

**mitsubishi**

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**MOTION CONTROLLER  
(SV22)  
(VIRTUAL MODE)**

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*Programming Manual*

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**type A171SCPU, A273UHCPU**

# REVISIONS

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

Print Date	*Manual Number	Revision
Nov., 1995	IB (NA) 67263-A	First edition
Jan, 1997	IB (NA) 67263-C	Additions Sections 1.2, Appendix 5 Partial Additions Section 4.5.9 Partial Revisions For Safe Operations, Sections 1, 2.3.2, 2.3.3, 2.3.4, 3, 4.2 (POINT), 4.2(3), 4.5.2, 4.5.8(1), 6.3.2, 7.1.2, 7.2.1(1)(d), 7.2.1(2)(b), 7.2.1(2)(c), 7.2.1(2)(e), 7.2.1(3)(f), 7.2.1(3)(g), 7.4.1(3), 8.1.1, 8.4.1, 8.4.2(2), 8.4.5, 8.4.6, 8.4.7, 8.4.8(1)(b), 8.5.1(2)(t), 8.5.2, 10.2, 10.3, 10.4, 10.5, 10.6, Appendix 2.1, Appendix 4.2, Appendix 4.3(2)(c), Appendix 5

## 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.












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## For Safe Operations

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### 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 A171SCPU user's manual/A273UHCPU user's manual, or the instruction manual for the product you are using on any terminal. Doing so may lead to destruction or damage.
-  Do not mistake the terminal connections, as this may lead to destruction or damage.
-  Do not mistake the polarity (+/-), as this may lead to destruction or damage.
-  The servo amplifier's heat radiating fins, regenerative resistor and servo amplifier, etc., will be hot while the power is ON and for a short time after the power is turned OFF. Do not touch these parts as doing so may lead to burns.
-  Always turn the power OFF before touching the servomotor shaft or coupled machines, as these parts may lead to injuries.
-  Do not go near the machine during test operations or during operations such as teaching. Doing so may lead to injuries.















### 4. Various precautions

Strictly observe the following precautions.

Mistaken handling of the unit may lead to faults, injuries or electric shocks.

#### (1) System structure

#### CAUTION

-  Always install a leakage breaker on the control unit and servo amplifier power source.
-  If installation of a magnetic contactor for power shut off during an error, etc., is specified in the instruction manual for the servo amplifier, etc., always install the magnetic contactor.
-  Install an external emergency stop circuit so that the operation can be stopped immediately and the power shut off.
-  Use the control unit, servo amplifier, servomotor and regenerative resistor with the combinations listed in A171SCPU user's manual/A273UHCPU user's manual, or the instruction manual for the product you are using. 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.
-  Use wires and cables within the length of the range described in A171SCPU user's manual/A273UHCPU user's manual, or the instruction manual for the product you are using.

 **CAUTION**

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

**(2) Parameter settings and programming**

 **CAUTION**

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

### (3) Transportation and installation

#### ⚠ CAUTION

- ⚠ Transport the product with the correct method according to the weight.
- ⚠ Use the servomotor suspension bolts only for the transportation of the servomotor. Do not transport the servomotor with machine installed on it.
- ⚠ Do not stack products past the limit.
- ⚠ When transporting the control unit or servo amplifier, never hold the connected wires or cables.
- ⚠ When transporting the servomotor, never hold the cabled, 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 A171SCPU user's manual/A273UHCPU user's manual, or the instruction manual for the product you are using in a place where the weight can be withstood.
- ⚠ Do not get on or place heavy objects on the product.
- ⚠ Always observe the installation direction.
- ⚠ Keep the designated clearance between the control unit or servo amplifier and control panel inner surface or the control unit and servo amplifier, control unit or servo amplifier and other devices.
- ⚠ Do not install or operate control units, servo amplifiers or servomotors that are damaged or that have missing parts.
- ⚠ Do not block the intake/outtake ports of the servomotor with cooling fan.
- ⚠ Do not allow conductive matter such as screw or cutting chips or combustible matter such as oil enter the control unit, servo amplifier or servomotor.
- ⚠ The control unit, servo amplifier and servomotor are precision machines, so do not drop or apply strong impacts on them.
- ⚠ Securely fix the control unit and servo amplifier to the machine according to A171SCPU user's manual/A273UHCPU user's manual, or the instruction manual for the product you are using. 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	Servo Motor
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	1000 m or less above sea level.	
Vibration	According to each instruction manual.	

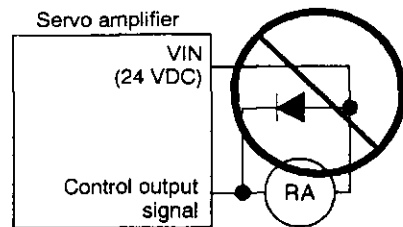
 **CAUTION**

- ⚠ 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.
- ⚠ If the absolute positioning system is used, home position return is required after initial start up or after replacement of a controller or absolute positioning compatible motor.



## (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 of 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 A171SCPU/A273UHCPU specifications
Input frequency	According to A171SCPU/A273UHCPU specifications
Tolerable momentary power failure	According to A171SCPU/A273UHCPU specifications

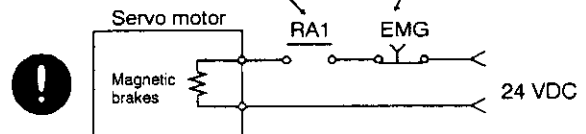
## (7) Remedies for error's

### ⚠ CAUTION

- ⚠ If an error occurs in the self diagnosis of the control unit or servo amplifier, confirm the check details according to this manual or 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 re-starts suddenly.)

Shut off with servo ON signal OFF, alarm, magnetic brake signal.

Shut off with the emergency stop signal (EMG).









## (8) Maintenance, inspection and part replacement

### ⚠ CAUTION




- ⚠ Perform the daily and periodic inspections according to A171SCPU user's manual/A273UHCPU user's manual, or the instruction manual for the product you are using.
- ⚠ 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.
- ⚠ 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 mugger test (insulation resistance measurement) during inspection.

 **CAUTION**

-  When replacing the control unit or servo amplifier, always set the new unit settings correctly.
-  To prevent positional displacements after a controller or absolute positioning compatible motor is replaced, use one of the following methods to conduct home position return.
  - 1) PC write the servo data with the peripheral device, turn the power OFF and back ON, then conduct home position return.
  - 2) Use the peripheral device back-up functions to 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 this 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.

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# 1. GENERAL DESCRIPTION

## 1. GENERAL DESCRIPTION

The A171SCPU/A273UHCPU (hereafter referred to as "servo system CPU") features two operating modes (REAL and VIRTUAL) at motion controllers where the operating systems (OS) shown below have been installed:

SW2SRX-SV22L  
SW2SRX-SV22J  
SW2SRX-SV22U ) ..... collectively abbreviated to "SV22"

This manual explains the mechanical device program required to operate the motion controller in the VIRTUAL mode. In order to execute positioning control in the VIRTUAL mode, positioning parameter settings, servo programs, and a positioning sequence program must be created in addition to the mechanical system program. Details for these procedures are given in the following manual:

Motion Controller (SV13/22)  
Programming Manual (REAL Mode) ..... IB-67265

Differences between the REAL and VIRTUAL modes are discussed in section 2.3 of this manual. Be sure to familiarize yourself with these differences before attempting positioning control in the VIRTUAL mode.






### REMARK

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

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

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### CAUTION

-  When designing the system, provide external protective and safety circuits for safety in the event of trouble with the motion controller.
-  Printed circuit boards have components susceptible to the effects of static electricity mounted on them: ground your body or the work bench before handling them. Do not directly touch conductive or electrical parts of the product.
-  Set parameters within the ranges indicated in this manual.
-  Use the program instructions in accordance with the conditions stipulated in this manual.
-  Some of the devices used in programs have fixed applications: use them in accordance with the conditions stipulated in this manual.

# 1. GENERAL DESCRIPTION

## [Conventions Used in This Manual]

Where positioning signals appear in this manual, they are shown in the "A171SCPU → A273UHCPU 8-axis specification → A273UHCPU 32-axis specification" order. If only one positioning signal is shown, it applies to all the CPUs.

Moreover, all detailed explanations given in this manual are based on the A273UHCPU (8-axis specification) operation. If another CPU is being used, the positioning signals which appear in these explanations should be replaced with the ones which apply to the CPU being used. (Positioning signals for each CPU are shown in Appendix 5.)

A273UHCPU (8-axis specification)

A171SCPU      A273UHCPU (32-axis specification)

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### 4. SERVO SYSTEM CPU DEVICES

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**4.2.3 All-Axes servo START accept flag (M2009/M2009/M2049) . . . . . Signal sent from PCPU to SCPU**

The all-axes servo START flag indicates that servo operation is possible.

- ON . . . . . Servo is operative.
- OFF . . . . . Servo is inoperative.

**4.2.4 Manual pulse generator enabled flag (M2012/M2012 - M2014/M2051 - M2053) . . . . . Signal sent from SCPU to PCPU**

The manual pulse generator flag designates the enabled/disabled status for positioning executed by pulse inputs from manual pulse generators connected to the A171SENC PULSER \*1/A273EX P1 - P3 \*2

- ON . . . . . Positioning control by manual pulse generator inputs is enabled.
- OFF . . . . . Positioning control by manual pulse generator inputs is disabled (inputs are ignored).

**4.2.5 JOG simultaneous START command (M2015/M2015/M2048) . . . . . Signal sent from SCPU to PCPU**

- (1) When M2015 switches ON, a JOG simultaneous START will occur at the JOG execution axis (axes 1 - 4/axes 1 - 8/axes 1 - 32) designated at the JOG Simultaneous START Axis Area (D1015).
- (2) When M2015 switches OFF, the JOG axis motion will decelerate and stop.

**REMARKS**

(1) \*1: For details regarding the A171SENC PULSER (connector), refer to the Motion Controller (A171SCPU) User's Manual

(2) \*2: For details regarding the A273EX P1 - P3 (connector), refer to the Motion Controller (A273UHCPU) User's Manual.

} Applies to A273UHCPU (8-axis specification)

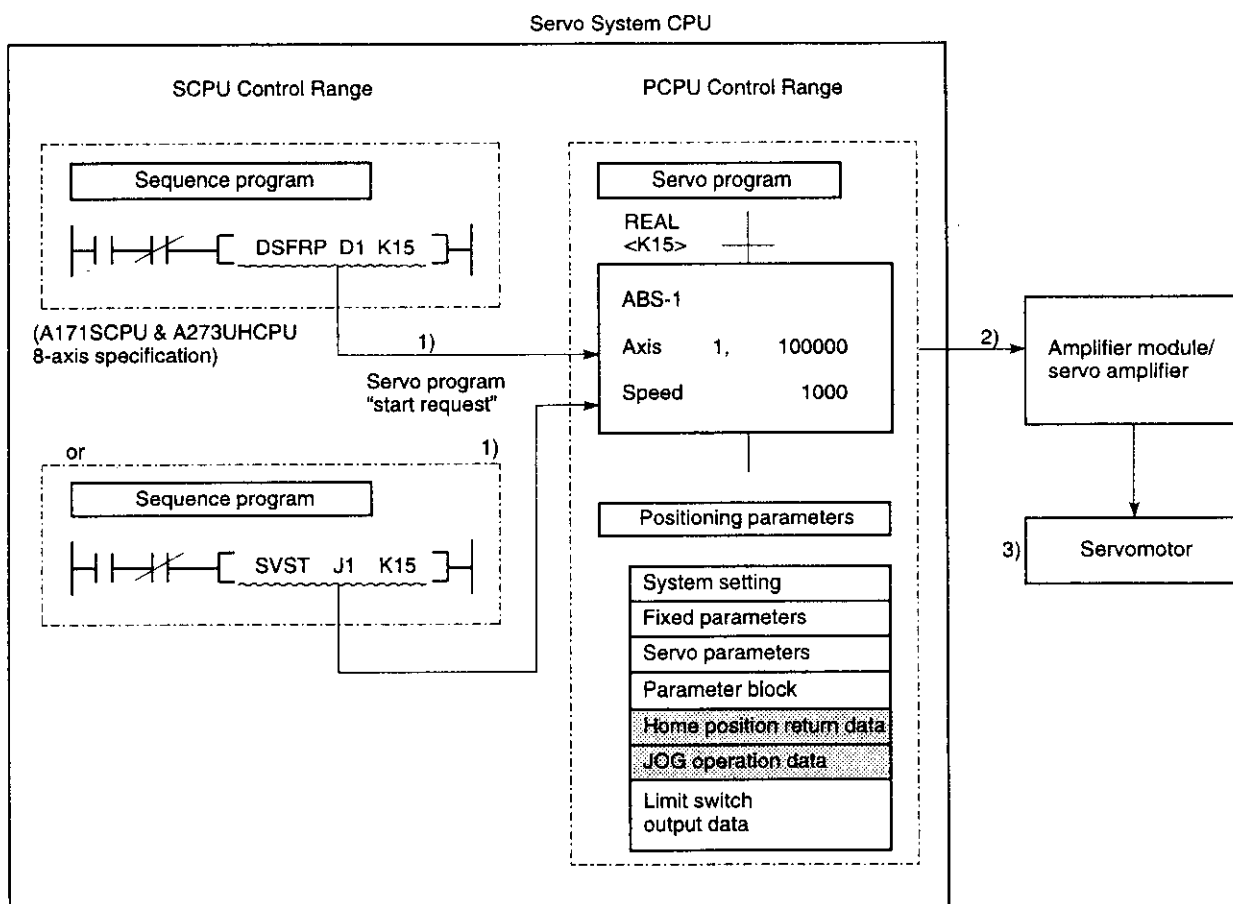
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# 1. GENERAL DESCRIPTION

## 1.1 Summary of REAL and VIRTUAL Modes

### (1) REAL mode

- (a) The REAL mode is used to execute direct control by the servo program at systems using servomotors.
- (b) To utilize the REAL mode, positioning parameter settings must be designated, and a positioning sequence program must be created.
- (c) The procedure for REAL mode positioning control is as follows:
  - 1) A REAL mode servo program "start request" is issued with a DSFRP [A171SCPU & A273UHCPU 8-axis specification]/SVST instruction in the positioning sequence program.
  - 2) Positioning control occurs in accordance with the specified servo program. (Output to amplifier and servo amplifier modules.)
  - 3) Servomotor control is executed.



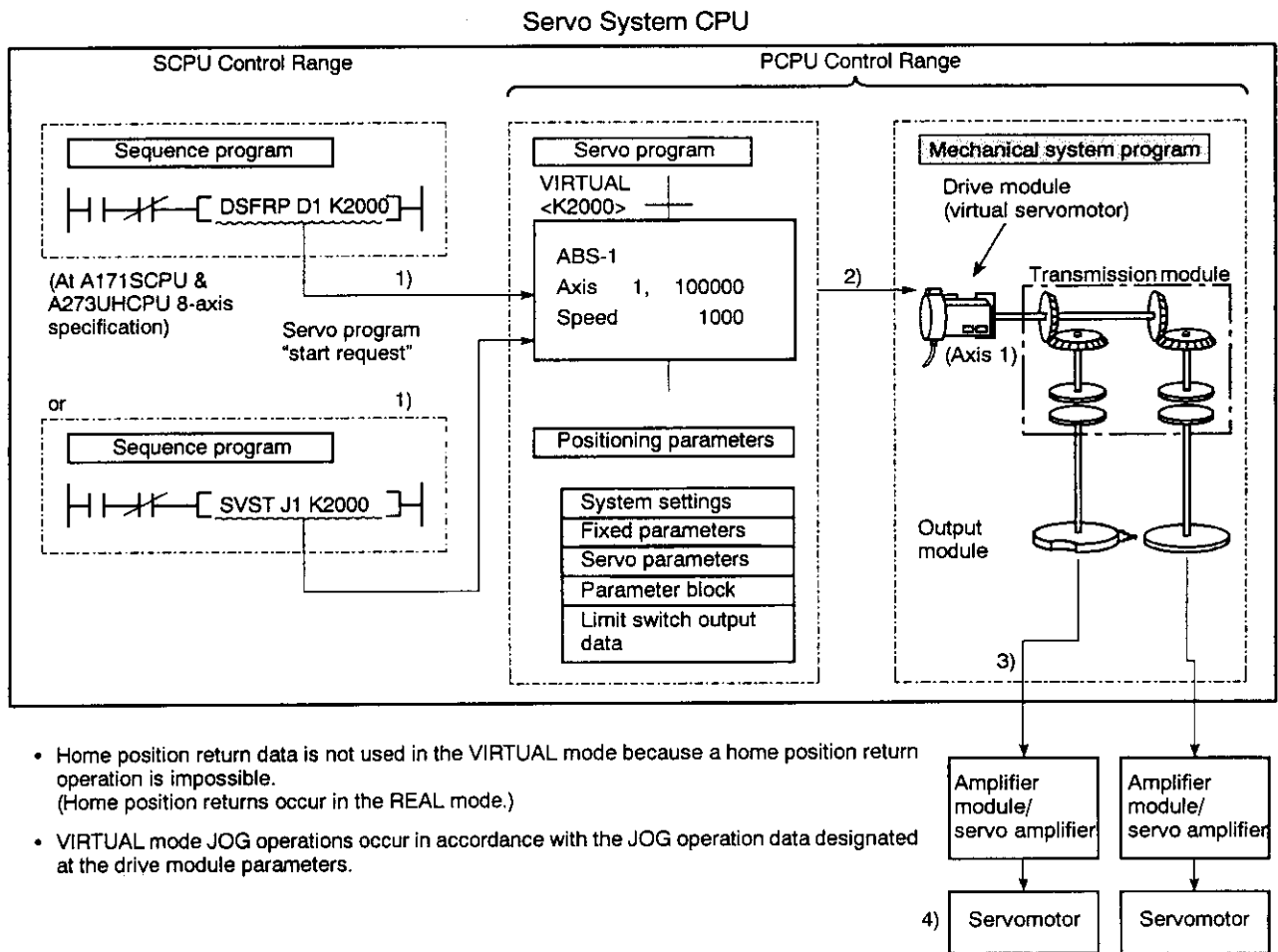
Amplifier module/  
servo amplifier

Servomotor

# 1. GENERAL DESCRIPTION

## (2) VIRTUAL mode

- (a) The VIRTUAL mode is used to execute synchronous processing (with software) using a mechanical system program comprised of a virtual main shaft and mechanical module. This mode permits the synchronous control for conventional positioning by main shaft, gear, and cam, etc., to be replaced by a servomotor positioning control format.
- (b) In addition to the positioning parameter settings, servo program, and positioning sequence program used in the REAL mode, the VIRTUAL mode also requires a "mechanical system program".
- (c) The procedure for VIRTUAL mode positioning control is as follows:
  - 1) A VIRTUAL mode servo program "start request" is issued with a DSFRP [A171SCPU & A273UHCPU 8-axis specification]/SVST instruction in the positioning sequence program.
  - 2) The mechanical system program's virtual servomotor is started.
  - 3) The calculation result from the transmission module is output to the amplifier module/servo amplifier designated for the output module.
  - 4) Servomotor control is executed.



# 1. GENERAL DESCRIPTION

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## 1.2 Upgraded Functions

The following functions have been added or improved compared to the original version. See the programming manual for details about these functions.

- (1) Added function to change the cam shaft present value in one revolution in the VIRTUAL mode

The present value in one revolution can now be changed for a camshaft rotation by executing the sequence program CHGA instruction during VIRTUAL mode operation.

- (2) Added indirect designation of gear ratios in a mechanical system program

In addition to designating the gear ratio for a mechanical system program with constants, the gear ratio can now be indirectly designated using D and W.

- (3) Added high-speed read function

Using a signal from an input unit mounted in the motion base unit as a trigger, this added function allows up to 11 data items from 16 data types, including the feed present value or deviation counter value, to be simultaneously read to designated devices.

- (4) Added cancel and start functions for an executing servoprogram

It is now possible to cause a deceleration stop by designating the servoprogram cancel function to turn ON the cancel signal (designated bit device) during servoprogram execution.

Also, by also designating the start function, the designated servoprogram can be automatically started after the stop is applied.

- (5) Upgraded constant-speed control instructions

The following three functions have been added.

- (a) Skip function

After setting a skip signal (designated bit device) for each pass point, the signal can be turned ON to abort positioning for the associated pass point and start positioning of the next pass point.

- (b) FIN signal wait function

Designate the FIN signal wait function and set an M code at each pass point, to synchronize the FIN signal turning ON with the end of each pass point.

- (c) Circular interpolation function with CPSTART3, CPSTART4

Circular interpolation is now possible with 2 axes.

# 1. GENERAL DESCRIPTION

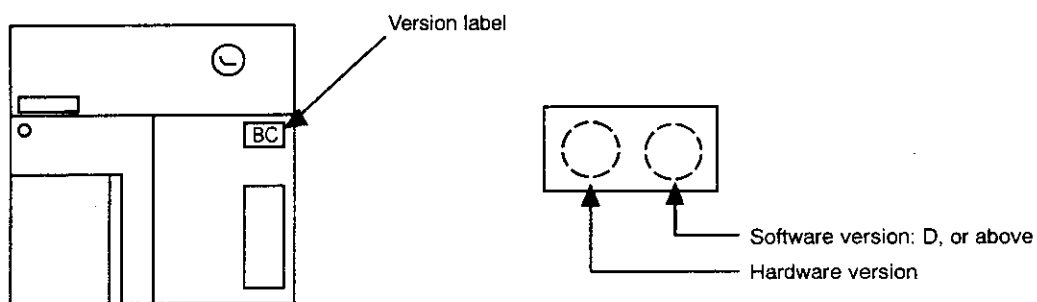
- (6) Compatible with MR-J2-B servo amplifiers.
- (7) Management of the present value when using an absolute encoder has been improved (for details, see Section 1.2.1).

The following positioning OS and positioning software package are required to use the functions (1) to (7), described above.

For A171SCPU

- CPU Version

Use a A171SCPU unit marked with software version D, or above, on the front panel. Do not use version C, or earlier.



- Positioning OS

Model Name	OS Version
SW0SRX-SV22L	U, or above

- Positioning software package

Model Name	OS Version
SW2SRX-GSV22PE	P, or above

For A273UHCPU

- Positioning OS

Model Name	OS Version
SW2SRX-SV22J SW2SRX-SV22U	U, or above

- Positioning software package

Model Name	OS Version
SW2SRX-GSV22PE	P, or above

# 1. GENERAL DESCRIPTION

---

## 1.2.1 Improved present value management

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

### (1) Added functions

- (a) An encoder data validity check is now possible during operation.
  - It is checked whether the amount of change at the encoder in 3.5 ms intervals corresponds to rotation within 180° at the motor shaft. (If abnormal, an error is displayed.)
  - Consistency between the encoder data and the feedback position controlled at the servo amplifier is checked. (If abnormal, an error is displayed.)
- (b) Addition of the present value history monitor has enabled monitoring of the following data at a peripheral device.
  - Encoder present value/servo command value/monitor present value when the power is switched ON.
  - Encoder present value/servo command value/monitor present value when the power is switched OFF.
  - Encoder present value/servo command value/monitor present value when a home position return is performed.
- (c) By setting the allowable travel while the power is OFF, a change in the encoder data to a value outside the setting range while the power is OFF can now be checked when the servo amplifier power is turned ON. (If abnormal, an error is displayed.)

# 1. GENERAL DESCRIPTION

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

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

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

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

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

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

- (3) Restrictions due to servo amplifier

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

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



# 1. GENERAL DESCRIPTION

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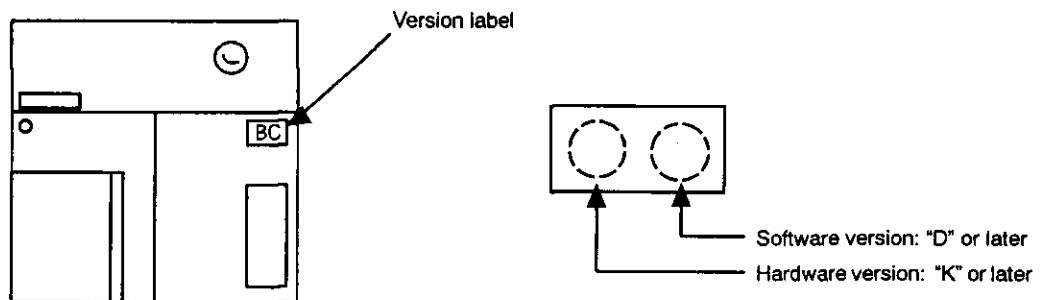
## (4) Restrictions on the servo system CPU

[When using A171SCPU]

- CPU version

Use an A171SCPU for which the hardware version indicated on the front of the module is "K" and the software version indicated is "D" or later.

(A171SCPU whose hardware version is "J" or earlier, or whose software version is "C" or earlier, cannot be used.)



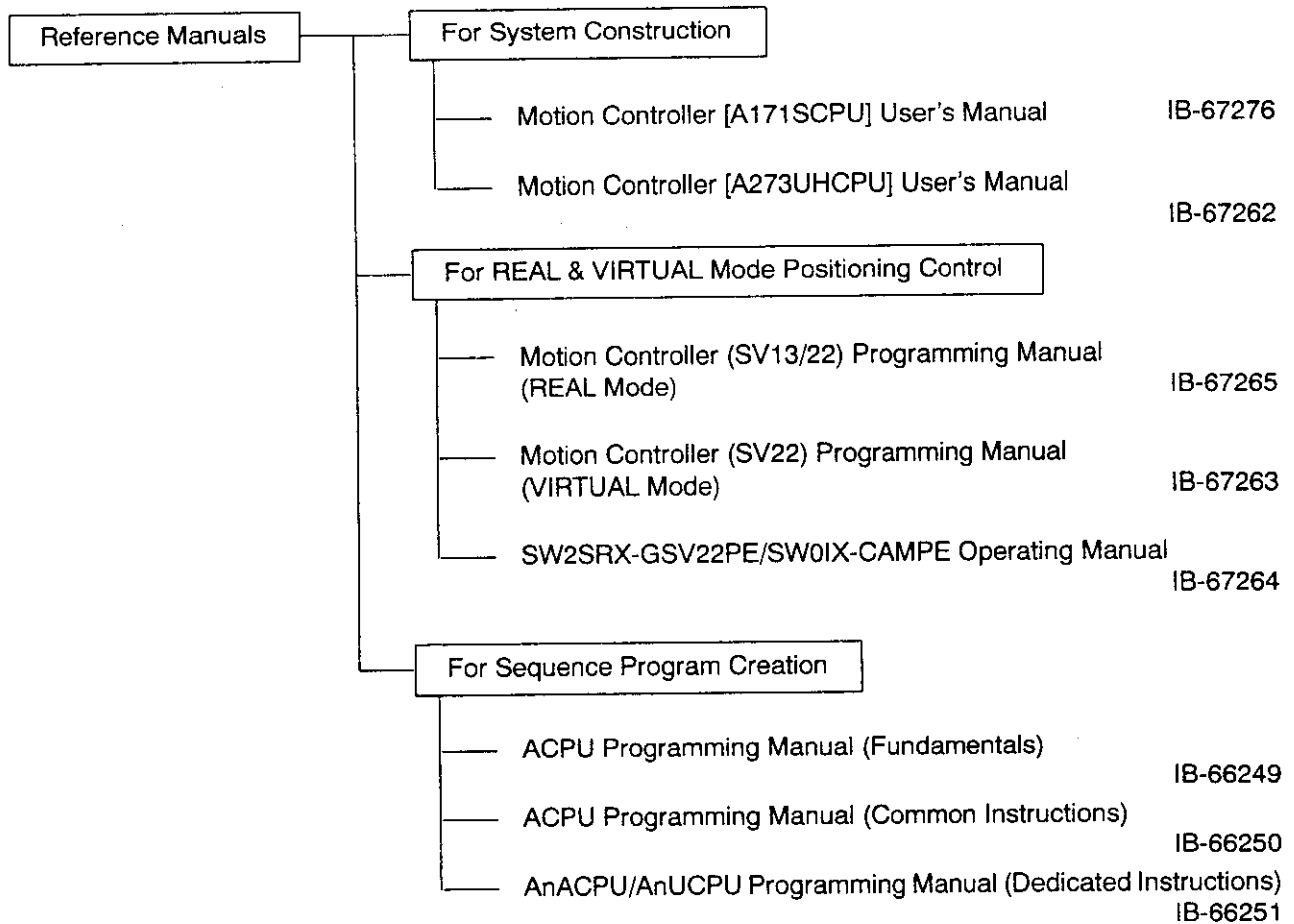
[When using A273UHCPU]

- There are no restrictions due to the hardware.

# 1. GENERAL DESCRIPTION

## 1.3 Reference Materials

The manuals shown below should be referred to when using the motion controller.



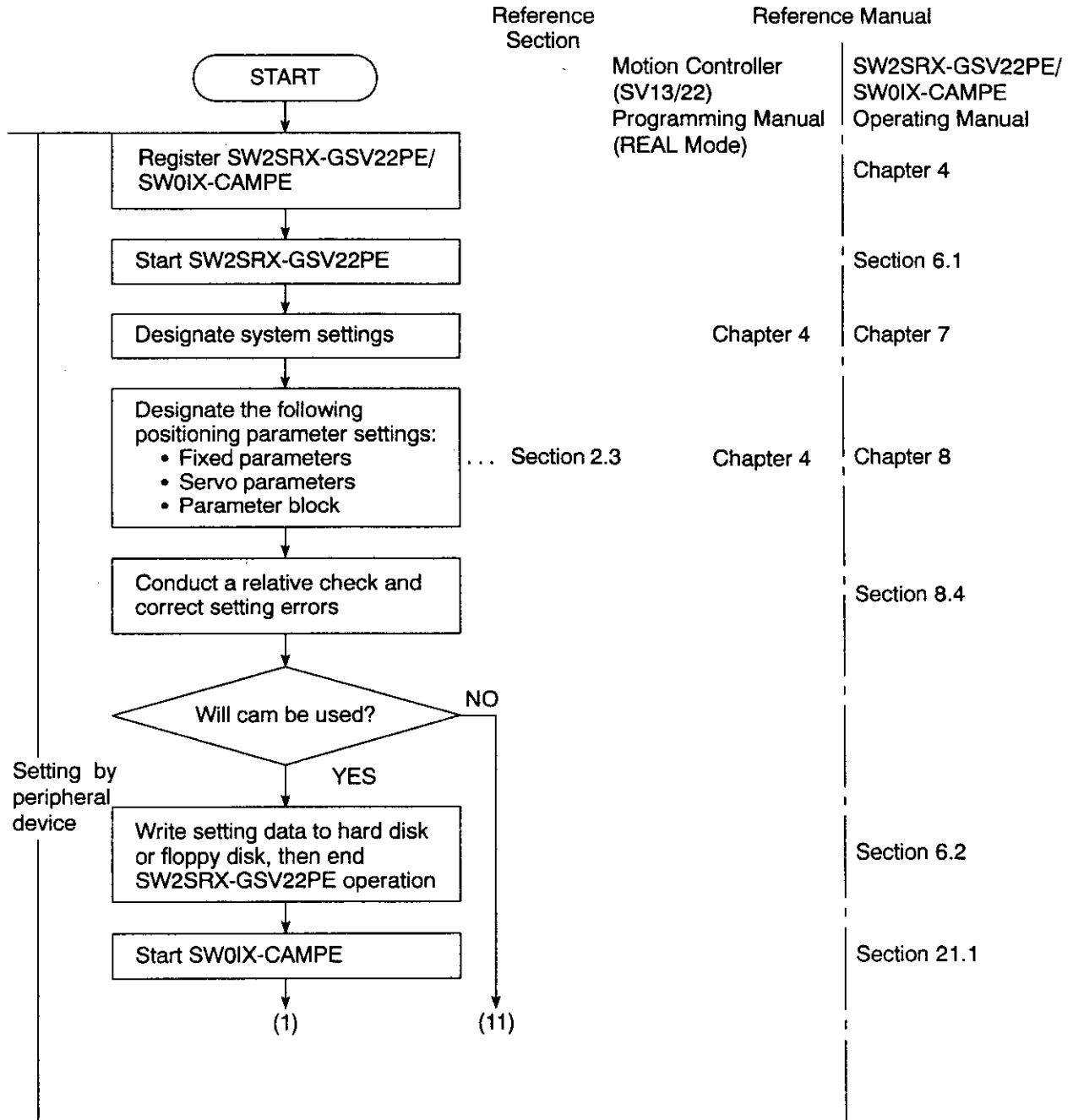
## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

### 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

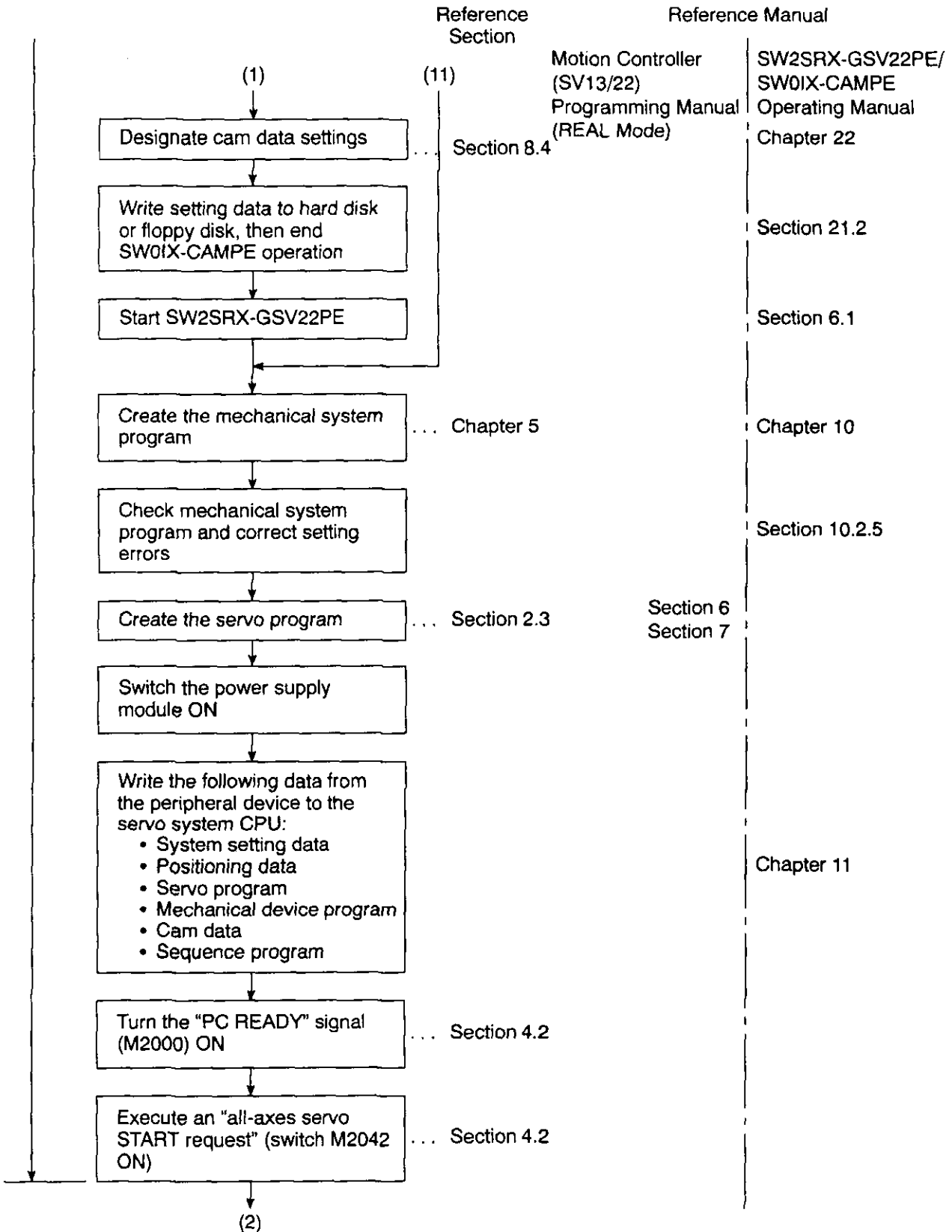
The procedure for VIRTUAL mode positioning control is discussed in this section.

#### 2.1 System Start-Up

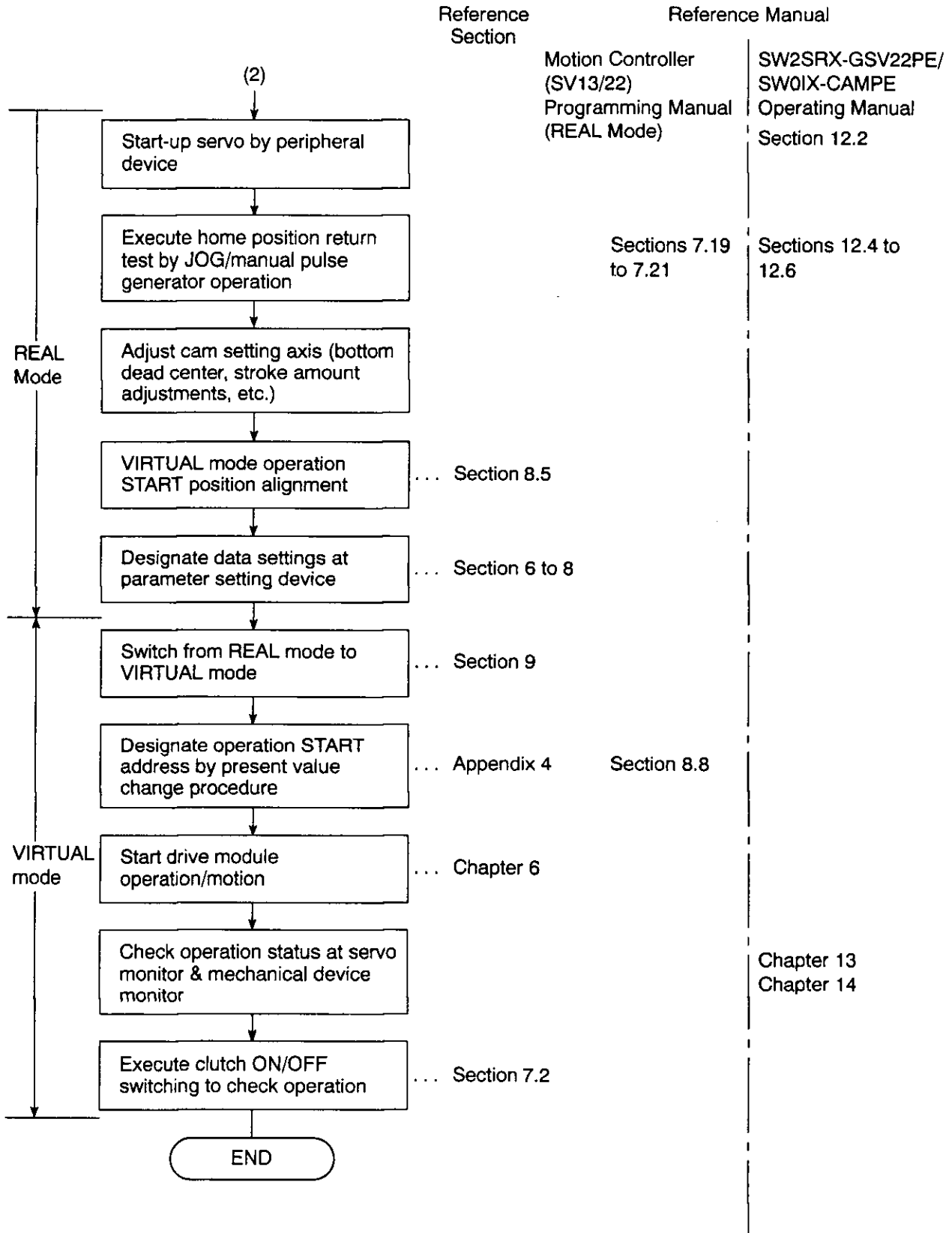
The procedure for a VIRTUAL mode system start-up is shown below.



## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL



## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL



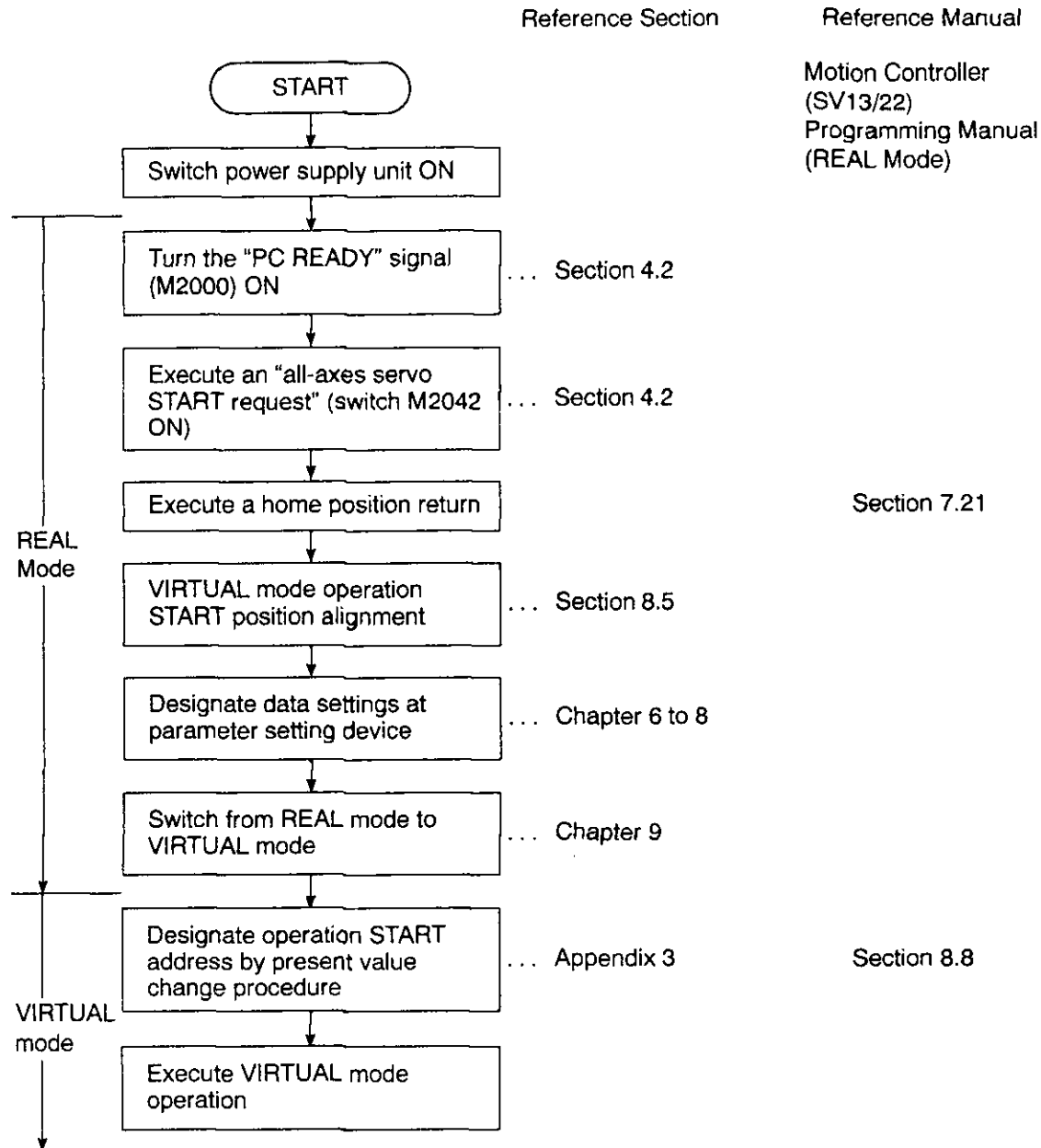
## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

### 2.2 Operation

The preparation procedure for VIRTUAL mode operation is shown below.

#### 2.2.1 Operation with incremental system

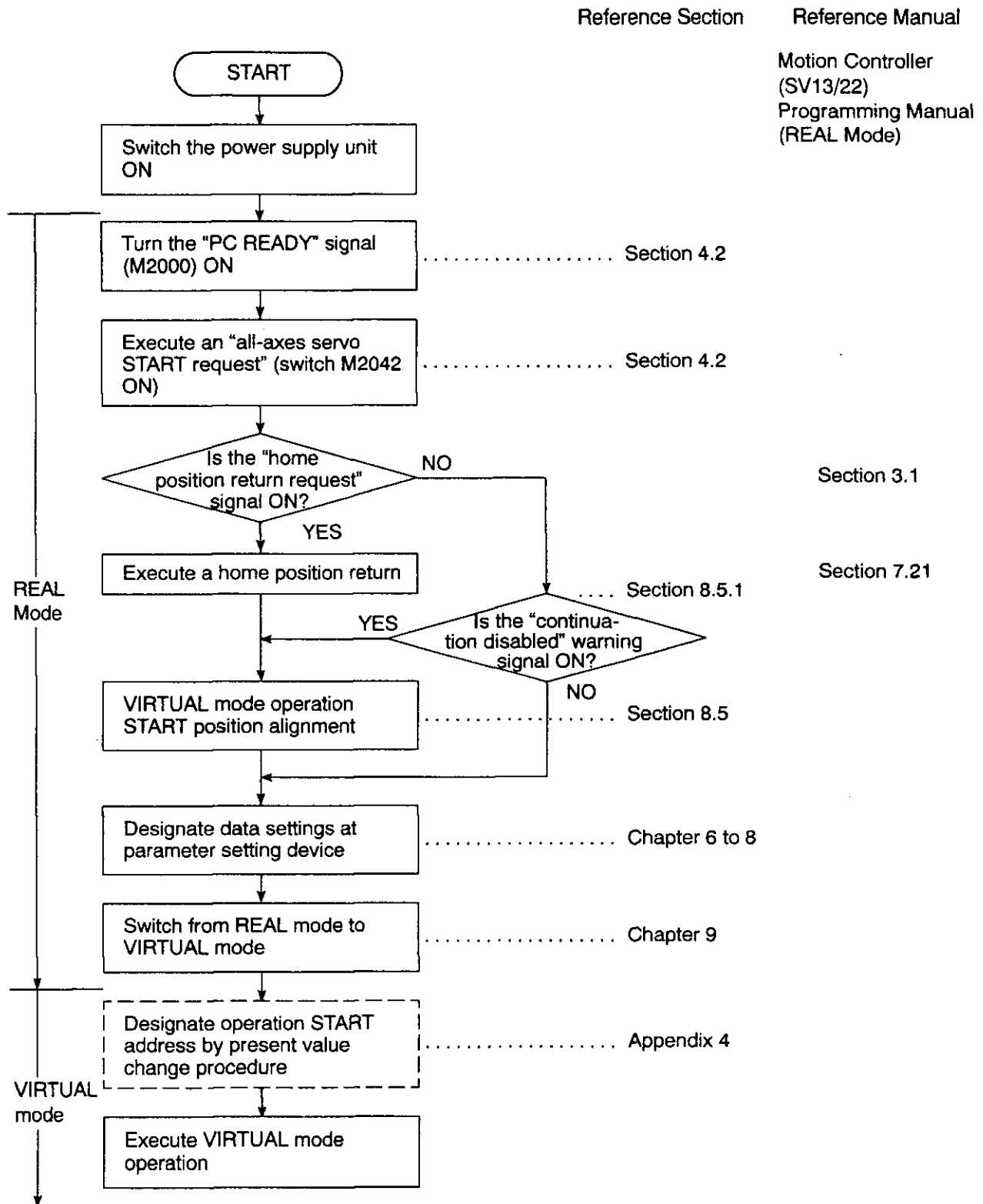
The operation procedure when an incremental system is used is shown below.



## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

### 2.2.2 Operation with an absolute (absolute position) system

The operation procedure when an absolute system is used is shown below.



## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

### 2.3 Differences Between The REAL and VIRTUAL Modes

Portions of the positioning data, positioning device, and servo programs, etc., used in REAL mode operations are different when used in VIRTUAL mode operations. The Motion Controller (SV13/22) Programming Manual (REAL Mode) should be read after acquainting yourself with these differences.

#### 2.3.1 Positioning data

Positioning data used in the VIRTUAL mode is shown in Table 2.1 below.

Table 2.1 Positioning Data List

Item	REAL Mode	VIRTUAL Mode	Remarks
System settings	○	○	
Fixed parameters	○	△	System-of-units varies according to the output module used
Servo parameters	○	○	
Parameter block	○	△	Use of "pulse" only
Home position return data	○	-	
JOG operation data	○	-	
Limit switch output data	○	△	

[○]: Used [△]: Conditional use [-]: Not used

#### 2.3.2 Positioning device

The operating ranges of VIRTUAL mode positioning devices are shown in Tables 2.2 to 2.4 below.

(1) When A171SCPU is used

Table 2.2 Operating Range of Positioning Devices

Device Name	REAL Mode	VIRTUAL Mode
Internal relays	M1600 - M2047	M1200 - M2047
Special relays	M9073 - M9079	
Data registers	D800 - D1023	D670 - D1023
Special registers	D9180 - D9199	

(2) When A273UHCPU (8-Axis specification) is used

Table 2.3 Operating Range of Positioning Devices

Device Name	REAL Mode	VIRTUAL Mode
Input/output	X/Y0 - 17F <sup>*1</sup>	X/Y0 - 17F
Internal relays	M1984 - M2047	
Special relays	M9073 - M9079	
Data registers	D800 - D1023	D670 - D1023
Special registers	D9180 - D9199	



## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

- (3) When A273UHCPU (32-axis specification) is used

**Table 2.4 Operating Range of Positioning Device**

Device Name	REAL Mode	VIRTUAL Mode
Internal relays	M2000 - M3839	M3840 - M5487
Special relays	M9073 - M9079	
Data registers	D0 - D799	D800 - D1559
Special registers	D9180 - D9199	

### 2.3.3 Servo program

- (1) Servo program area

- (a) The same servo program No. cannot be used in both the REAL and VIRTUAL modes. For VIRTUAL mode operations, the servo program's range must be designated in advance. (The range setting is executed at an IBM PC running the SW2SRX-GSV22PE software.)

- (2) Servo instructions

- (a) The home position return, speed control (II), speed/position switching functions, and high-speed oscillation functions are inoperative in the VIRTUAL mode.
- (b) The parameter block's control system-of-units and the torque limit value items (positioning data designated by the servo program) are not used.

- (3) The servo instructions available in the TEST and VIRTUAL modes are shown in Table 2.5 below.

**Table 2.5 Servo Instruction List for REAL & VIRTUAL Modes**

Item		REAL Mode	VIRTUAL Mode	Remarks	
Servo instruction	Speed/position control	VPF			
		VPR	○	×	
		VPSTRAT.			
	Speed control (II)	VPF	○	×	
VPR					
Home position return	ZERO	○	×	Switch to VIRTUAL mode after home position return has been executed in the REAL mode	
High-speed oscillation	OSC	○	×		
Positioning data	Parameter block	Control system-of-units	○	-	Fixed as "pulse"
		Torque limit value	○	-	Designated at drive module's parameter setting

[○]: Used [×]: Unusable [-]: Not used

## 2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

### 2.3.4 Control change (present value change & speed change)

When a control change is executed in the VIRTUAL mode, the drive module's feed present value and speed will change. Control changes are not possible for the output module.

The differences between control changes in the REAL and VIRTUAL modes are shown in Table 2.6 below.

**Table 2.6 Control Changes in the REAL & VIRTUAL Modes**

Item	REAL Mode	VIRTUAL Mode						Remarks
		Drive Module		Output Module				
		VIRTUAL Servo Motor	Synchronous Encoder	Roller	Ball Screw	Rotary Table	Cam	
Present value change	○	○	△	×	×	×	△	The programming method for a synchronous encoder "present value change" is different. (See Appendix 3.2.)
Speed change	○	○	×	×*				

#### REMARK

- (1) The [○], [△], [×] symbols used in Table 2.6 indicate the following:  
 [○]: Setting/execution possible  
 [△]: Execution possible, but programming method is different  
 [×]: Setting/execution impossible
- (2) \*: If the output module is a roller which uses a speed change gear, a speed change can be executed by changing the speed change gear ratio.
- (3) For details regarding the drive and output modules, refer to the sections shown below.
  - Drive module: Chapters 5 & 6
  - Output module: Chapters 5 & 8

### 3. PERFORMANCE SPECIFICATIONS

#### 3. PERFORMANCE SPECIFICATIONS

The PCPU performance specifications are shown in Tables 3.1 to 3.3.

(1) When A171SCPU is used

**Table 3.1 PCPU Performance Specifications (for A171SCPU)**

Item		PCPU Performance/Specifications				
Number of controlled axes		4 axes (simultaneous control of 2-4 axes; individual control of 4 axes)				
Interpolation functions		Linear interpolation (2, 3, 4 axes); Circular interpolation (2 axes)				
Control format		PTP (Point-To-Point), speed control, fixed pitch feed, constant speed control, follow-up control, synchronous control				
Control units		Drive module	Virtual servomotor		Pulse	
			Synchronous encoder			
		Output module	Roller		mm, inch	
			Ball screw			
			Rotary table		Fixed as "degrees"	
		Cam		mm, inch, pulse		
Program	Language	Dedicated instructions (sequence program, SFC, servo program, mechanical system program)				
	Capacity	13k steps (13312 steps)				
	Number of positioning points	Approx. 800 points per axis (varies according to program). Indirect designation of positioning data is also possible				
	Setting method	Settings designated at IBM PC where SW2SRX/GSV22PE is started up.				
Mechanical System Program		Mechanical device module	Number of modules per servo system CPU	Number of modules per block		
				At connected shaft	At auxiliary input shaft	
	Drive modules	Virtual servomotor	4	Total of 6	-	-
		Synchronous encoder	2			
	Virtual axes	Virtual main shaft	4	Total of 8	-	-
		Virtual auxiliary input shaft	4			
	Transmission modules	Gear	8		1	1
		Clutch	8		1	1
		Speed change gear	8		1	1
		Differential gear	4		1	-
		Differential gear (for connection to virtual main shaft)	4		Number of modules per system	-
				1		
	Output modules	Cam	4	Total of 4	1	
		Roller	4			
Ball screw		4				
Rotary table		4				
Cam	Types	Max. of 64				
	Resolution per cycle	256, 512, 1024, 2048				
	Memory capacity	Approx. 32k bytes				
	Stroke amount resolution	32767				
	Control modes	Two-way cam, feed cam				
Positioning	Method	PTP ..... Selection of absolute data method or incremental method Fixed-pitch feed ..... Incremental method Constant speed control .... Absolute data method and incremental method can be used together Position follow-up control ... Absolute data method				

### 3. PERFORMANCE SPECIFICATIONS

Table 3.1 PCPU Performance Specifications (for A171SCPU) (Continued)

Item		PCPU Performance/Specifications	
Positioning	Position commands	Setting range	-2147483648 - 2147483647 (pulse)
		Max. setting value	4294967296 (pulse)
	Speed command (command unit)	1 - 1000000 (pulse/s)	
	Acceleration/deceleration processing	Automatic trapezoidal acceleration/deceleration Acceleration time ..... 1 - 65535 (ms) Deceleration time ..... 1 - 65535 (ms) S curve acceleration/deceleration S curve ratio ..... 0 - 100%	
Com- pensation	Backlash compensation	(0 - 65535) × position command units (units converted to pulses → 0 - 65535 pulses)	
	Electronic gear	Compensation function for error in actual travel value with respect to command value	
Home position return function		When not using the absolute position system, the "near-zero point dog" or "count" formats can be selected. When using the absolute position system, the "data set", "near-zero point dog", or "count" formats can be selected.	
JOG operation function		Provided	
Manual pulse generator operation function		1 unit can be connected	
M function		M code output function provided	
Limit switch output function		Number of output points: 8 output points per axis (up to 10 ON/OFF setting points per axis are possible)	
Absolute position system		Possible with a motor equipped with an absolute position detector. (Possible to select the absolute data method or incremental method for each axis)	

### 3. PERFORMANCE SPECIFICATIONS

(2) When A273UHCPU (8-axis specification) is used

**Table 3.2 Performance Specifications (for A273UHCPU 8-axis Specification)**

Item		PCPU Performance/Specifications				
Number of controlled axes		8 axes (simultaneous control of 2-4 axes; individual control of 8 axes)				
Interpolation functions		Linear interpolation (2, 3, 4 axes); Circular interpolation (2 axes)				
Control format		PTP (Point-To-Point), speed control, fixed pitch feed, constant speed control, follow-up control, synchronous control				
Control units		Drive module	Virtual servomotor		Pulse	
			Synchronous encoder			
		Output module	Roller		mm, inch	
			Ball screw			
			Rotary table		Fixed as "degrees"	
Cam				mm, inch, pulse		
Program	Language	Dedicated instructions (servo program, mechanical system program)				
	Capacity	13k steps (13312 steps)				
	Number of positioning points	Approx. 800 points per axis (varies according to program). Indirect designation of positioning data is also possible				
	Setting method	Settings designated at IBM PC where SW2SRX/GSV22PE is started up.				
Mechanical System Program		Mechanical device module	Number of modules per servo system CPU		Number of modules per block	
					At connected shaft	At auxiliary input shaft
	Drive modules	Virtual servomotor	8	Total of 11	-	-
		Synchronous encoder	3			
	Virtual axes	Virtual main shaft	8	Total of 16	-	-
		Virtual auxiliary input shaft	8			
	Transmission modules	Gear	16		1	1
		Clutch	16		1	1
		Speed change gear	16		1	1
		Differential gear	8		1	-
		Differential gear (for connection to virtual main shaft)	8		Number of modules per system	
	Output modules	Cam	8	Total of 8	1	
		Roller	8			
		Ball screw	8			
Rotary table		8				
Cam	Types	Max. of 64				
	Resolution per cycle	256, 512, 1024, 2048				
	Memory capacity	32k bytes (stored in block No.10 of memory cassette's extension file register area)*				
	Stroke amount resolution	32767				
	Control modes	Two-way cam, feed cam				
Positioning	Method	PTP . . . . . Selection of absolute data method or incremental method				
		Fixed-pitch feed . . . . . Incremental method				
	Position commands	Setting range		-2147483648 - 2147483647 (pulse)		
		Max. setting value		4294967296 (pulse)		
Speed command (command unit)	1 - 1000000 (pulse/s)					

### 3. PERFORMANCE SPECIFICATIONS

Table 3.2 PCPU Performance Specifications (for A273UHCPU 8-axis Specification) (Continued)

Item		PCPU Performance/Specifications
Positioning	Acceleration/deceleration processing	Automatic trapezoidal acceleration/deceleration Acceleration time ..... 1 - 65535 (ms) Deceleration time ..... 1 - 65535 (ms) S curve acceleration/deceleration S curve ratio ..... 0 - 100%
Compensation	Backlash compensation	(0 - 65535) × position command units (units converted to pulses → 0 - 65535 pulses)
	Electronic gear	Compensation function for error in actual travel value with respect to command value
Home position return function		When not using the absolute position system, the "near-zero point dog" or "count" formats can be selected. When using the absolute position system, the "data set", "near-zero point dog", or "count" formats can be selected.
JOG operation function		Provided
Manual pulse generator operation function		3 units can be connected
M function		M code output function provided
Limit switch output function		Number of output points: 8 output points per axis (up to 10 ON/OFF setting points per axis are possible)
Absolute position system		Possible with a motor equipped with an absolute position detector. (Possible to select the absolute data method or incremental method for each axis)

**POINTS**

(1) \*: When the cam is used in the VIRTUAL mode, only the memory cassettes shown below can be used.

- For A273UHCPU (8/32-axis specification)

- A3NMCA16 (128k bytes)
- A3NMCA24 (192k bytes)
- A3NMCA40 (320k bytes)
- A3NMCA56 (448k bytes)
- A3NMCA96 (768k bytes)

(2) If a cam shaft "1-revolution mode" limit switch output is executed in the SV22's VIRTUAL mode, the A3NMCA16 memory cassette cannot be used. (A3NMCA24 or higher is required.)

### 3. PERFORMANCE SPECIFICATIONS

(3) When A273UHCPU (32-axis specification) is used

**Table 3.3 PCPU Performance Specifications (for A273UHCPU 32-axis Specification)**

Item		PCPU Performance/Specifications				
Number of controlled axes		32 axes (simultaneous control of 2-4 axes; individual control of 32 axes)				
Interpolation functions		Linear interpolation (2, 3, 4 axes); Circular interpolation (2 axes)				
Control format		PTP (Point-To-Point), speed control, fixed pitch feed, constant speed control, follow-up control, synchronous control				
Control units		Drive module	Virtual servomotor		Pulse	
			Synchronous encoder			
		Output module	Roller		mm, inch	
			Ball screw			
			Rotary table		Fixed as "degrees"	
Cam		mm, inch, pulse				
Program	Language	Dedicated instructions (servo program, mechanical system program)				
	Capacity	14k steps (14334 steps)				
	Number of positioning points	Approx. 100 points per axis (varies according to program). Indirect designation of positioning data is also possible				
	Setting method	Settings designated at IBM PC where SW2SRX/GSV22PE is started up.				
Mechanical System Program		Mechanical device module	Number of modules per servo system CPU		Number of modules per block	
					At connected shaft	At auxiliary input shaft
	Drive modules	Virtual servomotor	32	Total of 44	-	-
		Synchronous encoder	12			
	Virtual axes	Virtual main shaft	32	Total of 64	-	-
		Virtual auxiliary input shaft	32			
	Transmission modules	Gear	64		1	1
		Clutch	64		1	1
		Speed change gear	64		1	1
		Differential gear	32		1	-
		Differential gear (for connection to virtual main shaft)	32		Number of modules per system	
	Output modules	Cam	32	Total of 32	1	
		Roller	32			
Ball screw		32				
Rotary table		32				
Cam	Types	Max. of 256				
	Resolution per cycle	256, 512, 1024, 2048				
	Memory capacity	132k bytes (stored in block No.10 of memory cassette's extension file register area)*				
	Stroke amount resolution	32767				
	Control modes	Two-way cam, feed cam				
Positioning	Method	PTP . . . . . Selection of absolute data method or incremental method				
		Fixed-pitch feed . . . . . Incremental method				
	Position commands	Constant speed control . . . Absolute data method and incremental method can be used together				
		Position follow-up control . Absolute data method				
Speed command (command unit)	Setting range	-2147483648 - 2147483647 (pulse)				
	Max. setting value	4294967296 (pulse)				

### 3. PERFORMANCE SPECIFICATIONS

Table 3.3 PCPU Performance Specifications (for A273UHCPU 32-axis Specification) (Continued)

Item		PCPU Performance/Specifications
Positioning	Acceleration/deceleration processing	Automatic trapezoidal acceleration/deceleration Acceleration time ..... 1 - 65535 (ms) Deceleration time ..... 1 - 65535 (ms) S curve acceleration/deceleration S curve ratio ..... 0 - 100%
Com-pensation	Backlash compensation	$(0 - 65535) \times$ position command units (units converted to pulses $\rightarrow$ 0 - 65535 pulses)
	Electronic gear	Compensation function for error in actual travel value with respect to command value
Home position return function		When not using the absolute position system, the "near-zero point dog" or "count" formats can be selected. When using the absolute position system, the "data set", "near-zero point dog", or "count" formats can be selected.
JOG operation function		Provided
Manual pulse generator operation function		3 units can be connected
M function		M code output function provided
Limit switch output function		Number of output points: 8 output points per axis (up to 10 ON/OFF setting points per axis are possible)
Absolute position system		Possible with a motor equipped with an absolute position detector. (Possible to select the absolute data method or incremental method for each axis)

#### POINTS

(1) \*: When the cam is used in the VIRTUAL mode, only the memory cassettes shown below can be used.

- For A273UHCPU (8/32-axis specification)

A3NMCA16 (128k bytes)  
A3NMCA24 (192k bytes)  
A3NMCA40 (320k bytes)  
A3NMCA56 (448k bytes)  
A3NMCA96 (768k bytes)

(2) If a cam shaft "1-revolution mode" limit switch output is executed in the SV22's VIRTUAL mode, the A3NMCA16 memory cassette cannot be used. (A3NMCA24 or higher is required.)



## 4. SERVO SYSTEM CPU DEVICES

### 4. SERVO SYSTEM CPU DEVICES

The applications of servo system CPU devices used for VIRTUAL mode positioning operation are explained in this section.

Section 4.1 discusses the memory maps of devices used for VIRTUAL mode positioning. Subsequent sections discuss the common devices (internal relay, data register, special relay, special register).

Details on the devices for mechanical modules (I/O devices, data registers) are given in Chapter 6 and Chapter 8.

- Drive modules: Section 6.3
- Output modules: Section 8.5

#### 4.1 Device List

##### (1) Axis input/output (X/Y/M)

The number of VIRTUAL mode input/output points varies according to the servo system CPU which used, as follows:

- For the A171SCPU: 848 points (M1200 - M2047)
- For the A273UHCPU (8-axis specification): 384 points (X/Y0 - X/Y17F)
- For the A273UHCPU (32-axis specification): 3088 points (M2400 - M5487)

Table 4.1 below shows the axis input/output signals used for VIRTUAL mode positioning operations.

**Table 4.1 Axis Input/Output Signal List**

Signal Name	Device No.			Signal Direction	Reference Section
	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)		
Drive module status signals	M1200 - M1279	X100 - X17F	M4000 - M4639	PCPU → SCPU	Section 6.3.1
Synchronous encoder status signals	M1360 - M1365	X0E0 - X0EA	M4640 - M4687		Section 6.3.1
Drive module command signals	M1400 - M1479	Y100 - Y17F	M4800 - M5439	SCPU → PCPU	Section 6.3.1
Synchronous encoder command signals	M1560, M1561	Y0E0 - Y0E2	M5440 - M5487		Section 6.3.1
Output module status signals	M1600 - M1679	X000 - X07F	M2400 - M3039	PCPU → SCPU	Section 8.5.1
Output module command signals	M1800 - M1879	X000 - X07F	M3200 - M3839	SCPU → PCPU	Section 8.5.1

## 4. SERVO SYSTEM CPU DEVICES

### (2) Internal relay (M)

The number of VIRTUAL mode internal relay points varies according to the servo system CPU which used, as follows:

- For the A171SCPU: 64 points (M1984 - M2047)
- For the A273UHCPU (8-axis specification): 64 points (M1984 - M2047)
- For the A273UHCPU (32-axis specification): 320 points (M2000 - M2319)

Table 4.2 below shows the internal relays used for VIRTUAL mode positioning operations.

**Table 4.2 Internal Relay List**

Signal Name	Device No.			Signal Direction	Reference Section
	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)		
Clutch ON/OFF status	M1984 - M1991	M1984 - M1999	M2160 - M2223	PCPU → SCPU	Section 7.2.1
PC READY	M2000			SCPU → PCPU	Section 4.2.1
Virtual servomotor START accept flag	M2001 - M2004	M2001 - M2008	M2001 - M2032	PCPU → SCPU	Section 4.2.2
All-axes servo START accept flag	M2009	M2009	M2049		Section 4.2.3
Manual pulse generator enable flag	M2012	M2012 - M2014	M2051 - M2053	SCPU → PCPU	Section 4.2.4
JOG simultaneous START command	M2015	M2015	M2048		Section 4.2.5
Cam & limit switch output data batch change request flag	-	M2016	M2056		Section 4.2.6
Cam & limit switch output data batch change completion flag	-	M2017	M2057		Section 4.2.7
Cam & limit switch output data batch change error flag	-	M2018	M2058		Section 4.2.8
START buffer full	M2020	M2020	M2050	PCPU → SCPU	Section 4.2.9
Speed change in progress flag	M2021 - M2024	M2021 - M2028	M2061 - M2092		Section 4.2.10
Synchronous encoder axis present value change in progress flag	M2031	M2031 - M2033	M2101 - M2112		Section 4.2.11
Speed switching point designation flag	M2040			SCPU → PCPU	Section 4.2.12
System setting error flag	M2041			PCPU → SCPU	Section 4.2.13
All-axes servo START command flag	M2042			SCPU → PCPU	Section 4.2.14
REAL/VIRTUAL mode switching request flag	M2043				Section 4.2.15
REAL/VIRTUAL mode status	M2044			PCPU → SCPU	Section 4.2.16
REAL/VIRTUAL mode switching error detection flag	M2045				Section 4.2.17
Synchronization discrepancy warning flag	M2046				Section 4.2.18
Motion slot module error detection flag	M2047				Section 4.2.19
Automatic deceleration in progress flag	-	-	M2128 - M2159		Section 4.2.20
Speed change "0" accept flag	-	-	M2240 - M2271	Section 4.2.21	

## 4. SERVO SYSTEM CPU DEVICES

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### (3) Special relays

Table 4.3 below shows the special relays used for VIRTUAL mode positioning operations.

**Table 4.3 Special Relay List**

Signal Name	Device No.	Signal Direction	Reference Section
WDT error flag	M9073	PCPU → SCPU	Section 4.3.1
PCPU READY-completed flag	M9074		Section 4.3.2
In-test-mode flag	M9075		Section 4.3.3
External emergency stop input flag	M9076		Section 4.3.4
Manual pulse generator axis setting error flag	M9077		Section 4.3.5
TEST mode request flag	M9078		Section 4.3.6
Servo program setting error flag	M9079		Section 4.3.7

## 4. SERVO SYSTEM CPU DEVICES

### (4) Data registers

Table 4.4 below shows the data registers used for VIRTUAL mode positioning operations.

**Table 4.4 Data Register List**

Signal Name	Device No.			Signal Direction	Reference Section
	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)		
Virtual servomotor monitor area	D700 - D723	D700 - D747	D800 - D1119	PCPU → SCPU	Section 6.3.2
Storage area of present value after main shaft differential gear	D670 - D677	D670 - D685			
Synchronous encoder monitor area	D748 - D755	D748 - D759	D1120 - D1239		Section 6.3.2
Storage area of present value after main shaft differential gear	D686 - D689	D686 - D691			
Cam monitor area	D760 - D779	D760 - D799	D1240 - D1559		Section 8.5.2
Output module monitor area	D800 - D879	D800 - D959	D0 - D639	PCPU → SCPU (*1)	Section 8.5.2
Virtual servomotor control change area	D960 - D983	D960 - D1007	D640 - D703	SCPU → PCPU	Section 6.3.2
Limit switch output enabled/disabled area	D1008 - D1009	D1008 - D1011	D760 - D775		Section 4.4.1
Manual pulse generator axis setting	D1012	D1012 - D1014	D714 - D719		Section 6.3.2
JOG simultaneous START axis setting	D1015	D1015	D710 - D713		Section 6.3.2
Manual pulse generator 1-pulse input magnification setting	D1016 - D1019	D1016 - D1023	D720 - D751		Section 6.3.2

\*1: The signal direction is SCPU → PCPU for the "travel value setting register" item only.

## 4. SERVO SYSTEM CPU DEVICES

### (5) Special registers

Table 4.5 below shows the special registers used for VIRTUAL mode positioning operations.

**Table 4.5 Special Register List**

Signal Name	Device No.			Signal Direction	Reference Section
	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)		
Limit switch output status storage area	D9180 - D9181	D9180 - 9183	D776 - D791	PCPU → SCPU	Section 4.5.1
PCPU error cause storage area	D9184				Section 4.5.2
Servo amplifier type storage area	D9185 - 9186	D9185 - D9186	D792 - D799		Section 4.5.3
Manual pulse generator axis setting error cause storage area	D9187	D9187	D9185 - D9187		Section 4.5.4
TEST mode request error cause storage area	D9188	D9188	D9182 - D9183		Section 4.5.5
Error program No. storage area	D9189				Section 4.5.6
Error information storage area	D9190				Section 4.5.7
Servo amplifier motion slot loading information storage area	D9191	D9191	D9191 - D9192		Section 4.5.8
Manual pulse generator smoothing magnification storage area	D9192	D9192 - D9194	D752 - D754	SCPU → PCPU	Section 4.5.9
REAL/VIRTUAL mode switching error information storage area	D9195	D9195	D9193 - D9195	PCPU → SCPU	Section 4.5.10

## 4. SERVO SYSTEM CPU DEVICES

### 4.2 Internal Relays (M)

(1) When A171SCPU is used

The A171SCPU has 2048 (M/L0 - M/L2047) internal relay & latch relay signals. Of these, the M1984 to M2047 signals are used for positioning operations, and their applications are shown in Table 4.6 below.

**Table 4.6 Internal Relay List (for A171SCPU)**

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction
M1984	Virtual axis No.1 drive clutch ON/OFF status	PCPU → SCPU	M2013	Unusable	-
			M2014		
M1985	Virtual axis No.1 auxiliary input shaft clutch ON/OFF status		M2015	JOG simultaneous START command	SCPU → PCPU
M1986	Virtual axis No.2 drive clutch ON/OFF status		M2016 - M2019	Unusable	-
M1987	Virtual axis No.2 auxiliary input shaft clutch ON/OFF status		M2020	START buffer full	PCPU → SCPU
M1988	Virtual axis No.3 drive clutch ON/OFF status		M2021	Virtual axis No.1 speed change in progress flag	
M1989	Virtual axis No.3 auxiliary input shaft clutch ON/OFF status		M2022	Virtual axis No.2 speed change in progress flag	
M1990	Virtual axis No.4 drive clutch ON/OFF status		M2023	Virtual axis No.3 speed change in progress flag	
M1991	Virtual axis No.4 auxiliary input shaft clutch ON/OFF status		M2024	Virtual axis No.4 speed change in progress flag	
M1992 - M1999	Unusable		-	M2025 - M2030	Unusable
M2000	PC READY	SCPU → PCPU	M2031	Synchronous encoder (P1) axis present value change in progress	PCPU → SCPU
M2001	Virtual axis No.1 START accept flag	PCPU → SCPU	M2032 - M2039	Unusable	-
M2002	Virtual axis No.2 START accept flag		M2040	Speed switching point designation flag	SCPU → PCPU
M2003	Virtual axis No.3 START accept flag		M2041	System setting error flag	PCPU → SCPU
M2004	Virtual axis No.4 START accept flag		M2042	All-axes servo START command flag	SCPU → PCPU
M2005 - M2008	Unusable	-	M2043	REAL/VIRTUAL mode switching request	
M2009	All-axes servo START accept flag	PCPU → SCPU	M2044	REAL/VIRTUAL mode status	PCPU → SCPU
M2010	Unusable	-	M2045	REAL/VIRTUAL mode switching error detection	
M2011			M2046	Synchronization discrepancy warning flag	
M2012	Manual pulse generator enabled flag	SCPU → PCPU	M2047	Motion slot error detection flag	

## 4. SERVO SYSTEM CPU DEVICES

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### POINTS

- (1) Internal relays for positioning operations are not latched even when within the latch range.  
The expression "M1984 - M2047" is therefore used in this manual when referring to internal relays for positioning operations in order to indicate that they are not latched.
- (2) Monitoring of internal relays (for positioning operations) at peripheral devices occurs as follows.
  - (a) For an IBM PC booted up with SW2SRX-GSV22PE, the internal relays for positioning operations set for the latch range are displayed as L1984 to L2047.

## 4. SERVO SYSTEM CPU DEVICES

(2) When A273UHCPU (8-axis specification) is used

The A273UHCPU (8-axis specification) has 8192 (M/L0 - M/L8191) internal relay & latch relay signals. Of these, the M1984 to M2047 signals are used for positioning operations, and their applications are shown in Table 4.7 below.

**Table 4.7 Internal Relay List (for A273UHCPU 8-axis Specification)**

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction	
M1984	Virtual axis No.1 drive clutch ON/OFF status	PCPU → SCPU	M2008	Virtual axis No.8 START accept flag	PCPU → SCPU	
M1985	Virtual axis No.1 auxiliary input shaft clutch ON/OFF status		M2009	All-axes servo START accept flag		
M1986	Virtual axis No.2 drive clutch ON/OFF status		M2010	Unusable	-	
M1987	Virtual axis No.2 auxiliary input shaft clutch ON/OFF status		M2011			
M1988	Virtual axis No.3 drive clutch ON/OFF status		M2012	Manual pulse generator No.1 enabled flag	SCPU → PCPU	
M1989	Virtual axis No.3 auxiliary input shaft clutch ON/OFF status		M2013	Manual pulse generator No.2 enabled flag		
M1990	Virtual axis No.4 drive clutch ON/OFF status		M2014	Manual pulse generator No.3 enabled flag		
M1991	Virtual axis No.4 auxiliary input shaft clutch ON/OFF status		M2015	JOG simultaneous START command		
M1992	Virtual axis No.5 drive clutch ON/OFF status		M2016	Cam & limit switch output data batch change request flag	PCPU → SCPU	
M1993	Virtual axis No.5 auxiliary input shaft clutch ON/OFF status		M2017	Cam & limit switch output data batch change completed flag		
M1994	Virtual axis No.6 drive clutch ON/OFF status		M2018	Cam & limit switch output data batch change error flag	-	
M1995	Virtual axis No.6 auxiliary input shaft clutch ON/OFF status		M2019	Unusable		
M1996	Virtual axis No.7 drive clutch ON/OFF status		M2020	START buffer full	PCPU → SCPU	
M1997	Virtual axis No.7 auxiliary input shaft clutch ON/OFF status		M2021	Virtual axis No.1 speed change in progress flag		
M1998	Virtual axis No.8 drive clutch ON/OFF status		M2022	Virtual axis No.2 speed change in progress flag		
M1999	Virtual axis No.8 auxiliary input shaft clutch ON/OFF status		M2023	Virtual axis No.3 speed change in progress flag		
M2000	PC READY		SCPU → PCPU	M2024		Virtual axis No.4 speed change in progress flag
M2001	Virtual axis No.1 START accept flag		PCPU → SCPU	M2025	Virtual axis No.5 speed change in progress flag	PCPU → SCPU
M2002	Virtual axis No.2 START accept flag			M2026	Virtual axis No.6 speed change in progress flag	
M2003	Virtual axis No.3 START accept flag	M2027		Virtual axis No.7 speed change in progress flag		
M2004	Virtual axis No.4 START accept flag	M2028		Virtual axis No.8 speed change in progress flag		
M2005	Virtual axis No.5 START accept flag	M2029		Unusable	-	
M2006	Virtual axis No.6 START accept flag	M2030				
M2007	Virtual axis No.7 START accept flag	M2031		Synchronous encoder (P1) axis present value change in progress	PCPU → SCPU	



## 4. SERVO SYSTEM CPU DEVICES

Table 4.7 Internal Relay List (for A273UHCPU 8-axis Specification) (Continued)

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction
M2032	Synchronous encoder (P2) axis present value change in progress	PCPU → SCPU	M2043	REAL/VIRTUAL mode switching request	SCPU → PCPU
M2033	Synchronous encoder (P3) axis present value change in progress		M2044	REAL/VIRTUAL mode status	PCPU → SCPU
M2034 - M2039	Unusable	-	M2045	REAL/VIRTUAL mode switching error detection	
M2040	Speed switching point designation flag	SCPU → PCPU	M2046	Synchronization discrepancy warning flag	
M2041	System setting error flag	PCPU → SCPU	M2047	Motion slot error detection flag	
M2042	All-axes servo START command flag	SCPU → PCPU			

### POINTS

- (1) Internal relays for positioning operations are not latched even when within the latch range.  
The expression "M1984 - M2047" is therefore used in this manual when referring to internal relays for positioning operations in order to indicate that they are not latched.
- (2) Monitoring of internal relays (for positioning operations) at peripheral devices occurs as follows.
  - (a) For an IBM PC booted up with SW2SRX-GSV22PE, the internal relays for positioning operations set for the latch range are displayed as L1984 to L2047.

## 4. SERVO SYSTEM CPU DEVICES

(3) When A273UHCPU (32-axis specification) is used

The A273UHCPU (32-axis specification) has 8192 (M/L0 - M/L8191) internal relay & latch relay signals. Of these, the M2000 to M2319 signals are used for positioning operations, and their applications are shown in Table 4.8 below.

**Table 4.8 Internal Relay List (for A273UHCPU 32-axis Specification)**

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction	
M2000	PC READY	SCPU → PCPU	M2024	Virtual axis No. 24 START accept flag	PCPU → SCPU	
M2001	Virtual axis No. 1 START accept flag	PCPU → SCPU	M2025	Virtual axis No. 25 START accept flag		
M2002	Virtual axis No. 2 START accept flag		M2026	Virtual axis No. 26 START accept flag		
M2003	Virtual axis No. 3 START accept flag		M2027	Virtual axis No. 27 START accept flag		
M2004	Virtual axis No. 4 START accept flag		M2028	Virtual axis No. 28 START accept flag		
M2005	Virtual axis No. 5 START accept flag		M2029	Virtual axis No. 29 START accept flag		
M2006	Virtual axis No. 6 START accept flag		M2030	Virtual axis No. 30 START accept flag		
M2007	Virtual axis No. 7 START accept flag		M2031	Virtual axis No. 31 START accept flag		
M2008	Virtual axis No. 8 START accept flag		M2032	Virtual axis No. 32 START accept flag		
M2009	Virtual axis No. 9 START accept flag		M2033 - M2039	Unusable		-
M2010	Virtual axis No. 10 START accept flag		M2040	Speed switching point designation flag		PCPU → SCPU
M2011	Virtual axis No. 11 START accept flag		M2041	System setting error flag		SCPU → PCPU
M2012	Virtual axis No. 12 START accept flag		M2042	All-axes servo START command flag	PCPU → SCPU	
M2013	Virtual axis No. 13 START accept flag	M2043	REAL/VIRTUAL mode switching request	SCPU → PCPU		
M2014	Virtual axis No. 14 START accept flag	M2044	REAL/VIRTUAL mode status	PCPU → SCPU		
M2015	Virtual axis No. 15 START accept flag	M2045	REAL/VIRTUAL mode switching error detection			
M2016	Virtual axis No. 16 START accept flag	M2046	Synchronization discrepancy warning flag			
M2017	Virtual axis No. 17 START accept flag	M2047	Motion slot error detection flag	SCPU → PCPU		
M2018	Virtual axis No. 18 START accept flag	M2048	JOG simultaneous START command			
M2019	Virtual axis No. 19 START accept flag	M2049	All-axes servo START accept flag	PCPU → SCPU		
M2020	Virtual axis No. 20 START accept flag	M2050	START buffer full			
M2021	Virtual axis No. 21 START accept flag	M2051	Manual pulse generator No. 1 enabled flag	SCPU → PCPU		
M2022	Virtual axis No. 22 START accept flag	M2052	Manual pulse generator No. 2 enabled flag			
M2023	Virtual axis No. 23 START accept flag	M2053	Manual pulse generator No. 3 enabled flag			

## 4. SERVO SYSTEM CPU DEVICES

Table 4.8 Internal Relay List (for A273UHCPU 32-axis Specification) (Continued)

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction
M2054	Unusable	-	M2082	Virtual axis No.22 speed change in progress flag	PCPU → SCPU
M2055			M2083	Virtual axis No.23 speed change in progress flag	
M2056	Cam & limit switch output data batch change request flag	SCPU → PCPU	M2084	Virtual axis No.24 speed change in progress flag	
M2057	Cam & limit switch output data batch change completed flag	PCPU → SCPU	M2085	Virtual axis No.25 speed change in progress flag	
M2058	Cam & limit switch output data batch change error flag		M2086	Virtual axis No.26 speed change in progress flag	
M2059	Unusable	-	M2087	Virtual axis No.27 speed change in progress flag	
M2060			M2088	Virtual axis No.28 speed change in progress flag	
M2061	Virtual axis No.1 speed change in progress flag	PCPU → SCPU	M2089	Virtual axis No.29 speed change in progress flag	
M2062	Virtual axis No.2 speed change in progress flag		M2090	Virtual axis No.30 speed change in progress flag	
M2063	Virtual axis No.3 speed change in progress flag		M2091	Virtual axis No.31 speed change in progress flag	
M2064	Virtual axis No.4 speed change in progress flag		M2092	Virtual axis No.32 speed change in progress flag	
M2065	Virtual axis No.5 speed change in progress flag		M2093 - M2100	Unusable	-
M2066	Virtual axis No.6 speed change in progress flag		M2101	Synchronous encoder (P1) axis present value change in progress	PCPU → SCPU
M2067	Virtual axis No.7 speed change in progress flag		M2102	Synchronous encoder (P2) axis present value change in progress	
M2068	Virtual axis No.8 speed change in progress flag		M2103	Synchronous encoder (P3) axis present value change in progress	
M2069	Virtual axis No.9 speed change in progress flag		M2104	Synchronous encoder (P4) axis present value change in progress	
M2070	Virtual axis No.10 speed change in progress flag		M2105	Synchronous encoder (P5) axis present value change in progress	
M2071	Virtual axis No.11 speed change in progress flag	M2106	Synchronous encoder (P6) axis present value change in progress		
M2072	Virtual axis No.12 speed change in progress flag	M2107	Synchronous encoder (P7) axis present value change in progress		
M2073	Virtual axis No.13 speed change in progress flag	M2108	Synchronous encoder (P8) axis present value change in progress		
M2074	Virtual axis No.14 speed change in progress flag	M2109	Synchronous encoder (P9) axis present value change in progress		
M2075	Virtual axis No.15 speed change in progress flag	M2110	Synchronous encoder (P10) axis present value change in progress		
M2076	Virtual axis No.16 speed change in progress flag	M2111	Synchronous encoder (P11) axis present value change in progress		
M2077	Virtual axis No.17 speed change in progress flag	M2112	Synchronous encoder (P12) axis present value change in progress		
M2078	Virtual axis No.18 speed change in progress flag	M2113 - M2127	Unusable	-	
M2079	Virtual axis No.19 speed change in progress flag	M2128	Virtual axis No.1 automatic deceleration in progress flag	PCPU → SCPU	
M2080	Virtual axis No.20 speed change in progress flag	M2129	Virtual axis No.2 automatic deceleration in progress flag		
M2081	Virtual axis No.21 speed change in progress flag	M2130	Virtual axis No.3 automatic deceleration in progress flag		

## 4. SERVO SYSTEM CPU DEVICES

Table 4.8 Internal Relay List (for A273UHCPU 32-axis Specification) (Continued)

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction
M2131	Virtual axis No.4 automatic deceleration in progress flag	PCPU → SCPU	M2159	Virtual axis No.32 automatic deceleration in progress flag	PCPU → SCPU
M2132	Virtual axis No.5 automatic deceleration in progress flag		M2160	Virtual axis No.1 drive clutch ON/OFF status	
M2133	Virtual axis No.6 automatic deceleration in progress flag		M2161	Virtual axis No.1 auxiliary input shaft clutch ON/OFF status	
M2134	Virtual axis No.7 automatic deceleration in progress flag		M2162	Virtual axis No.2 drive clutch ON/OFF status	
M2135	Virtual axis No.8 automatic deceleration in progress flag		M2163	Virtual axis No.2 auxiliary input shaft clutch ON/OFF status	
M2136	Virtual axis No.9 automatic deceleration in progress flag		M2164	Virtual axis No.3 drive clutch ON/OFF status	
M2137	Virtual axis No.10 automatic deceleration in progress flag		M2165	Virtual axis No.3 auxiliary input shaft clutch ON/OFF status	
M2138	Virtual axis No.11 automatic deceleration in progress flag		M2166	Virtual axis No.4 drive clutch ON/OFF status	
M2139	Virtual axis No.12 automatic deceleration in progress flag		M2167	Virtual axis No.4 auxiliary input shaft clutch ON/OFF status	
M2140	Virtual axis No.13 automatic deceleration in progress flag		M2168	Virtual axis No.5 drive clutch ON/OFF status	
M2141	Virtual axis No.14 automatic deceleration in progress flag		M2169	Virtual axis No.5 auxiliary input shaft clutch ON/OFF status	
M2142	Virtual axis No.15 automatic deceleration in progress flag		M2170	Virtual axis No.6 drive clutch ON/OFF status	
M2143	Virtual axis No.16 automatic deceleration in progress flag		M2171	Virtual axis No.6 auxiliary input shaft clutch ON/OFF status	
M2144	Virtual axis No.17 automatic deceleration in progress flag		M2172	Virtual axis No.7 drive clutch ON/OFF status	
M2145	Virtual axis No.18 automatic deceleration in progress flag		M2173	Virtual axis No.7 auxiliary input shaft clutch ON/OFF status	
M2146	Virtual axis No.19 automatic deceleration in progress flag		M2174	Virtual axis No.8 drive clutch ON/OFF status	
M2147	Virtual axis No.20 automatic deceleration in progress flag		M2175	Virtual axis No.8 auxiliary input shaft clutch ON/OFF status	
M2148	Virtual axis No.21 automatic deceleration in progress flag		M2176	Virtual axis No.9 drive clutch ON/OFF status	
M2149	Virtual axis No.22 automatic deceleration in progress flag		M2177	Virtual axis No.9 auxiliary input shaft clutch ON/OFF status	
M2150	Virtual axis No.23 automatic deceleration in progress flag		M2178	Virtual axis No.10 drive clutch ON/OFF status	
M2151	Virtual axis No.24 automatic deceleration in progress flag		M2179	Virtual axis No.10 auxiliary input shaft clutch ON/OFF status	
M2152	Virtual axis No.25 automatic deceleration in progress flag		M2180	Virtual axis No.11 drive clutch ON/OFF status	
M2153	Virtual axis No.26 automatic deceleration in progress flag		M2181	Virtual axis No.11 auxiliary input shaft clutch ON/OFF status	
M2154	Virtual axis No.27 automatic deceleration in progress flag		M2182	Virtual axis No.12 drive clutch ON/OFF status	
M2155	Virtual axis No.28 automatic deceleration in progress flag		M2183	Virtual axis No.12 auxiliary input shaft clutch ON/OFF status	
M2156	Virtual axis No.29 automatic deceleration in progress flag		M2184	Virtual axis No.13 drive clutch ON/OFF status	
M2157	Virtual axis No.30 automatic deceleration in progress flag		M2185	Virtual axis No.13 auxiliary input shaft clutch ON/OFF status	
M2158	Virtual axis No.31 automatic deceleration in progress flag		M2186	Virtual axis No.14 drive clutch ON/OFF status	

## 4. SERVO SYSTEM CPU DEVICES

Table 4.8 Internal Relay List (for A273UHCPU 32-axis Specification) (Continued)

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction
M2187	Virtual axis No.14 auxiliary input shaft clutch ON/OFF status	PCPU → SCPU	M2215	Virtual axis No.28 auxiliary input shaft clutch ON/OFF status	PCPU → SCPU
M2188	Virtual axis No.15 drive clutch ON/OFF status		M2216	Virtual axis No.29 drive clutch ON/OFF status	
M2189	Virtual axis No.15 auxiliary input shaft clutch ON/OFF status		M2217	Virtual axis No.29 auxiliary input shaft clutch ON/OFF status	
M2190	Virtual axis No.16 drive clutch ON/OFF status		M2218	Virtual axis No.30 drive clutch ON/OFF status	
M2191	Virtual axis No.16 auxiliary input shaft clutch ON/OFF status		M2219	Virtual axis No.30 auxiliary input shaft clutch ON/OFF status	
M2192	Virtual axis No.17 drive clutch ON/OFF status		M2220	Virtual axis No.31 drive clutch ON/OFF status	
M2193	Virtual axis No.17 auxiliary input shaft clutch ON/OFF status		M2221	Virtual axis No.31 auxiliary input shaft clutch ON/OFF status	
M2194	Virtual axis No.18 drive clutch ON/OFF status		M2222	Virtual axis No.32 drive clutch ON/OFF status	
M2195	Virtual axis No.18 auxiliary input shaft clutch ON/OFF status		M2223	Virtual axis No.32 auxiliary input shaft clutch ON/OFF status	
M2196	Virtual axis No.19 drive clutch ON/OFF status		M2224 - M2239	Unusable	-
M2197	Virtual axis No.19 auxiliary input shaft clutch ON/OFF status		M2240	Virtual axis No.1 speed change "0" accept flag	PCPU → SCPU
M2198	Virtual axis No.20 drive clutch ON/OFF status		M2241	Virtual axis No.2 speed change "0" accept flag	
M2199	Virtual axis No.20 auxiliary input shaft clutch ON/OFF status		M2242	Virtual axis No.3 speed change "0" accept flag	
M2200	Virtual axis No.21 drive clutch ON/OFF status		M2243	Virtual axis No.4 speed change "0" accept flag	
M2201	Virtual axis No.21 auxiliary input shaft clutch ON/OFF status		M2244	Virtual axis No.5 speed change "0" accept flag	
M2202	Virtual axis No.22 drive clutch ON/OFF status		M2245	Virtual axis No.6 speed change "0" accept flag	
M2203	Virtual axis No.22 auxiliary input shaft clutch ON/OFF status		M2246	Virtual axis No.7 speed change "0" accept flag	
M2204	Virtual axis No.23 drive clutch ON/OFF status		M2247	Virtual axis No.8 speed change "0" accept flag	
M2205	Virtual axis No.23 auxiliary input shaft clutch ON/OFF status		M2248	Virtual axis No.9 speed change "0" accept flag	
M2206	Virtual axis No.24 drive clutch ON/OFF status		M2249	Virtual axis No.10 speed change "0" accept flag	
M2207	Virtual axis No.24 auxiliary input shaft clutch ON/OFF status		M2250	Virtual axis No.11 speed change "0" accept flag	
M2208	Virtual axis No.25 drive clutch ON/OFF status		M2251	Virtual axis No.12 speed change "0" accept flag	
M2209	Virtual axis No.25 auxiliary input shaft clutch ON/OFF status		M2252	Virtual axis No.13 speed change "0" accept flag	
M2210	Virtual axis No.26 drive clutch ON/OFF status		M2253	Virtual axis No.14 speed change "0" accept flag	
M2211	Virtual axis No.26 auxiliary input shaft clutch ON/OFF status		M2254	Virtual axis No.15 speed change "0" accept flag	
M2212	Virtual axis No.27 drive clutch ON/OFF status		M2255	Virtual axis No.16 speed change "0" accept flag	
M2213	Virtual axis No.27 auxiliary input shaft clutch ON/OFF status		M2256	Virtual axis No.17 speed change "0" accept flag	
M2214	Virtual axis No.28 drive clutch ON/OFF status	M2257	Virtual axis No.18 speed change "0" accept flag		

## 4. SERVO SYSTEM CPU DEVICES

Table 4.8 Internal Relay List (for A273UHCPU 32-axis Specification) (Continued)

Device No.	Signal Name	Signal Direction	Device No.	Signal Name	Signal Direction	
M2258	Virtual axis No. 19 speed change "0" accept flag	PCPU → SCPU	M2266	Virtual axis No. 27 speed change "0" accept flag	PCPU → SCPU	
M2259	Virtual axis No. 20 speed change "0" accept flag		M2267	Virtual axis No. 28 speed change "0" accept flag		
M2260	Virtual axis No. 21 speed change "0" accept flag		M2268	Virtual axis No. 29 speed change "0" accept flag		
M2261	Virtual axis No. 22 speed change "0" accept flag		M2269	Virtual axis No. 30 speed change "0" accept flag		
M2262	Virtual axis No. 23 speed change "0" accept flag		M2270	Virtual axis No. 31 speed change "0" accept flag		
M2263	Virtual axis No. 24 speed change "0" accept flag		M2271	Virtual axis No. 32 speed change "0" accept flag		
M2264	Virtual axis No. 25 speed change "0" accept flag		M2272 - M2319	Unusable		-
M2265	Virtual axis No. 26 speed change "0" accept flag					

### POINTS

- (1) Internal relays for positioning operations are not latched even when within the latch range.  
The expression "M2000 - M2319" is therefore used in this manual when referring to internal relays for positioning operations in order to indicate that they are not latched.
- (2) Monitoring of internal relays (for positioning operations) at peripheral devices occurs as follows.
  - (a) For an IBM PC booted up with SW2SRX-GSV22PE, the internal relays for positioning operations set for the latch range are displayed as L2000 to L2319.

## 4. SERVO SYSTEM CPU DEVICES

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

- (1) This signal notifies the PCPU that SCPU operation is normal. It is switched ON and OFF by the sequence program.
    - (a) When M2000 is ON, positioning or home position return functions can be executed by the servo program specified by the sequence program, and JOG operations can be executed by the sequence program.
    - (b) When M2000 is OFF, and when a TEST mode has been established ("M9075" TEST mode in progress flag is ON)\* from a peripheral device, the functions described at item (a) above will be inoperative even if M2000 is switched ON.
  - (2) The fixed parameters, servo parameters, and limit switch output parameters can only be changed using a peripheral device when M2000 is OFF.
- If an attempt is made to change this data while M2000 is ON, an error will occur.
- (3) When M2000 is switched from OFF to ON, the following processing occurs.

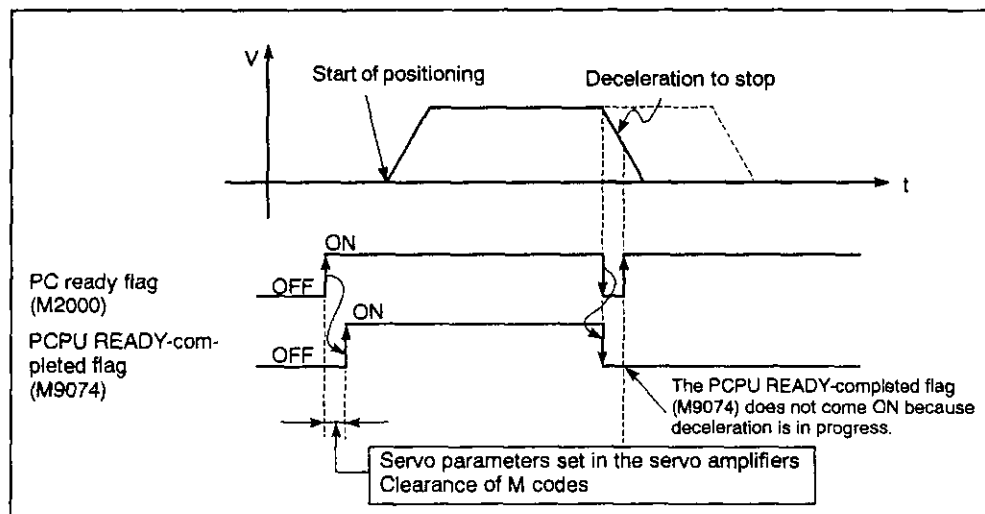
(a) Processing details

- 1) The servo parameters are transferred to the servo amplifier.
- 2) The M code storage area for all axes is cleared.
- 3) The default value of 300% is set in the torque limit value storage area.
- 4) The PCPU READY-completed flag (M9074) \* is turned ON.

(b) If there is an axis currently being driven, an error occurs, and the processing in (3), (a) above is not executed.

(c) While the test mode is in effect, the processing in (3), (a) above is not executed.

When the test mode is cancelled, the processing in (3), (a) will be executed if M2000 is ON.



**REMARK**

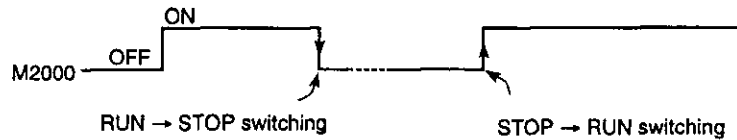
\*: For details regarding the "TEST mode in progress flag" and the "PCPU READY-completed flag", see Section 4.3.

## 4. SERVO SYSTEM CPU DEVICES

- (4) When M2000 turns OFF, the following processing is executed.
- (a) Processing details
- 1) The PCPU READY flag (M9074) is turned OFF.
  - 2) Operating axes are decelerated to a stop.

### POINT

The PC READY flag (M2000) switches OFF when a servo system CPU "STOP" status exists. When the RUN status is resumed, the status which existed prior to the STOP will be re-established.

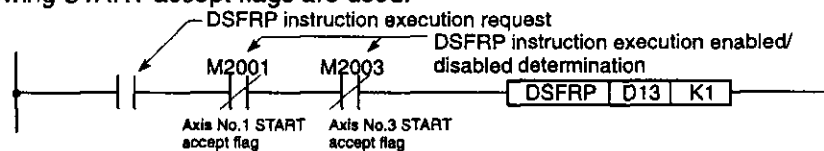


### 4.2.2 Virtual servomotor START accept flags (M2001 - M2004/M2001 - M2008/M2001 - M2032) ..... Signals from PCPU to SCPU

- (1) The START accept flag switches ON when the sequence program's positioning START instruction (DSFRP/SVST)\*2 is executed, and should be used for DSFRP/SVST enabled/disabled interlock purposes.

[Ex] When A273UHCPU (8-axis Specification) is Used

When requesting servo program execution for positioning at axes 1 and 3, the following START accept flags are used.

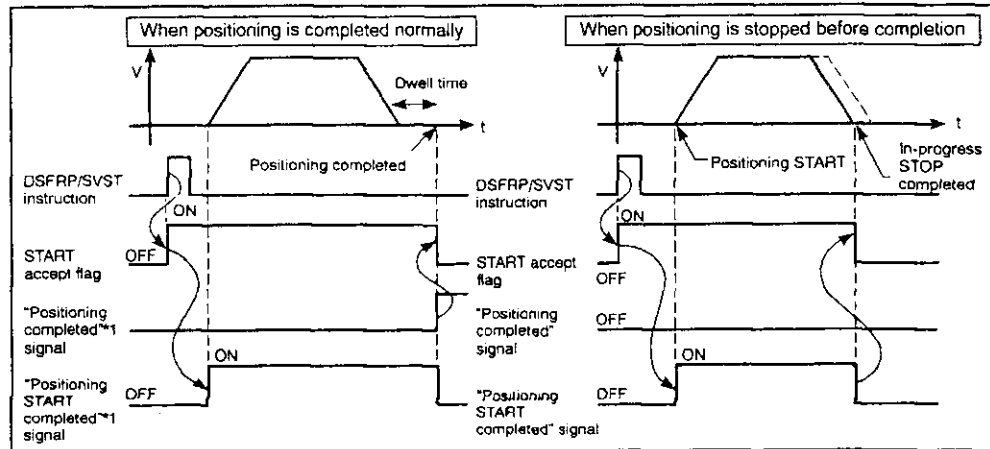




## 4. SERVO SYSTEM CPU DEVICES

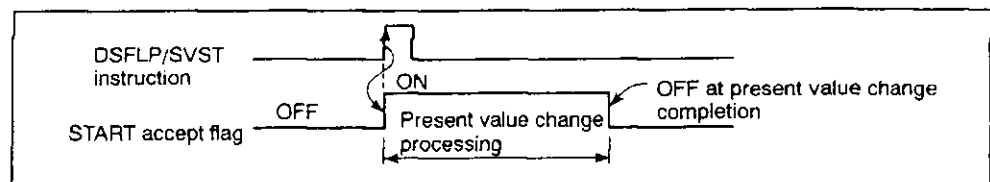
(2) START accept flag ON/OFF processing occurs as shown below.

- (a) When the sequence program's DSFRP/SVST instruction is executed, the START accept flag for the axis specified by the DSFRP/SVST instruction switches ON. The START accept flag switches OFF when positioning is completed. The START accept flag also switches OFF if positioning is stopped before completion.



### REMARKS

- (1) \*1: For details regarding the "positioning START completed" and "positioning completed" signals, see Section 8.5.1.
- (2) \*2: For details regarding the DSFRP/SVST instructions, refer to section 5.2 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).
  - (a) When executing positioning by switching the JOG instruction\*1 ON, the START accept flag will switch OFF when positioning is stopped by a JOG instruction OFF.
  - (b) The START accept flag is ON when the manual pulse generator is enabled (M2012/M2012 - M2014/M2051 - M2053: ON), and is OFF when the manual pulse generator is disabled (M2012/M2012 - M2014/M2051 - M2053: OFF).
  - (c) The START accept flag is ON during a present value change being executed by a sequence program DSFLP/SVST instruction. The START accept flag will switch OFF when the present value change is completed.



### POINTS

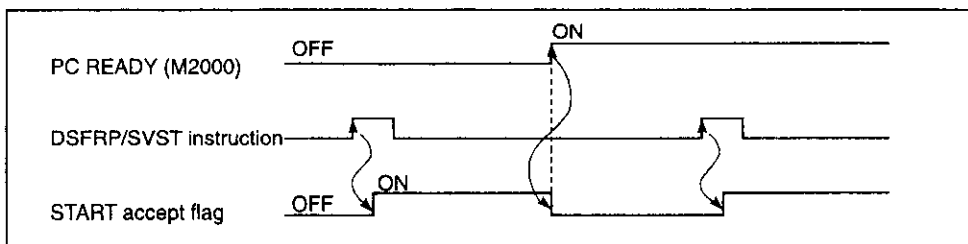
The user must not turn start accept flags ON/OFF.

- (1) If a start accept flag that is ON is switched OFF with the sequence program or a peripheral device, no error will occur but the positioning operation will not be reliable.
- (2) If a start accept flag that is OFF is switched ON with the sequence program or a peripheral device, no error will occur at that time, but the next time an attempt is made to start the axis a start accept flag ON error will occur and the axis will not start.

## 4. SERVO SYSTEM CPU DEVICES

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- (3) When M2000 is OFF, execution of a DSFRP/SVST instruction \*2 causes the start accept flag to come ON; the flag goes OFF when M2000 comes ON.



### REMARKS

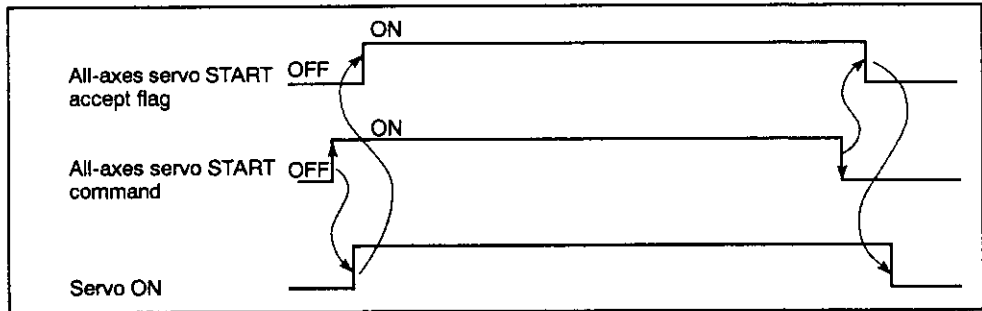
- (1) \*1: For details regarding JOG operation commands, see Section 6.3.1.
- (2) \*2: For details regarding DSFRP/SVST instructions, refer to the Motion Controller (SV13/22) Programming Manual (REAL Mode) and see Section 5.2.

## 4. SERVO SYSTEM CPU DEVICES

### 4.2.3 All-Axes servo START accept flag (M2009/M2009/M2049) . . . . Signal sent from PCPU to SCPU

The all-axes servo START flag indicates that servo operation is possible.

- ON . . . . . Servo is operative.
- OFF . . . . . Servo is inoperative.



### 4.2.4 Manual pulse generator enabled flag (M2012/M2012 - M2014/M2051 - M2053) . . . . . Signal sent from SCPU to PCPU

The manual pulse generator flag designates the enabled/disabled status for positioning executed by pulse inputs from manual pulse generators connected to the A171SENC PULSER \*1 /A273EX P1 - P3 \*2.

- ON . . . . . Positioning control by manual pulse generator inputs is enabled.
- OFF . . . . . Positioning control by manual pulse generator inputs is disabled (inputs are ignored).

### 4.2.5 JOG simultaneous START command (M2015/M2015/M2048) . . . . . Signal sent from SCPU to PCPU

- (1) When M2015 switches ON, a JOG simultaneous START will occur at the JOG execution axis (axes 1 - 4/axes 1 - 8/axes 1 - 32) designated at the JOG Simultaneous START Axis Area (D1015).
- (2) When M2015 switches OFF, the JOG axis motion will decelerate and stop.

#### REMARKS

- (1) \*1: For details regarding the A171SENC PULSER (connector), refer to the Motion Controller (A171SCPU) User's Manual.
- (2) \*2: For details regarding the A273EX P1 - P3 (connector), refer to the Motion Controller (A273UHCPU) User's Manual.

## 4. SERVO SYSTEM CPU DEVICES

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### 4.2.6 Cam data & limit switch output data batch change request flag (None/M2016/M2056) ..... Signal sent from SCPU to PCPU

- (1) No cam data & limit switch output data batch change request flag setting is possible when the A171SCPU is used.
- (2) The cam data & limit switch output data batch change request flag is used to replace existing cam data and limit switch output data with other cam data and limit switch output data when the power is switched ON, or when a servo system CPU reset occurs. (Cam data and limit switch output data changes can be executed in either the REAL or VIRTUAL mode.)
  - (a) When M2016 is switched from OFF to ON, the cam data and limit switch output data (cam shaft present value in 1 revolution mode limit switch output data) will be input to the PCPU.

Cam data input processing begins at the M2016 signal's leading edge (OFF → ON), and will continue even if the M2016 signal is switched OFF before completion.
  - (b) Execute a reset when cam data and limit switch output data input is completed normally, or when an error is detected.
    - 1) Normal completion .... M2017 is ON
    - 2) Error detected ..... M2018 is ON
- (3) For details regarding cam data and limit switch output data changes, see Sections 8.4.6 and 8.4.7.

### 4.2.7 Cam data & limit switch output data batch change completion flag (None/M2017/M2057) ..... Signal sent from PCPU to SCPU

- (1) No cam data & limit switch output data batch change completion flag setting is possible when the A171SCPU is used.
- (2) This flag indicates that the cam data and limit switch output data change has been completed normally.
  - (a) The flag is ON when the data change has been completed normally.
  - (b) M2017 switches OFF when M2016 is switched OFF.
- (3) Switching from the REAL mode to the VIRTUAL mode is impossible while cam data and limit switch output data are being input.

M2016 should be used as a VIRTUAL mode switching interlock function.

## 4. SERVO SYSTEM CPU DEVICES

### 4.2.8 Cam data & limit switch output data batch change error flag (None/M2018/M2058) ..... Signal sent from PCPU to SCPU

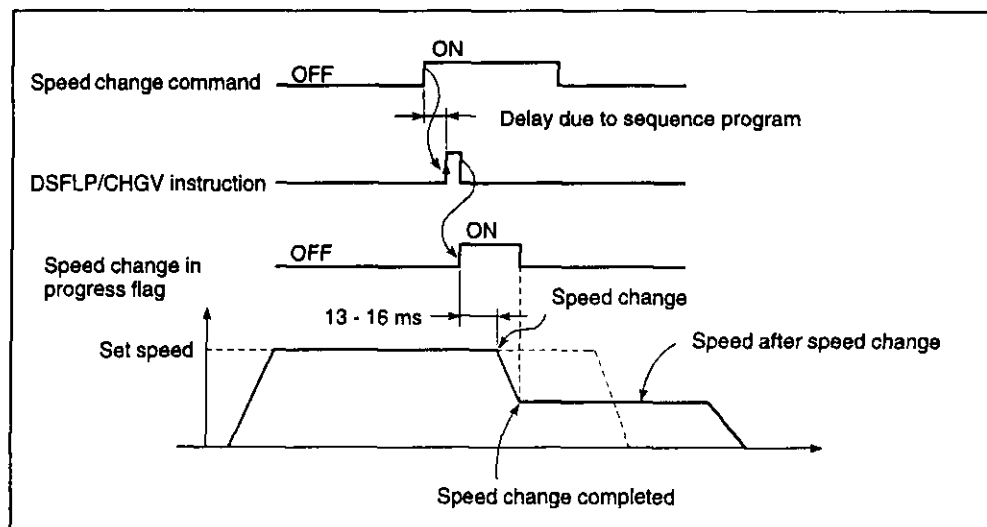
- (1) No cam data & limit switch output data batch change error flag setting is possible when the A171SCPU is used.
- (2) The cam data & limit switch output data batch change error flag indicates whether an error has occurred during the data change operation.
  - (a) The flag is OFF when no error has occurred during the batch change operation.
  - (b) The flag is ON when an error has occurred during the batch change operation.
- (3) M2018 switches OFF when M2016 is switched OFF.

### 4.2.9 START buffer full (M2020/M2020/M2050) ..... Signal sent from PCPU to SCPU

- (1) This signal switches ON when the PCPU fails to process the specified data within 15 seconds following a positioning START (DSFRP/SVST) instruction or a control change (DSFLP/CHGA/CHGV) instruction from the sequence program.
- (2) An M2020 reset must be executed from the sequence program.

### 4.2.10 Speed change in progress flag (M2021 - M2024/M2021 - M2028/M2061 - M2092) ..... Signal sent from PCPU to SCPU

This flag switches ON when a speed change (designated by a control change (DSFLP/CHGV) instruction at the sequence program) is in progress. This flag should be used for speed change program interlock purposes.

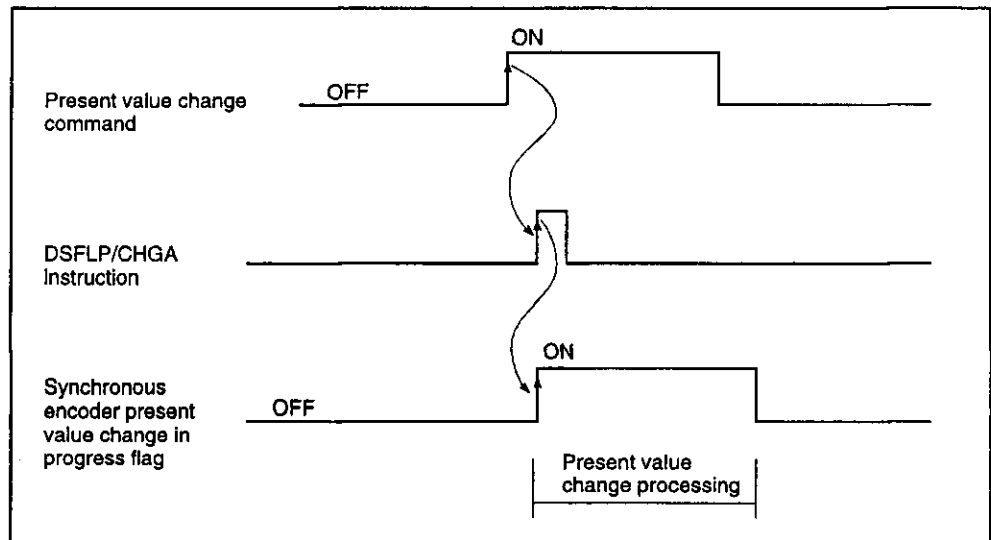


## 4. SERVO SYSTEM CPU DEVICES

### 4.2.11 Synchronous encoder present value change in progress flag (M2031/M2031 - M2033/M2101 - M2112) ..... Signal sent from PCPU to SCPU

This flag switches ON while a synchronous encoder present value change (designated by a control change (DSFLP/CHGV) instruction at the sequence program) is in progress.

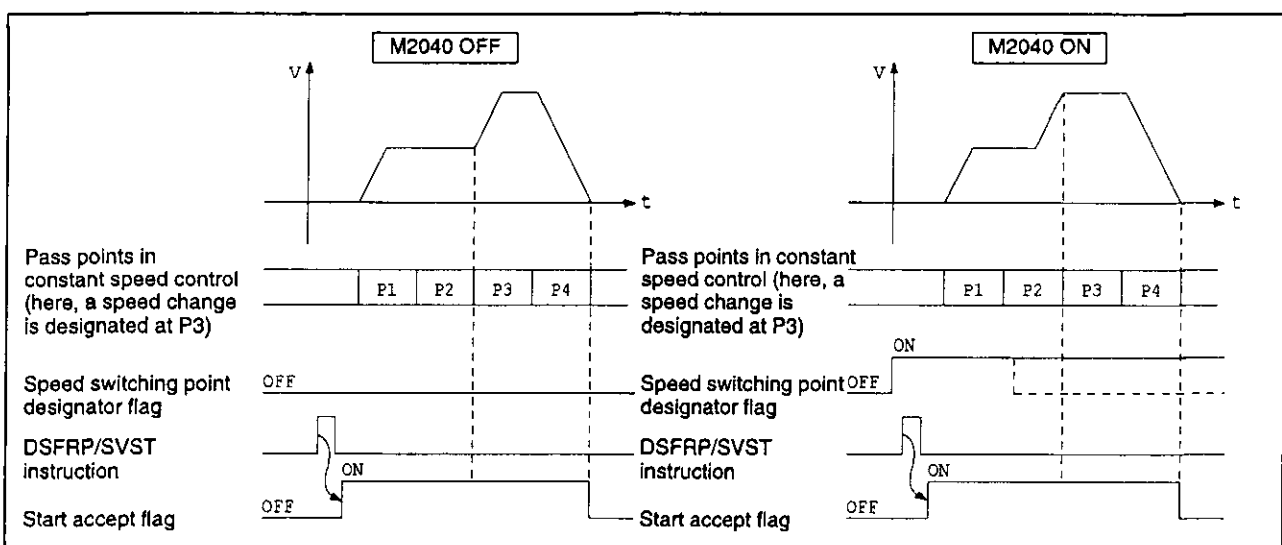
This flag should be used for synchronous encoder present value change program interlock purposes.



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

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

- (1) By turning M2040 ON before the start of constant speed control (before the servo program is started using the DSFRP/SVST instruction), control can be executed with a speed change at the start of the pass point.



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

## 4. SERVO SYSTEM CPU DEVICES

### 4.2.13 System setting error flag (M2041) ..... Signal sent from PCPU to SCPU

When the power is switched ON, or when the servo system CPU is reset, the system setting data set with a peripheral device is input, and a check is performed to determine if the set data matches the module mounting status (of the main base unit and extension base units).

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

(1) When using the A273UHCPU (8 or 32 axis specification), the causes of errors which occur are indicated by LEDs on the front of the CPU.

When using the A171SCPU, the ERROR LED on the front of the CPU will switch ON when an error occurs. Moreover, a log of errors which have occurred can be referred to at a peripheral device (device running SW2SRX-GSV22PE).

(2) Positioning cannot be started when M2041 is ON. To start the positioning operation, eliminate the error cause, and either switch the power back ON or execute a servo system CPU reset.

#### REMARK

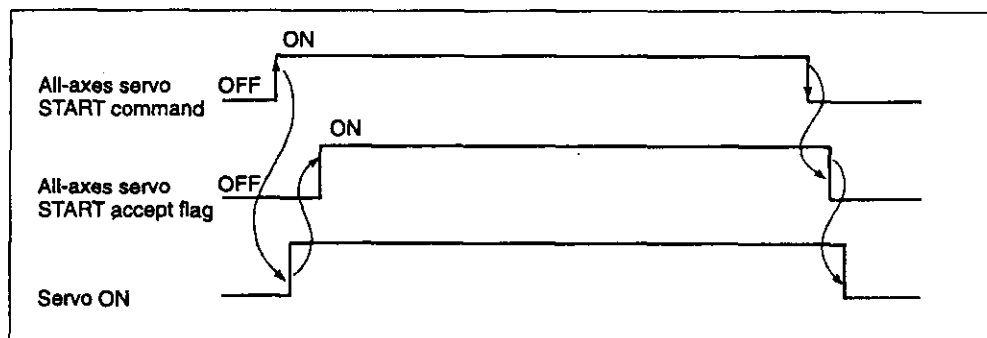
A slot designated as "not used" at the system setting data will be regarded as "not used" even if loaded with a module.

### 4.2.14 All-axes servo START command (M2042) ..... Signal sent from SCPU to PCPU

This signal is used to enable servo operation.

Servo operation ENABLED ... When M2042 is switched ON, the servo OFF signal (YnF) is OFF, and there are no active servo errors.

Servo operation DISABLED ... When M2042 switches ON, the servo OFF signal (YnF) is ON, or a servo error is detected.



#### POINT

Once M2042 is switched ON, it will not switch OFF even if the CPU is stopped.

## 4. SERVO SYSTEM CPU DEVICES

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### 4.2.15 REAL/VIRTUAL mode switching request flag (M2043) . . . . . Signal sent from SCPU to PCPU

This flag is used for switching between the REAL and VIRTUAL modes.

(1) To switch from the REAL to the VIRTUAL mode, turn M2043 ON after the M9074 PCPU READY flag comes ON.

- An error check occurs when M2043 is switched from OFF to ON. If no error is detected, switching to the VIRTUAL mode occurs, and the M2044 REAL/VIRTUAL Mode Determination flag switches ON.
- If an error is detected, switching to the VIRTUAL mode will not occur. In this case, the M2045 REAL/VIRTUAL Mode Switching Error flag will switch ON, and the error code will be stored at the D9195/D9195/D9193 error code storage error.

(2) To switch from the VIRTUAL to the REAL mode, turn M2043 OFF.

- If an "all-axes stopped" status exists at the virtual servomotors, switching to the REAL mode will occur, and M2044 will go OFF.
- Switching to the REAL mode will not occur if any of the virtual servomotor axes are in motion. In this case, M2045 will switch ON, and an error code will be stored at the D9195/D9195/D9193 error code storage error.

(3) For details regarding the procedure for switching between the REAL and VIRTUAL modes, see Chapter 9.

### 4.2.16 REAL/VIRTUAL mode status flag (M2044) . . . . . Signal sent from PCPU to SCPU

This flag verifies that switching between the REAL and VIRTUAL modes is completed, and verifies the present mode.

- OFF when the REAL mode is in effect, and switching from the VIRTUAL to REAL mode is completed.
- ON when switching from REAL to VIRTUAL mode is completed.

This flag should be used as an interlock function when executing a servo program START or a control change (speed change, present value change).

### 4.2.17 REAL/VIRTUAL mode switching error detection flag (M2045) . . . . . Signal sent from PCPU to SCPU

This flag indicates whether or not an error was detected when switching between the REAL and VIRTUAL modes.

- Remains OFF if no error was detected at mode switching.
- Switches ON if an error was detected at mode switching.

In this case, the error code will be stored at D9195/D9195/D9193.



## 4. SERVO SYSTEM CPU DEVICES

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### 4.2.18 Synchronization discrepancy warning flag (M2046) . . . . . Signal sent from PCPU to SCPU

- (1) This signal switches ON in the VIRTUAL mode when a discrepancy occurs between the drive module and output module synchronized positions.

This signal status determines whether or not drive module operation can be resumed after it has stopped.

- M2046 ON . . . . . Continued operation disabled
- M2046 OFF . . . . . Continued operation enabled

- (2) The synchronization discrepancy warning flag will switch ON when the following conditions occur.

- When operation is stopped by an external emergency stop (EMG) command.
- When a servo error occurs at the output module.

- (3) When the synchronization discrepancy warning flag switches ON, operation can be resumed by the following procedure.

- (a) Return to the REAL mode and eliminate the error cause.
- (b) Synchronize the axes.
- (c) Switch the synchronization discrepancy warning flag (M2046) OFF.
- (d) Switch to the VIRTUAL mode.
- (e) Resume operation.

## 4. SERVO SYSTEM CPU DEVICES

### 4.2.19 Motion slot module error detection flag (M2047) ..... Signal sent from PCPU to SCPU

This flag indicates whether the status of modules mounted at the base unit and extension base units is normal or abnormal.

- ON ..... Status of mounted module is abnormal
- OFF ..... Status of mounted module is normal

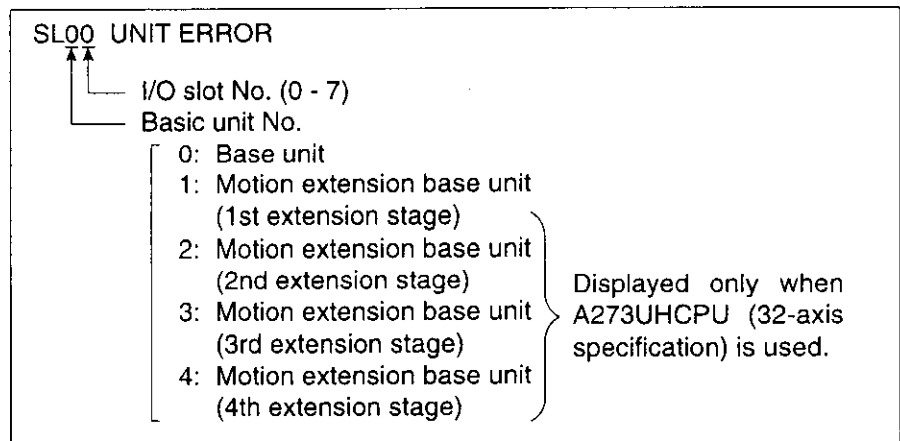
Module information is checked for errors both when the power is switched ON and after the power has been switched ON.

(1) When A171SCPU is used

- (a) When M2047 switches ON, the A171SCPU "ERROR" LED switches ON.
- (b) Required processing when an error is detected (axis STOP, servo OFF, etc.) should be conducted at the sequence program.

(2) When A273UHCPU (8/32-axis specification) is used

- (a) When M2047 switches ON, the following message is displayed at the A273UHCPU's LED display area.



- (b) Required processing when an error is detected (axis STOP, servo OFF, etc.) should be conducted at the sequence program.

#### POINT

Positioning control will continue even if an error is detected at an optional slot.

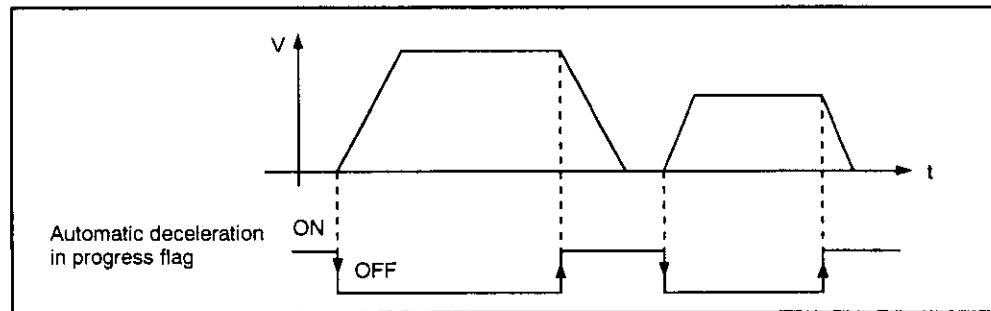
## 4. SERVO SYSTEM CPU DEVICES

### 4.2.20 Automatic deceleration in progress flag (M2128 - M2159):

When A273UHCPU 32-axis specification is used ..... Signal sent from PCPU to SCPU

This signal is ON when automatic deceleration processing occurs in virtual servomotor axis positioning or position follow-up control operations.

- (1) This flag is ON during automatic deceleration to the command address in position follow-up control, but will go OFF if the command address is changed.
- (2) This flag goes OFF on normal start completion, regardless of the control mode used.
- (3) The automatic deceleration in progress flag will not switch ON under the following conditions:
  - When deceleration is caused by switching the JOG signal OFF.
  - During manual pulse generator operation.
  - When deceleration occurs before operation is completed due to a STOP command or a STOP cause.
  - When the travel value is "0".



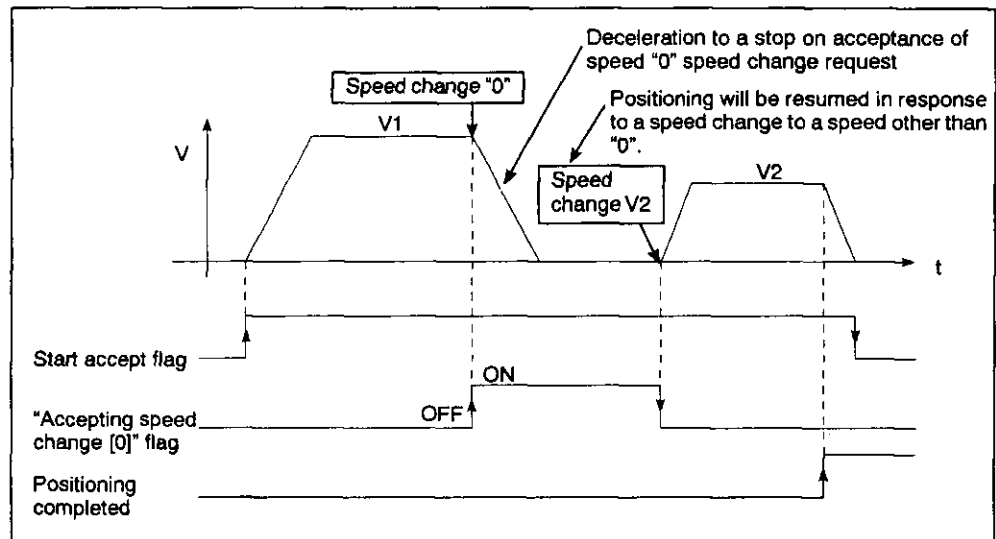
- (4) The "automatic deceleration in progress flags" are shown below.

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

## 4. SERVO SYSTEM CPU DEVICES

### 4.2.21 Speed change "0" accept flag (M2240 - M2171): When A273UHCPU 32-axis specification is used ..... Signal sent from PCPU to SCPU

- (1) This signal is ON while a speed change to "0" request is being accepted for a virtual servomotor axis.
- (2) This signal switches ON when a request for a speed change to speed "0" is accepted while axis motion is in progress. It switches OFF if a subsequent request is accepted for a speed change to a speed other than "0", or at the completion of a stop caused by a stop cause.



- (3) The speed change "0" accept flags are tabled below.

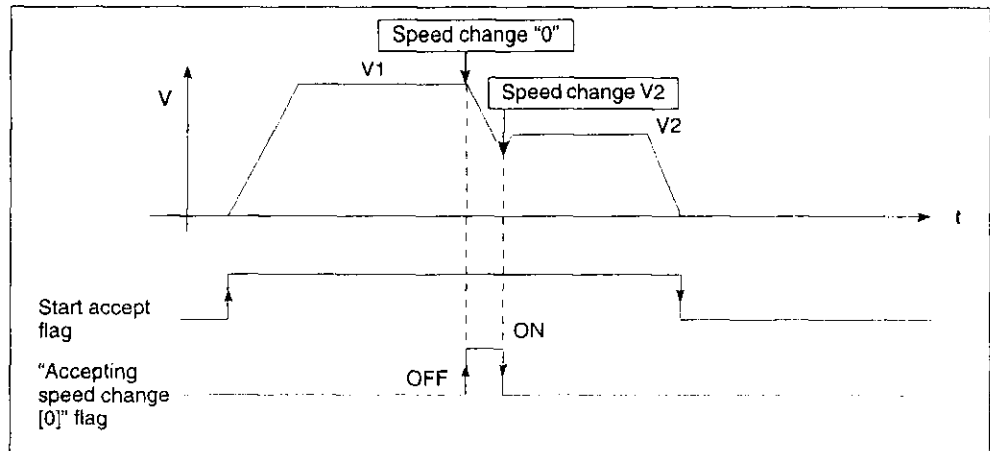
Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2240	9	M2248	17	M2256	25	M2264
2	M2241	10	M2249	18	M2257	26	M2265
3	M2242	11	M2250	19	M2258	27	M2266
4	M2243	12	M2251	20	M2259	28	M2267
5	M2244	13	M2252	21	M2260	29	M2268
6	M2245	14	M2253	22	M2261	30	M2269
7	M2246	15	M2254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

#### POINTS

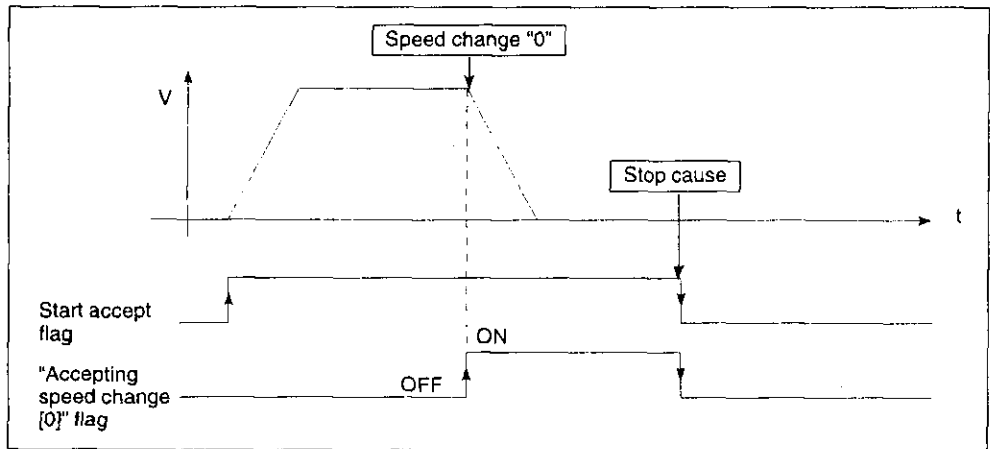
- (1) A START accept flag (M2001 - M2032) ON status when positioning is stopped indicates that a request for a speed change to speed "0" has been accepted. Verify this by checking the "speed change "0" accept flag" status.
- (2) During interpolation operations, the "speed change "0" accept flag" is designated for the interpolation axes.
- (3) A request for a speed change to speed "0" will be invalid under the following conditions:
  - After deceleration caused by a JOG OFF.
  - During manual pulse generator operation.
  - After an automatic deceleration START during positioning.
  - After deceleration due to a stop cause.

## 4. SERVO SYSTEM CPU DEVICES

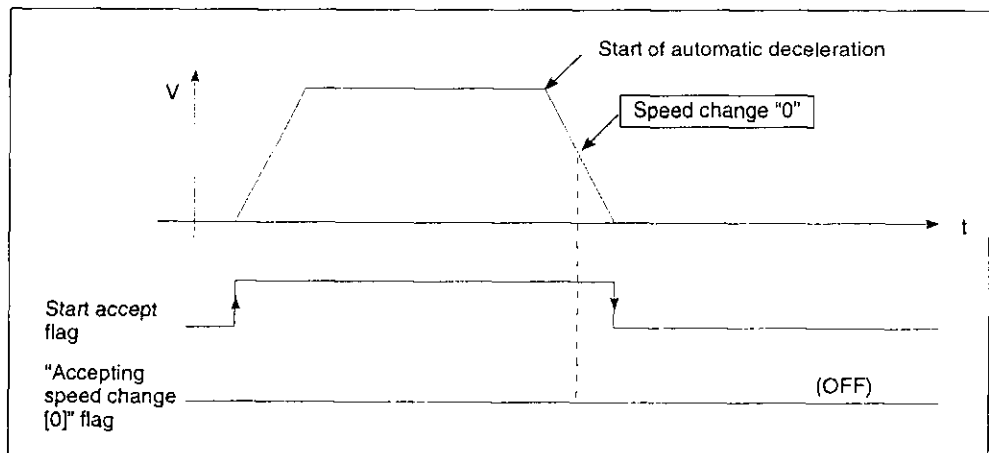
- (4) If another speed change request designating a speed other than "0" occurs during a deceleration and stop due to a speed change request for speed "0", the "speed change "0" accept flag" will switch OFF.



- (5) If a stop cause occurs after a speed change request for speed "0" has been accepted, the "speed change "0" accept flag" will switch OFF.

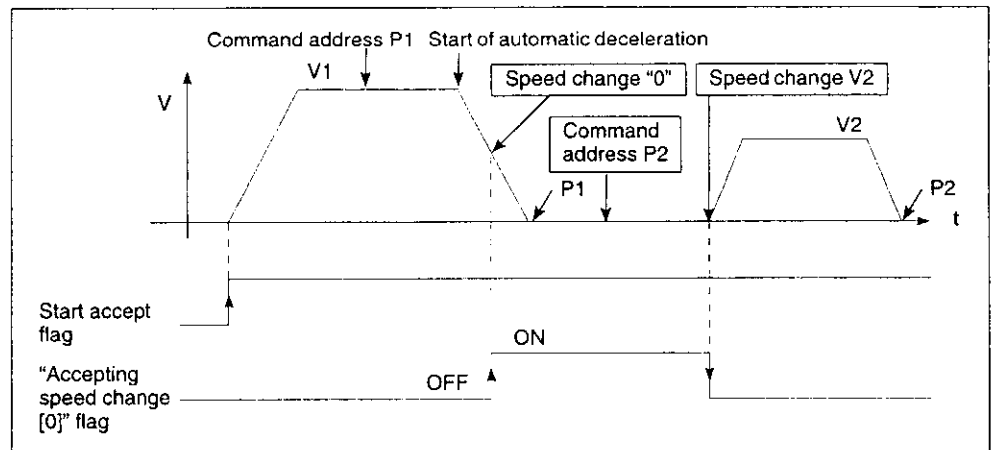


- (6) If a speed change request for speed "0" occurs after automatic deceleration has been started, the "speed change "0" accept flag" will not switch ON.



## 4. SERVO SYSTEM CPU DEVICES

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



### REMARK

During position follow-up control, positioning will not be started while the "speed change "0" accept flag" is ON, even if the command address is changed.

## 4. SERVO SYSTEM CPU DEVICES

### 4.3 Special Relays (SP, M)

The servo system CPU has 256 special relay points from M9000 to M9255.

Of these, the 7 points from M9073 to M9079 are used for positioning control, and their applications are indicated in Table 4.9.

**Table 4.9 Special Relay List**

Signal Name	Device No.	Mode Used		Signal Direction
		REAL Mode	VIRTUAL Mode	
WDT error flag	M9073	○	○	PCPU → SCPU
PCPU READY flag	M9074			
TEST mode ON flag	M9075			
External emergency stop input flag	M9076			
Manual pulse generator axis setting error flag	M9077			
TEST mode request flag	M9078			
Servo program setting error flag	M9079			

[O]: Used

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

This flag switches ON when a "watchdog timer error" is detected by the PCPU's self-diagnosis function. When the PCPU detects a WDT error, it executes an immediate stop without deceleration of the driven axes.

If the WDT error flag switches ON, press the servo system CPU's [RESET] key to execute a reset.

If M9073 remains ON after a reset occurs, there is a PCPU malfunction. The error cause is stored in the "PCPU error cause (D9184)" storage area (see Section 4.5.2).

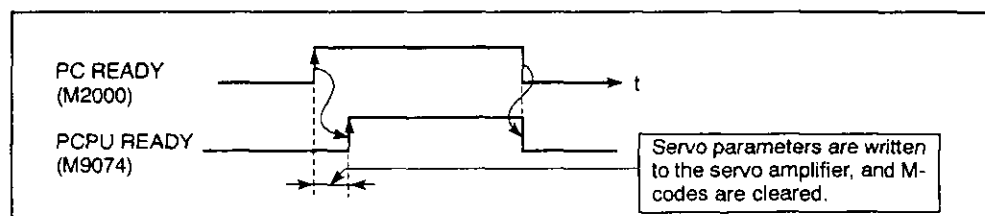
#### 4.3.2 PCPU READY flag (M9074) ..... Signal sent from PCPU to SCPU

This flag is used to determine (at the sequence program) if the PCPU is normal or abnormal.

- (1) When the PC READY flag (M2000) turns from OFF to ON, the fixed parameters, servo parameters, limit switch output data, etc., are checked, and if no error is detected the PCPU READY-completed flag comes ON.

The servo parameters are written to the servo amplifiers and the M codes are cleared.

- (2) The PCPU READY flag switches OFF when the PC READY (M2000) signal switches OFF.



## 4. SERVO SYSTEM CPU DEVICES

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### 4.3.3 TEST mode ON flag (M9075) ..... Signal sent from PCPU to SCPU

(1) This flag status indicates whether a TEST mode established from a peripheral device is currently in effect. It can be used as an interlock function when starting the servo program by a sequence program DSFRP/SVST instruction \*1.

- OFF ..... TEST mode is not in effect.
- ON ..... TEST mode is in effect.

(2) If the TEST mode is not established in response to a TEST mode request from a peripheral device, the "TEST mode request error flag (M9078)" will switch ON.

### 4.3.4 External emergency stop input flag (M9076) ..... Signal sent from PCPU to SCPU

This flag status indicates whether the external emergency stop input to the power module's EMG terminal is ON or OFF.

- OFF ..... External emergency stop input is ON.
- ON ..... External emergency stop input is OFF.

### 4.3.5 Manual Pulse Generator Axis Setting Error Flag (M9077) .... Signal sent from PCPU to SCPU

(1) This flag indicates whether the setting designated at the manual pulse generator (P1, P1 - P3) axis setting register (D1012 - D1014)\*2 is normal or abnormal.

- OFF ..... All D1012 - D1014 settings are normal.
- ON ..... At least one D1012 - D1014 setting is abnormal.

(2) When M9077 switches ON, the error content is stored at the manual pulse generator axis setting error register (D9187).

### 4.3.6 TEST Mode Request Error Flag (M9078) ..... Signal sent from PCPU to SCPU

(1) This flag switches ON if the TEST mode is not established in response to a TEST mode request from a peripheral device.

(2) When M9078 switches ON, the error content is stored at the manual pulse generator axis setting error register (D9188).



## 4. SERVO SYSTEM CPU DEVICES

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### 4.3.7 Servo Program Setting Error Flag (M9079) ..... Signal sent from PCPU to SCPU

This flag status indicates whether the positioning data at the servo program designated by the DSFRP/SVST instruction \*1 is normal or abnormal.

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

The content of a servo program error is stored at D9189 and D9190.

<b>REMARKS</b>
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\*1: For details regarding the DSFRP/SVST instruction, see Section 5.2 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

\*2: For details regarding the manual pulse generator axis setting register, see Section 6.3.2 of this manual.

## 4. SERVO SYSTEM CPU DEVICES

### 4.4 Data Registers

The A171SCPU has 1024 (D0 - D1023) data register points, and the A273UHCPU (8/32-axis specification) has 8192 (D0 - D8191) data register points. Of these data registers, the ones shown below are used for positioning control.

- At A171SCPU ..... D670 - D1023
- At A273UHCPU (8-axis specification) ..... D670 - D1023
- At A273UHCPU (32-axis specification) ..... D0 - D1559

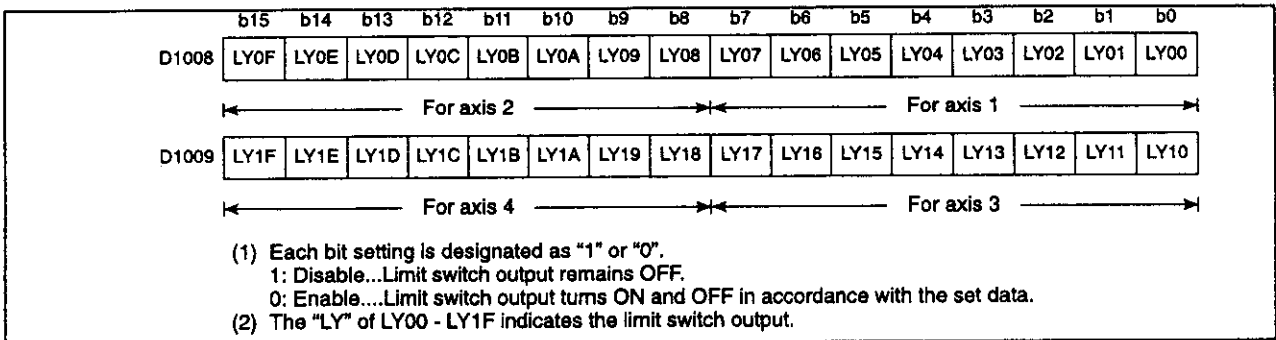
This section discusses the "limit switch output disable setting" register.

For details regarding drive module data registers, see Section 6.3.2. For details regarding output module data registers, see Section 8.5.2.

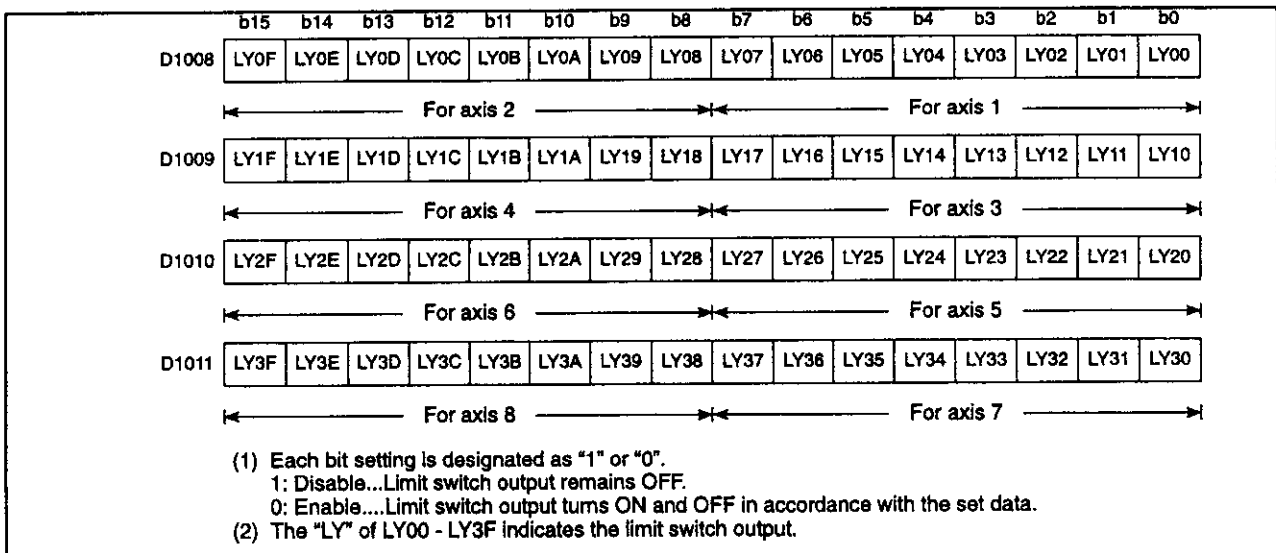
#### 4.4.1 Limit switch output disable setting register (D1008 - D1009/D1008 - D1011/D760 - D775) ..... Data sent from SCPU to PCPU

This register is used to disable (in 1-point units) external output of limit switch outputs. Limit switch output is disabled by setting its corresponding bit to "1" (external output OFF).

##### (1) When A171SCPU is used

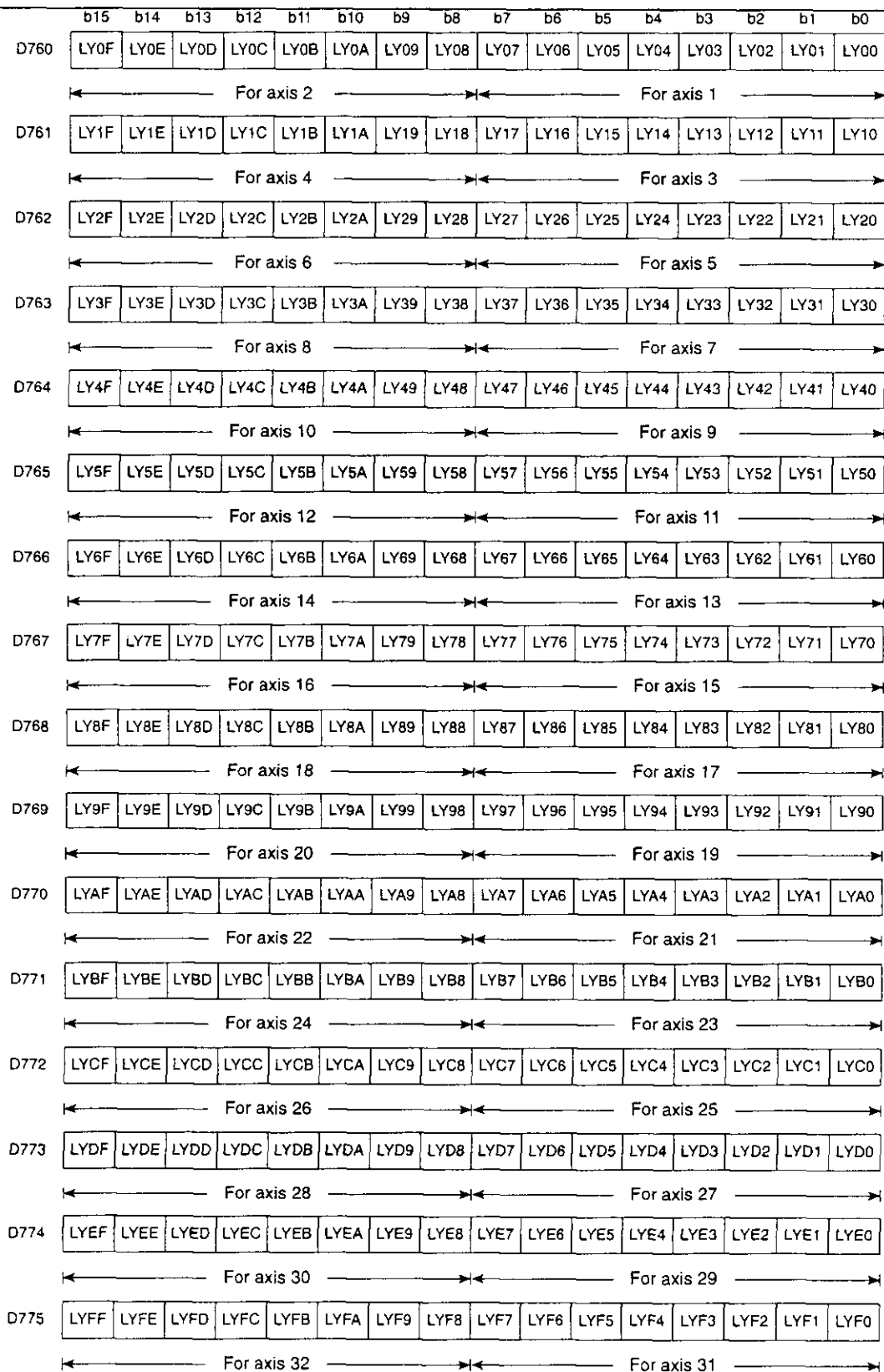


##### (2) When A273UHCPU (8-axis specification) is used



## 4. SERVO SYSTEM CPU DEVICES

(3) When A273UHCPU (32-axis specification) is used



- (1) Each bit setting is designated as "1" or "0".  
 1: Disable...Limit switch output remains OFF.  
 0: Enable...Limit switch output turns ON and OFF in accordance with the set data.
- (2) The "LY" of LY00 - LYFF indicates the limit switch output.

## 4. SERVO SYSTEM CPU DEVICES

### 4.5 Special Registers (SP, D)

The servo system CPU has 256 (D9000 - D9255) special register points.

Of these, 20 points (D9180 - D9199) are used for positioning control. (For details regarding special registers other than D9180 - D9199, refer to the ACPU Programming Manual (Common Instructions)).

In addition to the positioning control special registers, the A273UHCPU (32-axis specification) also employs some of the data registers as special registers (D752 - D754, D760 - D799).

A list of special registers used for positioning control is shown below.

(1) When A171SCPU is used

**Table 4.10 Special Register List (For A171SCPU)**

Device No.	Signal Name
D9180	Limit switch output status storage area for axis 1 and axis 2
D9181	Limit switch output status storage area for axis 3 and axis 4
D9182	Unusable
D9183	
D9184	PCPU error cause
D9185	Servo amplifier type
D9186	
D9187	Manual pulse generator axis setting error
D9188	Test mode request error
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	Area for setting the manual pulse generator smoothing magnification
D9193	Unusable
D9194	
D9195	REAL/VIRTUAL mode switching error information
D9196 - D9199	Unusable

## 4. SERVO SYSTEM CPU DEVICES

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(2) When A273UHCPU (8-axis specification) is used

**Table 4.11 Special Register List (for A273UHCPU 8-axis Specification)**

Device No.	Signal Name
D9180	Limit switch output status storage area for axis 1 and axis 2
D9181	Limit switch output status storage area for axis 3 and axis 4
D9182	Limit switch output status storage area for axis 5, and axis 6
D9183	Limit switch output status storage area for axis 7, and axis 8
D9184	PCPU error cause
D9185	Servo amplifier type
D9186	
D9187	Manual pulse generator axis setting error
D9188	Test mode request error
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	Manual pulse generator 1 (P1) smoothing magnification setting area
D9193	Manual pulse generator 2 (P2) smoothing magnification setting area
D9194	Manual pulse generator 3 (P3) smoothing magnification setting area
D9195	REAL/VIRTUAL mode switching error information
D9196 - D9199	Unusable

## 4. SERVO SYSTEM CPU DEVICES

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(3) When A273UHCPU (32-axis specification) is used

**Table 4.12 Special Register List (for A273UHCPU 32-axis Specification)**

Device No.	Signal Name
D752*	Manual pulse generator 1 (P1) smoothing magnification setting area
D753*	Manual pulse generator 2 (P2) smoothing magnification setting area
D754*	Manual pulse generator 3 (P3) smoothing magnification setting area
D776* - D791	Limit switch output status storage area
D792* - D799	Servo amplifier type
D9180 - D9181	Unusable
D9182 - D9183	Test mode request error
D9184	PCPU error cause
D9185 - D9187	Manual pulse generator axis setting error
D9188	Unusable
D9189	Error program number
D9190	Error item information
D9191 - D9192	Servo amplifier loading information
D9193 - D9195	REAL/VIRTUAL mode switching error information
D9196 - D9199	Unusable

\*: Data registers used

## 4. SERVO SYSTEM CPU DEVICES

### 4.5.1 Limit switch output status storage area (D9180 - D9181/D9180 - D9183/D776 - D791)

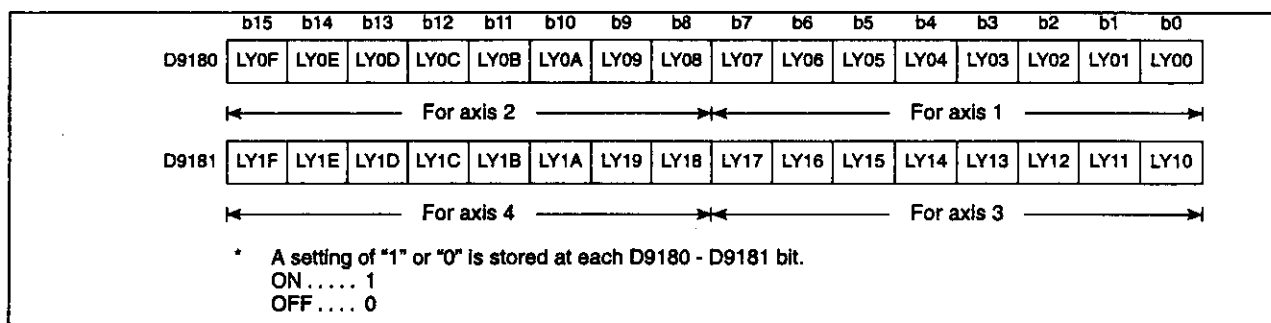
..... Data sent from PCPU to SCPU

(1) The status (ON/OFF) of limit switch outputs (designated from a peripheral device) to A1SY42 and AY42 are stored here as "1" or "0" data.

- ON ..... 1
- OFF ..... 0

(2) This area can be used to execute external outputs of limit switch output data, etc., from the sequence program.

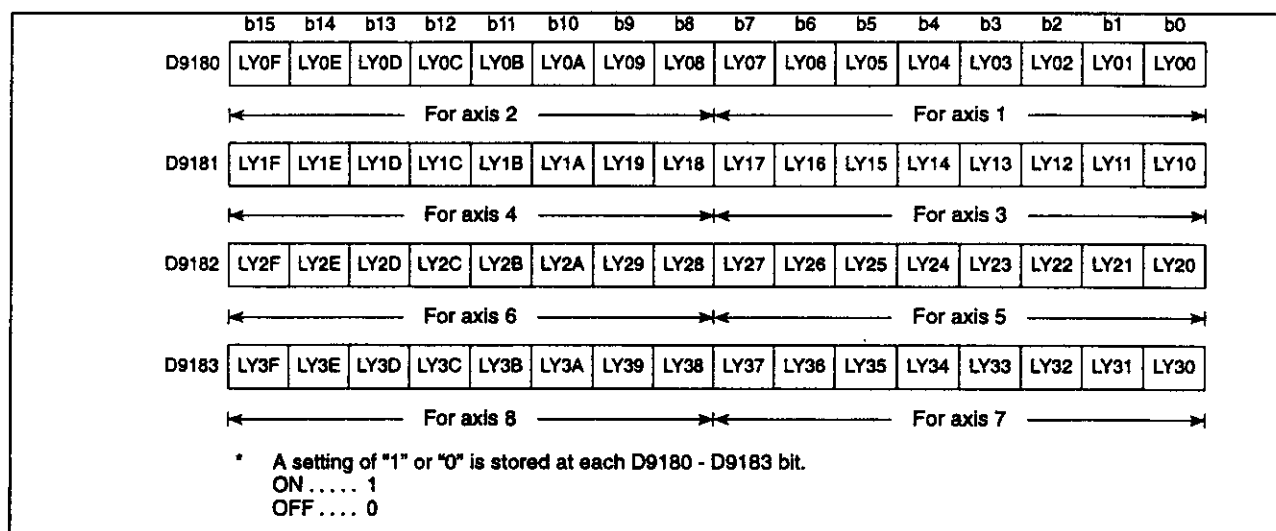
[When A171SCPU is used]



#### REMARK

The "LY" at the D9180 - D9181 LY□□ items indicates a limit switch output.

[When A273UHCPU (8-axis specification) is used]

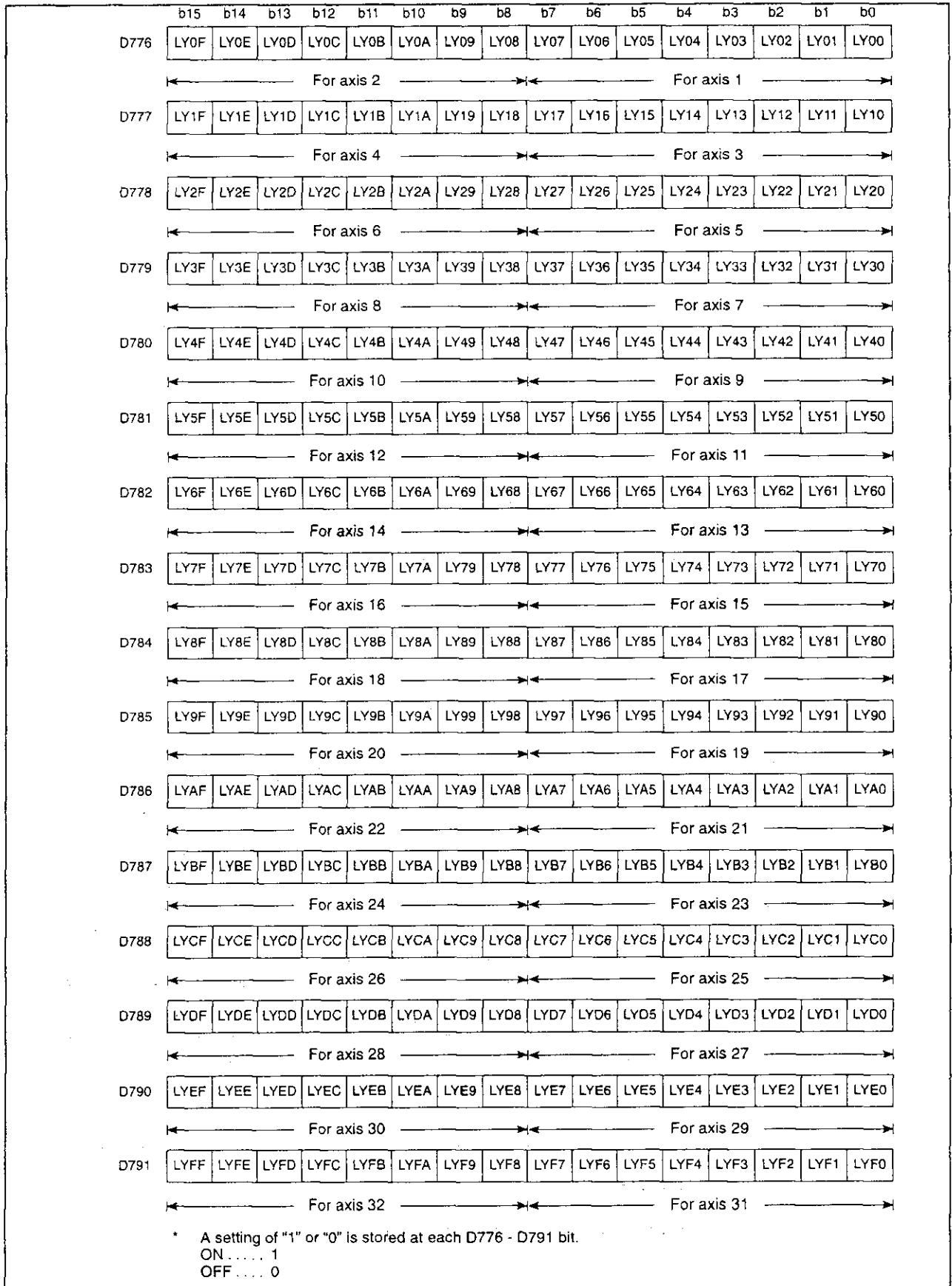


#### REMARK

The "LY" at the D9180 - D9183 LY□□ items indicates a limit switch output.

# 4. SERVO SYSTEM CPU DEVICES

[When A273UHCPU (32-axis specification) is used]





## 4. SERVO SYSTEM CPU DEVICES

### REMARK

The "LY" at the D776 - D791 LY□□ items indicates a limit switch output.

#### 4.5.2 PCPU error cause (D9184) ..... Data sent from PCPU to SCPU

This register is used to identify the nature of errors occurring in the PCPU part of the servo system.

##### (1) When A171SCPU is Used

Error Code	Error Cause	Operation When Error Occurs	Action to Take
2	PCPU operation period too long	All axes stop immediately, after which operation cannot be started.	Reset with the reset key.
3	SCPU software error 2		
300	SCPU software error 3		

##### (2) When A273UHCPU (8-Axis Specification) is Used

Error Code	Error Cause	Operation When Error Occurs	Action to Take
1	PCPU software error 1	All axes stop immediately, after which operation cannot be started.	Reset with the reset key.
2	PCPU operation period too long		
3	PCPU software error 2		
30	Hardware error between PCPU and SCPU.		
100 - 107 110 - 117	<p>CPU error in AC motor drive module</p> <p>1 0 0</p> <p>↑</p> <p>Indicates the slot number (0 - 7) of the AC motor drive module where the error occurred.</p> <p>Base information for the AC motor drive module where the error occurred.</p> <p>0: Main base unit 1: Motion extension base unit (stage 1)</p>	The servo error detected flag (X0n8) for the relevant axis comes ON and the servo OFF status is established. Thereafter, operation follows the setting for action to take in the event of an ADU servo error made in the system settings.	Reset with the reset key. If the error re-occurs after re-setting, the ADU is probably faulty; replace it.
200 - 207 210 - 217	<p>Hardware error in module installed in the motion main base unit or motion extension base unit</p> <p>2 0 0</p> <p>↑</p> <p>Indicates the slot number (0 - 7) of the module where the error occurred.</p> <p>Base information for the module where the error occurred.</p> <p>0: Main base unit 1: Motion extension base unit (stage 1)</p>	All axes stop immediately, after which operation cannot be started.	Reset with the reset key. If the error re-occurs after re-setting, the relevant module or the relevant slot (base unit) is probably faulty; replace the module/ base unit.

## 4. SERVO SYSTEM CPU DEVICES

Error Code	Error Cause	Operation When Error Occurs	Action to Take
250 - 251	Hardware error in MR-□-B separate servo amplifier interface 250 ↳ SSCNET number where error occurred 0: SSCNET 1	All axes stop immediately, after which operation cannot be started.	Reset with the reset key. If the error re-occurs after resetting, the relevant module or the relevant slot (base unit) is probably faulty: replace the module/ base unit.
300	PCPU software error 3		Reset with the reset key.

## 4. SERVO SYSTEM CPU DEVICES

(3) When A273UHCPU (32-axis specification) is used

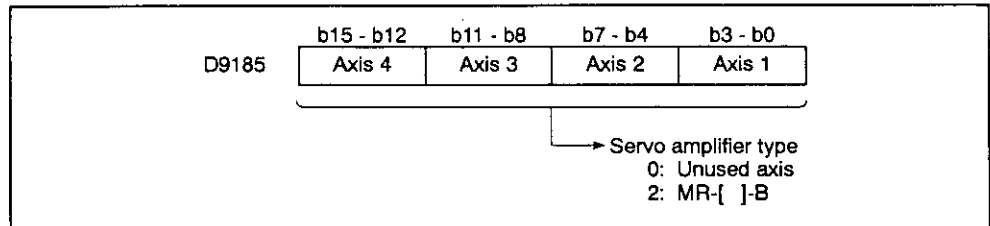
Error Code	Error Cause	Operation When Error Occurs	Action to Take
1	PCPU software error 1	All axes stop immediately, after which operation cannot be started.	Reset with the reset key.
2	PCPU calculation cycle over		
3	PCPU software error 2		
30	Hardware error between PCPU and SCPU		
100 - 107 110 - 117 120 - 127 130 - 137 140 - 147	<p>CPU error in AC motor drive module</p> <p>1 0 0 ↑ └─ Indicates the slot number (0 - 7) of the AC motor drive module where the error occurred.</p> <p>Base information for the AC motor drive module where the error occurred.</p> <p>0: Main base unit 1: Motion extension base unit (stage 1) 2: Motion extension base unit (stage 2) 3: Motion extension base unit (stage 3) 4: Motion extension base unit (stage 4)</p>	The servo error detected flag (M2408+20n) for the relevant axis comes ON and the servo OFF status is established. Thereafter, operation follows the setting for action to take in the event of an ADU servo error made in the system settings.	Reset with the reset key. If the error re-occurs after re-setting, the ADU is probably faulty: replace it.
200 - 207 210 - 217 220 - 227 230 - 237 240 - 247	<p>Hardware error in module installed in the motion main base unit or motion extension base unit</p> <p>2 0 0 ↑ └─ Indicates the slot number (0 - 7) of the module where the error occurred.</p> <p>Base information for the module where the error occurred.</p> <p>0: Main base unit 1: Motion extension base unit (stage 1) 2: Motion extension base unit (stage 2) 3: Motion extension base unit (stage 3) 4: Motion extension base unit (stage 4)</p>	All axes stop immediately, after which operation cannot be started.	Reset with the reset key. If the error re-occurs after re-setting, the relevant module or the relevant slot (base unit) is probably faulty: replace the module/ base unit.
250 - 253	<p>Hardware error in MR-[ ]-B separate servo amplifier interface</p> <p>2 5 0 └─ SSCNET number where error occurred</p> <p>0: SSCNET 1 1: SSCNET 2 2: SSCNET 3 3: SSCNET 4</p>		
300	PCPU software error 3		Reset with the reset key.
301	CPSTART instructions for 8 or more pass points have been executed, exceeding the number of programs that can be started simultaneously.		Reset with the reset key. Modify so that CPSTART instructions for 8 or more pass points do not exceed the number of programs that can be started simultaneously.
		Number of Programs that can be Started Simultaneously	
	Version with conventional functions	20	
	Version with additional functions	14	

## 4. SERVO SYSTEM CPU DEVICES

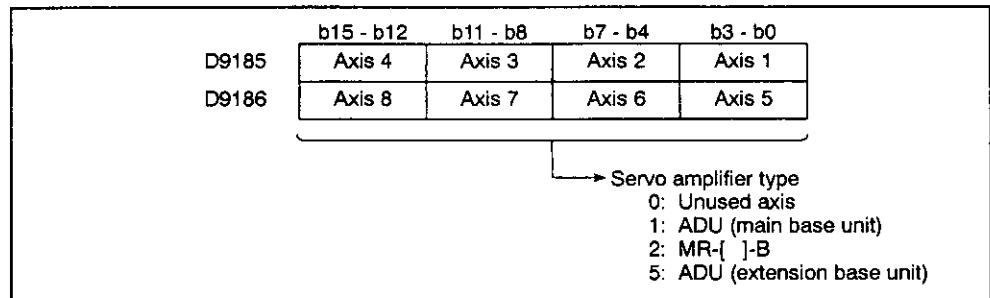
### 4.5.3 Servo amplifier type (D9185/D9185 - D9186/D792 - D799) . . . . . Data sent from PCPU to SCPU

When a servo system CPU power ON or reset occurs, the servo amplifier type designated at the system settings will be stored.

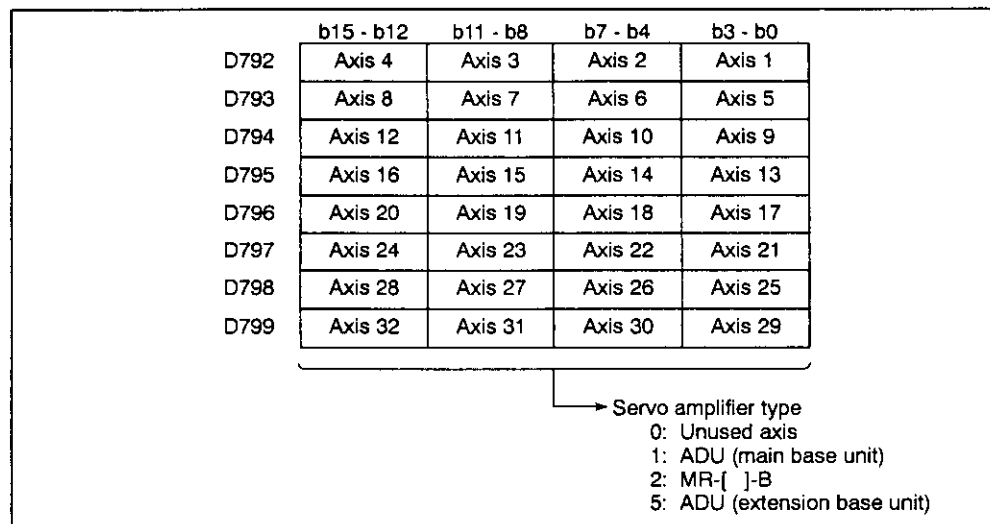
(1) When A171SCPU is used



(2) When A273UHCPU (8-axis specification) is used



(3) When A273UHCPU (32-axis specification) is used



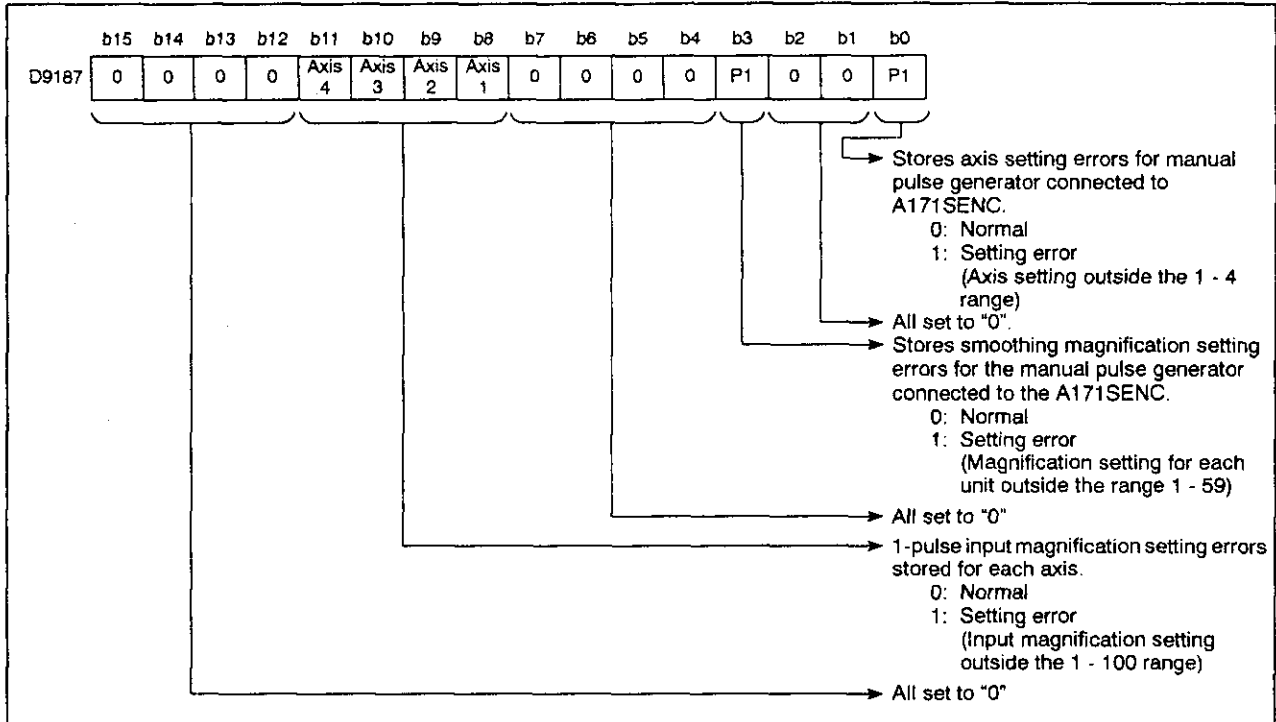
## 4. SERVO SYSTEM CPU DEVICES

### 4.5.4 Manual pulse generator axis setting error (D9187/D9187/D9185 - D9187)

..... Data sent from PCPU to SCPU

(1) When A171SCPU is used

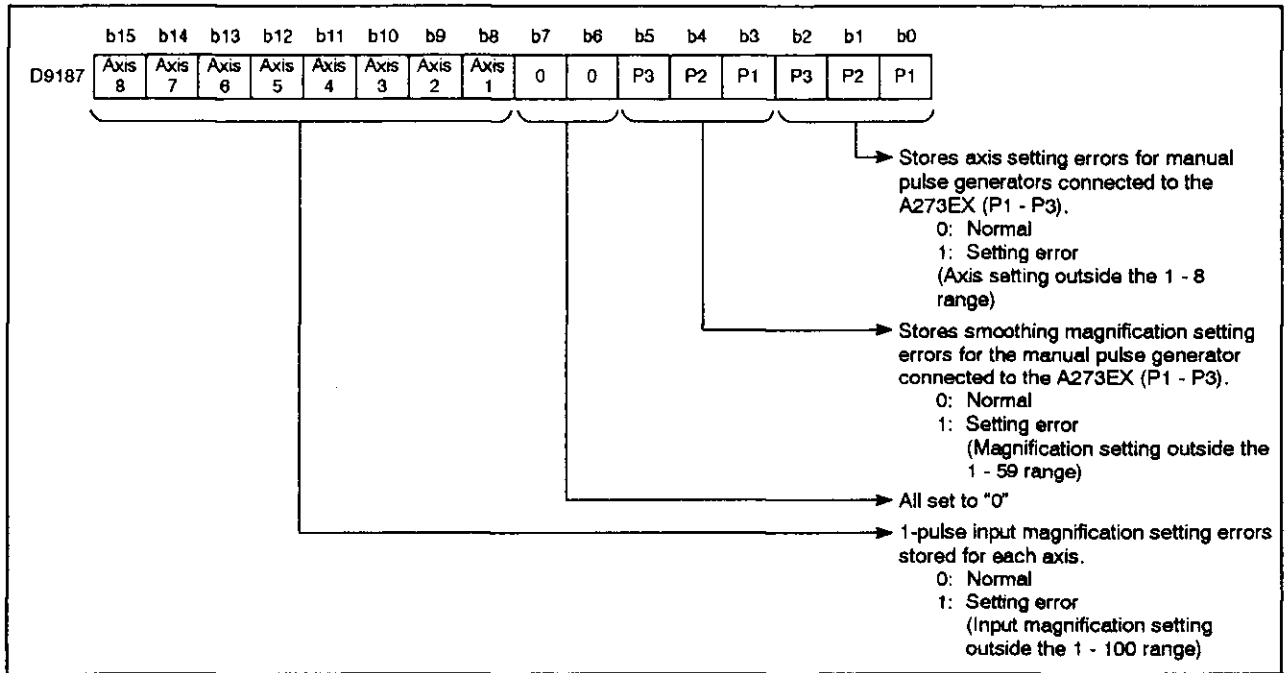
When the manual pulse generator axis setting error flag (M9077) switches ON, the error content will be stored.



## 4. SERVO SYSTEM CPU DEVICES

(2) When A273UHCPU (8-axis specification) is used

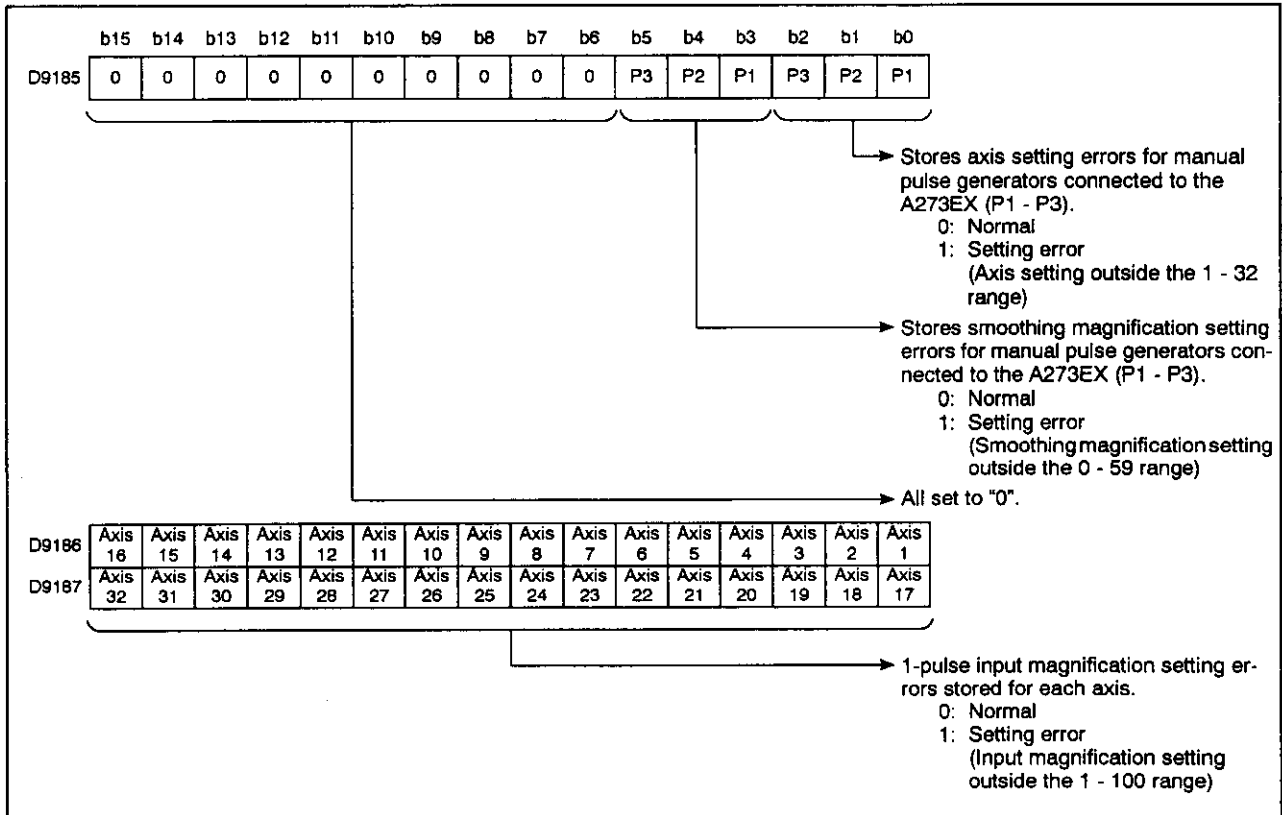
When the manual pulse generator axis setting error flag (M9077) switches ON, the error content will be stored.



## 4. SERVO SYSTEM CPU DEVICES

(3) When A273UHCPU (32-axis specification) is used

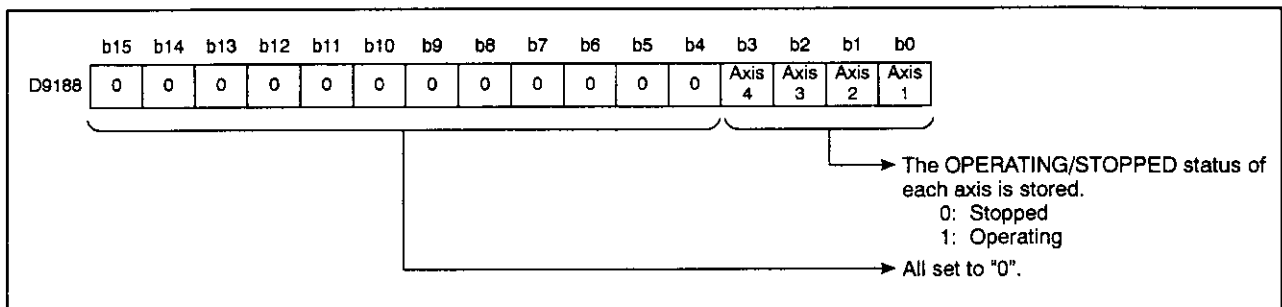
When the "manual pulse generator enabled flag" (M2051 - M2053) switches ON, the corresponding axis No. setting registers (D714 - D719), manual pulse generator smoothing magnification setting registers (D752 - D754), and manual pulse generator 1-pulse input magnification setting registers (D720 - D751) are checked for errors. If an error is found, its content will be stored at the manual pulse generator axis setting error storage area.



### 4.5.5 TEST mode request error (D9188/D9188/D9182 - D9183) . . . . . Data sent from PCPU to SCPU

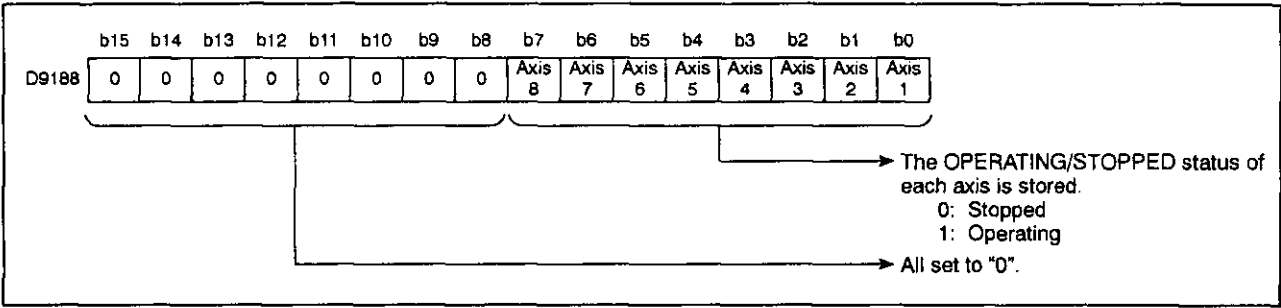
When the TEST mode request error flag (M9078) switches ON, the axis data for axes in motion at that time will be stored.

(1) When A171SCPU is used

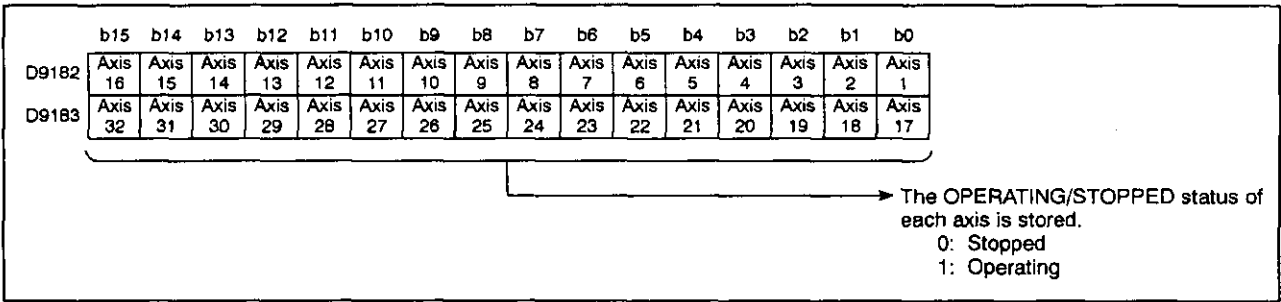


# 4. SERVO SYSTEM CPU DEVICES

(2) When A273UHCPU (8-axis specification) is used



(3) When A273UHCPU (32-axis specification) is used



### 4.5.6 Error program No. (D9189) ..... Data sent from PCPU to SCPU

- (1) When the servo program setting error flag (M9079)\*1 switches ON, the No. of the servo program (0 - 4095) where the error occurred is stored.
- (2) Each time another error occurs at other servo programs, the stored servo program No. is replaced by the No. of the servo program where the most recent error occurred.

**REMARK**

\*1: For details regarding the servo program setting error flag, see Section 4.3.7.



## 4. SERVO SYSTEM CPU DEVICES

### 4.5.7 Error item information (D9190) ..... Data sent from PCPU to SCPU

When the servo program setting error flag (M9079) switches ON, the error code corresponding to the erroneous setting item will be stored.

Error Code	Error Description
900	The servo program designated by the DSFRP/SVST instruction does not exist.
901	The axis No. designated by the DSFRP/SVST instruction is different from the axis No. designated by the servo program.
902	The instruction code is unreadable (incorrect code).
904	A REAL mode servo program was started while in the VIRTUAL mode.
905	An instruction that cannot be executed in the VIRTUAL mode (VPF,VPR,VVF,VVR,VPSTART, ZERO) was designated.
906	An axis designated as "unused" at the system settings is used in the servo program designated by the DSFRP/SVST instruction.
Error item data	A setting item error exists in the servo program designated by the DSFRP/SVST instruction.*1

#### REMARK

\*1: For details regarding error item data, see Section 6.3 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

## 4. SERVO SYSTEM CPU DEVICES

### 4.5.8 Servo amplifier installation information (D9191/D9191/D9191 - D9192)

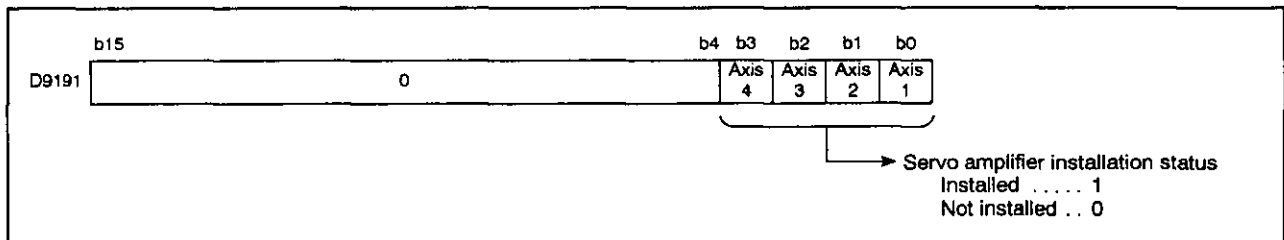
..... Data sent from PCPU to SCPU

(1) When A171SCPU is used

When a servo system CPU power ON or reset occurs, the servo amplifier installation status is checked, and the results are stored.

Least significant 4 bits ..... Servo amplifier installation status

An INSTALLED status will be established at axes where the installation status changes from NOT INSTALLED to INSTALLED when power is switched ON. If the status changes from INSTALLED to NOT INSTALLED at power ON, the INSTALLED status will remain in effect.



(a) Servo amplifier installation status

1) Installed/Not Installed Status

- Installed ..... MR-[ ]-B status is normal (normal communication with servo amplifier)
- Not Installed ..... Servo amplifier is not installed.  
Servo amplifier power is OFF.  
Normal communication with the servo amplifier is impossible due to a connecting cable problem, etc.

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

System Settings	MR-[ ]-B	
	Installed	Not Installed
USED (axis No. setting)	"1" is stored	"0" is stored
NOT USED	"0" is stored	"0" is stored

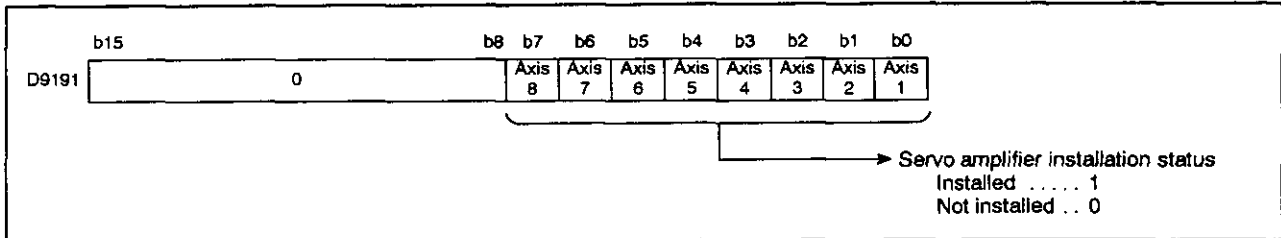
## 4. SERVO SYSTEM CPU DEVICES

(2) When A273UHCPU (8-axis specification) is used

When a servo system CPU power ON or reset occurs, the servo amplifier installation status is checked, and the results are stored.

Least significant 8 bits . . . . . Servo amplifier installation status

An INSTALLED status will be established at axes where the installation status changes from NOT INSTALLED to INSTALLED when power is switched ON. If the status changes from INSTALLED to NOT INSTALLED at power ON, the INSTALLED status will remain in effect.



(a) Servo amplifier installation status

1) Installed/not installed status

- Installed . . . . . ADU or MR-[ ]-B status is normal  
(normal communication with servo amplifier)
- Not installed . . . . . Servo amplifier is not installed.  
Servo amplifier power is OFF.  
Normal communication with the servo amplifier is impossible due to a connecting cable problem, etc.

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

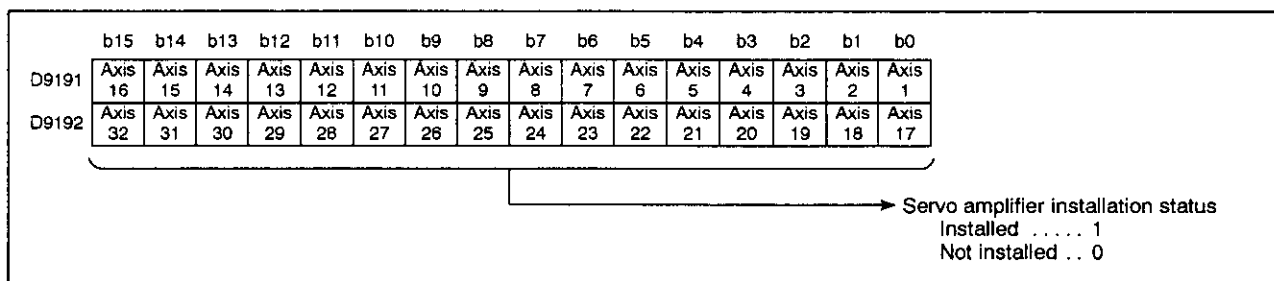
System Settings	ADU		MR-[ ]-B	
	Installed	Not Installed	Installed	Not Installed
USED (axis No. setting)	"1" is stored	Major error	"1" is stored	"0" is stored
NOT USED	"0" is stored	"0" is stored	"0" is stored	"0" is stored

## 4. SERVO SYSTEM CPU DEVICES

(3) When A273UHCPU (32-axis specification) is used

When a servo system CPU power ON or reset occurs, the servo amplifier installation status is checked, and the results are stored.

An INSTALLED status will be established at axes where the installation status changes from NOT INSTALLED to INSTALLED when power is switched ON. If the status changes from INSTALLED to NOT INSTALLED at power ON, the INSTALLED status will remain in effect.



(a) Servo amplifier installation status

1) Installed/not installed status

- Installed ..... ADU or MR-[ ]-B status is normal  
(normal communication with servo amplifier)
- Not installed ..... Servo amplifier is not installed.  
Servo amplifier power is OFF.  
Normal communication with the servo amplifier is impossible due to a connecting cable problem, etc.

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

System Settings	ADU		MR-[ ]-B	
	Installed	Not Installed	Installed	Not Installed
USED (axis No. setting)	"1" is stored	Major error	"1" is stored	"0" is stored
NOT USED	"0" is stored	"0" is stored	"0" is stored	"0" is stored

## 4. SERVO SYSTEM CPU DEVICES

### 4.5.9 Manual pulse generator smoothing magnification setting area (D9192/D9192 - D9194/D752 - D754) ..... Data sent from SCPU to PCPU

- (1) This area is used for setting the manual pulse generator's smoothing time constant.

<A17ASCPU>

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

<A273UHCPU (8-axis)>

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

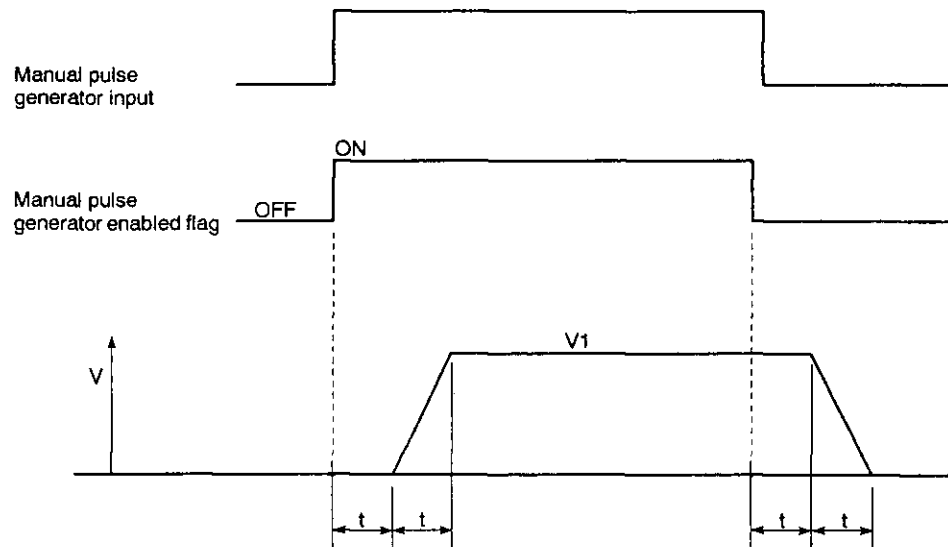
<A273UHCPU (32-axis)>

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

- (2) When the smoothing magnification setting is designated, the smoothing time constant is determined by the following formula.

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

- (3) Operation



$$\text{Output speed (V1)} = \left( \text{Number of input pulses/ms} \right) \times \left( \text{Manual pulse generator's 1-pulse input magnification setting} \right)$$

$$\text{Travel value (L)} = \left( \text{Travel value per pulse} \right) \times \left( \text{Number of input pulses/ms} \right) \times \left( \text{Manual pulse generator's 1-pulse input magnification setting} \right)$$

## 4. SERVO SYSTEM CPU DEVICES

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### REMARK

(1) The following units are used for the "travel value per pulse" value.

Setting units:    mm    : 0.1  $\mu$ m  
                  inch    : 0.00001 inch  
                  degree : 0.00001 degree  
                  pulse  : 1 pulse

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

### 4.5.10 REAL/VIRTUAL mode switching error information (D9195/D9195/D9193 - D9195) ..... Data sent from PCPU to SCPU

- (1) If an error occurs when switching between the REAL and VIRTUAL modes, the corresponding error code will be stored.

For details regarding the error codes, see Section 10.6.

## 5. MECHANICAL SYSTEM PROGRAM

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### 5. MECHANICAL SYSTEM PROGRAM

This section discusses the VIRTUAL mode's mechanical system program.

This program consists of a mechanical module connection diagram and the mechanical module parameters.

- The mechanical module connection diagram shows the virtual mechanical system consisting of connected virtual mechanical modules.
- The mechanical module parameters are the parameters used at the mechanical module connection diagram for control of the mechanical modules.

For details regarding the mechanical module parameters, refer to the mechanical module parameter lists shown in Chapters 6 to 8.

# 5. MECHANICAL SYSTEM PROGRAM

## 5.1 Mechanical Module Connection Diagram

The mechanical module connection diagram shows a virtual system consisting of mechanical modules. The mechanical module connection configuration is shown in Fig. 5.1 below.

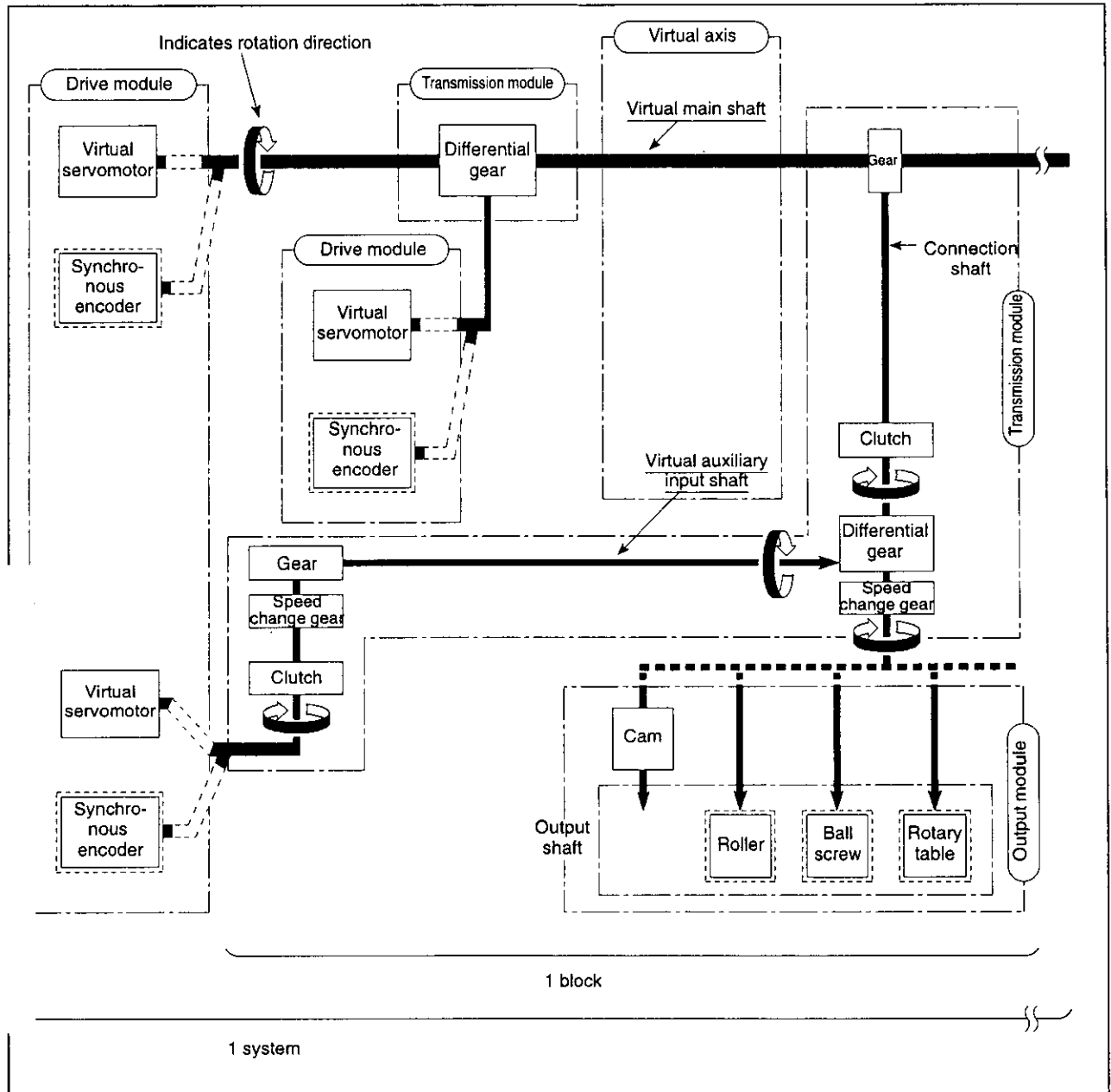


Fig. 5.1 Mechanical Module Connection Configuration

### POINTS

- (1) Either a virtual servomotor or a virtual synchronous encoder can be connected at the drive module.
- (2) One of the following can be connected at the output module:  
Cam, roller, ball screw, or rotary table.



## 5. MECHANICAL SYSTEM PROGRAM

### (1) Block

The term "block" refers to a single series of elements between and including a virtual transmission module (gear connected to the virtual main shaft) and an output module. Refer to Table 5.1 to determine the number of mechanical modules which can be connected in one block.

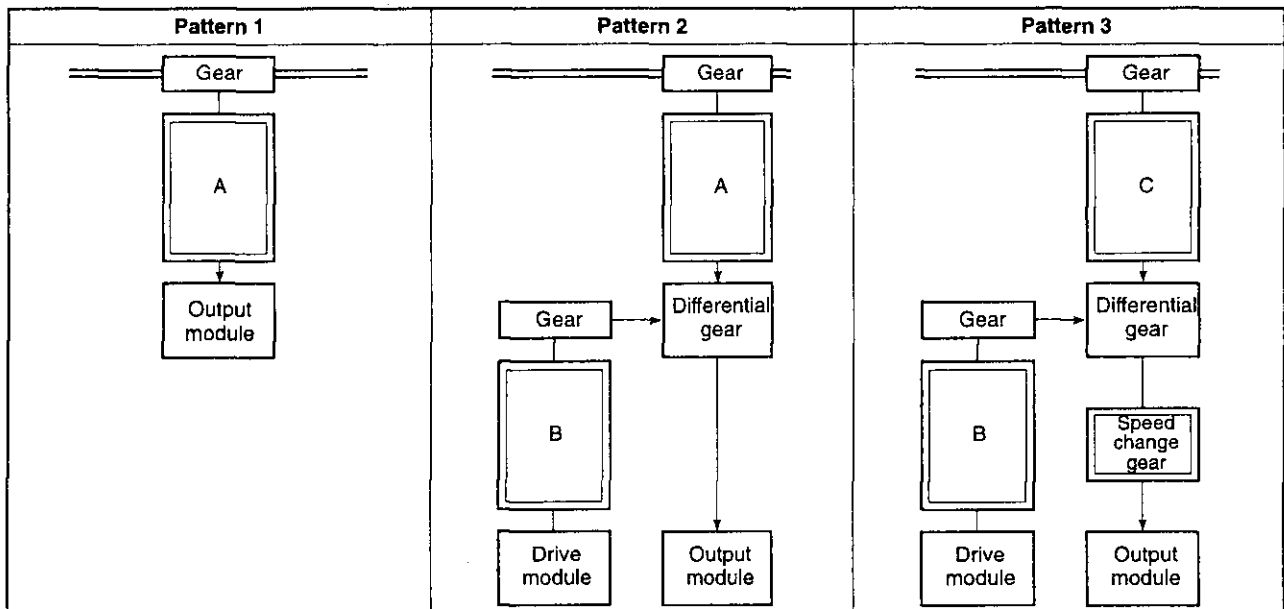
### (2) System

The term "system" refers to all the blocks which are connected to a single virtual main shaft. One system can consist of up to 8 blocks.

### (3) Transmission module connections

There are 3 transmission module connection patterns:

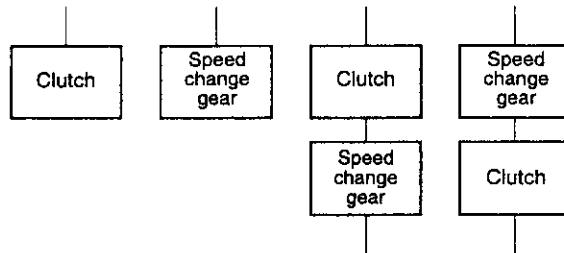
- Pattern 1 . . . . . Without a differential gear.
- Pattern 2 . . . . . Without a speed change gear at the output side of the differential gear.
- Pattern 3 . . . . . With a speed change gear at the output side of the differential gear.



## 5. MECHANICAL SYSTEM PROGRAM

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- (a) Transmission modules which can be connected at "A" and "B" above
- 1) A clutch, speed change gear, and clutch & speed change gear can be connected at "A" and "B".
  - 2) If a clutch & speed change gear are used, there are no connection constraints.



- (b) Transmission module which can be connected at "C"
- Only a clutch can be connected at "C".

# 5. MECHANICAL SYSTEM PROGRAM





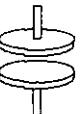



## 5.2 Mechanical Module List

Summaries of mechanical modules used in VIRTUAL mode mechanical module connection diagrams are given in Tables 5.1 to 5.3.

For details regarding each mechanical module, see Chapters 5 to 8.





(1) When A171SCPU is used

**Table 5.1 Mechanical Module List (for A171SCPU)**

Classification	Mechanical Module		Max. Number Used					Function Description	Reference Section	
	Name	Appearance	Number Per Servo System CPU	Number Per System		Number Per Block				
				Number Per System	Connection Shaft Side	Auxiliary Input Shaft Side				
Drive module	Virtual servo motor		4	Total of 5	4	Total of 5	-	-	• Used to drive the mechanical system program's virtual axis by servo program or JOG operation.	Section 6.1
	Synchronous encoder		1		1		-	-	• Used to drive the virtual axis by input pulses from an external synchronous encoder.	Section 6.2
Virtual axis	Virtual main shaft	-	4	Total of 8	1	-	-	• This is a virtual "link shaft". • Drive module rotation is transferred to the transmission module.	-	
	Virtual auxiliary input shaft	-	4		4	-	-	• This is the auxiliary input shaft for input to the transmission module's differential gear. • This shaft is automatically displayed when a differential gear and gear are connected.	-	
Transmission module	Gear		8	8	1	1	• Transfers the drive module's rotation to the output shaft. • The travel value (pulse) input from the drive module is adjusted according to the gear ratio setting value, and is then transmitted to the output shaft so that rotation occurs in the set direction.	Section 7.1		
	Direct clutch		8	8	1	1	• Engages/disengages the output module with the drive module rotation. • In response to clutch ON/OFF switching, there is a direct clutch for direct transfer, and a smoothing clutch for acceleration/deceleration processing which occurs in accordance with the smoothing time constant setting.	Section 7.2		
	Smoothing clutch		8	8	1	1	• The ON/OFF mode, address mode, or the external input mode can be used, depending on the application.			
	Speed change gear		8	8	1	1	• Used to change the speed of the output module (roller). • The input shaft speed is adjusted according to the gear ratio setting value, and is then transmitted to the output shaft.	Section 7.3		
	Differential gear		4	4	1	-	-	• Auxiliary input shaft rotation is subtracted from virtual main shaft rotation and the result is transmitted to the output shaft.	Section 7.4	
		1		-	-	• Auxiliary input shaft rotation is subtracted from virtual main shaft rotation and the result is transmitted to the output shaft. (For virtual main shaft connection)				

## 5. MECHANICAL SYSTEM PROGRAM




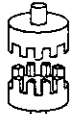






Table 5.1 Mechanical Module List (for A171SCPU) (Continued)

Classi- fication	Mechanical Module		Max. Number Used					Function Description	Refer- ence Section	
	Name	Appearance	Number Per Servo System CPU	Number Per System	Number Per Block					
					Con- nec- tion Shaft Side	Aux- iliary Input Shaft Side				
Output module	Roller		4	4	Total of 4	Total of 4	1	1	• Used when speed control occurs at the final output.	Section 8.1
	Ball screw		4	4					• Used when linear positioning occurs at the final output.	Section 8.2
	Rotary table		4	4					• Used when angle control occurs at the final output shaft.	Section 8.3
	Cam		4	4					<ul style="list-style-type: none"> <li>• Used when control other than those shown above occurs at the final output shaft. Position control will occur in accordance with the cam pattern setting data.</li> <li>• There are 2 cam control modes: the two-way cam mode, and the feed cam mode.</li> </ul>	Section 8.4

## 5. MECHANICAL SYSTEM PROGRAM



(2) When A273UHCPU (8-axis specification) is used

**Table 5.2 Mechanical Module List (For A273UHCPU 8-Axis Specification)**

Classification	Mechanical Module		Max. Number Used					Function Description	Reference Section	
	Name	Appearance	Number Per Servo System CPU	Number Per System		Number Per Block				
						Connection Shaft Side	Auxiliary Input Shaft Side			
Drive module	Virtual servo motor		8	Total of 11	8	Total of 11	-	-	• Used to drive the mechanical system program's virtual axis by servo program or JOG operation.	Section 6.1
	Synchronous encoder		3		3		-	-	• Used to drive the virtual axis by input pulses from an external synchronous encoder.	Section 6.2
Virtual axis	Virtual main shaft	-	8	Total of 16	1	8	-	-	• This is a virtual "link shaft". • Drive module rotation is transferred to the transmission module.	-
	Virtual auxiliary input shaft	-	8		8		-	-	• This is the auxiliary input shaft for input to the transmission module's differential gear. • This shaft is automatically displayed when a differential gear and gear are connected.	-
Transmission module	Gear		16	16	1	1	-	-	• Transfers the drive module's rotation to the output shaft. • The travel value (pulse) input from the drive module is adjusted according to the gear ratio setting value, and is then transmitted to the output shaft so that rotation occurs in the set direction.	Section 7.1
	Direct clutch		16	16	1	1	-	-	• Engages/disengages the output module with the drive module rotation. • In response to clutch ON/OFF switching, there is a direct clutch for direct transfer, and a smoothing clutch for acceleration/deceleration processing which occurs in accordance with the smoothing time constant setting.	Section 7.2
	Smoothing clutch									
	Speed change gear		16	16	1	1	-	-	• Used to change the speed of the output module (roller). • The input shaft speed is adjusted according to the gear ratio setting value, and is then transmitted to the output shaft.	Section 7.3
	Differential gear		8	8	8	1	-	-	• Auxiliary input shaft rotation is subtracted from virtual main shaft rotation and the result is transmitted to the output shaft.	Section 7.4
		1			-	• Auxiliary input shaft rotation is subtracted from virtual main shaft rotation and the result is transmitted to the output shaft. (For virtual main shaft connection)				
Output module	Roller		8	Total of 8	8	Total of 8	1	1	• Used when speed control occurs at the final output.	Section 8.1
	Ball screw		8		8				• Used when linear positioning occurs at the final output.	Section 8.2

## 5. MECHANICAL SYSTEM PROGRAM











Table 5.2 Mechanical Module List (for A273UHCPU 8-axis Specification) (Continued)

Classification	Mechanical Module		Max. Number Used					Function Description	Reference Section
	Name	Appearance	Number Per Servo System CPU	Number Per System	Number Per Block				
					Connection Shaft Side	Auxiliary Input Shaft Side			
Output module	Rotary table		8	8				<ul style="list-style-type: none"> <li>Used when angle control occurs at the final output shaft.</li> </ul>	Section 8.3
	Cam		8	Total of 8	Total of 8	1	1	<ul style="list-style-type: none"> <li>Used when control other than those shown above occurs at the final output shaft. Position control will occur in accordance with the cam pattern setting data.</li> <li>There are 2 cam control modes: the two-way cam mode, and the feed cam mode.</li> </ul>	Section 8.4

## 5. MECHANICAL SYSTEM PROGRAM



(3) When A273UHCPU (32-axis specification) is used

Table 5.3 Mechanical Module List (for A273UHCPU 32-axis Specification)

Classification	Mechanical Module		Max. Number Used					Function Description	Reference Section	
	Name	Appearance	Number Per Servo System CPU	Number Per System		Number Per Block				
						Connection Shaft Side	Auxiliary Input Shaft Side			
Drive module	Virtual servo motor		32	Total of 44	32	Total of 44	-	-	• Used to drive the mechanical system program's virtual axis by servo program or JOG operation.	Section 6.1
	Synchronous encoder		12		12		-	-	• Used to drive the virtual axis by input pulses from an external synchronous encoder.	Section 6.2
Virtual axis	Virtual main shaft	-	32	Total of 64	4	32	-	-	• This is a virtual "link shaft". • Drive module rotation is transferred to the transmission module.	-
	Virtual auxiliary input shaft	-	32		-		-	• This is the auxiliary input shaft for input to the transmission module's differential gear. • This shaft is automatically displayed when a differential gear and gear are connected.	-	
Transmission module	Gear		64	64	1	1	• Transfers the drive module's rotation to the output shaft • The travel value (pulse) input from the drive module is adjusted according to the gear ratio setting value, and is then transmitted to the output shaft so that rotation occurs in the set direction.	Section 7.1		
	Direct clutch		64	64	1	1	• Engages/disengages the output module with the drive module rotation. • In response to clutch ON/OFF switching, there is a direct clutch for direct transfer, and a smoothing clutch for acceleration/deceleration processing which occurs in accordance with the smoothing time constant setting. • The ON/OFF mode, address mode, or the external input mode can be used, depending on the application.	Section 7.2		
	Smoothing clutch									
	Speed change gear		64	64	1	1	• Used to change the speed of the output module (roller). • The input shaft speed is adjusted according to the gear ratio setting value, and is then transmitted to the output shaft.	Section 7.3		
	Differential gear		32	32	1	-	-	• Auxiliary input shaft rotation is subtracted from virtual main shaft rotation and the result is transmitted to the output shaft. • Auxiliary input shaft rotation is subtracted from virtual main shaft rotation and the result is transmitted to the output shaft. (For virtual main shaft connection)	Section 7.4	
		4		-						
Output module	Roller		32	Total of 32	32	Total of 32	1	1	• Used when speed control occurs at the final output.	Section 8.1
	Ball screw		32		32		• Used when linear positioning occurs at the final output.	Section 8.2		

## 5. MECHANICAL SYSTEM PROGRAM

Table 5.3 Mechanical Module List (For A273UHCPU 32-Axis Specification) (Continued)

Classification	Mechanical Module		Max. Number Used				Function Description	Reference Section	
	Name	Appearance	Number Per Servo System CPU	Number Per System	Number Per Block				
					Con- nec- tion Shaft Side	Aux- iliary Input Shaft Side			
Output module	Rotary table		32	32	Total of 32	1	1	<ul style="list-style-type: none"> <li>• Used when angle control occurs at the final output shaft.</li> </ul>	Section 8.3
	Cam		32	32				<ul style="list-style-type: none"> <li>• Used when control other than those shown above occurs at the final output shaft. Position control will occur in accordance with the cam pattern setting data.</li> <li>• There are 2 cam control modes: the two-way cam mode, and the feed cam mode.</li> </ul>	Section 8.4