150	Axis 23					
M2151	Axis 24					
M2152	Axis 25					
M2153	Axis 26					
M2154	Axis 27					
M2155	Axis 28					
M2156	Axis 29					
M2157	Axis 30					
M2158	Axis 31					
M2159	Axis 32					
M2160	Unusable (20 points)		—	—	—	—
M2161						
M2162						
M2163						
M2164						
M2165						
M2166						
M2167						
M2168						
M2169						
M2170						
M2171						
M2172						
M2173						
M2174						
M2175						
M2176						
M2177						
M2178						
M2179						

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2180	Unusable (60 points)	—	—	—	—
M2181					
M2182					
M2183					
M2184					
M2185					
M2186					
M2187					
M2188					
M2189					
M2190					
M2191					
M2192					
M2193					
M2194					
M2195					
M2196					
M2197					
M2198					
M2199					
M2200					
M2201					
M2202					
M2203					
M2204					
M2205					
M2206					
M2207					
M2208					
M2209					
M2210					
M2211					
M2212					
M2213					
M2214					
M2215					
M2216					
M2217					
M2218					
M2219					
M2220					
M2221					
M2222					
M2223					
M2224					
M2225					
M2226					
M2227					
M2228					
M2229					
M2230					
M2231					
M2232					
M2233					
M2234					
M2235					
M2236					
M2237					
M2238					
M2239					

Common device list (Continued)

Device No.	Signal name		Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2240	Axis 1	Speed change "0" accepting flag	Operation cycle		Status signal (Note-2)	
M2241	Axis 2					
M2242	Axis 3					
M2243	Axis 4					
M2244	Axis 5					
M2245	Axis 6					
M2246	Axis 7					
M2247	Axis 8					
M2248	Axis 9					
M2249	Axis 10					
M2250	Axis 11					
M2251	Axis 12					
M2252	Axis 13					
M2253	Axis 14					
M2254	Axis 15					
M2255	Axis 16					
M2256	Axis 17					
M2257	Axis 18					
M2258	Axis 19					
M2259	Axis 20					
M2260	Axis 21					
M2261	Axis 22					
M2262	Axis 23					
M2263	Axis 24					
M2264	Axis 25					
M2265	Axis 26					
M2266	Axis 27					
M2267	Axis 28					
M2268	Axis 29					
M2269	Axis 30					
M2270	Axis 31					
M2271	Axis 32					
M2272 to M2279	Unusable (8 points)		—	—	—	—

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-4)
M2280 to M2319	Unusable (40 points)	—	—	—	—

Explanation of the request register

No.	Function	Bit device	Request register
1	PLC ready flag	M2000	D704
2	All axes servo ON command	M2042	D706
3	JOG operation simultaneous start command	M2048	D708
4	Manual pulse generator 1 enable flag	M2051	D755
5	Manual pulse generator 2 enable flag	M2052	D756
6	Manual pulse generator 3 enable flag	M2053	D757

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.
(Note-3): Handling of D704 to D708 and D755 to D757 registers
Because cannot be turn on/off for every bit from the PLC CPU, the above bit devices are assigned to D register, and each bit device becomes on with the lowest rank bit 0 → 1 of each register, and each bit device becomes off with 1 → 0.
Use it when the above functions are requested from the PLC CPU using the S(P).DDRD and S(P).DDWR instruction.
(Note-4): It can also be ordered the device of a remark column.

⚠CAUTION

- The data executed later becomes effective when the same device is executed in the Motion program and PLC program.

(6) Special relay allocated device list (Status)

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note)
M2320	Fuse blown detection	Error occurrence		Status signal	M9000
M2321	AC/DC DOWN detection				M9005
M2322	Battery low				M9006
M2323	Battery low latch				M9007
M2324	Self-diagnostic error				M9008
M2325	Diagnostic error				M9010
M2326	Always ON	Main operation			M9036
M2327	Always OFF				M9037
M2328	Clock data error	Error occurrence			M9026
M2329	PCPU WDT error flag				M9073
M2330	PCPU READY complete flag	At request			M9074
M2331	Test mode ON flag				M9075
M2332	External forced stop input flag	Operation cycle			M9076
M2333	Manual pulse generator axis setting error flag	Error occurrence			M9077
M2334	TEST mode request error flag				M9078
M2335	Motion program setting error flag				M9079
M2336	CPU No.1 reset flag	At status change			M9240
M2337	CPU No.2 reset flag				M9241
M2338	CPU No.3 reset flag				M9242
M2339	CPU No.4 reset flag				M9243
M2340	CPU No.1 error flag				M9244
M2341	CPU No.2 error flag				M9245
M2342	CPU No.3 error flag				M9246
M2343	CPU No.4 error flag				M9247
M2344	Unusable	—	—	—	—
M2345	CPU No.1 MULTR complete flag	At instruction completion		Status signal	M9216
M2346	CPU No.2 MULTR complete flag				M9217
M2347	CPU No.3 MULTR complete flag				M9218
M2348	CPU No.4 MULTR complete flag				M9219
M2349 to M2399	Unusable	—	—	—	—

(Note) : The same status as a remark column is output.

(7) Common device list (Command signal)

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-1) , (Note-2)
M3072	PLC ready flag		Main cycle	Command signal	M2000
M3073	Unusable	—	—	—	—
M3074	All axes servo ON command		Operation cycle	Command signal	M2042
M3076	JOG operation simultaneous start command		Main cycle		M2048
M3077	Manual pulse generator 1 enable flag				M2051
M3078	Manual pulse generator 2 enable flag				M2052
M3079	Manual pulse generator 3 enable flag				M2053
M3080 to M3135	Unusable	—	—	—	—

(Note-1) : The device of a remarks column turns ON by OFF to ON of the above device, and the device of a remarks column turns OFF by ON to OFF of the above device. The state of a device is not in agreement when the device of a remarks column is turned on directly. In addition, when the request from a data register and the request from the above device are performed simultaneously, the request from the above device becomes effective.

(Note-2) : It can also be ordered the device of a remark column.

(8) Special relay allocated device list (Command signal)

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction	Remark (Note-1), (Note-2)
M3136	Clock data set request		Main cycle	Command signal	M9025
M3137	Clock data read request				M9028
M3138	Error reset				M9060
M3139 to M3199	Unusable	—	—	—	—

(Note-1) : The device of a remarks column turns ON by OFF to ON of the above device, and the device of a remarks column turns OFF by ON to OFF of the above device. The state of a device is not in agreement when the device of a remarks column is turned on directly.

(Note-2) : It can also be ordered the device of a remark column.

APPENDIX 2.2 Data registers (D)

(1) Axis monitor device list

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

Signal name

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0	Machine value	Operation cycle		Command unit	Monitor device
1					
2	Real machine value				
3					
4	Deviation counter value			PLS	
5					
6	Minor error code	Immediate		—	
7	Major error code				
8	Servo error code	Main cycle			
9	Home position return re-travel value	Operation cycle		PLS	
10	Travel value after proximity dog ON			Command unit	
11					
12	Execute program No.	At start		—	
13	M-code	Operation cycle			
14	Torque limit value			%	
15	Unusable	—	—	—	—
16					
17					
18	Real current value at stop input	Operation cycle		Command unit	Monitor device
19					

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(2) Control change register list

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

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0	JOG speed setting		At start	Command unit	Command device
1					

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(3) Axis monitor device 2 list

Axis No.	Device No.
1	D800 to D819
2	D820 to D839
3	D840 to D859
4	D860 to D879
5	D880 to D899
6	D900 to D919
7	D920 to D939
8	D940 to D959
9	D960 to D979
10	D980 to D999
11	D1000 to D1019
12	D1020 to D1039
13	D1040 to D1059
14	D1060 to D1079
15	D1080 to D1099
16	D1100 to D1119
17	D1120 to D1139
18	D1140 to D1159
19	D1160 to D1179
20	D1180 to D1199
21	D1200 to D1219
22	D1220 to D1239
23	D1240 to D1259
24	D1260 to D1279
25	D1280 to D1299
26	D1300 to D1319
27	D1320 to D1339
28	D1340 to D1359
29	D1360 to D1379
30	D1380 to D1399
31	D1400 to D1419
32	D1420 to D1439

Signal name

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0 1	Current value	Operation cycle		Command unit	Monitor device
2	Execute sequence No. (main)	Immediate		—	
3	Execute block No. (main)				
4	Execute program No. (sub)				
5	Execute sequence No. (sub)				
6	Execute block No. (sub)				
7	Unusable	—	—	—	—
8	G43/G44 command	Immediate		—	Monitor device
9	Tool length offset data No.				
10 11	Tool length offset data			Command unit	
12 13 14 15 16 17 18 19	Unusable	—	—	—	—

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(4) Control program monitor device list

Device No.	Signal name
D1440 to D1445	
D1446 to D1451	
D1452 to D1457	
D1458 to D1463	
D1464 to D1469	
D1470 to D1475	
D1476 to D1481	
D1482 to D1487	
D1488 to D1493	
D1494 to D1499	
D1500to D1505	
D1506 to D1511	
D1512 to D1517	
D1518 to D1523	
D1524 to D1529	
D1530 to D1535	

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0	Program No.	Immediate			Monitor device
1	Sequence No.				
2	Block No.				
3	Error code (Minor error code)				
4	Execute status				
5	Unusable (Note-1)	—	—	—	—

D1445 : CLEAR request status storage register

(Note-1): D1445 (CLEAR request status storage register) is used in the "control program stop function from the PLC CPU".

(5) Control change register 2 list

Axis No.	Device No.
1	D1536 to D1538
2	D1539 to D1541
3	D1542 to D1544
4	D1545 to D1547
5	D1548 to D1550
6	D1551 to D1553
7	D1554 to D1556
8	D1557 to D1559
9	D1560 to D1562
10	D1563 to D1565
11	D1566 to D1568
12	D1569 to D1571
13	D1572 to D1574
14	D1575 to D1577
15	D1578 to D1580
16	D1581 to D1583
17	D1584 to D1586
18	D1587 to D1589
19	D1590 to D1592
20	D1593 to D1595
21	D1596 to D1598
22	D1599 to D1601
23	D1602 to D1604
24	D1605 to D1607
25	D1608 to D1610
26	D1611 to D1613
27	D1614 to D1616
28	D1617 to D1619
29	D1620 to D1622
30	D1623 to D1625
31	D1626 to D1628
32	D1629 to D1631

Signal name

	Signal name	Refresh cycle	Fetch cycle	Unit	Signal direction
0	Override ratio setting register (0 to 100)		Operation cycle	%	Command device
1	Unusable	—	—	—	—
2					

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.
(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

(6) Tool length offset data setting register list (Higher rank, lower rank)

Device No.	Signal name
D1651, D1650	Tool length offset data 1
D1653, D1652	Tool length offset data 2
D1655, D1654	Tool length offset data 3
D1657, D1656	Tool length offset data 4
D1659, D1658	Tool length offset data 5
D1661, D1660	Tool length offset data 6
D1663, D1662	Tool length offset data 7
D1665, D1664	Tool length offset data 8
D1667, D1666	Tool length offset data 9
D1669, D1668	Tool length offset data 10
D1671, D1670	Tool length offset data 11
D1673, D1672	Tool length offset data 12
D1675, D1674	Tool length offset data 13
D1677, D1676	Tool length offset data 14
D1679, D1678	Tool length offset data 15
D1681, D1680	Tool length offset data 16
D1683, D1682	Tool length offset data 17
D1685, D1684	Tool length offset data 18
D1687, D1686	Tool length offset data 19
D1689, D1688	Tool length offset data 20

(7) Common device list

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction
D704	PLC ready flag request		Main cycle	Command device
D705	Speed switching point specified flag request			
D706	All axes servo ON command request			
D707	CLEAR request control program No. setting register			
D708	JOG operation simultaneous start command request			
D709	Unusable	—	—	—
D710	JOG operation simultaneous start axis setting register		At start	Command device
D711				
D712				
D713				
D714	Manual pulse generator axis 1 No. setting register		At the manual pulse generator enable flag	
D715				
D716	Manual pulse generator axis 2 No. setting register			
D717				
D718	Manual pulse generator axis 3 No. setting register			
D719				
D720	Manual pulse generators 1-pulse input magnification setting register (Note-1),(Note-2): Axis 1			
D721	Axis 2			
D722	Axis 3			
D723	Axis 4			
D724	Axis 5			
D725	Axis 6			
D726	Axis 7			
D727	Axis 8			
D728	Axis 9			
D729	Axis 10			
D730	Axis 11			
D731	Axis 12			
D732	Axis 13			
D733	Axis 14			
D734	Axis 15			
D735	Axis 16			
D736	Axis 17			
D737	Axis 18			
D738	Axis 19			
D739	Axis 20			
D740	Axis 21			
D741	Axis 22			
D742	Axis 23			
D743	Axis 24			
D744	Axis 25			
D745	Axis 26			
D746	Axis 27			
D747	Axis 28			
D748	Axis 29			
D749	Axis 30			
D750	Axis 31			
D751	Axis 32			

Device No.	Signal name	Refresh cycle	Fetch cycle	Signal direction
D752	Manual pulse generator 1 smoothing magnification setting register		At the manual pulse generator enable flag	Command device
D753	Manual pulse generator 2 smoothing magnification setting register			
D754	Manual pulse generator 3 smoothing magnification setting register			
D755	Manual pulse generator 1 enable flag request		Main cycle	
D756	Manual pulse generator 2 enable flag request			
D757	Manual pulse generator 3 enable flag request			
D758	Unusable	—	—	—
D759	PCPU ready complete flag status	Main cycle		Monitor device
D760	Unusable (40 points)	—	—	—
D761				
D762				
D763				
D764				
D765				
D766				
D767				
D768				
D769				
D770				
D771				
D772				
D773				
D774				
D775				
D776				
D777				
D778				
D779				
D780				
D781				
D782				
D783				
D784				
D785				
D786				
D787				
D788				
D789				
D790				
D791				
D792				
D793				
D794				
D795				
D796				
D797				
D798				
D799				

(Note-1): The range of axis No.1 to 8 is valid in the Q172HCPU.

(Note-2): Device area of 9 axes or more is unusable in the Q172HCPU.

APPENDIX 2.3 Motion Registers (#)

Motion registers (#)

Axis No.	Device No.	Signal name
1	#8064 to #8067	
2	#8068 to #8071	
3	#8072 to #8075	
4	#8076 to #8079	
5	#8080 to #8083	
6	#8084 to #8087	
7	#8088 to #8091	
8	#8092 to #8095	
9	#8096 to #8099	
10	#8100 to #8103	
11	#8104 to #8107	
12	#8108 to #8111	
13	#8112 to #8115	
14	#8116 to #8119	
15	#8120 to #8123	
16	#8124 to #8127	
17	#8128 to #8131	
18	#8132 to #8135	
19	#8136 to #8139	
20	#8140 to #8143	
21	#8144 to #8147	
22	#8148 to #8151	
23	#8152 to #8155	
24	#8156 to #8159	
25	#8160 to #8163	
26	#8164 to #8167	
27	#8168 to #8171	
28	#8172 to #8175	
29	#8176 to #8179	
30	#8180 to #8183	
31	#8184 to #8187	
32	#8188 to #8191	

	Signal name (Note-1)	Signal description	Refresh cycle	Signal direction
+0	Servo amplifier type	0 : Unused 256 : MR-J3-B	When the servo amplifier power-on	Monitor device
+1	Motor current	$\times$0.1[%]	Operation cycle 1.7[ms] or less: Operation cycle Operation cycle 3.5[ms] or more: 3.5[ms]	
+2 +3	Motor speed	$\times$0.1[r/min]		

(Note-1) : The value that the lowest servo monitor device No. was added "+0, +1 ···" on each axis is shown.

APPENDIX 2.4 Special Relays

Special relays are internal relays whose applications are fixed in the Motion CPU. For this reason, they cannot be used in the same way as the normal internal relays by the Motion programs.
However, they can be turned ON/OFF as needed in order to control the Motion CPU.

The headings in the table that follows have the following meanings.

Item	Explanation
No.	• Indicates the device No. of the special relay.
Name	• Indicates the name of the special relay.
Meaning	• Indicates the nature of the special relay.
Details	• Indicates detailed information about the nature of the special relay.
Set by (When set)	• Indicates whether the relay is set by the system or user, and, if it is set by system, when setting is performed. <Set by> S : Set by system (Motion CPU) U : Set by user (Motion SFC program or test operation using a peripheral device) S/U : Set by both system (Motion CPU) and user <When set> Indicated only if setting is done by system (Motion CPU) . Main process : Set during each main processing (free time processing of the CPU) Initial process : Set only during initial processing (when power supply is turned ON, or when executed the reset) Status change : Set only when there is a change in status Error : Set when error is occurred. Request : Set only when there is a user request (Special relay, etc.) Operation cycle : Set during each operation cycle of the Motion CPU.

Special relay list

<table>
<tr><th>No.</th><th>Name</th><th>Meaning</th><th>Details</th><th>Set by
(When set)</th><th>Remark</th></tr>
<tr><td>M9000</td><td>Fuse blown detection</td><td>OFF : Normal
ON : Fuse blown module detected</td><td>• Turn on when there is one or more output modules control of self CPU which fuse has been blown.
Remains on if normal status is restored.</td><td rowspan="7">S (Occur an error)</td><td rowspan="19"></td></tr>
<tr><td rowspan="2">M9005</td><td rowspan="2">AC/DC DOWN detection</td><td rowspan="2">OFF : AC/DC DOWN not detected
ON : AC/DC DOWN detected</td><td>• Turn on if a momentary power interruption of less than 20ms occurred during use of the AC power supply module, and reset by turning power off to on.</td></tr>
<tr><td>• Turn on if a momentary power interruption of less than 10ms occurred during use of the DC power supply module, and reset by turning power off to on.</td></tr>
<tr><td>M9006</td><td>Battery low</td><td>OFF : Normal
ON : Battery low</td><td>• Turned on when the voltage of the external battery reduces to less than specified value. Turn off when the voltage of the external battery becomes normal.
• Synchronizes with "BAT. LED"
• Check the voltage of the external battery, only when it is set with "external battery use" by system setting.</td></tr>
<tr><td>M9007</td><td>Battery low latch</td><td>OFF : Normal
ON : Battery low</td><td>• Turn on when the voltage of the external battery reduces to less than specified value. Remains on if normal status is restored.
• Synchronizes with "BAT. LED"
• Check the voltage of the external battery, only when it is set with "external battery use" by system setting.</td></tr>
<tr><td>M9008</td><td>Self-diagnostic error</td><td>OFF : No error
ON : Error</td><td>• Turn on when error is found as a result of self-diagnosis.
Remains on if normal status is restored.</td></tr>
<tr><td>M9010</td><td>Diagnostic error</td><td>OFF : No error
ON : Error</td><td>• Turn on when error is found as a result of diagnosis.
Remains on if normal status is restored.</td></tr>
<tr><td>M9025</td><td>Clock data set request</td><td>OFF : Ignored
ON : Set request present used</td><td>• Write clock data stored in D9025 to D9028 to the clock element when M9025 has changed from off to on.</td><td>U</td></tr>
<tr><td>M9026</td><td>Clock data error</td><td>OFF : No error
ON : Error</td><td>• Turn on by clock data (D9025 to D9028) error.</td><td>S (Request)</td></tr>
<tr><td>M9028</td><td>Clock data read request</td><td>OFF : Ignored
ON : Read request</td><td>• Read clock data from D9025 to D9028 in BCD when M9028 is on.</td><td>U</td></tr>
<tr><td>M9036</td><td>Always ON</td><td>ON ———
OFF</td><td>• Turn on without regard to position of RUN/STOP switch on.</td><td rowspan="2">S (Main processing)</td></tr>
<tr><td>M9037</td><td>Always OFF</td><td>ON
OFF ———</td><td>• Turn off without regard to position of RUN/STOP switch on.</td></tr>
<tr><td>M9060</td><td>Error reset</td><td>OFF → ON : Error reset</td><td>• A release of the error is executed.</td><td>U</td></tr>
<tr><td>M9073</td><td>PCPU WDT error flag</td><td>ON : Abnormal
OFF : Normal</td><td>• Turn on when a "watchdog timer error" is detected by the Motion CPU self-diagnosis function.
When the Motion CPU detects a WDT error, it executes an immediate stop without deceleration of the operating axes.
• The error cause is stored in the "Motion CPU WDT error cause (D9184)".</td><td>S (Occur an error)</td></tr>
<tr><td>M9074</td><td>PCPU READY complete flag</td><td>ON : PCPU READY completion
OFF : PCPU READY uncompletion</td><td>• When the PLC ready flag (M2000) turn off to on, the fixed parameters, servo parameters and limit switch output data, etc., are checked, and if no error is detected this flag turns on.
• Turn off when the PLC ready (M2000) signal turns off.</td><td>S (Request)</td></tr>
<tr><td>M9075</td><td>Test mode ON flag</td><td>ON : TEST mode is in effect.
OFF : TEST mode is not in effect.</td><td>• This flag status indicates whether a TEST mode established from a peripheral device is currently in effect.
• If the TEST mode is not established in response to a TEST mode request from a peripheral device, the "TEST mode request error flag (M9078)" will turn on.</td><td>S (Request)</td></tr>
<tr><td>M9076</td><td>External forced stop input flag</td><td>ON : Forced stop OFF
OFF : Forced stop ON</td><td>• This flag status indicate whether the forced stop.</td><td>S (Operation cycle)</td></tr>
</table>

Special relay list (continued)

No.	Name	Meaning	Details	Set by (When set)	Remark
M9077	Manual pulse generator axis setting error flag	ON : At least one D714 to D719 setting is abnormal. OFF : All D714 to D719 settings are normal.	• This flag indicates whether the setting designated at the manual pulse generator axis setting register (D714 to D719) is normal or abnormal. • When this relay turns on, the error content is stored at the manual pulse generator axis setting error register (D9185 to D9187).	S(Occur an error)	
M9078	TEST mode request error flag	ON : Abnormal OFF : Normal	• Turn on if the TEST mode is not established in response to a TEST mode request from a peripheral device. • When this relay turns on, the error content is stored at the TEST mode request error register (D9182 to D9183).	S(Occur an error)	
M9079	Servo program setting error flag	ON : Abnormal OFF : Normal	• This flag status indicates whether the positioning data of the servo program(K) specified with the Motion SFC program is normal or abnormal, and if error is detected this flag turns on. • The content of a servo program setting error is stored at D9189 and D9190.	S(Occur an error)	
M9216	CPU No.1 MULTR complete flag	OFF to ON : CPU No.1 read completion	• Turn on when the data read from CPU No.1 is performed normally by MULTR instruction.	S(Read completion)	
M9217	CPU No.2 MULTR complete flag	OFF to ON : CPU No.2 read completion	• Turn on when the data read from CPU No.2 is performed normally by MULTR instruction.		
M9218	CPU No.3 MULTR complete flag	OFF to ON : CPU No.3 read completion	• Turn on when the data read from CPU No.3 is performed normally by MULTR instruction.		
M9219	CPU No.4 MULTR complete flag	OFF to ON : CPU No.4 read completion	• Turn on when the data read from CPU No.4 is performed normally by MULTR instruction.		
M9240	CPU No.1 reset flag	OFF : CPU No.1 reset release ON : CPU No.1 resetting	• Turn off at reset release of the CPU No.1. • Turn on during reset of the CPU No.1. (It also contains when a CPU is removed from the base unit.) • The other CPU is also resetting.	S(Change status)	
M9241	CPU No.2 reset flag	OFF : CPU No.2 reset release ON : CPU No.2 resetting	• Turn off at reset release of the CPU No.2. • Turn on during reset of the CPU No.2. (It also contains when a CPU is removed from the base unit.) • The error of the "MULTI CPU DOWN" (error code : 7000) occurs in the other CPU.		
M9242	CPU No.3 reset flag	OFF : CPU No.3 reset release ON : CPU No.3 resetting	• Turn off at reset release of the CPU No.3. • Turn on during reset of the CPU No.3. (It also contains when a CPU is removed from the base unit.) • The error of the "MULTI CPU DOWN" (error code : 7000) occurs in the other CPU.		
M9243	CPU No.4 reset flag	OFF : CPU No.4 reset release ON : CPU No.4 resetting	• Turn off at reset release of the CPU No.4. • Turn on during reset of the CPU No.4. (It also contains when a CPU is removed from the base unit.) • The error of the "MULTI CPU DOWN" (error code : 7000) occurs in the other CPU.		
M9244	CPU No.1 error flag	OFF : CPU No.1 normal ON : On CPU No.1 stop error	• Turn off when the CPU No.1 is normal. (It contains at continuation error.) • Turn on during stop error of the CPU No.1. (Note-1)		
M9245	CPU No.2 error flag	OFF : CPU No.2 normal ON : On CPU No.2 stop error	• Turn off when the CPU No.2 is normal. (It contains at continuation error.) • Turn on during stop error of the CPU No.2. (Note-1)		
M9246	CPU No.3 error flag	OFF : CPU No.3 normal ON : On CPU No.3 stop error	• Turn off when the CPU No.3 is normal. (It contains at continuation error.) • Turn on during stop error of the CPU No.3. (Note-1)		
M9247	CPU No.4 error flag	OFF : CPU No.4 normal ON : On CPU No.4 stop error	• Turn off when the CPU No.4 is normal. (It contains at continuation error.) • Turn on during stop error of the CPU No.4. (Note-1)		

(Note-1): The CPU No.1 is reset after the factor of the stop error is removed to cancel a stop error. → Resetting is cancelled.

APPENDIX 2.5 Special Registers

Special registers are internal registers whose applications are fixed in the Motion CPU. For this reason, it is not possible to use these registers in Motion SFC programs in the same way that normal registers are used.
However, data can be written as needed in order to control the Motion CPU.
Data stored in the special registers are stored as BIN values if no special designation has been made to the contrary.

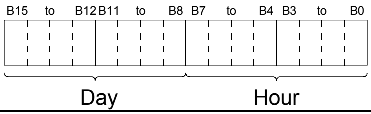
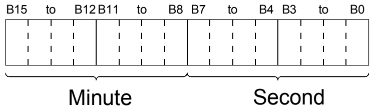
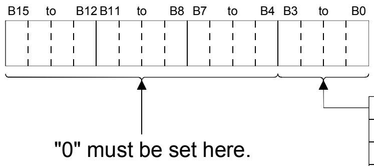
The headings in the table that follows have the following meanings.

Item	Explanation
Number	• Indicates the No. of the special register.
Name	• Indicates the name of the special register.
Meaning	• Indicates the nature of the special register.
Details	• Indicates detailed information about the nature of the special register.
Set by (When set)	• Indicates whether the register is set by the system or user, and, if it is set by system, when setting is performed. <Set by> S : Set by system (Motion CPU) U : Set by user (Motion SFC program or test operation using a peripheral device) S/U : Set by both system (Motion CPU) and user <When set> Indicated only if setting is done by system (Motion CPU) . Main process : Set during each main processing (free time processing of the CPU) Initial process : Set only during initial processing (when power supply is turned ON, or when executed the reset) Status change : Set only when there is a change in status Error : Set when error is occurred. Request : Set only when there is a user request (Special relay, etc.) Operation cycle : Set during each operation cycle of the Motion CPU.

Special register list

No.	Name	Meaning	Details	Set by (When set)	Remark
D9000	Fuse blown No.	Module No. with blown fuse	• When fuse blown modules are detected, the lowest I/O module No. is stored in D9000.	S (Occur an error)	
D9005	AC/DC DOWN counter No.	Number of times for AC/DC DOWN	• 1 is added to the stored value each time the input voltage becomes 85[%](AC power supply/65[%] DC power supply) or less of the rating while the CPU module is performing an operation, and the value is stored in BIN code.		
D9008	Diagnostic error	Diagnostic error number	• When error is found as a result of self-diagnosis, error No. is stored in BIN code. • Refer to the "Q173HCPU/Q172HCPU Motion Controller Programming Manual (COMMON)" 2.4 Multiple CPU Error Codes" " for details of the error code.		
D9010	Diagnostic error occurrence time	Diagnostic error occurrence time	• The age (A.D, the rightmost two digits) when data on D9008 are updated, and the month stored with a BCD code two digits. B15 to B8 B7 to B0 Year(0 to 99) | Month(1 to 12) Example : October 1995 H9510		
D9011			• The day when data on D9008 are updated, and the hour stored with a BCD code two digits. B15 to B8 B7 to B0 Day(1 to 31) | Hour(0 to 23) Example : 25st, 10 a.m H2510		
D9012			• The minute when data on D9008 are updated, and the second stored with a BCD code two digits. B15 to B8 B7 to B0 Minute(0 to 59) | Second(0 to 59) Example : 35 min., 48 sec. H3548		
D9013	Error information classification	Error information classification code	• The classification code to judge the error information stored in the error information (D9014) is stored. • The following code is stored. 0 : None 1 : Module No./CPU No./Base No. 2 : Parameter No.		
D9014	Error information	Error information	• Error information to comply with the diagnostic error (D9008) is stored. There are following two types informations to be stored. 1) Module No./CPU No./Base No. • Module No. or CPU No. is stored according to the error which occurred in the case of the Multiple CPU system. (Refer to each error code which is stored.) CPU No.1 : 1, CPU No.2 : 2, CPU No.3 : 3, CPU No.4 : 4 2) Parameter No.		
D9015	Operating state of CPU	Operating state of CPU	• The operation states of CPU as shown below are stored in D9015. B15 B12 B11 B8 B7 B4 B3 B0 2) (B7–B4) 1) (B3–B0) 1) Operating state of CPU: 0 : RUN, 2 : STOP 2) STOP cause: 0 : RUN/STOP switch, 4 : Error Note : Priority is earliest first	S (Main processing)	
D9017	Scan time	Scan time (1ms units)	• Main cycle is stored in the unit 1ms. • Setting range (0 to 65535[ms])		
D9019	Maximum scan time	Maximum scan time (1ms units)	• The maximum value of the main cycle is stored in the unit 1ms. • Setting range (0 to 65535[ms])		
D9025	Clock data	Clock data (Year, month)	• Stores the year (2 lower digits) and month in BCD. B15 to B12 B11 to B8 B7 to B4 B3 to B0 Year (B15–B8) Month (B7–B0) Example : July 1993 H9307	S/U (Request)	

Special register list (continued)

No.	Name	Meaning	Details	Set by (When set)	Remark
D9026	Clock data	Clock data (Day, hour)	• Stores the day and hour in BCD.  Example : 31st, 10 a.m. H3110	S/U(Request)	
D9027	Clock data	Clock data (Minute, second)	• Stores the minute and second in BCD.  Example : 35 min., 48 sec. H3548	S/U(Request)	
D9028	Clock data	Clock data (Day of week)	• Stores the day of the week in BCD.  Example : Friday H0005 Day of week 0 Sunday 1 Monday 2 Tuesday 3 Wednesday 4 Thursday 5 Friday 6 Saturday	S/U(Request)	
D9060	Error reset	Error No. of releasing an error	• Error No. of canceling error is stored.	U	
D9061	Multiple CPU No.	Multiple CPU No.	• CPU No. of the self CPU is stored.	S(Initial processing)	
D9112	Connect/ disconnect	Connect/ disconnect of SSCNET	• When the servo amplifier or SSCNETⅢ cable of SSCNET system are exchanged or re-connected, an user side requires connect/disconnect, and a system side stores the states of command accept waiting or execute waiting for connect/disconnect.	–	
			0 : Connect/disconnect command accept waiting -1 : Connect/disconnect execute waiting	S (Main processing)	
			1 to 32 : Disconnect command -10 : Re-connect command -2 : Connect/disconnect execute command	U	
D9182 D9183	Test mode request error	It is operating in requirement error occurrence of the test mode, axis information	• Each axis is stopping: 0/Operating: 1, information is stored as a bit data. D9182: b0 to b15 (Axis 1 to Axis 16) D9183: b0 to b15 (Axis 17 to Axis 32)	S(Occur an error)	
D9184	Motion CPU WDT error cause	Error meaning of WDT error occurs	The following error codes are stored in D9184. 1: S/W fault 1 2: Operation cycle over 3: Q bus WDT error 4: WDT error 30: Information processor H/W error 201 to 215: Q bus H/W fault 250 to 253: Servo amplifier interface H/W fault 300: S/W fault3 301: 15 CPSTART instructions of 8 or more points were started simultaneously.	S(Occur an error)	
D9185 D9186 D9187	Manual pulse generator axis setting error	Manual pulse generator axis setting error information	• Contents of the manual pulse generator axis setting error is stored when the manual pulse generator axis setting error flag (M9077) turn on. (Normal: 0/Setting error: 1) D9185: The manual pulse generator axis setting error is stored in b0 to b2 (P1 to P3). The smoothing magnification setting is stored in b3 to b5 (P1 to P3). D9186: One pulse input magnification setting error is stored in b0 to b15 (axis 1 to axis 16). D9187: One pulse input magnification setting error is stored in b0 to b15 (axis 17 to axis 32).	S(Occur an error)	

Special register list (continued)

No.	Name	Meaning	Details	Set by (When set)	Remark
D9188	Motion operation cycle	Motion operation cycle	• The time when the motion operation cycle is stored in the [μs] unit.	S (Operation cycle)	
D9189	Error program No.	Error program No. of servo program	When the servo program setting error flag (M9079) turns on, the erroneous servo program No. will be stored.	S (Occur an error)	
D9190	Error item information	Error code of servo program	When the servo program setting error flag (M9079) turns on, the error code corresponding to the erroneous setting item will be stored.		
D9191 D9192	Servo amplifier loading information	Servo amplifier loading information	• The loading status (loading : 1/non-loading : 0) of the servo amplifier checked in initial process, and stored as the bit data. D9191 : b0 to b15 (axis 1 to axis 16) D9192 : b0 to b15 (axis 17 to axis 32) • The axis which turned from non-loading to loading status after power-on is handled as loaded. (However, the axis which turned from loading to non-loading status remains as loaded.)	S (Initial processing)	
D9193 D9194 D9195	Real/virtual mode switching error	Real/virtual mode Switching error code	• When a mode switching error occurs in real-to-virtual or virtual-to-real mode switching, or a mode continuation error occurs in the virtual mode, its error information is stored.	S (Occur an error)	
D9196	PC link communication error codes	PC link communication error codes	• The following error code is stored. 00 : No error 01 : Receiving timing error 02 : CRC error 03 : Communication response code error 04 : Received frame error 05 : Communication task start error (Each error code is reset to "00" when normal communication is restarted.)		
D9197	Operation cycle of the Motion CPU setting	Operation cycle of the Motion CPU setting	• The time when the setting operation cycle is stroed in the [μs] unit.	S (Initial processing)	
D9200	State of switch	State of CPU switch	• The CPU switch status is stored in the following format. B15 B12 B11 B8 B7 B4 B3 B0 3) No used. 2) 1) 1) CPU switch status: 0 : RUN, 1 : STOP, 2 : L.CLR 2) Memory card switch: Always OFF 3) Dip switch: B8 through B12 correspond to SW1 through SW5 of system setting switch 1. 0 : OFF/1 : ON B13 through B15 is not used.	S (Main processing)	
D9201	State of LED	State of CPU-LED	• Information concerning which of the following states the LEDs on the CPU are in is stored in the following bit patterns. • 0 is off, 1 is on, and 2 is flicker B15 B12 B11 B8 B7 B4 B3 B0 8) 7) 6) 5) 4) 3) 2) 1) 1) : RUN 5) : BOOT 2) : ERROR 6) : No used 3) : M.RUN 7) : No used 4) : BAT.ALARM 8) : MODE Bit patterns for MODE 0 : OFF 1 : Green 2 : Orange	S (Change status)	

(Note) : It adds newly at the Motion controller Q series.

APPENDIX 3 Processing Times of the Motion CPU

The processing time of each signal and each instruction for positioning control in the Multiple CPU system is shown below.

(1) CPU processing time [ms]

		Q173HCPU				Q172HCPU	
Operation cycle		0.88	1.77	3.55	7.11	0.88	1.77
Axis designation program start processing time	WAIT ON/OFF	1.9 to 2.6	3.2 to 4.3	4.7 to 6.6	13.3 to 18.6	1.9 to 2.6	3.2 to 4.3
	SVST instruction from PLC CPU	6.7 to 8.4	6.6 to 9.3	7.9 to 12.0	17.9 to 20.1	6.7 to 8.4	6.6 to 9.3
Speed change response (Note-1) (CHGV instruction from PLC CPU)		2.2 to 2.8	3.0 to 4.4	5.5 to 8.2	13.0 to 17.7	2.2 to 2.8	3.0 to 4.4
Time from PLC ready flag (M2000) ON to PCPU ready flag (M9074) ON		39 to 433					

(Note-1): This processing time varies depending on the PLC scan time. Use this time merely for reference.

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

Note that an installation period of less than one year after installation in your company or your customer’s premises or a period of less than 18 months (counted from the date of production) after shipment from our company, whichever is shorter, is selected.

[Gratis Warranty Range]

(1) Diagnosis of failure

As a general rule, diagnosis of failure is done on site by the customer.
However, Mitsubishi or Mitsubishi service network can perform this service for an agreed upon fee upon the customer’s request.
There will be no charges if the cause of the breakdown is found to be the fault of Mitsubishi.

(2) Breakdown repairs

There will be a charge for breakdown repairs, exchange replacements and on site visits for the following four conditions, otherwise there will be a charge.

1) Breakdowns due to improper storage, handling, careless accident, software or hardware design by the customer
2) Breakdowns due to modifications of the product without the consent of the manufacturer
3) Breakdowns resulting from using the product outside the specified specifications of the product
4) Breakdowns that are outside the terms of warranty

Since the above services are limited to Japan, diagnosis of failures, etc. are not performed abroad.
If you desire the after service abroad, please register with Mitsubishi. For details, consult us in advance.

2. Exclusion of Loss in Opportunity and Secondary Loss from Warranty Liability

Mitsubishi will not be held liable for damage caused by factors found not to be the cause of Mitsubishi; opportunity loss or lost profits caused by faults in the Mitsubishi products; damage, secondary damage, accident compensation caused by special factors unpredictable by Mitsubishi; damages to products other than Mitsubishi products; and to other duties.

3. Onerous Repair Term after Discontinuation of Production

Mitsubishi shall accept onerous product repairs for seven years after production of the product is discontinued.

4. Delivery Term

In regard to the standard product, Mitsubishi shall deliver the standard product without application settings or adjustments to the customer and Mitsubishi is not liable for on site adjustment or test run of the product.

5. Precautions for Choosing the Products

(1) These products have been manufactured as a general-purpose part for general industries, and have not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
(2) Before using the products for special purposes such as nuclear power, electric power, aerospace, medicine, passenger movement vehicles or under water relays, contact Mitsubishi.
(3) These products have been manufactured under strict quality control. However, when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions in the system.
(4) When exporting any of the products or related technologies described in this catalogue, you must obtain an export license if it is subject to Japanese Export Control Law.

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