MITSUBISHI

# MOTION CONTROLLER (SV51)

## *Programming Manual*

## type A171SCPU, A273UHCPU

MITSUBISHI ELECTRIC

## REVISIONS

* The manual number is noted at the lower left of the back cover.

| Print Date | *Manual Number | Revision |
|---|---|---|
| Sep. 1997 | IB(NA)-67369-A | First edition |

# INTRODUCTION

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

## Precautions for Safety

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

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

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

# For Safe Operations

## 1. Prevention of electric shocks

**⚠ WARNING**

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

## 2. For fire prevention

**⚠ CAUTION**

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

## 3. For injury prevention

**⚠ CAUTION**

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

## 4. Various precautions

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

### (1) System structure

**⚠ CAUTION**

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

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

## (2) Parameter settings and programming

| ⚠ CAUTION |
|---|
| ⚠ Set the parameter values to those that are compatible with the control unit, servo amplifier, servomotor and regenerative resistor model and the system application. The protective functions may not function if the settings are incorrect.<br>⚠ The regenerative resistor model and capacity parameters must be set to values that conform to the operation mode, servo amplifier and servo power unit. The protective functions may not function if the settings are incorrect.<br>⚠ 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.<br>⚠ 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.<br>⚠ 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.<br>⚠ 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.<br>⚠ 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.<br>⚠ Use the program commands for the program with the conditions specified in the instruction manual.<br>⚠ 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.<br>⚠ Some devices used in the program have fixed applications, so use these with the conditions specified in the instruction manual.<br>⚠ 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.<br>⚠ Use the interlock program specified in the special function unit's instruction manual for the program corresponding to the special function unit. |

## (3) Transportation and installation

**⚠ CAUTION**

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

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

**⚠ CAUTION**

⚠ When coupling with the synchronization encoder or servomotor shaft end, do not apply impact such as by hitting with a hammer. Doing so may lead to detector damage.

⚠ Do not apply a load larger than the tolerable load onto the servomotor shaft. Doing so may lead to shaft breakage.

⚠ When not using the unit for a long time, disconnect the power line from the control unit or servo amplifier.

⚠ Place the control unit and servo amplifier in static electricity preventing vinyl bags and store.

⚠ When storing for a long time, contact the Service Center or Service Station.

## (4) Wiring

**⚠ CAUTION**

⚠ Correctly and securely wire the wires. Reconfirm the connections for mistakes and the terminal screws for tightness after wiring. Failing to do so may lead to run away of the servomotor.

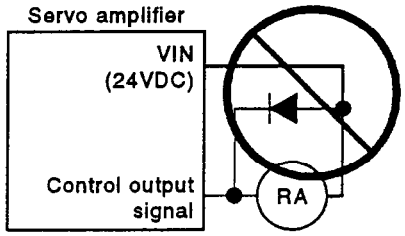
⚠ After wiring, install the protective covers such as the terminal covers to the original positions.

⚠ Do not install a phase advancing capacitor, surge absorber or radio noise filter (option FR-BIF) on the output side of the servo amplifier.

⚠ Correctly connect the output side (terminals U, V, W). Incorrect connections will lead the servomotor to operate abnormally.

⚠ Do not connect a commercial power supply to the servomotor, as this may lead to trouble.

⚠ Do not mistake the direction of the surge absorbing diode installed on the DC relay for the control signal output of brake signals, etc. Incorrect installation may lead to signals not being output when trouble occurs or the protective functions not functioning.




⚠ Do not connect or disconnect the connection cables between each unit, the encoder cable or sequence expansion cable while the power is ON.

⚠ Securely tighten the cable connector fixing screws and fixing mechanisms. Insufficient fixing may lead to the cables combing off during operation.

⚠ Do not bundle the power line or cables.

## (5) Trial operation and adjustment

**⚠ CAUTION**

⚠ Confirm and adjust the program and each parameter before operation. Unpredictable movements may occur depending on the machine.

⚠ Extreme adjustments and changes may lead to unstable operation, so never make them.

⚠ When using the absolute position system function, on starting up, and when the controller or absolute value motor has been replaced, always perform a home position return.

## (6) Usage methods

**⚠ CAUTION**

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

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

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

⚠ Do not make any modifications to the unit.

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

⚠ Use the units with the following conditions.

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

## (7) Remedies for errors

**⚠ CAUTION**

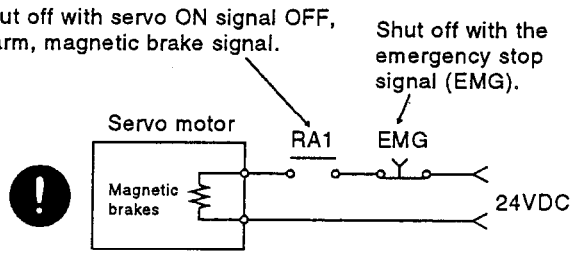
⚠ If an error occurs in the self diagnosis of the control unit or servo amplifier, confirm the check details according to the instruction manual, and restore the operation.

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

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

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

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




## (8) Maintenance, inspection and part replacement

**⚠ CAUTION**

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

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

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

⚠ Periodically replace consumable parts such as batteries according to the instruction manual.

**⚠ CAUTION**

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

## (9) Disposal

**⚠ CAUTION**

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

## (10) General cautions

**⚠ CAUTION**

⚠ All drawings provided in the instruction manual show the state with the covers and safety partitions removed to explain detailed sections. When operating the product, always return the covers and partitions to the designated positions, and operate according to the instruction manual.
⚠ Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment.
All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples.
Owing to the very great variety in possible applications of this equipment, you must satisfy yourself as to its suitability for your specific application.

# TABLE OF CONTENTS

# 1. OVERVIEW

This manual describes the parameters, dedicated devices used for positioning as well as positioning methods that are necessary for performing positioning control with the motion controller (SV51).
The following positioning control functions are available with the motion controller (SV51).

| Applicable CPU | Positioning Control Axes | Machine Control Axes | Number of Machines |
|---|---|---|---|
| A171SCPU | 4 axes | 4 axes | 2 |
| A273UHCPU (8 axes specification) | 8 axes | | |

In this manual, the above CPU's are collectively referred to as servo system CPU.
The following software packages are used for system setup, servo parameter and servo program setting, testing and monitoring.

- SW2SRX-GSV51P software package
- SW2NX-GSV51P software package

} An abbreviated designation, GSV51P, is used for referring to these packages.

**⚠CAUTION**

⚠ When designing the system, always construct any protection or safety circuit for preventing motion controller-related problems externally.

⚠ Always ground printed wiring boards using the human body or a work bench when handling them directly, as the board contains electronic components that are susceptible to static electricity.
Do not touch the electronically charged parts or electronic components of the product.

⚠ Set parameters within the ranges specified in this manual.

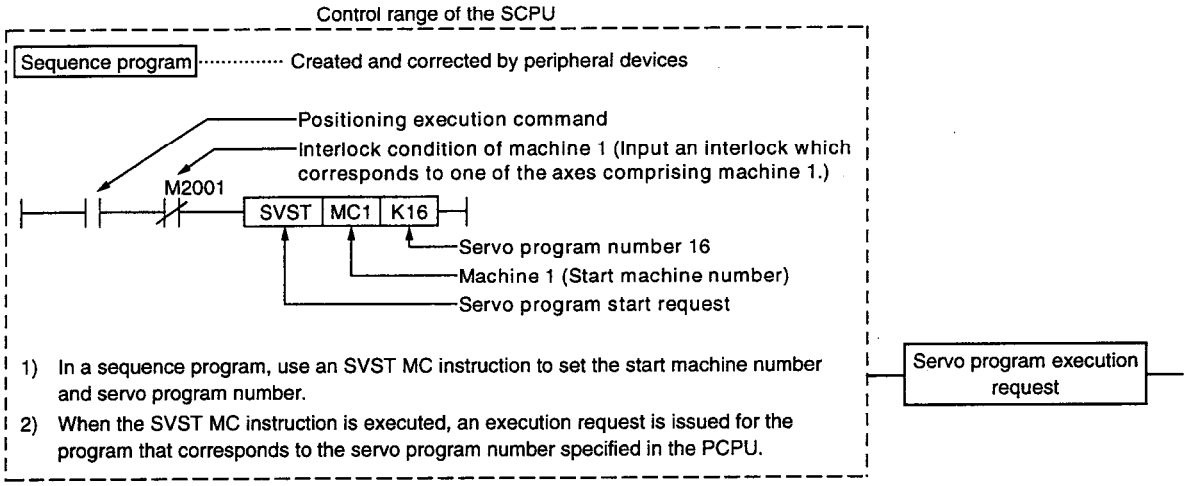
⚠ Use program instructions in the program under the conditions specified in this manual.

⚠ Use devices in the program under the conditions specified in this manual, as some devices are designed only for certain applications.

- This manual describes the functions that are only available with the motion controller (SV51). For the functions of the motion controller (SV13), refer to the programming manual of the SV13.

**[Performing machine control by using the servo system CPU]**

**Servo system CPU system**




(1) Create servo programs and positioning control parameters by peripheral devices.

(2) Use a sequence program (SVST MC instruction) for positioning and starting.

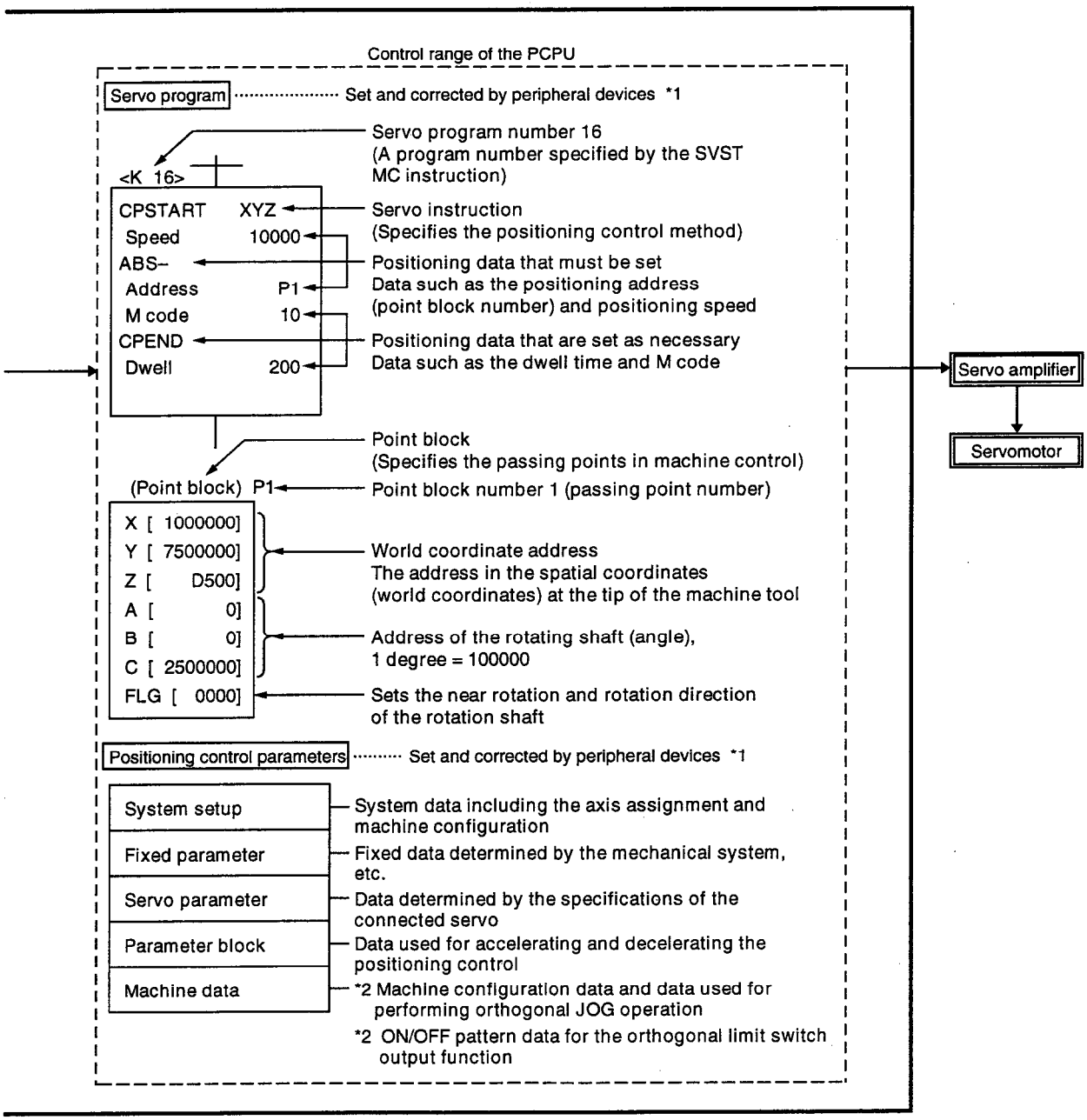
  (a) Specify the start machine number and servo program number using the SVST MC instruction.

    1) The servo program number can be set directly or indirectly (by using D or W registers).

    2) The start machine number can only be set directly.

  (b) Take an interlock by using start acknowledge flags (M2001 to M2004/M2001 to M2008).

(3) Perform the specified machine control by using the specified servo program.




**REMARK**

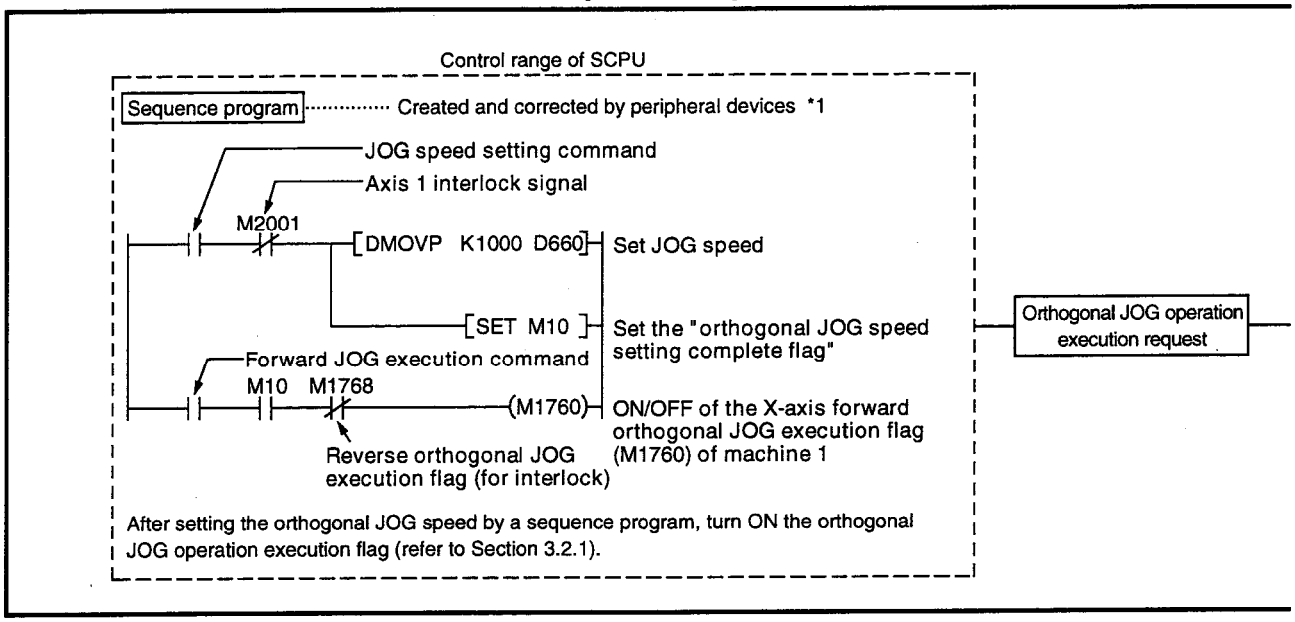
*1 : The following peripheral devices can be used when started up with the GS□ P.
- IBM PC
- PC98
- A271DVP

*2 : The JOG operation of a machine that generates in a three-dimensional coordinate system represented by X, Y and Z axes, is called orthogonal JOG operation. The function that performs limit switch output at each of X, Y and Z coordinate address is called orthogonal limit switch output function.

**[Performing orthogonal JOG operation by using the servo system CPU]**

The orthogonal JOG operation of a specified axis of the machine can be performed by a sequence program with the servo system CPU.
The following is an overview of the orthogonal JOG operation.

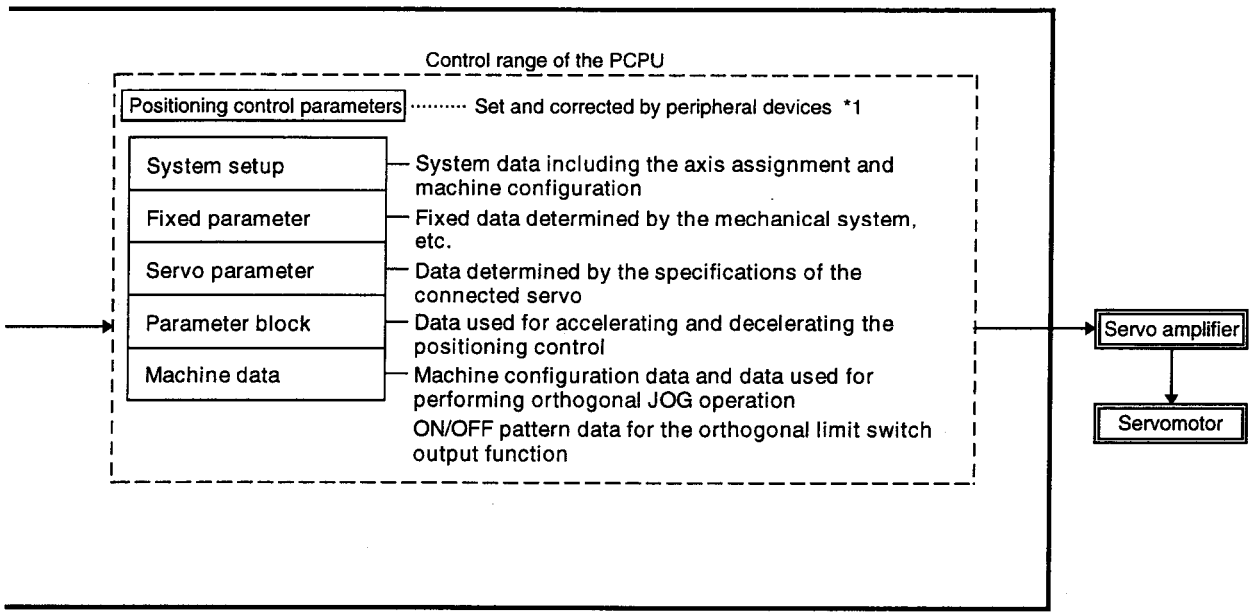
**Servo system CPU system**




(1) Set positioning control parameters using peripheral devices.

(2) By a sequence program, set the orthogonal JOG speed to the orthogonal JOG operation speed setting register of each machine.

(3) Perform orthogonal JOG operation of the corresponding machine axis while the orthogonal JOG operation execution flag is turned ON by the sequence program.
For the relationship between the machine number and the orthogonal JOG execution flags (forward/reverse), refer to Section 3.2.1.




**REMARK**

*1 : The following peripheral devices can be used when started up with the GSV5□P.
- IBM PC
- PC98

# 2. PERFORMANCE SPECIFICATIONS

The performance specifications of the PCPU are shown in Table 2.1.

**Table 2.1 PCPU Performance Specification List**

<table>
<tr><th colspan="2">Item</th><th colspan="4">PCPU Performance and Specifications</th></tr>
<tr><td rowspan="2">Control axes</td><td>A171SCPU</td><td colspan="4">4 axes (2 to 4 axes simultaneous, 4 axes independent)</td></tr>
<tr><td>A273UHCPU<br>(8 axes specification)</td><td colspan="4">8 axes (2 to 4 axes simultaneous, 8 axes independent)</td></tr>
<tr><td colspan="2">Control machines</td><td colspan="4">Maximum 2 units</td></tr>
<tr><td colspan="2">Interpolation function</td><td colspan="4">Linear interpolation (maximum 4 axes), circular interpolation (2 axes), three-dimensional circular interpolation (3 axes)</td></tr>
<tr><td colspan="2">Control system</td><td colspan="4">PTP (Point To Point), speed control, speed switching control, fixed-dimension feed, uniform speed control, position follow-up control, three-dimensional interpolation CP control</td></tr>
<tr><td colspan="2">Control unit</td><td colspan="4">mm, inch, degree, PULSE</td></tr>
<tr><td rowspan="3">Program</td><td>Language</td><td colspan="4">Dedicated instructions (sequence ladder + servo program). Servo programs can be SFC programmed.</td></tr>
<tr><td>Capacity</td><td colspan="4">5120 steps (A171SCPU/A273UHCPU)</td></tr>
<tr><td>Positioning points</td><td colspan="4">Maximum 1024 points<br>Positioning data can be specified indirectly.</td></tr>
<tr><td></td><td>Setting method</td><td colspan="4">Set by an IBM PC or PC98 started up with the GSV5□P.</td></tr>
<tr><td rowspan="8">Positioning</td><td>System</td><td colspan="4">PTP: Select either the absolute system or increment system<br>Speed, position control, fixed-dimension feed: Increment system<br>Uniform speed control: The absolute system and increment system can be used simultaneously.<br>Position follow-up control: Absolute system<br>Three-dimensional interpolation PC control: The absolute system and increment system can be used simultaneously.</td></tr>
<tr><td rowspan="6">Position command</td><td colspan="4">A command unit can be selected for each axis from the following four types.</td></tr>
<tr><td>Control unit</td><td>Command unit</td><td>Address setting range</td><td>Travel setting range</td></tr>
<tr><td>mm</td><td>× $10^{-1}$ μ m</td><td rowspan="2">–2147483648 to 2147483647</td><td rowspan="3">0 to ± 2147483647</td></tr>
<tr><td>inch</td><td>× $10^{-5}$ inches</td></tr>
<tr><td>degree</td><td>× $10^{-5}$ degrees</td><td>0 to 35999999</td></tr>
<tr><td>PULSE</td><td>PULSE</td><td>–2147483648 to 2147483647</td></tr>
<tr><td>Speed command<br>(command unit)</td><td colspan="4">0.01 to 6000000.00 (mm/min.)<br>0.001 to 600000.000 (inches/min.)<br>0.001 to 600000.000 (degrees/min.)<br>1 to 1000000 (PLS/s)</td></tr>
<tr><td rowspan="2">Acceleration/<br>deceleration<br>processing</td><td>Automatic trapezoidal<br>acceleration/deceleration</td><td colspan="4">Acceleration time ····· 1 to 65535 (ms)<br>Deceleration time ····· 1 to 65535 (ms)</td></tr>
<tr><td>S-shape<br>acceleration/deceleration</td><td colspan="4">S-shape ratio setting 0 to 100 (%)</td></tr>
<tr><td rowspan="2">Compensation</td><td>Backlash compensation</td><td colspan="4">(0 to 65535) × Position command unit (Convert the unit to PULSE. 0 to 65535 PULSE)</td></tr>
<tr><td>Electronic gear</td><td colspan="4">Error compensation function for the actual travel relative to the command value.</td></tr>
<tr><td colspan="2">Zero return function</td><td colspan="4">Non-absolute position system: Selectable from the near point dog system and count system.<br>Absolute position system: Selectable from the data set system, near point dog system and count system.</td></tr>
<tr><td colspan="2">Jog operation/orthogonal JOG operation function</td><td colspan="4">Available</td></tr>
<tr><td rowspan="2">Manual pulse<br>generator<br>operation<br>function</td><td>A171SCPU</td><td colspan="4">Up to one manual pulse generator can be connected.<br>Set the axis number to be controlled by a sequence program.<br>The smoothing scale can be set.</td></tr>
<tr><td>A273UHCPU (8 axes<br>specification)</td><td colspan="4">Up to three manual pulse generators can be connected.<br>Set the axis number to be controlled by a sequence program.<br>The smoothing scale can be set.</td></tr>
<tr><td colspan="2">M function</td><td colspan="4">The M code output function available.</td></tr>
<tr><td colspan="2">Limit switch output function</td><td colspan="4">8 points per axis. Up to 10 ON/OFF setting points can be set.</td></tr>
<tr><td colspan="2">Orthogonal limit switch output function</td><td colspan="4">8 points per coordinate. Up to 10 ON/OFF setting points can be set.</td></tr>
<tr><td colspan="2">Absolute position system</td><td colspan="4">Used with a motor with an absolute position detector (Either the absolute system or increment system can be specified for each axis.)</td></tr>
</table>

# 3. POSITIONING SIGNALS

## 3.1 Internal Relays (M)

There are 2048 internal relays/latch relays in the A171SCPU (M/L0 to M/L2047), while there are 8192 in the A273UHCPU (8 axes specification, M/L0 to M/L8191).
Of these, the relays at the points M1560 to M1599, M1760 to M1799 and M1960 to M2047 are used for positioning control, and their application is pre-determined as shown in Table 3.1.

**Table 3.1 Internal Relay List**

<A171SCPU/A273UHCPU (8 axes specification)>

| Device Number | Signal Name | | | Signal Direction |
|---|---|---|---|---|
| M1560 to M1599 | Unusable by the user | | | PCPU → SCPU |
| M1760 | Machine 1 Orthogonal JOG start command flag | X | Forward | SCPU → PCPU |
| M1761 | | Y | | |
| M1762 | | Z | | |
| M1763 | | A | | |
| M1764 | | B | | |
| M1765 | | C | | |
| M1766 | Unusable by the user | | | — |
| M1767 | | | | |
| M1768 | Machine 1 Orthogonal JOG start command flag | X | Reverse | SCPU → PCPU |
| M1769 | | Y | | |
| M1770 | | Z | | |
| M1771 | | A | | |
| M1772 | | B | | |
| M1773 | | C | | |
| M1774 | Unusable by the user | | | — |
| M1775 | | | | |
| M1776 | Machine 1 single step valid flag | | | SCPU → PCPU |
| M1777 | Machine 1 single step restart flag | | | |
| M1778 | Orthogonal stroke limit invalid | | | |
| M1779 to M1799 | Unusable by the user | | | — |
| M1960 | Machine 2 Orthogonal JOG start command flag | X | Forward | SCPU → PCPU |
| M1961 | | Y | | |
| M1962 | | Z | | |
| M1963 | | A | | |
| M1964 | | B | | |
| M1965 | | C | | |
| M1966 | Unusable by the user | | | — |
| M1967 | | | | |
| M1968 | Machine 2 Orthogonal JOG start command flag | X | Reverse | SCPU → PCPU |
| M1969 | | Y | | |
| M1970 | | Z | | |
| M1971 | | A | | |
| M1972 | | B | | |
| M1973 | | C | | |

**Table 3.1 Internal Relay List (Continued)**

<A171SCPU/A273UHCPU (8 axes specification)>

| Device Number | Signal Name | Signal Direction |
|---|---|---|
| M1974 | Unusable by the user | — |
| M1975 | | |
| M1976 | Machine 2 single step valid flag | SCPU → PCPU |
| M1977 | Machine 2 single step restart flag | |
| M1978 | Orthogonal stroke limit invalid | |
| M1979 to M1999 | Unusable by the user | — |

**Table 3.1 Internal Relay List (Continued)**

<A171SCPU/A273UHCPU (8 axes specification)>

| Device Number | Signal Name | Signal Direction |
|---|---|---|
| M2000 | PC ready | SCPU → PCPU |
| M2001 (1 axis) to M2008 (8 axes) | Start acknowledge flag | PCPU → SCPU |
| M2009 | All axes servo ON acknowledge flag | PCPU → SCPU |
| M2010 to M2011 | Unusable by the user | — |
| M2012 to M2014 | Manual pulse generator enable flag | SCPU → PCPU |
| M2015 | JOG simultaneous start command | SCPU → PCPU |
| M2016 | Speed switching point specification flag | |
| M2017 to M2019 | Unusable by the user | — |
| M2020 | Start buffer full | PCPU → SCPU |
| M2021(1 axis) to M2028 (8 axes) | Speed changing flag | PCPU → SCPU |
| M2029 to M2040 | Unusable by the user | — |
| M2041 | System setup error flag | PCPU → SCPU |
| M2042 | All axes servo start command | SCPU → PCPU |
| M2043 to M2046 | Unusable by the user | — |
| M2047 | Option slot unit error | PCPU → SCPU |

**POINTS**

(1) The internal relays for positioning control will not be latched even within the latch range.
The internal relays for positioning control are represented as Mxxxx in this manual to indicate that they are not latched.

(2) The following rule applies when the internal relays for positioning control are monitored by a peripheral device:
In a peripheral device started with the GSV5□P, the relays are displayed as Mxxxx regardless of the latch range setting.

### 3.1.1 Orthogonal JOG start command flags (M1760 to M1765, M1768 to M1773, M1960 to M1965, M1968 to M1973)

..... Signals from SCPU to PCPU

These flags are used for the orthogonal JOG operation of each axis that comprises the machine.
The orthogonal JOG operation of the corresponding machine is performed by a sequence program while the orthogonal JOG start command flag is ON.
However, more than one axis cannot be started simultaneously.
When the orthogonal JOG start command flag is turned OFF, the machine decelerates and stops within the deceleration time set by the parameter block.

**Table 3.2 Orthogonal JOG Start Command Flag Areas**

<A171SCPU/A273UHCPU (8 axes specification)>

| Name | | Machine Number *1 | |
|---|---|---|---|
| | | 1 | 2 |
| X | Forward | M1760 | M1960 |
| | Reverse | M1768 | M1968 |
| Y | Forward | M1761 | M1961 |
| | Reverse | M1769 | M1969 |
| Z | Forward | M1762 | M1962 |
| | Reverse | M1770 | M1970 |
| A | Forward | M1763 | M1963 |
| | Reverse | M1771 | M1971 |
| B | Forward | M1764 | M1964 |
| | Reverse | M1772 | M1972 |
| C | Forward | M1765 | M1965 |
| | Reverse | M1773 | M1973 |

(1) Orthogonal JOG operation is performed in the address increase direction by a sequence program while the forward orthogonal JOG start command flag is ON.
(2) Orthogonal JOG operation is performed in the address decrease direction by a sequence program while the reverse orthogonal JOG start command flag is ON.

**REMARK**

*1 : The machine numbers shown in Table 3.2 are assigned in the system setup mode of a peripheral device.

**POINT**

Take an interlock by a sequence program in order to prevent the forward and reverse orthogonal JOG start command flags from being turned ON simultaneously.

### 3.1.2 Single step valid/restart flags (M1776, M1777, M1976, M1977)

····· Signals from SCPU to PCPU

These flags are used during three-dimensional interpolation CP control for stopping or restarting the operation.

(1) Single step valid flag (M1776, M1976)
When the single step valid flag is turned ON, the operation decelerates and stops at the end of the point at which the flag was turned ON.

(2) Single step restart flag (M1777, M1977)
When the single step valid flag is turned ON, the operation that has been stopped is restarted by turning ON the single step restart flag.

(3) For the details of single step valid/restart flags, refer to Section 8.4.

**Table 3.3 Single Step Valid/Restart Flag Areas**

<A171SCPU/A273UHCPU (8 axes specification)>

| Name | Machine Number *1 | |
|---|---|---|
| | 1 | 2 |
| Single step valid | M1776 | M1976 |
| Single step restart | M1777 | M1977 |

**REMARK**

*1 : The machine numbers shown in Table 3.2 are assigned in the system setup mode of a peripheral device.

### 3.1.3 Orthogonal stroke limit invalid (M1778, M1978)

····· Signals from SCPU to PCPU

Orthogonal stroke limit invalid signals are used for invalidating the stroke limit check by the orthogonal stroke limit setting specified by "machine constant 2 setting" of "machine data setting."

- ON ····· Orthogonal stroke limit check is not performed.
- OFF ····· Orthogonal stroke limit check is performed.

## 3.2 Data Registers (D)

There are 1024 data registers in the A171SCPU (D0 to D1023), while there are 8192 in the A273UHCPU (8 axes specification, D0 to D8191).
Of these, the 224 registers at the points D800 to D1023 (A171SCPU/A273UHCPU (8 axes specification)) are used for positioning control, and their application is pre-determined as shown in Table 3.4.

**Table 3.4 Data Register List**

<A171SCPU/A273UHCPU (8 axes specification)>

| Device Number | | Signal Name | |
|---|---|---|---|
| Machine 1 | Machine 2 | | |
| D600<br>D601 | D680<br>D681 | Coordinate present value | X |
| D602<br>D603 | D682<br>D683 | | Y |
| D604<br>D605 | D684<br>D685 | | Z |
| D606<br>D607 | D686<br>D687 | Rotating shaft angle present value | A *1 |
| D608<br>D609 | D688<br>D689 | | B *2 |
| D610<br>D611 | D690<br>D691 | | C *3 |
| D612 | D692 | FL | |
| D613 | D693 | Unusable by the user | |
| D614 | D694 | Execution point block number | |
| D615 | D695 | Execution point number | |
| D616<br>D617 | D696<br>D697 | Command coordinate value | X |
| D618<br>D619 | D698<br>D699 | | Y |
| D620<br>D621 | D700<br>D701 | | Z |
| D622<br>D623 | D702<br>D703 | Command rotating shaft angle | A *1 |
| D624<br>D625 | D704<br>D705 | | B *2 |
| D626<br>D627 | D706<br>D707 | | C *3 |
| D628 | D708 | Command FL | |
| D629 | D709 | Unusable by the user | |
| D630<br>D631 | D710<br>D711 | Machine coordinate present value | X |
| D632<br>D633 | D712<br>D713 | | Y |
| D634<br>D635 | D714<br>D715 | | Z |
| D636<br>D637 | D716<br>D717 | Machine rotating shaft angle present value | A *1 |
| D638<br>D639 | D718<br>D719 | | B *2 |
| D640<br>D641 | D720<br>D721 | | C *3 |
| D642 | D722 | Machine FL | |
| D643<br>to<br>D659 | D723<br>to<br>D739 | Unusable by the user | |

| Device Number | | Signal Name |
|---|---|---|
| Machine 1 | Machine 2 | |
| D660<br>D661 | D740<br>D741 | Orthogonal JOG speed setting register |
| D662 | D742 | Override ratio setting register |
| D663<br>to<br>D679 | D743<br>to<br>D759 | Unusable by the user |
| D760<br>to<br>D799 | | Unusable by the user |

**REMARK**

*1, *2, *3 : For a robot with multiple joints, these indicate rotation angles around X, Y and Z axes.

**Table 3.4 Data Register List (Continued)**

<A171SCPU/A273UHCPU (8 axes specification)>

| Device Number | Signal Name | | Device Number | Signal Name |
|---|---|---|---|---|
| D800 to D819 | Monitor data of Axis 1 | Head data register number<br>0 Feed present value L<br>1 H<br>2 Actual present value L<br>3 H<br>4 Error counter value L<br>5 H<br>6 Minor error code<br>7 Severe error code<br>8 Servo error code<br>9 Travel during near point dog ON L<br>10 H<br>11 Zero return re-travel<br>12 Execution program number<br>13 M code<br>14 Torque limit value<br>15 Travel change register L<br>16 H<br>17 Actual present value at STOP input L<br>18 H<br>19 For uniform speed control | D1012 | Resister that sets the axis number controlled by manual pulse generator 1. |
| D820 to D839 | Monitor data of Axis 2 | | D1013 | Resister that sets the axis number controlled by manual pulse generator 2. |
| D840 to D859 | Monitor data of Axis 3 | | D1014 | Resister that sets the axis number controlled by manual pulse generator 3. |
| D860 to D879 | Monitor data of Axis 4 | | D1015 | Register that sets JOG operation simultaneous start axes. * |
| D880 to D899 | Monitor data of Axis 5 | | D1016 | Register that sets the single-pulse input scale of the axis 1 manual pulse generator. |
| D900 to D919 | Monitor data of Axis 6 | | D1017 | Register that sets the single-pulse input scale of the axis 2 manual pulse generator. |
| D920 to D939 | Monitor data of Axis 7 | | D1018 | Register that sets the single-pulse input scale of the axis 3 manual pulse generator. |
| D940 to D959 | Monitor data of Axis 8 | | D1019 | Register that sets the single-pulse input scale of the axis 4 manual pulse generator. |
| D960 to D965 | Axis 1 control change data storage area | Head data register number<br>0 Present value change register L<br>1 H<br>2 Speed change register L<br>3 H<br>4 JOG speed setting register L<br>5 H | D1020 | Register that sets the single-pulse input scale of the axis 5 manual pulse generator. |
| D966 to D971 | Axis 2 control change data storage area | | D1021 | Register that sets the single-pulse input scale of the axis 6 manual pulse generator. |
| D972 to D977 | Axis 3 control change data storage area | | D1022 | Register that sets the single-pulse input scale of the axis 7 manual pulse generator. |
| D978 to D983 | Axis 4 control change data storage area | | D1023 | Register that sets the single-pulse input scale of the axis 8 manual pulse generator. |
| D984 to D989 | Axis 5 control change data storage area | | | |
| D990 to D995 | Axis 6 control change data storage area | | | |
| D996 to D1001 | Axis 7 control change data storage area | | | |
| D1002 to D1007 | Axis 8 control change data storage area | | | |
| D1008 to D1011 | Limit switch output disable setting | | | |

* : Same axis simultaneous start cannot be performed during orthogonal JOG operation.

* : Axes 5 through 8 display "0" for the A171SCPU.

### 3.2.1 Machine monitor data areas (D600 to D759)

..... Data from/to PCPU and SCPU

Machine monitor data areas are the areas where the PCPU stores such data as coordinate present values (X, Y, Z), execution point block numbers and override ratios, during machine control.
These areas can be used for confirming the control status of the machine from the sequence program.
The user cannot write data to machine monitor data areas (excluding override ratio setting registers and orthogonal JOG speed setting registers).

**Table 3.5 Machine Monitor Data Area List (PCPU → SCPU)**

<A171SCPU/A273UHCPU (8 axes specification)>

| Device Number | | Signal Name | |
|---|---|---|---|
| Machine 1 | Machine 2 | | |
| D600<br>D601 | D680<br>D681 | Coordinate present value | X |
| D602<br>D603 | D682<br>D683 | | Y |
| D604<br>D605 | D684<br>D685 | | Z |
| D606<br>D607 | D686<br>D687 | Rotating shaft angle present value | A |
| D608<br>D609 | D688<br>D689 | | B |
| D610<br>D611 | D690<br>D691 | | C |
| D612 | D692 | FL | |
| D613 | D693 | Unusable by the user | |
| D614 | D694 | Execution point block number | |
| D615 | D695 | Execution point number | |
| D616<br>D617 | D696<br>D697 | Command coordinate value | X |
| D618<br>D619 | D698<br>D699 | | Y |
| D620<br>D621 | D700<br>D701 | | Z |
| D622<br>D623 | D702<br>D703 | Command rotating shaft angle | A |
| D624<br>D625 | D704<br>D705 | | B |
| D626<br>D627 | D706<br>D707 | | C |
| D628 | D708 | Command FL | |
| D629 | D709 | Unusable by the user | |
| D630<br>D631 | D710<br>D711 | Machine coordinate present value | X |
| D632<br>D633 | D712<br>D713 | | Y |
| D634<br>D635 | D714<br>D715 | | Z |
| D636<br>D637 | D716<br>D717 | Machine rotating shaft angle present value | A |
| D638<br>D639 | D718<br>D719 | | B |
| D640<br>D641 | D720<br>D721 | | C |
| D642 | D722 | Machine FL | |
| D643<br>to<br>D659 | D723<br>to<br>D739 | Unusable by the user | |

(1) Coordinate present value storage register ····· Data from PCPU to SCPU
Stores the present world coordinate values of the tip of the machine.

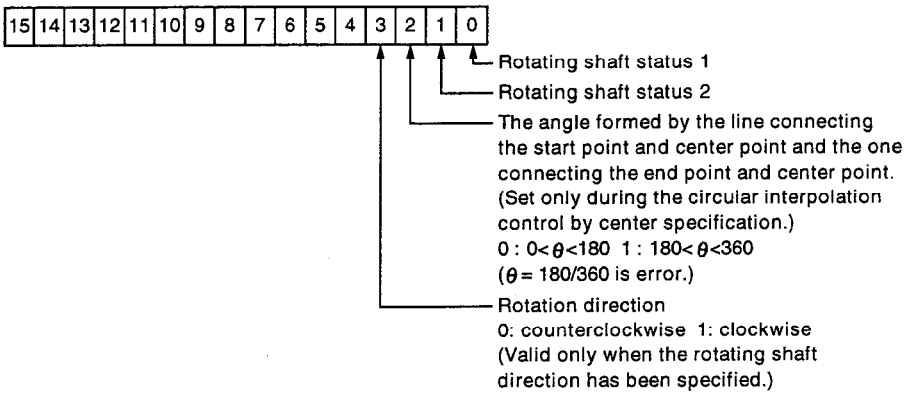
| | |
|---|---|
| $-2^{31}$ to $2^{31}-1$ | $\times 10^{-1}$ μm |
| | $\times 10^{-5}$ inch |

(2) Rotating shaft angle present value storage register ····· Data from PCPU to SCPU
Stores the rotation angle present value of each X, Y and Z axis.

| | |
|---|---|
| 0 to 35999999 | $\times 10^{-5}$ degrees |

(3) FL (structure flag)

Meaning of a flag




| Rotating Shaft Status 1 | Rotating Shaft Status 2 | |
|---|---|---|
| 1 | 0 | Rotating shaft near rotation |
| 0 | 1 | Rotating shaft direction specification |
| 0 | 0 | Rotating shaft command value |

(4) Execution point block number storage register ····· Data from PCPU to SCPU
Stores the point block numbers (0 to 1023) that are being executed under three-dimensional interpolation CP control. End points are stored during circular interpolation.

**Table 3.6 Machine Data Setting Area List (SCPU → PCPU)**

| Device Number | | Signal Name |
|---|---|---|
| Machine 1 | Machine 2 | |
| D660<br>D661 | D740<br>D741 | Orthogonal JOG speed setting register |
| D662 | D742 | Override ratio setting register |
| D663<br>to<br>D679 | D743<br>to<br>D759 | Unusable by the user |
| D760<br>to<br>D799 | | Unusable by the user |

**POINTS**

(1) Unused machine numbers are not usable by the user.
(2) Storing of data to a machine monitor data area is delayed by the following time depending upon the ON/OFF status of the positioning device (input, internal relay or special).
(a) Coordinate present value ····· 14.2 ms
(b) Execution point block number ····· 14.2 ms
(c) Override ratio ····· 14.2 ms

(5) Override ratio setting register ····· Data from SCPU to PCPU
This is an area used for setting a ratio relative to the command speed (override ratio) of three-dimensional interpolation CP control, and changing the speed accordingly.
(Refer to Section 9.2.)

(6) Orthogonal JOG speed setting register

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

(b) The orthogonal JOG speed setting ranges are shown below.

| Item \ Unit | mm | | inch | |
|---|---|---|---|---|
| | Setting Range | Unit | Setting Range | Unit |
| Orthogonal JOG speed | 1 to 600000000 | $\times 10^{-2}$ mm/min | 1 to 600000000 | $\times 10^{-3}$ inch/min |

(c) At the start of the orthogonal JOG start signal (OFF → ON), the value changes to the one stored in the orthogonal JOG speed setting register.
Orthogonal JOG speed cannot be changed by modifying the data during orthogonal JOG operation.

(d) For the details of orthogonal JOG operation, refer to Section 7.20.2.

# 4. POSITIONING CONTROL PARAMETERS

## 4.1 System Setup

(1) In the system setup, the unit to be used (model), motor type (model), axis numbers (1 to 4/1 to 8) and other data are set.

(2) To perform positioning by machine control, machine setup must be done in addition to system setup.

(3) System setup data and machine setting data are set by peripheral devices.

### 4.1.1 System setup

(1) For the details of setting contents, refer to the instruction manual of the motion controller (SV13).

### 4.1.2 Machine setup

(1) In machine setup, the axis numbers that have been set by system setup are assigned to the joint axes.

(2) The setting contents are shown below.

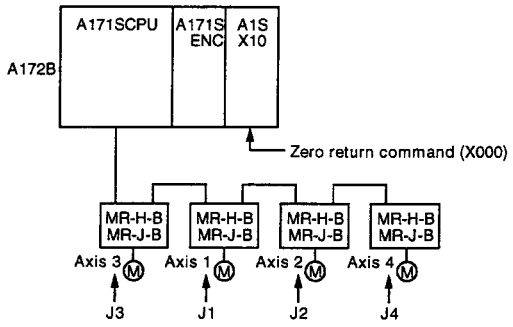
**Table 4.8 Machine Setup List**

| No. | Item | Setting Range | Default | Remark |
|---|---|---|---|---|
| 1 | Machine number | 1 to 2 (maximum 2 units) | — | Set machine numbers to be specified by the SVST MC instruction (machine control instruction). |
| 2 | Axis number assignment | 1 to 8 | — | Assign to the joint axes the axis numbers that have been set by system setup. |

**[Notes]**

(1) Place axis numbers in the order of J1 to J4 starting from the youngest number. (When an error occurs, it will be minor error 1330.)

Example




(2) Set the stroke range of each joint axis (J1 to J6) using fixed parameters.

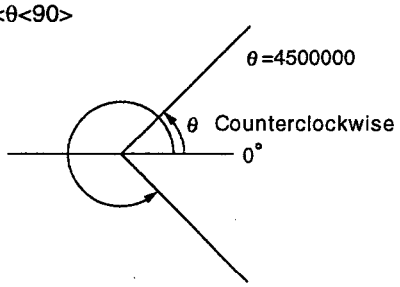
Example

<When the rotating shaft stroke range is –90<θ<90>

- Set the low/high stroke limits as follows:

| | |
|---|---|
| Stroke low limit | 27000001 |
| Stroke high limit | 8999999 |

- Set in the counterclockwise direction.

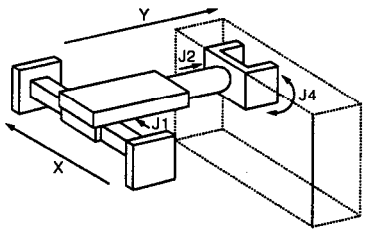
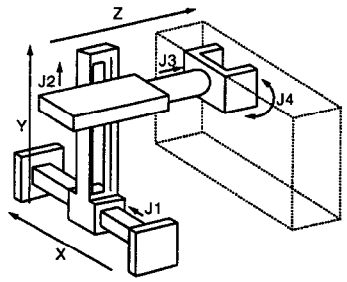


# 4.2 Machine Constants

## 4.2.1 Machine constant 1

**(1) Machine type**

Sets a machine type that is appropriate for the machine to be controlled.
A list of machine types is shown in the following page.

| | | 1 | 0 |
|---|---|---|---|
| Relationship between the machine and joint axes | |  |  |
| Joint axes | J1 | X component | |
| | J2 | Y component | |
| | J3 | — | Z component |
| | J4 | Rotating shaft | |
| | J5 | — | |
| | J6 | — | |

**(2) Arm length**

Set "0."

| Arm length | Setting Range | Default |
|---|---|---|
| | 0 to $2^{31}-1$ ($\times 10^{-1}$ µm/$10^{-5}$ inch) | 0 |

**(3) Orthogonal JOG speed limit value**

Set the maximum speed during orthogonal JOG operation.

**(4) Parameter block specification**

Set parameter block numbers.

## 4.2.2 Machine constant 2

No.1 through 4, 8 through 18 and 25 through 48 are unused.
The items set in No.5 through 7 and 19 through 24 are shown below.

**(1) Base conversion**

Set in No. 5, 6 and 7.

| No. | Item | Setting Range | Default | Remark |
|---|---|---|---|---|
| 5 | Base conversion Bx | 0 to $2^{31}-1$ ($\times 10^{-1}$ µm, $10^{-5}$ inch)*1 (Example) When the base position is at 1.25m (4.1 ft.) from the world coordinate origin, set "12500000." | 0 | Set the base position as seen from the world. coordinate origin |
| 6 | Base conversion By | | | |
| 7 | Base conversion Bz | | | |

*1 : The unit is determined by the unit of arm length of machine constant 1.

### (2) Orthogonal stroke limit

Set in No. 19, 20, 21, 22, 23 and 24.

| No. | Item | Setting Range | Default | Remark |
|---|---|---|---|---|
| 19 | Orthogonal stroke limit check + X | $-2^{31}$ to $+2^{31}-1$ ($\times 10^{1}$ μm, $10^{-5}$ inch)*1 (Example) When the travel range is −12.3m (4.1 ft), set "−123000000." | 0 | • Set by orthogonal coordinates an allowable travel range of the tool operation point in the world coordinate system.<br>• When orthogonal limits are not used, set "0" for both + and −.<br>• If the high limit value is smaller than the low limit value, limit check will not be performed correctly. |
| 20 | Orthogonal stroke limit check − X | | | |
| 21 | Orthogonal stroke limit check + Y | | | |
| 22 | Orthogonal stroke limit check − Y | | | |
| 23 | Orthogonal stroke limit check + Z | | | |
| 24 | Orthogonal stroke limit check − Z | | | |

*1 : The unit is determined by the unit of arm length of machine constant 1.

- World coordinate system ·····A coordinate system that is set on the ground or work floor. All positioning programs and coordinate value monitoring are based on the world coordinate system.
- Base ·····The intersection of the bottom face of the robot and the J1 axis rotation center (the robot installation position).
- Base conversion ·····The base position as seen from the origin of the world coordinate system. The world coordinate system can be shifted by using base conversion. Base conversion is set by machine constant 2. It can also be changed by using a coordinate value change instruction (CHGA MC).

**REMARK**

When 0 or 1 is set as machine type, the joint axis J4 need not be assigned an axis number.

# 5. SEQUENCE PROGRAM

This chapter explains the starting of a servo program, etc., by a sequence program to perform positioning control.

## 5.1 Notes on Creating A Sequence Program

This section explains items that must be noted when creating a sequence program or SFC program.

**(1) Positioning control instructions**

The following instructions are used as positioning control instructions:

(a) Servo start instructions (SVST/SVST MC) (Refer to Section 5.2.)
Different servo start instructions are used depending on the type of the servo program.
- For control of 1 to 4 axes (SVST)
- For machine control (SVST MC)

(b) Present value change/speed change instructions (DSFLP/CHGA/CHGV) (Refer to Section 5.3.)

(c) Coordinate value change instruction (CHGA MC) (Refer to Section 5.4.)

**(2) Unusable instructions**

The DSFL instruction (left shifting of word data by one word) and the DSFR instruction (right shifting of word data by one word) cannot be used.

If the DSFL or DSFR instruction is executed, an operation error occurs, which gives rise to the following situations:

(a) An operation error flag (M9010, M9011) is turned ON.

(b) "50" (OPERATION ERROR) is stored in the self-diagnosis error code storage register (D9008).

(c) Steps of the executed DSFR or DSFL instruction are stored in the error step storage register (D9010, D9011).
When performing a word data shift, use the BMOV instruction. (Refer to Appendix 4.)

**(3) Dedicated devices for the PCPU**

Of the servo system CPU devices, those shown in Table 5.1 are used only for the PCPU and their application is pre-determined.

In sequence programs, confirm their application before use. (Refer to Chapter 3 for details.)

**Table 5.1 Dedicated Devices for the PCPU**

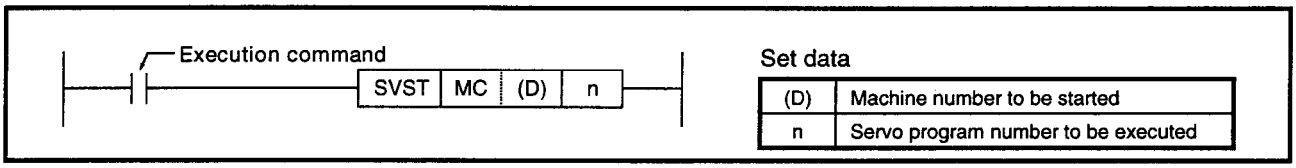
| Device Name | Device Number | |
|---|---|---|
| | A171SCPU | A273UHCPU (8 Axes Specification) |
| Input | — | X0 to XFF |
| Output | — | Y0 to YFF |
| Internal relay | M1600 to M2047 | M2000 to M2047 |
| Data register | D800 to D1023 | |
| Special relay | M9073 to M9079 | |
| Special register | D9180 to D9199 | |

## 5.2 Machine Start Request Instruction (SVST MC)

This is a start request instruction for servo programs for machine control.

| | Applicable Device | | | | | | | | | | | | | | | | | | | Digit Specification | Number of Steps | Subset | Index | Carry Flag | Flag Error | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bit Device | | | | | | | Word (16 Bit) Device | | | | | | | | Constant | | Pointer | | Level | | | | | | |
| | X | Y | M | L | S | B | F | T | C | D | W | R | A0 | A1 | Z | V | K | H | P | I | N | | | | | M9012 | M9010 | M9011 |
| (D) | | | | | | | | | | | | | | | | | ○ | | | | | | 13 | | ○ *1 | | | ○ |
| n | | | | | | | | | | ○ | ○ | | | | | | ○ | ○ | | | | | | | | | | |

*1 : Usable only by indirect specification.



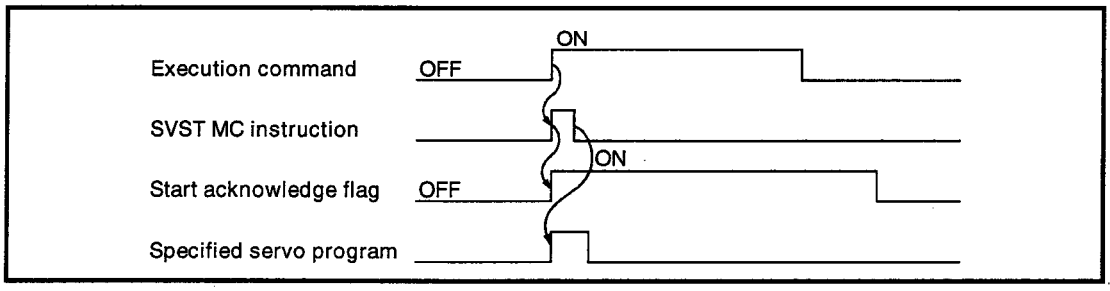

Set data

| | |
|---|---|
| (D) | Machine number to be started |
| n | Servo program number to be executed |

At the start of the execution command of the SVST MC instruction, the following processing are performed.

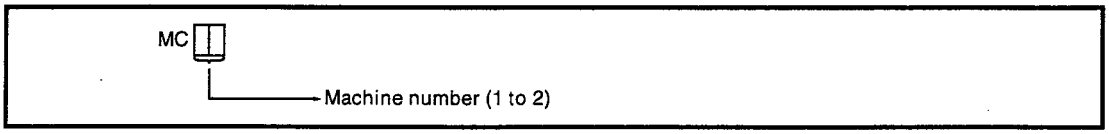
- Turns ON the start acknowledgment (M200n) that corresponds to the axes of the machine (number) specified in (D). (Refer to Section 3.2.5.)
- Issues a start request for the servo program specified by n.

**[Operation Timing]**




**[Data Setting]**

(1) Setting the start machine number
The start machine number in (D) is set as follows:




Example

Each start machine number is specified as follows:

- Machine number 1 ..... MC1
- Machine number 2 ..... MC2

(2) Setting the servo program number
The servo program number is set in two ways: by direct setting or indirect setting.
(a) In direct setting, a servo program number is set directly by using a numeric value (0 to 4095).

Example

The servo program number 50 is set as follows.

• When specified by K ..... K50

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

1) The usable word devices are shown in the table below.

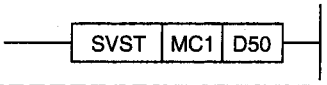
| Word Device | CPU | |
|---|---|---|
| | A171S | A273UH (8 Axes Specification) |
| D | 0 to 799 | 0 to 8191 *1 |
| W | 0 to 3FF | 0 to 1FFF |
| R | 0 to 4095 | 0 to 8191 |

*1 : Excludes 600 to 799 and 800 to 1023.

Example

When the servo program number to be started is specified by using the data in the word device (D50), set as follows:

• Specify by word device (D).




2) For the index specification of the indirectly set word device, index registers (Z, V) or dedicated instructions (IX · IXEND) can be used.

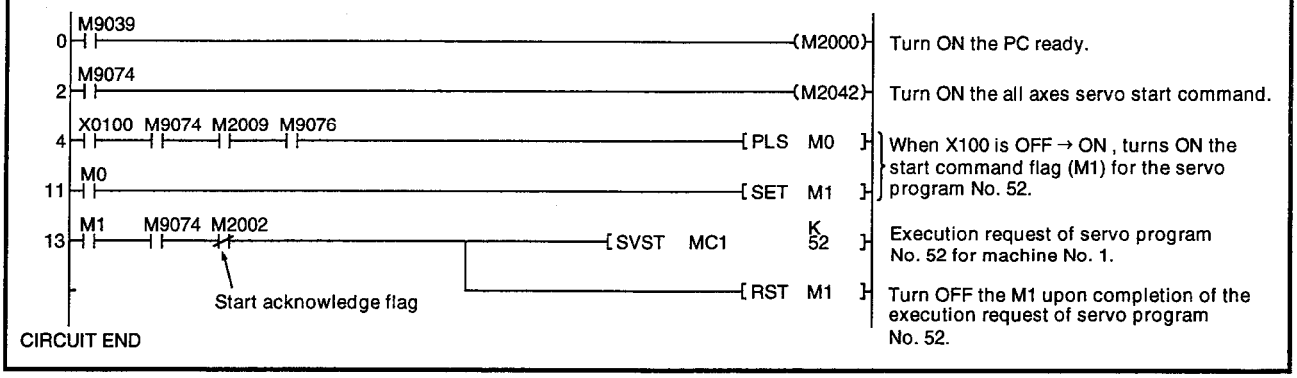
- For index registers (Z, V), refer to the ACPU Programming Manual (Basics) (SH-3435).
- For dedicated instructions (IX · IXEND), refer to the AnACPU/AnUCPU Programming Manual (Dedicated Instructions) (SH-3437).

**[Error Descriptions]**

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

- A value other than 1 and 2 is set in (D).
- The machine number specified in (D) has not been set (or does not exist).
- The specification in n contains a format error.
- A value other than 0 to 4095 is set in n.

**[Program Example]**




**POINTS**

(1) Use only CPSTART XYZ for the servo program specified at machine start.

(2) When starting axes independently, use the SVST instruction.

# 6. SERVO PROGRAM FOR POSITIONING CONTROL

## 6.1 Three-dimensional Interpolation CP Control

(1) The machine is controlled by the three-dimensional interpolation CP control.
(2) Once started, it passes the preset passing points and performs uniform speed positioning by using the specified positioning method.
(3) The positioning of passing points is performed and the path to the passing points is selected by the servo program.
(4) The address that the user specifies in the servo program (in the point block) is not the address of each axis, but that on the spatial coordinates (world coordinate) at the tip of the machine.
(5) The servo program can perform repeated controls between any passing points, change of speed and M code at a passing point, and ON/OFF of limit switch output at a passing point.
(6) When an address is indirectly specified in a loop using the repeat instructions (FOR-TIMES, FOR-ON, FOR-OFF to NEXT), a data set pointer is set for the update of indirect device.

### 6.1.1 Start, passing points, end specifications of three-dimensional interpolation CP control

The three-dimensional interpolation CP control is performed by the machine specified by the positioning instruction in the sequence program.

| Servo Instruction | | Positioning System | Control Axes | Items to Set Using Peripheral Device | | | | | | | | | | | | | | | | | | | | | | Speed change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Common | | | | | | | Arc | | | Parameter Block | | | | | | | | | | Others | | |
| | | | | Parameter block No. | Axis | Address/travel | Command speed | Dwell time | M code | Torque limit value | Auxiliary point | Radius | Center point | Control unit | Speed limit value | Acceleration period | Deceleration period | Sudden stop deceleration limit time | Torque limit value | Deceleration process at STOP input | Allowable circular interpolation error range | S ratio | Adjacent passing | Command speed (uniform speed) | Point block No. | |
| Start | CPSTART XYZ | — | 4 | △ | | | ○ | | | | | | | | △ | △ | △ | △ | | △ | | | | | | |
| End | CPEND | | — | | | | | △ | | | | | | | | | | | | | | | | | | |
| Passing point | ABS— | Absolute | 4 | | | ○ | | | △ | | | | | | | | | | | | | | △ | △ | ○ | Allowed |
| | ABS ↷ | | | | | ○ | | | △ | | ○ | | | | | | | | | | △ | | | △ | ○ | |
| | ABS ↶ | | | | | ○ | | | △ | | | | ○ | | | | | | | | △ | | | △ | ○ | |
| | ABS ↻ | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ABS/ | | | | | ○ | | | △ | | | | | | | | | | | | | | △ | △ | ○ | |
| | INC— | Increment | 4 | | | ○ | | | △ | | | | | | | | | | | | | | △ | △ | ○ | |
| | INC ↷ | | | | | ○ | | | △ | | ○ | | | | | | | | | | △ | | | △ | ○ | |
| | INC ↶ | | | | | ○ | | | △ | | | | ○ | | | | | | | | △ | | | △ | ○ | |
| | INC ↻ | | | | | | | | | | | | | | | | | | | | | | | | | |
| | INC/ | | | | | ○ | | | △ | | | | | | | | | | | | | | △ | △ | ○ | |

○ : Setting compulsory
△ : Setting required

**[Description of Control]**

Start and end of three-dimensional interpolation CP control

The start and end of three-dimensional interpolation CP control are specified with the instructions listed below:

(1) CPSTART XYZ
Starts the three-dimensional interpolation CP control.
Sets the command speed.

(2) CPEND
Ends the three-dimensional interpolation CP that was started by CPSTART XYZ.

Positioning control system to the passing point

The positioning control to the passing point at which the control change is performed is specified with the instructions listed below:

(1) ABS —, INC —
Specifies the linear interpolation control.

(2) ABS ⌒, INC ⌒
Specifies the circular interpolation control by setting an auxiliary point.

(3) ABS ⌒, INC ⌒, ABS ⌣, INC ⌣
Specifies the circular interpolation control by setting the center point.

(4) ABS/, INC/
Specifies the joint interpolation control.

Linear interpolation and joint interpolation

While the locus between the passing points is a straight line for the linear interpolation, that for the joint interpolation is inconsistent. However, the passing points of the linear interpolation and joint interpolation will be the same.
When the locus of passing points is significant (i.e., when it must be a straight line), use the linear interpolation.
To reach the point in a shorter time without considering the locus of passing points, use the joint interpolation.

**POINTS**

(1) During the three-dimensional interpolation CP control, the command in-position signal (M16m3/Xn2) is not output. As for other signals, they are operated at the same timing as during the uniform speed control.

(2) For the circular interpolation control by setting the center point, an error occurs if the angle of the arc is 180° (error code: 109). In this case, perform the circular interpolation control by setting an auxiliary point.

Servo program and operation timing

The servo program, machine setting and operation timing for the three-dimensional interpolation CP control are shown in Figure 6.1.

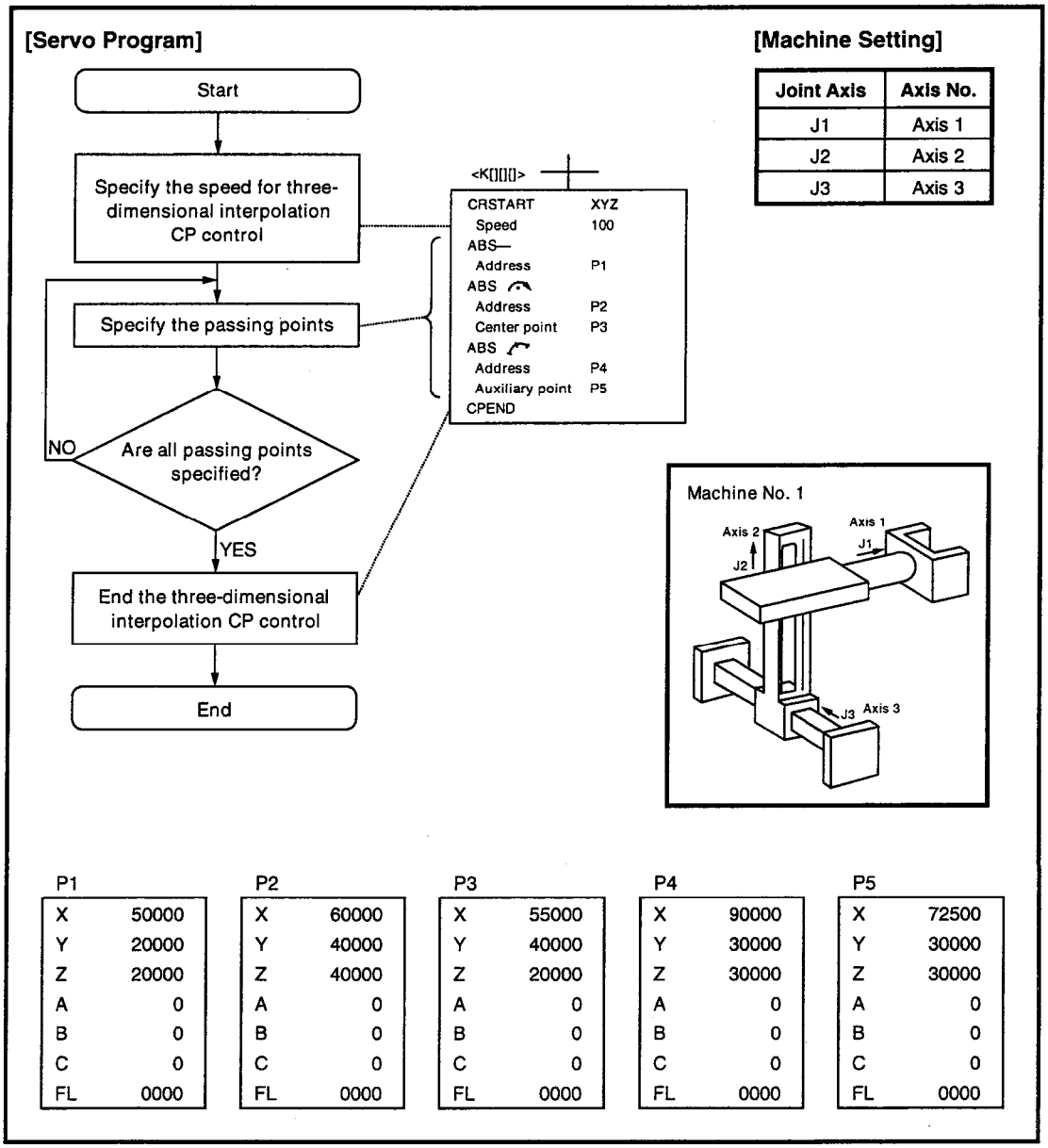



**Figure 6.1 The Servo Program, Machine Setting and Operation Timing for the Three-dimensional Interpolation CP Control**

[Operation Timing]

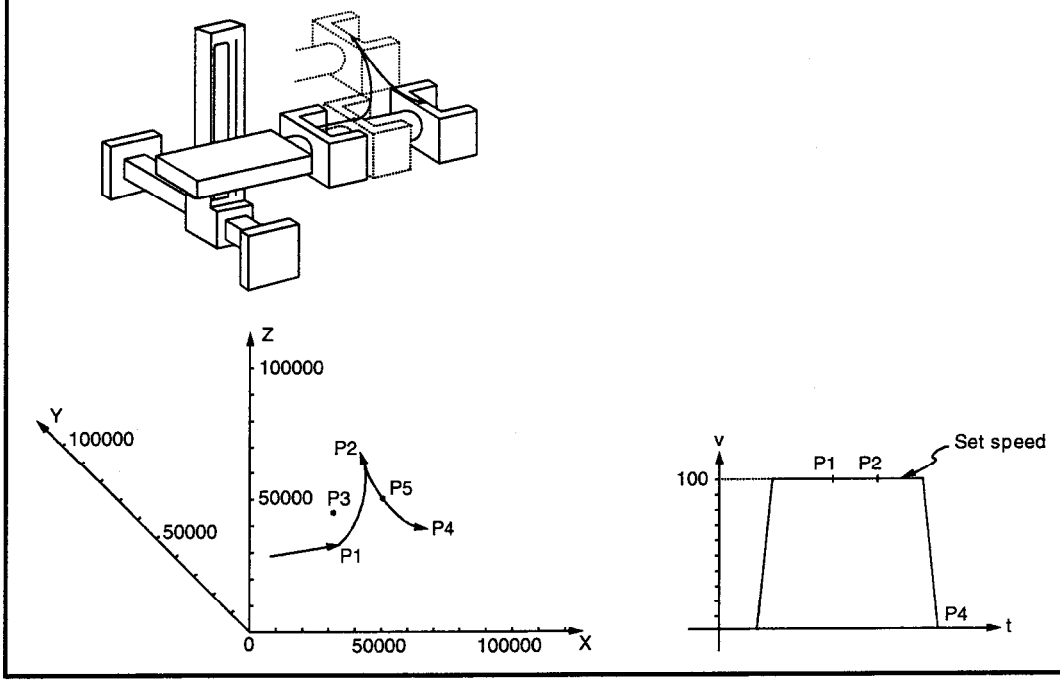



**Figure 6.2 The Servo Program, Machine Setting and Operation Timing for the Three-dimensional Interpolation CP Control (Continued)**

**[Notes]**

(1) The machine No. and the number of control axes may not be changed during control.

(2) The absolute system (ABS□) and increment system (INC□) may coexist for the positioning control to the passing points.

(3) The passing points may include addresses whose travel directions change.

(4) The three-dimensional interpolation CP control (CPSTART XYZ instruction) may not start simultaneously.
If the program No. of CPSTART XYZ is specified during the START instruction (simultaneous start), a servo program error occurs and the program does not start.

(5) The torque limit value (set at the parameter block) at the start and that specified at the passing points will become invalid. The control is continued with the torque limit value before the start (the default is 300% for all axes at power on).

(6) The speed can be changed after the start.
There are three methods as listed below to change the speed after the start:

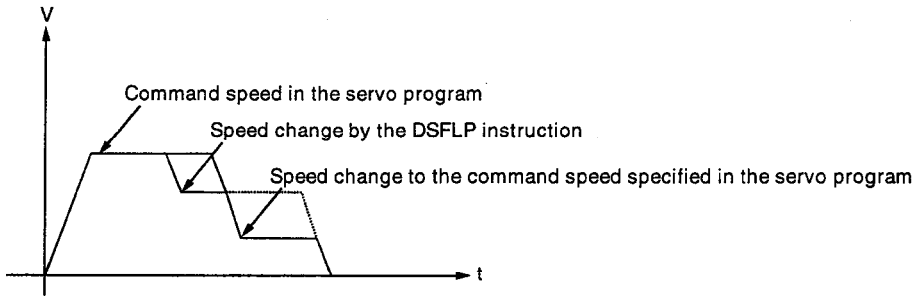
- Speed change in the servo program (CPSTART XYZ) (Refer to Section 7.16.2)
- Speed change by a sequence program (DSFLP instruction) (Refer to Section 8.7)
- Speed change by changing the override setting register (Refer to Section 9.2)

Take the following precautions when performing a speed change:

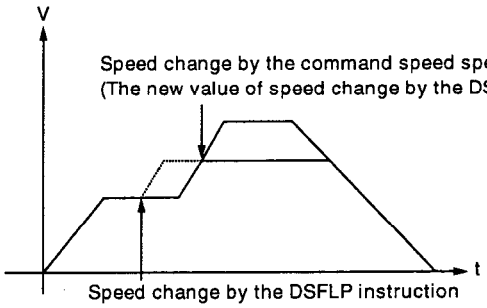
(a) When a circular interpolation by setting the center point is included in the uniform speed control.
When a setting is made in which the locus of arc, computed from the center point address and the start address, do not pass the end address (within the allowable circular interpolation error range), the error correction (refer to Section 4.5.3) may not be performed correctly if the speed is changed.
When performing the circular interpolation by setting the center point as the means for positioning during uniform speed control, set the start address, center point address and the end address so they form a correct arc.

(b) When the speed switching in the servo program and speed change by the DSFLP instruction are specified to the same program
Of the change speed by the DSFLP instruction and the speed specified in the servo program, the smaller value is selected.
The speed change by the DSFLP instruction is performed when it is less than the speed specified in the servo program. It is not performed when exceeding the specified speed.

1) When change speed by the DSFLP instruction > command speed in the servo program
The instruction speed of the servo program is selected.



2) When change speed by the DSFLP instruction < command speed in the servo program
The change speed by the DSFLP instruction becomes valid.




(7) An overrun occurs if the distance to the final positioning point does not reach the deceleration distance for the positioning speed (command speed) when the final positioning point is detected after the start.
At this time, error code "211" (overrun error) is stored in the minor error storage register for each axis.

(8) A maximum of 768 steps (approximately 100 points) can be specified in one three-dimensional interpolation CP control.

(9) When positioning is performed outside the range of stroke limit after the start, error code "106" is stored in the minor error storage register for each axis, and it decelerates to stop.

(10) The minimum travel between the passing points of the three-dimensional interpolation CP control are as below:

| Command speed × 0.02 < Travel distance (PLS) |
|---|

If the distance between passing points is extremely short, the positioning speed drops.

Example
When passing points are set for each pulse, the positioning speed will be around 280 pps regardless of the command speed setting.

(11) At the circular interpolation by setting the center point, if the end address = center point address, it is controlled as a linear interpolation.

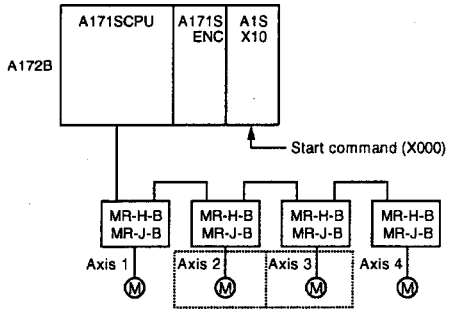
(12) At the circular interpolation by setting an auxiliary point, if the end address = auxiliary point address, it is controlled as a linear interpolation.

**[Program Example]**

A program which performs three-dimensional interpolation CP control for machine 1 is explained with the following conditions.

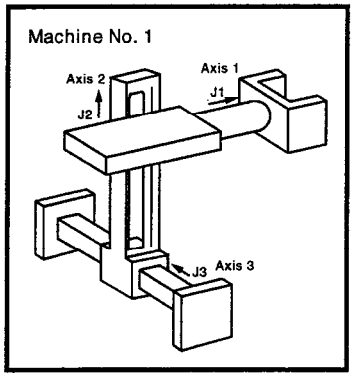
(1) System configuration

The three-dimensional interpolation CP control is performed for machine 1.




(2) Machine setting

| Joint Axis | Axis No. |
|---|---|
| J1 | Axis 1 |
| J2 | Axis 2 |
| J3 | Axis 3 |




(3) Positioning condition

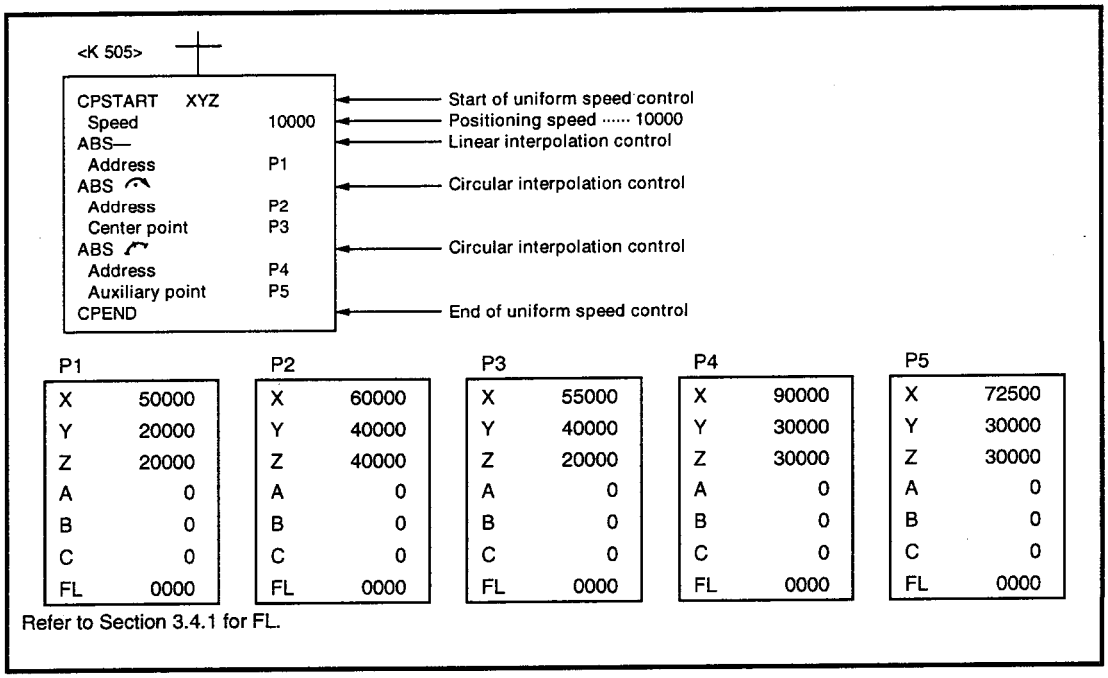
(a) The three-dimensional interpolation CP control conditions are listed below.

| Item | Setting | | |
|---|---|---|---|
| Servo program number | 505 | | |
| Positioning speed | 10000 | | |
| Positioning method | Linear interpolation | Three-dimensional circular interpolation by setting the center point | Three-dimensional circular interpolation by setting an auxiliary point |
| Passing point | P1 | P2 | P4 |

(b) Start command for the three-dimensional interpolation CP control ···· X100 rise (OFF → ON)

(4) Servo program

Servo program No. 505, which performs three-dimensional interpolation CP control, is shown in the figure below.

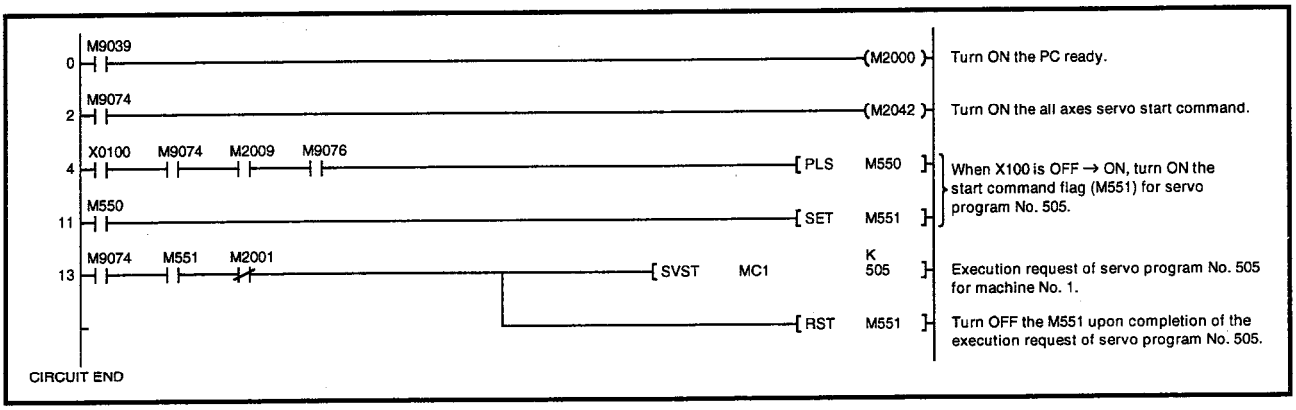



| P1 | | P2 | | P3 | | P4 | | P5 | |
|---|---|---|---|---|---|---|---|---|---|
| X | 50000 | X | 60000 | X | 55000 | X | 90000 | X | 72500 |
| Y | 20000 | Y | 40000 | Y | 40000 | Y | 30000 | Y | 30000 |
| Z | 20000 | Z | 40000 | Z | 20000 | Z | 30000 | Z | 30000 |
| A | 0 | A | 0 | A | 0 | A | 0 | A | 0 |
| B | 0 | B | 0 | B | 0 | B | 0 | B | 0 |
| C | 0 | C | 0 | C | 0 | C | 0 | C | 0 |
| FL | 0000 | FL | 0000 | FL | 0000 | FL | 0000 | FL | 0000 |

Refer to Section 3.4.1 for FL.

(5) Sequence program

The sequence program that executes the servo program is shown in the figure below.



### 6.1.2 Specification of passing points using the repeat instruction

The method to specify the passing points when between any passing points are repeatedly executed, is explained.

| Servo Instruction | Positioning System | Control Axes | Items to Set Using Peripheral Device | | | | | | | | | | | | | | | | | | | | | | Speed change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Common | | | | | | | Arc | | | Parameter Block | | | | | | | | | Others | | | |
| | | | Parameter block No. | Axis | Address/travel | Command speed | Dwell time | M code | Torque limit value | Auxiliary point | Radius | Center point | Control unit | Speed limit value | Acceleration period | Deceleration period | Sudden stop deceleration limit time | Torque limit value | Deceleration process at STOP input | Allowable circular interpolation error range | S ratio | Adjacent passing | Command speed (uniform speed) | Point block No. | |
| FOR-TIMES | — | — | | | | | | | | | | | | | | | | | | | | | ○ | | — |
| FOR-ON | | | | | | | | | | | | | | | | | | | | | | | | | |
| FOR-OFF | | | | | | | | | | | | | | | | | | | | | | | | | |
| NEXT | — | — | | | | | | | | | | | | | | | | | | | | | | | |

○ : Setting compulsory

**[Description of Control]**

Setting the head of the repeat range

The head of the repeat range is specified by the instructions below.

(1) FOR-TIMES (loop out count setting)

(a) Repeatedly executes the repeat range for the specified times.

(b) The setting range is 1 to 32767.
When set out of the setting range (–32768 to 0), control is carried out as though the setting is "1".

(c) The devices that can be used as the repeat count are listed below:

1) Data register (D) ⟩ For indirect setting
2) Link register (W) ⟩
3) Decimal constant (K)
4) Hexadecimal constant (H)

(2) FOR-ON (loop out trigger condition setting)

(a) Repeatedly executes the set repeat range until the specified bit device is turned ON.

(b) The bit devices that can be used as the loop out trigger condition are listed below.

1) Input (X)
2) Output (Y)
3) Internal relay (M)/special relay (SP.M)
4) Latch relay (L)
5) Link relay (B)
6) Annunciator (F)

(3) FOR-OFF (loop out trigger condition setting)

(a) Repeatedly executes the set repeat range until the specified bit device is turned OFF.

(b) The bit devices that can be used as the loop out trigger conditions are listed blow.

1) Input (X)
2) Output (Y)
3) Internal relay (M)/special relay (SP.M)
4) Latch relay (L)
5) Link relay (B)
6) Annunciator (F)

The operations of repeat control using FOR-TIMES, FOR-ON and FOR-OFF are listed below.

**[Servo Program]**

```
CPSTART XYZ
  Speed          10000
ABS—
  Address        P1
 1)
                 2)
ABS ↷                    ┐
  Address        P2      │
  Center point   P3      ├ 3)
ABS ↷                    │
  Address        P1      │
  Center point   P3      ┘
NEXT
CPEND
```

| 1) | 2) | | |
|---|---|---|---|
| | **Condition 1** | **Condition 2** | **Condition 3** |
| FOR-TIMES | K1 | K2 | K3 |
| FOR-ON | X110 → ON from the beginning | X110 → ON during the first execution of 3) | X110 → ON during the third execution of 3) |
| FOR-OFF | X111 → OFF from the beginning | X111 → OFF during the first execution of 3) | X111 → OFF during the third execution of 3) |

P1

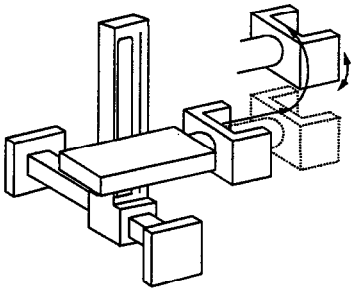
| | |
|---|---|
| X | D100 |
| Y | D102 |
| Z | D104 |
| A | |
| B | |
| C | |
| FL | 0000 |

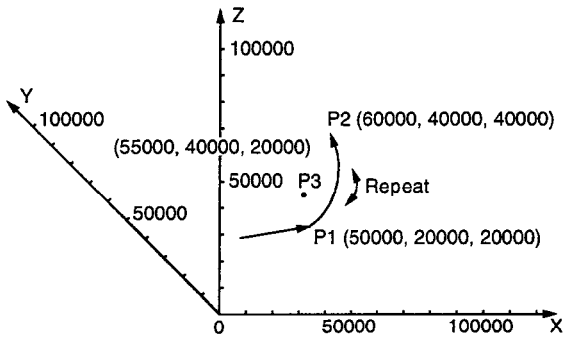
P2

| | |
|---|---|
| X | D106 |
| Y | D108 |
| Z | D110 |
| A | |
| B | |
| C | |
| FL | 0000 |

P3

| | |
|---|---|
| X | D114 |
| Y | D116 |
| Z | D118 |
| A | |
| B | |
| C | |
| FL | 0000 |



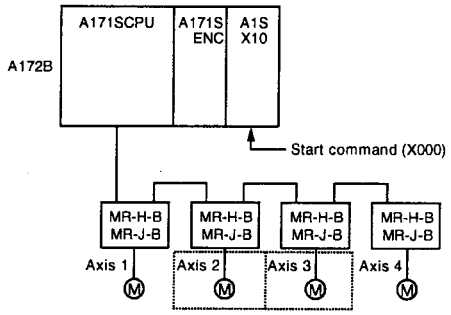


**[Program Example]**

The program to repeatedly perform the same process during the three-dimensional interpolation CP control is explained with the following conditions.

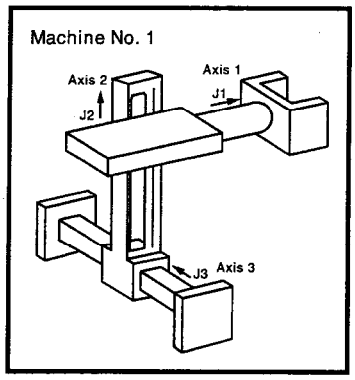
(1) System configuration

The three-dimensional interpolation CP control is performed for machine 1.




(2) Machine setting

| Joint Axis | Axis No. |
|---|---|
| J1 | Axis 1 |
| J2 | Axis 2 |
| J3 | Axis 3 |




(3) Positioning condition

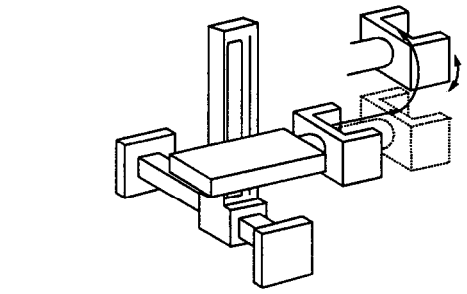
(a) The uniform speed control is listed below.

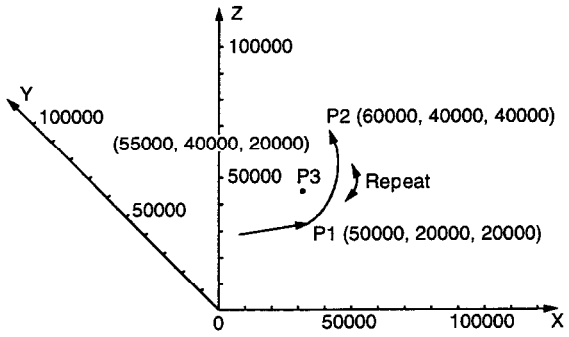
| Item | Setting |
|---|---|
| Servo program number | 510 |
| Machine number | 1 |
| Positioning method | 10000 |

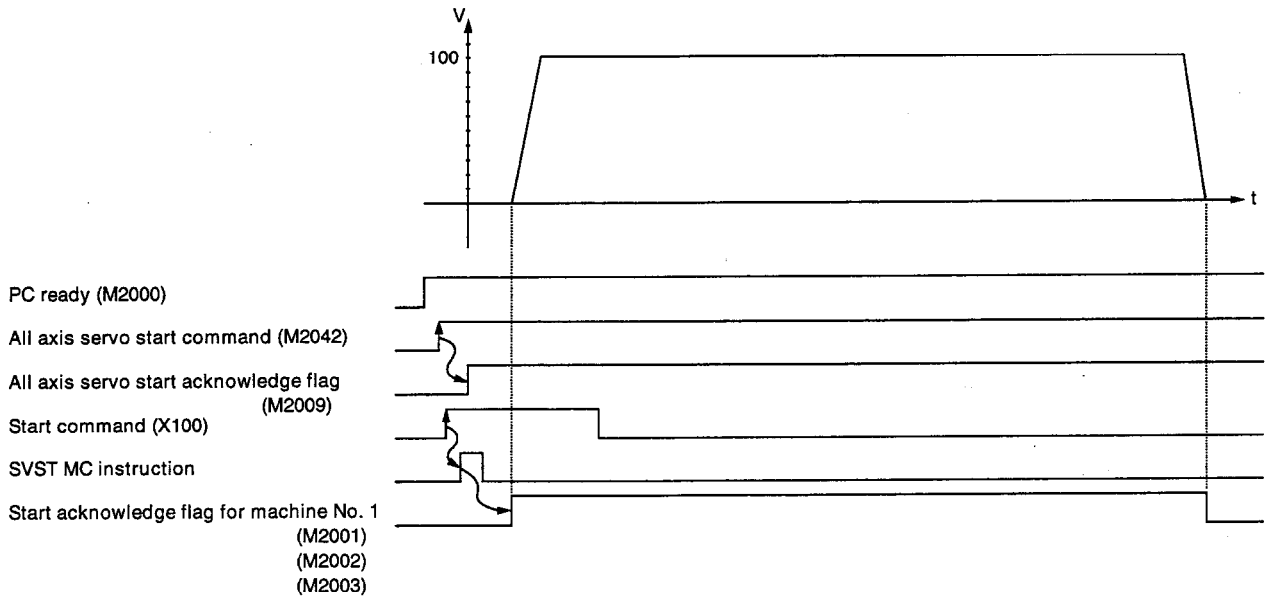
(b) Start command for the three-dimensional interpolation CP control ··· X100 rise (OFF → ON)

(4) Operation timing

The operation timing for the uniform speed control is shown in the figures below.

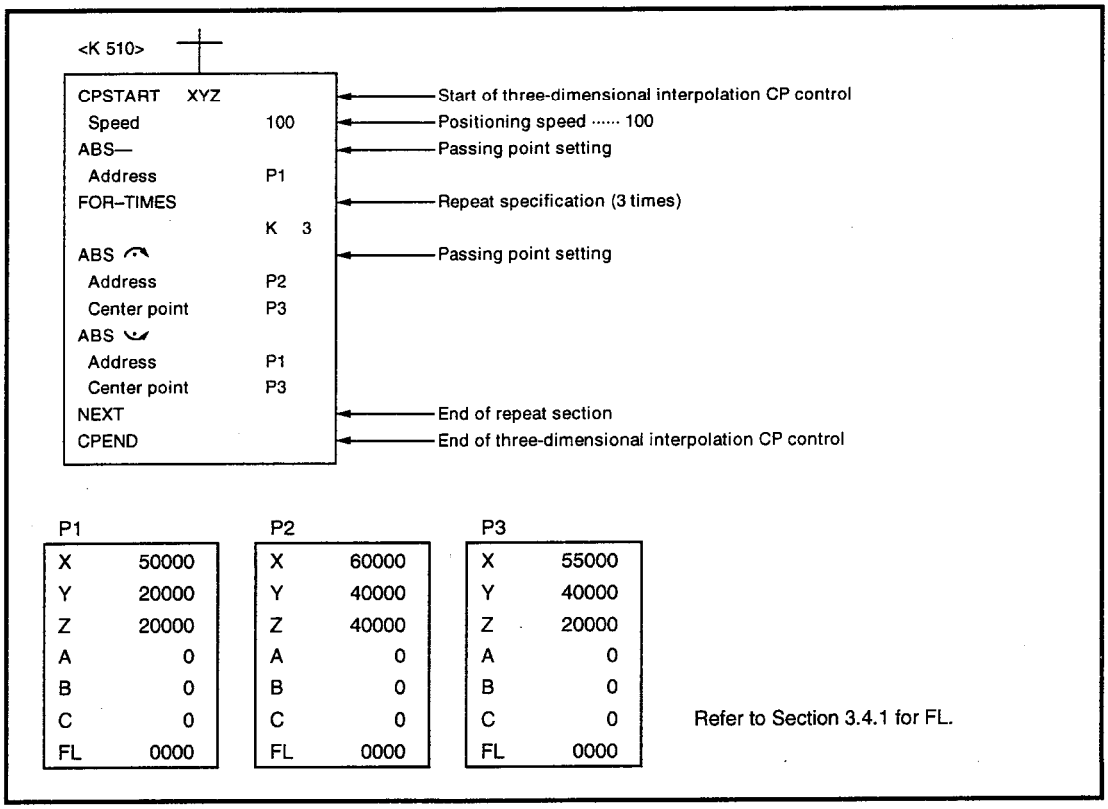




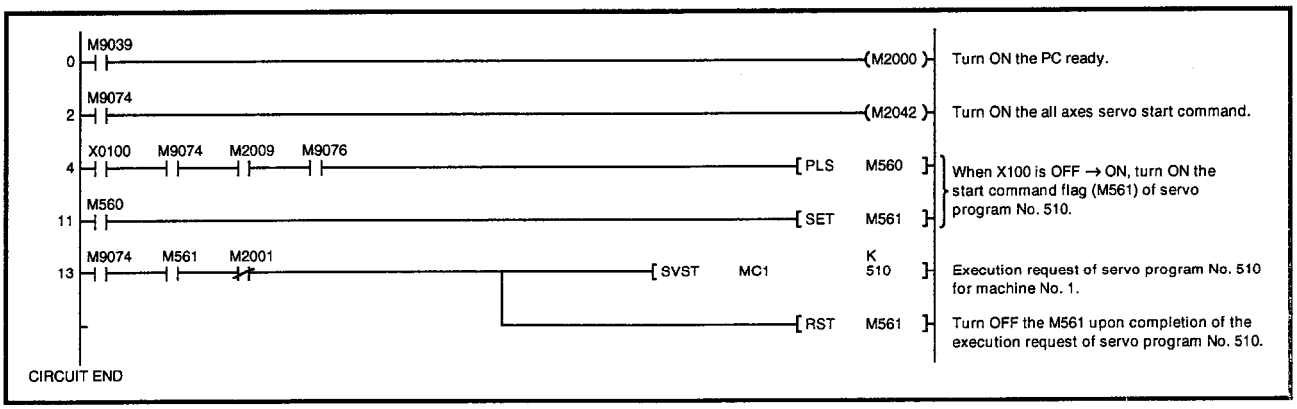
(5) Servo program

Servo program No. 510, which performs the uniform speed control, is shown in the figure below.




(6) Sequence program

The sequence program that executes the servo program is shown in the figure below.



# 6.2 Specification of Point Block for Positioning

## 6.2.1 Indirect setting method by word device (D, W)

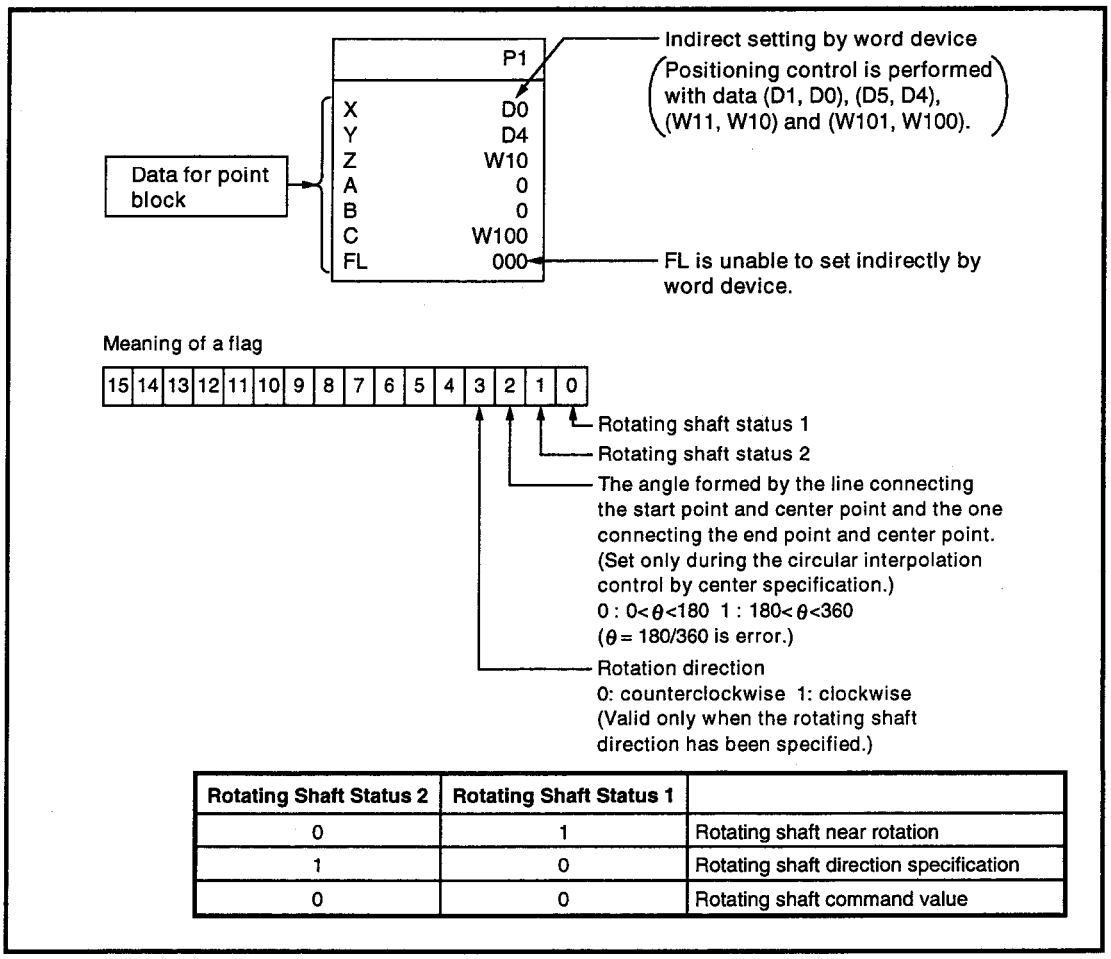
The indirect setting method by the word device is a method to specify word device (D, W) number to the positioning data to be specified in the servo program.
By changing the content (data) of word device specified in the sequence program, multiple positioning controls can be performed with one servo program.

(1) Devices for indirect data setting
The devices for indirect data setting include the data register (D) and link register (W). (Word devices other than the data register and link register may not be used.) The applicable data registers are listed below:

| Word Device | CPU | |
|---|---|---|
| | A171S | A273UH (8 Axes Specification) |
| D | 0 to 799 | 0 to 8191 * |
| W | 0 to 3FF | 0 to 1FFF |

* : Excludes 600 to 799 and 800 to 1023.

**[Setting Data for Point Block]**




| Rotating Shaft Status 2 | Rotating Shaft Status 1 | |
|---|---|---|
| 0 | 1 | Rotating shaft near rotation |
| 1 | 0 | Rotating shaft direction specification |
| 0 | 0 | Rotating shaft command value |

**Figure 6.4 Indirect Setting Example by Word Device for Point Block Data**

(2) Data entry of positioning/point block data
With the indirect setting by the word device, the word device data specified is read when the PCPU executes the servo program.
Therefore, when performing a positioning control, it is necessary to perform the start request for the servo program after setting data in the device for the indirect setting.

# 7. AUXILIARY AND APPLICATION FUNCTIONS FOR THE MACHINE CONTROL

## 7.1 Orthogonal Limit Switch Output Function

The orthogonal limit switch output function is a function in which the ON/OFF signals that correspond to the machine's world coordinate address are externally output from the A1SY42-type output unit in the three-dimensional interpolation CP control.

### 7.1.1 Orthogonal limit switch output data

| Item | Setting Content | Initial Value | Remark |
|---|---|---|---|
| ON/OFF point setting | −2147483648 to 2147483647 ($\times 10^{-1}$ μm, $\times 10^{-5}$ inch) Unit ($\times 10^{-1}$ μm / $\times 10^{-5}$ inch) | 0 | Up to 10 points can be set for each coordinate. |

### 7.1.2 Orthogonal limit switch output function

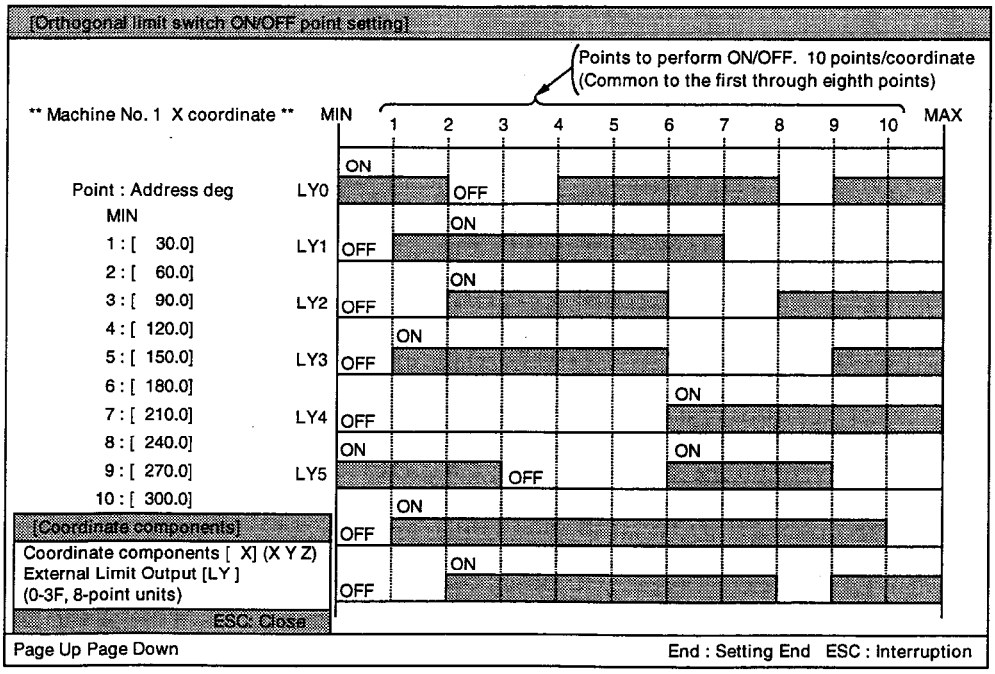
**[Description of Control]**

(1) The orthogonal limit switch function outputs from A1SY42 when A171SCPU is used, or from AY42 when A273UHCPU (8 axes specification) is used, while switching the ON/OFF patterns at the addresses set.
In order to execute the limit switch output function, it is necessary to set at the peripheral device the coordinate components (X/Y/Z) that output limit switch, the output destination (refer to Section 9.1.2(2)) of the external limit switch, addresses of points to perform ON/OFF and the ON/OFF pattern (may not be set using the sequence program).
The limit switch output points as well as ON/OFF points for each coordinate are as follows.

(a) Limit switch output point ..... 8 points/coordinate
Total 64 points

(b) ON/OFF point ..... 10 points/coordinate
Set an address in the stroke limit range for each point.

**[Orthogonal Limit Switch Setting]**



(2) Setting the external limit switch output destination
Set the destination of limit switch output to A1SY42/AY42. Assign the output destination to any 8 points (LY0, LY8, LY10, LY18, LY20, LY28, LY30, LY38, blank).
(Duplicate assignment is not allowed.)

| LY0F | LY0E | LY0D | LY0C | LY0B | LY0A | LY09 | LY08 | LY07 | LY06 | LY05 | LY04 | LY03 | LY02 | LY01 | LY00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 (for axis 2) | | | | | | | | 0 (for axis 1) | | | | | | | |
| LY1F | LY1E | LY1D | LY1C | LY1B | LY1A | LY19 | LY18 | LY17 | LY16 | LY15 | LY14 | LY13 | LY12 | LY11 | LY10 |
| 18 (for axis 4) | | | | | | | | 10 (for axis 3) | | | | | | | |
| LY2F | LY2E | LY2D | LY2C | LY2B | LY2A | LY29 | LY28 | LY27 | LY26 | LY25 | LY24 | LY23 | LY22 | LY21 | LY20 |
| 28 (for axis 6) | | | | | | | | 20 (for axis 5) | | | | | | | |
| LY3F | LY3E | LY3D | LY3C | LY3B | LY3A | LY39 | LY38 | LY37 | LY36 | LY35 | LY34 | LY33 | LY32 | LY31 | LY30 |
| 38 (for axis 8) | | | | | | | | 30 (for axis 7) | | | | | | | |

Example

When the output destination is specified to 0, 0 indicates the head address of the area for axis 1, consisting of LY0 to LY 7 (10 → LY10 to LY17).

(a) When blank is specified, output is not performed.

(b) When the set external limit switch output destination is the same as the limit switch destination that does not use the machine, the orthogonal limit switch output has priority.

Example

When axes 1, 2 and 3 are used for transfer, etc. and the machine is configured with axes 4, 5 and 6, if the output destinations (X, Y and Z coordinates) of the machine's external limit switch are specified to 0, 8, 10 respectively, they are overlapped with the limit switch output destinations of the axes 1, 2 and 3, that do not use the machine. In this case, the orthogonal limit switch output has priority over them.

(3) Limit switch enable/disable setting

The limit switch output may be set to enable/disable for each axis or each point depending on the device as shown below.

By setting the output destination of external limit switch (refer to Section 7.1.2 (2)), the axis that corresponds to each coordinate (X/Y/Z) is determined.

Set the limit switch enable/disable setting to the axes that have been determined during the output destination setting of external limit switch.

Example

When setting the orthogonal limit switch output ON/OFF point as follows:

- Coordinate components X Y
  | |
- External limit output 0 8

The X coordinate is equivalent to axis 1, and the Y coordinate to axis 2.

**Table 7.1 Limit Switch Enable/Disable Setting**

| Set Data/Device | Setting Unit | Process Description | Valid Timing for Set Data |
|---|---|---|---|
| Set external limit output destination for the orthogonal limit switch ON/OFF point setting | Per axis | When set<br>Corresponding axis may output the set ON/OFF patterns.<br>When not set<br>Output of corresponding axes are all OFF. | (1) At the rise of PC ready (M2000)<br>(2) In the test mode |
| Limit switch output disable setting register (D1008 to D1011) | Per point | Disabled (1) bit<br>Output for the disabled (1) bit becomes OFF.<br>Enabled(0) bit<br>Output for the enabled (0) bit outputs the ON/OFF pattern based on the set ON/OFF pattern. | During M2000 ON |

**REMARK**

Data in Table 7.1 are also valid for operations in test mode by using a peripheral device.

(4) Note

(a) The orthogonal limit switch output is triggered by OFF → ON of PC ready (M2000), and performed during the PCPU preparation complete status (M9074 : ON) based on the "actual present value" of each axis. When the PCPU preparation complete flag (M9074) turns OFF, all points become OFF.

(b) The orthogonal limit switch output is output regardless of M18m6/Yn6. To disable the output, set the corresponding bit data to the limit output disable setting register (D1008 to D1011).

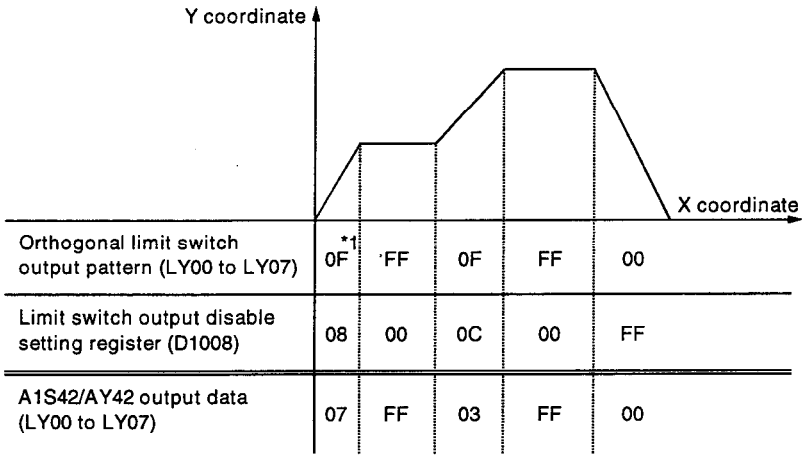
Servo program and operation timing

**[Servo Program]**

<K10>

```
CPSTART XYZ
Speed     900000
ABS—
  Address     P0
ABS—
  Address     P1
ABS—
  Address     P2
ABS—
  Address     P3
ABS—
  Address     P4
CPEND
```

**[Operation Timing]**




| | | | | | |
|---|---|---|---|---|---|
| Orthogonal limit switch output pattern (LY00 to LY07) | 0F *1 | FF | 0F | FF | 00 |
| Limit switch output disable setting register (D1008) | 08 | 00 | 0C | 00 | FF |
| A1S42/AY42 output data (LY00 to LY07) | 07 | FF | 03 | FF | 00 |

*1 0F →

| Output Destination | ON/OFF |
|---|---|
| LY00 | ON |
| LY01 | ON |
| LY02 | ON |
| LY03 | ON |
| LY04 | OFF |
| LY05 | OFF |
| LY06 | OFF |
| LY07 | OFF |

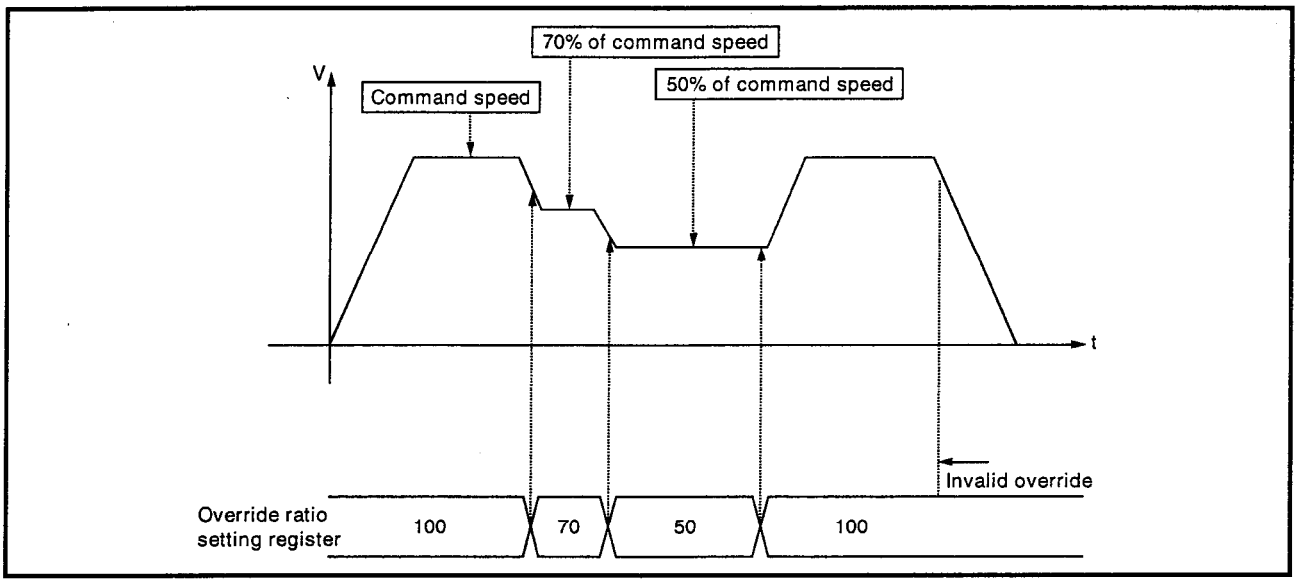
## 7.2 Override Function

At (during) the start of three-dimensional interpolation CP control, the speed may be changed by setting the ratio (override ratio) of the command speed in the servo program (CPSTART XYZ).

**[Notes]**

(1) Set valid override ratio for each machine.

(2) Set it in the override ratio setting register in the range of 0 to 100 (%).
The following shows the speed change timing by the override ratio.




(3) The override ratio is always effective during the three-dimensional interpolation CP control execution.

(4) The override ratio is also valid for speed changes by the DSFLP instruction.

(5) When the override ratio setting register value is out of range (other than 0 to 100), the process listed below is performed:

- At power supply on ····· Controls at the default (100%)
- During operation ····· Continues controlling with the previous data

(6) The override ratio is invalid once the automatic deceleration or deceleration due to an error is started.

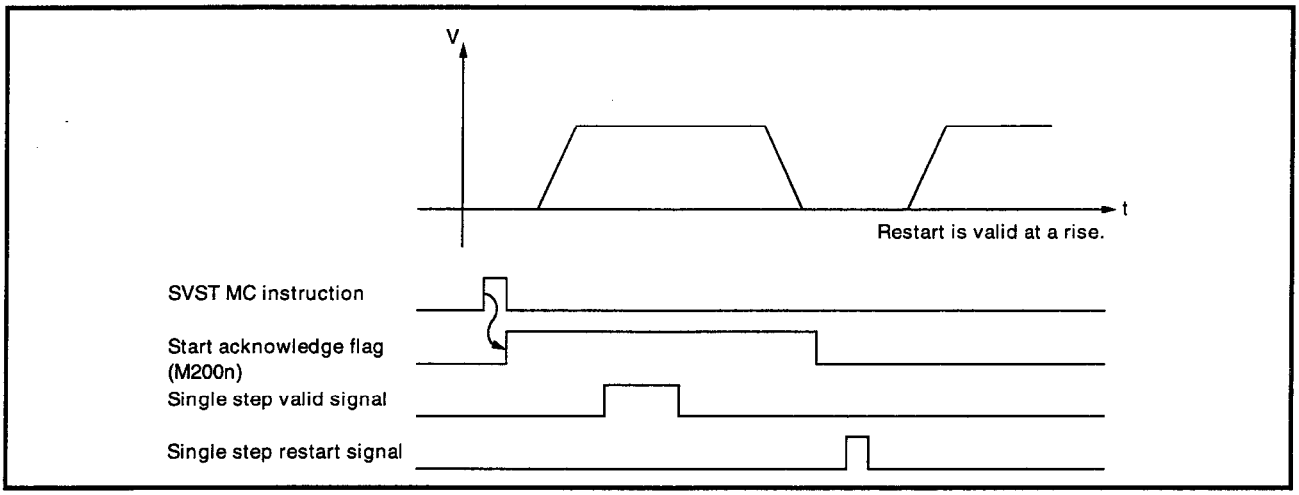
| Name | Machine 1 | | Machine 2 | |
|---|---|---|---|---|
| | Upper Level | Lower Level | Upper Level | Lower Level |
| Override | D663 | D662 | D743 | D742 |

**POINTS**

The override data is backed up.
Directly write the initial override setting of 100 to a sequence program or a device.

## 7.3 Single Step Operation

It is possible to perform a deceleration stop at the end of the point in which the signal was turned ON, by turning ON the single step valid signal during control.
Also, restarting is possible by turning ON the single step restart signal.




(1) The following shows single step valid/restart signals that correspond to the machine number.

| Name | Machine Number * | |
|---|---|---|
| | 1 | 2 |
| Single step valid | M1776 | M1976 |
| Single step restart | M1777 | M1977 |

**REMARK**

* : The assignment of machine number is performed in the system setting mode of peripheral devices.

(2) When adjacent passing is valid, if the single step valid signal turns ON in the middle of operation, it travels to the specified point. By turning the single step valid signal ON again, it resumes from the next step. At this time, the adjacent passing remains valid as well.

# APPENDICES

## APPENDIX 1 SCPU ERROR CODE LIST

If an error occurs when the PC is switched to the RUN status or is in the RUN status, the error indication and error code (including the step number) are stored in a special register by the self-diagnosis function. When an error occurs, refer to Table 1.1 for its cause and the corrective action to take. Eliminate the cause of the error by taking the appropriate corrective action. Error codes can be read at a peripheral device; for details on the relevant operation, see the Operating Manual for the peripheral device.

**⚠ CAUTION**

⚠ When an error occurs, check the points stated in this manual and reset the error.

### 1.1 SCPU Error Code List

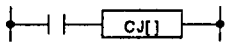
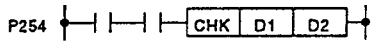
The list presented below gives the error numbers, and the error contents, causes, and corrective actions for each error message.

**Table 1.1 Error Code List**

| Error Message (When an A273UHCPU (8/32 Axis Specification) is Used) | Contents of Special Register D9008 (BIN Value) | CPU Status | Error Contents and Cause | Corrective Action |
|---|---|---|---|---|
| "INSTRCT.CODE ERR"<br>(When an instruction is executed.) | 10 | Stopped | An instruction code that cannot be decoded has been included in the program.<br>(1) A ROM which includes undecodable instruction codes has been installed.<br>(2) The memory contents have changed for some reason and now include an undecodable instruction code. | (1) Read the error step with a peripheral device, and correct the program at that step.<br>(2) If the ROM is the problem, either rewrite its contents or replace it with a ROM into which the correct contents have been written. |
| "PARAMETER ERROR"<br>(On switching on the power or resetting.<br>On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 11 | Stopped | The parameter data in the CPU's memory has been changed due to noise or incorrect installation of the memory. | (1) Check the installation of the memory and install it correctly.<br>(2) Read the parameter data of the CPU memory at a peripheral device, check the data, correct it, and write the corrected data back into the memory. |
| "MISSING END INS."<br>(When M9056 or M9057 is ON.<br>On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 12 | Stopped | (1) There is no END (FEND) instruction in the program.<br>(2) When a subprogram is set in the parameters, there is no END instruction in the subprogram. | (1) Write an END instruction at the end of the program. |
| "CAN'T EXECUTE (P)"<br>(When a CJ/SCJ/JMP/CALL(P)/FOR-NEXT instruction is executed.<br>On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 13 | Stopped | (1) The jump destination designated with a CJ/SCJ/CALL/CALLP/JMP instruction does not exist, or more than one exists.<br>(2) There is a CHG instruction but no subprogram is set.<br>(3) Although there is no CALL instruction, there is a RET instruction in the program and is has been executed.<br>(4) A CJ/SCJ/CALL/CALLP/JMP instruction whose jump destination is at or beyond the END instruction has been executed.<br>(5) The number of FOR instructions does not match the number of NEXT instructions.<br>(6) A JMP instruction has been included between a FOR and NEXT command, exiting the FOR - NEXT sequence.<br>(7) The subroutine has been exited by execution of a JMP instruction before execution of a RET instruction.<br>(8) Execution of a JMP instruction has caused a jump into a step in a FOR - NEXT range, or into a subroutine. | (1) Read the error step with a peripheral device, and correct the program at that step.<br>(Correct, for example, by inserting a jump destination, or making sure there is only one jump destination.) |

APP

## Table 1.1 Error Code List (Continued)

| Error Message (When an A273UHCPU (8/32 Axis Specification) Is Used) | Contents of Special Register D9008 (BIN Value) | CPU Status | Error Contents and Cause | Corrective Action |
|---|---|---|---|---|
| "CHK FORMAT ERR."<br>(On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 14 | Stopped | (1) An instruction other than an LDX, LDIX, ANDX, or ANIX instruction (including NOP) has been included in the same ladder block as a CHK instruction.<br>(2) More than one CHK instruction exists.<br>(3) The number of contacts in a CHK instruction ladder block exceeds 150.<br>(4) The device number of an X device in a CHK instruction ladder block exceeds X7FE when using an A373CPU or X1FFE when using an A373U/A273U.<br>(5) The following ladder block   has not been inserted before the CHK instruction ladder block.<br>(6) The D1 device (number) of a CHK D1 D2 instruction is not the same as the device (number) of the contact before the CJ[ ] instruction.<br>(7) The pointer P254 is not appended at the head of a CHK instruction ladder block.   | (1) Check if any of items (1) to (6) in the column to the left apply to the program with the CHK instruction ladder block, correct any problem in the program with a peripheral device, then restart program operation.<br>(2) This error code is only valid when the I/O control method used is the direct method. |
| "CAN'T EXECUTE (I)"<br>(When an interruption occurs.<br>On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 15 | Stopped | (1) An interrupt module is used but there is no number for the corresponding interrupt pointer I in the program. Or, more than one exists.<br>(2) There is no IRET instruction in the interrupt program.<br>(3) There is an IRET instruction other than in the interrupt program. | (1) Check the whether or not an interrupt program corresponding to the interrupt module exists and either create an interrupt program or eliminate the duplicated I number.<br>(2) Check if there is an IRET instruction in the interrupt program: if there is not, insert one.<br>(3) Check if there is an IRET instruction other than in the interrupt program: if there is, delete it. |
| "CASSETTE ERROR"<br>(On switching on the power or resetting.) | 16 | Stopped | No memory cassette is installed. | Install a memory cassette and reset. |
| "RAM ERROR"<br>(On switching on the power or resetting.<br>When M9084 is turned ON<br>in the STOP status.) | 20 | Stopped | (1) On checking if data can be read from and written to the CPU data memory area normally, it is determined that one or both are not possible. | There is a hardware fault. Contact your nearest Mitsubishi service center, agent, or office, and explain the problem. |
| "OPE.CIRCUIT ERR."<br>(On switching on the power or resetting.) | 21 | Stopped | (1) The operation circuit that executes sequence processing in the CPU does not operate normally. | |
| "WDT ERROR"<br>(At any time) | 22 | Stopped | The scan time has exceeded the watchdog error monitor time.<br>(1) The user program scan time has been exceeded due to the conditions.<br>(2) A momentary power interruption has occurred during scanning, extending the scan time. | (1) Calculate and check the scan time for the user program and shorten the scan time, e.g. by using a CJ instruction.<br>(2) Monitor the contents of special register D9005 with a peripheral device. If the contents are other than "0" the power supply voltage is unstable: in this case check the power supply and reduce voltage fluctuation. |
| "END NOT EXECUTE"<br>(When END processing is executed.) | 24 | Stopped | (1) When the END instruction is executed it is read as another instruction code, e.g. due to noise.<br>(2) The END instruction has been changed to another instruction code somehow. | (1) Reset and establish the RUN status again.<br>If the same error is displayed again, the cause is a CPU hardware error.<br>Contact your nearest Mitsubishi service center, agent, or office, and explain the problem. |
| "WDT ERROR"<br>(At any time) | 25 | Stopped | A loop has been established for execution of the sequence program, due for example to a CJ instruction, and the END instruction cannot be executed. | Check if any program will be run in an endless loop: if there is such a program, modify the program. |
| "UNIT VERIFY ERR."<br>(When an END instruction is executed.<br>(However, no check is performed when M9084 or M9094 is ON.) | 31 | Stopped (RUN) | The I/O information does not match a loaded module when the power is switched ON.<br>(1) An I/O module (this includes special function modules) is loose, or has become detached, during operation. Or, a completely different module has been loaded. | (1) The bit in special registers D9116 to D9123 that corresponds to the module for which the verification error occurred will be set to "1": check for the module whose bit is set to "1" by monitoring these registers with a peripheral device and replace that module.<br>(2) If the current arrangement of loaded modules is acceptable, reset with the reset switch. |

## Table 1.1 Error Code List (Continued)

| Error Message (When an A273UHCPU (8/32 Axis Specification) is Used) | Contents of Special Register D9008 (BIN Value) | CPU Status | Error Contents and Cause | Corrective Action |
|---|---|---|---|---|
| "FUSE BREAK OFF"<br>(When an END instruction is executed. (However, no check is performed when M9084 or M9094 is ON.) | 32 | RUN (Stopped) | There is an output module with a blown fuse. | (1) Check the blown fuse indicator LEDs of the output modules and replace the fuse of the module whose indicator LED is lit.<br>(2) Modules with blown fuses can also be detected by using a peripheral device. The bit in special registers D9100 to D9107 that corresponds a module whose fuse has blown will be set to "1": monitor these registers to check. |
| "CONTROL-BUS ERR."<br>(When FROM, TO instructions are executed. On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 40 | Stopped | FROM, TO instructions cannot be executed.<br>(1) Fault in the control bus to the special function module. | (1) There is a hardware fault of the special function module, CPU module, or base unit: replace each module/unit to find the defective one. Contact your nearest Mitsubishi service center, agent, or office, and explain the problem with the defective module/unit. |
| "SP.UNIT DOWN"<br>(When FROM, TO instructions are executed. On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 41 | Stopped | On execution of a FROM, TO instruction, a special function module was accessed but no response was received.<br>(1) The accessed special function module is faulty. | There is a hardware fault in the accessed special function module: contact your nearest Mitsubishi service center, agent, or office, and explain the problem. |
| "LINK UNIT ERROR"<br>(On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 42 | Stopped | (1) A data link module for use with MELSECNET has been loaded at the master station. | (1) Remove the data link module for MELSECNET from the master station. After making this correction, reset and start operation from the initial status. |
| "I/O INT.ERROR"<br>(When an interruption occurs.) | 43 | Stopped | An interruption has occurred although there is no interrupt module. | (1) There is a hardware fault in one of the modules: replace each module in turn to determine which one is defective. Contact your nearest Mitsubishi service center, agent, or office, and explain the problem with the defective module. |
| "SP.UNIT LAY.ERR."<br>(On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 44 | Stopped | (1) Three or more computer link modules have been installed for one CPU module.<br>(2) Two or more data link modules for MELSECNET have been installed.<br>(3) Two or more interrupt modules have been installed.<br>(4) In the parameter settings made at a peripheral device, an allocation for a special function module has been made where there is in fact an I/O module, or vice versa. | (1) Do not install more than two computer link modules.<br>(2) Do not install more than one data link module for MELSECNET.<br>(3) Install only one interrupt module<br>(4) Re-set the I/O allocations in the parameter settings made at the peripheral device so that they agree with the loaded modules. |
| "SP.UNIT ERROR"<br>(When a FROM, TO instruction is executed) | 46 | Stopped (RUN) | (1) A location where there is no special function module has been accessed (when the FROM, TO instruction was executed). | (1) Read the error step using a pe-ripheral device, check the contents of the FROM, TO instruction at that step, and correct it using the peripheral device. |
| "LINK PARA.ERROR"<br>(On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN}) | 47 | RUN | (1) The data written to the link parameter area when link range settings are made by parameter setting at a peripheral device differ for some reason from the parameter data read by the CPU.<br>(2) The setting for the total number of slave stations is "0". | (1) Write the parameters again and check.<br>(2) If the error is displayed again, there is a hardware fault. Contact your nearest Mitsubishi service center, agent, or office, and explain the problem. |
| "OPERATION ERROR"<br>(When a command is executed) | 50 | RUN (Stopped) | (1) The result of BCD conversion is outside the stipulated range (max. 9999 or 99999999).<br>(2) A setting exceeding the stipulated device range has been made and operation is therefore impossible.<br>(3) A file register has been used in the program without having made a file register capacity setting. | (1) Read the error step with a pe ripheral device, and correct the program at that step. (Check the device setting range, BCD conversion value, etc.) |
| "BATTERY ERROR"<br>(At any time (However, no check is performed when M9084 is ON.)) | 70 | RUN | (1) The battery voltage has fallen below the stipulated value.<br>(2) The battery's lead connecter has not been installed. | (1) Replace the battery.<br>(2) If the battery is used to back up the RAM memory or to retain memory contents during momentary power interruptions, install a lead connector. |

## APPENDIX 2 ERROR CODES STORED BY THE PCPU

The errors that are detected at the PCPU are servo program setting errors and positioning errors.

(1) Servo program setting errors

Servo program setting errors are errors in the positioning data set in the servo program and are checked for when a servo program is started. They are errors that occur when the positioning data is designated indirectly.

When a servo program setting error occurs, the following happens:

- The servo program setting error flag (M9079) comes ON.
- The program number of the program in which the error occurred is stored in the error program No. register (D9189).
- The error code is stored in the error item information register (D9190).

(2) Positioning error

(a) Positioning errors are errors that occur when positioning starts or during positioning: they are classified into minor errors, major errors, and servo errors.

1) Minor errors..... These are errors generated by sequence programs or servo programs; they are assigned error codes 1 to 999.
The cause of minor errors can be eliminated by checking the error code and correcting the sequence program or servo program.

2) Major error..... These are errors generated by external input signals or control commands from the SCPU; they are assigned error codes 1000 to 1999.
When a major error occurs, check the error code and eliminate the error cause in the external input signal status or sequence program.

3) Servo error..... These are errors detected by the servo amplifier; they are assigned error codes 2000 to 2999.
When a servo error occurs, check the error code and eliminate the error cause at the servo side.

(b) When an error occurs, the error detection signal for the relevant axis comes ON, and the error code is stored in the minor error code, major error code, or servo error code register.

**Table 2.1 Error Code Registers, Error Detection Flags**

<A171SCPU>

| Device / Error Class | Error Code Register | | | | Error Detection Signal |
|---|---|---|---|---|---|
| | Axis 1 | Axis 2 | Axis 3 | Axis 4 | |
| Minor error | D806 | D826 | D846 | D866 | M1607+20n |
| Major error | D807 | D827 | D847 | D867 | |
| Servo error | D808 | D828 | D848 | D868 | M1608+20n |

<A273UHCPU (8 axis specification)>

**Table 2.2 Error Code Registers, Error Flags**

| Device / Error Class | Error Code Register | | | | | | | | Error Detec-tion Signal |
|---|---|---|---|---|---|---|---|---|---|
| | Axis 1 | Axis 2 | Axis 3 | Axis 4 | Axis 5 | Axis 6 | Axis 7 | Axis 8 | |
| Minor error | D806 | D826 | D846 | D866 | D886 | D906 | D926 | D946 | Xn7 |
| Major error | D807 | D827 | D847 | D867 | D887 | D907 | D927 | D947 | |
| Servo error | D808 | D828 | D848 | D868 | D888 | D908 | D928 | D948 | Xn8 |

<A273UHCPU (32 axis specification)>

**Table 2.3 Error Code Registers, Error Flags**

| Device / Error Class | Error Code Register | | | | | | | | | | | | | | | | Error Detection Signal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Axis 1 | Axis 2 | Axis 3 | Axis 4 | Axis 5 | Axis 6 | Axis 7 | Axis 8 | Axis 9 | Axis 10 | Axis 11 | Axis 12 | Axis 13 | Axis 14 | Axis 15 | Axis 16 | |
| Minor error | D6 | D26 | D46 | D66 | D86 | D106 | D126 | D146 | D166 | D186 | D206 | D226 | D246 | D266 | D286 | D306 | M2407+20n |
| Major error | D7 | D27 | D47 | D67 | D87 | D107 | D127 | D147 | D167 | D187 | D207 | D227 | D247 | D267 | D287 | D307 | |
| Servo error | D8 | D28 | D48 | D68 | D88 | D108 | D128 | D148 | D168 | D188 | D208 | D228 | D248 | D268 | D288 | D308 | M2408+20n |

| Device / Error Class | Error Code Register | | | | | | | | | | | | | | | | Error Detection Signal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Axis 17 | Axis 18 | Axis 19 | Axis 20 | Axis 21 | Axis 22 | Axis 23 | Axis 24 | Axis 25 | Axis 26 | Axis 27 | Axis 28 | Axis 29 | Axis 30 | Axis 31 | Axis 32 | |
| Minor error | D326 | D346 | D366 | D386 | D406 | D426 | D446 | D466 | D486 | D506 | D526 | D546 | D566 | D586 | D606 | D626 | M2407+20n |
| Major error | D327 | D347 | D367 | D387 | D407 | D427 | D447 | D467 | D487 | D507 | D527 | D547 | D567 | D587 | D607 | D627 | |
| Servo error | D328 | D348 | D368 | D388 | D408 | D428 | D448 | D468 | D488 | D508 | D528 | D548 | D568 | D588 | D608 | D628 | M2408+20n |

(c) If another error occurs after an error code has been stored, the existing error code is overwritten, deleting it.
However, it is possible to check the history of error occurrence by using a peripheral device started up with the GSV13PE/GSV22PE software.

(d) Error detection flags and error codes are latched until the error code reset signal (M1807+20n/Yn7/M3207+20n) or servo error reset signal (M1808+20n/Yn8/M3208+20n) comes ON.

**POINTS**

(1) When some servo errors occur, the same error code will be stored again even if the servo error reset signal (M1806+20n/Xn8/M3208+20n: ON) is issued.
(2) When a servo error occurs, reset the servo error after first eliminating the error cause at the servo side.

## 2.1 Servo Program Setting Errors

The error codes, error contents, and corrective actions for servo program setting errors are shown in Table 2.4. The "**" in error codes marked with an asterisk indicates the axis number (1 to 4/1 to 8/1 to 32).

**Table 2.4 Servo Program Setting Error List**

| Error Code Stored In D9190 | Error Name | Error Contents | Error Processing | Corrective Action |
|---|---|---|---|---|
| 1 | Parameter Block number Setting error | The designated parameter block number is outside the range 1 to 16 (A273UH 32-axis specification : 1 to 64). | The servo program is executed with the parameter block number set to the default value of "1". | Designate the parameter block number in the range 1 to 16 (1 to 64). |
| n03* | Address/travel value setting error (Excluding speed control and speed/position switching control) | (1) An address outside the designated range is set when executing absolute positioning control.<br>Units: degree; Address Setting Range: 0 to 35999999; × $10^{-4}$degree | (1) Axis motion does not start. (When executing interpolation control, none of the interpolation control axes start.)<br>(2) If the error is detected during speed switching control or constant speed control, a deceleration stop is executed.<br>(3) When multiple servo programs are to be executed simultaneously, if an error occurs in one servo program none of the programs are executed. | (1) If the control unit is degrees, set the address in the range 0 to 35999999. |
| | | (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control. | | (2) Set the travel value in the range 0 to ±($2^{31}$−1). |
| 4 | Commanded speed error | (1) The commanded speed is set outside the range of 1 to the speed limit value.<br>(2) The designation for the commanded speed is outside the applicable range.<br>mm: 1 to 600000000; × $10^{-2}$mm/min<br>inch: 1 to 600000000; × $10^{-3}$inch/min<br>degree: 1 to 600000000; × $10^{-4}$degree/min<br>PULSE: 1 to 1000000; PLS/sec | (1) The axis does not start if the commanded speed is set at "0" or less.<br>(2) If the set commanded speed exceeds the speed limit value, control is executed at the speed limit value. | (1) Set the commanded speed in the range from 1 to the speed limit value. |
| 5 | Dwell time setting error | The dwell time is set outside the range 0 to 5000. | Control is executed using the default value of "0". | Set the dwell time in the range from 0 to 5000. |
| 6 | M code setting error | The M code is set outside the range 0 to 255. | Control is executed using the default value of "0". | Set the M code in the range from 0 to 255. |
| 7 | Torque limit value setting error | The torque limit value is set outside the range 1 to 500. | Control is executed using the torque limit value set in the designated parameter block. | Set the torque limit value in the range from 1 to 500. |
| n08* | Auxiliary point setting error (when executing circular interpolation by designating an auxiliary point). | (1) An address outside the designated range is set when executing absolute positioning control.<br>Units: degree; Address Setting Range: 0 to 35999999; × $10^{-4}$degree | Positioning control does not start. | (1) If the control unit is degrees, set the address in the range 0 to 35999999. |
| | | (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control. | | (2) Set the travel value in the range 0 to ±2147483647. |
| | | (3) The start point is also the auxiliary point, or the auxiliary point is also the end point. | | (3) Set the start, auxiliary, and end points so that they are not equal to one another. |
| | | (4) The auxiliary point is located on a straight line between the start and end points. | | (4) Set the auxiliary point at a location not on the straight line between the start and end points. |
| n09* | Radius setting error (when executing circular interpolation by designating a radius) | (1) An address outside the applicable range is set when executing absolute positioning control.<br>Units: degree; Address Setting Range: 0 to 35999999; × $10^{-4}$degree | Positioning control does not start. | (1) If the control unit is degrees, set the address in the range 0 to 35999999. |
| | | (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control. | | (2) Set the travel value in the range 0 to ±2147483647. |
| | | (3) The start point is also the end point. | | (3) Set the start and end points so that they are not equal to each another. |
| | | (4) The distance between the start and end points is greater than the radius. | | (4) Change the relationship between the start-to-end point distance (L) and the radius (R) so that it conforms with the following equation: $\frac{L}{2R} \leq 1$ |

## Table 2.4 Servo Program Setting Error List (Continued)

<table>
<tr><th>Error Code Stored In D9190</th><th>Error Name</th><th>Error Contents</th><th>Error Processing</th><th>Corrective Action</th></tr>
<tr><td rowspan="2">n10*</td><td rowspan="2">Center point setting error (when executing circular interpolation by designating a center point)</td><td>(1) An address outside the applicable range is set when executing absolute positioning control.<br><table><tr><th>Units</th><th colspan="2">Address Setting Range</th></tr><tr><td>degree</td><td>0 to 35999999</td><td>x $10^{-5}$degree</td></tr></table></td><td rowspan="2">Positioning control does not start.</td><td>(1) If the control unit is degrees, set the address in the range 0 to 35999999.</td></tr>
<tr><td>(2) The travel value is set to -2147483648 (H80000000) when executing incremental positioning control.</td><td>(2) Set the travel value in the range 0 to ±2147483647.</td></tr>
<tr><td>11</td><td>Interpolation control unit setting error</td><td>The interpolation control unit is set outside the range 0 to 3.</td><td>Control is executed at the default value of "3".</td><td>Set the interpolation control unit in the range 0 to 3.</td></tr>
<tr><td>12</td><td>Speed limit value setting error</td><td>The speed limit value is set outside the applicable range.</td><td>Control is executed at the default value of 200000 PLS/sec.</td><td>Set the speed limit value in the specified range.</td></tr>
<tr><td>13</td><td>Acceleration time setting error</td><td>The acceleration time is set to "0".</td><td rowspan="3">Control is executed at the default value of 1000.</td><td>Set the acceleration time in the range 1 to 65535.</td></tr>
<tr><td>14</td><td>Deceleration time setting error</td><td>The deceleration time is set to "0".</td><td>Set the deceleration time in the range 1 to 65535.</td></tr>
<tr><td>15</td><td>Rapid stop deceleration time setting error</td><td>The rapid stop deceleration time is set to "0".</td><td>Set the rapid stop deceleration time in the range 1 to 65535.</td></tr>
<tr><td>16</td><td>Torque limit value setting error</td><td>The torque limit value is set outside the range 1 to 500.</td><td>Control is executed at the default value of 300%.</td><td>Set the torque limit value in the range 1 to 500.</td></tr>
<tr><td>17</td><td>Allowable error range for circular interpolation setting error</td><td>The allowable error range for circular interpolation is set outside the applicable range.<br><table><tr><th>Units</th><th colspan="2">Address Setting Range</th></tr><tr><td>mm</td><td rowspan="4">1 to 100000</td><td>x $10^{-1}$µm</td></tr><tr><td>inch</td><td>x $10^{-5}$inch</td></tr><tr><td>degree</td><td>x $10^{-5}$degree</td></tr><tr><td>PULSE</td><td>PLS</td></tr></table></td><td>Control is executed at the default value (100PLS).</td><td>Set the allowable error range for circular interpolation in the applicable range.</td></tr>
<tr><td>18</td><td>Repeat count error</td><td>The repeat count is set outside the range 1 to 32767.</td><td>Control is executed with the repeat count set to "1".</td><td>Set the repeat count in the range 1 to 32767.</td></tr>
<tr><td rowspan="3">19</td><td rowspan="3">START instruction setting error</td><td>(1) The servo program designated by the START instruction does not exist.</td><td rowspan="3">Positioning control does not start.</td><td>(1) Create a servo program designated by the START instruction.</td></tr>
<tr><td>(2) There is a START instruction in the designated servo program.</td><td>(2) Delete the servo program containing the START instruction.</td></tr>
<tr><td>(3) More than one axis has been designated for the started servo program.</td><td>(3) Do not designate more than one axis.</td></tr>
<tr><td>20</td><td>Point setting error</td><td>No point has been designated in the instruction for constant speed control.</td><td>Positioning control does not start.</td><td>Designate a point between CPSTART and CPEND.</td></tr>
<tr><td>21</td><td>Reference axis speed setting error</td><td>In linear interpolation using the reference axis speed designation method, an axis not involved in the interpolation has been designated as the reference axis.</td><td>Positioning control does not start.</td><td>Set one of the axes involved in the interpolation as the reference axis.</td></tr>
<tr><td>22</td><td>S-curve ratio setting error</td><td>The S-curve ratio when designating S-curve acceleration/deceleration is outside the range 0 to 100%.</td><td>Control is executed with an S-curve ratio of 100%.</td><td>Set the S-curve ratio within the range 0 to 100%.</td></tr>
<tr><td>23</td><td>VSTART setting error</td><td>Not even one speed switching point has been set between a VSTART and VEND instruction, or between a FOR and NEXT instruction. (Applies with A273UHCPU (8/32 axis specification) only.)</td><td>Positioning control does not start.</td><td>Set a speed switching point between the VSTART and VEND instructions or the FOR and NEXT instructions.</td></tr>
<tr><td>24</td><td>Cancel function start program No. error</td><td>The start program No. for the cancel function has been set outside the range 0 to 4095.</td><td>Positioning control does not start.</td><td>Set the start program No. within the range 0 to 4095 and then start.</td></tr>
<tr><td>25</td><td>High-speed oscillation command amplitude error</td><td>Operation cannot be started because the amplitude commanded for the high-speed oscillation function is outside the range 1 to 2147483647.</td><td>Positioning control does not start.</td><td>Set the commanded amplitude within the range 1 to 2147483647 and then start.</td></tr>
<tr><td>26</td><td>High-speed oscillation starting angle error</td><td>Operation cannot be started because the commanded starting angle for the high-speed oscillation function is outside the range 0 to 3599 (x 0.1 degrees).</td><td>Positioning control does not start.</td><td>Set the starting angle within the range 0 to 3599 (x 0.1 degrees) and then start.</td></tr>
<tr><td>27</td><td>High-speed oscillation frequency error</td><td>Operation cannot be started because the commanded frequency for the high-speed oscillation function is outside the range 1 to 5000 (CPM).</td><td>Positioning control does not start.</td><td>Set the frequency within the range 1 to 5000 (CPM) and then start.</td></tr>
</table>

## Table 2.4 Servo Program Setting Error List (Continued)

| Error Code Stored in D9190 | Error Name | Error Contents | Error Processing | Corrective Action |
|---|---|---|---|---|
| 900 | START instruction setting error | The servo program designated by the DSFRP/SVST program does not exist. | Positioning control does not start. | Set the correct servo program number. |
| 901 | START instruction setting error | (1) The axis number set for the DSFRP/SVST instruction is different from the axis number set for the servo program. | Positioning control does not start. | (1) Set the correct axis number. |
| | | (2) A DSFRP instruction has been used when executing 4-axis linear interpolation. | | (2) Use the SVST instruction for 4-axis linear interpolation. |
| 902 | Servo program instruction code error | The instruction code cannot be decoded (a non-existent instruction code has been designated). | Positioning control does not start. | Set the correct instruction code. |
| 903 | Start error | A virtual mode program was started in the real mode. | Positioning control does not start. | Check the mode allocation for the program. |
| 904 | Start error | A real mode program was started in the virtual mode. | Positioning control does not start. | Check the mode allocation for the program. |
| 905 | Start error | An instruction that cannot be used in the virtual mode (VPF, VPR, VPSTART, ZERO, VVF, VVR, OSC) was issued. | Positioning control does not start. | Correct the servo program. |
| 906 | Axis No. setting error | An axis not used in the system settings has been set for the servo program set in a DSFRP/SVST instruction. | Positioning control does not start. | Set an axis number that is setted in the system settings. |
| 907 | Start error | Start attempted during processing for switching from real mode to virtual mode. | Positioning control does not start. | Use M2034 (real/virtual mode switching request), M2044 (real/virtual mode status) as interlocks for starting. |
| 908 | Start error | Start attempted during processing for switching from virtual mode to real mode. | | |

## 2.2 Minor Errors

(1) (2) Errors at Startup (100 to 199)

The following lists errors detected at startup.

The error codes, error cause, error processing, and corrective actions are shown in Table 2.5.

* : During interpolation, an error code is stored in the error code storage areas of all corresponding interpolation axes.

**Table 2.5 List of Errors at Startup (100 to 199)**

| Error Code | Control Type | | | | | | | | | | | | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | | | |
| 100 | | | | | | | ○ | ○ | ○ | | | | • PC ready (M2000) or PCPU preparation complete (M9074) is OFF. | Stopped | • Set the servo system CPU to RUN. |
| 101 | | | | | | | ○ | ○ | ○ | | | | • Start acknowledge of corresponding axis (M2001 to M2008) is ON. | | • Set the PC ready (M2000) to ON. |
| 103 | | | | | | | ○ | ○ | ○ | | | | • Stop command of corresponding axis (M1800 + 20n) is ON. | | • Interlock using the program so the axis during startup is not started. (Enter the corresponding axis and the start enable OFF as the start condition.) |
| 104 | | | | | | | ○ | ○ | ○ | | | | • Sudden stop command of corresponding axis (M1801 + 20n) is ON. | | • Set the stop instruction (M1800 + 20n) to OFF, then start. |
| 106* | | | | | | | | | | | | | • Positioning is specified to out of stroke limit range. | | • Set the sudden stop instruction (M1801 + 20n) to OFF, then start. |
| 107 | | | | | | | | | | | | | • In the circular interpolation by setting an auxiliary point, the specified address does not make an arc. (Relationship of the start-point, auxiliary-point and end-point addresses) | | • Perform positioning within the stroke limit range. |
| 110* | ○ | | | | | ○ | | | | | | | • In circular interpolation, difference of the end point address and the ideal end point exceeds the allowable circular interpolation error range. | | • Correct the address for the MELFA-BASIC program. |
| 115 | | | | | | | | | ○ | | | | • At the start of near point dog method zero return, the zero return complete (M1610+20n) is ON. | | • Repeated start of zero return cannot be performed.<br>• Return to the state before the near point dog ON by JOG or positioning, then perform zero return. |
| 116 | | | | | | | ○ | | | | | | • JOG speed is set to 0.<br>• The set JOG speed exceeds the JOG speed limit value. | Controlled by the JOG speed limit value. | • Set the correct speed (within the range). |
| 117 | | | | | | | | ○ | | | | | • At the simultaneous start of JOG operation, the same axis is set for both forward and reverse | Performs forward start of only the corresponding axis. | • Set correctly. |
| 120 | | | | | | | | | | ○ | | | ZCT is not set.<br>At the re-travelling of the dog-method or count-method zero return or at startup of data-set-method zero return, the zero point passing signal(M1606 + 20n) is OFF. | Zero return does not complete normally. | • Perform zero return after passing the zero point. |

**Table 2.5 List of Errors at Startup (100 to 199) (Continued)**

| Error Code | Control Type | | | | | | | | | | | | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | | | |
| 161* | | | | | | | | | | | | ○ | • Inconsistent solution error<br>• Because the end address is at a special point, the values J1 to J16 for the end point cannot be operated. | JOG speed is set to 0. | • Correct the point block address of servo program. |
| 162* | | | | | | | | | | | | ○ | • Out of operation range error<br>• The end address is out of operation range (a position where the robot arm cannot reach). | | • Correct the point block address of servo program. |
| 163* | | | | | | | | | | | | ○ | • Construction flag interpolation error<br>• Because the construction flag (position information, multiple rotation information) of the end address is different from the start point, the linear and circular interpolation cannot be performed. | | • Correct the point block address of servo program.<br>• Correct the MELFA-BASIC program so it performs joint interpolation. |
| 166* | | | | | | | | | ○ | | | ○ | • Positioned out of orthogonal stroke limit range (three-dimensional interpolation CP). Three-dimensional<br>• Three-dimensional interpolation CP control has been started out of the orthogonal stroke limit range.<br>• Orthogonal JOG has been started in the off-direction from the orthogonal stroke limit range. | | • Position within the orthogonal stroke limit range.<br>• Move into the orthogonal stroke limit range by JOG, etc.<br>• When the orthogonal stroke limit is unnecessary, set the orthogonal stroke limit invalid (machine1...M1778) to ON. |
| 172 | | | | | | | | | | | | ○ | • Excessive adjacent amount<br>Adjacent amount value exceeds 214,748mm. | | • Set the adjacent amount value within the range. |
| 173 | | | | | | | | | | | | ○ | • Excessive speed specification<br>Command speed is over the speed limit value.<br>When speed limit value is 60000.00mm/min, the specification speed is 1000mm/sec. | | • Set the command speed below the speed limit value. |
| 174 | | | | | | | | | | | | ○ | • Out of override range<br>Override range exceeds 100%. | | • Set the range of override from 1 to100%. |

(3) Errors during startup (200 to 299)
The errors detected at start.
The error codes, error causes, error processing and corrective actions are shown in Table 2.6.

**Table 2.6 List of Errors During Startup (200 to 299)**

| Error Code | Control Type | | | | | | | | | | | | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | | | |
| 200 | | | | | | | ○ | ○ | | | | ○ | • During startup by a start request from the sequence program, the PC ready (M2000) became OFF. | Deceleration stopped | • Set the PC ready (M2000) to ON after all axes have stopped. |
| 201 | | | | | | | | | ○ | | | | • During zero return, the PC ready (M2000) became OFF. | | • Perform zero return again after setting the PC ready (M2000) to ON, or the stop command (M1800 + 20n) and sudden stop command (M1801 + 20n) to OFF. (For the near point dog method, perform zero return again after returning to the state before near point dog was turned ON, by the JOG operation or positioning.) |
| 202 | | | | | | | | | ○ | | | | • During zero return, the stop command (M1800 + 20n) became ON. | | |
| 203 | | | | | | | | | ○ | | | | • During zero return, the sudden stop command (M1800 + 20n) became ON. | Sudden stop | |
| 204 | | | | | | | ○ | ○ | ○ | | | ○ | • During deceleration by the PC ready (M2000) turned OFF, the PC ready (M2000) was turned ON again. | No operation | • After all axes have stopped, set the PC ready (M2000) from OFF to ON. (OFF → ON of PC ready (M2000) during deceleration will cause no operation.) |
| 207 | | | | | | | ○ | | | | | ○ | • During startup, the present feed value exceeded the stroke limit range. For circular interpolation, only the axes at which the stroke limit range was exceeded are stored. | Deceleration stopped | • Correct the stroke limit range or set travel so the positioning control is performed within the stroke limit range. |
| | | | | | | | | | | | | | • Zero return is not completed when the absolute position detection of the rotating axis is performed. | | • Perform zero return. |
| 211 | | | | | | | | | | | | | • During startup, when the final positioning address is detected, an overrun occurs because the deceleration distance falls short of the distance for the output speed. | | • Set the speed that does not result in overrun.<br>• Set the travel that does not result in overrun. |
| 214 | | | | | | | | ○ | | | | | • The corresponding axis tried to operate in the manual pulse generator mode by enabling the manual pulse generator during startup. | Manual pulse generator is ignored until it stops. | • After the corresponding axis has stopped, perform the manual pulse generator operation. |
| 226 | | | | | | | | | | | | ○ | • The override ratio became out of 1 to 100% range. | Continued | • Set in the range of 0 to 100%. |

**Table 2.6 List of Errors During Startup (200 to 299) (Continued)**

| Error Code | Control Type | | | | | | | | | | | | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | | | |
| 231 | | | | | | | | | | | | | • Inconsistent solution error<br>Interpolation computation of J1 to J16 cannot be performed because it passes a special path. | Sudden stop | • Correct the servo program. |
| 232 | | | | | | | | | | | | | • Out of operation range error<br>Tried to move out of operation range during transfer (tried to move to a position the robot arm cannot reach). | | • Correct the point block address of the servo program. |
| 235 | | | | | | | | | | | | | • Machine axis over speed (own axis)<br>When the specified machine operation is performed, speed limit value for the axis (machine constant 2) is exceeded. | | • Set the speed so it does not become over speed.<br>Correct the servo program so joint interpolation will be performed. |
| 236 | | | | | | | | | | | | | • Machine axis over speed(other axis)<br>Machine axis over speed(error code 235) occurred at other machine axis. (This is for detecting errors of other axes.)<br>e.g.) When axis J6 becomes has an over speed, axes J1 to J5 will get error code 236, while axis J6 will get error code 235. | | |
| 237 | | | | | | | | | | | | ○ | • Orthogonal stroke limit (machine axis)<br>During startup, the coordinate value exceeded the orthogonal stroke limit range (for the axis which is assigned to the machine). | | • Correct the orthogonal stroke limit range or the set travel so that the positioning control is within the orthogonal stroke limit range.<br>When the orthogonal stroke limit is unnecessary, set the orthogonal stroke limit invalid (M1778) to ON. |
| 238 | | | | | | | | | | | | ○ | • Orthogonal stroke limit (non-machine axis)<br>During startup, when there are interpolation axes that are assigned to the machine, the coordinate value of the machine exceeded the orthogonal stroke limit range. (This is for detecting errors of the axes that are not assigned to the machine.)<br>(e.g.) Assume axes 1 to 6 are assigned to J1 to J6 of the machine and axes 7 and 8 are not a part of the machine configuration. At this time, if interpolation is performed with two axes, namely axes 1 and 7, and the machine exceeds the orthogonal stroke limit range, axis 1 gets error code 237 and axis 7 gets error code 238. | | |

## 2.3 Major Error

The major errors are generated by the control commands from the external input signals or the SCPU, and have the error codes of 1000 to 1999.
The major errors include errors at startup, errors during startup, absolute value system errors and the system error.

(1) Errors at startup (1000 to 1999)
The errors detected at starting.
The error code, cause of error, error processing, corrective actions are listed in the table 2.6.

**Table 2.7 List of Errors at Startup (1000 to 1099)**

| Error Code | Control Type | | | | | | | | | | | | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | | | |
| 1000 | | | | | | | ○ | ○ | ○ | | | ○ | • External stop signal for the corresponding axis became ON. | Sudden stop | • Turn OFF the stop signal. |
| 1001 | | | | | | | ○ | ○ | ○ | | | ○ | • At a forward-direction (address increasing direction) startup, external FLS (high limit LS) signal was OFF. | | • Move in the reverse direction using the JOG operation, etc. and set it back to the external limit range. |
| 1002 | | | | | | | ○ | ○ | ○ | | | ○ | • At a reverse-direction (address decreasing direction) startup, external RLS (low limit LS) signal was OFF. | | • Move in the forward direction using the JOG operation, etc. and set it back to the external limit range. |
| 1003 | | | | | | | | | ○ | | | ○ | • At the near point dog method zero return startup, external DOG (near point dog) signal was turned ON. | | • Set it back to the state before the near point dog was turned ON using the JOG operation, etc., then perform zero return. |
| 1004 | | | | | | | ○ | ○ | ○ | | | ○ | • The servo status of the corresponding axis is not READY (M1615 + 20n : OFF).<br>(1) Servo amplifier power is OFF.<br>(2) During initial processing because the servo amplifier power was turned ON.<br>(3) Servo amplifier unloaded<br>(4) Servo error<br>(5) Cable fault | | • Wait until the servo status becomes READY (M1615 + 20n : OFF). |
| 1005 | | | | | | | ○ | ○ | ○ | | | ○ | • Servo error detection signal (M1608 + 20n) of the corresponding axis was turned ON. | | • After removing the error from the servo side, reset M1608 + 20n with the servo error reset (M1808 + 20n), then start. |

(2) Errors during startup (1100 to 1199)
These are the errors detected during startup.
The error code, error causes, error processing and corrective actions are shown in Table 2.8.

**Table 2.8 List of Errors during Startup (1100 to 1199)**

| Error Code | Control Type: Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1101 | | | | | | | ○ | ○ | ○ | | | ○ | • During the forward-direction (address increasing direction) start, external FLS (high limit LS) signal is turned OFF. | Deceleration stop according to the "stop processing upon STOP input" in the parameter block. | • Move in the reverse direction using the JOG operation, etc. and set it back to the external limit range. |
| 1102 | | | | | | | ○ | ○ | ○ | | | ○ | • During the reverse-direction (address decreasing direction) start, external RLS (low limit LS) signal is turned OFF. | | • Move in the forward direction using the JOG operation, etc. and set it back to the external limit range. |
| 1103 | | | | | | | | | ○ | | | | • During zero return, the external signal stop (stop signal) is turned ON. | | • If during near point dog method zero return, set it back to the state before the near point dog was turned ON using the JOG operation, etc., then perform zero return. |
| 1104 | | | | | | | ○ | ○ | ○ | | | ○ | • During startup, the servo error detection is turned ON. | Immediate stop without deceleration | • It becomes ready to restart after the servo error processing. |
| 1105 | | | | | | | ○ | ○ | ○ | | | ○ | • During startup, the servo amplifier power is turned OFF (servo unloaded detected, faulty cables, etc.). | Turn OFF M1615 + 20n. | • Turn ON the servo amplifier power. Confirm the connection cable to the servo amplifier. |

(3) Absolute position system errors (1200 to 1299)
These are the errors detected in the absolute position system.
The error codes, error causes, error processing and corrective actions are shown in Table 2.9.

**Table 2.9 Absolute Position System Error List (1200 to 1299)**

| Error Code | Control Type: Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1201 | | | | | | | | | | | | | • Upon power on, a sum check error for backup data (standard value) occurred. | Stopped | • Replace the main module because the internal memory error has occurred or the EEROM life has been expired in the servo system CPU.<br>• This may occur at the time of purchase. In this case, perform zero return. |

(4) System errors (1300 to 1399, 1500 to 1599)
These are the errors detected when the power is started.
The error codes, error causes, error processing and corrective actions are shown in Table 2.9.

**Table 2.10 List of Errors on the Basic Base Side (1300 to 1399, 1500 to 1599)**

| Error Code | Control Type | | | | | | | | | | | | Error Cause | Error Processing | Corrective Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Positioning | Fixed-dimension feed | Speed | Speed position | Speed switch | Uniform speed | JOG | Manual pulse generator | Zero return | Position follow-up | OCR | Three-dimensional interpolation CP | | | |
| 1330 | | | | | | | | | | | | ○ | •There is a fraction in gear ratio on the rotating shaft.<br>•The gear ratio exceeds the operation range. | Stopped | • Review the parameters. |
| 1332 | | | | | | | | | | | | ○ | •A machine type which is not applicable is set. | | • Correct the machine type setting. Install the machine library compatible with the set machine type to the servo system CPU. |
| 1333 | | | | | | | | | | | | ○ | • An axis number which is not applicable is assigned to the machine. | | • Review the axis number assignment of the joint axis definition in the system setting. |
| 1334 | | | | | | | | | | | | ○ | • The same axis number is set in different machine settings.<br>• The axis assignments are overlapped in the same machine. | | • Review the axis number assignment of the joint axis definition in the system setting. |
| 1335 | | | | | | | | | | | | ○ | • The combination pattern set for each of the machine's axes cannot be used in the set machine type. | | • Review the unit setting of each axis. |
| 1336 | | | | | | | | | | | | ○ | • The interpolation control unit of the parameter block specified by machine constant 1 is abnormal for the combination pattern in the unit of individual axis of the machine.<br>• The interpolation unit set in the parameter block and fixed parameter for the rotating shaft are different. | | • Correct so that the unit of interpolation control by the parameter block becomes normal. |
| 1337 | | | | | | | | | | | | ○ | • Failed to initialize the coordinate conversion process. | | • Review machine constants 1 and 2. |
| 1338 | | | | | | | | | | | | ○ | • Machine constant 2 (base conversion) is incorrect. | | • Review machine constant 2. |
| 1339 | | | | | | | | | | | | ○ | • Machine constant 2 (tool conversion) is incorrect. | | • Review machine constant 2. |
| 1340 | | | | | | | | | | | | ○ | • Machine constant 2 (arm length, arm shift amount) is incorrect. | | • Review machine constant 2. |
| 1341 | | | | | | | | | | | | ○ | • Stroke limit of each joint axis of the machine is incorrect. | | • Review each axis stroke limit data. |

## 2.4 Servo Errors

Servo errors include servo amplifier errors and servo power supply module errors (only when using an A273UHCPU (8/32 axis specification)).
[When using A273UHCPU (32-axis specification)]
When using A273UHCPU (32-axis specification), the processing when a servo error is detected can be set separately for each system.
(However, this applies only to servo errors detected at the ADU.)
The processing and systems are set in the system settings at a peripheral device.

| | Setting | Control Details |
|---|---|---|
| 1 | System servo OFF (default) | • If even one ADU axis is subject to a servo error, servo OFF is established for all the axes in that system. (Same control as when all axes servo OFF is performed.) |
| 2 | Servo OFF of affected axis only | • Only the ADU axis subject to the servo error goes into the servo OFF status and other axes are unaffected.<br>• However:<br>(1) Where there are two axes per module, if one of the axes is subject to a servo error then both axes go into the servo OFF status.<br>(2) When the following servo errors occur, servo OFF for individual systems becomes effective.<br>Overcurrent (2032)<br>Insufficient voltage (2810)<br>Excessive regeneration (2830)<br>Overvoltage (2833)<br>Amplifier power supply overheated (2847) |

(1) Servo amplifier errors (2000 to 2799)
The servo amplifier errors are errors detected by the servo amplifier and are assigned error codes 2000 to 2799.
Servo errors include errors at an ADU (only when using an A273UHCPU (8/32 axis specification)) and errors at an MR-[ ]-B.
In the following tables, the types of servo amplifier are indicated by symbols: (A) for "ADU", and (M) for MR-[ ]-B.
The servo error detection signal (M1608+20n/Xn8/M2408+20n) comes ON when a servo error occurs. Eliminate the cause of the error, reset the error by turning ON the servo error reset signal (M1808+20n/Yn8/M3208+20n), and reset operation. (Note that the servo error detection signal will not come ON in response to error codes in the range 2100 to 2499 because these codes are for warnings.)

Note: 1. When an excessive regeneration error (code 2030), or overload 1 or 2 error (codes 2050, 2051) occurs, the state that applied when the error occurred is stored in the servo amplifier even after the protection circuit has operated. The memory contents are cleared if the external power supply is turned OFF, but are not cleared by the reset signal.

2. Repeated resetting by turning OFF the external power supply after occurrence of error code 2030, 2050, or 2051, may cause devices to be destroyed by overheating. Only restart operation after eliminating the cause of the error.

Details of servo errors are given in Table 2.14.

**⚠ CAUTION**

⚠ If a controller or servo amplifier self-diagnosis error occurs, check the points stated in this manual and clear the error.

## Table 2.11 Servo Amplifier Error List (2000 to 2799)

| Error Code | Amplifier Type | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|---|
| | | Name | Description | | | |
| 2010 | (A) | P-N not connected. | • P-N of the ADU are not connected to P-N of the servo power supply module. | At any time during operation. | Immediate stop. | • Review the wiring. |
| | (M) | Low voltage | • The power supply voltage is less than 160 VAC.<br>• A momentary power interruption of 15 ms or longer has occurred.<br>• The power supply voltage dropped, for example when motion control started, due to insufficient power capacity. | | | • Measure the input voltage (R, S, T) with a voltmeter.<br>• Monitor with an oscilloscope to check whether a momentary power interruption has occurred.<br>• Review the power capacity. |
| 2012 | (A) | Internal memory error | • ADU SRAM fault | • When the servo amplifier power is turned ON. | | • Replace the ADU. |
| | (M) | Memory error 1 | • Servo amplifier SRAM is faulty.<br>• Servo amplifier EPROM check sum error. | • When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | | • Replace the servo amplifier. |
| 2013 | (M) | Clock error | • Servo amplifier clock fault. | At any time during operation | | • Replace the servo amplifier. |
| 2014 | (A) | Watchdog | • Fault in servo control system<br>• ADU failure | | | • Reset the servo system CPU and check again.<br>• Replace the ADU. |
| | (M) | | • Servo amplifier hardware fault<br>• Servo system CPU hardware fault | | | • Replace the servo amplifier.<br>• Replace the servo system CPU. |
| 2015 | (A) | 2-port memory error | • Faulty 2-port memory in ADU | • When the servo amplifier power is turned ON<br>• When a servo error is reset | | • Reset the servo system CPU and check again.<br>• Replace the ADU. |
| | (M) | Memory error 2 | • Servo amplifier EEPROM fault | • When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | | • Replace the servo amplifier. |
| 2016 | (A) | Position sensor error 1 | • Communication with the encoder is not normal at initialization.<br>• The encoder type set in the system settings (ABS/INC) does not match the encoder actually connected. | • When the servo amplifier power is turned ON<br>• When a servo error is reset | | • Reset the servo system CPU and check again.<br>• Replace the servomotor (encoder).<br>• Review the system settings. |
| | (M) | | • Fault in communication with the encoder | • When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | | • Check if the connector of the encoder cable is loose.<br>• Replace the servomotor.<br>• Replace the encoder cable. |
| 2017 | (A) | PCB error | • ADU A/D onverter faulty | • When the servo amplifier power is turned ON<br>• When a servo error is reset | | • Reset the servo system CPU and check again.<br>• Replace the ADU. |
| | (M) | | • Faulty device in the servo amplifier PCB. | • When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | | • Replace the servo amplifier. |
| 2019 | (M) | Memory error 3 | • Servo amplifier flash ROM check sum error | • When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | | • Replace the servo amplifier. |

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

| Error Code | Amplifier Type | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|---|
| | | Name | Description | | | |
| 2020 | (A) | Position sensor error 2 | • Communication with the encoder was not performed normally during operation. | At any time during operation | Immediate stop | • Check the connection between the encoder and ADU.<br>• Replace the servomotor (encoder). |
| | (M) | | • Fault in communication with the encoder | | | • Check if the connector of the encoder cable is loose.<br>• Replace the servomotor.<br>• Replace the encoder cable. |
| 2024 | (M) | Output ground fault | • U, V, or W of the servo amplifier output grounded | | | • Use a multimeter to check between the U, V, and W terminals and the case.<br>• Use a multimeter and megger tocheck between the U, V, and W terminals of the motor and the core. |
| 2025 | (A) | Absolute position lost | • The voltage of the supercapacitor inside the absolute encoder has dropped below 2.5 ±0.2 V.<br>• The absolute encoder rotated at greater than 500 rpm during a momentary power interruption. | • When the servo amplifier power is turned ON<br>• When a servo error is reset | | • Replace the battery (MR-JBAT-[ ]).<br>• Check the connection between the encoder and ADU. |
| | (M) | Battery alarm | • The voltage of the supercapacitor inside the absolute position sensor has dropped. | • When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | | • Turn the power ON for 2 to 3 minutes to charge the supercapacitor, switch the power OFF then ON again, and execute a home position return. |
| | | | • The battery voltage is low. | | | • Turn the servo amplifier power OFF, then measure the battery voltage. |
| | | | • Failure of battery cable or battery. (Home position return must be re-executed after clearing the error.) | | | • Replace the servo amplifier battery. |
| 2026 | (A) | Unit mismatch | • There is a discrepancy between the servo parameters (system settings) and the actually installed servo amplifier. | • When the servo amplifier power is turned ON<br>• When a servo error is reset | | • Review the system settings. |
| 2030 | (M) | Excessive regeneration | • The frequency of ON/OFF switching of the power transistor for regeneration is too high. (Caution is required since the regenerative resistor could overheat.) | At any time during operation | | • Reduce the frequency of acceleration and deceleration or feed speed while checking the servo monitor regeneration level (%).<br>• Reduce the load.<br>• Increase the servomotor capacity. |
| | | | • Servo parameter (system settings) setting error | | | • Check the servo parameters (regenerative resistor and motor type settings in the system settings). |
| | | | • Incorrect wiring of regenerative resistor | | | • Connect the regenerative resistor correctly. |
| | | | • Failure of regenerative resistor | | | • Replace the regenerative resistor. |
| | | | • Power transistor for regeneration damaged by short circuit | | | • Replace the servo amplifier. |
| 2031 | (A) | Overspeed | • The commanded speed is too high. | | | • Review the commanded speed. |
| | | | • An overshoot occurred during acceleration. | | | • Review the servo parameters. |
| | | | • Encoder failure | | | • Replace the encoder. |
| | | | • Failure or incorrect wiring of encoder cable | | | • Check the connection between the encoder and ADU. |

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

| Error Code | Amplifier Type | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|---|
| | | Name | Description | | | |
| 2031 | (M) | Overspeed | • The motor rpm has exceeded 115% of the rated rpm.<br>• An overshoot has occurred because the acceleration time constant is too small.<br>• An overshoot has occurred because the servo system is unstable.<br>• Position sensor fault. | At any time during operation | Immediate stop | • Check the motor rpm in the servo parameters.<br>• Check if the number of pulses per revolution and travel value per revolution in the fixed parameters match the machine specifications.<br>• If an overshoot occurs during acceleration, check the acceleration time and deceleration time in the fixed parameters.<br>• If overshoot occurs, increase the speed integral compensation by adjusting the position loop gain / position control gain 1, 2, speed loop gain / speed control gain 1, 2 in the servo parameters.<br>• Check if the encoder cable is disconnected.<br>• Replace the servomotor. |
| 2032 | (A) | Overcurrent | • A servomotor that does not match the setting has been connected.<br>• The U, V, W phases in the ADU outputs have shorted with each other or to ground.<br>• Incorrect wiring of U, V, W phases in the ADU outputs<br>• The transistor module of the ADU is damaged.<br>• ADU failure<br>• Failure of coupling between the servomotor and encoder<br>• The servomotor oscillated. | • When the servo amplifier power is turned ON<br>• When a servo error is reset | | • Review the system settings.<br>• Check the servomotor cable.<br>• Correct the servomotor wiring.<br>• Replace the ADU.<br>• Replace the servomotor.<br>• Review the servo parameters. |
| | (M) | | • U, V, W in the servo amplifier outputs have short circuited with each other.<br>• U, V, W in the servo amplifier outputs have shorted to ground.<br>• Incorrect wiring of U, V, W phases in the servo amplifier outputs.<br>• The servo amplifier transistor is damaged.<br>• Failure of coupling between servomotor and encoder<br>• Encoder cable failure<br>• A servomotor that does not match the setting has been connected.<br>• The servomotor oscillated.<br>• Noise entered the overcurrent detection circuit. | At any time during operation | | • Check if there is a short circuit between U, V, W of the servo amplifier outputs.<br>• Check if U, V, W of the servo amplifier outputs have been grounded to the ground terminal. Check if U, V, W of the servomotor are grounded to the core. If grounding is found, replace the servo amplifier and/or motor.<br>• Correct the wiring.<br>• Replace the servo amplifier.<br>• Replace the servomotor.<br>• Replace the encoder cable.<br>• Check the connected motor set in the system settings.<br>• Check and adjust the gain value set in the servo parameters.<br>• Check if any relays or valves are operating in the vicinity. |
| 2033 | (M) | Overvoltage | • The converter bus voltage has reached 400 V or more.<br>• The frequency of acceleration and deceleration was too high for the regenerative ability.<br>• The regenerative resistor has been connected incorrectly.<br>• The regenerative resistor in the servo amplifier is destroyed.<br>• The power transistor for regeneration is damaged.<br>• The power supply voltage is too high. | | | • Increase the acceleration time and deceleration time in the fixed parameters.<br>• Check the connection between C and P of the terminal block for the terminal block for regenerative resistance.<br>• Measure between C and P of the terminal block for regenerative resistance with a multimeter; if abnormal, replace the servo amplifier. (Measure about 3 minutes after the charge lamp has gone out.)<br>• Replace the servo amplifier.<br>• Measure the input voltage (R, S, T) with a voltmeter. |

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

| Error Code | Amplifier Type | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|---|
| | | Name | Description | | | |
| 2034 | (M) | Communications error | • Error in data received from the servo system CPU | At any time during operation | Immediate stop | • Check the connection of the motion bus cable.<br>• Check if there is a disconnection in the motion us cable.<br>• Check if the motion bus cable is clamped correctly. |
| 2035 | (A) | Data error | • The commanded speed is too high. | | | • Review the commanded speed. |
| | | | • Servo system CPU failure | | | • Replace the servo system CPU. |
| | (M) | | • There is excessive variation in the position commands from the servo system CPU; commanded speed is too high. | | | • Check the commanded speed, and the number of pulses per revolution and travel value per revolution in the fixed parameters. |
| | | | • Noise has entered the commands from the servo system CPU. | | | • Check the connection of the motion bus cable connector.<br>• Check if the motion bus cable is clamped correctly.<br>• Check if the motion bus cable is clamped correctly.<br>• Check if any relays or valves are operating in the vicinity. |
| 2036 | (A) | Transmission error | • Servo system CPU failure | | | • Replace the servo system CPU. |
| | (M) | | • Fault in communication with the servo system CPU | | | • Check the connection of the motion bus cable connector.<br>• Check if there is a disconnection in the motion bus cable.<br>• Check if the motion bus cable is clamped correctly. |
| 2042 | (M) | Feedback error | • Encoder signal fault | | | • Replace the servomotor. |
| 2045 | (A) | Amplifier fin overheating | • The fan of the ADU has stopped. | | | • Replace the fan of the ADU. |
| | | | • The continuous output current rating of the ADU was exceeded. | | | • Reduce the load. |
| | | | • Failure of ADU thermal sensor | | | • Replace the ADU. |
| | (M) | Fin overheating | • The heat sink in the servo amplifier is overheated.<br>• Amplifier error (rated output exceeded)<br>• Power repeatedly switched ON/OFF during overload.<br>• Cooling fault | | | • If the effective torque of the servomotor is high, reduce the load.<br>• Reduce the frequency of acceleration and deceleration.<br>• Check if the amplifier's fan has stopped. (MR-H150B or higher)<br>• Check if the passage of cooling air is obstructed.<br>• Check if the temperature inside the panel is too high (range: 0 to +55°C).<br>• Check if the electromagnetic brake was actuated from an external device during operation.<br>• Replace the servo amplifier. |
| 2046 | (A) | Motor overheating | • The thermal protector incorporated in the servomotor operated. | | | • Replace the servomotor. |
| | | | • The continuous output rating of the motor has been exceeded. | | | • Reduce the load. |
| | (M) | | • The servomotor is overloaded. | | | • If the effective torque of the servomotor is high, reduce the load. |
| | | | • The servomotor and regenerative option are overheated. | | | • Check the ambient temperature of the servomotor (range: 0 to +40°C). |
| | | | • The thermal protector incorporated in the encoder is faulty. | | | • Replace the servomotor. |

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

| Error Code | Amplifier Type | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|---|
| | | Name | Description | | | |
| 2050 | (A) | Overload | • The rated current of the motor has been exceeded.<br>• The load inertia or friction is too great. | At any time during operation | Immediate stop | • Reduce the load. |
| | | | • Hunting occurred due to parameter setting error. | | | • Review the servo parameters. |
| | (M) | Overload 1 | • An overload current of about 200% has been continuously supplied to the servo amplifier and servomotor. | | | • Check if there has been a collision at the machine.<br>• If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load.<br>• If hunting occurs, adjust the position loop gain in the ervo parameters.<br>• Check the connection of U, V, W of the servo amplifier and servomotor.<br>• Check for disconnection of the encoder cable.<br>• Replace the servomotor. |
| 2051 | (M) | Overload 2 | • The servo amplifier and servomotor were overloaded at a torque close to the maximum torque (95% or more of the current control value). | | | • Check if there has been a collision at the machine.<br>• If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load.<br>• If hunting occurs, adjust the position loop gain / position control gain 1, 2, speed loop gain/ speed control gain 1, 2 in the servo parameters.<br>• Check the connection of U, V, W of the servo amplifier and servomotor.<br>• Check for disconnection of the encoder cable.<br>• Replace the servomotor.<br>• If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier. |
| 2052 | (A) | Excessive error | •The deviation counter value has exceeded the stipulated value.<br>• Adequate acceleration is not possible because the inertia is too great. | | | • Review the servo parameters. |
| | | | • Encoder or cable failure. | | | • Replace the encoder, cable. |
| | (M) | | • The difference between the servo amplifier command pulses and feedback pulses has exceeded 80000 pulses. | | | • Check if there has been a collision at the machine.<br>• Increase the time constant for acceleration and deceleration.<br>• Increase the position loop gain / position control gain 1, 2, in the servo parameters.<br>• Check for disconnection of the encoder cable.<br>• Replace the servomotor.<br>• If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier. |
| 2057 | (A) | Hardware fault | • Hardware fault in an ADU | | | • Replace the ADU |
| 2086 | (M) | RS232 communication error | • Parameter unit communication error | | Operation continues | • Check for disconnection of the parameter unit cable.<br>• Replace the parameter unit. |
| 2102 | (A) | Battery warning | • The voltage of the backup battery for the absolute encoder has become low. | | | • Replace the battery (MR-JBAT-[ ]). |
| | (M) | | • The voltage of the battery installed in the servo amplifier has become low. | | | • Replace the battery. |
| 2103 | (M) | Battery disconnection warning | • The power supply voltage to the absolute position sensor has become low. | | | • Replace the battery.<br>• Check for disconnection of the encoder cable.<br>• Replace the servomotor.<br>• Replace the servo amplifier. |

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2140</td><td>(M)</td><td>Excessive regeneration warning</td><td>• An excessive regeneration error (2030) is likely to occur (regeneration of 85% of the maximum load capacity for the regenerative resistor has been detected).</td><td rowspan="15">At any time during operation</td><td rowspan="5">Operation continues</td><td>• Refer to the details on the excessive regeneration error (2030).</td></tr>
<tr><td rowspan="2">2141</td><td>(A)</td><td rowspan="2">Overload warning</td><td>• A load of 80% of the level that will cause an overload error (2050) has been detected.</td><td>• Refer to the details on the overload error (2050).</td></tr>
<tr><td>(M)</td><td>• An overload error (2050, 2051) is likely to occur (85% of overload level detected).</td><td>• Refer to the details on the overload errors (2050, 2051).</td></tr>
<tr><td>2143</td><td>(A)</td><td>Absolute position counter warning</td><td>• Encoder failure</td><td>• Replace the encoder.</td></tr>
<tr><td>2146</td><td>(M)</td><td>Servo emergency stop</td><td>• The connection between 1A and 1B (emergency stop input) of CN6 of the servo amplifier encoder has been broken.</td><td>• Establish a short circuit between 1A and 1B of CN6 of the servo amplifier encoder.</td></tr>
<tr><td rowspan="2">2147</td><td>(A)</td><td rowspan="2">Emergency stop</td><td>• An emergency stop has been executed.</td><td rowspan="2">Immediate stop</td><td rowspan="2">• Release the emergency stop.</td></tr>
<tr><td>(M)</td><td>• An emergency stop (EMG) signal has been input from the servo system CPU.</td></tr>
<tr><td>2149</td><td>(M)</td><td>Main circuit OFF warning</td><td>• The servo ON (SON) signal was turned ON while the contactor was OFF.<br>• The main circuit bus voltage fell to 215 V or lower at 50 rpm or lower.</td><td rowspan="3">Operation continues</td><td>• Turn the main circuit contactor or circuit power supply ON.</td></tr>
<tr><td>2196</td><td>(M)</td><td>Home position setting error warning</td><td>• After a home position set command, the droop pulses did not come within the in-position range.</td><td>• Re-attempt home position return.</td></tr>
<tr><td>2201 to 2224</td><td>(A)</td><td>Parameter warning</td><td>• An incorrect parameter setting has been made.<br>
<table>
<tr><td>2201</td><td>Amplifier setting</td></tr>
<tr><td>2202</td><td>Motor type</td></tr>
<tr><td>2203</td><td>Motor capacity</td></tr>
<tr><td>2204</td><td>Number of feedback pulese</td></tr>
<tr><td>2205</td><td>In-position range</td></tr>
<tr><td>2206</td><td>Position control gain 2 (Actual position gain)</td></tr>
<tr><td>2207</td><td>Speed control gain 2 (Actual speed gain)</td></tr>
<tr><td>2208</td><td>Speed integral compensation</td></tr>
<tr><td>2209</td><td>Torque limit (forward)</td></tr>
<tr><td>2210</td><td>Torque limit (reverse)</td></tr>
<tr><td>2211</td><td>Emergency stop time delay</td></tr>
<tr><td>2212</td><td>Position control gain 1 (Model position gain)</td></tr>
<tr><td>2213</td><td>Speed control gain 1 (Model speed gain)</td></tr>
<tr><td>2214</td><td>Load inertia ratio</td></tr>
<tr><td>2215</td><td>Excessive error alarm level</td></tr>
<tr><td>2216</td><td>Special compensation processing</td></tr>
<tr><td>2217</td><td>Special servo processing</td></tr>
<tr><td>2218</td><td>Td dead band compensation</td></tr>
<tr><td>2219</td><td>Feed forward gain</td></tr>
<tr><td>2220</td><td>Torque imbalance compensation</td></tr>
<tr><td>2221</td><td>Dither control</td></tr>
<tr><td>2222</td><td>Gain operation time</td></tr>
<tr><td>2223</td><td>Servo responsibility</td></tr>
<tr><td>2224</td><td>—</td></tr>
</table></td><td>Operation continues</td><td>• Review the system settings and servo parameters.</td></tr>
</table>

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301 to 2336</td><td>(M)</td><td>Parameter error</td><td>• Out-of-range parameter setting has been designated. Incorrect parameter values are ignored and the values before setting are retained.<br><table><tr><td>2301</td><td>Amplifier setting</td></tr><tr><td>2302</td><td>Regenerative resistance</td></tr><tr><td>2303</td><td>Motor type</td></tr><tr><td>2304</td><td>Motor capacity</td></tr><tr><td>2305</td><td>Motor rpm</td></tr><tr><td>2306</td><td>Number of feedback pulses</td></tr><tr><td>2307</td><td>Rotating direction setting</td></tr><tr><td>2308</td><td>Automatic tuning setting</td></tr><tr><td>2309</td><td>Servo responsibility</td></tr><tr><td>2310</td><td>Torque limit (forward)</td></tr><tr><td>2311</td><td>Torque limit (reverse)</td></tr><tr><td>2312</td><td>Load inertia ratio</td></tr><tr><td>2313</td><td>Position control gain 1</td></tr><tr><td>2314</td><td>Speed control gain 1</td></tr><tr><td>2315</td><td>Position control gain 2</td></tr><tr><td>2316</td><td>Speed control gain 2</td></tr><tr><td>2317</td><td>Speed integral compensation</td></tr><tr><td>2318</td><td>Notch filter</td></tr><tr><td>2319</td><td>Feed forward coefficient</td></tr><tr><td>2320</td><td>In-position range</td></tr><tr><td>2321</td><td>Electromagnetic brake sequence output</td></tr><tr><td>2322</td><td>Monitor output mode selection</td></tr><tr><td>2323</td><td>Optional function 1</td></tr><tr><td>2324</td><td>Optional function 2</td></tr><tr><td>2325</td><td>Optional function 3</td></tr><tr><td>2326</td><td>Optional function 4</td></tr><tr><td>2327</td><td>Monitor output 1 offset</td></tr><tr><td>2328</td><td>Monitor output 2 offset</td></tr><tr><td>2329</td><td>Pre-alarm data selection</td></tr><tr><td>2330</td><td>Zero speed</td></tr><tr><td>2331</td><td>Excessive error alarm level</td></tr><tr><td>2332</td><td>Optional function 5</td></tr><tr><td>2333</td><td>Optional function 6</td></tr><tr><td>2334</td><td>PI-PID switching position droop</td></tr><tr><td>2335</td><td>Torque limit compensation factor</td></tr><tr><td>2336</td><td>Speed integral compensation (actual speed differential compensation)</td></tr></table></td><td>At any time during operation</td><td>Operation continues</td><td>• Check the servo parameter setting range.</td></tr>
</table>

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301 to 2324</td><td>(A)</td><td>Parameter error</td><td>• Out-of-range parameter setting has been designated. Incorrect parameter values are ignored and the values before setting are retained.<br><table><tr><td>2301</td><td>Amplifier setting</td></tr><tr><td>2302</td><td>Motor type</td></tr><tr><td>2303</td><td>Motor capacity</td></tr><tr><td>2304</td><td>Number of feedback pulese</td></tr><tr><td>2305</td><td>In-position range</td></tr><tr><td>2306</td><td>Position control gain 2 (Actual position gain)</td></tr><tr><td>2307</td><td>Speed control gain 2 (Actual speed gain)</td></tr><tr><td>2308</td><td>Speed integral compensation</td></tr><tr><td>2309</td><td>Torque limit (forward)</td></tr><tr><td>2310</td><td>Torque limit (reverse)</td></tr><tr><td>2311</td><td>Emergency stop time delay</td></tr><tr><td>2312</td><td>Position control gain 1 (Model position gain)</td></tr><tr><td>2313</td><td>Speed control gain 1 (Model speed gain)</td></tr><tr><td>2314</td><td>Load inertia ratio</td></tr><tr><td>2315</td><td>Excessive error alarm level</td></tr><tr><td>2316</td><td>Special compensation processing</td></tr><tr><td>2317</td><td>Special servo processing</td></tr><tr><td>2318</td><td>Td dead band compensation</td></tr><tr><td>2319</td><td>Feed forward gain</td></tr><tr><td>2320</td><td>Torque imbalance compensation</td></tr><tr><td>2321</td><td>Dither control</td></tr><tr><td>2322</td><td>Gain operation time</td></tr><tr><td>2323</td><td>Servo responsibility</td></tr><tr><td>2324</td><td>—</td></tr></table></td><td>At any time during operation</td><td rowspan="2">Operation continues</td><td>• Check the servo parameter setting range.</td></tr>
<tr><td>2500</td><td>(A)</td><td>Parameter error</td><td>• The following servo parameters were set incorrectly.<br>• Amplifier/external regenerative resistance setting<br>• Motor type<br>• Motor capacity</td><td>• When the servo amplifier power is turned ON<br>• When a servo error is reset</td><td>• Review the system settings and the servo parameters.</td></tr>
</table>

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2501 to 2524</td><td>(A)</td><td>Parameter error</td><td>• Incorrect parameter settings have been made.<table><tr><td>2501</td><td>Amplifier setting</td></tr><tr><td>2502</td><td>Motor type</td></tr><tr><td>2503</td><td>Motor capacity</td></tr><tr><td>2504</td><td>Number of feedback pulese</td></tr><tr><td>2505</td><td>In-position range</td></tr><tr><td>2506</td><td>Position control gain 2 (Actual position gain)</td></tr><tr><td>2507</td><td>Speed control gain 2 (Actual speed gain)</td></tr><tr><td>2508</td><td>Speed integral compensation</td></tr><tr><td>2509</td><td>Torque limit (forward)</td></tr><tr><td>2510</td><td>Torque limit (reverse)</td></tr><tr><td>2511</td><td>Emergency stop time delay</td></tr><tr><td>2512</td><td>Position control gain 1 (Model position gain)</td></tr><tr><td>2513</td><td>Speed control gain 1 (Model speed gain)</td></tr><tr><td>2514</td><td>Load inertia ratio</td></tr><tr><td>2515</td><td>Excessive error alarm level</td></tr><tr><td>2516</td><td>Special compensation processing</td></tr><tr><td>2517</td><td>Special servo processing</td></tr><tr><td>2518</td><td>Td dead band compensation</td></tr><tr><td>2519</td><td>Feed forward gain</td></tr><tr><td>2520</td><td>Torque imbalance compensation</td></tr><tr><td>2521</td><td>Dither control</td></tr><tr><td>2522</td><td>Gain operation time</td></tr><tr><td>2523</td><td>Servo responsibility</td></tr><tr><td>2524</td><td>—</td></tr></table></td><td>• When the servo amplifier power is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset</td><td>Operation continues</td><td>• Review the system settings and the servo parameters.</td></tr>
</table>

Table 2.11 Servo Amplifier Error List (2000 to 2799) (Continued)

| Error Code | Amplifier Type | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|---|
| | | Name | Description | | | |
| 2601 to 2636 | (M) | Initial parameter error | • The set parameter values are incorrect.<br>• The parameter data has been destroyed.<br>2601 Amplifier setting<br>2602 Regenerative resistance<br>2603 Motor type<br>2604 Motor capacity<br>2605 Motor rpm<br>2606 Number of feedback pulses<br>2607 Rotating direction setting<br>2608 Automatic tuning setting<br>2609 Servo responsibility<br>2610 Torque limit (forward)<br>2611 Torque limit (reverse)<br>2612 Load inertia ratio<br>2613 Position control gain 1<br>2614 Speed control gain 1<br>2615 Position control gain 2<br>2616 Speed control gain 2<br>2617 Speed integral compensation<br>2618 Notch filter<br>2619 Feed forward coefficient<br>2620 In-position range<br>2621 Electromagnetic brake sequence output<br>2622 Monitor output mode selection<br>2623 Optional function 1<br>2624 Optional function 2<br>2625 Optional function 3<br>2626 Optional function 4<br>2627 Monitor output 1 offset<br>2628 Monitor output 2 offset<br>2629 Pre-alarm data selection<br>2630 Zero speed<br>2631 Excessive error alarm level<br>2632 Optional function 5<br>2633 Optional function 6<br>2634 PI-PID switching position droop<br>2635 Torque limit compensation factor<br>2636 Speed integral compensation (actual speed differential compensation) | • When the servo amplifier power supply is turned ON<br>• At the leading edge of the PC READY flag (M2000)<br>• When a servo error is reset<br>• When the power to the servo system CPU is turned ON | Immediate stop | • Check and change the set parameter values, then switch the power to the servo system CPU OFF then ON again, press the reset key, or turn the PC READY flag (M2000) OFF then ON again. |

(2) Servo power supply module errors (2800 to 2999: only applicable when using 273UHCPU (8/32 axis specification))
Servo power supply module errors are detected by the servo amplifier, and their codes are 2800 to 2999.
The servo error detection signal (M1608+20n/Xn8/M2408+20n) comes ON when a servo error occurs. Eliminate the cause of the error, reset the error by turning ON the servo error reset signal (M1808+20n/Yn8/M3208+20n), and reset operation. (Note that the servo error detection signal will not come ON in response to error codes in the range 2900 to 2999 because these codes are for warnings.)

Note: 1. Regarding the excessive regeneration error (error code 2830), the state at the time the error occurred remains stored in the servo amplifier even after the protection circuit has operated. The memory contents are cleared when the external power supply is turned OFF, but are not cleared by the RESET signal.
2. If error code 2830 is repeatedly reset by turning OFF the external power supply, devices may be destroyed due to overheating: only restart operation after the cause of the error has been completely eliminated.

The servo power supply module errors are shown in Table 2.15.

**Table 2.12 Servo Power Supply Module Error List (2800 to 2999)**

| Error Code | Error Cause | | When Error Checked | Error Processing | Corrective Action |
|---|---|---|---|---|---|
| | Name | Description | | | |
| 2810 | Low voltage | • The voltage to the power supply module fell below 170 VAC.<br>• A momentary power interruption occurred. | At any time during operation | Immediate stop | • Review the power supply equipment. |
| | | • The load is too great. | | | • Review the power capacity. |
| 2830 | Excessive regeneration | • The maximum load capacity of the regenerative resistor has been exceeded due to frequent operation or continuous regenerative operation. | | | • Review the operation pattern, either by reducing the frequency of acceleration and deceleration or reducing the speed. |
| | | • The power transistor for regeneration has been damaged. | | | • Replace the servo power supply module. |
| | | • The regenerative resistor setting in the system settings is incorrect. | | | • Review the system settings. |
| | | • The regenerative resistor is wired incorrectly. | | | • Connect the wiring correctly. |
| 2833 | Overvoltage | • The regenerative resistor is connected incorrectly. | | | • Correct the wiring. |
| | | • The power transistor for regeneration has been damaged. | | | • Replace the servo power supply module. |
| | | • The regenerative resistor is destroyed. | | | • Replace the regenerative resistor. |
| | | • The power supply voltage is too high. | | | • Review the power supply equipment. |
| 2847 | Amplifier power supply overheating | • The servo power supply module fan is stopped. | | | • Replace the fan. |
| | | • The continuous output current of the power supply module has been exceeded. | | | • Reduce the load. |
| | | • Thermal sensor fault. | | | • Replace the servo power supply module. |
| 2940 | Excessive regeneration warning | • 80% of the level that would cause an excessive regeneration error (2830) was detected. | | Operation continues. | • Refer to the details on the excessive regeneration error (2830). |

MITSUBISHI ELECTRIC CORPORATION

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IB (NA) 67369-A (9709) MEE Printed in Japan