MITSUBISHI

MOTION CONTROLLER (SV22) (VIRTUAL MODE)

Programming Manual

type A171SCPU, A273UHCPU

MITSUBISHI ELECTRIC

REVISIONS

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INTRODUCTION

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

Precautions for Safety

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

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

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

For Safe Operations

1. Prevention of electric shocks

WARNING

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

2. For fire prevention

CAUTION

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

3. For injury prevention

⚠ CAUTION

- ⚠ Do not apply a voltage other than that specified in 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 installer 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.

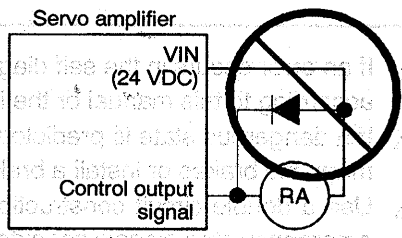
⚠ After wiring, install the protective covers such as the terminal covers to the original positions.

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

⚠ Use the units with the following conditions.

Item	Conditions
Input power	According to 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

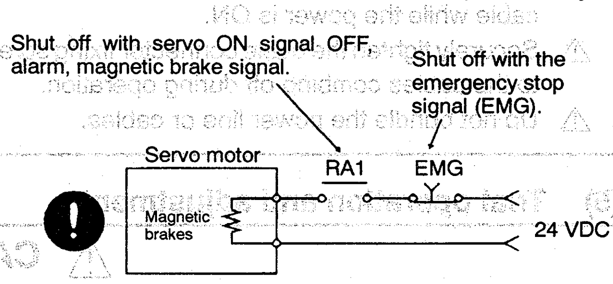
⚠ If an error occurs in the self diagnosis of the control unit or servo amplifier, confirm the check details according to this manual or the instruction manual, and restore the operation.

⚠ 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 restarts suddenly.)



(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.

CONTENTS

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 .... collectively abbreviated to "SV22"
SW2SRX-SV22U

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 amplifer	MR-[ ]-B

IBM PC/AT is a registered trade mark of the International Business Machines Corporation

⚠ 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.

[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)

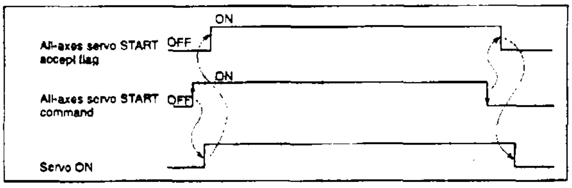
A171SCPU A273UHCPU (32-axis specification)

4. SERVO SYSTEM CPU DEVICES

4.2.3 All-Axes servo START accept flag (M2000/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.

Applies to A273UHCPU (8-axis specification)

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.

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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.

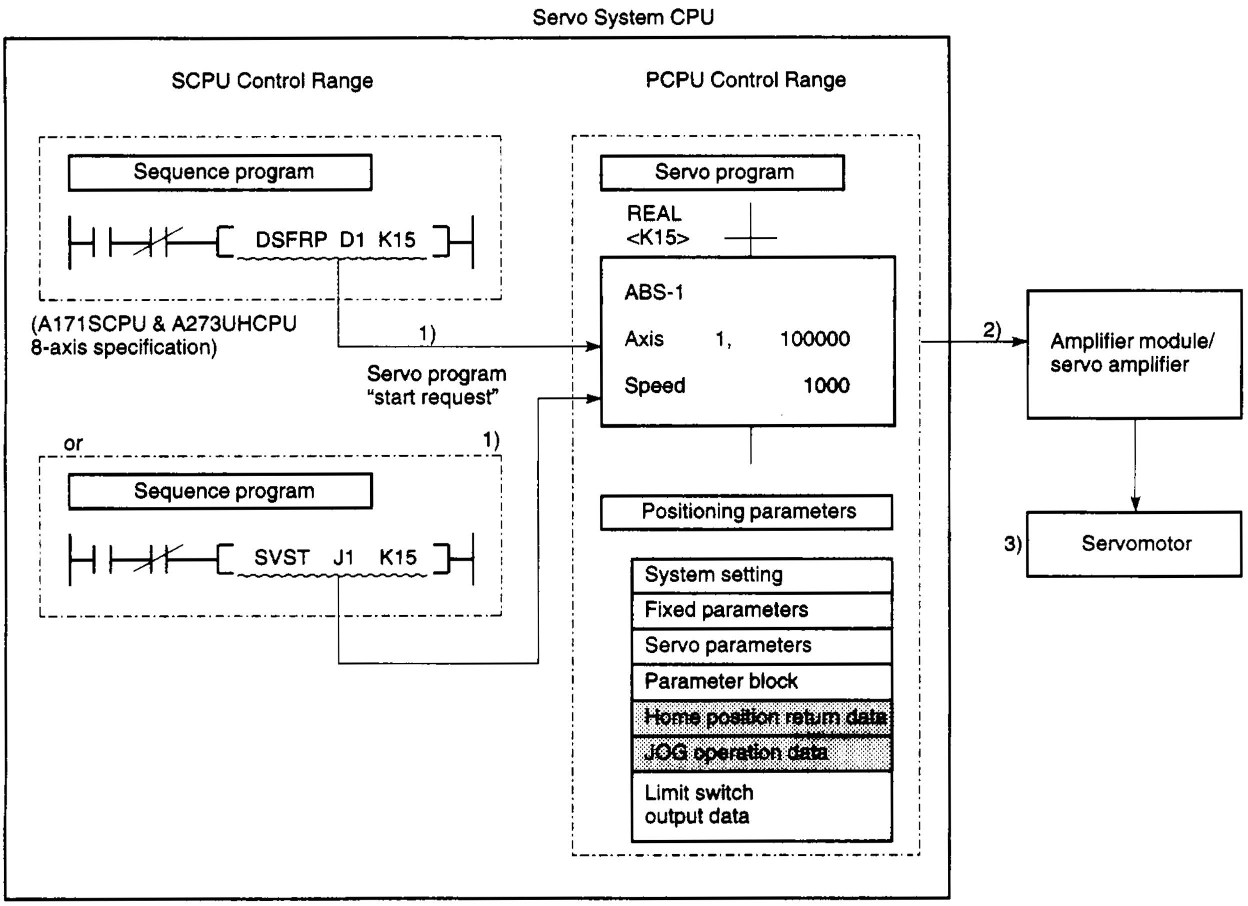
(b) To utilize the REAL mode, positioning parameter settings must be designated, and a positioning sequence program must be created.

(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.



(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".

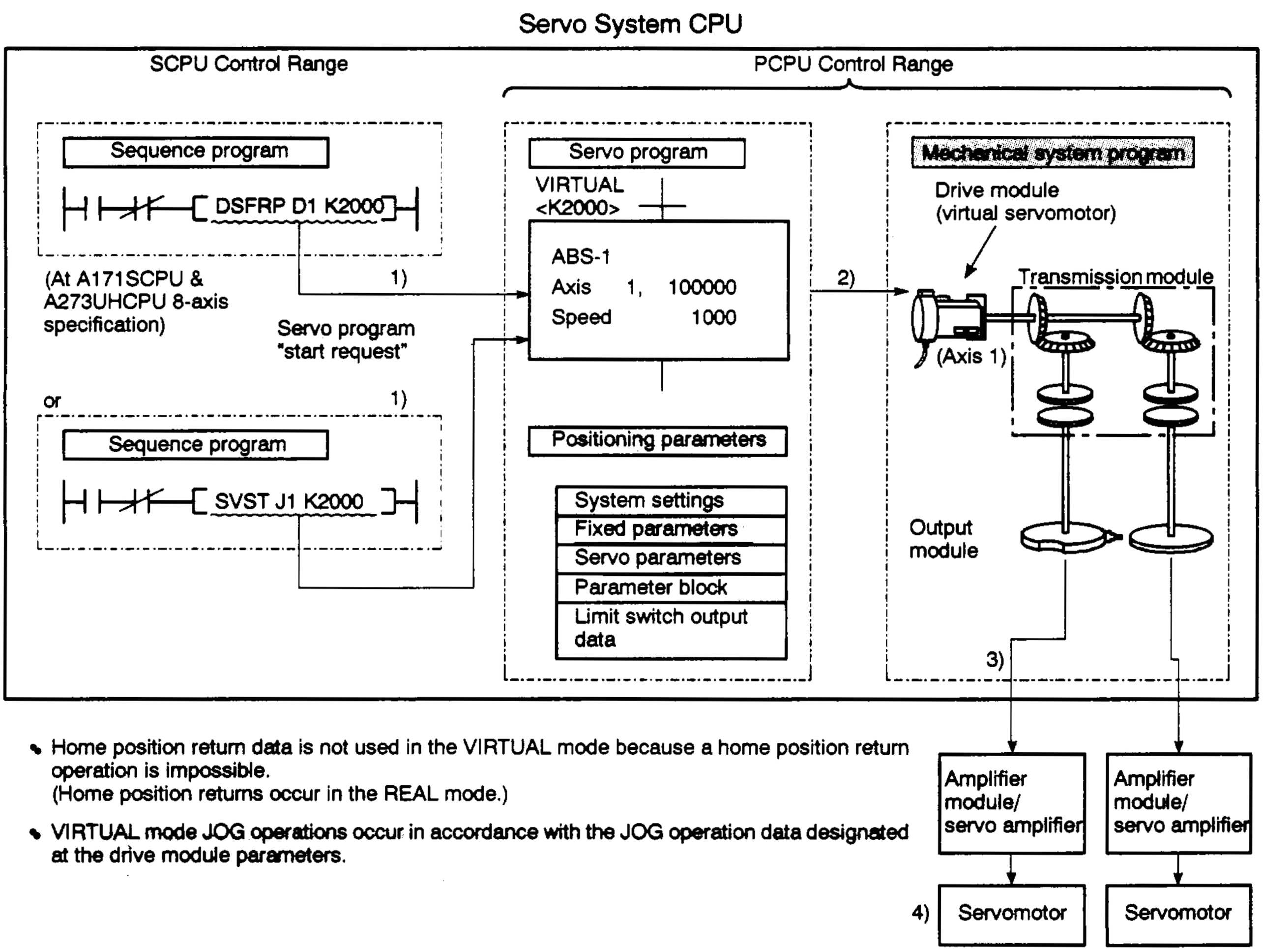
(c) The procedure for VIRTUAL mode positioning control is as follows:

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.



- Home position return data is not used in the VIRTUAL mode because a home position return operation is impossible. (Home position returns occur in the REAL mode.)
- VIRTUAL mode JOG operations occur in accordance with the JOG operation data designated at the drive module parameters.

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.

(6) Compatible with MR-J2-B servo amplifiers.

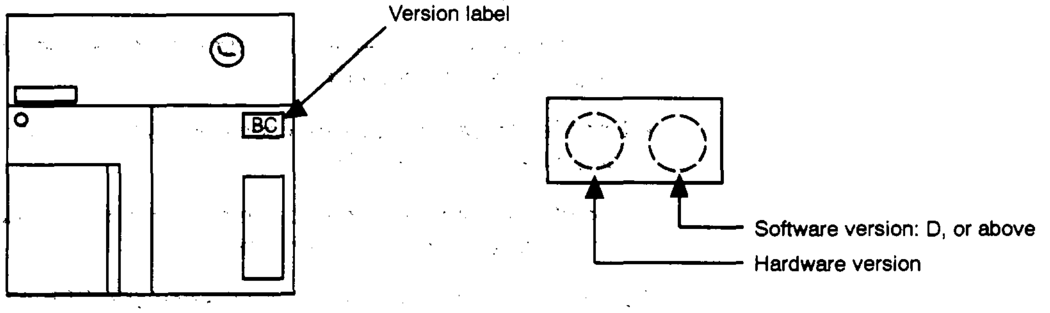
(7) Management of the present value when using an absolute encoder has been improved (for details, see Section 1.2.1).

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

1.2.1 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.)

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

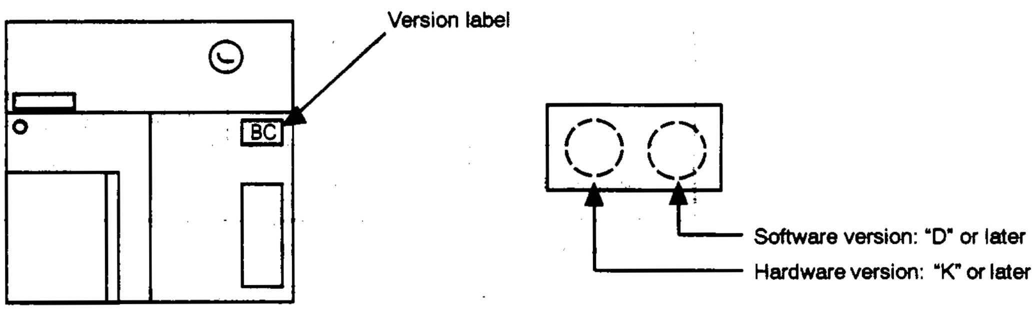
(4) Restrictions on the servo system CPU

[When using A171SCPU]

- CPU version

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

(A171SCPUs whose hardware version is "J" or earlier, or whose software version is "C" or earlier, cannot be used.)



[When using A273UHCPU]

- There are no restrictions due to the hardware.

1.3 Reference Materials

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

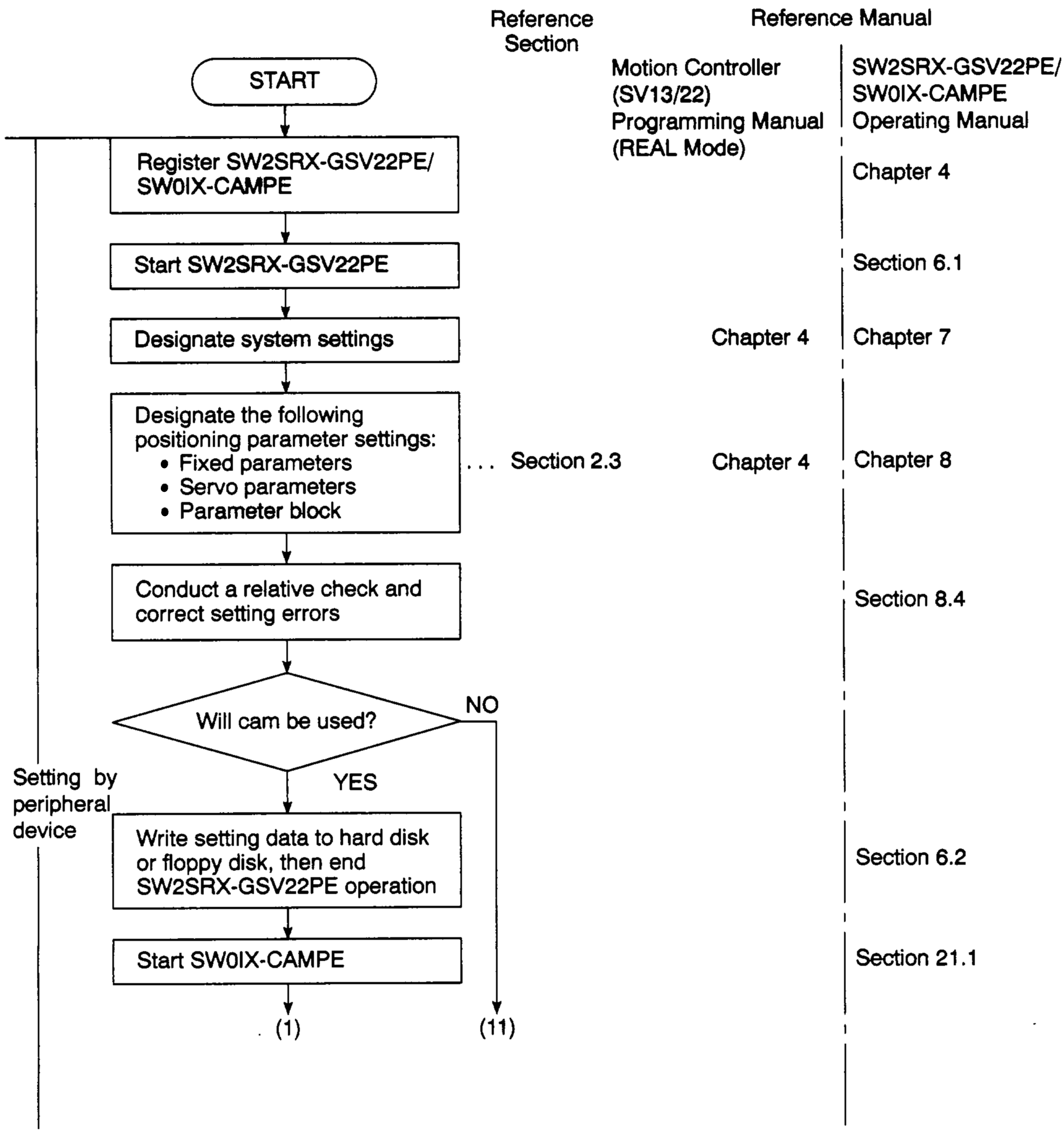
- Reference Manuals
  - For System Construction
    - Motion Controller [A171SCPU] User's Manual IB-67276
    - Motion Controller [A273UHCPU] User's Manual IB-67262
  - For REAL & VIRTUAL Mode Positioning Control
    - Motion Controller (SV13/22) Programming Manual (REAL Mode) IB-67265
    - Motion Controller (SV22) Programming Manual (VIRTUAL Mode) IB-67263
    - SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual IB-67264
  - For Sequence Program Creation
    - ACPU Programming Manual (Fundamentals) IB-66249
    - ACPU Programming Manual (Common Instructions) IB-66250
    - AnACPU/AnUCPU Programming Manual (Dedicated Instructions) IB-66251

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

(1)

Procedure	Reference Section	Reference Manual: Motion Controller (SV13/22) Programming Manual (REAL Mode)	Reference Manual: SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual
(11) → Designate cam data settings	Section 8.4		Chapter 22
Write setting data to hard disk or floppy disk, then end SW0IX-CAMPE operation			Section 21.2
Start SW2SRX-GSV22PE			Section 6.1
Create the mechanical system program	Chapter 5		Chapter 10
Check mechanical system program and correct setting errors			Section 10.2.5
Create the servo program	Section 2.3	Section 6 Section 7	
Switch the power supply module ON			
Write the following data from the peripheral device to the servo system CPU: • System setting data • Positioning data • Servo program • Mechanical device program • Cam data • Sequence program			Chapter 11
Turn the "PC READY" signal (M2000) ON	Section 4.2		
Execute an "all-axes servo START request" (switch M2042 ON)	Section 4.2		

(2)

2

(2)

Mode	Step	Reference Section	Reference Manual: Motion Controller (SV13/22) Programming Manual (REAL Mode)	Reference Manual: SW2SRX-GSV22PE/ SW0IX-CAMPE Operating Manual
REAL Mode	Start-up servo by peripheral device			Section 12.2
REAL Mode	Execute home position return test by JOG/manual pulse generator operation		Sections 7.19 to 7.21	Sections 12.4 to 12.6
REAL Mode	Adjust cam setting axis (bottom dead center, stroke amount adjustments, etc.)			
REAL Mode	VIRTUAL mode operation START position alignment	... Section 8.5		
REAL Mode	Designate data settings at parameter setting device	... Section 6 to 8		
VIRTUAL mode	Switch from REAL mode to VIRTUAL mode	... Section 9		
VIRTUAL mode	Designate operation START address by present value change procedure	... Appendix 4	Section 8.8	
VIRTUAL mode	Start drive module operation/motion	... Chapter 6		
VIRTUAL mode	Check operation status at servo monitor & mechanical device monitor			Chapter 13 Chapter 14
VIRTUAL mode	Execute clutch ON/OFF switching to check operation	... Section 7.2		
	END			

2.2 Operation

The preparation procedure for VIRTUAL mode operation is shown below.

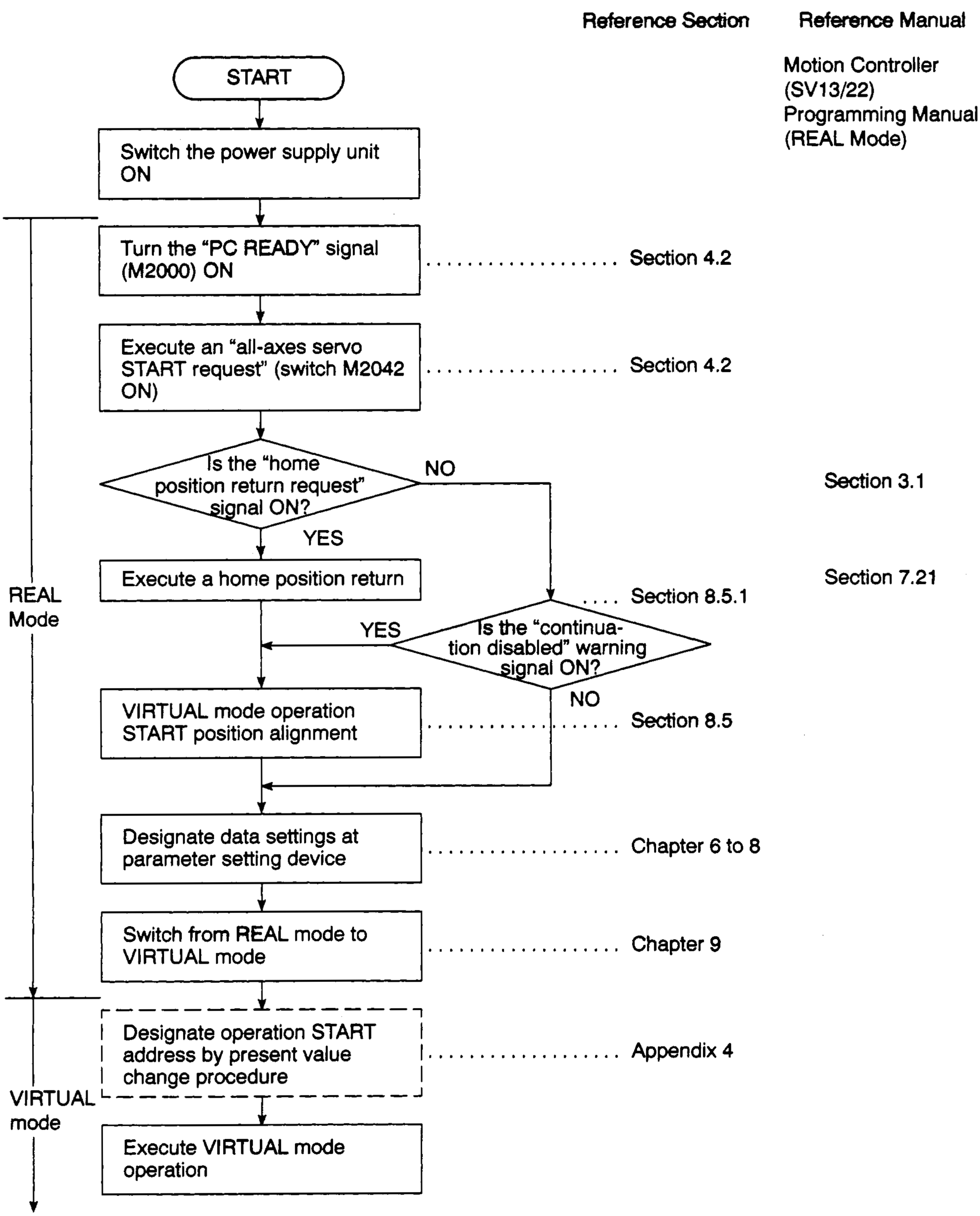
2.2.1 Operation with incremental system

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

Mode	Step	Reference Section	Reference Manual
	START		Motion Controller (SV13/22) Programming Manual (REAL Mode)
	Switch power supply unit ON		
REAL Mode	Turn the "PC READY" signal (M2000) ON	... Section 4.2	
REAL Mode	Execute an "all-axes servo START request" (switch M2042 ON)	... Section 4.2	
REAL Mode	Execute a home position return		Section 7.21
REAL Mode	VIRTUAL mode operation START position alignment	... Section 8.5	
REAL Mode	Designate data settings at parameter setting device	... Chapter 6 to 8	
REAL Mode	Switch from REAL mode to VIRTUAL mode	... Chapter 9	
VIRTUAL mode	Designate operation START address by present value change procedure	... Appendix 3	Section 8.8
VIRTUAL mode	Execute VIRTUAL mode operation		

2.2.2 Operation with an absolute (absolute position) system

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



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*1	X/Y0 - 17F
Internal relays	M1984 - M2047	
Special relays	M9073 - M9079	
Data registers	D800 - D1023	D670 - D1023
Special registers	D9180 - D9199	

(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

2.3.4 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

MEMO

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				

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%	
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		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)	

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

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

<table>
<tr><th colspan="2">Item</th><th colspan="5">PCPU Performance/Specifications</th></tr>
<tr><td colspan="2">Number of controlled axes</td><td colspan="5">8 axes (simultaneous control of 2-4 axes; individual control of 8 axes)</td></tr>
<tr><td colspan="2">Interpolation functions</td><td colspan="5">Linear interpolation (2, 3, 4 axes); Circular interpolation (2 axes)</td></tr>
<tr><td colspan="2">Control format</td><td colspan="5">PTP (Point-To-Point), speed control, fixed pitch feed, constant speed control, follow-up control, synchronous control</td></tr>
<tr><td colspan="2" rowspan="6">Control units</td><td rowspan="2">Drive module</td><td colspan="2">Virtual servomotor</td><td colspan="2" rowspan="2">Pulse</td></tr>
<tr><td colspan="2">Synchronous encoder</td></tr>
<tr><td rowspan="4">Output module</td><td colspan="2">Roller</td><td colspan="2" rowspan="2">mm, inch</td></tr>
<tr><td colspan="2">Ball screw</td></tr>
<tr><td colspan="2">Rotary table</td><td colspan="2">Fixed as "degrees"</td></tr>
<tr><td colspan="2">Cam</td><td colspan="2">mm, inch, pulse</td></tr>
<tr><td rowspan="4">Program</td><td>Language</td><td colspan="5">Dedicated instructions (servo program, mechanical system program)</td></tr>
<tr><td>Capacity</td><td colspan="5">13k steps (13312 steps)</td></tr>
<tr><td>Number of positioning points</td><td colspan="5">Approx. 800 points per axis (varies according to program).
Indirect designation of positioning data is also possible</td></tr>
<tr><td>Setting method</td><td colspan="5">Settings designated at IBM PC where SW2SRX/GSV22PE is started up.</td></tr>
<tr><td rowspan="18">Mechanical System Program</td><td rowspan="2"></td><td rowspan="2">Mechanical device module</td><td colspan="2" rowspan="2">Number of modules per servo system CPU</td><td colspan="2">Number of modules per block</td></tr>
<tr><td>At connected shaft</td><td>At auxiliary input shaft</td></tr>
<tr><td rowspan="2">Drive modules</td><td>Virtual servomotor</td><td>8</td><td rowspan="2">Total of 11</td><td rowspan="2">–</td><td rowspan="2">–</td></tr>
<tr><td>Synchronous encoder</td><td>3</td></tr>
<tr><td rowspan="2">Virtual axes</td><td>Virtual main shaft</td><td>8</td><td rowspan="2">Total of 16</td><td rowspan="2">–</td><td rowspan="2">–</td></tr>
<tr><td>Virtual auxiliary input shaft</td><td>8</td></tr>
<tr><td rowspan="6">Transmission modules</td><td>Gear</td><td colspan="2">16</td><td>1</td><td>1</td></tr>
<tr><td>Clutch</td><td colspan="2">16</td><td>1</td><td>1</td></tr>
<tr><td>Speed change gear</td><td colspan="2">16</td><td>1</td><td>1</td></tr>
<tr><td>Differential gear</td><td colspan="2">8</td><td>1</td><td>–</td></tr>
<tr><td rowspan="2">Differential gear (for connection to virtual main shaft)</td><td colspan="2" rowspan="2">8</td><td>Number of modules per system</td><td rowspan="2">–</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="4">Output modules</td><td>Cam</td><td>8</td><td rowspan="4">Total of 8</td><td colspan="2" rowspan="4">1</td></tr>
<tr><td>Roller</td><td>8</td></tr>
<tr><td>Ball screw</td><td>8</td></tr>
<tr><td>Rotary table</td><td>8</td></tr>
<tr><td rowspan="5">Cam</td><td>Types</td><td colspan="5">Max. of 64</td></tr>
<tr><td>Resolution per cycle</td><td colspan="5">256, 512, 1024, 2048</td></tr>
<tr><td>Memory capacity</td><td colspan="5">32k bytes (stored in block No.10 of memory cassette's extension file register area)*</td></tr>
<tr><td>Stroke amount resolution</td><td colspan="5">32767</td></tr>
<tr><td>Control modes</td><td colspan="5">Two-way cam, feed cam</td></tr>
<tr><td rowspan="4">Positioning</td><td>Method</td><td colspan="5">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</td></tr>
<tr><td rowspan="2">Position commands</td><td>Setting range</td><td colspan="4">–2147483648 - 2147483647 (pulse)</td></tr>
<tr><td>Max. setting value</td><td colspan="4">4294967296 (pulse)</td></tr>
<tr><td>Speed command (command unit)</td><td colspan="5">1 - 1000000 (pulse/s)</td></tr>
</table>

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%
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		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) 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 1	–
	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 Constant speed control . . . Absolute data method and incremental method can be used together Position follow-up control . Absolute data method				
	Position commands	Setting range	–2147483648 - 2147483647 (pulse)			
		Max. setting value	4294967296 (pulse)			
	Speed command (command unit)	1 - 1000000 (pulse/s)				

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) × 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.)

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

(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

(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) 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.

(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

4.2 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
M1984	Virtual axis No.1 drive clutch ON/OFF status	
M1985	Virtual axis No.1 auxiliary input shaft clutch ON/OFF status	
M1986	Virtual axis No.2 drive clutch ON/OFF status	
M1987	Virtual axis No.2 auxiliary input shaft clutch ON/OFF status	PCPU → SCPU
M1988	Virtual axis No.3 drive clutch ON/OFF status	
M1989	Virtual axis No.3 auxiliary input shaft clutch ON/OFF status	
M1990	Virtual axis No.4 drive clutch ON/OFF status	
M1991	Virtual axis No.4 auxiliary input shaft clutch ON/OFF status	
M1992 - M1999	Unusable	–
M2000	PC READY	SCPU → PCPU
M2001	Virtual axis No.1 START accept flag	
M2002	Virtual axis No.2 START accept flag	PCPU → SCPU
M2003	Virtual axis No.3 START accept flag	
M2004	Virtual axis No.4 START accept flag	
M2005 - M2008	Unusable	–
M2009	All-axes servo START accept flag	PCPU → SCPU
M2010	Unusable	–
M2011		
M2012	Manual pulse generator enabled flag	SCPU → PCPU

Device No.	Signal Name	Signal Direction
M2013	Unusable	–
M2014		
M2015	JOG simultaneous START command	SCPU → PCPU
M2016 - M2019	Unusable	–
M2020	START buffer full	
M2021	Virtual axis No.1 speed change in progress flag	
M2022	Virtual axis No.2 speed change in progress flag	PCPU → SCPU
M2023	Virtual axis No.3 speed change in progress flag	
M2024	Virtual axis No.4 speed change in progress flag	
M2025 - M2030	Unusable	–
M2031	Synchronous encoder (P1) axis present value change in progress	PCPU → SCPU
M2032 - M2039	Unusable	–
M2040	Speed switching point designation flag	SCPU → PCPU
M2041	System setting error flag	PCPU → SCPU
M2042	All-axes servo START command flag	SCPU → PCPU
M2043	REAL/VIRTUAL mode switching request	
M2044	REAL/VIRTUAL mode status	
M2045	REAL/VIRTUAL mode switching error detection	PCPU → SCPU
M2046	Synchronization discrepancy warning flag	
M2047	Motion slot error detection flag	

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.

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

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.

(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	
M2001	Virtual axis No. 1 START accept flag		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	PCPU → SCPU
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	PCPU → SCPU	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	
M2015	Virtual axis No. 15 START accept flag		M2045	REAL/VIRTUAL mode switching error detection	PCPU → SCPU
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	
M2018	Virtual axis No. 18 START accept flag		M2048	JOG simultaneous START command	SCPU → PCPU
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	
M2022	Virtual axis No. 22 START accept flag		M2052	Manual pulse generator No. 2 enabled flag	SCPU → PCPU
M2023	Virtual axis No. 23 START accept flag		M2053	Manual pulse generator No. 3 enabled flag	

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	

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		M2159	Virtual axis No.32 automatic deceleration in progress flag	
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	PCPU → SCPU	M2173	Virtual axis No.7 auxiliary input shaft clutch ON/OFF status	PCPU → SCPU
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 p8ogress 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	

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	

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.

4.2.1 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.

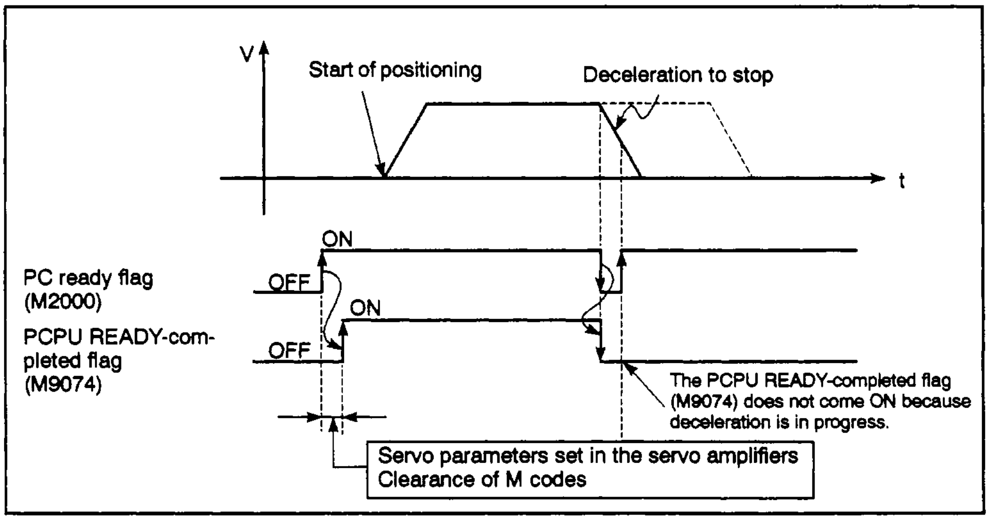
3) The default value of 300% is set in the torque limit value storage area.

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) When M2000 turns OFF, the following processing is executed.

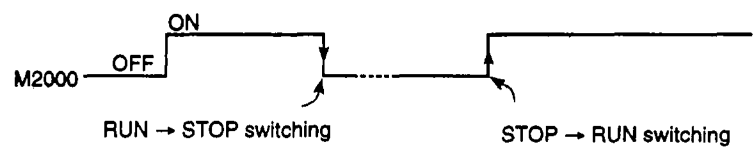
(a) Processing details

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.

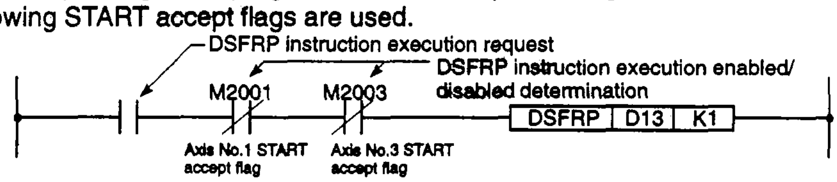


4.2.2 Virtual servomotor START accept flags (M2001 - M2004/M2001 - M2008/M2001 - M2032) .... Signals from PCPU to SCPU

(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.

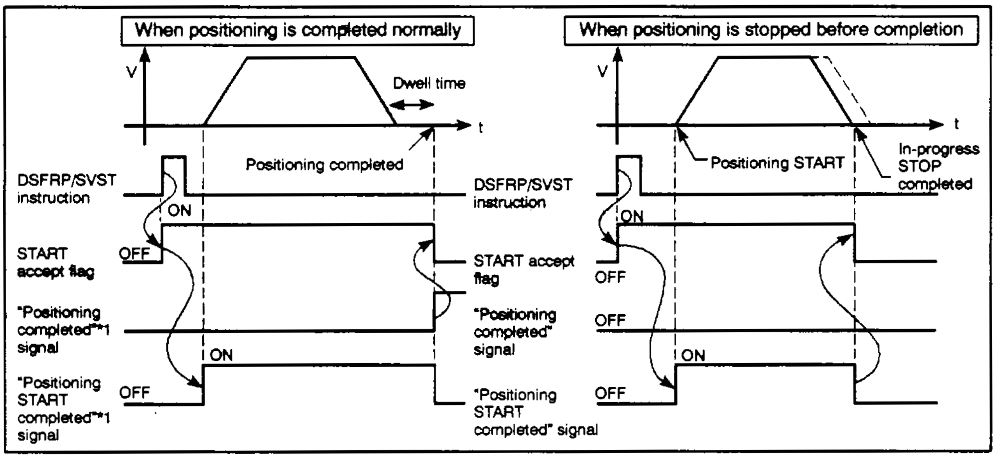
[Ex] When A273UHCPU (8-axis Specification) is Used

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



(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

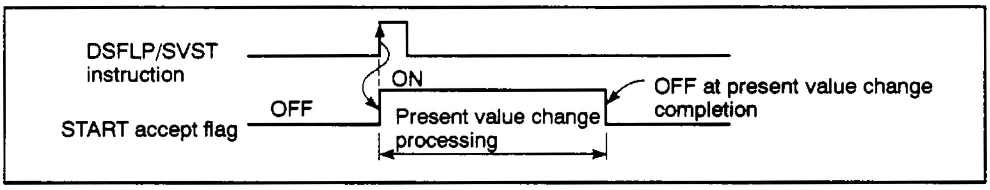
(1) *1: For details regarding the "positioning START completed" and "positioning completed" signals, see Section 8.5.1.

(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.



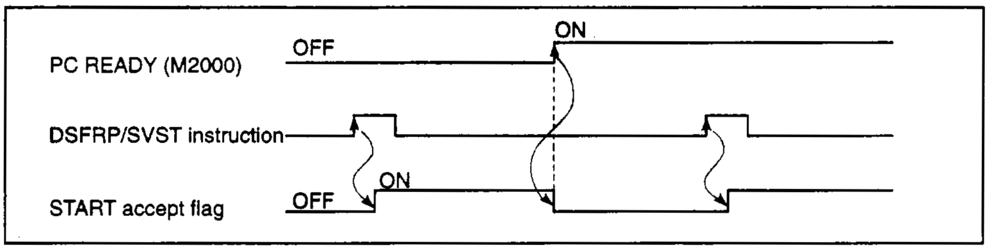
POINTS

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.

(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

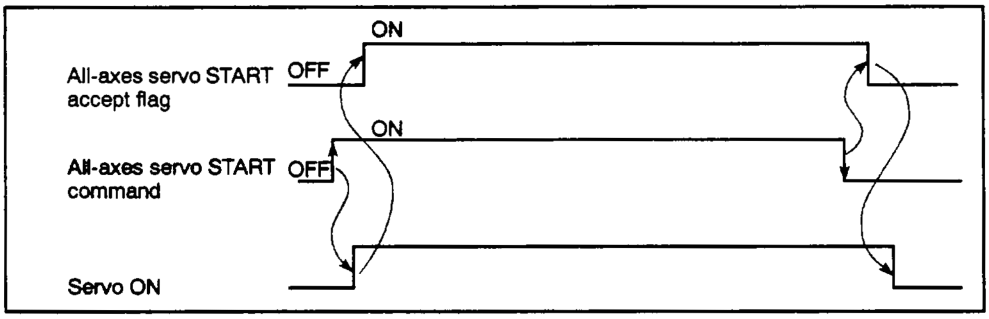
(1) *1: For details regarding JOG operation commands, see Section 6.3.1.

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

4.2.3 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.

4.2.6 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.

4.2.8 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.

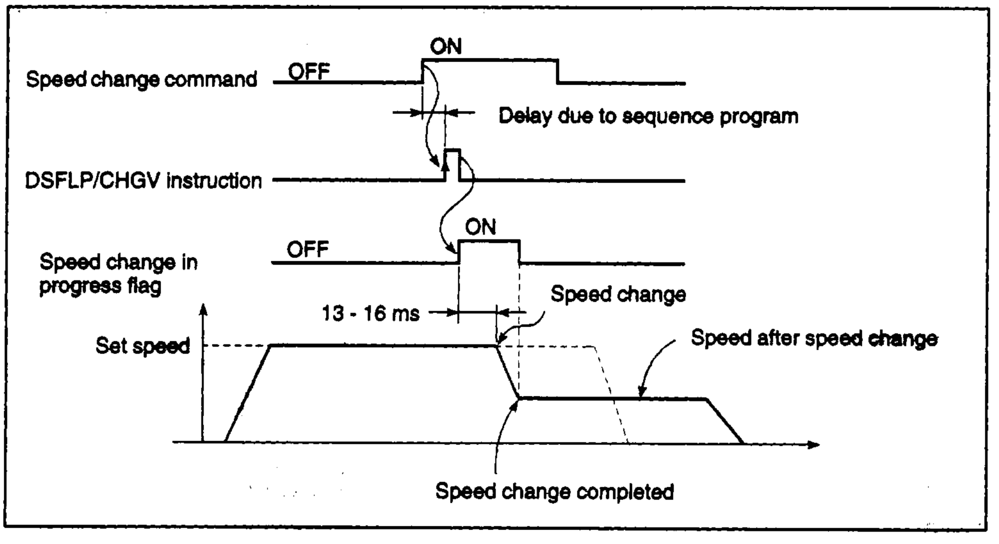
4.2.9 START buffer full (M2020/M2020/M2050) .... Signal sent from PCPU to SCPU

(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

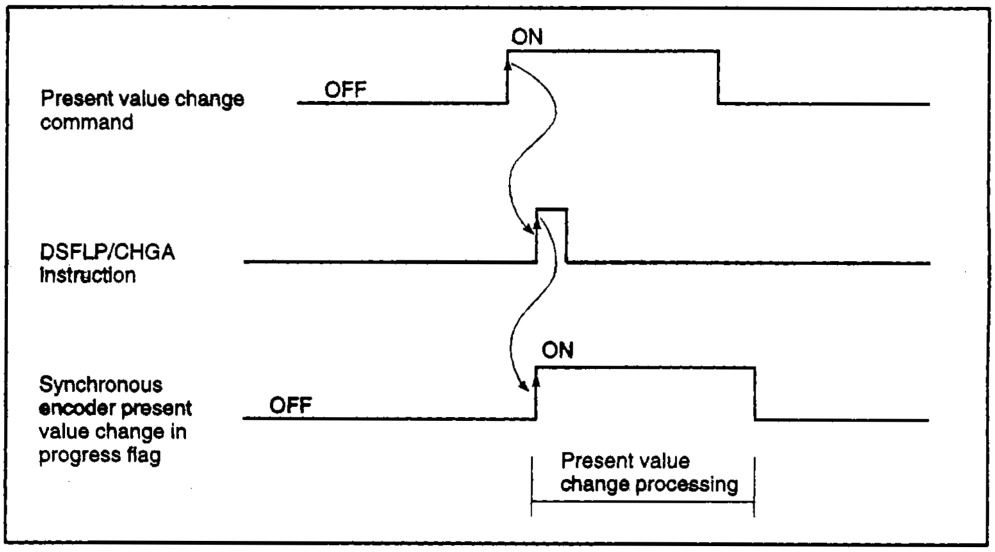
This flag switches ON when a speed change (designated by a control change (DSFLP/CHGV) instruction at the sequence program) is in progress. This flag should be used for speed change program interlock purposes.



4.2.11 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.

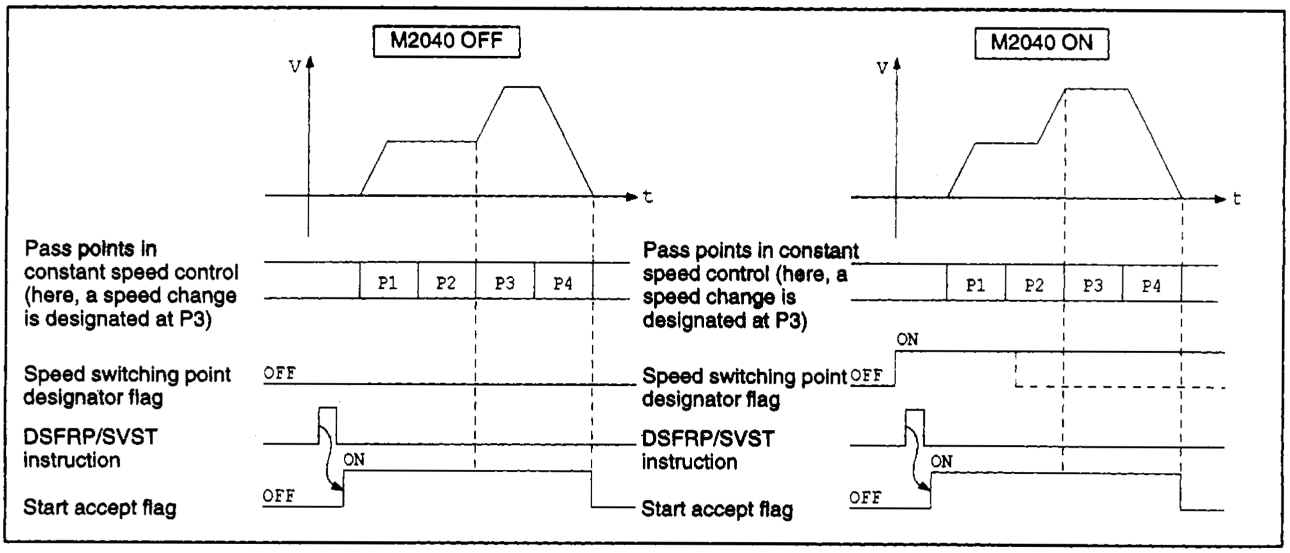
This flag should be used for synchronous encoder present value change program interlock purposes.



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.

4.2.13 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

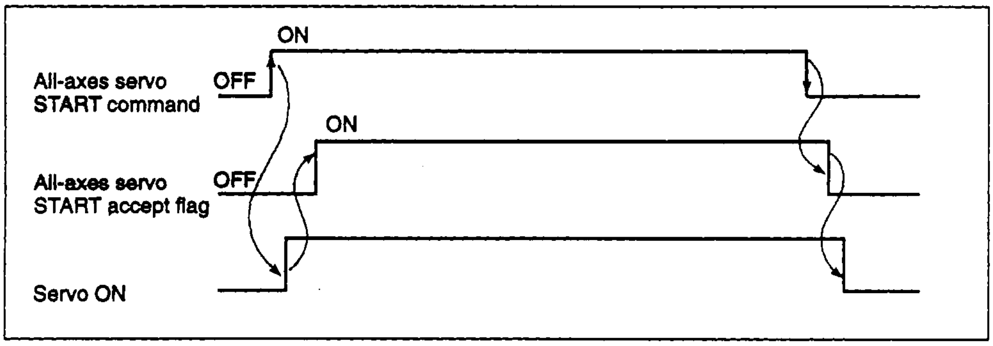
A slot designated as "not used" at the system setting data will be regarded as "not used" even if loaded with a module.

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 2042 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.

4.2.15 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.

4.2.18 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.

4.2.19 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.

```
SL00 UNIT ERROR
  └─ I/O slot No. (0 - 7)
 └── Basic unit No.
     0: Base unit
     1: Motion extension base unit
        (1st extension stage)
     2: Motion extension base unit
        (2nd extension stage)      Displayed only when
     3: Motion extension base unit A273UHCPU (32-axis
        (3rd extension stage)      specification) is used.
     4: Motion extension base unit
        (4th extension stage)
```

(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.

4.2.20 Automatic deceleration in progress flag (M2128 - M2159): When A273UHCPU 32-axis specification is used .... Signal sent from PCPU to SCPU

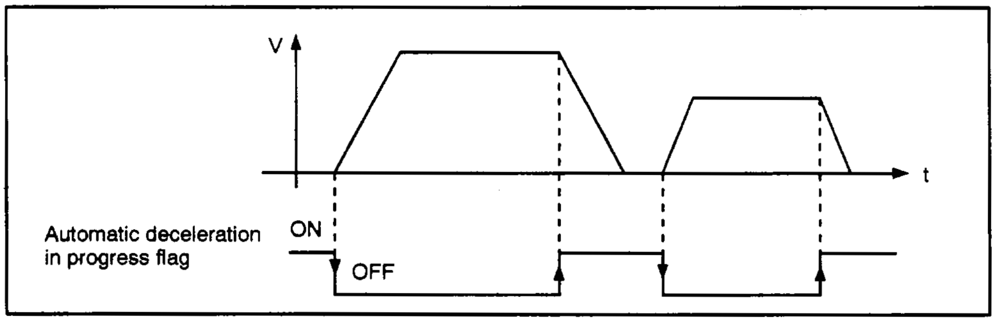
This signal is ON when automatic deceleration processing occurs in virtual servomotor axis positioning or position follow-up control operations.

(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".



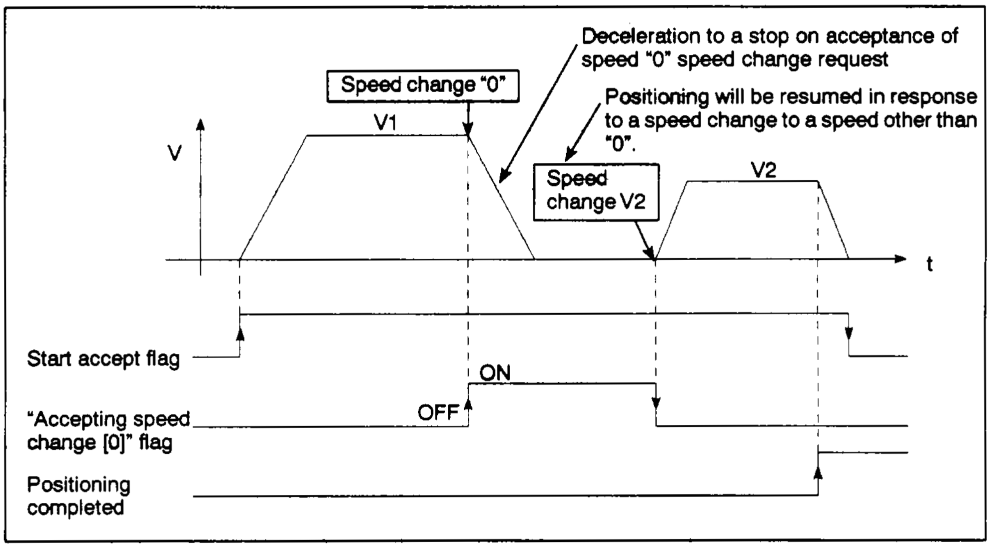
(4) The "automatic deceleration in progress flags" are shown below.

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

4.2.21 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

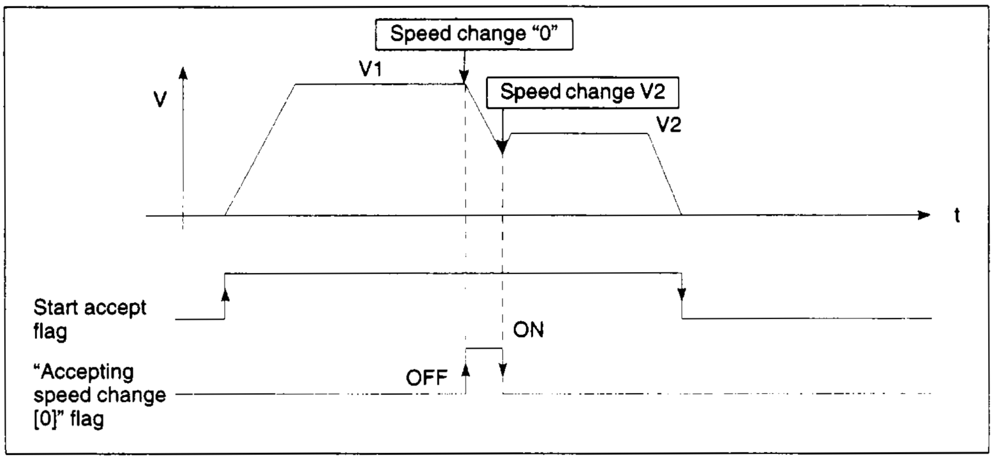
POINTS

(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.

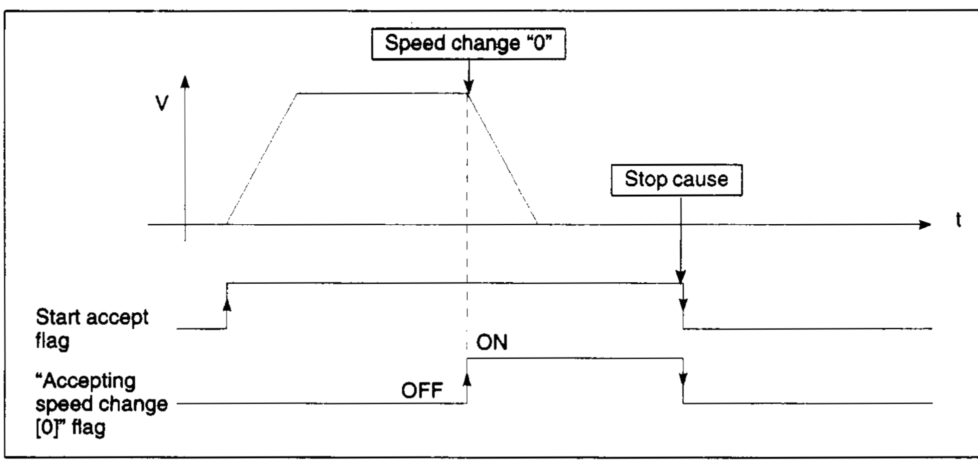
(2) During interpolation operations, the "speed change "0" accept flag" is designated for the interpolation axes.

(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.

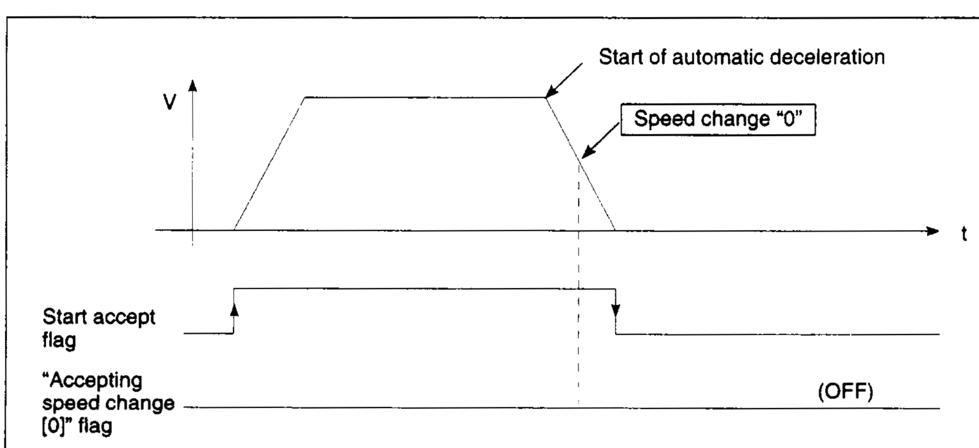
(4) If another speed change request designating a speed other than "0" occurs during a deceleration and stop due to a speed change request for speed "0", the "speed change "0" accept flag" will switch OFF.



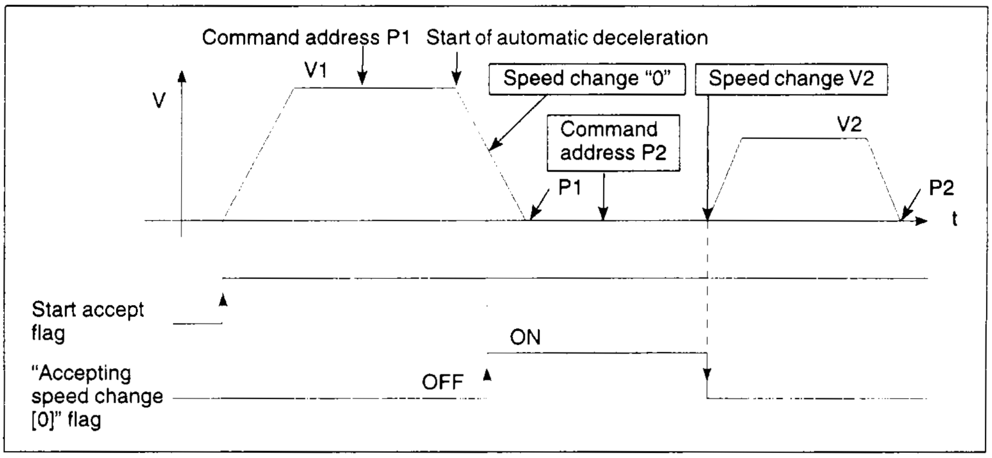
(5) If a stop cause occurs after a speed change request for speed "0" has been accepted, the "speed change "0" accept flag" will switch OFF.



(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.



(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.

4.3 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).

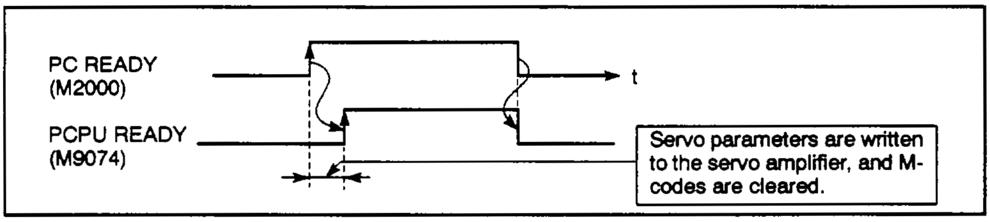
4.3.2 PCPU READY flag (M9074) .... Signal sent from PCPU to SCPU

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.



4.3.3 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).

4.3.7 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.

REMARKS

*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.

4.4 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

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

(1) 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 - LY1F indicates the limit switch output.

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

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

(1) 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 - LY3F indicates the limit switch output.

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

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D760	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D761	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							
D762	LY2F	LY2E	LY2D	LY2C	LY2B	LY2A	LY29	LY28	LY27	LY26	LY25	LY24	LY23	LY22	LY21	LY20
	For axis 6								For axis 5							
D763	LY3F	LY3E	LY3D	LY3C	LY3B	LY3A	LY39	LY38	LY37	LY36	LY35	LY34	LY33	LY32	LY31	LY30
	For axis 8								For axis 7							
D764	LY4F	LY4E	LY4D	LY4C	LY4B	LY4A	LY49	LY48	LY47	LY46	LY45	LY44	LY43	LY42	LY41	LY40
	For axis 10								For axis 9							
D765	LY5F	LY5E	LY5D	LY5C	LY5B	LY5A	LY59	LY58	LY57	LY56	LY55	LY54	LY53	LY52	LY51	LY50
	For axis 12								For axis 11							
D766	LY6F	LY6E	LY6D	LY6C	LY6B	LY6A	LY69	LY68	LY67	LY66	LY65	LY64	LY63	LY62	LY61	LY60
	For axis 14								For axis 13							
D767	LY7F	LY7E	LY7D	LY7C	LY7B	LY7A	LY79	LY78	LY77	LY76	LY75	LY74	LY73	LY72	LY71	LY70
	For axis 16								For axis 15							
D768	LY8F	LY8E	LY8D	LY8C	LY8B	LY8A	LY89	LY88	LY87	LY86	LY85	LY84	LY83	LY82	LY81	LY80
	For axis 18								For axis 17							
D769	LY9F	LY9E	LY9D	LY9C	LY9B	LY9A	LY99	LY98	LY97	LY96	LY95	LY94	LY93	LY92	LY91	LY90
	For axis 20								For axis 19							
D770	LYAF	LYAE	LYAD	LYAC	LYAB	LYAA	LYA9	LYA8	LYA7	LYA6	LYA5	LYA4	LYA3	LYA2	LYA1	LYA0
	For axis 22								For axis 21							
D771	LYBF	LYBE	LYBD	LYBC	LYBB	LYBA	LYB9	LYB8	LYB7	LYB6	LYB5	LYB4	LYB3	LYB2	LYB1	LYB0
	For axis 24								For axis 23							
D772	LYCF	LYCE	LYCD	LYCC	LYCB	LYCA	LYC9	LYC8	LYC7	LYC6	LYC5	LYC4	LYC3	LYC2	LYC1	LYC0
	For axis 26								For axis 25							
D773	LYDF	LYDE	LYDD	LYDC	LYDB	LYDA	LYD9	LYD8	LYD7	LYD6	LYD5	LYD4	LYD3	LYD2	LYD1	LYD0
	For axis 28								For axis 27							
D774	LYEF	LYEE	LYED	LYEC	LYEB	LYEA	LYE9	LYE8	LYE7	LYE6	LYE5	LYE4	LYE3	LYE2	LYE1	LYE0
	For axis 30								For axis 29							
D775	LYFF	LYFE	LYFD	LYFC	LYFB	LYFA	LYF9	LYF8	LYF7	LYF6	LYF5	LYF4	LYF3	LYF2	LYF1	LYF0
	For axis 32								For axis 31							

(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.

4.5 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

(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

(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

4.5.1 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]

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

- A setting of "1" or "0" is stored at each D9180 - D9181 bit.
  ON 1
  OFF 0

REMARK

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

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

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

- A setting of "1" or "0" is stored at each D9180 - D9183 bit.
  ON 1
  OFF 0

REMARK

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

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

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D776	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D777	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							
D778	LY2F	LY2E	LY2D	LY2C	LY2B	LY2A	LY29	LY28	LY27	LY26	LY25	LY24	LY23	LY22	LY21	LY20
	For axis 6								For axis 5							
D779	LY3F	LY3E	LY3D	LY3C	LY3B	LY3A	LY39	LY38	LY37	LY36	LY35	LY34	LY33	LY32	LY31	LY30
	For axis 8								For axis 7							
D780	LY4F	LY4E	LY4D	LY4C	LY4B	LY4A	LY49	LY48	LY47	LY46	LY45	LY44	LY43	LY42	LY41	LY40
	For axis 10								For axis 9							
D781	LY5F	LY5E	LY5D	LY5C	LY5B	LY5A	LY59	LY58	LY57	LY56	LY55	LY54	LY53	LY52	LY51	LY50
	For axis 12								For axis 11							
D782	LY6F	LY6E	LY6D	LY6C	LY6B	LY6A	LY69	LY68	LY67	LY66	LY65	LY64	LY63	LY62	LY61	LY60
	For axis 14								For axis 13							
D783	LY7F	LY7E	LY7D	LY7C	LY7B	LY7A	LY79	LY78	LY77	LY76	LY75	LY74	LY73	LY72	LY71	LY70
	For axis 16								For axis 15							
D784	LY8F	LY8E	LY8D	LY8C	LY8B	LY8A	LY89	LY88	LY87	LY86	LY85	LY84	LY83	LY82	LY81	LY80
	For axis 18								For axis 17							
D785	LY9F	LY9E	LY9D	LY9C	LY9B	LY9A	LY99	LY98	LY97	LY96	LY95	LY94	LY93	LY92	LY91	LY90
	For axis 20								For axis 19							
D786	LYAF	LYAE	LYAD	LYAC	LYAB	LYAA	LYA9	LYA8	LYA7	LYA6	LYA5	LYA4	LYA3	LYA2	LYA1	LYA0
	For axis 22								For axis 21							
D787	LYBF	LYBE	LYBD	LYBC	LYBB	LYBA	LYB9	LYB8	LYB7	LYB6	LYB5	LYB4	LYB3	LYB2	LYB1	LYB0
	For axis 24								For axis 23							
D788	LYCF	LYCE	LYCD	LYCC	LYCB	LYCA	LYC9	LYC8	LYC7	LYC6	LYC5	LYC4	LYC3	LYC2	LYC1	LYC0
	For axis 26								For axis 25							
D789	LYDF	LYDE	LYDD	LYDC	LYDB	LYDA	LYD9	LYD8	LYD7	LYD6	LYD5	LYD4	LYD3	LYD2	LYD1	LYD0
	For axis 28								For axis 27							
D790	LYEF	LYEE	LYED	LYEC	LYEB	LYEA	LYE9	LYE8	LYE7	LYE6	LYE5	LYE4	LYE3	LYE2	LYE1	LYE0
	For axis 30								For axis 29							
D791	LYFF	LYFE	LYFD	LYFC	LYFB	LYFA	LYF9	LYF8	LYF7	LYF6	LYF5	LYF4	LYF3	LYF2	LYF1	LYF0
	For axis 32								For axis 31							

* A setting of "1" or "0" is stored at each D776 - D791 bit.
ON 1
OFF 0

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	CPU error in AC motor drive module 1 0 0 Indicates the slot number (0 - 7) of the AC motor drive module where the error occurred. Base information for the AC motor drive module where the error occurred. 0: Main base unit 1: Motion extension base unit (stage 1)	The servo error detected flag (X0n8) for the relevant axis comes ON and the servo OFF status is established. Thereafter, operation follows the setting for action to take in the event of an ADU servo error made in the system settings.	Reset with the reset key. If the error reoccurs after resetting, the ADU is probably faulty: replace it.
200 - 207 210 - 217	Hardware error in module installed in the motion main base unit or motion extension base unit 2 0 0 Indicates the slot number (0 - 7) of the module where the error occurred. Base information for the module where the error occurred. 0: Main base unit 1: Motion extension base unit (stage 1)	All axes stop immediately, after which operation cannot be started.	Reset with the reset key. If the error reoccurs after resetting, the relevant module or the relevant slot (base unit) is probably faulty: replace the module/base unit.

Error Code	Error Cause	Operation When Error Occurs	Action to Take
250 - 251	Hardware error in MR-□-B separate servo amplifier interface 2 5 0 └ 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 reoccurs 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.

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

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

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

	b15 - b12	b11 - b8	b7 - b4	b3 - b0
D9185	Axis 4	Axis 3	Axis 2	Axis 1

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

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

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

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

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

	b15 - b12	b11 - b8	b7 - b4	b3 - b0
D792	Axis 4	Axis 3	Axis 2	Axis 1
D793	Axis 8	Axis 7	Axis 6	Axis 5
D794	Axis 12	Axis 11	Axis 10	Axis 9
D795	Axis 16	Axis 15	Axis 14	Axis 13
D796	Axis 20	Axis 19	Axis 18	Axis 17
D797	Axis 24	Axis 23	Axis 22	Axis 21
D798	Axis 28	Axis 27	Axis 26	Axis 25
D799	Axis 32	Axis 31	Axis 30	Axis 29

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

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.

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

- Stores axis setting errors for manual pulse generator connected to A171SENC.
  - 0: Normal
  - 1: Setting error (Axis setting outside the 1 - 4 range)
- All set to "0".
- Stores smoothing magnification setting errors for the manual pulse generator connected to the A171SENC.
  - 0: Normal
  - 1: Setting error (Magnification setting for each unit outside the range 1 - 59)
- All set to "0"
- 1-pulse input magnification setting errors stored for each axis.
  - 0: Normal
  - 1: Setting error (Input magnification setting outside the 1 - 100 range)
- All set to "0"

(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.

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

b2 to b0: Stores axis setting errors for manual pulse generators connected to the A273EX (P1 - P3).
0: Normal
1: Setting error
(Axis setting outside the 1 - 8 range)

b5 to b3: Stores smoothing magnification setting errors for the manual pulse generator connected to the A273EX (P1 - P3).
0: Normal
1: Setting error
(Magnification setting outside the 1 - 59 range)

b7, b6: All set to "0"

b15 to b8: 1-pulse input magnification setting errors stored for each axis.
0: Normal
1: Setting error
(Input magnification setting outside the 1 - 100 range)

(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.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9185	0	0	0	0	0	0	0	0	0	0	P3	P2	P1	P3	P2	P1

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

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9186	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D9187	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

1-pulse input magnification setting errors stored for each axis.
0: Normal
1: Setting error
(Input magnification setting outside the 1 - 100 range)

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

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

- b0 - b3: The OPERATING/STOPPED status of each axis is stored.
  0: Stopped
  1: Operating
- b4 - b15: All set to "0".

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

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

b7–b0 → The OPERATING/STOPPED status of each axis is stored.
0: Stopped
1: Operating

b15–b8 → All set to "0".

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

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9182	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D9183	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

→ The OPERATING/STOPPED status of each axis is stored.
0: Stopped
1: Operating

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.

4.5.7 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).

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

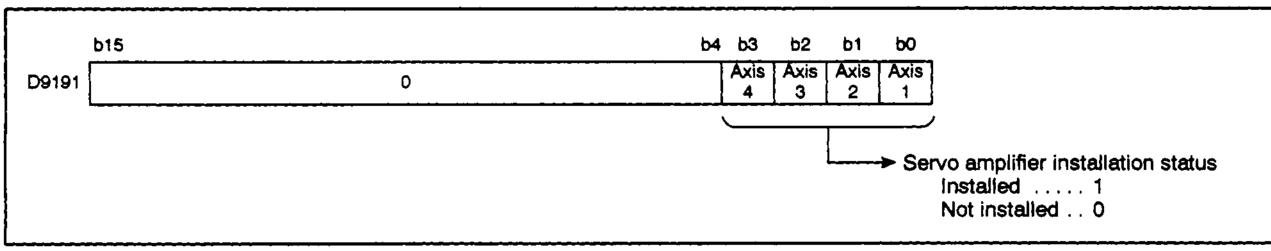
.... **Data sent from PCPU to SCPU**

(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

(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.

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

Servo amplifier installation status (b7 to b0)
Installed 1
Not installed .. 0

(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

(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.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9191	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D9192	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

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

(a) Servo amplifier installation status

1) Installed/not installed status

- Installed .... 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

4.5.9 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	

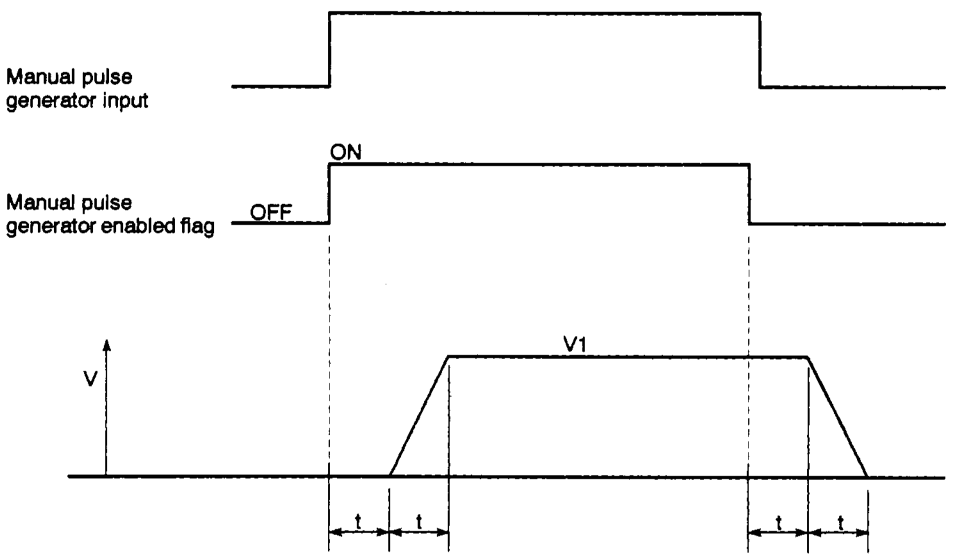
<A273UHCPU (32-axis)>

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.

Smoothing time constant (t) = [Smoothing magnification + 1] × 56.8 (ms)

(3) Operation



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

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

REMARK

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

Setting units:	mm	: 0.1 μm
	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

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.

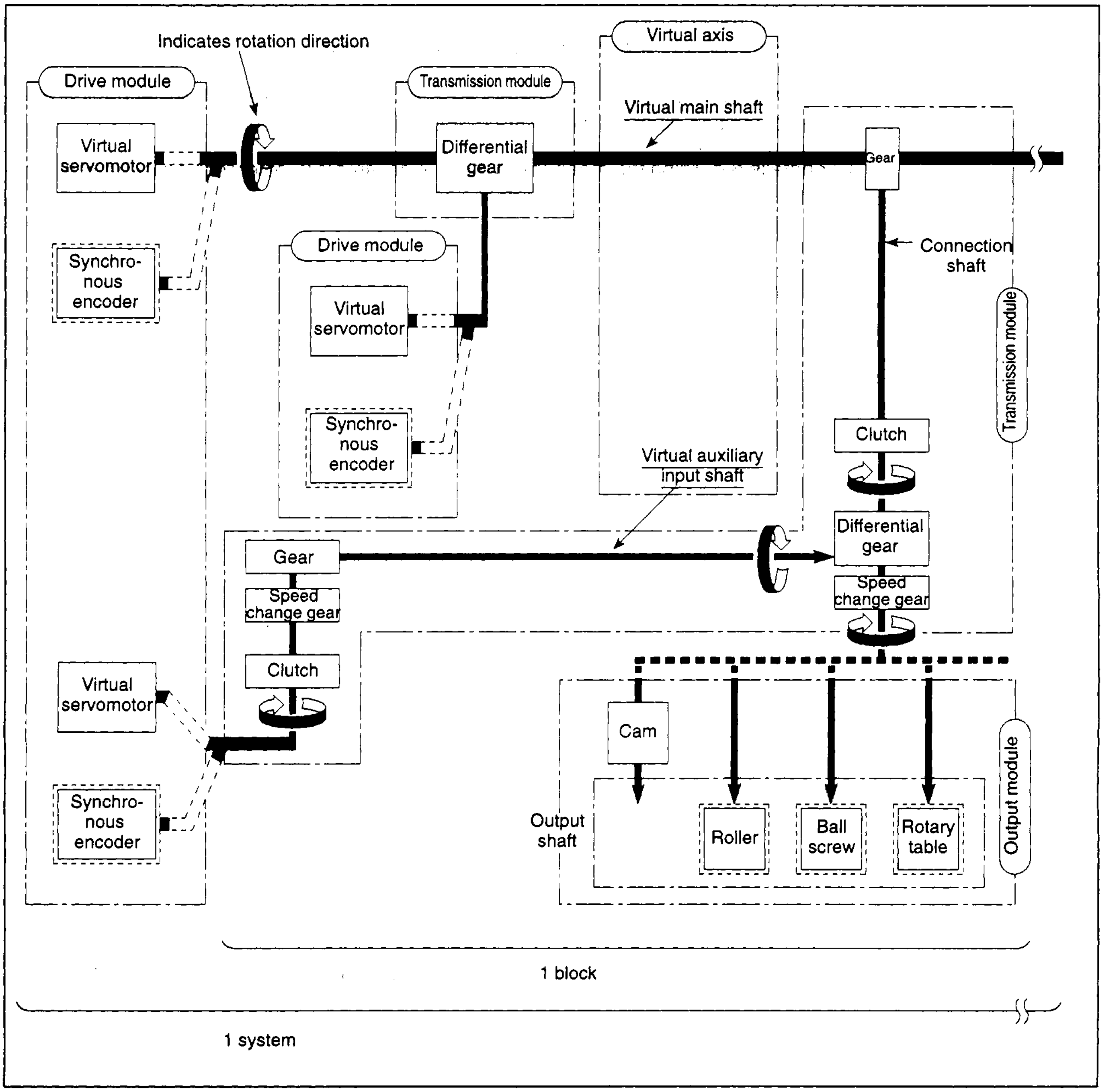


Fig. 5.1 Mechanical Module Connection Configuration

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.

(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.

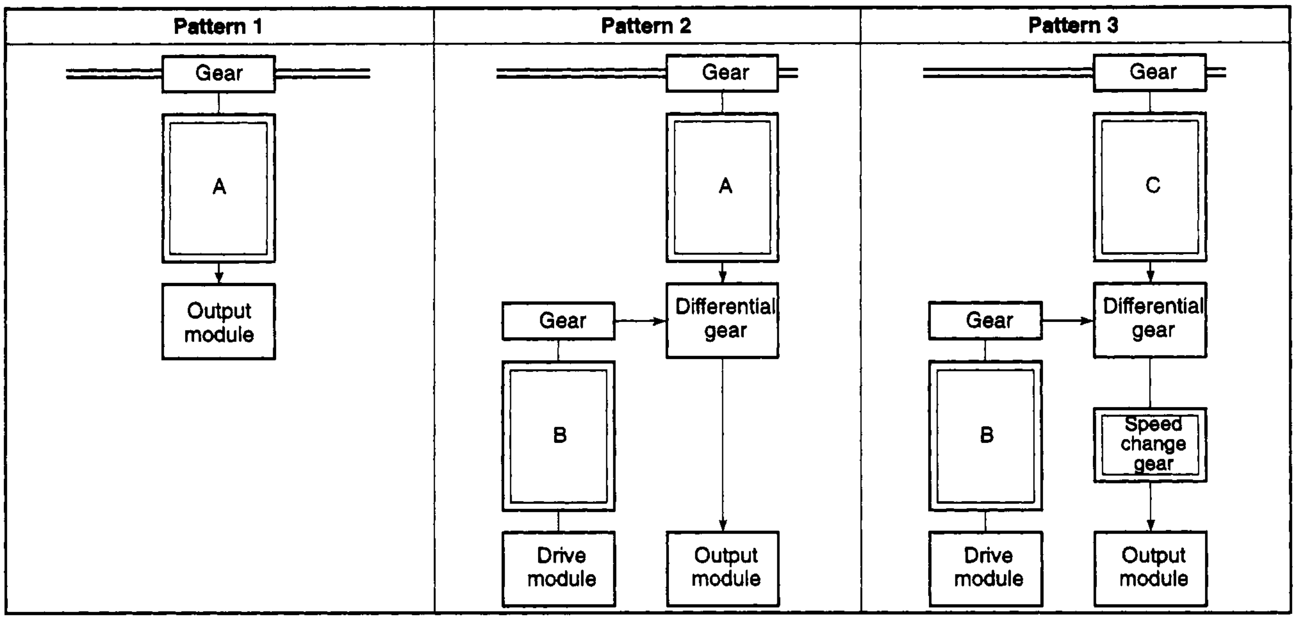
(2) System

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:

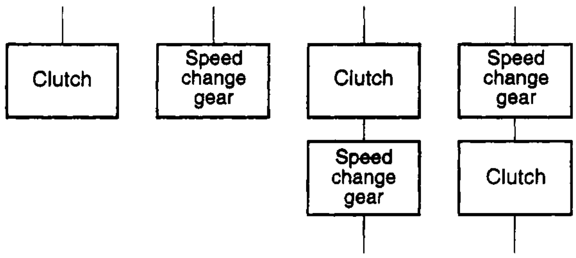
- Pattern 1 ..... Without a differential gear.
- Pattern 2 ..... Without a speed change gear at the output side of the differential gear.
- Pattern 3 ..... With a speed change gear at the output side of the differential gear.



(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".

5.2 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)

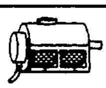
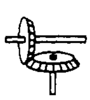
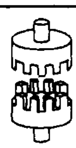
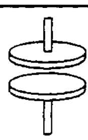
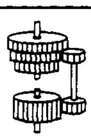
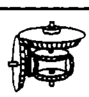
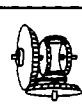
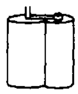
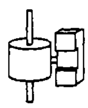
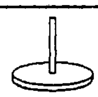
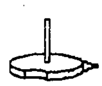
Classification	Mechanical Module: Name	Mechanical Module: Appearance	Max. Number Used: Number Per Servo System CPU		Max. Number Used: Number Per System		Number Per Block: Connection Shaft Side	Number Per Block: Auxiliary Input Shaft Side	Function Description	Reference Section
Drive module	Virtual servo 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. • 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		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)	

Table 5.1 Mechanical Module List (for A171SCPU) (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	Roller		4	Total of 4	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				• 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. • There are 2 cam control modes: the two-way cam mode, and the feed cam mode.	Section 8.4

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

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

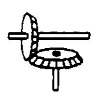
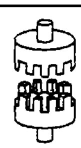
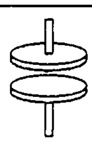
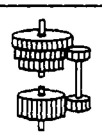
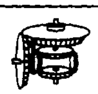
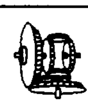
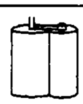
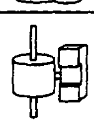
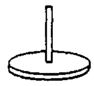
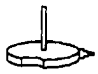
Classification	Mechanical Module: Name	Mechanical Module: Appearance	Max. Number Used: Number Per Servo System CPU		Max. Number Used: Number Per System		Number Per Block: Connection Shaft Side	Number Per Block: Auxiliary Input Shaft Side	Function Description	Reference Section
Drive module	Virtual servo 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		–	–	• 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. • 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		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		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

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

<table>
<tr><th rowspan="3">Classi-fication</th><th colspan="2">Mechanical Module</th><th colspan="6">Max. Number Used</th><th rowspan="3">Function Description</th><th rowspan="3">Refer-ence Section</th></tr>
<tr><th rowspan="2">Name</th><th rowspan="2">Appearance</th><th rowspan="2" colspan="2">Number Per Servo System CPU</th><th rowspan="2" colspan="2">Number Per System</th><th colspan="2">Number Per Block</th></tr>
<tr><th>Con-nec-tion Shaft Side</th><th>Aux-iliary Input Shaft Side</th></tr>
<tr><td rowspan="2">Output module</td><td>Rotary table</td><td></td><td>8</td><td rowspan="2">Total of 8</td><td>8</td><td rowspan="2">Total of 8</td><td rowspan="2">1</td><td rowspan="2">1</td><td>• Used when angle control occurs at the final output shaft.</td><td>Section 8.3</td></tr>
<tr><td>Cam</td><td></td><td>8</td><td>8</td><td>• 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.
• There are 2 cam control modes: the two-way cam mode, and the feed cam mode.</td><td>Section 8.4</td></tr>
</table>

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

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

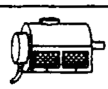
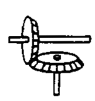
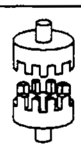
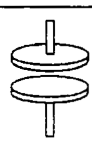
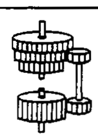
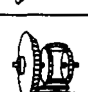
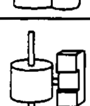
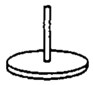
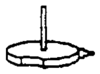
Classification	Mechanical Module: Name	Mechanical Module: Appearance	Max. Number Used: Number Per Servo System CPU	Max. Number Used: Number Per System	Number Per Block: Connection Shaft Side	Number Per Block: Auxiliary Input Shaft Side	Function Description	Reference Section
Drive module	Virtual servo 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	–	–	• This is a virtual "link shaft". • Drive module rotation is transferred to the transmission module.	–
	Virtual auxiliary input shaft	–	32	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.	Section 7.4
				4	–		• 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		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

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

<table>
<tr><th rowspan="3">Classification</th><th colspan="2">Mechanical Module</th><th colspan="6">Max. Number Used</th><th rowspan="3">Function Description</th><th rowspan="3">Reference Section</th></tr>
<tr><th rowspan="2">Name</th><th rowspan="2">Appearance</th><th rowspan="2" colspan="2">Number Per Servo System CPU</th><th rowspan="2" colspan="2">Number Per System</th><th colspan="2">Number Per Block</th></tr>
<tr><th>Connection Shaft Side</th><th>Auxiliary Input Shaft Side</th></tr>
<tr><td rowspan="2">Output module</td><td>Rotary table</td><td></td><td>32</td><td rowspan="2">Total of 32</td><td>32</td><td rowspan="2">Total of 32</td><td rowspan="2">1</td><td rowspan="2">1</td><td>• Used when angle control occurs at the final output shaft.</td><td>Section 8.3</td></tr>
<tr><td>Cam</td><td></td><td>32</td><td>32</td><td>• 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.
• There are 2 cam control modes: the two-way cam mode, and the feed cam mode.</td><td>Section 8.4</td></tr>
</table>

6. DRIVE MODULE

The drive module drives the virtual axis. There are 2 types of drive module:

- Virtual servo motor .... See Section 6.1
- Synchronous encoder .... See Section 6.2

6.1 Virtual Servo Motor

The virtual servo motor is used to control the virtual axis by servo program or by JOG operation. Virtual servo motor operation and parameters are discussed below.

6.1.1 Virtual servo motor operation

(1) START procedure

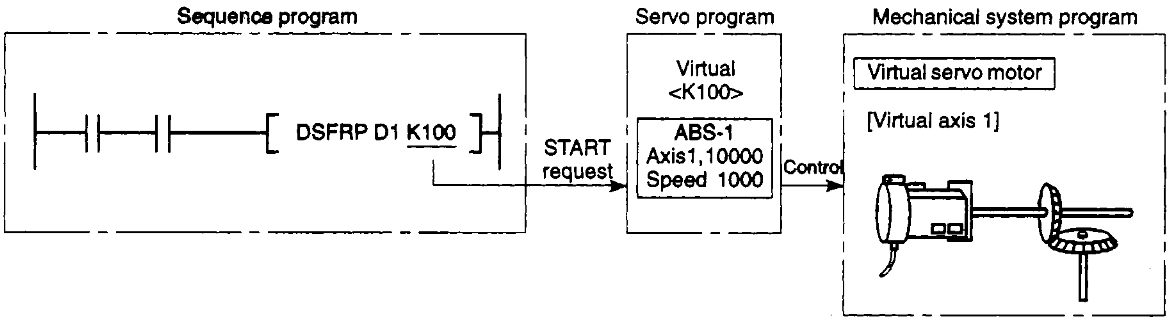
The virtual servo motor is started by the servo program or by JOG operation.

(a) START by servo program

The servo program is started by a sequence program DSFRP/SVST instruction. The start accept flag *1 (M2001 - M2004/M2001 - M2008/M2001 - M2032) of the designated axis will then switch ON.

For details regarding the DSFRP/SVST instruction, see Section 5.2 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

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



POINT

The DSFRP instruction is used only with the A171SCPU and the A273UHCPU (8-axis specification). It cannot be used with the A273UHCPU (32-axis specification).

REMARK

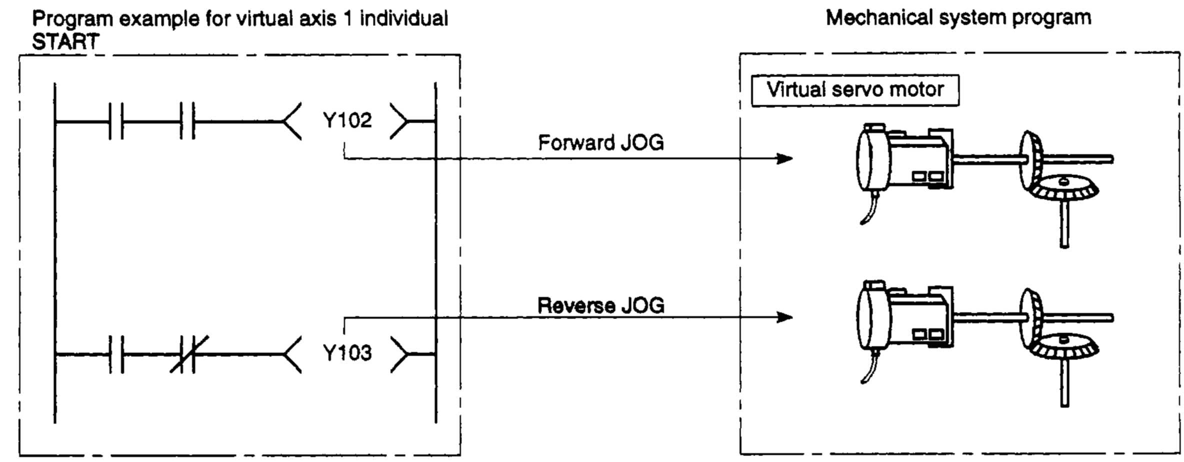
*1 For details regarding the START accept flag, see Section 4.2.

(b) START by JOG operation

An "individual" or "simultaneous" START can be executed at the JOG operation. For details regarding the JOG operation, see Section 7.16 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

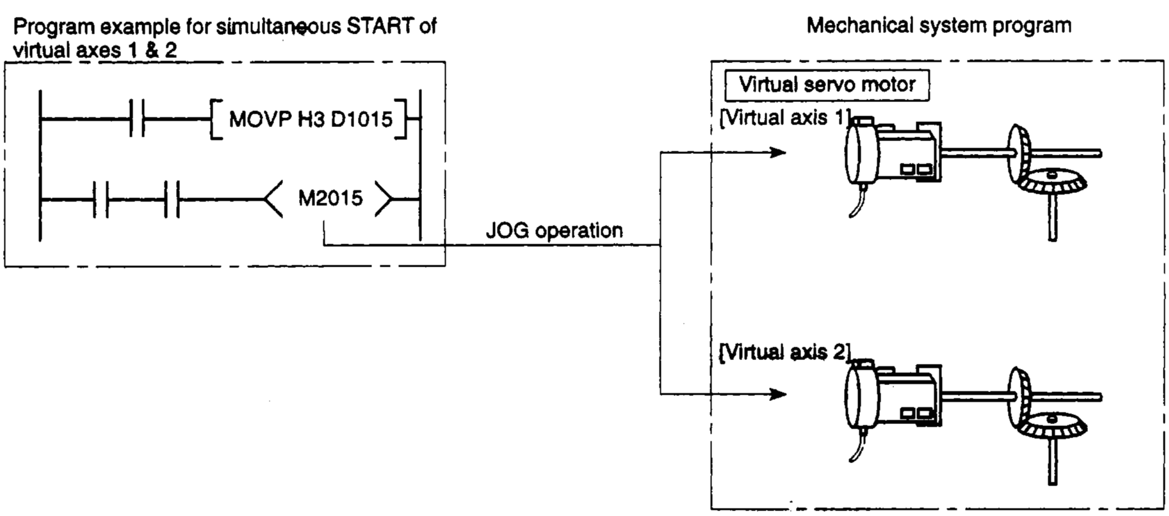
1) Individual START ...... Each axis can be started by a forward/reverse JOG command *1.

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



2) Simultaneous START ... The simultaneous START axis Nos. and rotation directions (forward/reverse) are designated at the JOG Simultaneous START Axis Setting Register D1015/D1015/D710 - D713)*2, and the axes are started when the JOG Simultaneous START Command Flag (M2015/M2015/M2048)*2 switches ON.

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



REMARKS

*1 For details regarding the forward/reverse JOG commands, see Section 6.3.1.

*2 See Section 6.3.2 for details regarding the JOG Simultaneous START Register, and Section 4.2.5 for details regarding the JOG Simultaneous START Command Flag.

(2) Procedure for stopping before completion

To stop virtual servo motor operation before positioning is completed, switch the stop/rapid stop command ON in the sequence program. (There are no external stop causes (STOP, FLS, RLS) for the virtual servo motor.)

(3) Control items

(a) During positioning control, the virtual servo motor backlash compensation amount is processed as "0".

(b) As the virtual servo motor has no feedback pulse, the deviation counter value and the present value are not stored.

(c) The virtual servo motor's feed present value is recorded in a backup memory, and is restored after switching from the REAL to VIRTUAL mode occurs following a power ON.

1) Operation continuation is possible when the output module is using the absolute position system (when position detection module/servo amplifier are used). However, if the servo motor for the output module which is connected to the virtual servo motor is operated while power is OFF, continuation will become impossible even if the absolute position system is being used.

If this occurs, a "VIRTUAL mode continuation disabled" warning signal *1 will switch ON.

To continue operation, the virtual servo motor or the output module's servo motor must be moved to the position where synchronous operation is possible.

2) If the output module is not using the absolute position system, the feed present value must be corrected (using the "present value change" function) after switching from the REAL to the VIRTUAL mode occurs.

(4) Control change

The following virtual servo motor control items can be changed:

- Present value change
- Speed change

Present value changes are executed by the CHGA instruction, and speed changes are executed by the CHGV instruction.

At the A171SCPU and A273UHCPU (8-axis Specification), the DSFLP instruction can also be used for present value changes and speed changes. (See appendix 4)

For details regarding the CHGA, CHGV, and DSFLP instructions, see Section 5.3 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

REMARK

*1 For details regarding the "VIRTUAL mode continuation disabled" warning signal, see Section 6.3.1.

(5) Operation mode when error occurs

The operation method when major errors occur at the output modules of a given system can be designated as shown below.

Control occurs as shown below, based on the parameter settings (see Table 6.1) of the virtual servo motor which is connected to the virtual main shaft.

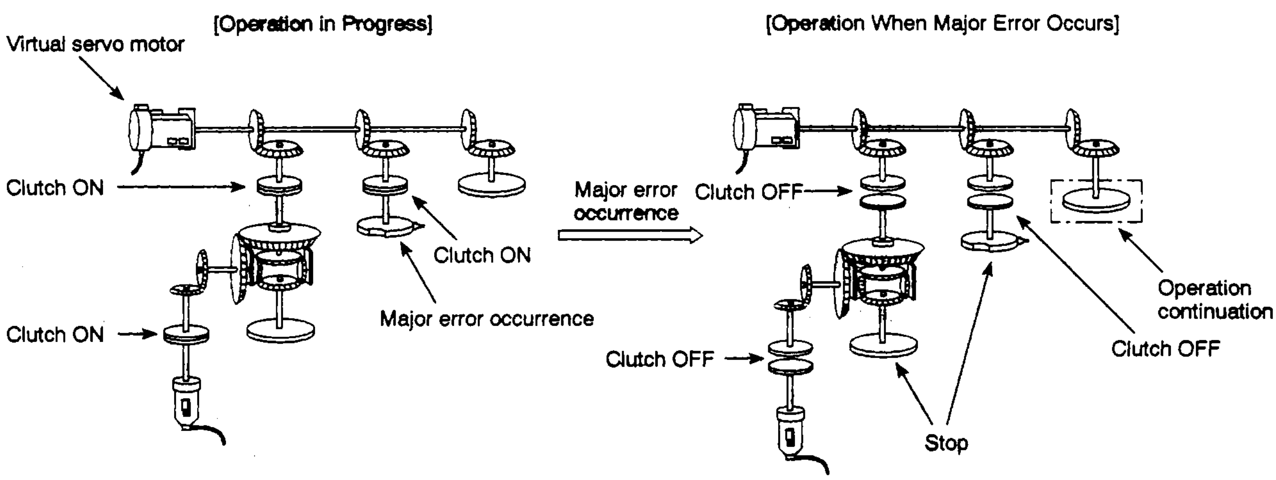
(a) Continuation . . . Output module operation continues even if a major output module error occurs. The error detection signal (M1607+20n/Xn7/M2407+20n) will switch ON at such times, and the corresponding error code will be recorded at the major error storage area.

The system and output module continuation/stop setting when a major output module error occurs is designated in the sequence program.

(b) Clutch OFF . . . . When a major output module error occurs, that system's clutch will be switched OFF and all connected output modules will stop. At this time, the clutch ON/OFF command device will not switch OFF, but the clutch status storage device will switch OFF regardless of the clutch ON/OFF command device's ON/OFF status.

Operation will continue at axes where no clutch is connected.

The drive module can be stopped from the sequence program, if required. To resume operation, eliminate the error cause, then switch the clutch ON/OFF command device ON.



Operation With "Clutch OFF" Setting

6.1.2 Parameter list

The virtual servo motor parameters are shown in Table 6.1. Parameters shown in this table are explained in items (1) to (4) below.

For details regarding the virtual servo motor parameter setting procedure, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 6.1 Parameter List

No.	Setting Item		Default Value	Setting Range
1	Virtual axis No.	For A171SCPU	0	1 - 4
		For A273UHCPU (8-axis Specification)	0	1 - 8
		For A273UHCPU (32-axis Specification)	0	1 - 32
2	Stroke limit upper limit		$2^{31}-1$ pulse	-2^{31} - $2^{31}-1$ pulse
3	Stroke limit lower limit		0 pulse	-2^{31} - $2^{31}-1$ pulse
4	Command in-position range		100 pulse	1 - 32767 pulse
5	JOG speed limit		20000 pulse/s	1 - 1000000 pulse/s
6	Parameter block		1	1 - 16
7	Operation mode when error occurs		Continuation	Continuation/Clutch OFF

(1) Virtual axis No. setting

The virtual axis No. is designated by the servo program during VIRTUAL mode operation. The number of the virtual servo motor which is connected to the virtual main shaft or the virtual auxiliary input shaft is designated.

(2) Stroke limit UPPER/LOWER limit settings

(a) Designates the upper and lower limits of the virtual axis travel range.

(b) A stroke limit range check occurs when the positioning control shown below is started or is in progress.

Start	Check ON/OFF	Remarks
Positioning control	ON	• When positioning is started, the feed present value is checked to confirm that is within the stroke limit range. If out of the range, an error (error code: 106) will occur, and positioning will not be executed. • When circular interpolation is started, an error (error codes: 207, 208) will occur if the interpolation path violates the stroke limit range, and operation will decelerate and stop.
Fixed-pitch feed control	ON	–
Speed control (I)	OFF	• Operation will continue until the present value becomes "0", and an external limit signal stop (FLS, RLS, STOP) occurs.
JOG operation	ON	• Operation is stopped at the point where the present value violates the stroke limit range. Motion is possible in the direction toward the stroke range.
Speed switching control	ON	–
Constant speed operation	ON	–
Position follow-up control	ON	• When positioning is started, the feed present value is checked to confirm that is within the stroke limit range. If out of the range, an error (error code: 106) will occur, and positioning will not be executed.
Manual pulse generator operation	ON	• Operation is stopped at the point where the present value violates the stroke limit range.

(3) Command in-position range

The term "command in-position" refers to the difference between the positioning address (command position) and present feed value.

The "command in-position" signal switches ON when the difference between the command position and the feed present value enters the setting range ([command in-position] – [feed present value] ≦ [command in-position range]).

The command in-position range is checked constantly during positioning control. (The command in-position range is not checked during speed control and JOG operation.)

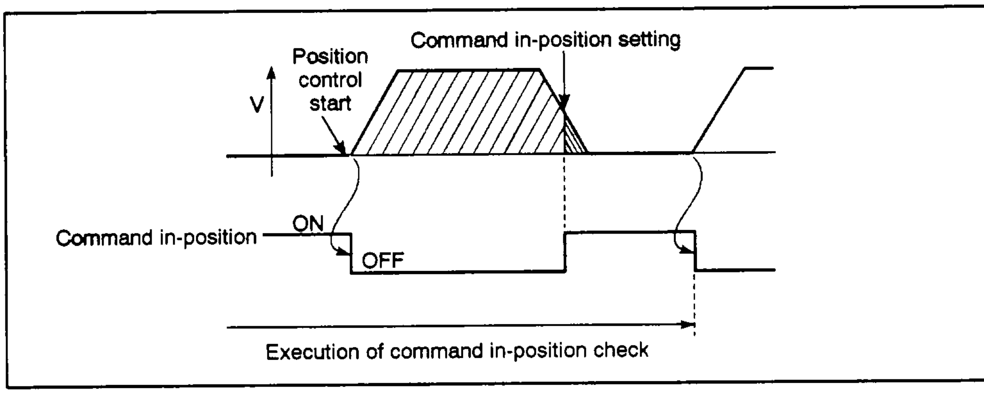


Fig. 6.1 Command In-position Range

(4) JOG speed limit & parameter block setting

The speed limit and parameter block used for JOG operations are explained below.

(a) JOG speed limit

Designates the maximum JOG speed for the virtual axis. If the JOG speed is set higher than the JOG speed limit value, the JOG speed is restricted to the JOG speed limit value.

(b) Parameter block setting

Designates the parameter block No. which is used for the JOG operation. The following parameter block data items are valid during a JOG operation: acceleration time, deceleration time, rapid stop deceleration time, and deceleration processing on STOP input.

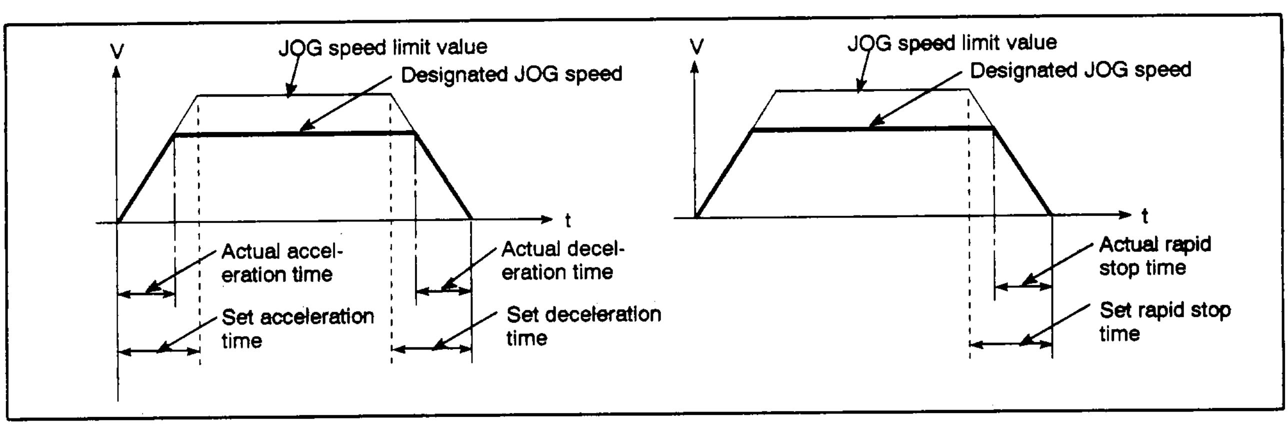


Fig. 6.2 Relationships between the JOG Speed Limit, Acceleration Time, Deceleration Time, and Rapid Stop Time

POINT

The parameter block system-of-units for interpolation control during a JOG operation is fixed as "pulses", regardless of the system-of-units setting.

6.2 Synchronous encoder

The synchronous encoder is used to execute virtual axis operation by pulse inputs from an external source. Synchronous encoder operation and parameters are discussed below.

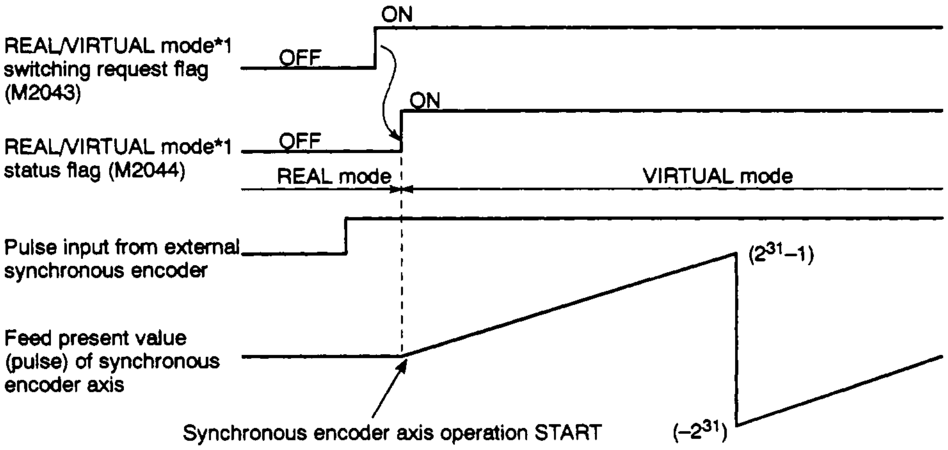
6.2.1 Synchronous encoder operation

(1) Operation START

A synchronous encoder axis START occurs when the reception of the pulse inputs from the external synchronous encoder begins. Pulse input reception occurs when switching from the REAL to the VIRTUAL mode is executed, and when the external signal (TREN: synchronous encoder input START signal)*2 input occurs.

(a) Pulse input reception at REAL to VIRTUAL mode switching occurs as follows

1) Reception of pulse inputs from the external synchronous encoder begins from the point when REAL to VIRTUAL mode switching occurs.



2) The clutch control mode *3 operation will be identical to its operation in the ON/OFF mode and the address mode, and can be used with incremental or absolute type synchronous encoders.

3) Transmission of synchronous encoder operation to the output module will or will not occur depending on the ON/OFF status of the connected clutch.

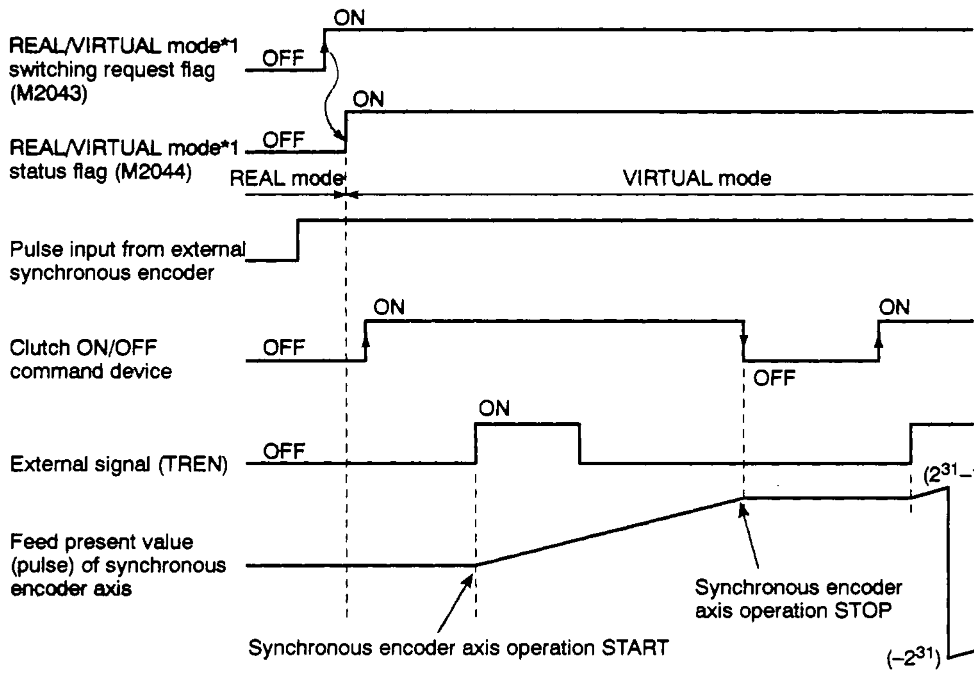
- When clutch is ON .... Transmission to the output module occurs.
- When clutch is OFF ... Transmission to the output module does not occur.

⚠ CAUTION

⚠ If the direct clutch is used and the mode is switched from REAL mode to VIRTUAL mode while the clutch is ON, rapid acceleration will occur at the output module axis, causing a servo error, and the machine will be subjected to a jolt.

(b) Pulse input reception at an external signal input occurs as follows

1) Reception of pulse inputs from the external synchronous encoder begins when the clutch is switched ON.



2) The clutch control mode *3 operation will be identical its operation at the external input mode. The synchronous encoder and clutch operations occur in a corresponding manner.

(2) Operation END

(a) Operation at the synchronous encoder axis is ended when the REAL mode is established in response to a VIRTUAL to REAL mode switching request (M2043 switched from ON to OFF).

(b) The procedure for ending operation at the synchronous encoder axis is as follows

1) Stop the output module

- Stop the external synchronous encoder.
- Switch the connected clutch OFF.

2) Switch from the VIRTUAL to REAL mode.

⚠ CAUTION

⚠ Switching to the REAL mode while synchronous encoder axis and output module operation is in progress will cause a sudden stop at the output module, resulting in a servo error, and the machine will be subjected to a jolt.

REMARKS

(1) *1: For details regarding the REAL/VIRTUAL mode switching request flag and the REAL/VIRTUAL mode switching status flag, see Section 4.2.

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

(3) *2: The synchronous encoder input START signal is input to the A171SENC/A273EX "TREN" terminal.
For details regarding the A171SENC "TREN" terminal, refer to the Motion Controller [A171SCPU] User's Manual.
For details regarding the A273EX "TREN" terminal, refer to the Motion Controller [A273UHCPU] User's Manual.

(4) *3: For details regarding the clutch control mode, see Section 7.2.1.

(3) STOP procedure

The synchronous encoder can be stopped by stopping the external synchronous encoder.

(There are no external inputs (FLS, RLS, STOP), sequence program stop commands, or rapid stop commands for the synchronous encoder.)

(4) Control items

(a) As the synchronous encoder has no feedback pulse, the "deviation counter value" and "actual present value" are not stored in memory.

(b) The synchronous encoder's feed present value is recorded in a backup memory, and is restored after switching from the REAL to VIRTUAL mode occurs following a power ON.

1) Operation continuation is possible when the output module is using the absolute position system (when position detection module/servo amplifier are used). However, if the servo motor for the output module which is connected to the synchronous encoder is operated while power is OFF, or if the synchronous encoder is operated while power is OFF, continuation will become impossible even if the absolute position system is being used.

If this occurs, a "VIRTUAL mode continuation disabled" warning signal will switch ON.

To continue operation, the output module's servo motor must be moved to the position where synchronous operation is possible.

2) If the output module is not using the absolute position system, the feed present value must be corrected (using the "present value change" function) after switching from the REAL to the VIRTUAL mode occurs.

(5) Control change

The following synchronous encoder control item can be changed:

- Present value change

Present value changes are executed by the CHGA instruction.

At the A171SCPU and A273UHCPU (8-axis specification), the DSFLP instruction can also be used for present value changes. (See appendix 4.)

For details regarding the CHGA and DSFLP instructions, see Section 5.3 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

6.2.2 Parameter list

The synchronous encoder parameters are shown in Tables 6.2 and 6.3.

For details regarding the synchronous encoder parameter setting procedure, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

(1) When A171SCPU is used

Table 6.2 Synchronous Encoder Parameter List (for A171SCPU)

No.	Setting Item	Default Value	Setting Range
1	Encoder No.	–	1
2	Operation mode when error occurs	Continuation	Continuation/Clutch OFF

(a) Encoder No.

Designates the number of the synchronous encoder which is connected to the manual pulse generator & synchronous encoder interface.

Manual Pulse Generator/Synchronous Encoder Interface Unit's	Encoder No.
P1/E1	1

P1: Connected to the manual pulse generator's input interface. This is for incremental type synchronous encoders.

E1: Connected to the serial synchronous encoder interface. This is for absolute type synchronous encoders.

*: Incremental and absolute type synchronous encoders can be used together.

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

Table 6.3 Synchronous Encoder Parameter List (for A273UHCPU 8-axis Specification)

No.	Setting Item	Default Value	Setting Range
1	Encoder No.	–	1 - 3
2	Operation mode when error occurs	Continuation	Continuation/Clutch OFF

(a) Encoder No.

Designates the synchronous encoder No. which is connected to the manual pulse generator & synchronous encoder interface.

1) For 8-axis specifications

Manual Pulse Generator/Synchronous Encoder Interface Unit's	Encoder No.
P1/E1	1
P2/E2	2
P3/E3	3

P1 - P3: Connected to the manual pulse generator's input interface. This is for incremental type synchronous encoders.

E1 - E3: Connected to the serial synchronous encoder interface. This is for absolute type synchronous encoders.

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

Table 6.4 Synchronous Encoder Parameter List (for A273UHCPU 32-axis Specification)

No.	Setting Item	Default Value	Setting Range
1	Encoder No.	–	1 - 12
2	Operation mode when error occurs	Continuation	Continuation/Clutch OFF

(a) For 32-axis specifications

Manual Pulse Generator/Synchronous Encoder Interface Unit's	Encoder No.
P1/E1	1
P2/E2	2
P3/E3	3
P4/E4	4
P5/E5	5
P6/E6	6
P7/E7	7
P8/E8	8
P9/E9	9
P10/E10	10
P11/E11	11
P12/E12	12

P1 - P12: Connected to the manual pulse generator's input interface. This is for incremental type synchronous encoders.

E1 - E12: Connected to the serial synchronous encoder interface. This is for absolute type synchronous encoders.

*: Both incremental and absolute type synchronous encoders can be used together.

(4) Operation Mode When Error Occurs

The operation method when major errors occur at the output modules of a given system can be designated as shown below.

Control occurs as shown below, based on the parameter settings (see Table 6.2 and 6.3) of the synchronous encoder which is connected to the synchronous encoder main shaft.

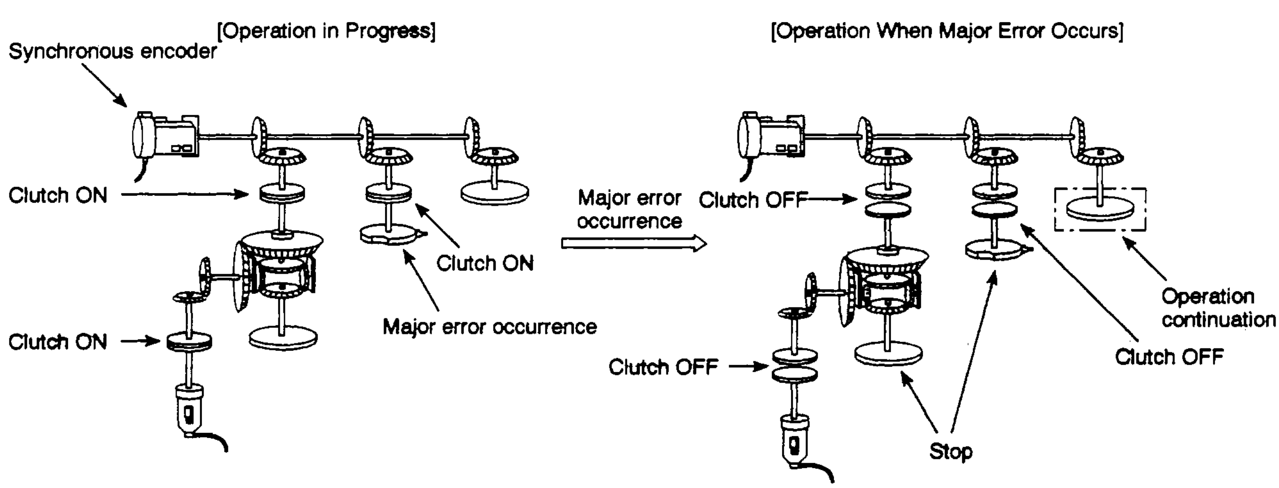
(a) Continuation . . . Output module operation continues even if a major output module error occurs. The error detection signal (M1607+20n/Xn7/M2407+20n) will switch ON at such times, and the corresponding error code will be recorded at the major error storage area.

The system and output module continuation/stop setting when a major output module error occurs is designated in the sequence program.

(b) Clutch OFF . . . . When a major output module error occurs, that system's clutch will be switched OFF and all connected output modules will stop. At this time, the clutch ON/OFF command device will not switch OFF, but the clutch status storage device will switch OFF regardless of the clutch ON/OFF command device's ON/OFF status.

Operation will continue at axes where no clutch is connected.

The drive module can be stopped from the sequence program, if required. To resume operation, eliminate the error cause, then switch the clutch ON/OFF command device ON.



Operation With "Clutch OFF" Setting

6.3 Common Devices (Input/Output, Internal Relay, Data Register)

The inputs/outputs, internal relays, and data registers used at the drive module are discussed in this section.

6.3.1 Input/output (X/Y) & Internal relay (M)

(1) Input/output (X/Y) & internal relay (M) list

(a) When A171SCPU is used

The M1200 - M1599 servo system CPU internal relays are used at the drive module.

- Inputs (M1200 - M1399)
  Inputs consist of data set at the PCPU. This data is used by the sequence program for checking the control status and for the designating the next positioning command, etc.

- Outputs (M1400 - M1599)
  Outputs are set at the sequence program, and are used for positioning commands, etc., which occur at the PCPU.

Table 6.5 Internal Relay List (for A171SCPU)

	Device					Signal Name	Virtual servo motor	Synchronous Encoder
	Synchronous Encoder	Virtual Servo Motor						
	P1/E1	Axis 1	Axis 2	Axis 3	Axis 4			
Inputs	M1360	-	-	-	-	Error detection	-	O
	M1361	-	-	-	-	External signal TREN		
	M1362	-	-	-	-	VIRTUAL mode continuation disabled warning		
	-	M1200	M1220	M1240	M1260	Positioning START completed	O	-
		M1201	M1221	M1241	M1261	Positioning completed		
		M1202	M1222	M1242	M1262	Unusable		
		M1203	M1223	M1243	M1263	Command in-position		
		M1204	M1224	M1244	M1264	Speed control in progress		
		M1205	M1225	M1245	M1265	Unusable		
		M1206	M1226	M1246	M1266			
		M1207	M1227	M1247	M1267	Error detection		
		M1208 - M1219	M1228 - M1239	M1248 - M1259	M1268 - M1279	Unusable		
Outputs	M1560	-	-	-	-	Error reset	-	O
	-	M1400	M1420	M1440	M1460	Stop command	O	-
		M1401	M1421	M1441	M1461	Rapid stop command		
		M1402	M1422	M1442	M1462	Forward JOG start		
		M1403	M1423	M1443	M1463	Reverse JOG start		
		M1404	M1424	M1444	M1464	Completed signal OFF command		
		M1405	M1425	M1445	M1465	Unusable		
		M1406	M1426	M1446	M1466			
		M1407	M1427	M1447	M1467	Error reset		
		M1408	M1428	M1448	M1468	Unusable		
		M1409	M1429	M1449	M1469	STOP input valid/invalid		
		M1410 - M1419	M1430 - M1439	M1450 - M1459	M1470 - M1479	Unusable		

O: Used -: Not used

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

The X/YE0 - XE5/YE2, XF8 - XFA, X/Y100 - X/Y17F inputs/outputs of the A273UHCPU (8-axis specification) are used at the drive module.

- Inputs (XE0 - XE5, XF8 - XFA, X100 - X17F)
  Inputs consist of data set at the PCPU. This data is used by the sequence program for checking the control status and for the designating the next positioning command, etc.

- Outputs (YE0 - YE2, Y100 - Y17F)
  Outputs are set at the sequence program, and are used for positioning commands, etc., which occur at the PCPU.

Table 6.6 Input/Output List (for A273UHCPU 8-axis Specification)

	Device											Signal Name	Virtual servo motor	Synchronous Encoder
	Synchronous Encoder			Virtual servo motor										
	P1/E1	P2/E1	P3/E1	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8			
Inputs	XE0	XE1	XE2	–	–	–	–	–	–	–	–	Error detection	–	○
	XE3	XE4	XE5	–	–	–	–	–	–	–	–	External signal TREN		
	XF8	XF9	XFA	–	–	–	–	–	–	–	–	VIRTUAL mode continuation disabled warning	○	–
	–	–	–	X100	X110	X120	X130	X140	X150	X160	X170	Positioning START completed		
				X101	X111	X121	X131	X141	X151	X161	X171	Positioning completed		
				X102	X112	X122	X132	X142	X152	X162	X172	Unusable		
				X103	X113	X123	X133	X143	X153	X163	X173	Command in-position		
				X104	X114	X124	X134	X144	X154	X164	X174	Speed control in progress		
				X105	X115	X125	X135	X145	X155	X165	X175	Unusable		
				X106	X116	X126	X136	X146	X156	X166	X176			
				X107	X117	X127	X137	X147	X157	X167	X177	Error detection		
				X108 · X10F	X118 · X11F	X128 · X12F	X138 · X13F	X148 · X13F	X158 · X15F	X168 · X16F	X178 · X17F	Unusable		
Outputs	YE0	YE1	YE2	–	–	–	–	–	–	–	–	Error reset		○
	–	–	–	Y100	Y100	Y120	Y130	Y140	Y150	Y160	Y170	Stop command	○	–
				Y101	Y101	Y121	Y131	Y141	Y151	Y161	Y171	Rapid stop command		
				Y102	Y102	Y122	Y132	Y142	Y152	Y162	Y172	Forward JOG start		
				Y103	Y103	Y123	Y133	Y143	Y153	Y163	Y173	Reverse JOG start		
				Y104	Y104	Y124	Y134	Y144	Y154	Y164	Y174	Completed signal OFF command		
				Y105	Y105	Y125	Y135	Y145	Y155	Y165	Y175	Unusable		
				Y106	Y106	Y126	Y136	Y146	Y156	Y166	Y176			
				Y107	Y107	Y127	Y137	Y147	Y157	Y167	Y177	Error reset		
				Y108	Y108	Y128	Y138	Y148	Y158	Y168	Y178	Unusable		
				Y109	Y109	Y129	Y139	Y149	Y159	Y169	Y179	STOP input valid/invalid		
				Y10A · Y10F	Y11A · Y11F	Y12A · Y12F	Y13A · Y13F	Y14A · Y14F	Y15A · Y15F	Y16A · Y16F	Y17A · Y17F	Unusable		

O: Used –: Not used

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

The M4000-M5487 servo system CPU internal relays are used at the drive module.

- Inputs (M4000 - M4687)
  Inputs consist of data set at the PCPU. This data is used by the sequence program for checking the control status and for designating the next positioning command, etc.

- Outputs (M4800 - M5487)
  Outputs are set at the sequence program, and are used for positioning commands, etc., sent to the PCPU.

Table 6.7 Internal Relay List (Synchronous Encoder) (for A273UHCPU 32-axis Specification)

	Device						Signal Name
	P1/E1	P2/E2	P3/E3	P4/E4	P5/E5	P6/E6	
Inputs	M4640	M4644	M4648	M4652	M4656	M4660	Error detection
	M4641	M4645	M4649	M4653	M4657	M4661	External signal TREN
	M4642	M4646	M4650	M4654	M4658	M4662	VIRTUAL mode continuation disabled warning
	M4643	M4647	M4651	M4655	M4659	M4663	Unusable
	P7/E7	P8/E8	P9/E9	P10/E10	P11/E11	P12/E12	
	M4664	M4668	M4672	M4676	M4680	M4684	Error detection
	M4665	M4669	M4673	M4677	M4681	M4685	External signal TREN
	M4666	M4670	M4674	M4678	M4682	M4686	VIRTUAL mode continuation disabled warning
	M4667	M4671	M4675	M4679	M4683	M4687	Unusable
Outputs	P1/E1	P2/E2	P3/E3	P4/E4	P5/E5	P6/E6	
	M5440	M5444	M5448	M5452	M5456	M5460	Error reset
	M5441	M5445	M5449	M5453	M5457	M5461	Unusable
	M5442	M5446	M5450	M5454	M5458	M5462	
	M5443	M5447	M5451	M5455	M5459	M5463	
	P7/E7	P8/E8	P9/E9	P10/E10	P11/E11	P12/E12	
	M5464	M5468	M5472	M5476	M5480	M5484	Error reset
	M5465	M5469	M5473	M5477	M5481	M5485	Unusable
	M5466	M5470	M5474	M5478	M5482	M5486	
	M5467	M5471	M5475	M5479	M5483	M5487	

O: Used –: Not used

Table 6.8 Internal Relay List (Virtual Servo Motor) (for A273UHCPU 32-axis Specification)

	Device								Signal Name
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	
Inputs	M4000	M4020	M4040	M4060	M4080	M4100	M4120	M4140	Positioning START completed
	M4001	M4021	M4041	M4061	M4081	M4101	M4121	M4141	Positioning completed
	M4002	M4022	M4042	M4062	M4082	M4102	M4122	M4142	Unusable
	M4003	M4023	M4043	M4063	M4083	M4103	M4123	M4143	Command in-position
	M4004	M4024	M4044	M4064	M4084	M4104	M4124	M4144	Speed control in progress
	M4005	M4025	M4045	M4065	M4085	M4105	M4125	M4145	Unusable
	M4006	M4026	M4046	M4066	M4086	M4106	M4126	M4146	
	M4007	M4027	M4047	M4067	M4087	M4107	M4127	M4147	Error detection
	M4008 - M4019	M4028 - M4039	M4048 - M4059	M4068 - M4079	M4088 - M4099	M4108 - M4119	M4128 - M4139	M4148 - M4149	Unusable
Outputs	M4800	M4820	M4840	M4860	M4880	M4900	M4920	M4940	Stop command
	M4801	M4821	M4841	M4861	M4881	M4901	M4921	M4941	Rapid stop command
	M4802	M4822	M4842	M4862	M4882	M4902	M4922	M4942	Forward JOG start
	M4803	M4823	M4843	M4863	M4883	M4903	M4923	M4943	Reverse JOG start
	M4804	M4824	M4844	M4864	M4884	M4904	M4924	M4944	Completed signal OFF command
	M4805	M4825	M4845	M4865	M4885	M4905	M4925	M4945	Unusable
	M4806	M4826	M4846	M4866	M4886	M4906	M4926	M4946	
	M4807	M4827	M4847	M4867	M4887	M4907	M4927	M4947	Error reset
	M4808	M4828	M4848	M4868	M4888	M4908	M4928	M4948	Unusable
	M4809	M4829	M4849	M4869	M4889	M4909	M4929	M4949	STOP input valid/invalid
	M4810 - M4819	M4830 - M4839	M4850 - M4859	M4870 - M4879	M4890 - M4899	M4910 - M4919	M4930 - M4939	M4950 - M4959	Unusable
	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	
Inputs	M4160	M4180	M4200	M4220	M4240	M4260	M4280	M4300	Positioning START completed
	M4161	M4181	M4201	M4221	M4241	M4261	M4281	M4301	Positioning completed
	M4162	M4182	M4202	M4222	M4242	M4262	M4282	M4302	Unusable
	M4163	M4183	M4203	M4223	M4243	M4263	M4283	M4303	Command in-position
	M4164	M4184	M4204	M4224	M4244	M4264	M4284	M4304	Speed control in progress
	M4165	M4185	M4205	M4225	M4245	M4265	M4285	M4305	Unusable
	M4166	M4186	M4206	M4226	M4246	M4266	M4286	M4306	
	M4167	M4187	M4207	M4227	M4247	M4267	M4287	M4307	Error detection
	M4168 - M4179	M4188 - M4199	M4208 - M4219	M4228 - M4239	M4248 - M4259	M4268 - M4279	M4288 - M4299	M4308 - M4319	Unusable
Outputs	M4960	M4980	M5000	M5020	M5040	M5060	M5080	M5100	Stop command
	M4961	M4981	M5001	M5021	M5041	M5061	M5081	M5101	Rapid stop command
	M4962	M4982	M5002	M5022	M5042	M5062	M5082	M5102	Forward JOG start
	M4963	M4983	M5003	M5023	M5043	M5063	M5083	M5103	Reverse JOG start
	M4964	M4984	M5004	M5024	M5044	M5064	M5084	M5104	Completed signal OFF command
	M4965	M4985	M5005	M5025	M5045	M5065	M5085	M5105	Unusable
	M4966	M4986	M5006	M5026	M5046	M5066	M5086	M5106	
	M4967	M4987	M5007	M5027	M5047	M5067	M5087	M5107	Error reset
	M4968	M4988	M5008	M5028	M5048	M5068	M5088	M5108	Unusable
	M4969	M4989	M5009	M5029	M5049	M5069	M5089	M5109	STOP input valid/invalid
	M4970 - M4979	M4990 - M4999	M5010 - M5019	M5030 - M5039	M5050 - M5059	M5070 - M5079	M5090 - M5099	M5110 - M5119	Unusable

O: Used –: Not used

Table 6.8 Internal Relay List (Virtual Servo Motor)
(for A273UHCPU 32-axis Specification) (Contined)

	Device								Signal Name
	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24	
Inputs	M4320	M4340	M4360	M4380	M4400	M4420	M4440	M4460	Positioning START completed
	M4321	M4341	M4361	M4381	M4401	M4421	M4441	M4461	Positioning completed
	M4322	M4342	M4362	M4382	M4402	M4422	M4442	M4462	Unusable
	M4323	M4343	M4363	M4383	M4403	M4423	M4443	M4463	Command in-position
	M4324	M4344	M4364	M4384	M4404	M4424	M4444	M4464	Speed control in progress
	M4325	M4345	M4365	M4385	M4405	M4425	M4445	M4465	Unusable
	M4326	M4346	M4366	M4386	M4406	M4426	M4446	M4466	
	M4327	M4347	M4367	M4387	M4407	M4427	M4447	M4467	Error detection
	M4328 - M4339	M4348 - M4359	M4368 - M4379	M4388 - M4399	M4408 - M4419	M4428 - M4439	M4448 - M4459	M4468 - M4479	Unusable
Outputs	M5120	M5140	M5160	M5180	M5200	M5220	M5240	M5260	Stop command
	M5121	M5141	M5161	M5181	M5201	M5221	M5241	M5261	Rapid stop command
	M5122	M5142	M5162	M5182	M5202	M5222	M5242	M5262	Forward JOG start
	M5123	M5143	M5163	M5183	M5203	M5223	M5243	M5263	Reverse JOG start
	M5124	M5144	M5164	M5184	M5204	M5224	M5244	M5264	Completed signal OFF command
	M5125	M5145	M5165	M5185	M5205	M5225	M5245	M5265	Unusable
	M5126	M5146	M5166	M5186	M5206	M5226	M5246	M5266	
	M5127	M5147	M5167	M5187	M5207	M5227	M5247	M5267	Error reset
	M5128	M5148	M5168	M5188	M5208	M5228	M5248	M5268	Unusable
	M5129	M5149	M5169	M5189	M5209	M5229	M5249	M5269	STOP input valid/invalid
	M5130 - M5139	M5150 - M5159	M5170 - M5179	M5190 - M5199	M5210 - M5219	M5230 - M5239	M5250 - M5259	M5270 - M5279	Unusable
	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	
Inputs	M4480	M4500	M4520	M4540	M4560	M4580	M4600	M4620	Positioning START completed
	M4481	M4501	M4521	M4541	M4561	M4581	M4601	M4621	Positioning completed
	M4482	M4502	M4522	M4542	M4562	M4582	M4602	M4622	Unusable
	M4483	M4503	M4523	M4543	M4563	M4583	M4603	M4623	Command in-position
	M4484	M4504	M4524	M4544	M4564	M4584	M4604	M4624	Speed control in progress
	M4485	M4505	M4525	M4545	M4565	M4585	M4605	M4625	Unusable
	M4486	M4506	M4526	M4546	M4566	M4586	M4606	M4626	
	M4487	M4507	M4527	M4547	M4567	M4587	M4607	M4627	Error detection
	M4488 - M4499	M4508 - M4519	M4528 - M4539	M4548 - M4559	M4568 - M4579	M4588 - M4599	M4608 - M4619	M4628 - M4639	Unusable
Outputs	M5280	M5300	M5320	M5340	M5360	M5380	M5400	M5420	Stop command
	M5281	M5301	M5321	M5341	M5361	M5381	M5401	M5421	Rapid stop command
	M5282	M5302	M5322	M5342	M5362	M5382	M5402	M5422	Forward JOG start
	M5283	M5303	M5323	M5343	M5363	M5383	M5403	M5423	Reverse JOG start
	M5284	M5304	M5324	M5344	M5364	M5384	M5404	M5424	Completed signal OFF command
	M5285	M5305	M5325	M5345	M5365	M5385	M5405	M5425	Unusable
	M5286	M5306	M5326	M5346	M5366	M5386	M5406	M5426	
	M5287	M5307	M5327	M5347	M5367	M5387	M5407	M5427	Error reset
	M5288	M5308	M5328	M5348	M5368	M5388	M5408	M5428	Unusable
	M5289	M5309	M5329	M5349	M5369	M5389	M5409	M5429	STOP input valid/invalid
	M5290 - M5299	M5310 - M5319	M5330 - M5339	M5350 - M5359	M5370 - M5379	M5390 - M5399	M5410 - M5419	M5430 - M5439	Unusable

O: Used –: Not used

(2) Input/output (X/Y) and internal relay (M) details

(a) Error detection signal (M1360, M1207+20n/XE0 - XE2, X1n7/M4640+4n, M4007+20n)*1

1) The error detection signal switches ON when a minor or major error occurs at the drive module, or at an output module which is connected to the drive module. ON/OFF switching of this signal permits error valid/invalid identification processing.

2) When the error detection signal switches ON, the corresponding error code is recorded at the error code storage area.

- Minor error code*2 .... Stored at minor error code storage area*3.
- Major error code*2 .... Stored at major error code storage area*3.

The error code or the output module error detection signal's ON/OFF status indicates whether the error occurred at the drive module or the output module.

3) When a normal status is restored at the drive module and output module, and the error reset command (Y1n7)*1 is switched ON, the error detection signal will switch OFF.

(b) External signal TREN (M1361/XE3, XE4, XE5/M4641+4n)*1

The external signal TREN is used for clutch control in the external input mode. This signal switches ON when input occurs at the A171SENC/A273EX "TREN" input terminal, and indicates the TREN terminal's input ON/OFF status.

(c) VIRTUAL mode continuation disabled warning signal (M1362/XF8 - XFA/M4642+4n)*1

As happens when the absolute type synchronous encoder is moved while power is OFF, this signal will switch ON when the present value read at power ON differs from that which was stored at power OFF (final present value of VIRTUAL mode operation). This signal status indicates whether VIRTUAL mode operation can be continued following a power ON or servo system CPU reset.

REMARK

(1) *1: The "n" of M1207+20n represents the numerical value corresponding to the virtual axis No.

n	0	2	4	6
Virtual axis No.	1	2	3	4

The "n" of X/Y1n7 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "m" of M4640+4n, M4641+4n, and 4642+4n represents the numerical value corresponding to the synchronous encoder No.

n	0	1	2	3	4	5
Synchronous encoder No.	P1/E1	P2/E2	P3/E3	P4/E4	P5/E5	P6/E6
n	6	7	8	9	10	11
Synchronous encoder No.	P7/E7	P8/E8	P9/E9	P10/E10	P11/E11	P12/E12

(2) *2: For details regarding drive module major & minor errors, see Section 10.3.
For details regarding output module major & minor errors, see Section 10.5.

(3) *3 For details regarding the minor and major error code storage areas, see Section 6.3.2.

(d) Positioning START completed signal (M1200+20n/X1n0/M4000+20n)*1

1) This signal switches ON when a positioning START is completed at the axis designated by a DSFRP/SVST instruction in the sequence program.

This signal is inoperative during JOG and speed control operations.

This signal can be used for M-code readouts, etc., when positioning is started. *2

2) The positioning START completed signal will switch OFF at the leading edge (OFF → ON) of the "completed" signal OFF command (M1404+20n/Y1n4/M4804+20n)*1, or when positioning is completed.

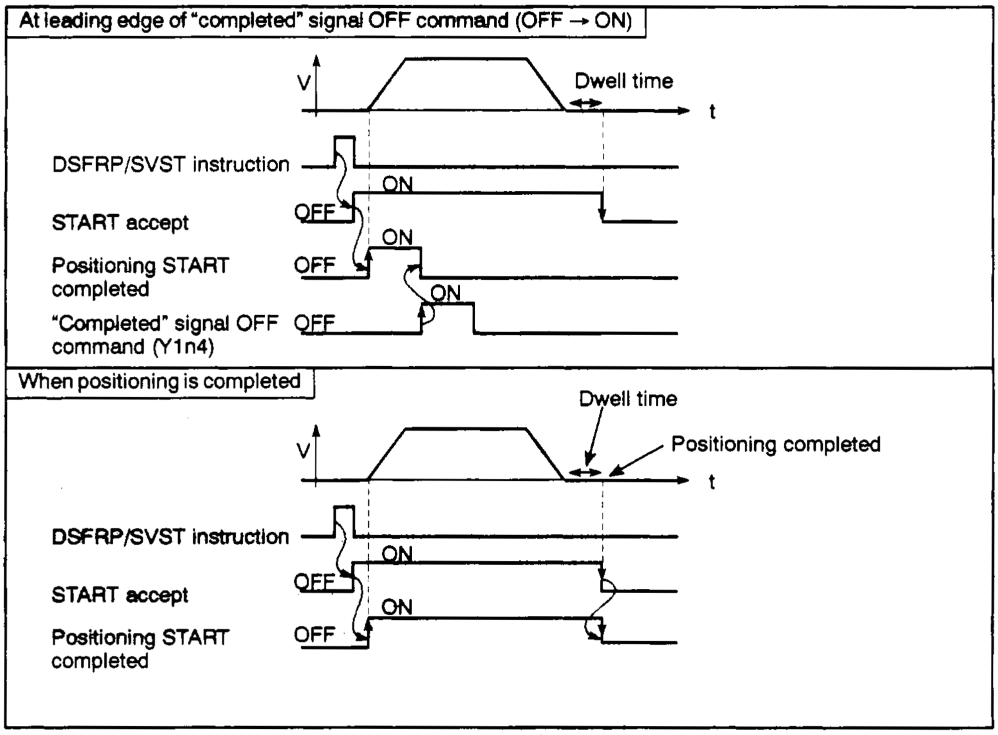


Fig. 6.3 Positioning START Completed Signal's ON/OFF Timing

REMARK

(1) *1: The "n" of M1200+20n and M1404+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

The "n" of M4n0 and Y1n4 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

*1: The "n" of M4000+20n and M4804+20n represents the numerical value corresponding to the virtual axis No.

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

(2) *2: For details regarding M-codes, see Section 8.2 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

(e) Positioning completed signal (M1201+20n/X1n1/M4001+20n)*1

1) This signal switches ON when positioning is completed at the axis designated by a DSFRP/SVST instruction in the sequence program.

This signal will not switch ON when JOG or speed control operations are started, or when they are stopped while in progress.

This signal can be used for M-code readouts when positioning is completed. *2

2) The positioning completed signal will switch OFF at the leading edge (OFF → ON) of the "completed" signal OFF command (M1404+20n/Y1n4/M4804+20n)*1, or when a positioning START is completed.

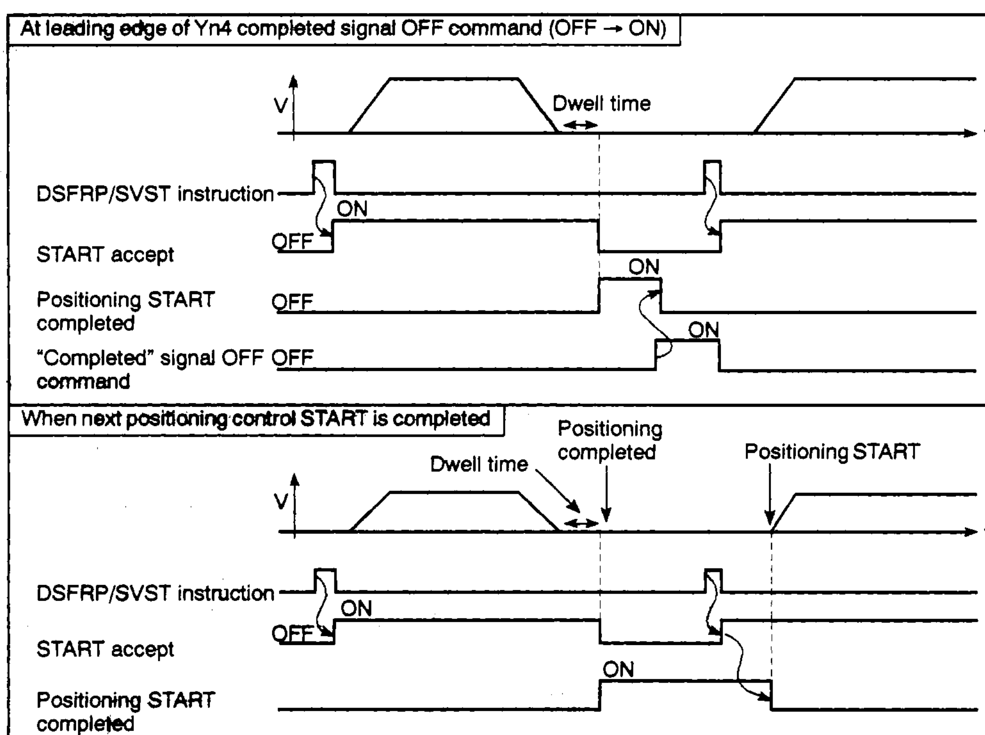


Fig. 6.4 Positioning START Completed Signal's ON/OFF Timing

REMARK

(1) *1: The "n" of M1201+20n and M1404+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

The "n" of X1n1 and Y1n4 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "n" of M4001+20n and M4804+20n represents the numerical value corresponding to the virtual axis No.

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

(2) *2: For details regarding M-codes, see Section 8.2 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

(f) Command in-position command (M1203+20n/X1n3/M4003+20n)*1

1) This signal switches ON when the absolute difference between the command position and the present value is less than the "command in-position range" designated by the virtual servo motor parameter setting (see Section 6.1.2).

   This signal switches OFF when the following occur:

   - Positioning control START
   - Speed control
   - JOG operation

2) A command in-position check occurs constantly during position control, but does not occur during speed control.

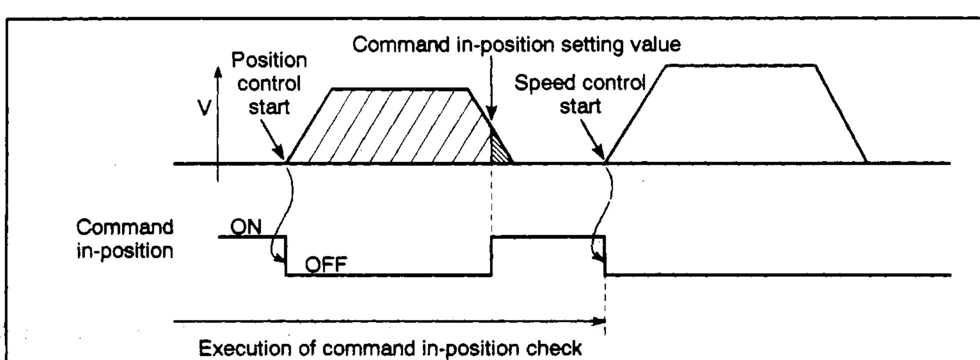


Fig. 6.5 Command In-position Signal's ON/OFF Timing

(g) Speed control in-progress signal (M1204+20n/X1n4/M4004+20n)*1

1) This signal switches ON when speed control is in progress, and serves to indicate whether speed control or position control is currently in progress. This signal will switch OFF when the next position control START occurs.

2) The speed control in-progress signal is OFF at power ON, and during position control.

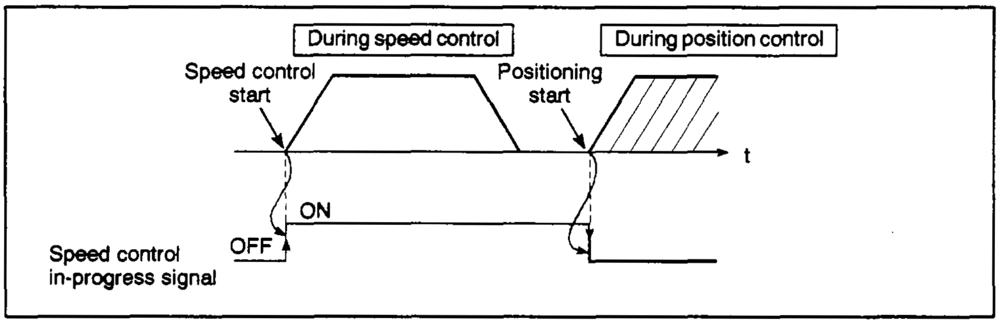


Fig. 6.6 Speed Control In-progress Signal's ON/OFF Timing

REMARK

(1) *1: The "n" of M1203+20n and M1204+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

The "n" of X1n3 and X1n4 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "n" of M4003+20n and M4004+20n represents the numerical value corresponding to the virtual axis No.

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

(h) Error reset command (M1560, M1407+20n/YE0-YE2, Y1n7/M5440+4n/ M4807+20n)*1

1) The error reset command is used to clear minor and major error code storage areas for the drive module of the axis where the error occurred, and to reset the error detection signal.

2) The relationship between the error reset command and the error detection signal is shown in Tables 6.9 to 6.11.

[When A171SCPU is used]

Table 6.9 Error Detection Signal & Error Signal List (for A171SCPU)

Drive Module		Error Detection Signal	Error Reset Signal
Synchronous encoder	P1/E1	M1360	M1560
Virtual servo motor	Virtual axis 1	M1207	M1407
	Virtual axis 2	M1227	M1427
	Virtual axis 3	M1247	M1447
	Virtual axis 4	M1267	M1467

[When A273UHCPU 8-axis specification is used]

Table 6.10 Error Detection Signal & Error Signal List (for A273UHCPU 8-axis Specification)

Drive Module		Error Detection Signal	Error Reset Signal
Synchronous encoder	P1/E1	XE0	YE0
	P2/E2	XE1	YE1
	P3/E3	XE2	YE2
Virtual servo motor	Virtual axis 1	X107	Y107
	Virtual axis 2	X117	Y117
	Virtual axis 3	X127	Y127
	Virtual axis 4	X137	Y137
	Virtual axis 5	X147	Y147
	Virtual axis 6	X157	Y157
	Virtual axis 7	X167	Y167
	Virtual axis 8	X177	Y177

[When A273UHCPU 32-axis specification is used]

Table 6.11 Error Detection Signal & Error Signal List (for A273UHCPU 32-axis Specification)

Drive Module		Error Detection Signal	Error Reset Signal	Drive Module		Error Detection Signal	Error Reset Signal
Synchronous encoder	P1/E1	M4640	M5440	Virtual servo motor	Virtual axis 11	M4207	M5007
	P2/E2	M4644	M5444		Virtual axis 12	M4227	M5027
	P3/E3	M4648	M5448		Virtual axis 13	M4247	M5047
	P4/E4	M4652	M5452		Virtual axis 14	M4267	M5067
	P5/E5	M4656	M5456		Virtual axis 15	M4287	M5087
	P6/E6	M4660	M5460		Virtual axis 16	M4307	M5107
	P7/E7	M4664	M5464		Virtual axis 17	M4327	M5127
	P8/E8	M4668	M5468		Virtual axis 18	M4347	M5147
	P9/E9	M4672	M5472		Virtual axis 19	M4367	M5167
	P10/E10	M4676	M5476		Virtual axis 20	M4387	M5187
	P11/E11	M4680	M5480		Virtual axis 21	M4407	M5207
	P12/E12	M4684	M5484		Virtual axis 22	M4427	M5227
Virtual servo motor	Virtual axis 1	M4007	M4807		Virtual axis 23	M4447	M5247
	Virtual axis 2	M4027	M4827		Virtual axis 24	M4467	M5267
	Virtual axis 3	M4047	M4847		Virtual axis 25	M4487	M5287
	Virtual axis 4	M4067	M4867		Virtual axis 26	M4507	M5307
	Virtual axis 5	M4087	M4887		Virtual axis 27	M4527	M5327
	Virtual axis 6	M4107	M4907		Virtual axis 28	M4547	M5347
	Virtual axis 7	M4127	M4927		Virtual axis 29	M4567	M5367
	Virtual axis 8	M4147	M4947		Virtual axis 30	M4587	M5387
	Virtual axis 9	M4167	M4967		Virtual axis 31	M4607	M5407
	Virtual axis 10	M4187	M4987		Virtual axis 32	M4627	M5427

3) When the error reset command switches ON, the following processing occurs.

- When the drive module and output module statuses are normal, the minor or major error code storage area is cleared, and the error detection signal is reset.
- If an error status still exists at the drive module and output module, the error code will again be recorded at the minor or major error code storage area.
  In this case, the error detection signal (M1360, M1207+20n/XE0 - XE2, X1n7/M4640+4n, M4007+20n)*1 will remain ON.

POINT

Do not switch the error reset command (M1560, M1407+20n/YE0 - YE2, Y1n7/M5440+4n, M4807+20n)*1 ON with a PLS instruction since this can disable the error reset function.

REMARK

*1: The "n" in M1207+20n and M1407+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

*1: The "n" of X1n7 and Y1n7 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "n" of M4640+4n and M5440+4n represents the numerical value corresponding to the synchronous encoder No.

n	0	1	2	3	4	5
Synchronous encoder No.	P1/E1	P2/E2	P3/E3	P4/E4	P5/E5	P6/E6
n	6	7	8	9	10	11
Synchronous encoder No.	P7/E7	P8/E8	P9/E9	P10/E10	P11/E11	P12/E12

The "n" of M4007+20n and M4807+20n represents the numerical value corresponding to the virtual axis No.

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

(i) Stop command (M1440+20n/Y1n0/M4800+20n)*1

1) The stop command is used to stop operation at an axis where motion is in progress, and it becomes effective at the leading edge (OFF → ON) of the signal. (Operation cannot be started at axes where the stop command is ON.)

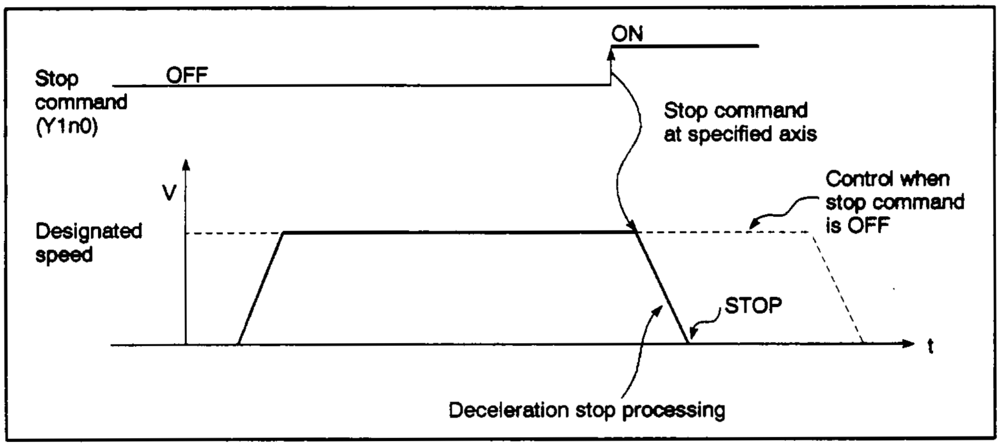


Fig. 6.7 Stop Processing by Stop Command

2) The stop command can also be used during speed control. (For details regarding speed control, see Section 7.14 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

3) STOP processing which occurs in response to the stop command is shown in Table 6.12 below.

Table 6.12 Stop Processing at Stop Command ON

Control In Progress	Processing at Stop Command ON	
	When Control is In Progress	When Deceleration to Stop is In Progress
Position control	Deceleration to a stop occurs within the deceleration time designated in the servo program or parameter block.	Stop command is ignored, and the deceleration stop processing continues.
Speed control		
JOG operation		

REMARK

*1: The "n" in M1400+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

The "n" of Y1n0 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "n" of M4800+20n represents the numerical value corresponding to the virtual axis No.

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

(j) Rapid stop command (M1401+20n/Y1n1/M4801+20n)*1

1) This command is used to execute a rapid sto+20np at an axis which is in motion, and it becomes effective at its leading edge (OFF → ON). (Operation cannot be started at axes where the rapid stop command is ON.)

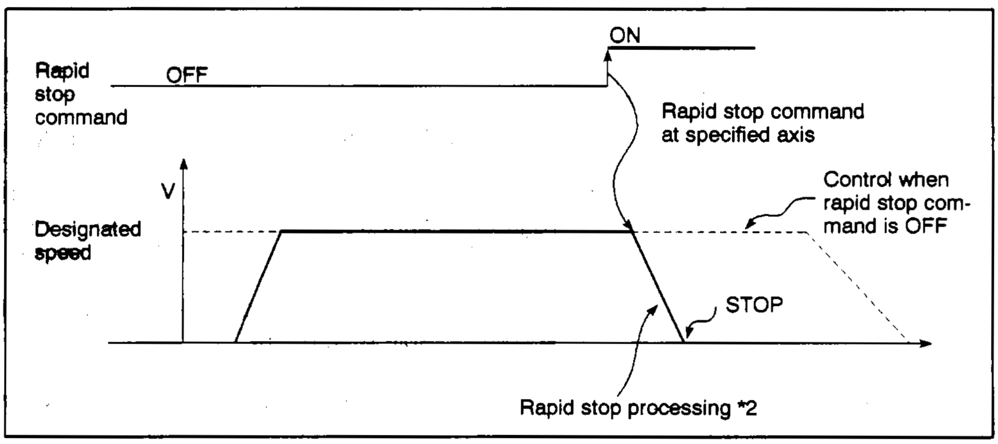
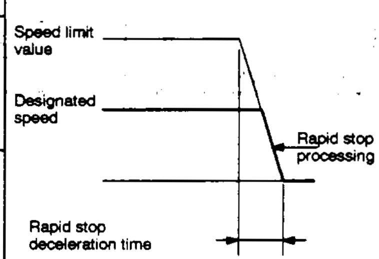
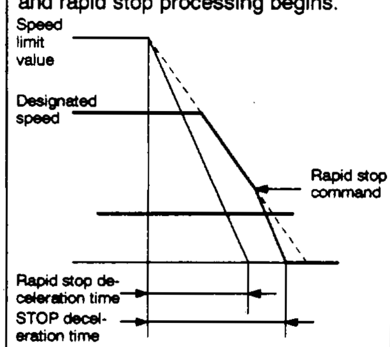


Fig. 6.8 Rapid Stop Processing by Rapid Stop Command

2) The rapid stop processing which occurs when the rapid stop command switches ON is shown in Table 6.11 below.

Table 6.13 Rapid Stop Processing When Rapid Stop Command is Switched ON

Control in Progress	Processing at Stop Command ON	
	When Control is in Progress	When Deceleration to Stop is in Progress
Position control	Rapid stop occurs. 	Deceleration processing is aborted, and rapid stop processing begins. 
Speed control		
JOG operation		

REMARKS

*1: The "n" in M1401+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

The "n" of Y1n1 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "n" of M4801+20n represents the numerical value corresponding to the virtual axis No.

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

*2: Rapid stop processing results in deceleration to a stop within the rapid stop deceleration time designated at the parameter block or servo program.

(k) Forward JOG start command (M1402+20n/Y1n2/M4802+20n)*1/Reverse JOG start command (M1403+20n/Y1n3/M4803+20n) *1

1) When the forward JOG start command (Y1n2) is ON in the sequence program, JOG operation occurs in the forward direction (direction in which the address increases).

   When the forward JOG start command (Y1n2) is switched OFF, a deceleration and STOP will occur within the deceleration time designated at the parameter block.

2) When the reverse JOG start command (Y1n3) is ON in the sequence program, JOG operation occurs in the reverse direction (direction in which the address decreases).

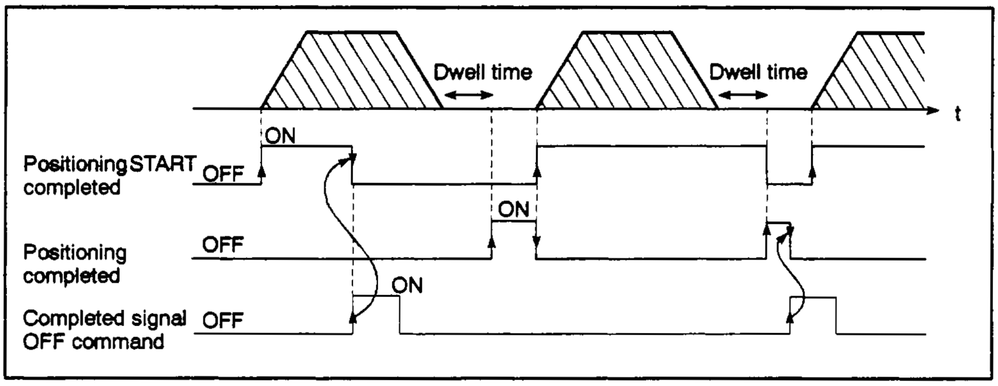
   When the reverse JOG start command (Y1n3) is switched OFF, a deceleration and STOP will occur within the deceleration time designated at the parameter block.

POINT

The sequence program features an interlock function which prevents the forward (Y1n2) and reverse (Y1n3) JOG start commands from being switched ON simultaneously.

(l) Completed signal OFF command (M1404+20n/Y1n4/M4804+20n)*1

This command is used to switch the "positioning START completed signal" (M1200+20n/X1n0/M4000+20n)*1 and the "positioning completed signal" (M1201+20n/X1n1/M4001+20n)*1 OFF in the sequence program.



POINT

Do not switch the "completed signal OFF command" ON by a PLS instruction. Such an action will make it impossible to switch the "positioning START completed signal" (X1n0) and the "positioning completed signal" (X1n1) OFF.

(m) External STOP input invalid command at START (M1409+20n/Y1n9/M4809+20n)*1

This command is used to designate a valid/invalid setting for the external STOP input.

- ON .... The external STOP input will be invalid, and axes where the STOP input is ON can be started.
- OFF ... The external STOP input will be valid, and axes where the STOP input is ON cannot be started.

POINT

After operation has been started by switching Y1n9 ON, switch the STOP input from OFF to ON to stop the operation by an external STOP input. (If the STOP input is ON when the START occurs, switch the STOP input ON → OFF → ON.)

REMARK

*1: The "n" of M1200+20n, M1201+20n, M1402+20n, M1403+20n, M1404+20n, and M1409+20n represents the numerical value corresponding to the virtual axis No.

n	0	1	2	3
Virtual axis No.	1	2	3	4

The "n" of X1n0, X1n1, Y1n2, Y1n3, Y1n4, and Y1n9 represents the numerical value (0 - 7) corresponding to the virtual axis No.

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

The "n" of M4000+20n, M4001+20n, M4802+20n, M4803+20n, M4804+20n, and M4809+20n represents the numerical value corresponding to the virtual axis No.

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

6.3.2 Data registers (D)

The following servo system CPU data registers are used at the drive module:

- For A171SCPU .... D 670 - D759, D960 - D1007, D1012 - D1023
- For A273UHCPU (8-Axis Specification)..... D 670 - D759, D960 - D1007, D1012 - D1023
- For A273UHCPU (32-Axis Specification) ... D670 - D1239

See Appendix 5 "Tables of Processing Times" for details about the delay time between the positioning device (input, internal relay, special relay) turning ON/OFF and the data being stored in the data register area.

(1) Data Register (D) List

(a) When A171SCPU is Used

Table 6.14 Data Register List (for A171SCPU)

Signal Name	Device				
	Synchro-nous Encoder	Virtual Servo Motor			
	P1/E1	Axis 1	Axis 2	Axis 3	Axis 4
Present value following main shaft's differential gear	D686	D670	D672	D674	D676
	D687	D671	D673	D675	D677
Feed present value	–	D700	D706	D712	D718
		D701	D707	D713	D719
Minor error code		D702	D708	D714	D720
Major error code		D703	D709	D715	D721
Execution program No.		D704	D710	D716	D722
M-code		D705	D711	D717	D723
Present value	D748	–	–	–	–
	D749	–	–	–	–
Minor error code	D750	–	–	–	–
Major error code	D751	–	–	–	–
Present value change	–	D960	D966	D972	D978
		D961	D967	D973	D979
Speed change		D962	D968	D974	D980
		D963	D969	D975	D981
JOG operation setting		D964	D970	D976	D982
		D965	D971	D977	D983
Manual pulse generator axis setting	D1012	–	–	–	–
JOG simultaneous START axis setting	–	D1015			
Manual pulse generator 1-pulse input magnification setting	–	D1016	D1017	D1018	D1019

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

Table 6.15 Data Register List (for A273UHCPU 8-axis Specification)

Signal Name	Device										
	P1/E1	P2/E2	P3/E3	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Present value following main shaft's differential gear	D686	D688	D690	D670	D672	D674	D676	D678	D680	D682	D684
	D687	D689	D691	D671	D673	D675	D677	D679	D681	D683	D685
Feed present value				D700	D706	D712	D718	D724	D730	D736	D742
				D701	D707	D713	D719	D725	D731	D737	D743
Minor error code	–	–	–	D702	D708	D714	D720	D726	D732	D738	D744
Major error code				D703	D709	D715	D721	D727	D733	D739	D745
Execution program No.				D704	D710	D716	D722	D728	D734	D740	D746
M-code				D705	D711	D717	D723	D729	D735	D741	D747
Present value	D748	D752	D756	–	–	–	–	–	–	–	–
	D749	D753	D757	–	–	–	–	–	–	–	–
Minor error code	D750	D754	D758	–	–	–	–	–	–	–	–
Major error code	D751	D755	D759	–	–	–	–	–	–	–	–
Present value change				D960	D966	D972	D978	D984	D990	D996	D1002
				D961	D967	D973	D979	D985	D991	D997	D1003
Speed change	–	–	–	D962	D968	D974	D980	D986	D992	D998	D1004
				D963	D969	D975	D981	D987	D993	D999	D1005
JOG operation setting				D964	D970	D976	D982	D988	D994	D1000	D1006
				D965	D971	D977	D983	D989	D995	D1001	D1007
Manual pulse generator axis setting	D1012	D1013	D1014	–	–	–	–	–	–	–	–
JOG simultaneous START axis setting	–	–	–	D1015							
Manual pulse generator 1-pulse input magnification setting	–	–	–	D1016	D1017	D1018	D1019	D1020	D1021	D1022	D1023

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

Table 6.16 Data Register List (for A273UHCPU 32-axis Specification)

Signal Name	Device No.								
	Synchronous Encoder								
	P1/E1	P2/E2	P3/E3	P4/E4	P5/E5	P6/E6	Axis 1	Axis 2	Axis 3
JOG speed setting	–	–	–	–	–	–	D640 D641	D642 D643	D644 D645
JOG simultaneous START axis setting									D710,
Manual pulse generator axis setting	D714 - D719						–	–	–
Manual pulse generator 1-pulse input magnification setting	–	–	–	–	–	–	D720	D721	D722
Feed present value							D800 D801	D810 D811	D820 D821
Present value	D1120 D1121	D1130 D1131	D1140 D1141	D1150 D1151	D1160 D1161	D1170 D1171	–	–	–
Minor error code	D1122	D1132	D1142	D1152	D1162	D1172	D802	D812	D822
Major error code	D1123	D1133	D1143	D1153	D1163	D1173	D803	D813	D823
Execution program No.	–	–	–	–	–	–	D804	D814	D824
M-code							D805	D815	D825
Unusable	D1124 D1125	D1134 D1135	D1144 D1145	D1154 D1155	D1164 D1165	D1174 D1175	–	–	–
Present value following main shaft's differential gear	D1126 D1127	D1136 D1137	D1146 D1147	D1156 D1157	D1166 D1167	D1176 D1177	D806 D807	D816 D817	D826 D827
Error search output shaft No.	D1128	D1138	D1148	D1158	D1168	D1178	D808	D818	D828
Constant speed control data set pointer	–	–	–	–	–	–	D809	D819	D829
Unusable	D1129	D1139	D1149	D1159	D1169	D1179	–	–	–

Signal Name	Device No.								
	Synchronous Encoder								
	P7/E7	P8/E8	P9/E9	P10/E10	P11/E11	P12/E12	Axis 17	Axis 18	Axis 19
JOG speed setting	–	–	–	–	–	–	D672 D673	D674 D675	D676 D677
JOG simultaneous START axis setting									D710,
Manual pulse generator axis setting	D714 - D719						–	–	–
Manual pulse generator 1-pulse input magnification setting	–	–	–	–	–	–	D736	D737	D738
Feed present value							D960 D961	D970 D971	D980 D981
Present value	D1180 D1181	D1190 D1191	D1200 D1201	D1210 D1211	D1220 D1221	D1230 D1231	–	–	–
Minor error code	D1182	D1192	D1202	D1212	D1222	D1232	D962	D972	D982
Major error code	D1183	D1193	D1203	D1213	D1223	D1233	D963	D973	D983
Execution program No.	–	–	–	–	–	–	D964	D974	D984
M-code							D965	D975	D985
Unusable	D1184 D1185	D1194 D1195	D1204 D1205	D1214 D1215	D1224 D1225	D1234 D1235	–	–	–
Present value following main shaft's differential gear	D1186 D1187	D1196 D1197	D1206 D1207	D1216 D1217	D1226 D1227	D1236 D1237	D966 D967	D976 D977	D986 D987
Error search output shaft No.	D1188	D1198	D1208	D1218	D1228	D1238	D968	D978	D988
Constant speed control data set pointer	–	–	–	–	–	–	D969	D979	D989
Unusable	D1189	D1199	D1209	D1219	D1229	D1239	–	–	–

Virtual Servo Motor													Signal Direction
Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	
D646	D648	D650	D652	D654	D656	D658	D660	D662	D664	D666	D668	D670	SCPU → PCPU
D647	D649	D651	D653	D655	D657	D659	D661	D663	D665	D667	D669	D671	
D711, 712, 713													
–	–	–	–	–	–	–	–	–	–	–	–	–	
D723	D724	D725	D726	D727	D728	D729	D730	D731	D732	D733	D734	D735	
D830	D840	D850	D860	D870	D880	D890	D900	D910	D920	D930	D940	D950	PCPU → SCPU
D831	D841	D851	D861	D871	D881	D891	D901	D911	D921	D931	D941	D951	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D832	D842	D852	D862	D872	D882	D892	D902	D912	D922	D932	D942	D952	PCPU → SCPU
D833	D843	D853	D863	D873	D883	D893	D903	D913	D923	D933	D943	D953	
D834	D844	D854	D864	D874	D884	D894	D904	D914	D924	D934	D944	D954	
D835	D845	D855	D865	D875	D885	D895	D905	D915	D925	D935	D945	D955	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D836	D846	D856	D866	D876	D886	D896	D906	D916	D926	D936	D946	D956	PCPU → SCPU
D837	D847	D857	D867	D877	D887	D897	D907	D917	D927	D937	D947	D957	
D838	D848	D858	D868	D878	D888	D898	D908	D918	D928	D938	D948	D958	
D839	D849	D859	D869	D879	D889	D899	D909	D919	D929	D939	D949	D959	
–	–	–	–	–	–	–	–	–	–	–	–	–	–

Virtual Servo Motor													Signal Direction
Axis 20	Axis 21	Axis 22	Axis 23	Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	
D678	D680	D682	D684	D686	D688	D690	D692	D694	D696	D698	D700	D702	SCPU → PCPU
D679	D681	D683	D685	D687	D689	D691	D693	D695	D697	D699	D701	D703	
D711, 712, 713													
–	–	–	–	–	–	–	–	–	–	–	–	–	
D739	D740	D741	D742	D743	D744	D745	D746	D747	D748	D749	D750	D751	
D990	D1000	D1010	D1020	D1030	D1040	D1050	D1060	D1070	D1080	D1090	D1100	D1110	PCPU → SCPU
D991	D1001	D1011	D1021	D1031	D1041	D1051	D1061	D1071	D1081	D1091	D1101	D1111	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D992	D1002	D1012	D1022	D1032	D1042	D1052	D1062	D1072	D1082	D1092	D1102	D1112	PCPU → SCPU
D993	D1003	D1013	D1023	D1033	D1043	D1053	D1063	D1073	D1083	D1093	D1103	D1113	
D994	D1004	D1014	D1024	D1034	D1044	D1054	D1064	D1074	D1084	D1094	D1104	D1114	
D995	D1005	D1015	D1025	D1035	D1045	D1055	D1065	D1075	D1085	D1095	D1105	D1115	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D996	D1006	D1016	D1026	D1036	D1046	D1056	D1066	D1076	D1086	D1096	D1106	D1116	PCPU → SCPU
D997	D1007	D1017	D1027	D1037	D1047	D1057	D1067	D1077	D1087	D1097	D1107	D1117	
D998	D1008	D1018	D1028	D1038	D1048	D1058	D1068	D1078	D1088	D1098	D1108	D1118	
D999	D1009	D1019	D1029	D1039	D1049	D1059	D1069	D1079	D1089	D1099	D1109	D1119	
–	–	–	–	–	–	–	–	–	–	–	–	–	–

(2) Data register (D) details

(a) Storage register for present value following the main shaft's differential gear .... Data sent from PCPU to SCPU

1) When switching to the VIRTUAL mode occurs, the same present value as that of the main shaft's drive module is adopted.

2) When a present value change is made at the main shaft's drive module, the present value following the main shaft's differential gear is also changed to the designated value at that time.

3) If no differential gear is connected to the main shaft, the present value of the main shaft's drive module will be stored at the storage register for the present value following the main shaft's differential gear.

4) The update cycle for the monitor device is as follows:

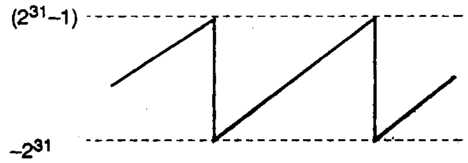
See Appendix 5 for details about the monitor device refresh period.

(b) Feed present value storage register .... Data sent from PCPU to SCPU

1) The target address which was output to the virtual servo motor in accordance with the servo program's positioning address and travel value is stored at this register.

2) This feed present value data is subjected to a stroke range check.

3) A "-2^{31} pulse to $(2^{31}-1)$ pulse" ring address is established.



4) Data in the feed present value storage register is stored in a backup memory when a power OFF or servo system CPU reset occurs.

5) The update cycle for the monitor device is as follows.

See Appendix 5 for details about the monitor device refresh period.

(c) Minor error code storage register .... Data sent from PCPU to SCPU

1) When a minor error occurs at the virtual servo motor/synchronous encoder, or at the output module, the corresponding error code (see Section 10.3) is stored in this register.

   Each time a minor error occurs, the previous error code stored in this register will be overwritten by the new error code.

2) To clear error codes for minor errors which occurred at the virtual servo motor or synchronous encoder, execute the drive module error reset command *1.

   To clear error codes for minor errors which occurred at the output module, execute the output module error reset command *2.

(d) Major error code storage register .... Data sent from PCPU to SCPU

1) When a major error occurs at the virtual servo motor/synchronous encoder, or at the output module, the corresponding error code (see Section 10.3) is stored in this register.

   Each time a major error occurs, the previous error code stored in this register will be overwritten by the new error code.

2) To clear error codes for major errors which occurred at the virtual servo motor or synchronous encoder, execute the drive module error reset command *1.

   To clear error codes for major errors which occurred at the output module, execute the output module error reset command *2.

(e) Execution program No. storage register
.... Data sent from PCPU to SCPU

1) The No. of the program being run is stored in this register when the DSFRP/SVST instruction is executed.

2) When the DSFRP/SVST instruction is not executed, the following values are stored in this register.

   - JOG operation .... FFFF $_H$
   - At power ON .... FF00 $_H$
   - When REAL → VIRTUAL mode switching occurs ... FF00 $_H$

REMARK

*1: For details regarding the drive module error reset command, see Section 6.3.1.

*2: For details regarding the output module error reset command, see Section 8.5.1.

(f) M-code storage register .... Data sent from PCPU to SCPU

1) The M-code settings in the servo program being run are stored in this register when positioning is started.

   If the servo program contains no M-codes, "0" will be stored.

2) The stored data will not be changed if positioning is started by a means other than a servo program.

3) The stored data will revert to "0" when REAL to VIRTUAL mode switching occurs at the leading edge of the programmable controller READY signal (M2000).

(g) Present value storage register .... Data sent from PCPU to SCPU

1) The virtual drive module and synchronous encoder present values are stored in this register.

2) A "–2147483648 (-2^{31}) pulse to 2147483647 ($2^{31}-1$)" ring address is established.

3) Data in the present value storage register is stored in a backup memory when a power OFF or servo system CPU reset occurs.

(h) Present value change register .... Data sent from SCPU to PCPU

1) When the feed present value of a stopped axis is changed, the new feed value is stored in this register.

2) The present value change register's setting range is as follows: "–2147483648 (-2^{31}) pulse to 2147483647 ($2^{31}-1$)"

3) When a positioning control change instruction (DSFLP/CHGA) *1 is executed, the value designated in the present value change register will become the feed present value. (See Appendix 4)

(i) Speed change register .... Data sent from SCPU to PCPU

1) When a speed change occurs at an axis in motion, the new speed is stored in this register.

2) The speed change register's setting range is "1 to 1000000 pulse/s."

3) When a positioning control change instruction (DSFLP)*1 is executed, the value designated in the speed change register will become the positioning speed value. (See Appendix 4)

REMARK

*1: For details regarding the positioning control change instructions, see Section 5.3 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

(j) Error search output shaft No. storage register
.... Data sent from SCPU to PCPU

1) If an error is found by the error search function while in the VIRTUAL mode, the axis No. of the output module where the error occurred will be stored in this register.

2) If a minor or major error occurs at an output shaft, the No. of the drive module axis where the output shaft is connected will be stored in this register, even if no error exists at the main shaft or auxiliary input shaft drive module (virtual servo motor and synchronous encoder) axes.

3) Error search and error reset

i) Error search at main shaft

Main shaft error searches are conducted for output axes connected to the main shaft, beginning from the lowest axis No.

The axis No. where a minor or major error is found will be stored in this error search output shaft No. storage register.

If an error reset is executed at this output shaft, the No. of another (if any) output shaft where an error exists will be stored.

ii) Error search at auxiliary input shaft

Auxiliary input shaft error searches are conducted for output axes connected to the auxiliary input shaft, beginning from the lowest axis No.

The axis No. where a minor or major error is found will be stored in this error search output shaft No. storage register.

However, if an auxiliary input to the main shaft occurs, using the differential gear (for virtual main shaft connection), an error search will not be conducted at output shafts which are connected to the auxiliary input shaft. In this case, output shaft errors will appear at the storage register for the main shaft.

4) Drive module axis errors

If an error occurs at the main shaft or auxiliary input shaft to which the output shaft is connected, "0" will be stored at the error search output shaft No. storage register, even if an error occurs at the output shaft.

(k) JOG speed setting register .... Data sent from SCPU to PCPU

1) The JOG speed which is used at JOG operations is stored in this register.
2) The JOG speed setting range is 1 to 1000000 pulse/s.
3) The JOG speed setting stored in this register is adopted at the leading edge (OFF → ON) of the JOG START signal.

   Even if the JOG speed setting is changed while a JOG operation is in progress, the JOG speed will remain unchanged.
4) For details regarding JOG operation, see Section 7.19 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

(l) JOG simultaneous START axis setting register
.... Data sent from SCPU to PCPU

1) The axis Nos. and operation directions of simultaneous START axes at a JOG operation are stored in this register.

i) When A171SCPU is Used

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

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

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

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

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

* The JOG simultaneous START axis setting is designated as "1" or "0".
1: Simultaneous START ON
0: Simultaneous START OFF

2) If the bit settings for a forward JOG start and reverse JOG start are both set to "1" for the same axis when the A273UHCPU (32-axis specification) is used, a minor error will be activated for that axis, and only a forward JOG start will occur.

(m) Manual pulse generator axis setting register
.... Data sent from SCPU to PCPU

1) The axis Nos. controlled by manual pulse generators P1 to P3 are stored in this register.

i) <A171SCPU>

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

Set up to 3 decimal digits, with the controlled axes (1 to 4) set at each digit.

ii) <A273UHCPU (8-axis specification)>

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

Set up to 3 decimal digits, with the controlled axes (1 to 8) set at each digit.

iii) <A273UHCPU (32-axis specification)>

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

- The settings for the axes controlled by manual pulse generators are made with "0" and "1".
  - 1: Designated axis
  - 0: Non-designated axis

(n) Manual pulse generator 1-pulse input magnification setting register
.... Data sent from SCPU to PCPU

1) During manual pulse generator operation, the "magnification (1 - 100) per pulse" setting is designated at this register.

<A171SCPU>

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

<A273UHCPU (8-axis)>

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

<A273UHCPU (32-axis)>

1-pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D720	Axis 1	1 - 100
D721	Axis 2	
D722	Axis 3	
D723	Axis 4	
D724	Axis 5	
D725	Axis 6	
D726	Axis 7	
D727	Axis 8	
D728	Axis 9	
D729	Axis 10	
D730	Axis 11	
D731	Axis 12	
D732	Axis 13	
D733	Axis 14	
D734	Axis 15	
D735	Axis 16	
D736	Axis 17	
D737	Axis 18	
D738	Axis 19	
D739	Axis 20	
D740	Axis 21	
D741	Axis 22	
D742	Axis 23	
D743	Axis 24	
D744	Axis 25	
D745	Axis 26	
D746	Axis 27	
D747	Axis 28	
D748	Axis 29	
D749	Axis 30	
D750	Axis 31	
D751	Axis 32	

REMARKS

(1) For details regarding manual pulse generator operation, see Section 7.20 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

(2) For details regarding JOG operation, see Section 7.19 of the Motion Controller (SV13/22) Programming Manual (REAL Mode).

MEMO

7. TRANSMISSION MODULE

There are the following four types of transmission module.

- Gear .... Section 7.1
- Clutch .... Section 7.2
- Speed change gear ... Section 7.3
- Differential gear .... Section 7.4

7.1 Gear

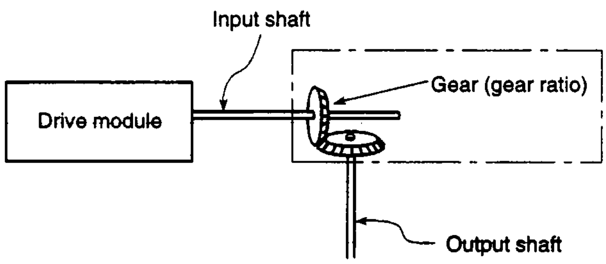
The operation of the gear and the parameters required to use a gear are explained here.

7.1.1 Gear operation

(1) The gear transfers a number of pulses which is the travel value (number of pulses) of the drive module (virtual servo motor, synchronous encoder) multiplied by the gear ratio set in the parameters, to the output shaft.

[Number of output shaft pulses] = [number of input shaft pulses] × [gear ratio]
(Units: pulses)

(2) The direction of rotation of the output shaft is set in the gear parameters.



REMARK

See Section 7.1.2 for details on the gear parameters.

7.1.2 Parameters

The gear parameters are presented in Table 7.1, and the items in this table are explained in (1) and (2) below. (For the method for setting gear parameters, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.)

Table 7.1 Parameter List

No.	Setting Item		Setting Default Value	Setting Range: Direct Setting	Setting Range: Indirect Setting	
1	Gear ratio	Number of gear teeth at input shaft (G_I)	1	1 - 65535	A171SCPU	D0 - D699
						W0 - W3FF
					A273UHCPU (8-axis specification)	D0 - D699 D1024 - D8191
						W0 - W1FFF
					A273UHCPU (32-axis specification)	D800 - D3069 D3080 - D8191
						W0 - W1FFF
		Number of gear teeth at output shaft (Go) (Gs)	1	1 - 65535	A171SCPU	D0 - D699
						W0 - W3FF
					A273UHCPU (8-axis specification)	D0 - D699 D1024 - D8191
						W0 - W1FFF
					A273UHCPU (32-axis specification)	D800 - D3069 D3080 - D8191
						W0 - W1FFF
2	Direction of rotation of output shaft		Forward	Forward Reverse	–	

(1) Gear ratio

(a) The gear ratio is the setting which determines the number of output pulses that are transmitted to the output shaft for every pulse from the drive module.

(b) The gear ratio is determined by the settings for the number of gear teeth at the input shaft (G_I) and the number of gear teeth at the output shaft (Go).

$$\text{Gear ratio} = \frac{\text{number of gear teeth at input shaft } (G_I)}{\text{number of gear teeth at output shaft (Go)}}$$

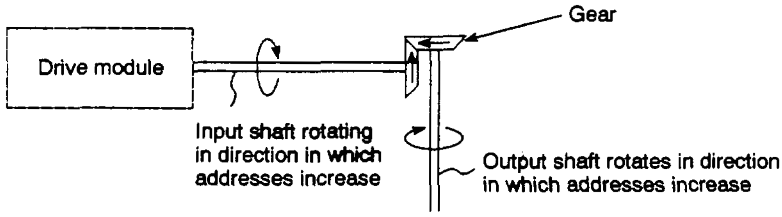
(2) Direction of rotation of output shaft

(a) This is the setting for the direction of rotation of the output shaft with respect to the direction of rotation of the input shaft.

(b) There are two directions of rotation for the output shaft: forward and reverse.

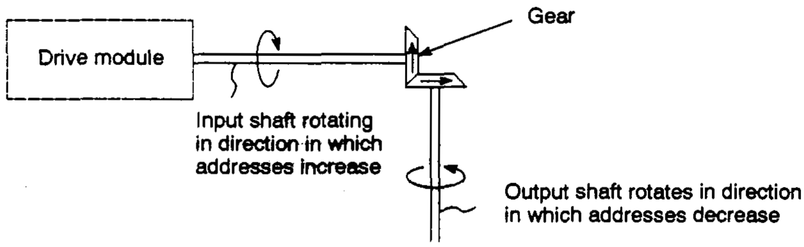
1) Forward

When the input shaft rotates in the direction in which addresses increase, the output shaft also rotates in the direction in which addresses increase.



2) Reverse

When the input shaft rotates in the direction in which addresses increase, the output shaft rotates in the direction in which addresses decrease.



7.2 Clutch

There are two types of clutch: the smoothing clutch and the direct clutch.

These two clutches operate in the same way; the difference is that with the smoothing clutch, acceleration and deceleration processing by smoothing processing is executed when the clutch is switched ON and OFF but this does not happen with the direct clutch.

(1) Comparison of smoothing clutch and direct clutch

(a) Smoothing clutch

When the clutch is switched ON/OFF, the output to the output shaft is executed by acceleration and deceleration processing (smoothing processing) in accordance with the smoothing time constant or amount of slip set in the clutch parameters.

(b) Direct clutch

When the clutch is switched ON/OFF, output to the output shaft is executed without acceleration and deceleration processing.

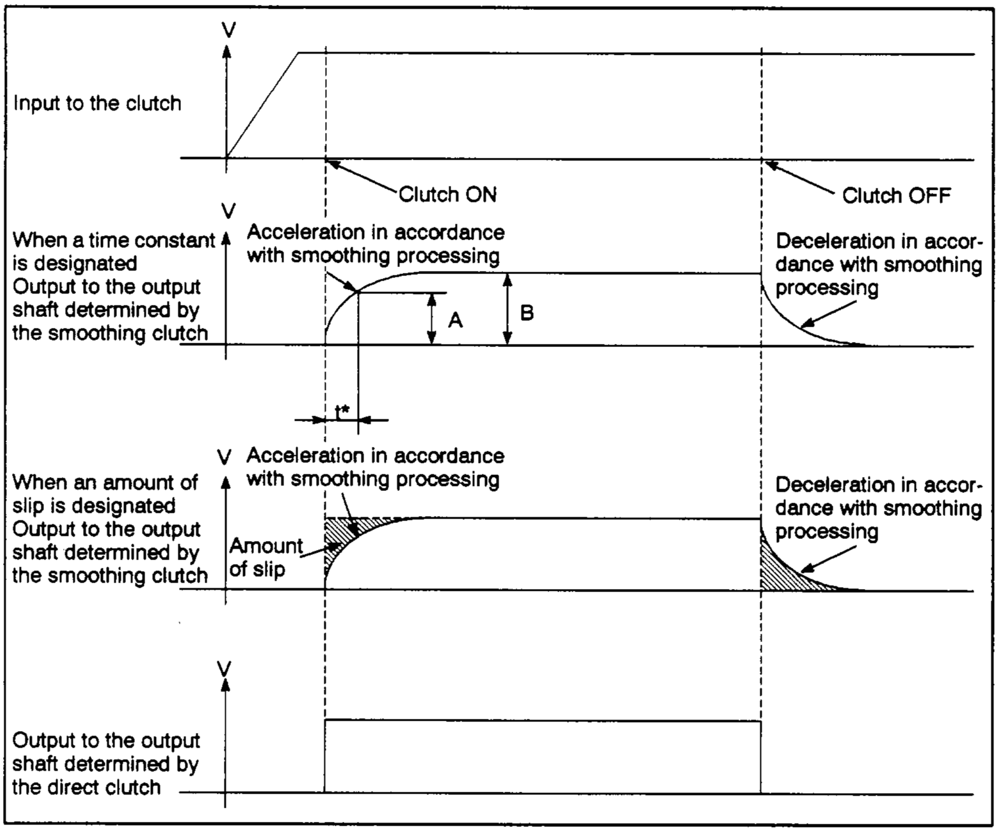


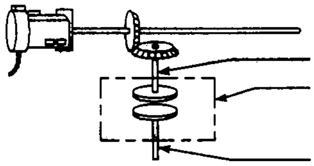
Fig. 7.1 Output to the Output Shaft Determined by the Smoothing Clutch and Direct Clutch

REMARKS

(1) Clutch ON/OFF status

Clutch ON status . . . The status in which pulses input to the clutch are output to the output shaft.

Clutch OFF status . . The status in which pulses input to the clutch are not output to the output shaft.



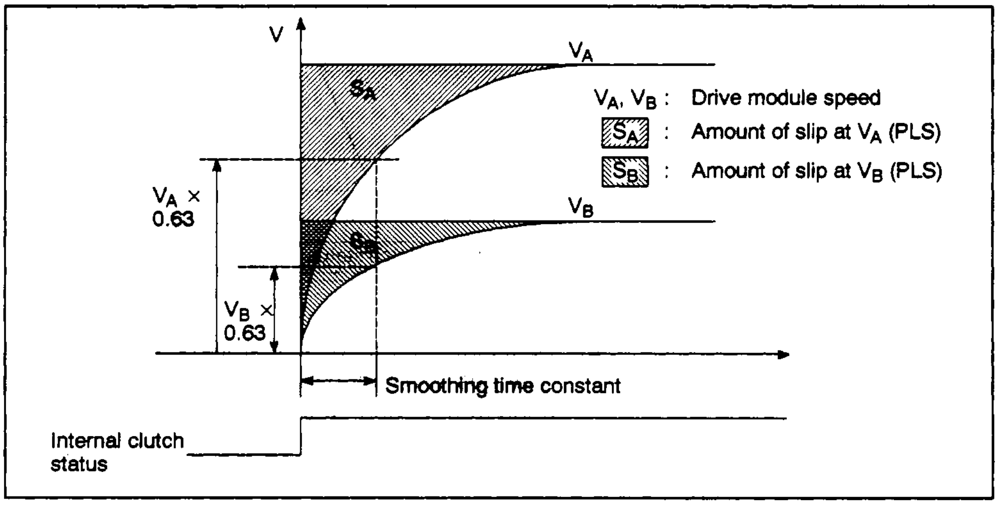
(2) • t: Smoothing time constant "t" is the time taken to reach the following condition:

$$t = \frac{A}{B} \times 100 = 63\%$$

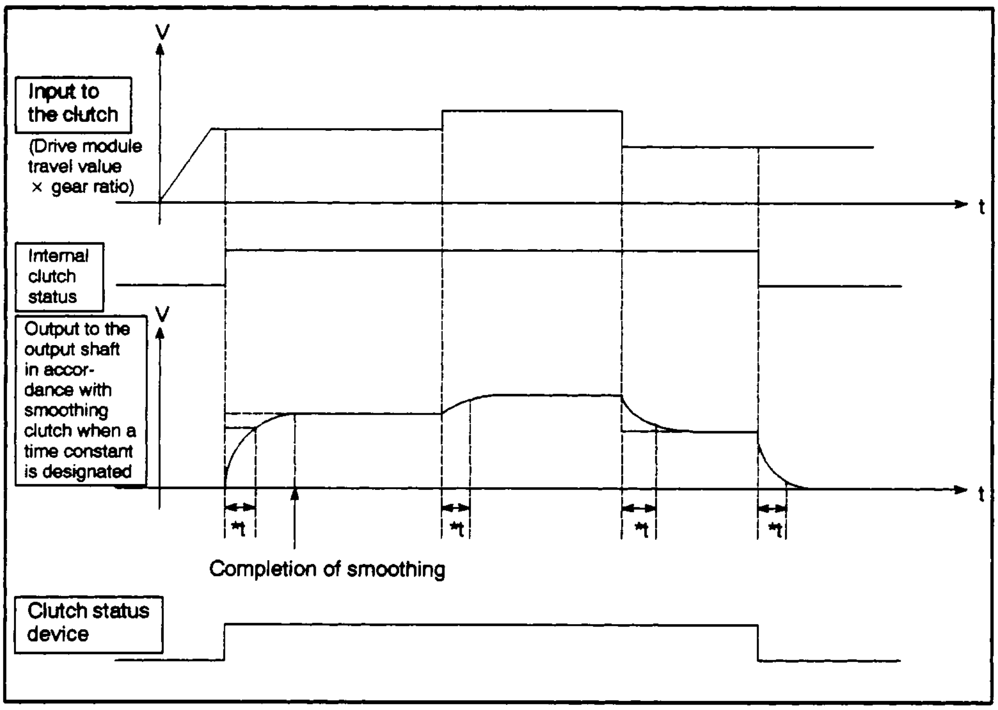
(2) Smoothing processing

(a) Method in which a smoothing time constant is designated

1) Since the time constant is fixed, the amount of slip of the clutch changes according to the speed of the drive module.



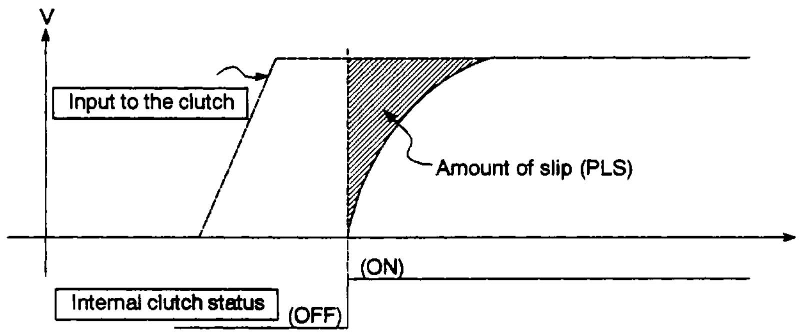
2) If the input to the clutch (drive module travel value x gear ratio) changes after completion of smoothing, smoothing processing is executed at that point also.



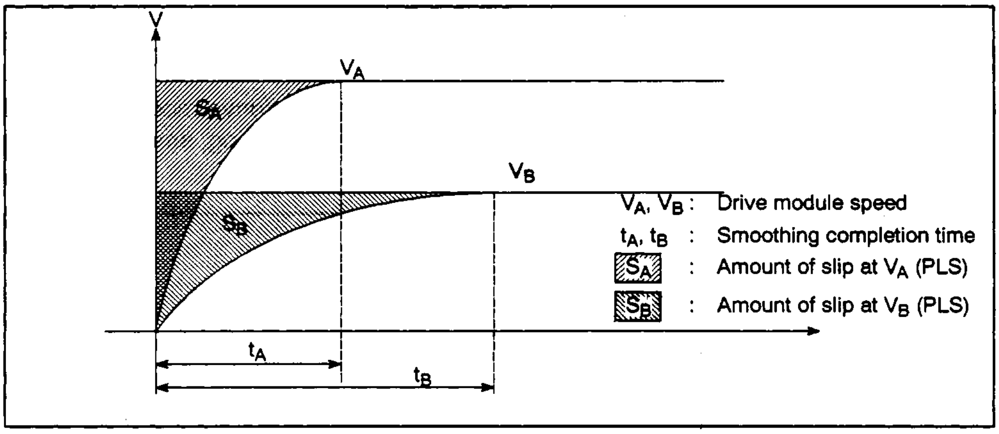
*t : Smoothing time constant

(b) Method in which the amount of slip is designated

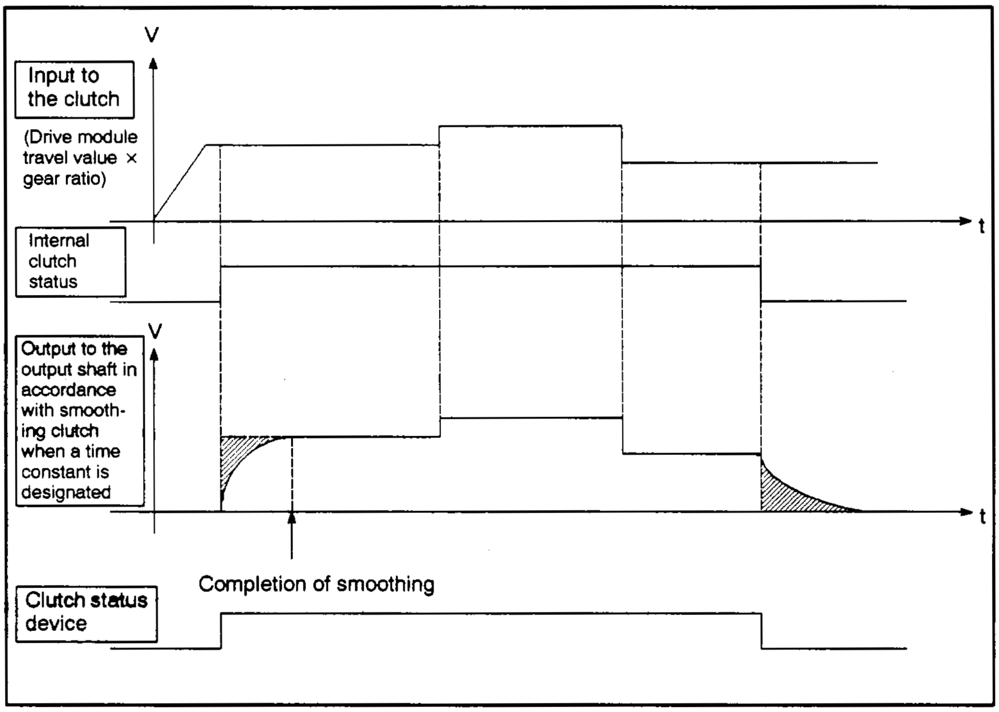
1) Designate the amount of slip indicated by the shaded area in the diagram below. You are recommended to designate an amount of slip that is greater than the input to the clutch (drive module travel value x gear ratio).



2) Since the amount of slip remains constant even if the drive module speed changes, the clutch ON/OFF position can be controlled without any influence from speed changes.



3) If the input to the clutch (drive module travel value x gear ratio) changes after completion of smoothing, smoothing processing is not executed at that point and direct output continues.



7.2.1 Explanation of clutch operation

There are three clutch modes:

- ON/OFF mode
- Address mode
- External input mode

Each of these modes is explained below.

(1) ON/OFF mode

(a) In this mode, the clutch is turned ON and OFF in accordance with the ON/OFF status of the clutch ON/OFF command device.

1) When the clutch ON/OFF command device comes ON, the clutch is set to the ON status.

2) When the clutch ON/OFF command device goes OFF, the clutch is set to the OFF status.

(b) In the ON/OFF mode, there is a maximum time lapse of 7.1 ms between the ON/OFF of the clutch ON/OFF device and the clutch being set to the ON/OFF status.

If greater accuracy is required, use the "address mode".

(c) The clutch ON/OFF status can be checked by means of the clutch ON/OFF status device.

1) When using A171SCPU

Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M1984
	Auxiliary input shaft	M1985
Output module for axis 2	Drive shaft	M1986
	Auxiliary input shaft	M1987
Output module for axis 3	Drive shaft	M1988
	Auxiliary input shaft	M1989
Output module for axis 4	Drive shaft	M1990
	Auxiliary input shaft	M1991

2) When using A273UHCPU (8-axis specification)

Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M1984
	Auxiliary input shaft	M1985
Output module for axis 2	Drive shaft	M1986
	Auxiliary input shaft	M1987
Output module for axis 3	Drive shaft	M1988
	Auxiliary input shaft	M1989
Output module for axis 4	Drive shaft	M1990
	Auxiliary input shaft	M1991
Output module for axis 5	Drive shaft	M1992
	Auxiliary input shaft	M1993
Output module for axis 6	Drive shaft	M1994
	Auxiliary input shaft	M1995
Output module for axis 7	Drive shaft	M1996
	Auxiliary input shaft	M1997
Output module for axis 8	Drive shaft	M1998
	Auxiliary input shaft	M1999

3) When using A273UHCPU (32-axis specification)

Connected Module		Corresponding Device	Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M2160	Output module for axis 17	Drive shaft	M2192
	Auxiliary input shaft	M2161		Auxiliary input shaft	M2193
Output module for axis 2	Drive shaft	M2162	Output module for axis 18	Drive shaft	M2194
	Auxiliary input shaft	M2163		Auxiliary input shaft	M2195
Output module for axis 3	Drive shaft	M2164	Output module for axis 19	Drive shaft	M2196
	Auxiliary input shaft	M2165		Auxiliary input shaft	M2197
Output module for axis 4	Drive shaft	M2166	Output module for axis 20	Drive shaft	M2198
	Auxiliary input shaft	M2167		Auxiliary input shaft	M2199
Output module for axis 5	Drive shaft	M2168	Output module for axis 21	Drive shaft	M2200
	Auxiliary input shaft	M2169		Auxiliary input shaft	M2201
Output module for axis 6	Drive shaft	M2170	Output module for axis 22	Drive shaft	M2202
	Auxiliary input shaft	M2171		Auxiliary input shaft	M2203
Output module for axis 7	Drive shaft	M2172	Output module for axis 23	Drive shaft	M2204
	Auxiliary input shaft	M2173		Auxiliary input shaft	M2205
Output module for axis 8	Drive shaft	M2174	Output module for axis 24	Drive shaft	M2206
	Auxiliary input shaft	M2175		Auxiliary input shaft	M2207
Output module for axis 9	Drive shaft	M2176	Output module for axis 25	Drive shaft	M2208
	Auxiliary input shaft	M2177		Auxiliary input shaft	M2209
Output module for axis 10	Drive shaft	M2178	Output module for axis 26	Drive shaft	M2210
	Auxiliary input shaft	M2179		Auxiliary input shaft	M2211
Output module for axis 11	Drive shaft	M2180	Output module for axis 27	Drive shaft	M2212
	Auxiliary input shaft	M2181		Auxiliary input shaft	M2213
Output module for axis 12	Drive shaft	M2182	Output module for axis 28	Drive shaft	M2214
	Auxiliary input shaft	M2183		Auxiliary input shaft	M2215
Output module for axis 13	Drive shaft	M2184	Output module for axis 29	Drive shaft	M2216
	Auxiliary input shaft	M2185		Auxiliary input shaft	M2217
Output module for axis 14	Drive shaft	M2186	Output module for axis 30	Drive shaft	M2218
	Auxiliary input shaft	M2187		Auxiliary input shaft	M2219
Output module for axis 15	Drive shaft	M2188	Output module for axis 31	Drive shaft	M2220
	Auxiliary input shaft	M2189		Auxiliary input shaft	M2221
Output module for axis 16	Drive shaft	M2190	Output module for axis 32	Drive shaft	M2222
	Auxiliary input shaft	M2191		Auxiliary input shaft	M2223

(d) See Appendix 5 for details about the refresh period of the clutch ON/OFF status device.

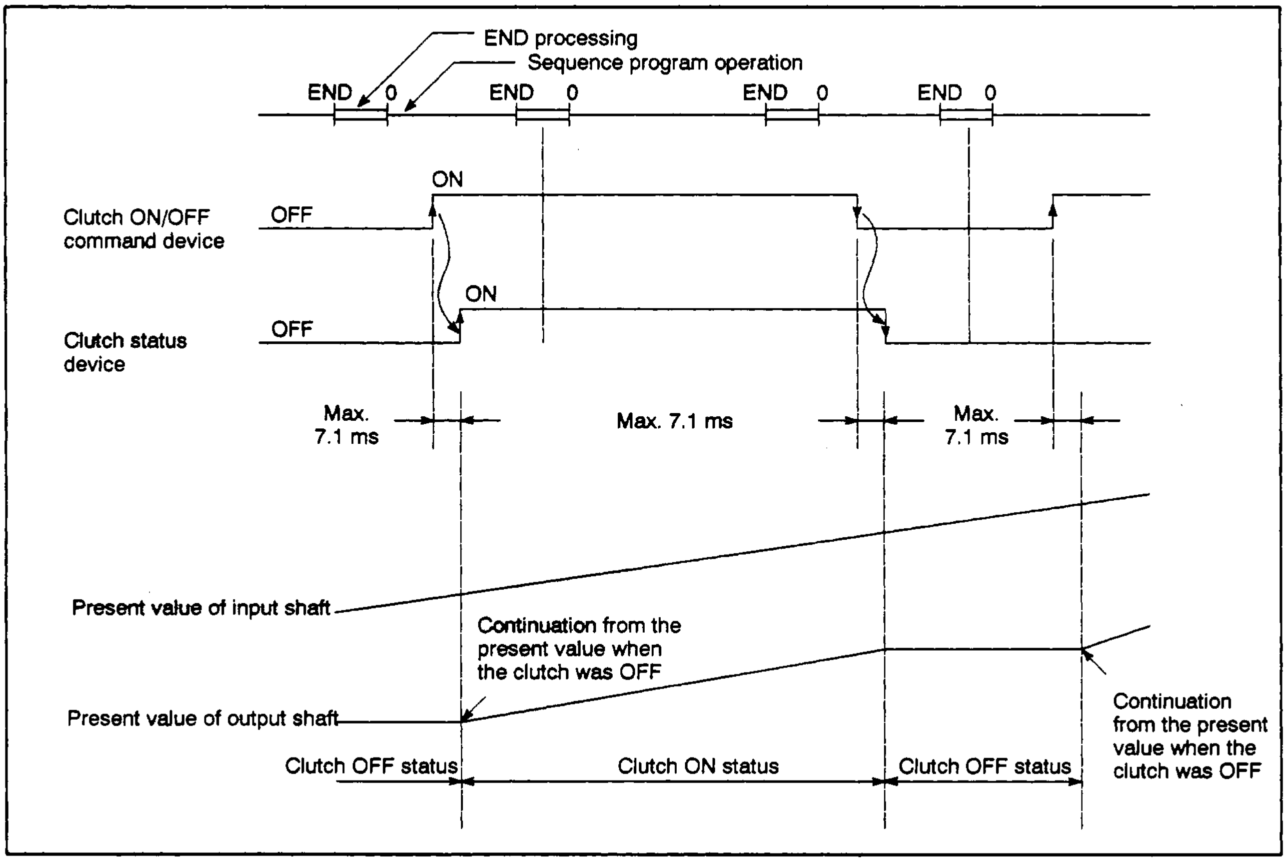


Fig. 7.2 Operation Timing for the ON/OFF Mode

(2) Address mode

(a) In this mode, the clutch is turned ON and OFF in accordance with the clutch ON/OFF command device and the present value of the virtual axis (effective when the mode setting device is set to "1").

1) When the designated clutch ON address is reached while the clutch ON/OFF command is ON, the clutch is set to the ON status.

2) When the designated OFF address is reached while the clutch ON/OFF command is OFF, the clutch is set to the OFF status.

(b) The clutch ON/OFF control differs according to the type of output module connected.

1) If the output module is a ball screw or roller, ON/OFF control is executed in accordance with the present value of the virtual axis.

If a differential gear is connected to the main shaft, ON/OFF control is executed in accordance with the present value after the main shaft's differential gear.

2) If the output module is a rotary table or cam, ON/OFF control is based on the virtual axis present value in one revolution.

See Rotary Tables and Cams in Section 8 "Output Modules" for details.

(c) Make sure that the clutch ON/OFF command device is turned ON/OFF, and the status in which the clutch ON/OFF address can be accepted is established, before the present value of the virtual axis reaches the clutch ON/OFF address.

In the address mode, a delay occurs from the time the clutch ON/OFF command device is turned ON/OFF until the clutch ON/OFF address can be accepted.

See Appendix 5 for details about the delay times.

1) When the clutch ON/OFF device is OFF, the clutch will not be set to the ON status even if the clutch ON address is reached.

2) When the clutch ON/OFF device is ON, the clutch will not be set to the OFF status even if the clutch OFF address is reached.

(d) The clutch ON/OFF status can be checked by means of the clutch ON/OFF status device.

1) When using A171SCPU

Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M1984
	Auxiliary input shaft	M1985
Output module for axis 2	Drive shaft	M1986
	Auxiliary input shaft	M1987
Output module for axis 3	Drive shaft	M1988
	Auxiliary input shaft	M1989
Output module for axis 4	Drive shaft	M1990
	Auxiliary input shaft	M1991

2) When using A273UHCPU (8-axis specification)

Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M1984
	Auxiliary input shaft	M1985
Output module for axis 2	Drive shaft	M1986
	Auxiliary input shaft	M1987
Output module for axis 3	Drive shaft	M1988
	Auxiliary input shaft	M1989
Output module for axis 4	Drive shaft	M1990
	Auxiliary input shaft	M1991
Output module for axis 5	Drive shaft	M1992
	Auxiliary input shaft	M1993
Output module for axis 6	Drive shaft	M1994
	Auxiliary input shaft	M1995
Output module for axis 7	Drive shaft	M1996
	Auxiliary input shaft	M1997
Output module for axis 8	Drive shaft	M1998
	Auxiliary input shaft	M1999

3) When using A273UHCPU (32-axis specification)

Connected Module		Corresponding Device	Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M2160	Output module for axis 17	Drive shaft	M2192
	Auxiliary input shaft	M2161		Auxiliary input shaft	M2193
Output module for axis 2	Drive shaft	M2162	Output module for axis 18	Drive shaft	M2194
	Auxiliary input shaft	M2163		Auxiliary input shaft	M2195
Output module for axis 3	Drive shaft	M2164	Output module for axis 19	Drive shaft	M2196
	Auxiliary input shaft	M2165		Auxiliary input shaft	M2197
Output module for axis 4	Drive shaft	M2166	Output module for axis 20	Drive shaft	M2198
	Auxiliary input shaft	M2167		Auxiliary input shaft	M2199
Output module for axis 5	Drive shaft	M2168	Output module for axis 21	Drive shaft	M2200
	Auxiliary input shaft	M2169		Auxiliary input shaft	M2201
Output module for axis 6	Drive shaft	M2170	Output module for axis 22	Drive shaft	M2202
	Auxiliary input shaft	M2171		Auxiliary input shaft	M2203
Output module for axis 7	Drive shaft	M2172	Output module for axis 23	Drive shaft	M2204
	Auxiliary input shaft	M2173		Auxiliary input shaft	M2205
Output module for axis 8	Drive shaft	M2174	Output module for axis 24	Drive shaft	M2206
	Auxiliary input shaft	M2175		Auxiliary input shaft	M2207
Output module for axis 9	Drive shaft	M2176	Output module for axis 25	Drive shaft	M2208
	Auxiliary input shaft	M2177		Auxiliary input shaft	M2209
Output module for axis 10	Drive shaft	M2178	Output module for axis 26	Drive shaft	M2210
	Auxiliary input shaft	M2179		Auxiliary input shaft	M2211
Output module for axis 11	Drive shaft	M2180	Output module for axis 27	Drive shaft	M2212
	Auxiliary input shaft	M2181		Auxiliary input shaft	M2213
Output module for axis 12	Drive shaft	M2182	Output module for axis 28	Drive shaft	M2214
	Auxiliary input shaft	M2183		Auxiliary input shaft	M2215
Output module for axis 13	Drive shaft	M2184	Output module for axis 29	Drive shaft	M2216
	Auxiliary input shaft	M2185		Auxiliary input shaft	M2217
Output module for axis 14	Drive shaft	M2186	Output module for axis 30	Drive shaft	M2218
	Auxiliary input shaft	M2187		Auxiliary input shaft	M2219
Output module for axis 15	Drive shaft	M2188	Output module for axis 31	Drive shaft	M2220
	Auxiliary input shaft	M2189		Auxiliary input shaft	M2221
Output module for axis 16	Drive shaft	M2190	Output module for axis 32	Drive shaft	M2222
	Auxiliary input shaft	M2191		Auxiliary input shaft	M2223

(e) See Appendix 5 for details about the refresh period of the clutch ON/OFF status device.

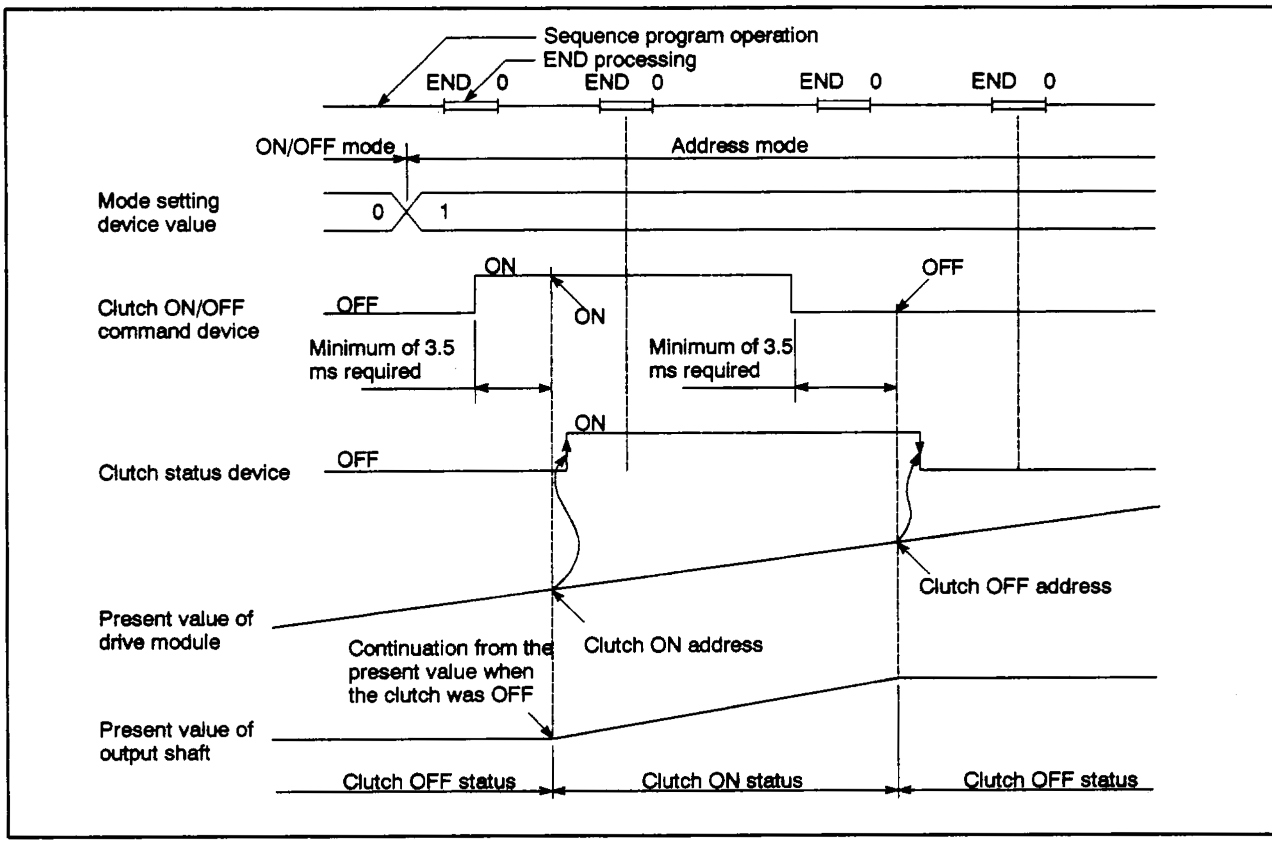


Fig. 7.3 Operation Timing for the Address Mode

POINTS

(1) If the mode setting device stores a value other than "0" or "1", this is regarded as an error and control is continued on the basis of the previously set value.

(2) See Appendix 5 for details about reading periods of the clutch ON/OFF address setting device value.

(3) Control mode changes (mode setting device value: 0 ↔ 1) are valid at any time.

(3) External input mode

(a) In this mode the clutch is turned ON and OFF in accordance with the clutch ON/OFF command bit device and the external input (TREN signal: synchronous encoder start signal).

Since the input pulses from the synchronous encoder are counted in response to the leading edge of the external input signal, the clutch in this mode gives high-speed response and high accuracy.

1) The clutch is set to the ON status at the leading edge (OFF → ON) of the external input signal after the clutch ON/OFF command bit device has come ON.

2) When the clutch ON/OFF command bit device goes OFF, the clutch is set to the OFF status after a maximum delay of 7.1 ms.

(b) Make sure that the clutch ON/OFF command device is turned ON and the external input acceptance enabled status is established before the external input (TREN signal) comes ON.

In the external input mode, a maximum of 7.1 ms is required after the clutch ON/OFF command device comes ON before the external input acceptance enabled status is established.

1) When the clutch ON/OFF command device is OFF, the clutch is not set to the ON status even if the external input changes from OFF to ON.

2) When the external input is ON, the clutch is not set to the ON status even if the clutch ON/OFF status comes ON.

3) Even if the external input goes OFF after the clutch has been set to the ON status, the clutch will remain ON.

(c) The clutch ON/OFF status can be checked by means of the clutch ON/OFF status device.

The ON/OFF status of the clutch status device is refreshed at 3.5 ms intervals.

1) When using A171SCPU

Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M1984
	Auxiliary input shaft	M1985
Output module for axis 2	Drive shaft	M1986
	Auxiliary input shaft	M1987
Output module for axis 3	Drive shaft	M1988
	Auxiliary input shaft	M1989
Output module for axis 4	Drive shaft	M1990
	Auxiliary input shaft	M1991

2) When using A273UHCPU (8-axis specification)

Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M1984
	Auxiliary input shaft	M1985
Output module for axis 2	Drive shaft	M1986
	Auxiliary input shaft	M1987
Output module for axis 3	Drive shaft	M1988
	Auxiliary input shaft	M1989
Output module for axis 4	Drive shaft	M1990
	Auxiliary input shaft	M1991
Output module for axis 5	Drive shaft	M1992
	Auxiliary input shaft	M1993
Output module for axis 6	Drive shaft	M1994
	Auxiliary input shaft	M1995
Output module for axis 7	Drive shaft	M1996
	Auxiliary input shaft	M1997
Output module for axis 8	Drive shaft	M1998
	Auxiliary input shaft	M1999

3) When using A273UHCPU (32-axis specification)

Connected Module		Corresponding Device	Connected Module		Corresponding Device
Output module for axis 1	Drive shaft	M2160	Output module for axis 17	Drive shaft	M2192
	Auxiliary input shaft	M2161		Auxiliary input shaft	M2193
Output module for axis 2	Drive shaft	M2162	Output module for axis 18	Drive shaft	M2194
	Auxiliary input shaft	M2163		Auxiliary input shaft	M2195
Output module for axis 3	Drive shaft	M2164	Output module for axis 19	Drive shaft	M2196
	Auxiliary input shaft	M2165		Auxiliary input shaft	M2197
Output module for axis 4	Drive shaft	M2166	Output module for axis 20	Drive shaft	M2198
	Auxiliary input shaft	M2167		Auxiliary input shaft	M2199
Output module for axis 5	Drive shaft	M2168	Output module for axis 21	Drive shaft	M2200
	Auxiliary input shaft	M2169		Auxiliary input shaft	M2201
Output module for axis 6	Drive shaft	M2170	Output module for axis 22	Drive shaft	M2202
	Auxiliary input shaft	M2171		Auxiliary input shaft	M2203
Output module for axis 7	Drive shaft	M2172	Output module for axis 23	Drive shaft	M2204
	Auxiliary input shaft	M2173		Auxiliary input shaft	M2205
Output module for axis 8	Drive shaft	M2174	Output module for axis 24	Drive shaft	M2206
	Auxiliary input shaft	M2175		Auxiliary input shaft	M2207
Output module for axis 9	Drive shaft	M2176	Output module for axis 25	Drive shaft	M2208
	Auxiliary input shaft	M2177		Auxiliary input shaft	M2209
Output module for axis 10	Drive shaft	M2178	Output module for axis 26	Drive shaft	M2210
	Auxiliary input shaft	M2179		Auxiliary input shaft	M2211
Output module for axis 11	Drive shaft	M2180	Output module for axis 27	Drive shaft	M2212
	Auxiliary input shaft	M2181		Auxiliary input shaft	M2213
Output module for axis 12	Drive shaft	M2182	Output module for axis 28	Drive shaft	M2214
	Auxiliary input shaft	M2183		Auxiliary input shaft	M2215
Output module for axis 13	Drive shaft	M2184	Output module for axis 29	Drive shaft	M2216
	Auxiliary input shaft	M2185		Auxiliary input shaft	M2217
Output module for axis 14	Drive shaft	M2186	Output module for axis 30	Drive shaft	M2218
	Auxiliary input shaft	M2187		Auxiliary input shaft	M2219
Output module for axis 15	Drive shaft	M2188	Output module for axis 31	Drive shaft	M2220
	Auxiliary input shaft	M2189		Auxiliary input shaft	M2221
Output module for axis 16	Drive shaft	M2190	Output module for axis 32	Drive shaft	M2222
	Auxiliary input shaft	M2191		Auxiliary input shaft	M2223

(d) The present value of the input shaft (virtual axis) only changes when the clutch is in the ON status.

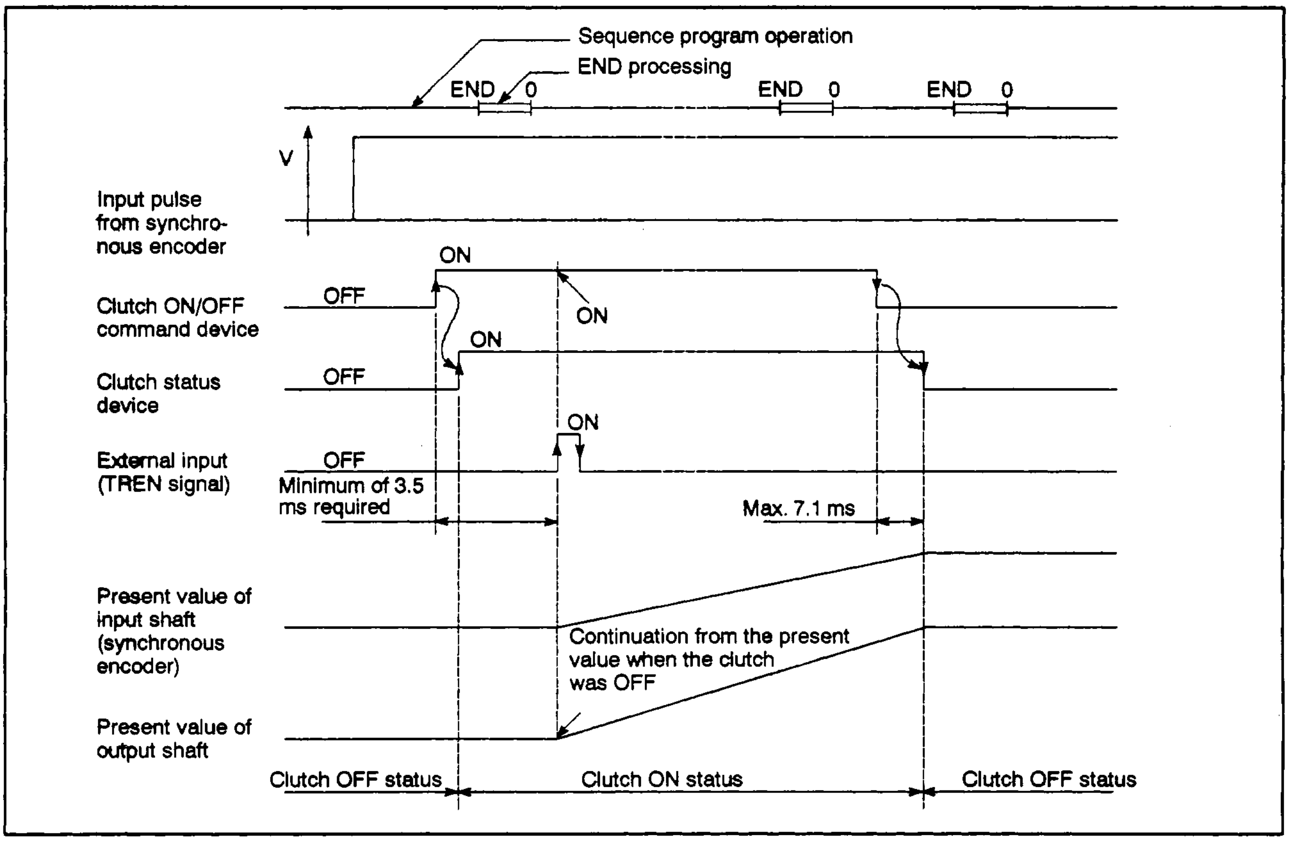


Fig. 7.4 Operation Timing for the External Input Mode

(e) When using the external input mode, only axes for which an incremental synchronous encoder (manual pulse generator) is set as the drive module can be used. Axes for which an absolute synchronous encoder is set as the drive module cannot be used.

(f) A synchronous encoder, external input and external input mode clutch can only be set in a 1:1 ratio.

The relationship between the synchronous encoder and external input is shown in the table below.

1) When A171SCPU is used

Synchronous Encoder	External Input (TREN Signal)
P1/E1	TREN 1

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

Synchronous Encoder	External Input (TREN Signal)
P1/E1	TREN 1
P2/E2	TREN 2
P3/E3	TREN 3

3) When using A273UHCPU (32-axis specification)

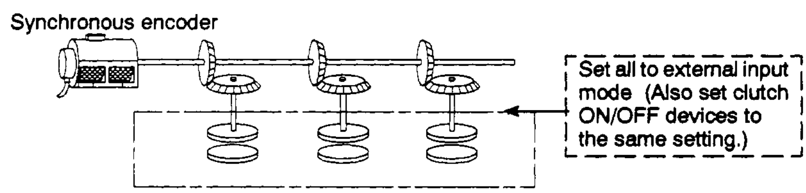
Synchronous Encoder	External Input (TREN Signal)	Synchronous Encoder	External Input (TREN Signal)
P1/E1	TREN 1	P7/E7	TREN 7
P2/E2	TREN 2	P8/E8	TREN 8
P3/E3	TREN 3	P9/E9	TREN 9
P4/E4	TREN 4	P10/E10	TREN 10
P5/E5	TREN 5	P11/E11	TREN 11
P6/E6	TREN 6	P12/E12	TREN 12

(g) If the clutch connected to an encoder is used in the external input mode, all other clutches connected to the same encoder number must be set to the external input mode.

However, it is permissible to use a combination of direct clutches and smoothing clutches.

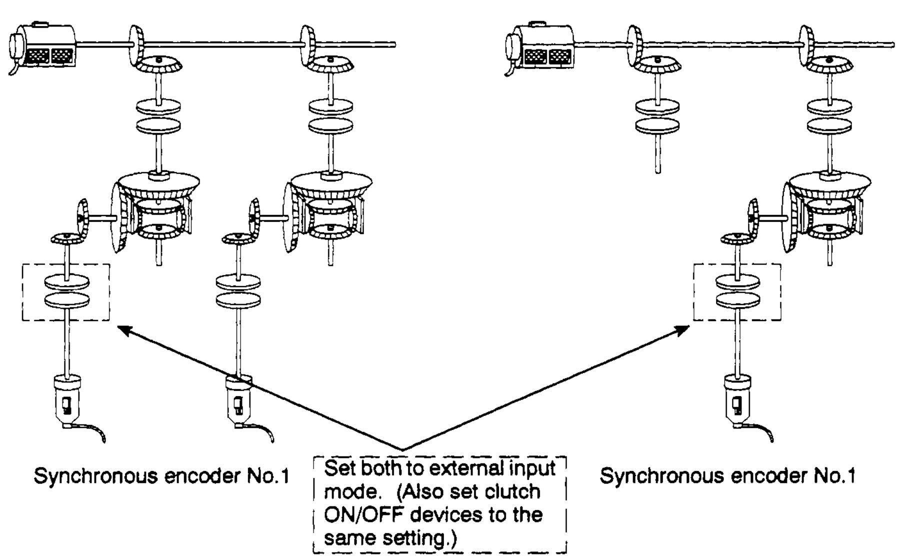
Example 1 Synchronous encoder connected to a drive shaft

If an external input mode clutch is used, set all clutches connected to the synchronous encoder to the external input mode. (Also set clutch ON/OFF devices to the same setting.)



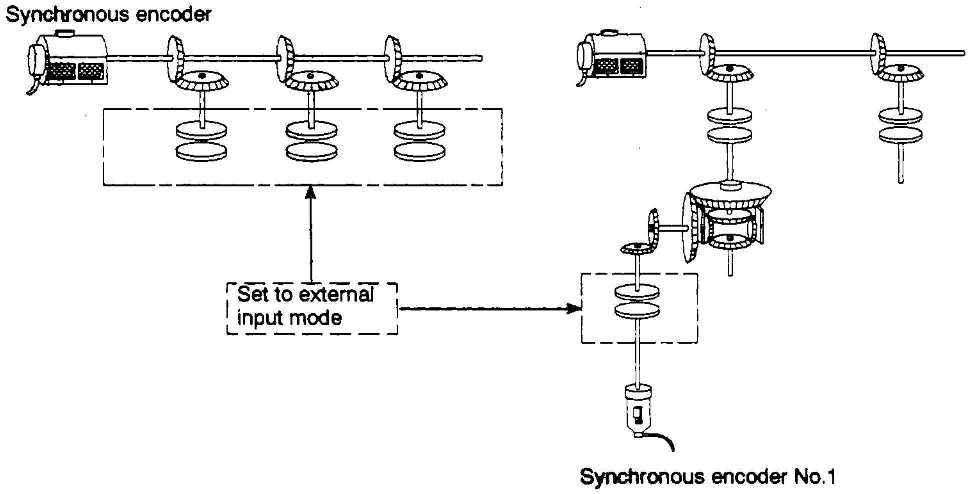
Example 2 Synchronchronous encoder connected to auxiliary input shafts

Set all the clutches connected to the same synchronous encoder set to the external input mode. (Also set clutch ON/OFF devices to the same setting.)



Example 3 Same synchronous encoder connected to a drive shaft and auxiliary input shaft

Set all the connected clutches to the external input mode.
(See examples 1 and 2 above)



7.2.2 Parameters

The clutch parameters are presented in Table 7.2 and each item in this table is explained in (1) through (6) below. For the method for setting clutch parameters, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 7.2 Parameter List

No.	Setting Item	Default Value	Setting Range			Setting Possible	
1	Control mode	ON/OFF mode	ON/OFF mode	ON/OFF mode Address mode in conjunction	External input mode	Direct clutch	Smoothing clutch
2	Mode setting device (1 word)	–	–	Word device	–	○	○
3	Clutch ON/OFF command device	–	Bit device			○	○
4	Clutch ON address setting device (2 words)	–	–	Word device	–	○	○
5	Clutch OFF address setting device (2 words)						
6	Clutch status storage device	–	–			–	–
7	Smoothing method	Time constant designation	Time constant designation/ Amount of slip designation			–	○
8	Smoothing time constant	0	0 - 65535 ms			–	○
9	Amount of slip setting device (2 words)	–	Word device			–	○

(1) Control mode

(a) This is the setting for the mode used to switch the clutch ON/OFF.

The following three modes can be set:

- ON/OFF mode
- ON/OFF mode and address mode in conjunction
- External input mode

For details on each of the control modes, see Section 7.2.1.

(b) When using an A171SCPU, if a synchronous encoder is used as the drive module, the control modes that can be set differ depending on the encoder interface connected to the A171SENC.

A171SENC Encoder Interface	Clutch Control Mode		
	ON/OFF Mode	Address Mode	External Input Mode
Manual pulse generator input (INC)	○	○	○
Serial encoder input (ABS)	○	○	×

○: Can be set ×: Cannot be set

(c) When using an A273UHCPU (8/32-axis specification), if a synchronous encoder is used as the drive module, the control modes that can be set differ depending on the encoder interface connected to the A273EX.

A273EX Encoder Interface	Clutch Control Mode		
	ON/OFF Mode	Address Mode	External Input Mode
Manual pulse generator input (INC)	○	○	○
Serial encoder input (ABS)	○	○	×

○: Can be set ×: Cannot be set

(2) Mode setting device (set only when using ON/OFF mode and address mode in conjunction; 1 word)

(a) This is the device used to switch between the ON/OFF mode and the address mode.

The settings of the mode setting device are as follows:

- 0 : ON/OFF mode
- 1 : Address mode

If a value other than 0 or 1 is set, this is regarded as an error and the previously set mode remains in effect.

(b) The following devices can be used as the mode setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 D0 - D699 *2 D1024 - D8191	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.

*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(3) Clutch ON/OFF command device

(a) This device is used to execute the clutch ON/OFF command.

(b) The following devices can be used as the clutch ON/OFF command device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Input	X0 - XFF	X180 - X1FFF	X0 - X1FFF
Output	Y0 - YFF	Y180 - Y1FFF	Y0 - Y1FFF
Internal relay/ latch relay	M/L0 - M/L1199	M/L0 - M/L1999 M/L2048 - ML8191	M/L0 - M/L1999 M/L4800 - ML8191 *1
Timer	TC0 - TC255 (timer coil)	TC0 - TC2047 (timer coil)	TC0 - TC2047 (timer coil)
	TT0 - TT255 (timer contact)	TT0 - TT2047 (timer contact)	TT0 - TT2047 (timer contact)
Counter	CC0 - CC255 (counter coil)	CC0 - CC1023 (counter coil)	CC0 - CC1023 (counter coil)
	CT0 - CT255 (counter contact)	CT0 - CT1023 (counter contact)	CT0 - CT1023 (counter contact)
Link relay	B0 -B3FF	B0 - B1FFF	B0 - B1FFF
Annunciator	F0 -F255	F0 - F2047	F0 - F2047

*1: The area used for the synchronous encoder shaft cannot be set.

(4) Clutch ON/OFF address setting device (can only be set when the ON/OFF mode and address mode are used in conjunction; 2 words for each mode)

(a) This device serves to set the address at which the clutch is switched ON and address at which the clutch is switched OFF in the address mode.

(b) The following devices can be used as clutch ON/OFF address setting devices:

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699 *3	*1 D0 - D699 *2 *3 D1024 - D8191	*1 *2 D800 - D8191 *3
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) The applicable range for clutch ON/OFF address settings is as follows.

1) When the output module is a ball screw or roller

–2147483648 (-2^{31}) - 2147483647 ($2^{31}-1$) pulse

2) When the output module is a cam or rotary table

0 to number of pulses in one rotation

(5) Smoothing method

(a) Set the method used for smoothing processing at the clutch.

The following two methods can be set:

- Time constant designation
- Amount of slip designation

(b) For details on the operation with each method, see Section 7.2.

(6) Smoothing time constant

This is the time taken to reach 63% of the speed of the output shaft speed.

(7) Amount of slip setting device (2 words)

(a) This is the device used to set the amount of clutch slip.

(b) The following devices can be used as amount of slip setting devices.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699 *3	*1 D0 - D699 *2 *3 D1024 - D8191	*1 *2 D800 - D8191 *3
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) The applicable setting range for amount of slip is 0 to 2147483647 pulse.

7.3 Speed change gear

This section describes the operation of the speed change gear and the parameters required to use it.

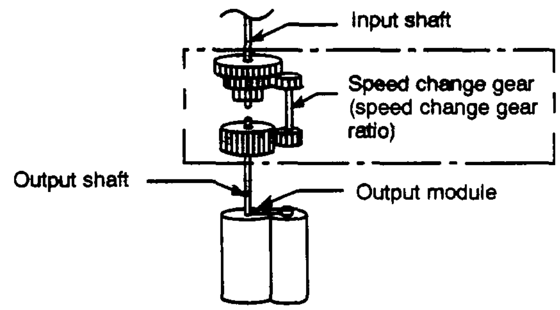
7.3.1 Operation

This section describes the operation of the speed-change gear.

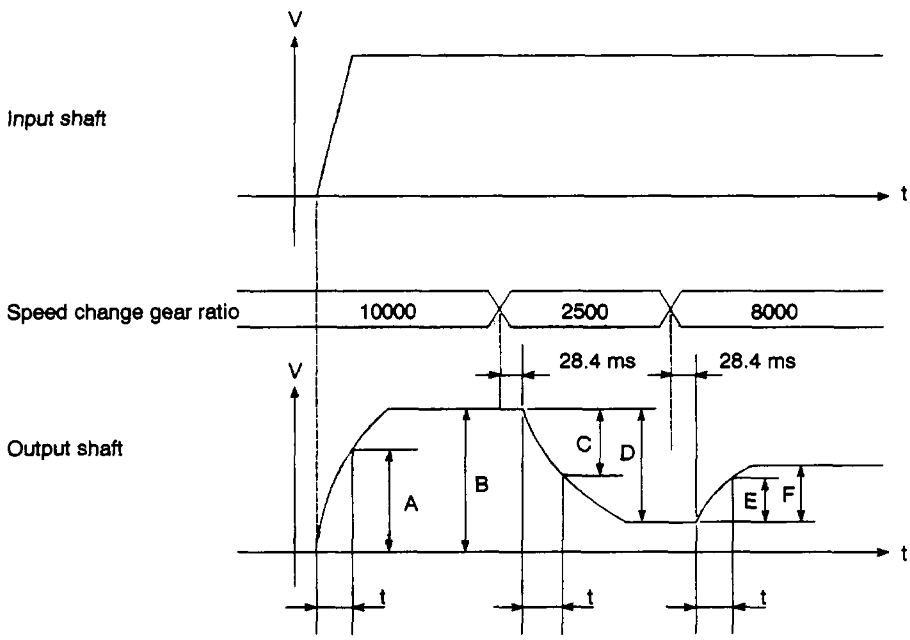
(1) The speed change gear transmits a speed which is the input shaft speed multiplied by a speed change gear ratio set in the speed change gear ratio setting device, to the output shaft.

[Output shaft speed] = [input shaft speed] × [speed change gear ratio]

(Units: pulse/s)



(2) If the speed change gear ratio changes, acceleration and deceleration processing is executed in accordance with the smoothing time constant (t) set in the speed change gear parameters.



REMARK

"t" is the time taken to reach the following condition:

$$\frac{A}{B} \times 100 = \frac{C}{D} \times 100 = \frac{E}{F} \times 100 = 63\%$$

POINT

The speed change gear is used to change the speed of roller output modules. Do not use the speed change gear with other output modules. However, with the upgraded version (OS Ver. U, or above) the speed change gear can be used with all output modules.

7.3.2 Parameter list

The speed change gear parameters are presented in Table 7.3 and each item in this table is explained in (1) through (3) below. For the method for setting speed change gear parameters, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 7.3 Speed Change Gear Parameter List

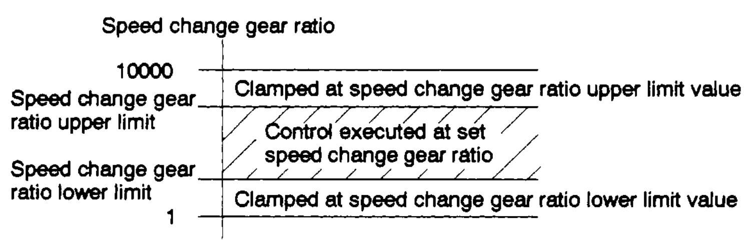
No.	Setting Item	Default Value	Setting Range	
1	Speed change gear ratio upper limit	10000	1 - 10000	
2	Speed change gear ratio lower limit	1	1 - 10000	
3	Speed change gear ratio setting device (1 word)	–	When using A171SCPU	D0 - D699
				W0 - W3FF
			When using A273UHCPU (8-axis specification)	D0 - D699 D1024 - D8191
				W0 - W1FFF
			When using A273UHCPU (32-axis specification)	D800 - D8191
				W0 - W1FFF
4	Smoothing time constant	0	0 - 65535 (ms)	

(1) Speed change gear ratio upper limit value/lower limit value

(a) This is the setting for the effective range (0.01% to 100%) for the speed change gear ratio set in the speed change gear ratio setting device.

(b) If the set value of the speed change gear ratio setting device is greater than the speed change gear ratio upper limit value, control is executed with the speed change gear ratio clamped at the upper limit value.

Conversely, if the set value of the speed change gear ratio setting device is smaller than the speed change gear ratio lower limit value, control is executed with the speed change gear ratio clamped at the lower limit value.



(c) The speed change gear ratio upper limit value/lower limit value is set in the range 1 to 10000, i.e. 100 times the settings actually made: 0.01% to 100%.

(d) Set the speed change gear ratio upper limit value/lower limit value in accordance with the formula below.

1 ≦ Speed change gear ratio lower limit ≦ Speed change gear ratio upper limit ≦ 10000

(2) Speed change gear ratio setting device

(a) This is the setting for the device that sets the speed change gear ratio of the speed change gear.

(b) The following devices can be used as speed change gear ratio setting devices.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 D0 - D699 *2 D1024 - D8191	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.

*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(c) The setting range is from the speed change gear ratio lower limit value to the speed change gear ratio upper limit value.

(3) Smoothing time constant

This is the setting for the time taken to reach 63% of the output shaft speed.

7.4 Differential Gear

The differential gear is used for the following purposes:

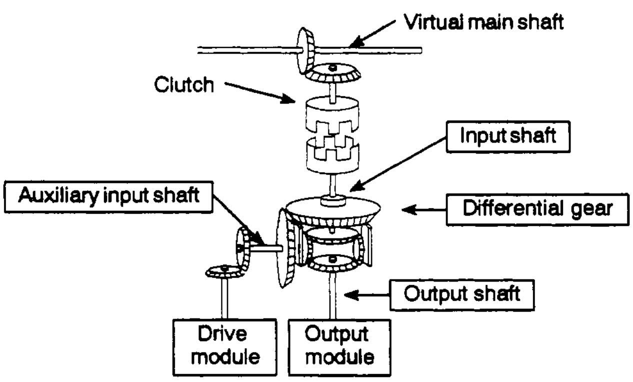
- For shifting the phase of the output module, or aligning with the operation start position.
- To conduct operation independently of the virtual main shaft.

7.4.1 Operation

(1) When the input shaft clutch is engaged

The differential gear subtracts the travel value of the auxiliary input shaft from the travel value of the input shaft and transmits the result to the output shaft.

[Output shaft travel value] = [input shaft travel value] – [auxiliary input shaft travel value]
(Units: pulses)

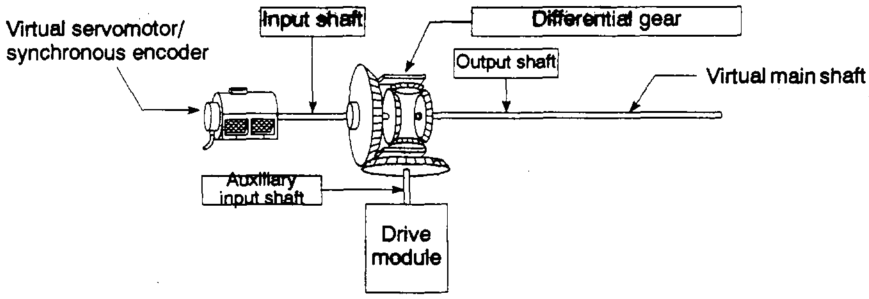


(2) When the input shaft clutch is disengaged

Since the differential gear only transmits the travel value from the auxiliary input shaft to the output shaft, independent operation using the auxiliary input shaft is possible.

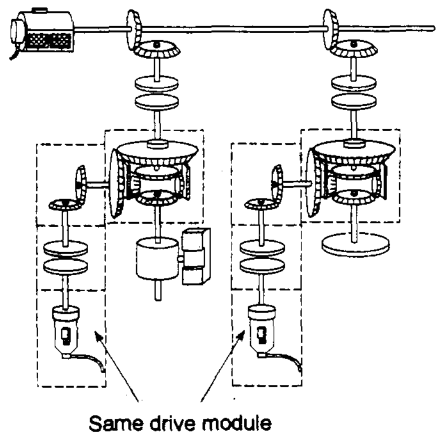
(3) When a differential gear for connecting a virtual main shaft is used.

This mechanism is used in operation in which the main shaft is switched, or when control in which the same drive module is used for auxiliary input to all blocks is performed.



Set different drive modules at the virtual main shaft side and the auxiliary input shaft side.

<Conventional mechanical mechanism program>



The mechanical modules enclosed by the dotted line frames take the place of the following elements, and the mechanical module processing time coefficient can be eliminated:

- Differential gear 1
- Drive module at auxiliary shaft side 1

7.4.2 Parameters (setting not necessary)

No parameters are set for the differential gear.

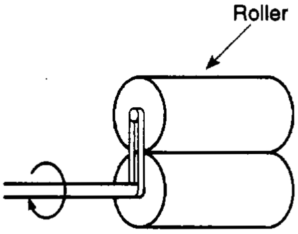
8. OUTPUT MODULES

Determine which of the following categories the mechanism actually controlled at the output module falls into and set the parameters in accordance with this mechanism.

- Rollers .... Section 8.1
- Ball screws ...... Section 8.2
- Rotary tables .... Section 8.3
- Cams .... Section 8.4

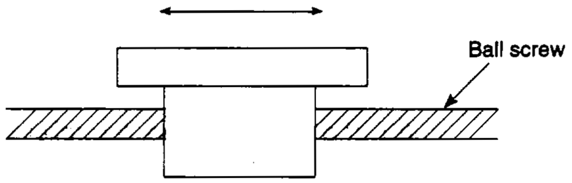
(1) Roller

The roller setting should be made if the final output (shaft) is used for speed control.



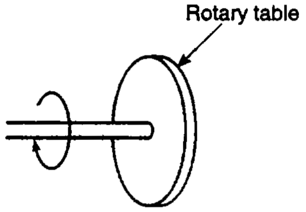
(2) Ball screw

The ball screw setting should be made if the final output (shaft) is used for linear positioning control.



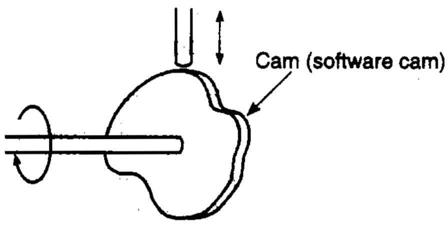
(3) Rotary table

The rotary table setting should be made if the final output (shaft) is used for angular control.



(4) Cam

The cam settings should be made if the final output (shaft) is controlled by connection to a software cam.



8. OUTPUT MODULES

8.1 Rollers

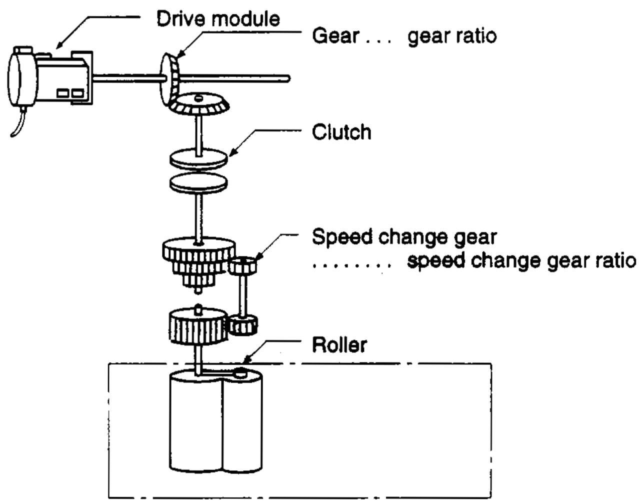
The operation of rollers and the parameter settings required to use rollers are explained here.

8.1.1 Roller operation

(1) Operation

(a) The roller speed is controlled to a speed which is the speed of the drive module multiplied by the gear ratio/speed change gear ratio of the transmission module.

[Roller speed] = [Drive module speed (pulse/s)] × [gear ratio] × [speed change gear ratio] (Units: pulses/s)



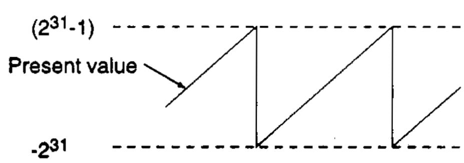
(b) If a clutch is used, the roller is controlled from the point when the clutch is turned ON.

(2) Control details

(a) The roller has no present value.

However, when a switch is made from the virtual mode to the real mode, the present value corresponding to the position reached by travel in the virtual mode is established.

[The present value is a ring address in the range -2147483648 (-2^{31}) pulses to 2147483647 ($2^{31}-1$) pulses.]



(b) Backlash compensation processing is continued in accordance with the settings made in the fixed parameters regardless of switches between the real mode and virtual mode.

(c) The peripheral velocity of the roller is monitored by means of a peripheral device and the roller peripheral velocity register.

For the calculation formula for the roller peripheral velocity, see Section 8.1.2, and for details on the roller peripheral velocity register, see Section 8.5.2.

8.1.2 Parameter list

The parameters for rollers are presented in Table 8.1, and each of the items in the table is explained in (1) to (6) below.

For details on setting roller parameters, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 8.1 Parameter List

No.	Setting		Default Value	Setting Range	
1	Output shaft number	When using an A171SCPU	0	1 - 4	
		When using an A273UHCPU (8-axis specification)	0	1 - 8	
		When using an A273UHCPU (32-axis specification)	0	1 - 32	
2	Unit setting		mm	mm	inch
3	Roller diameter (L)		0	0.1 - 214748364.7 μm	0.00001 - 21474.8364 inch
4	Number of pulses per roller revolution (N_L)		0	1 - 2147483647 pulse	
5	Permissible droop pulse value		65535	1 - 65535 pulse	
6	Speed limit value (V_L)		0	0.001 - 6000000.00 mm/min	0.001 - 600000.000 inch/mm
7	Torque limit value setting device (1 word)		–	–(300%)/word device	
8	Comment		None	32 one-byte characters	

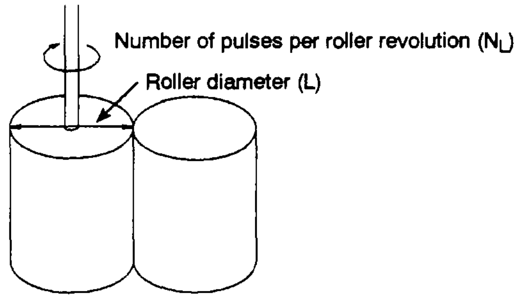
(1) Unit setting

(a) This is the setting for the units (mm/inch) for the roller.

(b) When an axis for which a roller setting has been made is in the real mode, the units (unit setting in the fixed parameters) can be any of the following: mm/inch/degree/pulse.

(2) Roller diameter (L)/Number of pulses per roller revolution (N_L)

(a) These are the settings for the roller diameter, and number of pulses per roller revolution, for the roller connected to the servomotor.



(b) The roller peripheral velocity is calculated from the roller diameter and number of pulses per roller revolution in accordance with the formula below.

1) When the units are millimeters

Roller periheral velocity = number of input per minute × $\frac{\pi \times L}{N_L}$ (mm/min)
L: mm

2) When the units are inches

Roller periheral velocity = number of input per minute × $\frac{\pi \times L}{N_L}$ (mm/min)
L: mm

An integral value obtained by raising 10 to power of the result of calculations 1) and 2) is stored in the roller peripheral velocity register.

(3) Permissible droop pulse value

(a) This is the setting for the permissible number of droop pulses at the deviation counter.

(b) The deviation counter value is continually monitored, and if it becomes larger than the permissible droop pulse value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

However, since operation of the roller shaft continues, the user must execute the appropriate error processing.

(4) Speed control limit (V_L)

(a) This is the setting for the maximum speed of the roller shaft.

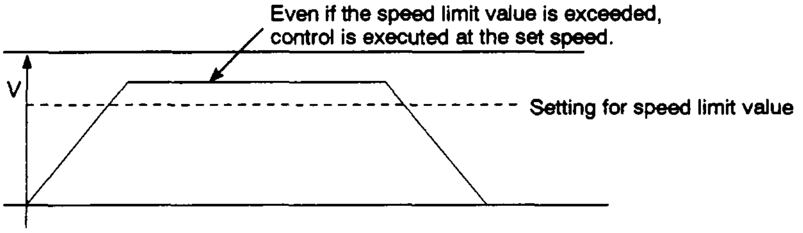
(b) Set the speed limit value within the following range.

$$1 \leqq \frac{V_L \times N_L}{60 \times \pi \times L} \leqq 1000000 \text{ (pulse/s)}$$

V_L: (mm/min) or (inch/min)
L: (mm) or (inch)

(c) If the speed of the roller shaft exceeds the speed limit value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

However, the roller shaft speed is not clamped.



(5) Torque limit value setting device (1 word)

(a) This sets the device which stores the setting for the torque limit value for the roller shaft.

Once the device has been set, torque control is executed in accordance with the setting stored in this device.

In the virtual mode, the torque limit setting is always valid.

If no device setting is made, the torque limit is set at 300%.

(b) The following devices can be set as the torque limit setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 *2 D0 - D699	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(c) The setting range for the torque limit value is 1 to 500%.

(6) Comment

(a) A comment is created for purposes such as describing the application of the roller shaft.

If a comment is created, it can be displayed when monitoring at a peripheral device.

(b) Comments up to 32 one-byte characters long can be created.

8.2 Ball Screws

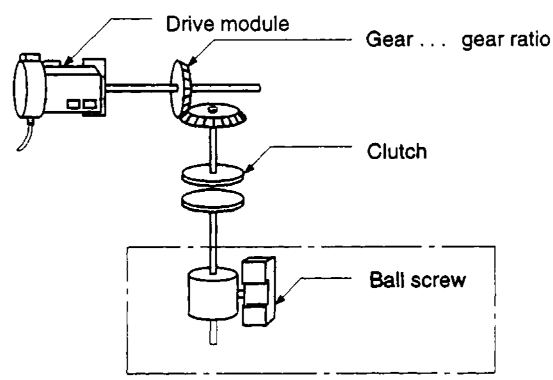
The operation of ball screws and the parameter settings required to use ball screws are explained here.

8.2.1 Ball screw operation

(1) Operation

A ball screw outputs a travel value which is the product of the drive module travel value and the gear ratio of the transmission module.

[Ball screw travel value] = [transmission module travel value (pulses)] × [gear ratio] (Units: pulses)



If a clutch is used, the ball screw is controlled from the point at which the clutch is turned ON.

(2) Control details

(a) The feed present value is maintained on switching from the real mode to the virtual mode or from the virtual mode to the real mode.

(b) Backlash compensation processing is continued in accordance with the settings made in the fixed parameters regardless of switches between the real mode and virtual mode.

(c) The travel value per pulse is controlled by the ball screw parameters (ball screw pitch, number of pulses per ball screw revolution).

Make it the same value as the travel value per pulse in the fixed parameters.

8.2.2 Parameter list

The parameters for ball screws are presented in Table 8.2, and each of the items in the table is explained in (1) to (8) below.

For details on setting ball screw parameters, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 8.2 Parameter List

No.	Setting		Default Value	Setting Range	
1	Output shaft number	When using an A171SCPU	0	1 - 4	
		When using an A273UHCPU (8-axis specification)	0	1 - 8	
		When using an A273UHCPU (32-axis specification)	0	1 - 32	
2	Unit setting		mm	mm	inch
3	Ball screw pitch (P)		0	0.1 - 214748364.7 μm	0.00001 - 21474.8364 inch
4	Number of pulses per ball screw revolution (N_P)		0	1 - 2147483648 pulse	
5	Permissible droop pulse value		65535	1 - 65535 pulse	
6	Stroke limit upper limit value		$2^{31}-1$	0.1 - 214748364.7 μm	0.00001 - 21474.83647 inch
7	Stroke limit lower limit value		0		
8	Speed limit value (V_L)		–	0.001 - 6000000.00 mm/min	0.001 - 600000.000 inch/mm
9	Limit switch output		Not used	Used/Not used	
10	Torque control limit setting device (1 word)		–	–(300%)/word device	
11	Comment		None	32 one-byte characters	

(1) Unit setting

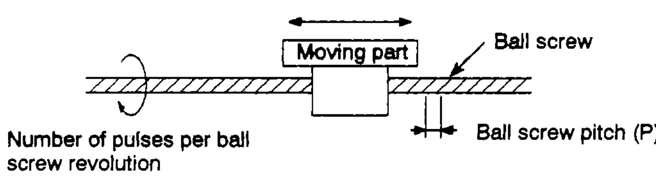
(a) This is the setting for the units (mm/inch) for the ball screw.

(b) Set the same units as used in the real mode (unit setting in the fixed parameters) for the ball screw units.

If the ball screw units and units in the real mode are different, a mode switching error will occur on switching from the real mode to the virtual mode.

(2) Ball screw pitch (P)/number of pulses per ball screw revolution (N_P)

(a) These are the settings for the pitch of the ball screw connected to the servomotor and the number of pulses when the ball screw rotates one revolution.



(b) The travel value per pulse is calculated from the ball screw pitch and number of pulses per ball screw revolution.

$$[\text{Travel per pulse}] = \frac{P}{N_P}$$

(3) Permissible droop pulse value

(a) This is the setting for the permissible number of droop pulses at the deviation counter.

(b) The deviation counter value is continually monitored, and if it becomes larger than the permissible droop pulse value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

(4) Stroke limit upper limit value/lower limit value

(a) This is the setting for the stroke range in the virtual mode.

(b) If the stroke range is exceeded during operation, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

However, ball screw shaft stop processing is not executed.

(5) Speed limit value (V_L)

(a) This is the setting for the maximum speed of the ball screw.

(b) Set the speed limit value within the following range.

1) When the units are millimeters

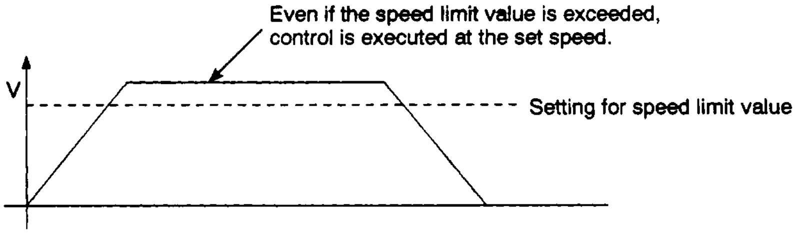
$$1 \leqq \frac{V_L \times 10^4 \times N_P}{60 \times P} \leqq 1000000 \text{ (pulse/s)}$$

2) When the units are inches

$$1 \leqq \frac{V_L \times 10^5 \times N_P}{60 \times P} \leqq 1000000 \text{ (pulse/s)}$$

(c) If the speed of the ball screw shaft exceeds the speed limit value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

However, the ball screw speed is not clamped.



(6) Limit switch output

(a) This setting determines whether or not a limit switch signal is output for the ball screw shaft.

- Limit switch output used ...... Limit switch signal is output based on the ball screw's actual present value.
- Limit switch output not used ... Limit switch signal is not output.

(7) Torque limit value setting device (1 word)

(a) This sets the device which stores the setting for the torque limit value for the ball screw shaft.

Once the device has been set, torque control is executed in accordance with the setting stored in this device.

In the virtual mode, the torque limit setting is always valid.

If no device setting is made, the torque limit is set at 300%.

(b) The following devices can be set as the torque limit setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 *2 D0 - D699	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.

*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(c) The setting range for the torque limit value is 1 to 500%.

(8) Comment

(a) A comment is created for purposes such as describing the application of the ball screw shaft.

If a comment is created, it can be displayed when monitoring at a peripheral device.

(b) Comments up to 32 one-byte characters long can be created.

8.3 Rotary Tables

The operation of rotary tables and the parameter settings required to use rotary tables are explained here.

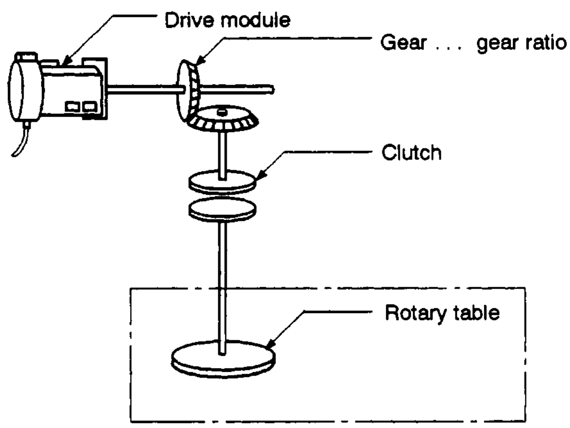
8.3.1 Rotary table operation

This section describes the operation of the rotary table.

(1) Operation

(a) A rotary table outputs a travel value which is the product of the drive module travel value and the gear ratio of the transmission module.

[Rotary table travel value] = [transmission module travel value (pulses)] × [gear ratio] (Units: pulses)



(b) If a clutch is used, the rotary table is controlled from the point at which the clutch is turned ON.

(2) Control details

(a) The feed present value is maintained on switching from the real mode to the virtual mode or from the virtual mode to the real mode.

(b) Backlash compensation processing is continued in accordance with the settings made in the fixed parameters regardless of switches between the real mode and virtual mode.

(c) The travel value per pulse is controlled by the rotary table parameters (number of pulses per rotary table revolution).

Make it the same value as the travel value per pulse in the fixed parameters.

8.3.2 Parameter list

The parameters for rotary tables are presented in Table 8.3, and each of the items in the table is explained in (1) to (9) below.

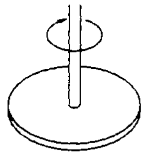
For details on setting rotary table parameters, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 8.3 Parameter List

No.	Setting		Default Value	Setting Range
1	Output shaft number	When using an A171SCPU	0	1 - 4
		When using an A273UHCPU (8-axis specification)	0	1 - 8
		When using an A273UHCPU (32-axis specification)	0	1 - 32
2	Number of pulses per rotary table revolution (N_D)		–	1 -1073741824 pulse
3	Permissible droop pulse value		65535	1 - 65535 pulse
4	Stroke limit upper limit value		0	0 - 359.99999 degree
5	Stroke limit lower limit value		0	0 - 359.99999 degree
6	Speed limit value (V_L)		0	0.001 - 600000.000 degree/min
7	Limit switch output		Not used	Used/Not used
8	Torque control limit setting device		–	–(300%)/word device
9	Comment		None	32 one-byte characters
10	Virtual axis present value in one revolution storage device (main shaft side)		–	–/ word device
11	Virtual axis present value in one revolution storage device (auxiliary input shaft side)		–	–/ word device

(1) Number of pulses per rotary table revolution (N_D)

(a) This is the setting for the number of pulses equivalent to one revolution of the rotary table connected to the servomotor.



(b) The travel value per revolution is calculated from the number of pulses per rotary table revolution in accordance with the following formula:

$$[\text{Travel per pulse}] = \frac{360}{N_D} \text{ (degree)}$$

(2) Permissible droop pulse value

(a) This is the setting for the permissible number of droop pulses at the deviation counter.

(b) The deviation counter value is continually monitored, and if it becomes larger than the permissible droop pulse value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

(3) Stroke limit upper limit value/lower limit value

(a) This is the setting for the stroke range in the virtual mode.

The settings for the stroke limit upper limit value and lower limit value can determine whether the stroke range is valid or not: if the stroke limit upper limit value is equal to the stroke limit lower limit value, the stroke limits are invalid.

(b) If the stroke range is exceeded during operation, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

However, rotary table shaft stop processing is not executed.

(4) Speed limit value (V_L)

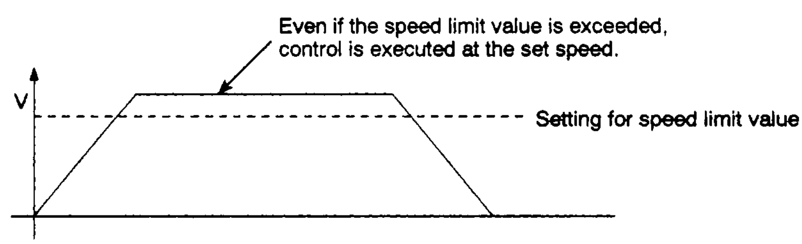
(a) This is the setting for the maximum speed of the rotary table shaft.

(b) Set the speed limit value within the range prescribed by the following formula:

$$1 \leqq \frac{V_L \times 10^5 \times N_D}{60 \times 360 \times 10^5} \leqq 1000000 \text{ (pulse/s)}$$

(c) If the speed of the rotary table shaft exceeds the speed limit value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

However, the rotary table shaft speed is not clamped.



(5) Limit switch output

(a) This setting determines whether or not a limit switch is output for the rotary table shaft.

- Limit switch output used ...... Limit switch signal is output based on the rotary table's actual present value.
- Limit switch output not used ... Limit switch signal is not output.

(6) Torque limit value setting device (1 word)

(a) This is the setting for the device which stores the setting for the torque limit value for the rotary table shaft.

Once the device has been set, torque control is executed in accordance with the setting stored in this device.

In the virtual mode, the torque limit setting is always valid.

If no device setting is made, the torque limit is set at 300%.

(b) The following devices can be set as the torque limit setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 *2 D0 - D699	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(c) The setting range for the torque limit value is 1 to 500%.

(7) Comment

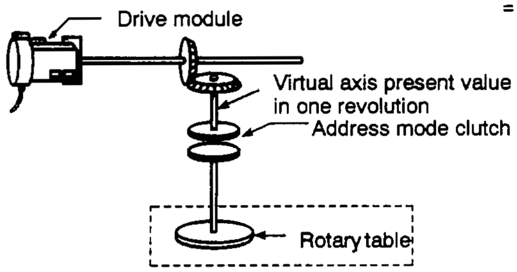
(a) A comment is created for purposes such as describing the application of the rotary table shaft.

If a comment is created, it can be displayed when monitoring at a peripheral device.

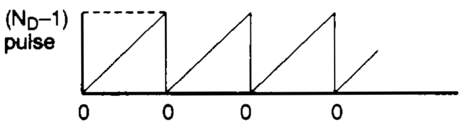
(b) Comments up to 32 one-byte characters long can be created.

(8) Virtual axis present value in one revolution storage device (main shaft side) (2 words)

This parameter is set if an address mode clutch has been set at the rotary table main shaft side.



Virtual axis present value in one revolution
= (drive module travel value × gear ratio) %N_D
(% : remainder operator)



The reference position (0) for the virtual axis present value in one revolution is set with the address clutch reference position setting signal (M1813+20n/YnD/M3213+20n).

(a) The virtual axis present value in one revolution for the main shaft side of the rotary table is stored in the set device.

(b) The following devices can be set as the virtual axis present value in one revolution storage device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 *3 D0 - D699	*1 *2 *3 D0 - D699	*1 *2 *3 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) The applicable range for the virtual axis present value in one revolution is 0 to (N_D-1) pulses. (N_D: number of pulses per rotary table revolution)

(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis present value in one revolution range: 0 to (N_D-1) pulses.

Therefore, set the value in the clutch ON/OFF address setting device within the range 0 to (N_D-1) pulses.

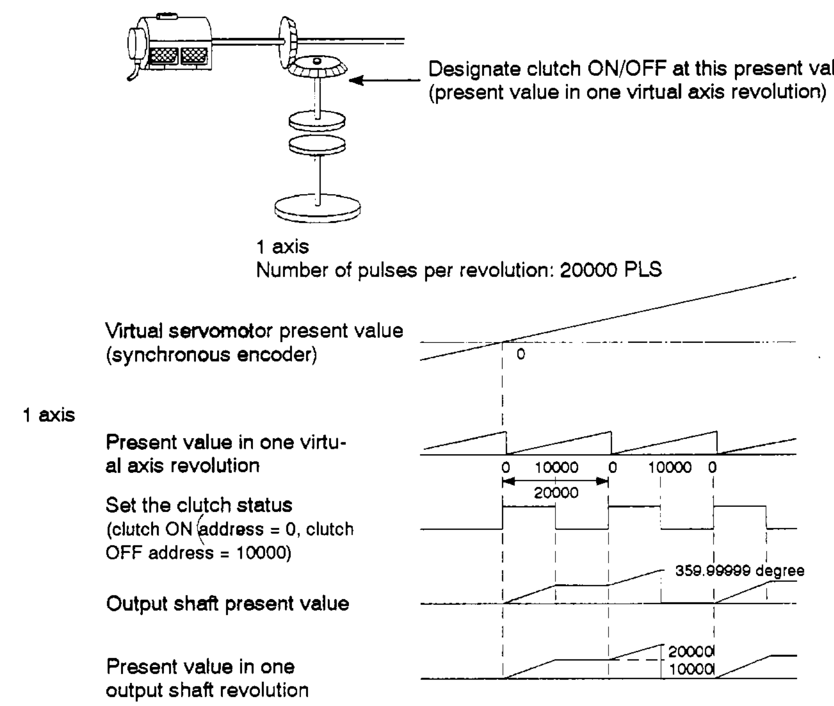
(e) The virtual axis present value in one revolution reference position "0" is set by turning M1813+20n/YnD/M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.

This sets the virtual axis present values in one revolution for both the main shaft and the auxiliary input shaft to "0".

If the switch to the virtual mode is made with M1813+20n/YnD/M3213+20n turned OFF, control continues from the virtual axis present value in one revolution that was effective last time the virtual mode was in effect.

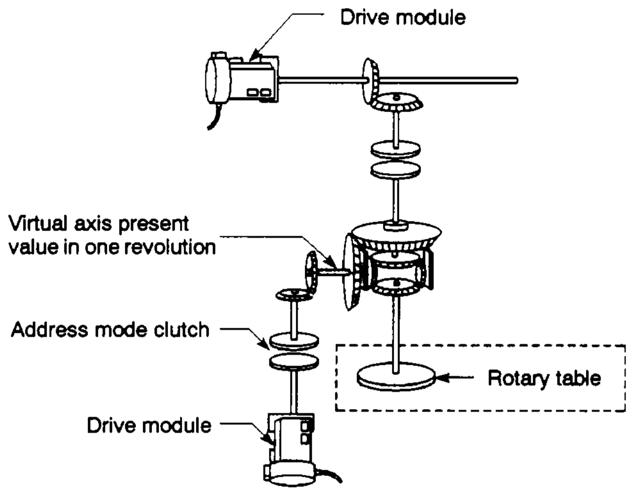
(f) An example of the operation of an address mode clutch is shown below.

Operation Example



(9) Virtual axis present value in one revolution storage device (auxiliary input shaft side) (2 words)

This parameter is set if an address mode clutch has been set at the rotary table auxiliary input shaft side.



(a) By setting the virtual axis present value in one revolution for the auxiliary input shaft of the rotary table in the set device, the current present value in one revolution of the virtual axis is stored.

(b) The following devices can be set as the virtual axis present value in one revolution storage device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 *3 D0 - D699	*1 *2 *3 D0 - D699	*1 *2 *3 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) The applicable range for the virtual axis present value in one revolution is 0 to (N_D-1) pulses. (N_D: number of pulses per rotary table revolution)

(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis present value in one revolution range: 0 to (N_D-1) pulses.

Therefore, set the value in the clutch ON/OFF address setting device within the range 0 to (N_D-1) pulses.

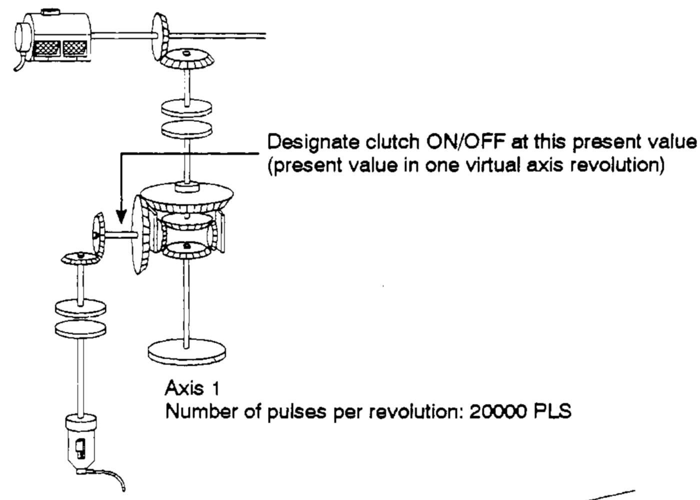
(e) The setting for the virtual axis present value in one revolution reference position "0" is made by turning M1813+20n/YnD/M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.

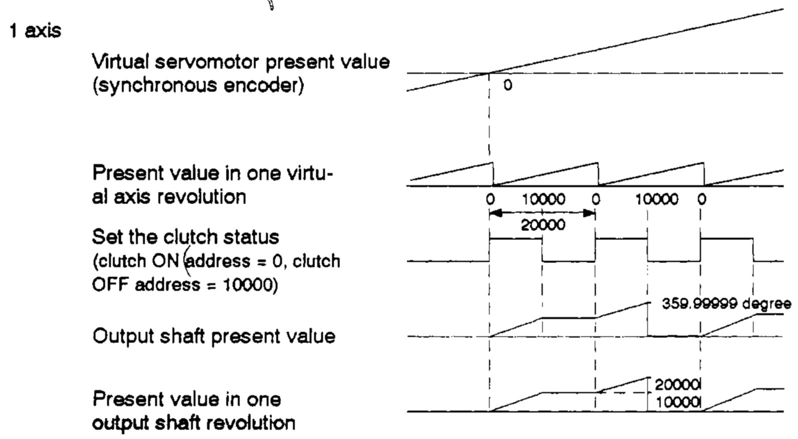
This sets the virtual axis present values in one revolution for both the main shaft and the auxiliary input shaft to "0".

If the switch to the virtual mode is made with M1813+20n/YnD/M3213+20n turned OFF, control continues from the virtual axis present value in one revolution that was effective last time the virtual mode was in effect.

(f) An example of the operation of an address mode clutch is shown below.

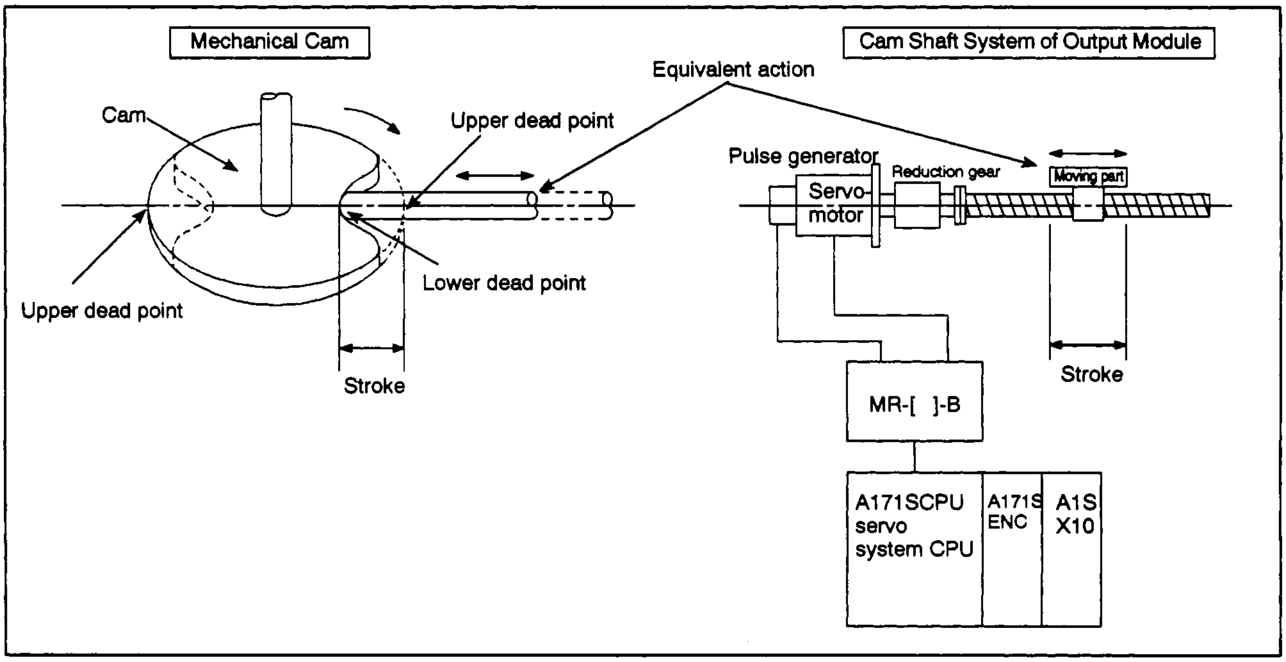
Operation Example





8.4 Cams

(1) For axes at which the output module is set as a cam, the same action as a cam is achieved by using a ball screw model as shown in the example below.
(Example: A171SCPU)



(2) The following two types of data have to be set in order to use a cam.

- Settings made when the cam data is created

  These are the settings made at a personal computer running the SW0IX-CAMPE software when creating the cam data (cam curve).

  (See Section 8.4.2)

- Cam parameters

  These are the parameters used to set a cam as the output module when creating the mechanical device program.

  (See Section 8.4.3)

8.4.1 Cam operation

The operation of cams is described below.

(1) Procedure for switching from the REAL mode to the VIRTUAL mode

On switching from the REAL mode to the VIRTUAL mode, perform device setting in accordance with the following procedure using the sequence program.

(a) Set a cam number and stroke in the "cam No. setting device" and "stroke setting device" set for each axis in the cam shaft parameters.

Switch the cam reference position setting signal (M1814+20n/YnE/M3214+20n)*1 ON/OFF as required.

(See Section 8.5.1 (17))

(b) Issue a REAL mode → VIRTUAL mode switching request (M2043: OFF → ON)

(c) Start operation based on the cam pattern, stroke, cam reference setting signal, and address clutch reference setting signal set for each cam shaft.

(2) Processing on switching from the REAL mode to the VIRTUAL mode

When a switch is made from the REAL mode to the VIRTUAL mode, the cam shaft present value in one revolution is indexed based on the cam reference position setting signal (M1814+20n/YnE/M3214+20n), the feed present value, the stroke lower limit value, the stroke and cam No. (cam pattern), at that time.

REMARKS

*1: The "n" in M1814+20n indicates a numerical value that corresponds to the axis number of the output module in the REAL mode.

n	0	1	2	3
Output shaft No.	1	2	3	4

The "n" of YnE indicates a numerical value (0 - 7) that corresponds to the axis number of the output module in the REAL mode.

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

The "n" in M3214+20n indicates a numerical value that corresponds to the axis number of the output module in the REAL mode.

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

(3) Operation

A value based on the cam shaft present value in one revolution and calculated using the stroke ratio in the cam data table is output.

[(Feed present value) = (stroke lower limit value) + (stroke) × (stroke ratio)]

The cam shaft present value in one revolution is determined by the travel value calculated by multiplying the drive module travel value by the transmission module gear ratio or other applicable value.

The number of pulses per stroke is controlled based on the travel value per pulse set in the fixed parameters in the REAL mode.

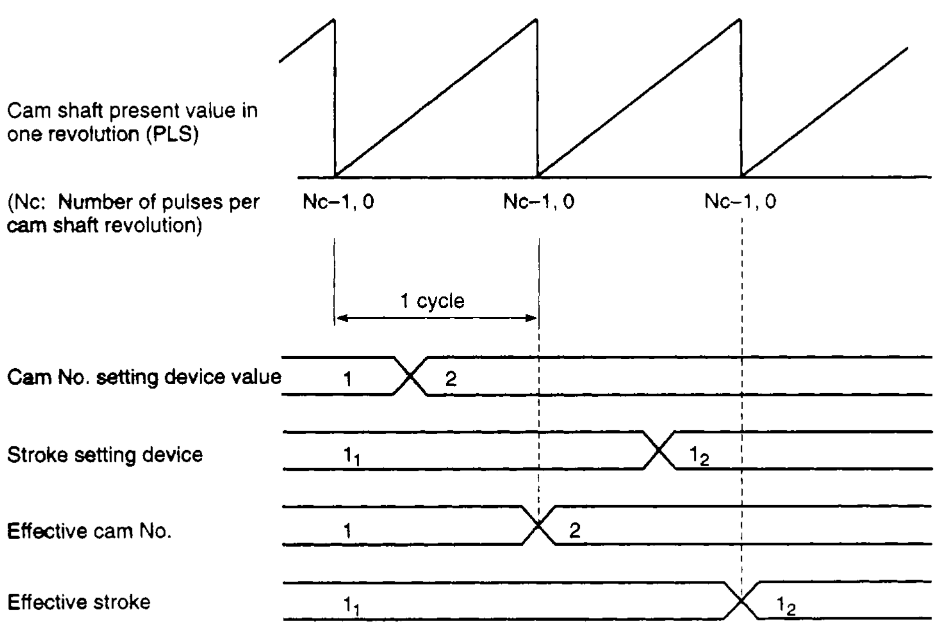
(4) Switching the stroke and cam No. during operation

(a) It is possible to change the cam stroke and effective cam number during cam operation by using the sequence program.

(b) The stroke and cam No. are changed by means of the address set in the "stroke, cam No. change point" setting made when creating the cam data.

When the "stroke, cam No. change point" is passed, the stroke/cam No. is changed on the basis of the value in the stroke setting device and cam No. setting device set in the cam parameters.

Example — The figure below shows the timing for switching between cam No.1 and cam No.2, and switching between stroke l1 and stroke l2 when the stroke/cam No. change point is set as "0".



(c) Causes of errors when changing the stroke/cam No. during operation

1) The set cam No. and stroke are always input to the PCPU on switching from the REAL mode to the VIRTUAL mode, and in the VIRTUAL mode.

On input to the PCPU, a relative check is executed. An error occurs, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON, and the error code is stored in the minor error code register in the following cases:

- When the stroke is outside the range 1 to 2147483647 ($2^{31}-1$).
When, in the two-way cam mode, the following condition is not met: stroke lower limit value + stroke $\leqq$ 2147483647 ($2^{31}-1$)

- When the control modes of the set cam Nos. are not the same.

2) Processing in the event of a cam No./stroke error

- If the error occurs on attempting to switch from the REAL mode to the VIRTUAL mode, the VIRTUAL mode is not established.

- If the error occurs on reaching the set "stroke, cam No. change point" (during cam operation), operation continues without switching to the set stroke/cam No.
Reset the error detection signal and the minor error code register with the error reset command (M1807+20n/Yn7/M3207+20n).

3) Processing in the event of an error

i) If an error occurs on switching from the REAL mode to the VIRTUAL mode, correct it by following the procedure below.

- Turn the REAL/VIRTUAL mode switching request flag (M2043) OFF.

- Set the cam No. and stroke correctly.

- Turn the REAL/VIRTUAL mode switching request flag ON and switch to the VIRTUAL mode.

ii) If an error occurs during cam operation, set the cam No. and stroke correctly.

(5) Control details

(a) On switching from the REAL mode to the VIRTUAL mode, or on switching from the VIRTUAL mode to the REAL mode, the currently effective feed present value of the cam remains effective.

(b) Backlash compensation processing is not executed in the case of cam shafts only. (If necessary, take this into account when creating the cam pattern.)

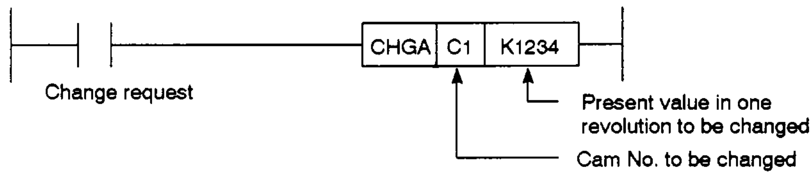
(c) No stroke limit upper limit value/lower limit value check or speed limit check is executed.

(6) Changing control

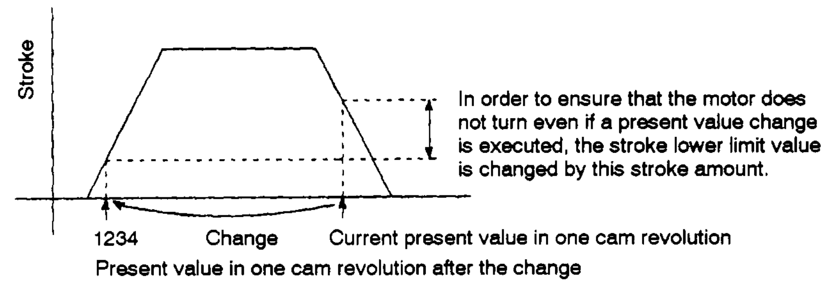
The cam shaft present value in one revolution can be changed to any required value to change cam control during operation in the VIRTUAL mode.

The present value change is executed using the CHGA instruction.
See Appendix 2.

[Example sequence program]

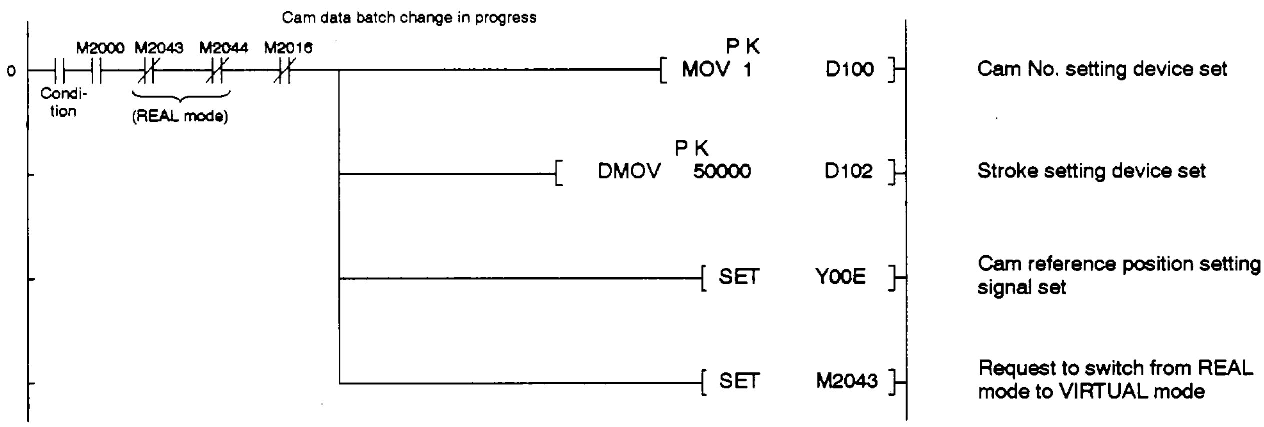


[Operation]

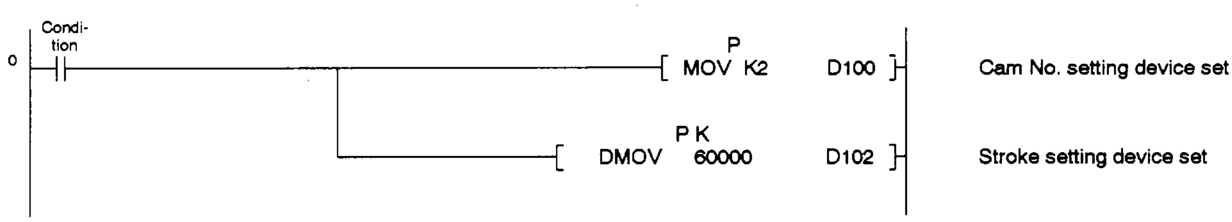


(7) Example sequence program (when using A273UHCPU, 8-axis specification)

[Switching from REAL mode to VIRTUAL mode]



[Changing cam No./stroke during operation]



8.4.2 Settings when creating cam data

The settings made when creating cam data at a peripheral device are described below.

Table 8.4 Table of Settings when Creating Cam Data

No.	Setting	Default Value	Setting Range
1	Cam No.	–	1 - 64
2	Resolution	256	256, 512, 1024, 2048
3	Stroke, cam No. change point	0	0 to (resolution –1)
4	Control mode	Two-way cam mode	• Two-way cam mode • Feed cam mode
5	Cam data table	0	0 - 32767

(1) Cam No.

This is the setting for the number of the created cam data.

Set this number in the sequence program.

(2) Resolution

(a) This setting determines the number of index divisions in one cam cycle.

(b) The time required to complete one cycle in which data for the maximum number of points possible under the set resolution are reliably output is calculated as follows:

3.5 ms $\times$ (set resolution)

(3) Stroke/cam No. change point

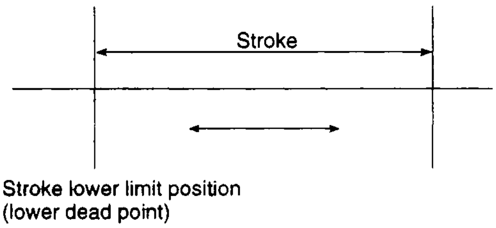
(a) This is the setting for the position at which the stroke/cam No. is switched during operation.

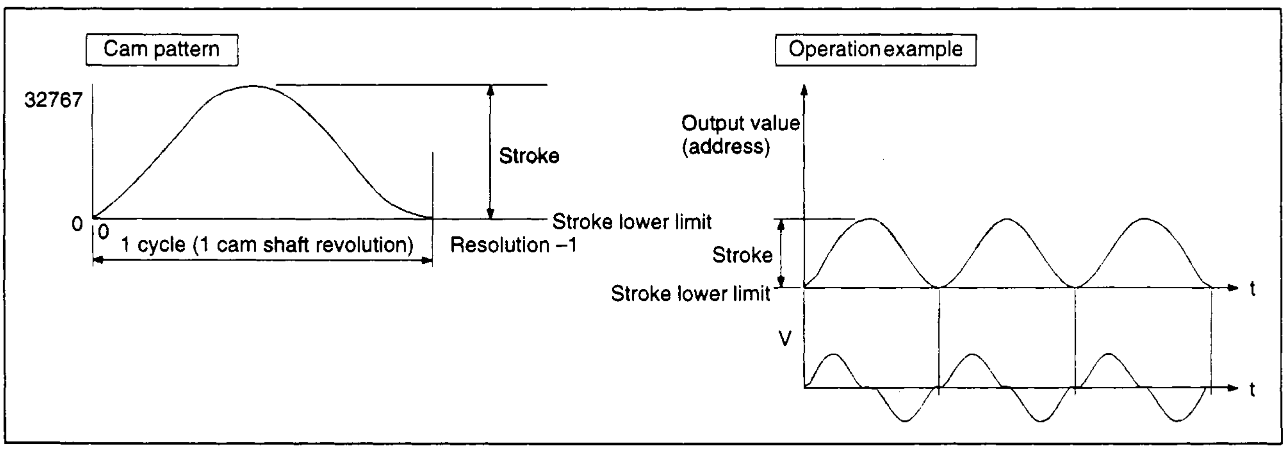
(b) When the set switching position [range: 0 to (resolution –1)] is reached, a switch is made to the set stroke and cam No., provided the stroke and cam No. are normal.

(4) Control mode

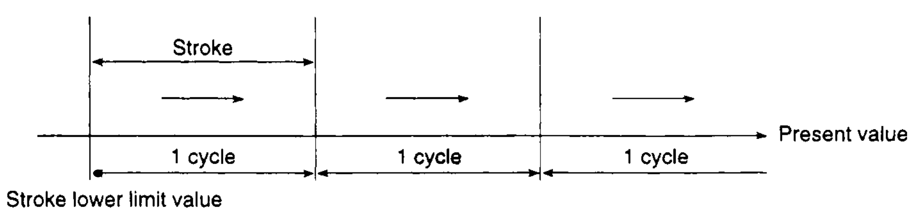
(a) This is the setting for the two-way cam mode or feed cam mode.

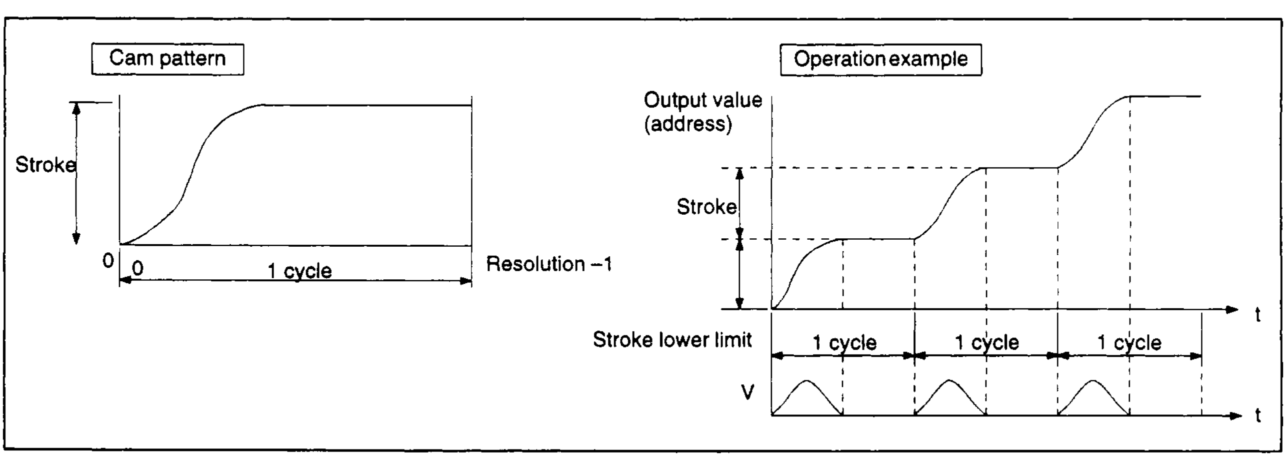
1) Two-way cam mode ... A two-way operation is repeated between the stroke lower limit position (lower dead point) and the range set for the stroke.





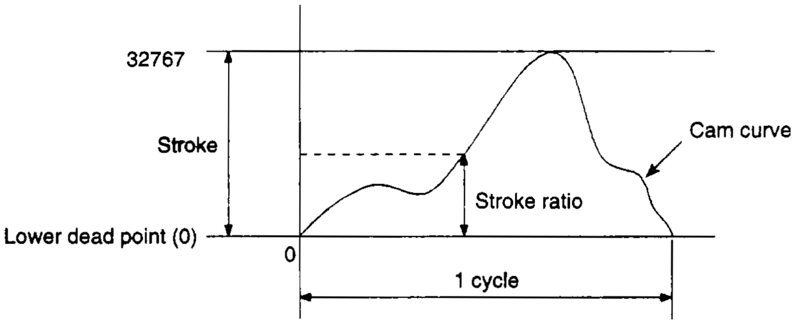
2) Feed cam mode .... With the stroke lower limit value (lower dead point) as the operation start position, positioning is executed by feeding one stroke length per cycle in a fixed direction.





(5) Cam data table

(a) The cam data table is generated by setting the stroke ratio (when the stroke is divided into 32767 divisions) at every point in the set resolution.



(b) The cam data table is automatically generated at the peripheral device when the cam curve is created.

The cam curves that can be used with the servo system CPU are indicated in Section 8.4.4.

8.4.3 Parameter list

The cam parameters are presented in Table 8.5 and item numbers 2 to 13 in the table are described in (1) through (12) below.

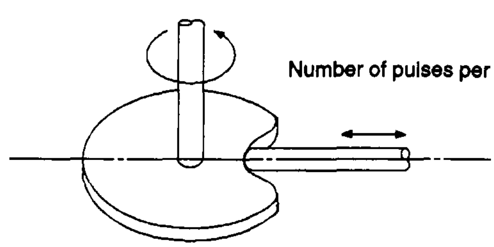
For details on how to set the cam parameters refer to the Operating Manual for the relevant motion controller.

Table 8.5 Parameter List

No.	Setting		Default Value	Setting Range		
1	Output shaft number	When using an A171SCPU	0	1 - 4		
		When using an A273UHCPU (8-axis specification)	0	1 - 8		
		When using an A273UHCPU (32-axis specification)	0	1 - 32		
2	Number of pulses per cam shaft revolution		0	1073741824 pulse		
3	Used cam No.		–	–		
4	Cam No. setting device (1 word) (Nc)		–	Word device		
5	Permissible droop pulse value		65535 (pulse)	1 - 65535 (pulse)		
6	Unit setting		mm	mm	inch	pulse
7	Stroke setting device (2 words)		–	Word device		
8	Limit switch output		Not used	Used/Not used		
9	Torque control limit setting device (1 word)		–	–(300%)/word device		
10	Comment		None	32 one-byte characters		
11	Stroke lower limit value storage device		–	–/ word device		
12	Present value in one virtual axis revolution storage device (main shaft side, 2 words)		–	–/ word device		
13	Present value in one virtual axis revolution storage device (auxiliary input shaft side, 2 words)		–	–/ word device		

(1) Number of pulses per cam shaft revolution (Nc)

(a) This is the setting for the number of pulses required to rotate the cam through one cycle.



(b) The setting for the number of pulses per cam shaft revolution is independent of the travel value per pulse (setting in the fixed parameters).

(2) Used cam No.

This parameter does not need to be set.

Operation will be possible as long as a registered cam No. is set.

(3) Cam No. setting device (1 word)

(a) This is the setting for the device that sets, in the sequence program, the cam No. that is to be used for control.

(b) The following devices can be used as the cam No. setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 *2 D0 - D699	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(c) If the value stored in the cam No. setting device is changed during operation, the switch to the changed cam No. will occur at the "stroke/cam No. switching position" set when the cam data was created.

(4) Permissible droop pulse value

(a) This is the setting for the permissible number of droop pulses at the deviation counter.

(b) The deviation counter value is continually monitored, and if it becomes larger than the permissible droop pulse value, the error detection signal (M1607+20n/Xn7/M2407+20n) comes ON.

(5) Unit setting

(a) This is the setting for the units (mm/inch/pulse) for the cam.

(b) The units for an axis for which a cam setting has been made are the units in the REAL mode (unit setting in the fixed parameters).

(6) Stroke setting device (2 words)

(a) This is the setting for the cam stroke.

(b) The following devices can be set as the stroke setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 *3 D0 - D699	*1 *2 *3 D0 - D699	*1 *2 *3 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) Set the stroke within the range indicated below.

- Setting range in the two-way cam mode

mm : Stroke lower limit value + stroke $\leqq$ 2147483647 $\times 10^{-1}$ μm
inch : Stroke lower limit value + stroke $\leqq$ 2147483647 $\times 10^{-5}$ inch
Pulse: Stroke lower limit value + stroke $\leqq$ 2147483647 pulse

- Setting range in the feed cam mode

mm : 0 < stroke $\leqq$ 2147483647 $\times 10^{-1}$ μm
inch : 0 < stroke $\leqq$ 2147483647 $\times 10^{-5}$ inch
Pulse: 0 < stroke $\leqq$ 2147483647 pulse

(7) Limit switch output

(a) This setting determines whether or not a limit switch signal is output.

1) Limit switch output not used ..... Limit switch signal is not output.

2) Limit switch output used

A limit switch signal is output in the present value mode/1 cam shaft revolution present value mode.

The selection of the present value mode or 1 cam shaft revolution present value mode is made in the limit switch ON/OFF point setting window.

If the [F5] key is pressed while the limit switch ON/OFF point setting window is displayed, the limit switch output mode selection screen is displayed.

Limit switch output mode
1: Present value
2: 1 cam shaft revolution present value

The default is 1: present value

Using the numeric keys, enter the limit switch output mode to be selected (1 or 2).

For details on the present value mode and the 1 cam shaft revolution present value mode, see Section 8.4.6.

(8) Torque limit value setting device (1 word)

(a) This is the setting for the device which stores the setting for the torque limit value for the cam shaft.

Once the device has been set, torque control is executed in accordance with the setting stored in this device.

In the virtual mode, the torque limit setting is always valid.

If no device setting is made, the torque limit is set at the default of 300%.

(b) The following devices can be set as the torque limit setting device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 *2 D0 - D699	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.

(c) The setting range for the torque limit value is 1 to 500%.

(9) Comment

(a) A comment is created for purposes such as describing the application of the ball screw shaft.

If a comment is created, it can be displayed when monitoring at a peripheral device.

(b) Comments up to 32 one-byte characters long can be created.

(10) Stroke lower limit value storage device

(a) This is the setting for the device that stores the cam stroke lower limit value.

The device stores the present stroke lower limit value.

(b) The following devices can be used as the stroke lower limit value storage device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 D0 - D699	*1 *2 D0 - D699	*1 *2 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

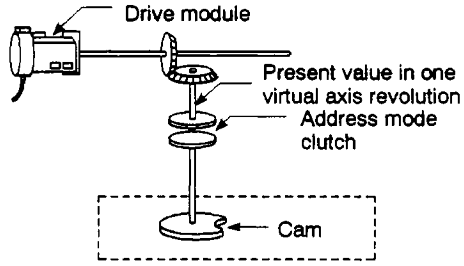
(c) The setting range for the stroke lower limit value is –2147483648 (-2^{31}) to 2147483647 ($2^{31}-1$).

1) The stroke lower limit value is determined as follows for each unit setting:

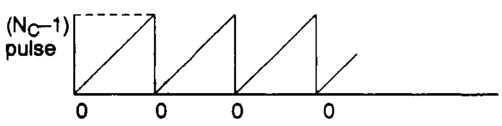
mm : Stroke lower limit value × 10^{-1} μm
inch : Stroke lower limit value × 10^{-5} inch
Pulse: Stroke lower limit value × 1 pulse

(11) Present value in one virtual axis revolution storage device (main shaft side, 2 words)

This parameter is set if an address mode clutch is set at the main shaft side of the cam.



Present value in one virtual axis revolution
= (drive module travel value x gear) %N_C
(%: remainder operator)



(a) The present value in one virtual axis revolution for the main shaft side of the cam is stored in this device.

(b) The following devices can be used as the present value in one virtual axis revolution storage device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 *3 D0 - D699	*1 *2 *3 D0 - D699	*1 *2 *3 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) The setting range for the present value in one virtual axis revolution is 0 to (N_C–1) pulses. (N_C: number of pulses in one cam shaft revolution)

(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis present value in one revolution range: 0 to (N_C–1) pulses.

Therefore, set a value in the range 0 to (N_C–1) pulses in the clutch ON/OFF address setting device.

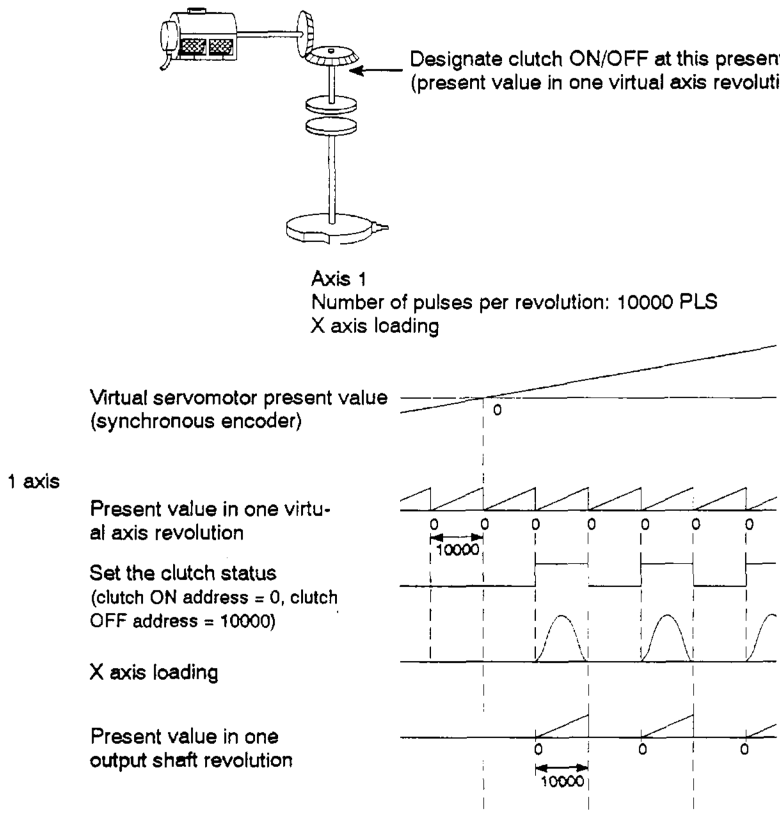
(e) The virtual axis present value in one revolution reference position "0" is set by turning M1813+20n/YnD/M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.

This sets the virtual axis present values in one revolution for both the main shaft and the auxiliary input shaft to "0".

If the switch to the virtual mode is made with M1813+20n/YnD/N3213+20n turned OFF, control continues from the virtual axis present value in one revolution that was effective last time the virtual mode was in effect.

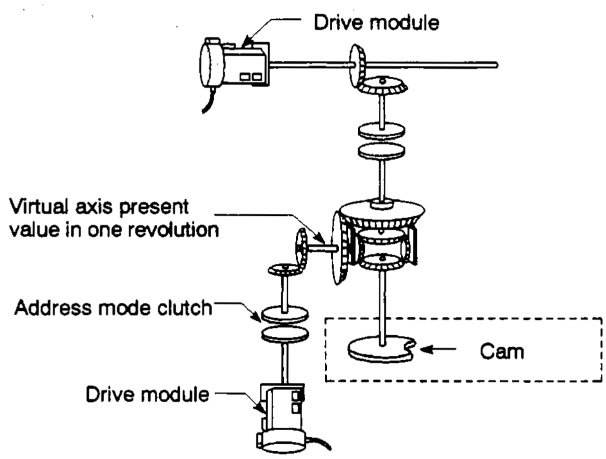
(f) An example of the operation of an address mode clutch is shown below.

Operation Example



(12) Virtual axis present value in one revolution storage device (auxiliary input shaft side) (2 words)

This parameter is set if an address mode clutch has been set at the cam auxiliary input shaft side.



(a) By setting the device to store the virtual axis present value in one revolution for the auxiliary input shaft of the cam, the current present value in one revolution of the virtual axis is stored.

(b) The following devices can be set as the virtual axis present value in one revolution storage device.

Device Type	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)
Data register	*1 *2 *3 D0 - D699	*1 *2 *3 D0 - D699	*1 *2 *3 D800 - D8191
Link register	W0 -W3FF	W0 - W1FFF	W0 - W1FFF

*1 : If a cam is used at the output module, the area used for the cam cannot be set.
*2 : If a differential gear is connected to the main shaft, the area it uses cannot be set.
*3 : The first device number of the devices must be an even number.

(c) The applicable range for the virtual axis present value in one revolution is 0 to (Nc–1) pulses.

(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis present value in one revolution range: 0 to (Nc–1) pulses.

Therefore, set the value in the clutch ON/OFF address setting device within the range 0 to (Nc–1) pulses.

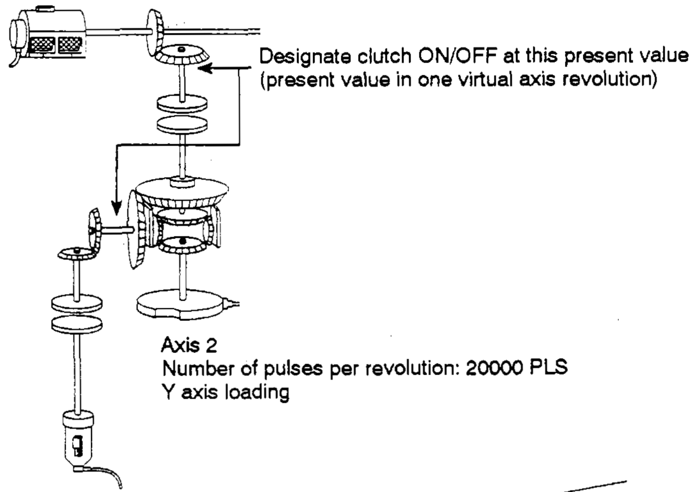
(e) The setting for the virtual axis present value in one revolution reference position "0" is made by turning M1813+20n/YnD/M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.

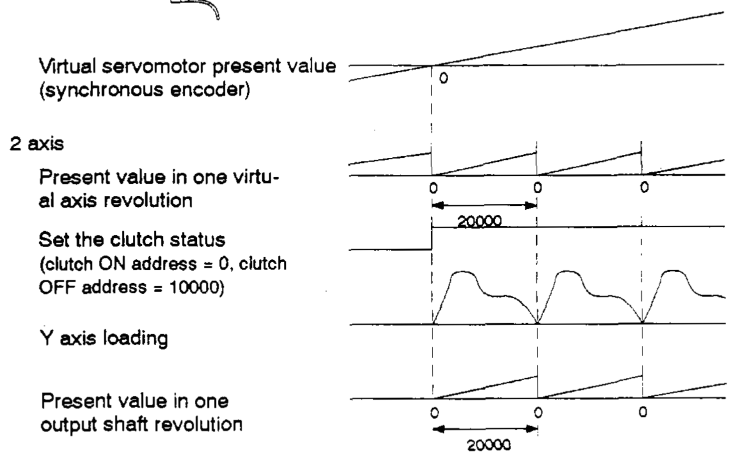
This sets the virtual axis present values in one revolution for both the main shaft and the auxiliary input shaft to "0".

If the switch to the virtual mode is made with M1813+20n/YnD/M3213+20n turned OFF, control continues from the virtual axis present value in one revolution that was effective last time the virtual mode was in effect.

(f) An example of the operation of an address mode clutch is shown below.

Operation Example





8.4.4 Cam curve list

Cam curves which can be used in the VIRTUAL mode are discussed below.

(1) Cam curve characteristics

The cam curve characteristics are compared in Table 8.6 below.

Table 8.6 Cam Curve Characteristics Comparison Table

Class		Cam Curve Name	Acceleration Curve Shape	Vm	Am	(A·V)m	(V·V)m	(S·V)m	Remarks
Discontinuous curves		Constant speed		1.00			1.00	1.00	
		Uniform acceleration		2.00	±4.00	±8.00	4.00	1.09	
Both-side stationary curve	Symmetrical curves	5th		1.88	±5.77	±6.69	3.52	1.19	
		Cycloid		2.00	±6.28	±8.16	4.00	1.26	
		Distorted trapezoid		2..00	±4.89	±8.09	4.00	1.20	Ta = 1/8
		Distorted sine		1.76	±5.53	±5.46	3.10	1.13	Ta = 1/8
		Distorted constant speed		1.28	±8.01	±5.73	1.63	1.07	Ta = 1/16 Ta = 1/4
	Asymmetrical curves	Trapecloid		2.18	±6.17	±10.84	4.76	1.28	m = 1
One-side stationary curve		Multiple hypotenuse		2.04	+5.55 −9.87	+7.75 −9.89	4.16	1.39	
Non-stationary curve		Single hypotenuse		1.57	±4.93	±3.88	2.47	1.02	

(2) Free-form curve

The spline interpolation function can be used to create free-form cam curves.

8.4.5 Creation of cam data by user

The user can create cam data by the 2 methods described below.

- Creation at IBM PC which has been started up with SW0IX-CAMPE.
- Creation at personal computer other than IBM PC.

(1) Creating cam data at IBM PC started up with SW0IX-CAMPE.

Cam data is created by creating a cam curve for 1 cam rotation using at the free-form curve or one of the cam curves shown in section 8.4.4.

For details regarding the creation of cam curves at IBM PC computers which have been started up with the SW0IX-CAMPE software, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operation Manual.

(2) Creating cam data at a personal computer other than an IBM PC

When the A171SCPU is used, cam data can be created in accordance with the cam data format stored at the internal memory's file register area.

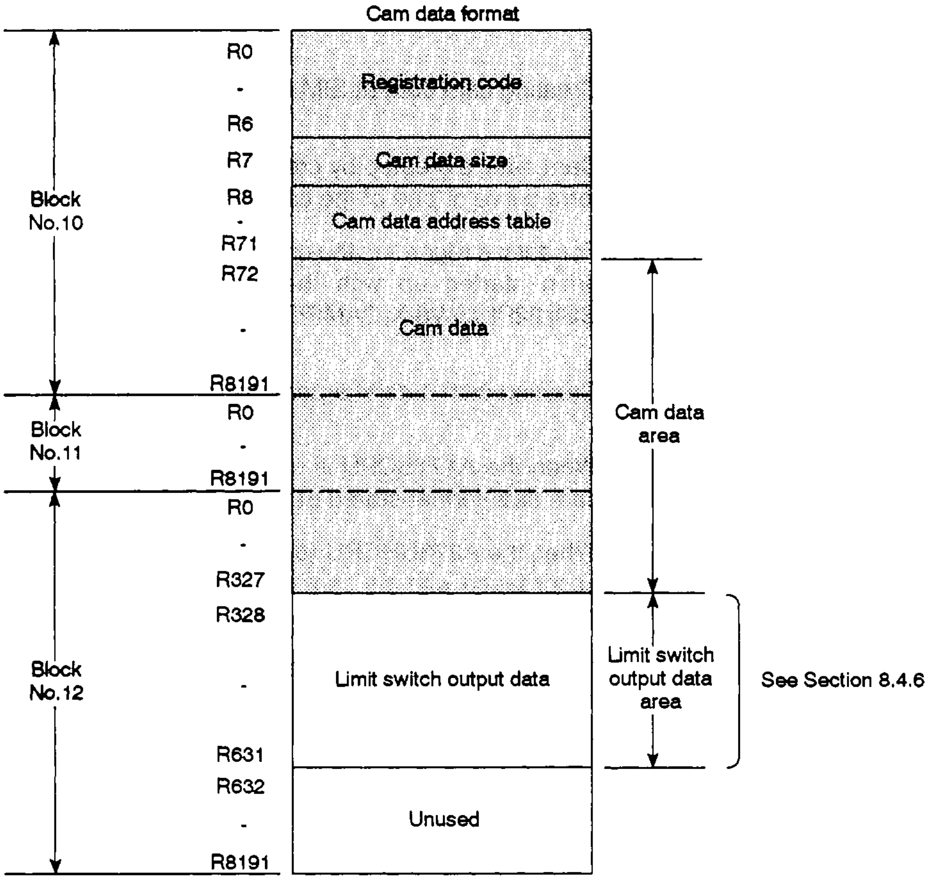
When the A273UHCPU (8-axis specification) is used, cam data can be created in accordance with the cam data format stored at block Nos.10 - 12 of the memory cassette's extension file register area.

When the A273UHCPU (32-axis specification) is used, cam data can be created in accordance with the cam data format stored at block Nos.10 - 18 of the memory cassette's extension file register area.

(a) Cam data format

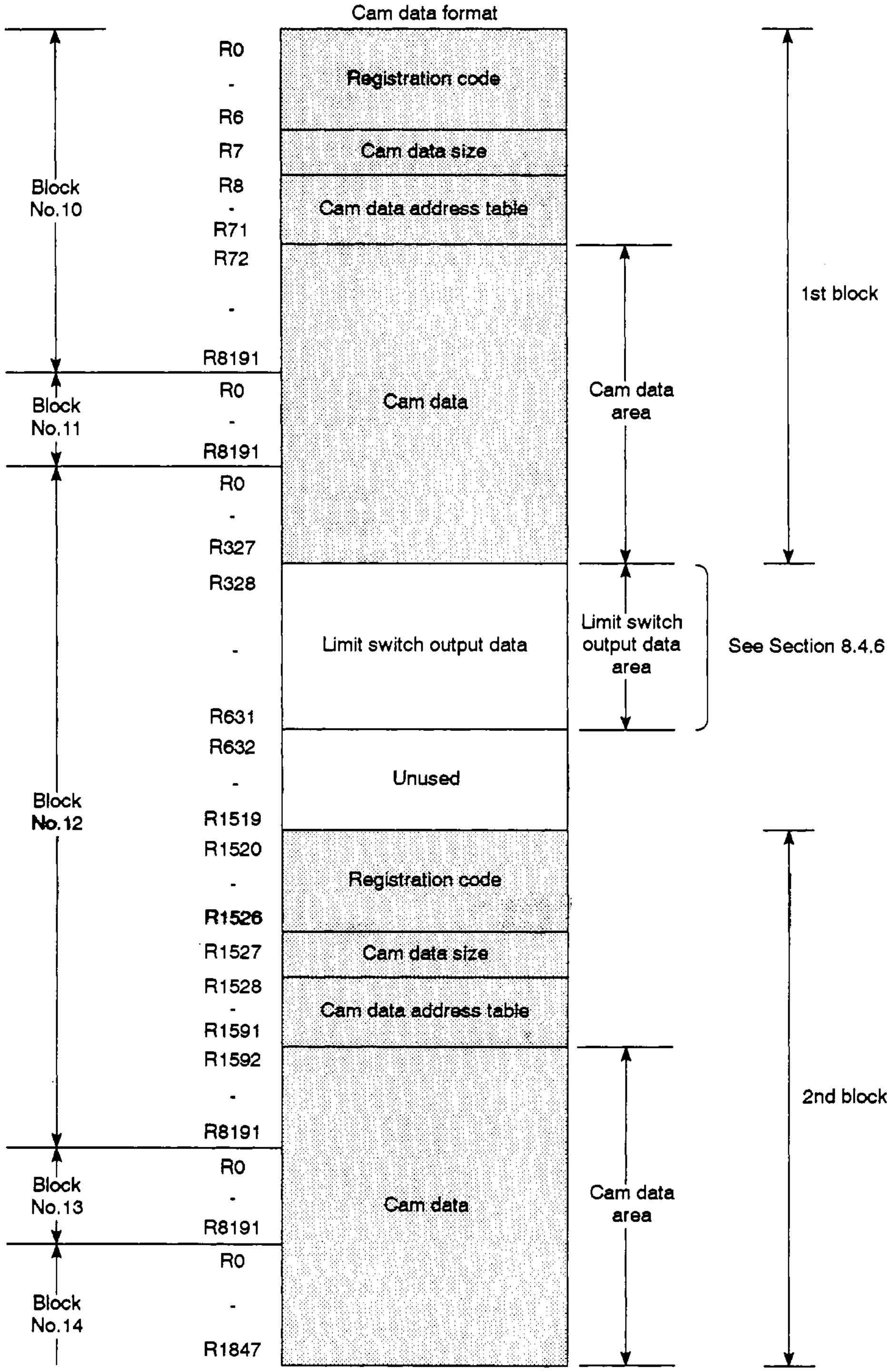
1) When A273UHCPU (8-axis specification) is used

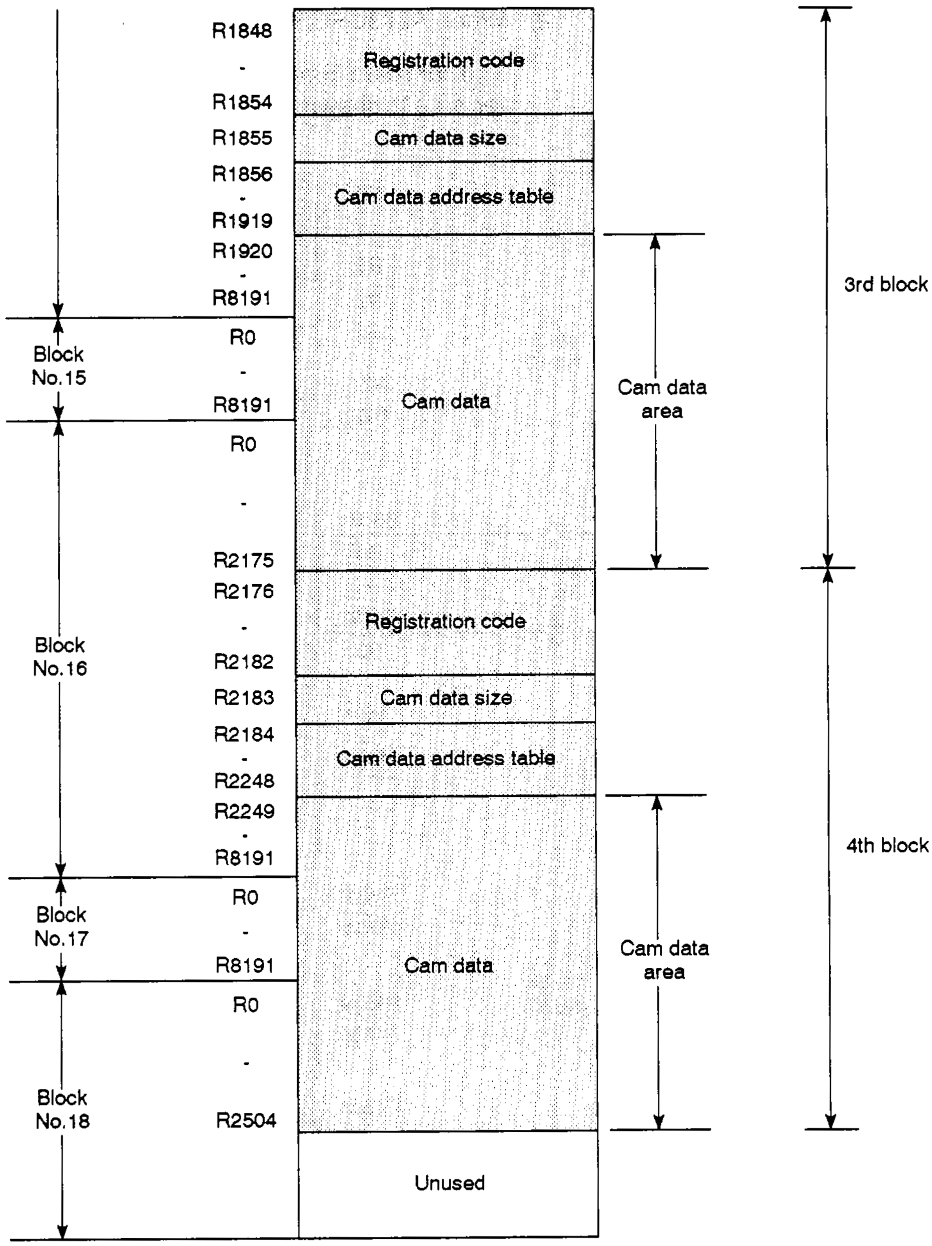
The cam data format stored at block Nos.10 - 12 of the extension file register area is shown below.



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

The cam data format stored at block Nos.10 - 18 of the extension file register area is shown below.




R1848
-
R1854
Registration code
R1855
Cam data size
R1856
-
R1919
Cam data address table
R1920
-
R8191
Block No.15
R0
-
R8191
Cam data
Cam data area
R0
-
R2175
3rd block
Block No.16
R2176
-
R2182
Registration code
R2183
Cam data size
R2184
-
R2248
Cam data address table
R2249
-
R8191
Block No.17
R0
-
R8191
Cam data
Cam data area
4th block
Block No.18
R0
-
R2504
Unused

(b) Registration codes

These codes indicate whether or not cam data is stored.

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

The registration codes shown below are stored at R0 - R6.

R0	$00FF_H$	Registration codes
R1	$11EE_H$	
R2	$22DD_H$	
R3	$33CC_H$	
R4	$44BB_H$	
R5	$55AA_H$	
R6	6699_H	

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

i) 1st block

The registration codes shown below are stored at R0 - R6.

R0	$00FF_H$	Registration codes
R1	$11EE_H$	
R2	$22DD_H$	
R3	$33CC_H$	
R4	$44BB_H$	
R5	$55AA_H$	
R6	6699_H	

ii) 2nd block

The registration codes shown below are stored at R1520 - R1526.

R1520	$00FF_H$	Registration codes
R1521	$11EE_H$	
R1522	$22DD_H$	
R1523	$33CC_H$	
R1524	$44BB_H$	
R1525	$55AA_H$	
R1526	6699_H	

iii) 3rd block

The registration codes shown below are stored at R1848 - R1854.

R1848	$00FF_H$	Registration codes
R1849	$11EE_H$	
R1850	$22DD_H$	
R1851	$33CC_H$	
R1852	$44BB_H$	
R1853	$55AA_H$	
R1854	6699_H	

iv) 4th block

The registration codes shown below are stored at R2176 - R2182.

R2176	$00FF_H$	Registration codes
R2177	$11EE_H$	
R2178	$22DD_H$	
R2179	$33CC_H$	
R2180	$44BB_H$	
R2181	$55AA_H$	
R2182	6699_H	

(c) Cam data size

This is the total byte length setting for the file register where cam data is stored. The total file register length, from R0 to the file register No. of the final data is converted to a "bytes" setting value.
(1 file register point = 2 bytes)

Example When cam data for a cam curve resolution of 256 is stored, the cam data size is as shown below.

	Cam data registration
R0 - R6	Registration code (14 bytes)
R7	Cam data size (2 bytes)
R8 - R71	Cam data address table (128 bytes)
R72 - R331	Cam data (520 bytes)

Cam data size setting value = 664 bytes

(d) Cam Data Address Table

1) When A171SCPU/A273UHCPU (8-axis specification) is used

This is the 1st address setting of the cam data stored for cam Nos.1 - 64. The 1st address for each cam No. is converted to a "number of bytes" (starting from R0) setting value. "0" is designated as the setting value at 1st address of unregistered cam Nos.

R8	Cam No.1 first address
R9	Cam No.2 first address
R10	Cam No.3 first address
⋮	⋮
R70	Cam No.63 first address
R71	Cam No.64 first address

Cam data address table

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

This is the 1st address setting of cam data (max. of 4 blocks) stored for cam Nos.1 - 64. The 1st address for each cam No. is converted to a "number of bytes" (starting from R0) setting value. "0" is designated as the setting value at 1st addresses of unregistered cam Nos.

i) 1st block

R8	Cam No.1 first address	1st block cam data address table
R9	Cam No.2 first address	
R10	Cam No.3 first address	
R70	Cam No.63 first address	
R71	Cam No.64 first address	

ii) 2nd block

R1528	Cam No.1 first address	2nd block cam data address table
R1529	Cam No.2 first address	
R1530	Cam No.3 first address	
R1590	Cam No.63 first address	
R1591	Cam No.64 first address	

iii) 3rd block

R1856	Cam No.1 first address	3rd block cam data address table
R1857	Cam No.2 first address	
R1858	Cam No.3 first address	
R1918	Cam No.63 first address	
R1919	Cam No.64 first address	

iv) 4th block

R2184	Cam No.1 first address	4th block cam data address table
R2185	Cam No.2 first address	
R2186	Cam No.3 first address	
R2247	Cam No.63 first address	
R2248	Cam No.64 first address	

(e) Cam Data

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

- Cam data Nos.1 - 64 are designated.
  It is not necessary to store cam data in the cam No. order.

- Each cam data item is designated as a stroke ratio (integer) between 0 and $7FFF_H$ (32767). The cam data must contain both "0" and "$7FFF_H$ (32767)" points.
  The following data is stored at the beginning of the cam data:
  control mode, cam No., resolution, and stroke and cam No. switching position.
  (See Section 8.4.2)

b15 b8 b7 b0: Control mode ¦ Cam No.

R72	Control mode ¦ Cam No.	→ Cam No.: 1 - 64 (1 - 40_H) setting; Control mode: 0: Two-way cam; 1: Feed cam
R73	Resolution	→ 256, 512, 1024, 2048 setting
R74	Stroke & cam No. switching position	→ "0 to (resolution −1)" setting
R75	Sum check	→ Dummy (setting unnecessary)
R76 -	The "0 to resolution −1" stroke ratio setting designated as 0 - $7FFF_H$.	

REMARK

(1) When using the A273UHCPU (8-axis specification), an A3NMCA16 (128k bytes) level memory cassette or higher is required.

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

- Cam data Nos.1 - 64 (max. of 4 blocks) are designated.
  It is not necessary to store cam data in the cam No. order.

- Each cam data item is designated as a stroke ratio (integer) between 0 - $7FFF_H$ (32767). The cam data must contain both "0" and "$7FFF_H$ (32767)" points.
  The following data is stored at the beginning of the cam data:
  control mode, cam No., resolution, and stroke and cam No. switching position.
  (See Section 8.4.2)

i) 1st block

b15 b8 b7 b0: Control mode ¦ Cam No.

R72	Control mode ¦ Cam No.	→ Cam No.: 1 - 64 (1 - 40_H) setting; Control mode: 0: Two-way cam; 1: Feed cam
R73	Resolution	→ 256, 512, 1024, 2048 setting
R74	Stroke & cam No. switching position	→ "0 to (resolution −1)" setting
R75	Sum check	→ Dummy (setting unnecessary)
R76 -	The "0 to resolution −1" stroke ratio setting designated as 0 - $7FFF_H$.	

ii) 2nd Block

b15 b8 b7 b0: Control mode | Cam No.
- Cam No. → 1 - 64 (1 - 40_H) setting
- Control mode → 0: Two-way cam; 1: Feed cam

R1580	Control mode / Cam No.	→ (see bit layout above)
R1581	Resolution	→ 256, 512, 1024, 2048 setting
R1582	Stroke & cam No. switching position	→ "0 to (resolution −1)" setting
R1583	Sum check	→ Dummy (setting unnecessary)
R1584 -	The "0 to resolution −1" stroke ratio setting designated as 0 - $7FFF_H$.	

iii) 3rd Block

b15 b8 b7 b0: Control mode | Cam No.
- Cam No. → 1 - 64 (1 - 40_H) setting
- Control mode → 0: Two-way cam; 1: Feed cam

R1920	Control mode / Cam No.	→ (see bit layout above)
R1921	Resolution	→ 256, 512, 1024, 2048 setting
R1922	Stroke & cam No. switching position	→ "0 to (resolution −1)" setting
R1923	Sum check	→ Dummy (setting unnecessary)
R1924 -	The "0 to resolution −1" stroke ratio setting designated as 0 - $7FFF_H$.	

iv) 4th Block

b15 b8 b7 b0: Control mode | Cam No.
- Cam No. → 1 - 64 (1 - 40_H) setting
- Control mode → 0: Two-way cam; 1: Feed cam

R2249	Control mode / Cam No.	→ (see bit layout above)
R2250	Resolution	→ 256, 512, 1024, 2048 setting
R2251	Stroke & cam No. switching position	→ "0 to (resolution −1)" setting
R2252	Sum check	→ Dummy (setting unnecessary)
R2253 -	The "0 to resolution −1" stroke ratio setting designated as 0 - $7FFF_H$.	

REMARK

When using the A273UHCPU (8/32-axis specification), an A3NMCA16 (128k bytes) level memory cassette or higher is required.

8.4.6 Limit switch outputs in present value mode & present value in 1 cam revolution mode

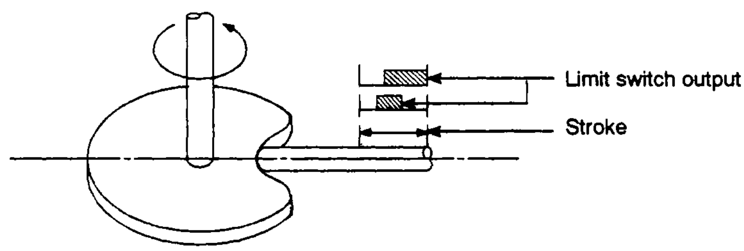
There are 2 types of limit switch outputs:

- Limit switch outputs in present value mode.
- Limit switch outputs in present value in 1 cam revolution mode.

(1) Limit switch outputs in present value mode.

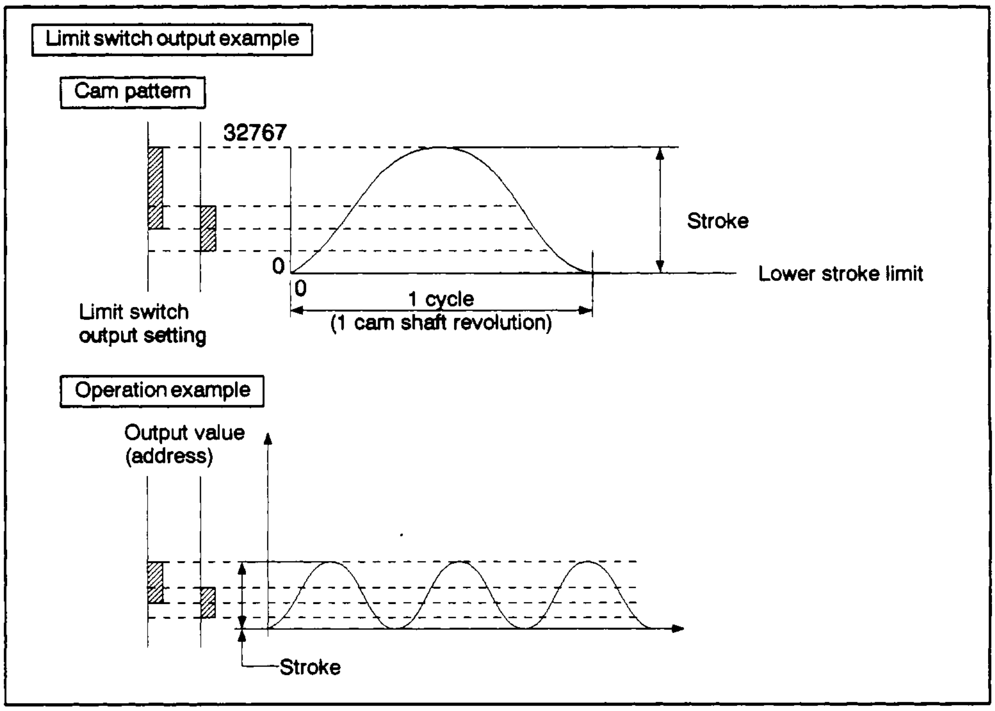
Limit switch outputs occur in accordance with the cam's actual present value (stroke).

[Cam]

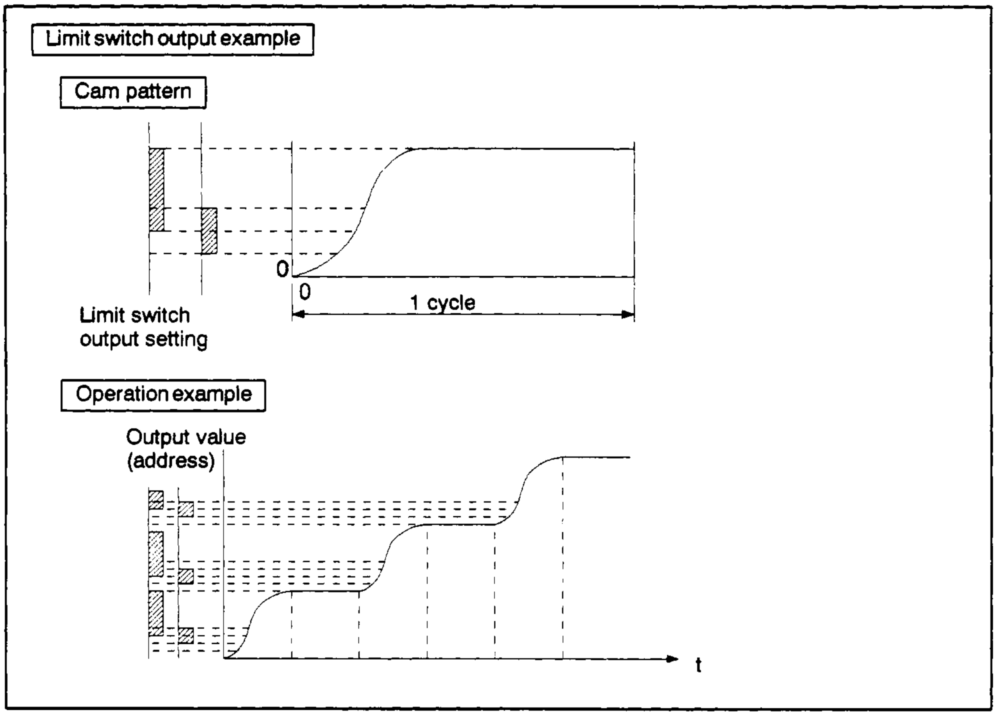


(a) For two-way cam

The limit switch output pattern is identical for both directions.



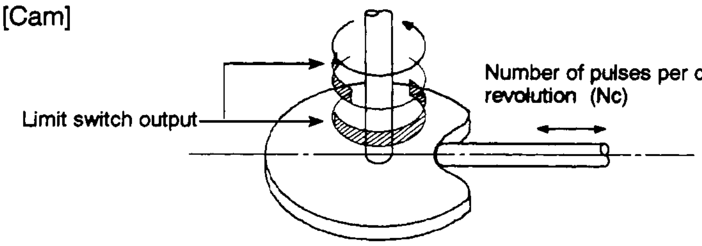
(b) For feed cam



(2) Limit switch outputs in 1 cam shaft revolution present value

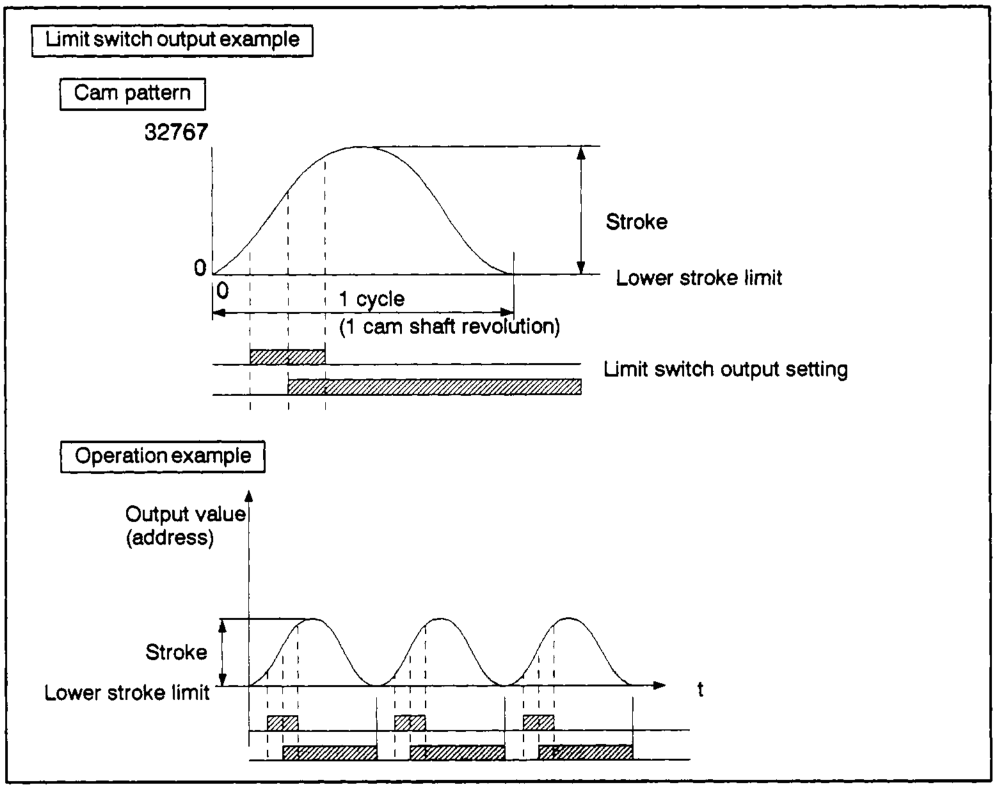
Limit switch outputs occur in accordance with the present value within 1 cam shaft revolution (0 to Nc – 1).

[Cam]

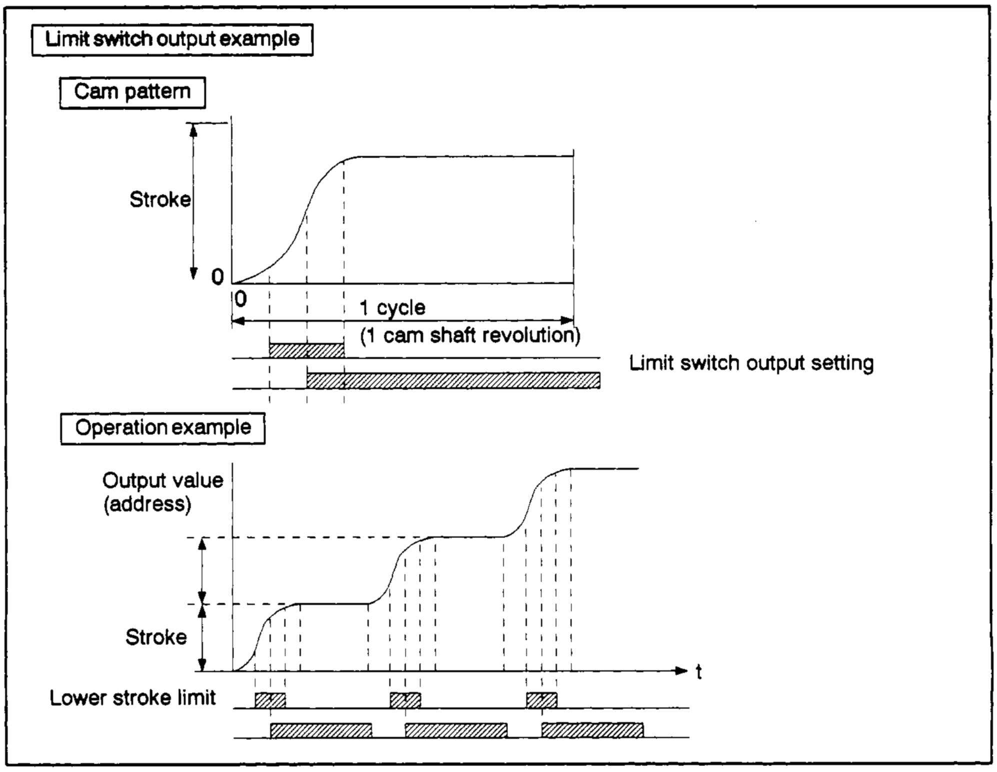


(a) For two-way cam

Different limit switch output patterns can be used for the feed and return strokes.



(b) For feed cam



8.4.7 Limit switch output data in present value within 1 cam revolution mode

Limit switch output data can be created by the user at IBM PC computers which have been started up with the SW2SRX-GSV22PE software.

For details regarding the limit switch output data creation procedure, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

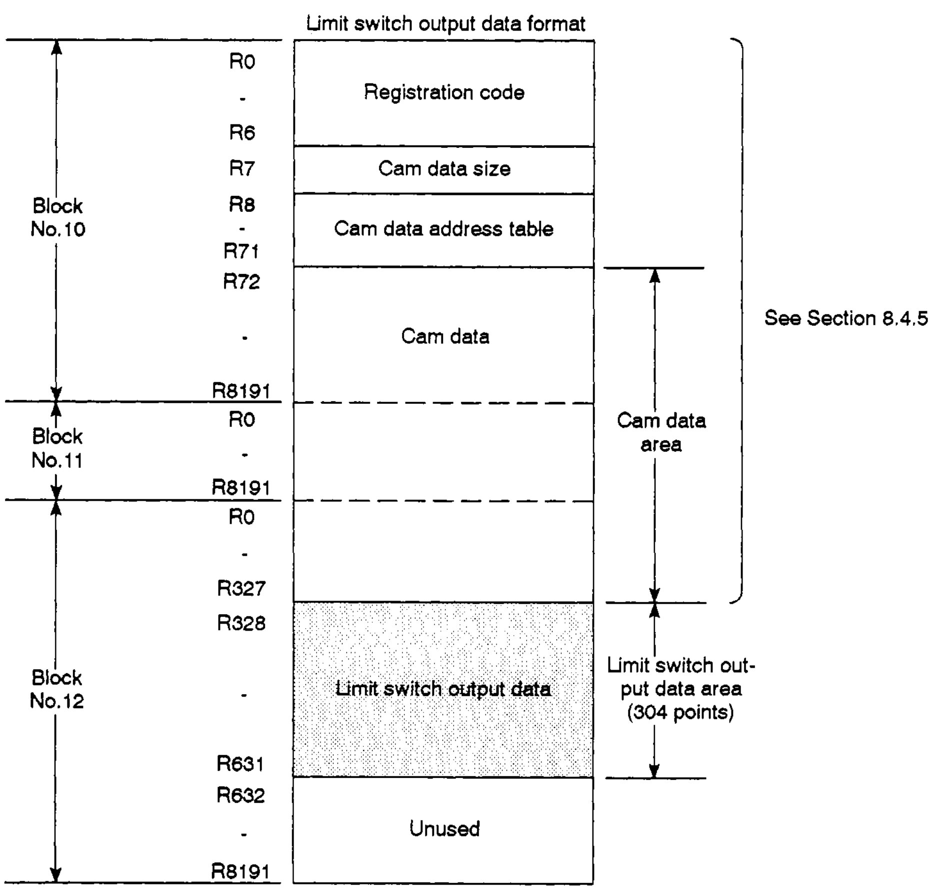
(1) Limit Switch Output Data Storage Area

(a) The limit switch output data for the axis designated in the present value in 1 cam revolution mode (see items 11 & 12 of Section 8.4.3) is stored at the internal memory's file register area when the A171SCPU is used, and at the memory cassette's extension file register area (block No.12) when the A273UHCPU (8/32-axis specification) is used.

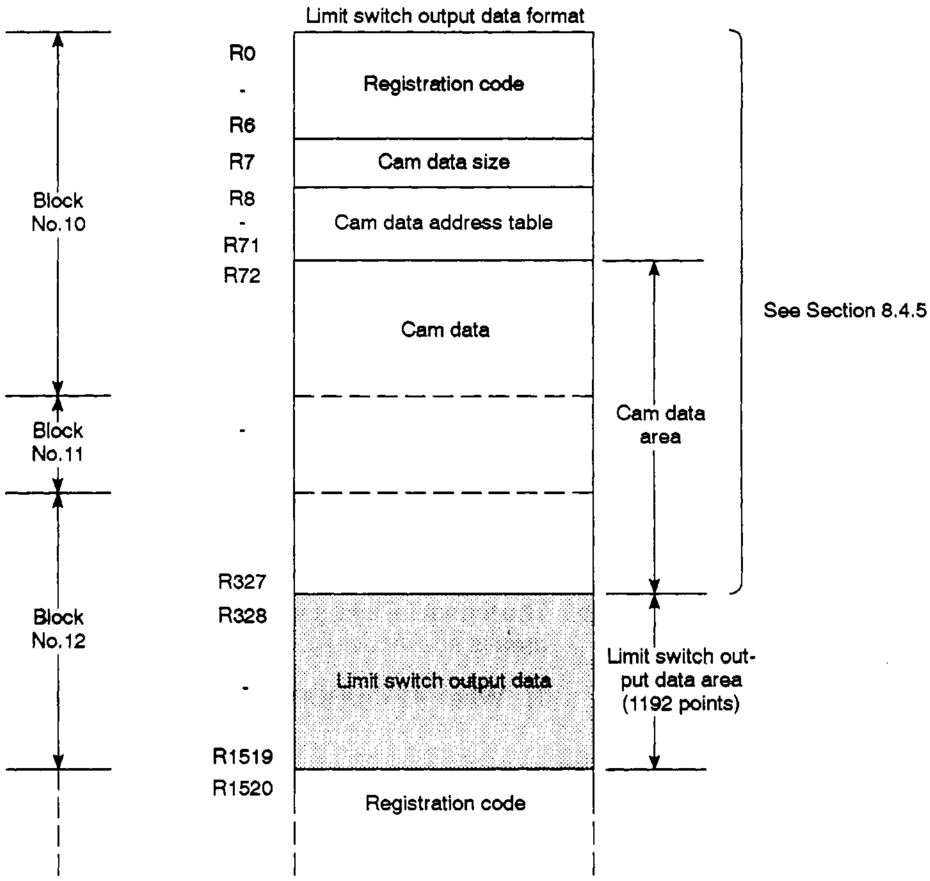
(When the A273UHCPU 8/32-axis specification is used, limit switch output data for modes other than the present value in 1 cam revolution mode are stored in the internal memory.)

(b) The format for limit switch output data stored at block No.12 of the file register area is shown below.

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



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



(c) The limit switch output data stored at the file register area is fetched when REAL to VIRTUAL mode switching occurs. If the limit switch output data is error-free, limit switch output control will occur in accordance with that data for the axis designated in the present value in 1 cam revolution mode.

(d) When "servo data PC write" is designated from a peripheral device, the "present value in 1 cam shaft revolution" mode's limit switch output data is written to the following areas:

When the A171SCPU is used, the data is written to R328 - R631 at the internal memory's file register area.

When the A273UHCPU (8-axis specification) is used, the data is written to block No.12 (R328 - R631) of the extension file register.

When the A273UHCPU (32-axis specification) is used, the data is written to block No.12 (R328 - R1519) of the extension file register.

When multiple limit switch output data exists, and switching between the data occurs, the data which has been written from a peripheral device must first be transferred to another device, and then written to the file register area if required. (See Section 8.4.8)

REMARK

When using the A273UHCPU (8/32-axis specification), an A3NMCA24 (194k bytes) level memory cassette or higher is required.

8.4.8 Batch changes of cam data & limit switch output data (for A273UHCPU 8/32-axis specification)

When a power ON or reset occurs at the A273UHCPU (8/32-axis specification) PCPU, the cam data and limit switch output data stored at block Nos.10 - 12/Nos.10 - 18 of the extension file register area are fetched, and control occurs accordingly.

A batch change of cam data and limit switch output data fetched by the PCPU can be executed by the sequence program when the A273UHCPU (8/32-axis specification) is used. (Not possible when the A171SCPU is used.)

Cam data and limit switch output data can be changed by the following procedure.

(1) Write the cam data & limit switch output data to block Nos.10 - 12/Nos.10 - 18 at the extension file register area. *1

(2) Execute a batch change of the cam data & limit switch output data (M2016/M2056: OFF → ON). *2

(3) Batch change processing of the cam data & limit switch output data occurs.

(4) The cam data & limit switch output data batch change request (M2016/M2056) is reset.

⚠ CAUTION

⚠ *1: The cam data & limit switch output data (data at block Nos.10 - 12/Nos.10 - 18 of the extension file register area) should not be changed under the following conditions:

- While cam data is being written to the programmable controller from a peripheral device. (Cam data area)
- While servo setting data is being written to the programmable controller from a peripheral device. (Limit switch output data area)
- When a REAL to VIRTUAL mode switching request (M2043: OFF → ON) is active. (Limit switch output data area)
- During a batch change of cam data & limit switch output data (M2016/M2056: OFF → ON).

⚠ *2: The cam data & limit switch output data batch change request (M2016/M2056: OFF → ON) should not be executed under the following condition:

- While cam data is being written to the programmable controller from a peripheral device.

At all other times, the cam data & limit switch output data batch change request (M2016/M2056: OFF → ON) can be executed in either the REAL or VIRTUAL mode.

(1) Writing cam data & limit switch output data to block Nos.10 - 12/Nos.10 - 18 at the extension file memory

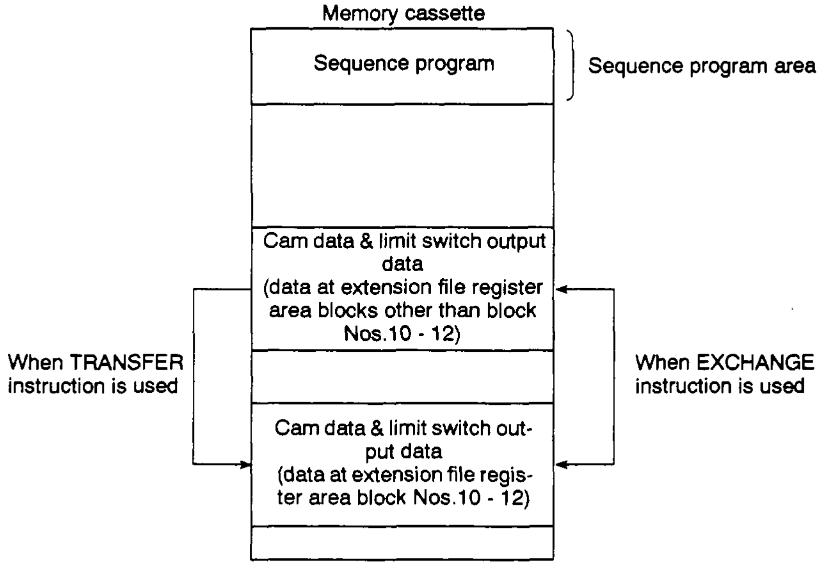
Cam data writing can be executed by any of the following:

- Sequence program
- Peripheral device
- Personal computer

(a) Writing from sequence program

The cam data and limit switch output data stored at block Nos.10 - 12/Nos.10 - 18 of the extension file register area can be replaced with cam data and limit switch output data stored at other extension file registers by using the transfer and exchange instructions.

Example When A273UHCPU (8-axis specification) is used

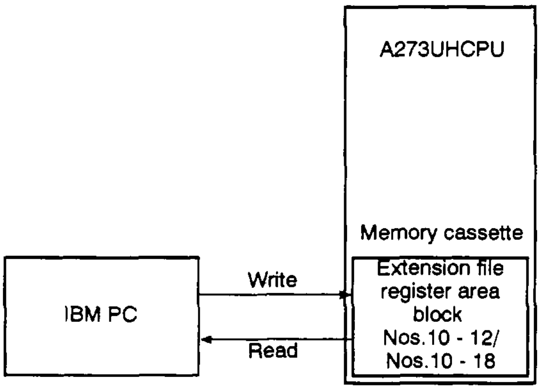


Execution is possible using a dedicated instruction.

(b) Writing from peripheral device

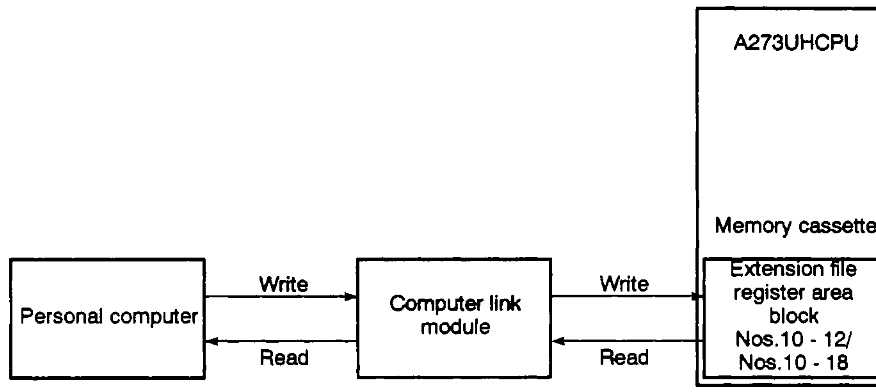
Cam data and limit switch output data can be written from an IBM PC which has been started up with SW2SRX-GSV22PE software.

For details regarding IBM PC operation procedures, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.



(c) Writing from personal computer

Cam data and limit switch output data stored at a personal computer can be written to extension file register area block Nos.10 - 12/Nos.10 - 18, via a computer link.

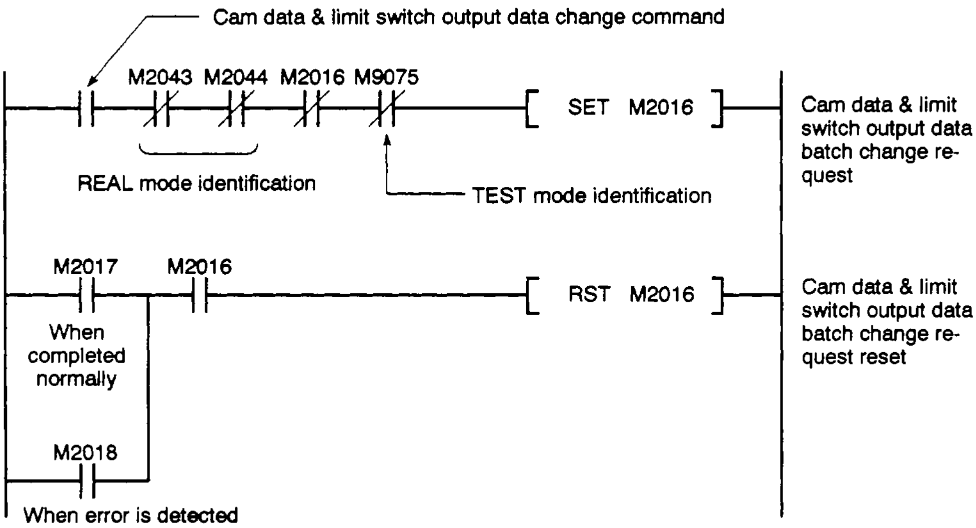


Limit switch output data at the extension file register area block No.12 is read by the personal computer, and the limit switch output data stored at the hard disk is written to the extension file register area block No.12 via a computer link.

(2) Cam data & limit switch output data batch change program

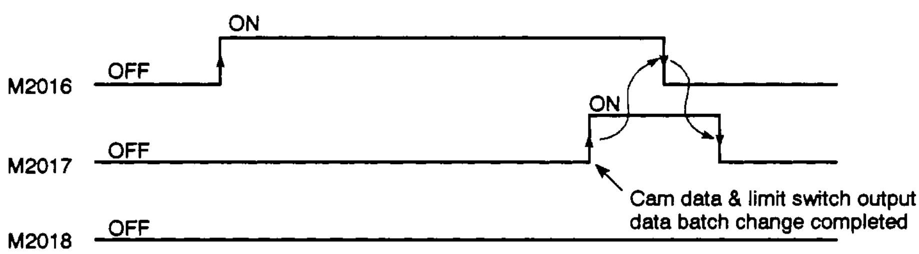
The sequence program shown below is used to write the cam data and limit switch output data stored at block Nos.10 - 12/Nos.10 - 18 of the extension file register area to the PCPU. (Example: when A273UHCPU 8-axis specification is used)

[Sequence Program]

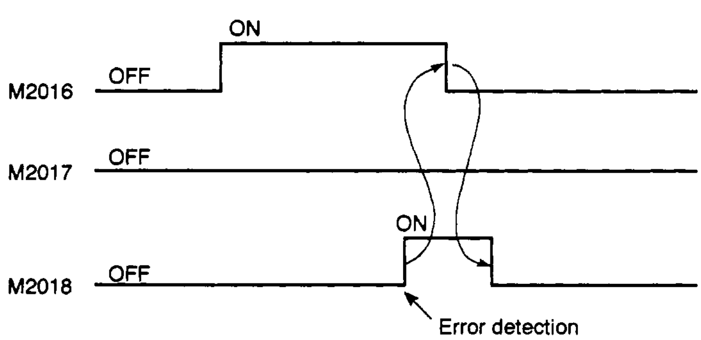


[Operation Timing]

- When completed normally



- When error is detected



(3) Cautions

(a) Cam data & limit switch output data batch change requests are invalid during a TEST mode status designated from a peripheral device.

⚠ CAUTION
⚠ The "TEST mode in progress (M9075)" signal should be included in the cam data & limit switch output data batch change request program as an interlock function.

(b) REAL to VIRTUAL mode switching is impossible while cam data & limit switch output data are being read to the PCPU (M2016/M2056: ON). The cam data batch change request flag (M2016/M2056) should be used in the REAL to VIRTUAL mode switching program as an interlock function.

(4) Error causes

The causes of errors which occur when a cam data & limit switch output data batch change request (M2016/M2056: OFF → ON) is executed are:

(a) Cam data writing from a peripheral device is in progress.

(b) Improper registration code at the file register's registration code storage area.

(c) The cam data size at the file register's cam data size storage area is outside the range 144 - 33434, or it is an odd-numbered byte count value.

8.5 Common Devices (Input/Output, Internal Relays, Data Registers)

The inputs/outputs, internal relays, and data registers used at the output module are discussed in this section.

8.5.1 Inputs/outputs (X/Y) and internal relays (M)

(1) Input/output (X/Y) and internal relay (M) list

(a) When A171SCPU is used

The servo system CPU's M1219 - M1279, M1419 - M1479, and M1600 - M1959 internal relays are used for the output module.

- Inputs (M1219 - M1279, M1600 - M1799)
  Inputs are data which indicate the PCPU setting status or external input (FLS/RLS signals, STOP signal, etc.) status. This data is used to verify (by sequence program) the control status of each axis, and to designate the next position, etc.
- Outputs (M1419 - M1479, M1800 - M1959)
  Output data is designated at the sequence program, and is used to send commands to the PCPU.

Table 8.7 Internal Relay (Input) List (for A171SCPU)

	Device				Signal Name		Roller	Ball Screw	Rotary Table	Cam
	Axis 1	Axis 2	Axis 3	Axis 4						
Inputs	M1219	M1239	M1259	M1279	M code output in progress signal		○	○	○	○
	M1600	M1620	M1640	M1660	Vacant (OFF)		–	–	–	–
	M1601	M1621	M1641	M1661						
	M1602	M1622	M1642	M1662	In-position		○	○	○	○
	M1603	M1623	M1643	M1663	Vacant (OFF)		–	–	–	–
	M1604	M1624	M1644	M1664						
	M1605	M1625	M1645	M1665						
	M1606	M1626	M1646	M1666	Zero-point pass		○	○	○	○
	M1607	M1627	M1647	M1667	Error detection		○	○	○	○
	M1608	M1628	M1648	M1668	Servo error detection		○	○	○	○
	M1609	M1629	M1649	M1669	Home position return request		○	○	○	○
	M1610	M1630	M1650	M1670	Home position return completed		○	○	○	○
	M1611	M1631	M1651	M1671	External signals	FLS	○	○	○	○
	M1612	M1632	M1652	M1672		RLS	○	○	○	○
	M1613	M1633	M1653	M1673		STOP	○	○	○	○
	M1614	M1634	M1654	M1674		DOG	○	○	○	○
	M1615	M1635	M1655	M1675	Servo ON/OFF status		○	○	○	○
	M1616	M1636	M1656	M1676	Torque limit in progress signal		○	○	○	○
	M1617	M1637	M1657	M1677	Vacant (OFF)		–	–	–	–
	M1618	M1638	M1658	M1678	VIRTUAL mode continuation disabled warning signal		○	○	○	○
	M1619	M1639	M1659	M1679	Vacant (OFF)		–	–	–	–

Table 8.8 Internal Relay (Output) List (for A171SCPU)

	Device				Signal Name	Roller	Ball Screw	Rotary Table	Cam
	Axis 1	Axis 2	Axis 3	Axis 4					
Out-puts	M1419	M1439	M1459	M1479	FIN signal	○	○	○	○
	M1800	M1820	M1840	M1860	Vacant	–	–	–	–
	M1801	M1821	M1841	M1861					
	M1802	M1822	M1842	M1862					
	M1803	M1823	M1843	M1863					
	M1804	M1824	M1844	M1864					
	M1805	M1825	M1845	M1865					
	M1806	M1826	M1846	M1866	Limit switch output enabled	–	○	○	○
	M1807	M1827	M1847	M1867	Error reset	○	○	○	○
	M1808	M1828	M1848	M1868	Vacant	–	–	–	–
	M1809	M1829	M1849	M1869					
	M1810	M1830	M1850	M1870					
	M1811	M1831	M1851	M1871					
	M1812	M1832	M1852	M1872					
	M1813	M1833	M1853	M1873	Address clutch reference setting	–	–	○	○
	M1814	M1834	M1854	M1874	Cam reference position setting	–	–	–	○
	M1815	M1835	M1855	M1875	Servo OFF	○	○	○	○
	M1816	M1836	M1856	M1876	Vacant	–	–	–	–
	M1817	M1837	M1857	M1877					
	M1818	M1838	M1858	M1878					
	M1819	M1839	M1859	M1879					

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

The servo system CPU's X/Y0 - X/Y7F, XD0 - XDF, XF0 - XF7 and X/Y10F - X/Y17F inputs/outputs are used for the output module.

- Inputs (X0 - X7F, XD0 - XDF, XF0 - XF7, X10F - X17F)
  Inputs are data which indicate the PCPU setting status or external input (FLS/RLS signals, STOP signal, etc.) status. This data is used to verify (by sequence program) the control status of each axis, and to designate the next position, etc.

- Outputs (Y0 - Y7F, Y10F - Y17F)
  Output data is designated at the sequence program, and is used to send commands to the PCPU.

Table 8.9 Input/Output List (for A273UHCPU 8-axis Specification)

	Device								Signal Name		Roll-er	Ball Screw	Rotary Table	Cam
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8						
Inputs	X0	X10	X20	X30	X40	X50	X60	X70	Vacant (OFF)		–	–	–	–
	X1	X11	X21	X31	X41	X51	X61	X71						
	X2	X12	X22	X32	X42	X52	X62	X72	In-position		○	○	○	○
	X3	X13	X23	X33	X43	X53	X63	X73	Vacant (OFF)		–	–	–	–
	X4	X14	X24	X34	X44	X54	X64	X74						
	X5	X15	X25	X35	X45	X55	X65	X75						
	X6	X16	X26	X36	X46	X56	X66	X76	Zero-point pass		○	○	○	○
	X7	X17	X27	X37	X47	X57	X67	X77	Error detection		○	○	○	○
	X8	X18	X28	X38	X48	X58	X68	X78	Servo error detection		○	○	○	○
	X9	X19	X29	X39	X49	X59	X69	X79	Home position return request		○	○	○	○
	XA	X1A	X2A	X3A	X4A	X5A	X6A	X7A	Home position return completed		○	○	○	○
	XB	X1B	X2B	X3B	X4B	X5B	X6B	X7B	FLS	FLS	○	○	○	○
	XC	X1C	X2C	X3C	X4C	X5C	X6C	X7C		RLS	○	○	○	○
	XD	X1D	X2D	X3D	X4D	X5D	X6D	X7D		STOP	○	○	○	○
	XE	X1E	X2E	X3E	X4E	X5E	X6E	X7E		DOG	○	○	○	○
	XF	X1F	X2F	X3F	X4F	X5F	X6F	X7F	Servo ON/OFF status		○	○	○	○
	XD0	XD1	XD2	XD3	XD4	XD5	XD6	XD7	Torque limit in progress signal		○	○	○	○
	XF0	XF1	XF2	XF3	XF4	XF5	XF6	XF7	VIRTUAL mode continuation disabled warning signal		○	○	○	○
	X10F	X11F	X12F	X13F	X14F	X15F	X16F	X17F	M code output in progress signal		○	○	○	○
Out-puts	Y0	Y10	Y20	Y30	Y40	Y50	Y60	Y70	Vacant		–	–	–	–
	Y1	Y11	Y21	Y31	Y41	Y51	Y61	Y71						
	Y2	Y12	Y22	Y32	Y42	Y52	Y62	Y72						
	Y3	Y13	Y23	Y33	Y43	Y53	Y63	Y73						
	Y4	Y14	Y24	Y34	Y44	Y54	Y64	Y74						
	Y5	Y15	Y25	Y35	Y45	Y55	Y65	Y75						
	Y6	Y16	Y26	Y36	Y46	Y56	Y66	Y76	Limit switch output enabled		–	○	○	○
	Y7	Y17	Y27	Y37	Y47	Y57	Y67	Y77	Error reset		○	○	○	○
	Y8	Y18	Y28	Y38	Y48	Y58	Y68	Y78	Servo error reset		○	○	○	○
	Y9	Y19	Y29	Y39	Y49	Y59	Y69	Y79	Vacant		–	–	–	–
	YA	Y1A	Y2A	Y3A	Y4A	Y5A	Y6A	Y7A						
	YB	Y1B	Y2B	Y3B	Y4B	Y5B	Y6B	Y7B						
	YC	Y1C	Y2C	Y3C	Y4C	Y5C	Y6C	Y7C						
	YD	Y1D	Y2D	Y3D	Y4D	Y5D	Y6D	Y7D	Address clutch reference setting		–	–	○	○
	YE	Y1E	Y2E	Y3E	Y4E	Y5E	Y6E	Y7E	Cam reference position setting		–	–	–	○
	YF	Y1F	Y2F	Y3F	Y4F	Y5F	Y6F	Y7F	Servo OFF		○	○	○	○
	Y10F	Y11F	Y12F	Y13F	Y14F	Y15F	Y16F	Y17F	FIN signal		○	○	○	○

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

The servo system CPU's M2400-M3839, M4019 - M4639 and M4819 - M5439 internal relays are used for the output module.

- Inputs (M2400 - M3039, M4019 - M4639)
  Inputs are data which indicate the PCPU setting status or external input (FLS/RLS signals, STOP signal, etc.) status. This data is used to verify (by sequence program) the control status of each axis, and to designate the next position, etc.

- Outputs (M3200 - M3839, M4819 - M5439)
  Output data is designated at the sequence program, and is used to send commands to the PCPU.

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Table 8.10 Internal Relay (Input/Output) List (for A273UHCPU 32-axis Specification)

	Signal Name		Roller	Ball Screw	Rotary Table	Cam	Device No.					
							Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
Inputs	Vacant (OFF)		–	–	–	–	M2400	M2420	M2440	M2460	M2480	M2500
							M2401	M2421	M2441	M2461	M2481	M2501
	In-position		○	○	○	○	M2402	M2422	M2442	M2462	M2482	M2502
	Vacant (OFF)		–	–	–	–	M2403	M2423	M2443	M2463	M2483	M2503
							M2404	M2424	M2444	M2464	M2484	M2504
							M2405	M2425	M2445	M2465	M2485	M2505
	Zero-point pass		○	○	○	○	M2406	M2426	M2446	M2466	M2486	M2506
	Error detection		○	○	○	○	M2407	M2427	M2447	M2467	M2487	M2507
	Servo error detection		○	○	○	○	M2408	M2428	M2448	M2468	M2488	M2508
	Home position return request		○	○	○	○	M2409	M2429	M2449	M2469	M2489	M2509
	Home position return completed		○	○	○	○	M2410	M2430	M2450	M2470	M2490	M2510
	FLS	FLS	○	○	○	○	M2411	M2431	M2451	M2471	M2491	M2511
		RLS	○	○	○	○	M2412	M2432	M1652	M2472	M2492	M2512
		STOP	○	○	○	○	M2413	M2433	M2453	M2473	M2493	M2513
		DOG	○	○	○	○	M2414	M2434	M2454	M2474	M2494	M2514
	Servo ON/OFF status		○	○	○	○	M2415	M2435	M2455	M2475	M2495	M2515
	Output module torque limit in progress signal		○	○	○	○	M2416	M2436	M2456	M2476	M2496	M2516
	External signals CHANGE		○	○	○	○	M2417	M2437	M2457	M2477	M2497	M2517
	VIRTUAL mode continuation disabled warning signal		○	○	○	○	M2418	M2438	M2458	M2478	M2498	M2518
	Vacant (OFF)		○	○	○	○	M2419	M2439	M2459	M2479	M2499	M2519
	M code output in progress signal		○	○	○	○	M4019	M4039	M4059	M4079	M4099	M4119
Outputs	Vacant		–	–	–	–	M3200	M3220	M3240	M3260	M3280	M3300
							M3201	M3221	M3241	M3261	M3281	M3301
							M3202	M3222	M3242	M3262	M3282	M3302
							M3203	M3223	M3243	M3263	M3283	M3303
							M3204	M3224	M3244	M3264	M3284	M3304
							M3205	M3225	M3245	M3265	M3285	M3305
	Limit switch output enabled		–	○	○	○	M3206	M3226	M3246	M3266	M3286	M3306
	Error reset		○	○	○	○	M3207	M3227	M3247	M3267	M3287	M3307
	Servo error reset		○	○	○	○	M3208	M3228	M3248	M3268	M3288	M3308
	Vacant		–	–	–	–	M3209	M3229	M3249	M3269	M3289	M3309
							M3210	M3230	M3250	M3270	M3280	M3310
							M3211	M3231	M3251	M3271	M3281	M3311
							M3212	M3232	M3252	M3272	M3282	M3312
	Address clutch reference setting		–	–	○	○	M3213	M3233	M3253	M3273	M3283	M3313
	Cam reference position setting		–	–	–	○	M3214	M3234	M3254	M3274	M3284	M3314
	Servo OFF		○	○	○	○	M3215	M3235	M3255	M3275	M3285	M3315
	Vacant		○	○	○	○	M3216	M3236	M3256	M3276	M3286	M3316
			○	○	○	○	M3217	M3237	M3257	M3277	M3287	M3317
			○	○	○	○	M3218	M3238	M3258	M3278	M3288	M3318
			○	○	○	○	M3219	M3239	M3259	M3279	M3289	M3319
	FIN signal		○	○	○	○	M4819	M4839	M4859	M4879	M4899	M4919

Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	Signal direction
M2520	M2540	M2560	M2580	M2600	M2620	M2640	M2660	M2680	M2700	–
M2521	M2541	M2561	M2581	M2601	M2621	M2641	M2661	M2681	M2701	
M2522	M2542	M2562	M2582	M2602	M2622	M2642	M2662	M2682	M2702	PCPU → SCPU
M2523	M2543	M2563	M2583	M2603	M2623	M2643	M2663	M2683	M2703	–
M2524	M2544	M2564	M2584	M2604	M2624	M2644	M2664	M2684	M2704	
M2525	M2545	M2565	M2585	M2605	M2625	M2645	M2665	M2685	M2705	
M2526	M2546	M2566	M2586	M2606	M2626	M2646	M2666	M2686	M2706	PCPU → SCPU
M2527	M2547	M2567	M2587	M2607	M2627	M2647	M2667	M2687	M2707	
M2528	M2548	M2568	M2588	M2608	M2628	M2648	M2668	M2688	M2708	
M2529	M2549	M2569	M2589	M2609	M2629	M2649	M2669	M2689	M2709	
M2530	M2550	M2570	M2590	M2610	M2630	M2650	M2670	M2690	M2710	
M2531	M2551	M2571	M2591	M2611	M2631	M2651	M2671	M2691	M2711	
M2532	M2552	M2572	M2592	M2612	M2632	M2652	M2672	M2692	M2712	
M2533	M2553	M2573	M2593	M2613	M2633	M2653	M2673	M2693	M2713	
M2534	M2554	M2574	M2594	M2614	M2634	M2654	M2674	M2694	M2714	
M2535	M2555	M2575	M2595	M2615	M2635	M2655	M2675	M2695	M2715	
M2536	M2556	M2576	M2596	M2616	M2636	M2656	M2676	M2696	M2716	
M2537	M2557	M2577	M2597	M2617	M2637	M2657	M2677	M2697	M2717	
M2538	M2558	M2578	M2598	M2618	M2638	M2658	M2678	M2698	M2718	
M2539	M2559	M2579	M2599	M2619	M2639	M2659	M2679	M2699	M2719	–
M4139	M4159	M4179	M4199	M4219	M4239	M4259	M4279	M4299	M4319	PCPU → SCPU
M3320	M3340	M3360	M3380	M3400	M3420	M3440	M3460	M3480	M3500	–
M3321	M3341	M3361	M3381	M3401	M3421	M3441	M3461	M3481	M3501	
M3322	M3342	M3362	M3382	M3402	M3422	M3442	M3462	M3482	M3502	
M3323	M3343	M3363	M3383	M3403	M3423	M3443	M3463	M3483	M3503	
M3324	M3344	M3364	M3384	M3404	M3424	M3444	M3464	M3484	M3504	
M3325	M3345	M3365	M3385	M3405	M3425	M3445	M3465	M3485	M3505	
M3326	M3346	M3366	M3386	M3406	M3426	M3446	M3466	M3486	M3506	SCPU → PCPU
M3327	M3347	M3367	M3387	M3407	M3427	M3447	M3467	M3487	M3507	
M3328	M3348	M3368	M3388	M3408	M3428	M3448	M3468	M3488	M3508	
M3329	M3349	M3369	M3389	M3409	M3429	M3449	M3469	M3489	M3509	–
M3330	M3350	M3370	M3390	M3410	M3430	M3450	M3470	M3490	M3510	
M3331	M3351	M3371	M3391	M3411	M3431	M3451	M3471	M3491	M3511	
M3332	M3352	M3372	M3392	M3412	M3432	M3452	M3472	M3492	M3512	
M3333	M3353	M3373	M3393	M3413	M3433	M3453	M3473	M3493	M3513	SCPU → PCPU
M3334	M3354	M3374	M3394	M3414	M3434	M3454	M3474	M3494	M3514	
M3335	M3355	M3375	M3395	M3415	M3435	M3455	M3475	M3495	M3515	
M3336	M3356	M3376	M3396	M3416	M3436	M3456	M3476	M3496	M3516	–
M3337	M3357	M3377	M3397	M3417	M3437	M3457	M3477	M3497	M3517	
M3338	M3358	M3378	M3398	M3418	M3438	M3458	M3478	M3498	M3518	
M3339	M3359	M3379	M3399	M3419	M3439	M3459	M3479	M3499	M3519	
M4939	M4959	M4979	M4999	M5019	M5039	M5059	M5079	M5099	M5119	SCPU → PCPU

Table 8.10 Internal Relay (Input/Output) List (for A273UHCPU 32-axis Specification) (Continued)

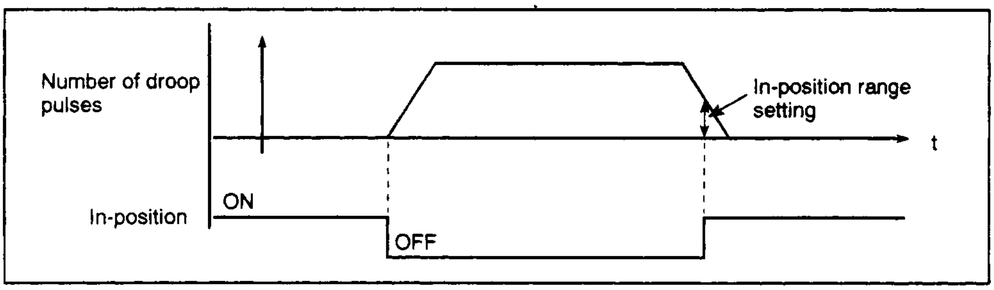
	Signal Name		Roller	Ball Screw	Rotary Table	Cam	Device No. Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22
Inputs	Vacant (OFF)		–	–	–	–	M2720	M2740	M2760	M2780	M2800	M2820
							M2721	M2741	M2761	M2781	M2801	M2821
	In-position		○	○	○	○	M2722	M2742	M2762	M2782	M2802	M2822
	Vacant (OFF)		–	–	–	–	M2723	M2743	M2763	M2783	M2803	M2823
							M2724	M2744	M2764	M2784	M2804	M2824
							M2725	M2745	M2765	M2785	M2805	M2825
	Zero-point pass		○	○	○	○	M2726	M2746	M2766	M2786	M2806	M2826
	Error detection		○	○	○	○	M2727	M2747	M2767	M2787	M2807	M2827
	Servo error detection		○	○	○	○	M2728	M2748	M2768	M2788	M2808	M2828
	Home position return request		○	○	○	○	M2729	M2749	M2769	M2789	M2809	M2829
	Home position return completed		○	○	○	○	M2730	M2750	M2770	M2790	M2810	M2830
	FLS	FLS	○	○	○	○	M2731	M2751	M2771	M2791	M2811	M2831
		RLS	○	○	○	○	M2732	M1652	M2772	M2792	M2812	M2832
		STOP	○	○	○	○	M2733	M2753	M2773	M2793	M2813	M2833
		DOG	○	○	○	○	M2734	M2754	M2774	M2794	M2814	M2834
	Servo ON/OFF status		○	○	○	○	M2735	M2755	M2775	M2795	M2815	M2835
	Output module torque limit in progress signal		○	○	○	○	M2736	M2756	M2776	M2796	M2816	M2836
	External signals CHANGE		○	○	○	○	M2737	M2757	M2777	M2797	M2817	M2837
	VIRTUAL mode continuation disabled warning signal		○	○	○	○	M2738	M2758	M2778	M2798	M2818	M2838
	Vacant		○	○	○	○	M2739	M2759	M2779	M2799	M2819	M2839
	M code output in progress signal		○	○	○	○	M4339	M4359	M4379	M4399	M4419	M4439
Outputs	Vacant		–	–	–	–	M3520	M3540	M3560	M3580	M3600	M3620
							M3521	M3541	M3561	M3581	M3601	M3621
							M3522	M3542	M3562	M3582	M3602	M3622
							M3523	M3543	M3563	M3583	M3603	M3623
							M3524	M3544	M3564	M3584	M3604	M3624
							M3525	M3545	M3565	M3585	M3605	M3625
	Limit switch output enabled		–	○	○	○	M3526	M3546	M3566	M3586	M3606	M3626
	Error reset		○	○	○	○	M3527	M3547	M3567	M3587	M3607	M3627
	Servo error reset		○	○	○	○	M3528	M3548	M3568	M3588	M3608	M3628
	Vacant		–	–	–	–	M3529	M3549	M3569	M3589	M3609	M3629
							M3530	M3550	M3570	M3580	M3610	M3630
							M3531	M3551	M3571	M3581	M3611	M3631
							M3532	M3552	M3572	M3582	M3612	M3632
	Address clutch reference setting		–	–	○	○	M3533	M3553	M3573	M3583	M3613	M3633
	Cam reference position setting		–	–	–	○	M3534	M3554	M3574	M3584	M3614	M3634
	Servo OFF		○	○	○	○	M3535	M3555	M3575	M3585	M3615	M3635
	Vacant		○	○	○	○	M3536	M3556	M3576	M3586	M3616	M3636
			○	○	○	○	M3537	M3557	M3577	M3587	M3617	M3637
			○	○	○	○	M3538	M3558	M3578	M3588	M3618	M3638
			○	○	○	○	M3539	M3559	M3579	M3589	M3619	M3639
	FIN signal		○	○	○	○	M5139	M5159	M5179	M5199	M5219	M5239

Axis 23	Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	Signal Direction
M2840	M2860	M2880	M2900	M2920	M2940	M2960	M2980	M3000	M3020	–
M2841	M2861	M2881	M2901	M2921	M2941	M2961	M2981	M3001	M3021	
M2842	M2862	M2882	M2902	M2922	M2942	M2962	M2982	M3002	M3022	PCPU → SCPU
M2843	M2863	M2883	M2903	M2923	M2943	M2963	M2983	M3003	M3023	
M2844	M2864	M2884	M2904	M2924	M2944	M2964	M2984	M3004	M3024	–
M2845	M2865	M2885	M2905	M2925	M2945	M2965	M2985	M3005	M3025	
M2846	M2866	M2886	M2906	M2926	M2946	M2966	M2986	M3006	M3026	
M2847	M2867	M2887	M2907	M2927	M2947	M2967	M2987	M3007	M3027	
M2848	M2868	M2888	M2908	M2928	M2948	M2968	M2988	M3008	M3028	
M2849	M2869	M2889	M2909	M2929	M2949	M2969	M2989	M3009	M3029	
M2850	M2870	M2890	M2910	M2930	M2950	M2970	M2990	M3010	M3030	
M2851	M2871	M2891	M2911	M2931	M2951	M2971	M2991	M3011	M3031	
M2852	M2872	M2892	M2912	M2932	M2952	M2972	M2992	M3012	M3032	PCPU → SCPU
M2853	M2873	M2893	M2913	M2933	M2953	M2973	M2993	M3013	M3033	
M2854	M2874	M2894	M2914	M2934	M2954	M2974	M2994	M3014	M3034	
M2855	M2875	M2895	M2915	M2935	M2955	M2975	M2995	M3015	M3035	
M2856	M2876	M2896	M2916	M2936	M2956	M2976	M2996	M3016	M3036	
M2857	M2877	M2897	M2917	M2937	M2957	M2977	M2997	M3017	M3037	
M2858	M2878	M2898	M2918	M2938	M2958	M2978	M2998	M3018	M3038	
M2859	M2879	M2899	M2919	M2939	M2959	M2979	M2999	M3019	M3039	–
M4459	M4479	M4499	M4519	M4539	M4559	M4579	M4599	M4619	M4639	PCPU → SCPU
M3640	M3660	M3680	M3700	M3720	M3740	M3760	M3780	M3800	M3820	
M3641	M3661	M3681	M3701	M3721	M3741	M3761	M3781	M3801	M3821	
M3642	M3662	M3682	M3702	M3722	M3742	M3762	M3782	M3802	M3822	
M3643	M3663	M3683	M3703	M3723	M3743	M3763	M3783	M3803	M3823	–
M3644	M3664	M3684	M3704	M3724	M3744	M3764	M3784	M3804	M3824	
M3645	M3665	M3685	M3705	M3725	M3745	M3765	M3785	M3805	M3825	
M3646	M3666	M3686	M3706	M3726	M3746	M3766	M3786	M3806	M3826	
M3647	M3667	M3687	M3707	M3727	M3747	M3767	M3787	M3807	M3827	SCPU → PCPU
M3648	M3668	M3688	M3708	M3728	M3748	M3768	M3788	M3808	M3828	
M3649	M3669	M3689	M3709	M3729	M3749	M3769	M3789	M3809	M3829	
M3650	M3670	M3690	M3710	M3730	M3750	M3770	M3790	M3810	M3830	
M3651	M3671	M3691	M3711	M3731	M3751	M3771	M3791	M3811	M3831	–
M3652	M3672	M3692	M3712	M3732	M3752	M3772	M3792	M3812	M3832	
M3653	M3673	M3693	M3713	M3733	M3753	M3773	M3793	M3813	M3833	
M3654	M3674	M3694	M3714	M3734	M3754	M3774	M3794	M3814	M3834	SCPU → PCPU
M3655	M3675	M3695	M3715	M3735	M3755	M3775	M3795	M3815	M3835	
M3656	M3676	M3696	M3716	M3736	M3756	M3776	M3796	M3816	M3836	
M3657	M3677	M3697	M3717	M3737	M3757	M3777	M3797	M3817	M3837	
M3658	M3678	M3698	M3718	M3738	M3758	M3778	M3798	M3818	M3838	–
M3659	M3679	M3699	M3719	M3739	M3759	M3779	M3799	M3819	M3839	
M5259	M5279	M5299	M5319	M5339	M5359	M5379	M5399	M5419	M5439	SCPU → PCPU

(2) Input/output (X/Y) and internal relay (M) details

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

1) The in-position signal is a signal that comes ON when the number of droop pulses at the deviation counter falls below the in-position range set in the servo parameters.



2) An in-position check is performed at the following times.

- When the servo system power is switched ON
- After automatic deceleration is started in positioning control
- After automatic deceleration is started due to the JOG start signal going OFF
- During manual pulse generator operation
- After the near zero point dog comes ON during home position return
- After deceleration is started by a stop command
- Speed change to zero speed

(the above: During REAL mode operation)

- Constant check .... During VIRTUAL mode operation

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

This signal switches ON when the zero point is passed following a servo amplifier power ON. Once the zero point has been passed, this signal remains ON until a CPU reset occurs.

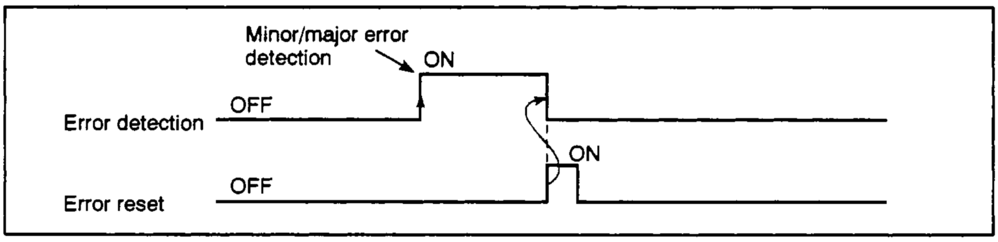
(c) Error detection signal (M1607+20n/Xn7/M2407+20n)

1) This signal switches ON when a minor or major error is detected, and it is used to determine if an error has occurred.

   When a minor error is detected, the corresponding error code is stored at the minor error code storage area.

   When a major error is detected, the corresponding error code is stored at the major error code storage area.

2) The error detection signal goes OFF when the error reset signal (M1807+20n/Yn7/M3207+20n) is switched ON.

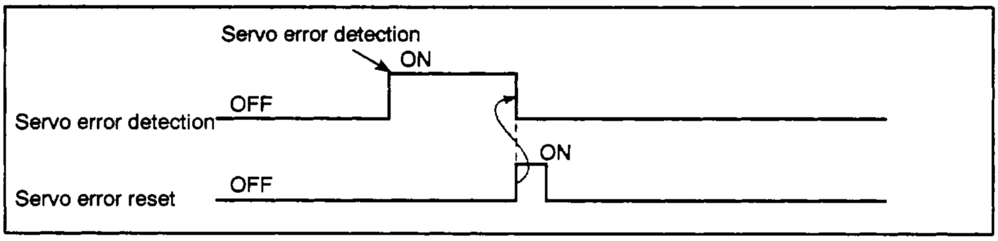


(d) Servo error detection signal (M1608+20n/Xn8/M2408+20n)

1) This signal switches ON when an error (excluding causes of warning errors and emergency stops) is detected at the servo amplifier, and it is used to determine if a servo error has occurred.

   When an error is detected at the servo amplifier, the corresponding error code is be stored at the servo error code storage area.

2) The servo error detection signal switches OFF when the servo error reset signal (M1808+20n/Yn8/M3208+20n) is switched ON, or when the servo power is switched OFF and back ON again. (Servo error reset is only effective in the REAL mode.)



(e) Home position return request signal (M1609+20n/Xn9/M2409+20n)

This signal switches ON when a home position address check is required at power ON or during positioning control.

1) Other than absolute position system

i) The home position return request signal switches ON at the following times.

- At power ON, and on resetting the servo system CPU
- During home position return

ii) The home position return request signal switches OFF when the home position return is completed.

2) Absolute position system

i) The home position return request signal switches ON at the following times.

- During home position return
- When a sum check error occurs (at power ON) for the backup data (reference values).

ii) The home position return request signal switches OFF when the home position return is completed.

(f) Home Position Return Completed Signal (M1610+20n/XnA/M2410+20n)

1) This signal switches ON when a home position return designated by the servo program or in the TEST mode is completed.

2) This signal switches OFF when a positioning start, JOG start, or manual pulse generator start occurs.

3) If a home position return is attempted (by the servo program) while this home position return completed signal is ON, the "consecutive home position return start" error will be activated, and the home position return operation will not be started. (Near-zero point dog type home position returns only.)

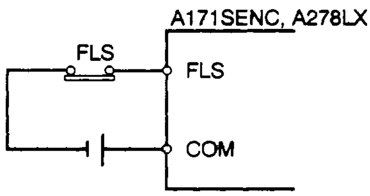
(g) FLS signal (M1611+20n/XnB/M2411+20n)

1) The FLS signal is controlled according to the ON/OFF status of upper limit switch inputs (FLS) to the A171SENC or A278LX from an external source.

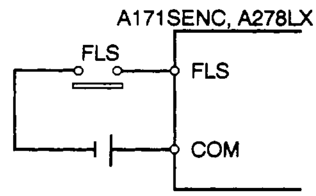
- Upper limit switch input OFF ..... FLS signal ON
- Upper limit switch input ON ...... FLS signal OFF

2) The upper limit switch (FLS) status at FLS signal ON/OFF is shown below.

When FLS signal is ON



When FLS signal is OFF



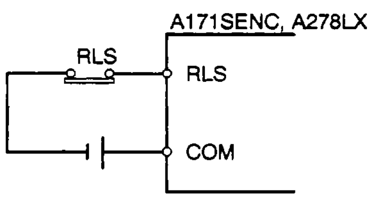
(h) RLS Signal (M1612+20n/XnC/M2412+20n)

1) The RLS signal is controlled according to the ON/OFF status of lower limit switch inputs (RLS) to the A171SENC or A278LX from an external source.

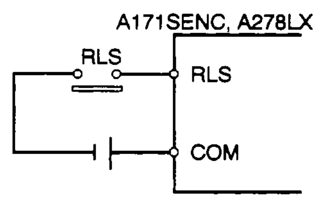
- Lower limit switch input OFF ..... RLS signal ON
- Lower limit switch input ON ...... RLS signal OFF

2) The lower limit switch (RLS) status at RLS signal ON/OFF is shown below.

When RLS signal is ON



When RLS signal is OFF



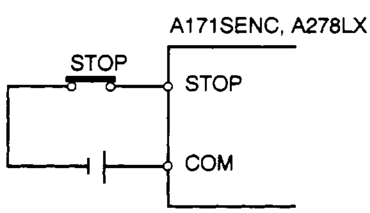
(i) STOP signal (M1613+20n/XnD/M2413+20n)

1) The STOP signal is controlled according to the ON/OFF status of STOP signal inputs to the A171SENC or A278LX from an external source.

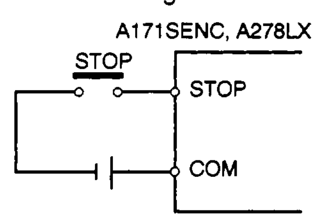
- STOP signal OFF .... STOP signal OFF
- STOP signal ON .... STOP signal ON

2) The STOP signal status at STOP signal ON/OFF is shown below.

When STOP signal is ON



When STOP signal is OFF



(j) DOG/CHANGE signal (M1614+20n) (for A171SCPU)

1) The DOG/CHANGE signal is controlled according to the ON/OFF status of near-zero point dog inputs to the A171SENC from an external source.

2) Regardless whether "N/O input" or "N/C input" is designated in the system settings, the DOG/CHANGE signal turns ON when the near-zero point dog or CHANGE signal is ON, and the near-zero point dog or CHANGE signal turns OFF.

3) If "N/O input" is designated in the system settings, the near-zero point dog or CHANGE input turns ON when the near-zero point dog or CHANGE signal turns ON. If "N/C input" is designated in the system settings, the near-zero point dog or CHANGE input turns ON when the near-zero point dog or CHANGE signal turns OFF.

(k) DOG signal (XnE/M2414+20n) (for A273UHCPU (8-/32-specification))

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

2) Regardless whether "N/O input" or "N/C input" is designated in the system settings, the DOG signal is ON when the near-zero point dog is ON, and the DOG signal is OFF when the near-zero point dog is OFF.

3) If "N/O input" is designated in the system settings, the near-zero point dog input turns ON when the near-zero point dog is ON. If "N/C input" is designated in the system settings, the near-zero point dog input turns ON when the near-zero point dog is OFF.

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

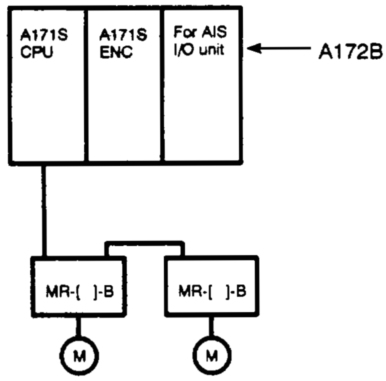
1) The servo READY signal switches ON when a READY status exists at the servo amplifiers connected to each axis.

2) The servo READY signal switches OFF at the following times:

- When no servo amplifier is installed
- When the servo parameters have not been set
- When an emergency stop signal is input to the power supply module from an external source
- When the servo OFF status is established by switching ON M1815+20n/Ynf/M3215+20n
- When a servo error occurs

See Section 10.4 "Servo Errors" for details.

i) When A171SCPU is used



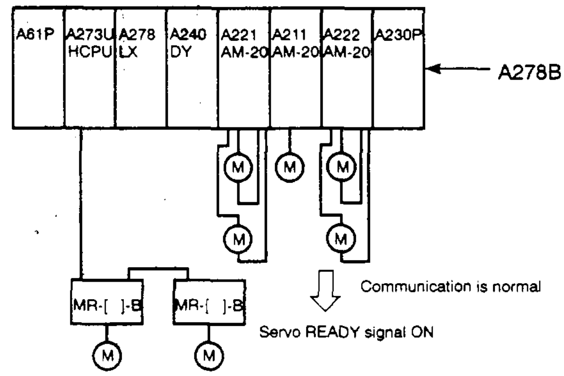
POINTS

(1) If a servo error occurs at any of the ADU axes (for A273UHCPU (8-/32-specification)), the servo is turned OFF for the axes designated in the system settings, as shown in the table below.

ADU Servo Error Processing System Setting	Servo Axes Turned OFF
Each system axes OFF	Servos turned OFF for all axes in the system where the servo error occurred.
Only error axis OFF	Servo turned OFF for the axis where the servo error occurred.

(2) If a servo error occurs in an axis using MR-[ ]-B, the servo is turned OFF for the axis where the servo error occurred.

ii) When A273UHCPU is used



(m) Torque control in progress signal (M1616+20n/XD0+n/M2416+20n)

This signal switches ON at axes where torque control is being executed.

(n) CHANGE signal (none/XD8+n/M2417+20n): for A273UHCPU 8/32-axis specification

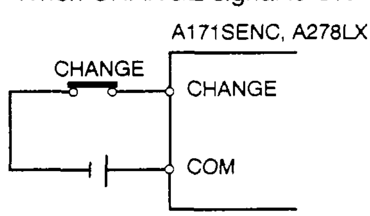
1) Setting is impossible when the A171SCPU is used.

2) The CHANGE signal is controlled according to the ON/OFF status of the speed and position control switching inputs (CHANGE) to the A171SENC or A278LX from an external source.

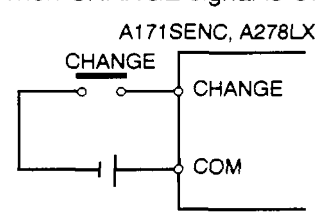
- Speed & position switching input OFF ..... CHANGE signal OFF
- Speed & position switching input ON ...... CHANGE signal ON

3) The speed switching switch (CHANGE) status at CHANGE signal ON and OFF is as shown below.

When CHANGE signal is ON



When CHANGE signal is OFF



REMARK

*1: The "n" in XD8+n represents a numeric value (0 - 7) corresponding to the virtual axis No.

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

The "n" in M2417+20n represents a numeric value corresponding to the virtual axis No.

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

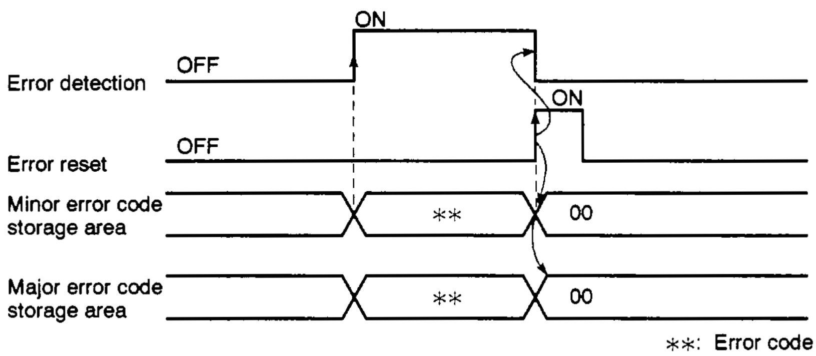
(o) Limit switch output enabled command (M1806+20n/Yn6/M3206+20n)

The limit switch output enable command is used to enable limit switch output.

- ON .... The limit switch output's ON/OFF pattern is output from AY42.
- OFF ...... The limit switch output is switched OFF from AY42.

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

The error reset command is used to clear the minor error codes and major error codes of axes for which errors have been detected (M1607+20n/Xn7/M2407+20n: ON), and to reset the error detected signal (M1607+20n/Xn7/M2407+20n).



(q) Address clutch reference setting signal (M1813+20n/YnD/M3213+20n)

This command signal is only operative when the output module is a rotary table or a cam connected to an address mode clutch, and it is used to designate the "0" reference position for the present value in 1 virtual axis revolution.

When a REAL to VIRTUAL mode switching request occurs, processing will be as shown below, depending on the ON/OFF status of the address clutch reference setting signal.

1) When the address clutch reference setting signal (M1813+20n/YnD/M3213+20n) is ON

   VIRTUAL mode operation will begin with the present value in 1 virtual axis revolution designated as "0" for the main shaft and auxiliary input shaft.

2) When the address clutch reference setting signal (M1813+20n/YnD/M3213+20n) is OFF

   - If the drive module is a virtual servo motor or an incremental type synchronous encoder, main shaft and auxiliary input shaft operation will be continued from the present value in 1 virtual axis revolution value from the previous VIRTUAL mode operation.
   - If the drive module is an absolute type synchronous encoder, main shaft and auxiliary input shaft operation will be continued from the present value in 1 virtual axis revolution value calculated from the encoder's present value.

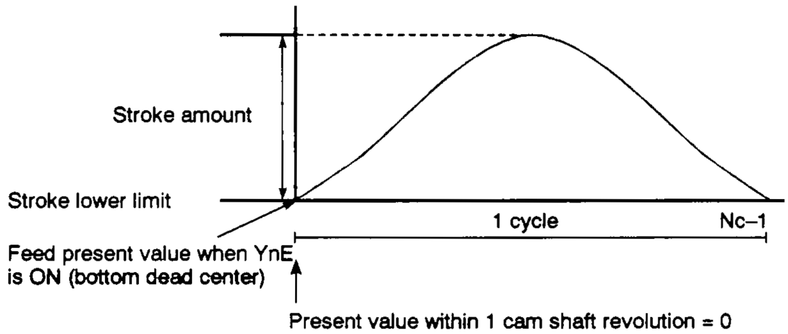
(r) Cam reference position setting signal (M1814+20n/YnE/M3214+20n)

This command signal is only operative when the output module is a cam, and it is used to designate the cam's reference position.

When a REAL to VIRTUAL mode switching request occurs, processing will be as shown below, depending on the ON/OFF status of the cam reference position setting signal.

1) When the cam reference position setting signal (M1814+20n/YnE/M3214+20n) is ON

- The present value becomes the cam's reference position.
- The current feed present value becomes the stroke lower limit value (bottom dead center). Moreover, a cam table search is conducted from the beginning of a cycle, and the bottom dead center (0) point is designated as the present value in 1 cam shaft revolution.



- After the system is started and the cam's bottom dead center alignment is completed, YnE must be switched ON the first time REAL to VIRTUAL mode switching occurs. Once the bottom dead center setting has been designated, it is not necessary to switch YnE ON when subsequent REAL to VIRTUAL mode switching occurs. (The bottom dead center position is stored in the backup memory.)

2) When the cam reference position setting signal (M1814+20n/YnE/M3214+20n) is OFF

- When the following condition exists, operation is continued with the stroke lower limit value and present value in 1 cam shaft revolution from the previous VIRTUAL mode operation adopted.

  [Final servo command value in previous VIRTUAL mode operation] – [current servo present value] ≦ [in-position]

- When the following condition exists, operation is continued with the stroke lower limit value from the previous VIRTUAL mode operation being adopted, and the present value in 1 cam shaft revolution calculated based on the current feed present value.

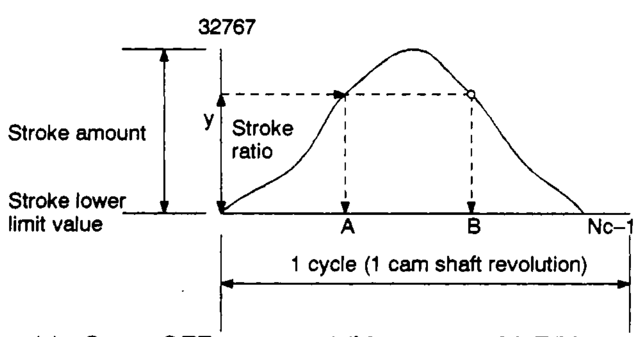
[Present value in 1 cam shaft revolution calculation]

The stroke ratio (y) is first calculated as follows:

[Feed present value] = [stroke] × [stroke ratio]
× [stroke lower limit value]

The cam table for the designated cam No. is then searched (from the beginning of a cycle), and the present value in 1 cam shaft revolution which corresponds to the relevant point is calculated.

Because the search for the present value in 1 cam shaft revolution is always conducted from the beginning of a cycle, beware of cases where the same stroke ratio appears more than once in the cycle. (Make the necessary position adjustment when switching from the REAL to VIRTUAL mode occurs.)



In the figure at left, there are 2 relevant points (A and B) for the calculated stroke ratio "y", but only point "A" is recognized.

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

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

- YnF OFF .... Servo ON
- YnF ON ..... Servo OFF (free run status)

This command is inoperative during positioning, and should therefore be executed after positioning is completed.

When the servo OFF command occurs in the VIRTUAL mode, the clutch will be disengaged before the servo OFF command is executed.

If the servo OFF command occurs while a "clutch ON" status exists, a minor error will occur, and the servo OFF command will become inoperative.

(t) VIRTUAL mode continuation disabled warning (X0F0 - X0F7)

If, for an ABS axis, the difference between the final servo command value in the last operation in the VIRTUAL mode and the servo present value the next time a switch is made to the VIRTUAL mode exceeds the "POWER OF ALLOWED TRAVELING POINTS (number of X feedback pulses)" in the system settings, a warning that VIRTUAL mode operation cannot be continued is issued, and the "VIRTUAL mode continuation disabled warning device" comes ON.

This is checked at the following times:

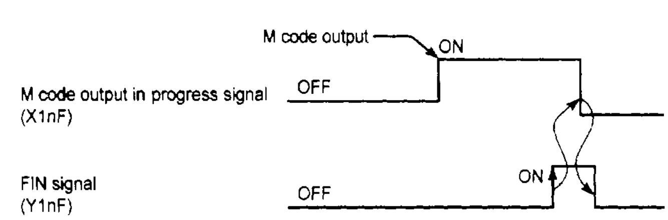
No.	Check Time	Remarks
1	When the ABS axis servo amplifier power is turned on	At this time, the minor error 901 (when the power is turned on in the REAL mode) or 9010 (when the power is turned on in the VIRTUAL mode) is also set.
2	Continuously during REAL mode operation	The device also comes ON in the following cases. (1) When a home position return is executed. (2) When a present value change is executed. (3) When jog operation, speed control I or II, or speed/position switching control is executed.

To reset the "VIRTUAL mode continuation disabled warning device", reset it in the sequence program.

(u) FIN signal (M1419+20n/Y1nF/M4819+20n)

1) Signal to end M code output.

2) The FIN signal turns OFF when the M code output in progress signal (M1219+20n/X1nF/M4019+20n) is OFF.

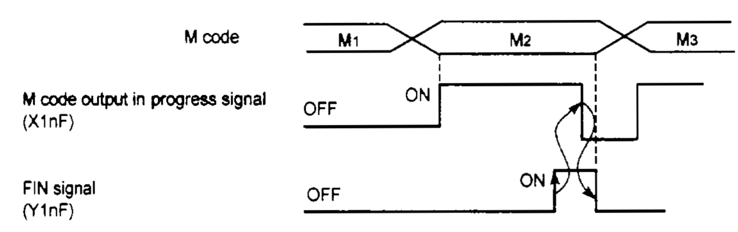


(v) M code output in progress signal (M1219+20n/X1nF/M4019+20n)

1) Signal indicating M codes are being output.

2) Turn on the FIN signal (M1419+20n/Y1nF/M4819+20n) to end M code output.

3) The M code output in progress signal turns OFF when the stop command, cancel signal, or skip signal is input.



POINTS

(1) The FIN signal and M code output in progress signal are used by the FIN signal wait function.

(2) The M code output in progress signal is enabled only if the FIN signal wait function is designated in the servoprogram. If this function is not designated, the M code output in progress signal does not turn ON during M code output.

8.5.2 Data registers (D)

(1) Data register (D) list

See Appendix 5 "Tables of Processing Times" for details about the delay time between the positioning device (input, internal relay, special relay) turning ON/OFF and the data being stored in the data register area.

(a) When A171SCPU is used

Servo system CPU data registers D760-D959 and 1008 - 1009 are used by the output modules.

Table 8.11 Data Register List (for A171SCPU)

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device			
					Axis 1	Axis 2	Axis 3	Axis 4
Effective cam No.	–	–	–	○	D760	D765	D770	D775
Effective stroke	–	–	–	○	D761	D766	D771	D776
					D762	D767	D772	D777
Present value in 1 cam shaft revolution	–	–	–	○	D763	D768	D773	D778
					D764	D769	D774	D779
Roller peripheral velocity	○	–	–	–	D800	D820	D840	D860
					D801	D821	D841	D861
Feed present value	–	○	○	○	D800	D820	D840	D860
					D801	D821	D841	D861
Present value	–	○	○	○	D802	D822	D842	D862
					D803	D823	D843	D863
Deviation counter value	○	○	○	○	D804	D824	D844	D864
					D805	D825	D845	D865
Minor error code	○	○	○	○	D806	D826	D846	D866
Major error code	○	○	○	○	D807	D827	D847	D867
Servo error code	○	○	○	○	D808	D828	D848	D868
(Travel value after DOG ON)	REAL mode data stored				D809	D829	D849	D869
					D810	D830	D850	D870
(Home position return second travel value)					D811	D831	D851	D871
(Execution program No.)	No change when "0"				D812	D832	D852	D872
(M-code)					D813	D833	D853	D873
Torque limit value	○	○	○	○	D814	D834	D854	D874
(Travel value change register)	Ignored				D815	D835	D855	D875
					D816	D836	D856	D876
(Actual present value at STOP input)	REAL mode data stored				D817	D837	D857	D877
					D818	D838	D858	D878
Vacant	–				D819	D839	D859	D879

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

Servo system CPU data registers D760-D959 are used by the output modules.

Table 8.12 Data Register List (for A273UHCPU 8-axis Specification)

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device							
					Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Effective cam No.	–	–	–	○	D760	D765	D770	D775	D780	D785	D790	D795
Effective stroke amount	–	–	–	○	D761	D766	D771	D776	D781	D786	D791	D796
					D762	D767	D772	D777	D782	D787	D792	D797
Present value within 1 cam shaft revolution	–	–	–	○	D763	D768	D773	D778	D783	D788	D793	D798
					D764	D769	D774	D779	D784	D789	D794	D799
Roller peripheral velocity	○	–	–	–	D800	D820	D840	D860	D880	D900	D920	D940
					D801	D821	D841	D861	D881	D901	D921	D941
Feed present value	–	○	○	○	D800	D820	D840	D860	D880	D900	D920	D940
					D801	D821	D841	D861	D881	D901	D921	D941
Present value	–	○	○	○	D802	D822	D842	D862	D882	D902	D922	D942
					D803	D823	D843	D863	D883	D903	D923	D943
Deviation counter value	○	○	○	○	D804	D824	D844	D864	D884	D904	D924	D944
					D805	D825	D845	D865	D885	D905	D925	D945
Minor error code	○	○	○	○	D806	D826	D846	D866	D886	D906	D926	D946
Major error code	○	○	○	○	D807	D827	D847	D867	D887	D907	D927	D947
Servo error code	○	○	○	○	D808	D828	D848	D868	D888	D908	D928	D948
(Travel value after DOG ON)	REAL mode data stored				D809	D829	D849	D869	D889	D909	D929	D949
					D810	D830	D850	D870	D890	D910	D930	D950
(Home position return second travel value)					D811	D831	D851	D871	D891	D911	D931	D951
(Execution program No.)	No change when "0"				D812	D832	D852	D872	D892	D912	D932	D952
(M-code)					D813	D833	D853	D873	D893	D913	D933	D953
Torque limit value	○	○	○	○	D814	D834	D854	D874	D894	D914	D934	D954
(Travel value change register)	Ignored				D815	D835	D855	D875	D895	D915	D935	D955
					D816	D836	D856	D876	D896	D916	D936	D956
(Actual present value at STOP input)	REAL mode data stored				D817	D837	D857	D877	D897	D917	D937	D957
					D818	D838	D858	D878	D898	D918	D938	D958
Vacant	–				D819	D839	D859	D879	D899	D919	D939	D959

(c) When A273UHCPU (32-axis specification) Is Used

Servo system CPU data registers D0 - D639 and D1240 - D1599 are used by the output modules.

Table 8.13 Data Register List (for A273UHCPU 32-axis specification)

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device							
					Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Vacant	–				D1240	D1250	D1260	D1270	D1280	D1290	D1300	D1310
Effective cam No.	–	–	–	○	D1241	D1251	D1261	D1271	D1281	D1291	D1301	D1311
Effective stroke amount	–	–	–	○	D1242	D1252	D1262	D1272	D1282	D1292	D1302	D1312
					D1243	D1253	D1263	D1273	D1283	D1293	D1303	D1313
Present value in 1 cam shaft revolution	–	–	–	○	D1244	D1254	D1264	D1274	D1284	D1294	D1304	D1314
					D1245	D1255	D1265	D1275	D1285	D1295	D1305	D1315
Roller peripheral velocity	○	–	–	–	D0	D20	D40	D60	D80	D100	D120	D140
					D1	D21	D41	D61	D81	D101	D121	D141
Feed present value	–	○	○	○	D0	D20	D40	D60	D80	D100	D120	D140
					D1	D21	D41	D61	D81	D101	D121	D141
Present value	–	○	○	○	D2	D22	D42	D62	D82	D102	D122	D142
					D3	D23	D43	D63	D83	D103	D123	D143
Deviation counter value	○	○	○	○	D4	D24	D44	D64	D84	D104	D124	D144
					D5	D25	D45	D65	D85	D105	D125	D145
Minor error code	○	○	○	○	D6	D26	D46	D66	D86	D106	D126	D146
Major error code	○	○	○	○	D7	D27	D47	D67	D87	D107	D127	D147
Servo error code	○	○	○	○	D8	D28	D48	D68	D88	D108	D128	D148
(Home position return second travel value)	REAL mode data stored				D9	D29	D49	D69	D89	D109	D129	D149
(Travel value after DOG ON)					D10	D30	D50	D70	D90	D110	D130	D150
					D11	D31	D51	D71	D91	D111	D131	D151
(Execution program No.)	No change when "0"				D12	D32	D52	D72	D92	D112	D132	D152
(M-code)					D13	D33	D53	D73	D93	D113	D133	D153
Torque limit value	○	○	○	○	D14	D34	D54	D74	D94	D114	D134	D154
Data set pointer for constant speed control	No change when "0"				D15	D35	D55	D75	D95	D115	D135	D155
(Travel value change register)	Ignored				D16	D36	D56	D76	D96	D116	D136	D156
					D17	D37	D57	D77	D97	D117	D137	D157
(Actual present value at STOP input)	REAL mode data stored				D18	D38	D58	D78	D98	D118	D138	D158
					D19	D39	D59	D79	D99	D119	D139	D159

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device							
					Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32
Vacant	–				D1480	D1490	D1500	D1510	D1520	D1530	D1540	D1550
Effective cam No.	–	–	–	○	D1481	D1491	D1501	D1511	D1521	D1531	D1541	D1551
Effective stroke amount	–	–	–	○	D1482	D1492	D1502	D1512	D1522	D1532	D1542	D1552
	–	–	–	○	D1483	D1493	D1503	D1513	D1523	D1533	D1543	D1553
Present value in 1 cam shaft revolution	–	–	–	○	D1484	D1494	D1504	D1514	D1524	D1534	D1544	D1554
					D1485	D1495	D1505	D1515	D1525	D1535	D1545	D1555
Roller peripheral velocity	○	–	–	–	D480	D500	D520	D540	D560	D580	D600	D620
					D481	D501	D521	D541	D561	D581	D601	D621
Feed present value	–	○	○	○	D480	D500	D520	D540	D560	D580	D600	D620
					D481	D501	D521	D541	D561	D581	D601	D621
Present value	–	○	○	○	D482	D502	D522	D542	D562	D582	D602	D622
					D483	D503	D523	D543	D563	D583	D603	D623
Deviation counter value	○	○	○	○	D484	D504	D524	D544	D564	D584	D604	D624
					D485	D505	D525	D545	D565	D585	D605	D625
Minor error code	○	○	○	○	D486	D506	D526	D546	D566	D586	D606	D626
Major error code	○	○	○	○	D487	D507	D527	D547	D567	D587	D607	D627
Servo error code	○	○	○	○	D488	D508	D528	D548	D568	D588	D608	D628
(Home position return second travel value)	REAL mode data stored				D489	D509	D529	D549	D569	D589	D609	D629
(Travel value after DOG ON)					D490	D510	D530	D550	D570	D590	D610	D630
					D491	D511	D531	D551	D571	D591	D611	D631
(Execution program No.)	No change when "0"				D492	D512	D532	D552	D572	D592	D612	D632
(M-code)					D493	D513	D533	D553	D573	D593	D613	D633
Torque limit value	○	○	○	○	D494	D514	D534	D554	D574	D594	D614	D634
Data set pointer for constant speed control	No change when "0"				D495	D515	D535	D555	D575	D595	D615	D635
(Travel value change register)	Ignored				D496	D516	D536	D556	D576	D596	D616	D636
					D497	D517	D537	D557	D577	D597	D617	D637
(Actual present value at STOP input)	REAL mode data stored				D498	D518	D538	D558	D578	D598	D618	D638
					D499	D519	D539	D559	D579	D599	D619	D639

Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
D1320	D1330	D1340	D1350	D1360	D1370	D1380	D1390	D1400	D1410	D1420	D1430	D1440	D1450	D1460	D1490
D1321	D1331	D1341	D1351	D1361	D1371	D1381	D1391	D1401	D1411	D1421	D1431	D1441	D1451	D1461	D1491
D1322	D1332	D1342	D1352	D1362	D1372	D1382	D1392	D1402	D1412	D1422	D1432	D1442	D1452	D1462	D1492
D1323	D1333	D1343	D1353	D1363	D1373	D1383	D1393	D1403	D1413	D1423	D1433	D1443	D1453	D1463	D1493
D1324	D1334	D1344	D1354	D1364	D1374	D1384	D1394	D1404	D1414	D1424	D1434	D1444	D1454	D1464	D1494
D1325	D1335	D1345	D1355	D1365	D1375	D1385	D1395	D1405	D1415	D1425	D1435	D1445	D1455	D1465	D1495
D160	D180	D200	D220	D240	D260	D280	D300	D320	D340	D360	D380	D400	D420	D440	D460
D161	D181	D201	D221	D241	D261	D281	D301	D321	D341	D361	D381	D401	D421	D441	D461
D160	D180	D200	D220	D240	D260	D280	D300	D320	D340	D360	D380	D400	D420	D440	D460
D161	D181	D201	D221	D241	D261	D281	D301	D321	D341	D361	D381	D401	D421	D441	D461
D162	D182	D202	D222	D242	D262	D282	D302	D322	D342	D362	D382	D402	D422	D442	D462
D163	D183	D203	D223	D243	D263	D283	D303	D323	D343	D363	D383	D403	D423	D443	D463
D164	D184	D204	D224	D244	D264	D284	D304	D324	D344	D364	D384	D404	D424	D444	D464
D165	D185	D205	D225	D245	D265	D285	D305	D325	D345	D365	D385	D405	D425	D445	D465
D166	D186	D206	D226	D246	D266	D286	D306	D326	D346	D366	D386	D406	D426	D446	D466
D167	D187	D207	D227	D247	D267	D287	D307	D327	D347	D367	D387	D407	D427	D447	D467
D168	D188	D208	D228	D248	D268	D288	D308	D328	D348	D368	D388	D408	D428	D448	D468
D169	D189	D209	D229	D249	D269	D289	D309	D329	D349	D369	D389	D409	D429	D449	D469
D170	D190	D210	D230	D250	D270	D290	D310	D330	D350	D370	D390	D410	D430	D450	D470
D171	D191	D211	D231	D251	D271	D291	D311	D331	D351	D371	D391	D411	D431	D451	D471
D172	D192	D212	D232	D252	D272	D292	D312	D332	D352	D372	D392	D412	D432	D452	D472
D173	D193	D213	D233	D253	D273	D293	D313	D333	D353	D373	D393	D413	D433	D453	D473
D174	D194	D214	D234	D254	D274	D294	D314	D334	D354	D374	D394	D414	D434	D454	D474
D175	D195	D215	D235	D255	D275	D295	D315	D335	D355	D375	D395	D415	D435	D455	D475
D176	D196	D216	D236	D256	D276	D296	D316	D336	D356	D376	D396	D416	D436	D456	D476
D177	D197	D217	D237	D257	D277	D297	D317	D337	D357	D377	D397	D417	D437	D457	D477
D178	D198	D218	D238	D258	D278	D298	D318	D338	D358	D378	D398	D418	D438	D458	D478
D179	D199	D219	D239	D259	D279	D299	D319	D339	D359	D379	D399	D419	D439	D459	D479

(2) Data register (D) details

(a) Effective cam No. register .... Data sent from PCPU to SCPU

1) The No. of the cam currently being controlled is stored in binary code at the effective cam No. register.

Cam No. updates occur at the sequence program's END processing.

2) The cam No. stored at the effective cam No. register is saved until operation at another cam is executed. (A stored cam No. is not cleared when control at that cam is ended.)

(b) Effective stroke register .... Data sent from PCPU to SCPU

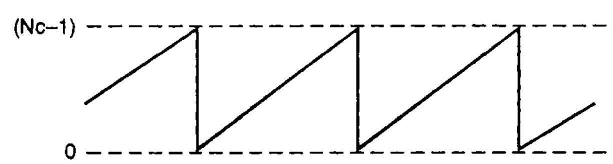
1) The current control stroke is stored in binary code at this register.

Stroke updates occur in the sequence program's END processing.

(c) Present value in 1 cam shaft revolution register
.... Data Sent From PCPU to SCPU

1) The present value in 1 cam shaft revolution designated by the parameter setting is stored at this register. The present value is a ring address in the range "0 to [number of pulses per cam shaft revolution (Nc)–1]".

Present value updates occur in the sequence program's END processing.



(d) Roller peripheral velocity register
.... Data sent from PCPU to SCPU

1) The storage range for the peripheral velocity at this register is as shown below.

Setting System-of-Units	Storage Range	Actual Roller Peripheral Velocity
mm	1 - 600000000	0.01 - 6000000.00 mm/min
inch		0.001 - 60000.000 inch/min

(e) Feed present value register .... Data sent from PCPU to SCPU

1) The target address which is output to the servo amplifier is stored at this register. The target address is based on the command address calculated from the mechanical system program settings.

2) A stroke range check occurs at this feed present value data.

(f) Actual Present Value register . Data sent from PCPU to SCPU

1) The present value obtained from actual travel (feed present value minus the deviation counter's droop pulse count) is stored at this register.

2) When a STOP status is in effect, the present feed value is equal to the actual present value.

(g) Deviation counter value register .... Data sent from PCPU to SCPU

The difference between the feed present value and the actual present value is stored at this register.

(h) Minor error code register .... Data sent from PCPU to SCPU

1) When a minor error occurs, the corresponding error code is stored at this register. Each time a subsequent error occurs, the stored error code is replaced by the new error code.

2) Minor error codes are cleared by executing an error reset (M1807+20n/Yn7/M3207+20n).

(i) Major error code register .... Data sent from PCPU to SCPU

1) When a major error occurs, the corresponding error code is stored at this register. Each time a subsequent error occurs, the stored error code is replaced by the new error code.

2) Major error codes are cleared by executing an error reset (M1807+20n/Yn7/M3207+20n).

(j) Servo error code register .... Data sent from PCPU to SCPU

1) When a servo error occurs, the corresponding error code is stored at this register. Each time a subsequent error occurs, the stored error code is replaced by the new error code.

2) When a servo error occurs, the system returns to the REAL mode.

(k) Torque limit value register .... Data sent from PCPU to SCPU

The designated servo torque limit value is stored at this register. A torque limit value of "300%" is stored here when the servo power is switched ON, and at the leading edge of the programmable controller READY (M2000) signal.

9. REAL & VIRTUAL MODE SWITCHING AND STOP/RESTART

This section discusses the procedure for switching between the REAL and VIRTUAL modes, and the data items which are checked when such switching occurs.

(1) Switching between the REAL & VIRTUAL modes

Switching between the REAL & VIRTUAL modes is executed by switching the M2043 signal (REAL/VIRTUAL mode switch request flag) ON and OFF.

- For REAL mode ...... A REAL mode switching request occurs when M2043 is switched from ON to OFF.
- For VIRTUAL mode ... A VIRTUAL mode switching request occurs when M2043 is switched from OFF to ON.

(2) REAL & VIRTUAL mode confirmation

The present control mode status (REAL or VIRTUAL) is confirmed by the ON/OFF status of the M2044 signal (REAL/VIRTUAL mode status).

- M2044 OFF .... REAL mode status.
- M2044 ON .... VIRTUAL mode status.

9.1 Switching from the REAL to VIRTUAL Mode

When a REAL to VIRTUAL mode switching request (M2043 OFF → ON) occurs, the following processing occurs:

- Check to determine if switching to the VIRTUAL mode is possible .... See Table 9.1
- Output module check .... See Table 9.2
- Synchronous encoder axis check ...... See Table 9.3

Switching from the REAL to VIRTUAL mode is possible if the check items shown in Tables 9.1 to 9.3 are all normal.

(1) Check to determine if switching to the VIRTUAL mode is possible

(a) The items shown in Table 9.1 are checked to determine if switching to the VIRTUAL mode is possible.

All the check items must be normal in order for switching to occur.

(b) If an error exists at any of the Table 9.1 check items, M2045*1 will switch ON, and the error code will be stored at the D9195/D9195/D9193-D9195*1 register.

Refer to section 10.6 for details regarding the error codes which are stored at D9195.

REMARK

*1: The proper names of M2045 and D9195/D9195/D9193 - D9195 are given below.

- M2045 .... REAL/VIRTUAL mode switching error detection flag
- D9195/D9195/D9193 - D9195 .. REAL/VIRTUAL mode switching error information register.

Table 9.1 Checklist for REAL to VIRTUAL Mode Switching

Check Sequence	Check Item	Output Module Checked				Normal Condition	Abnormal Condition
		Roller	Ball Screw	Rotary Table	Cam		
1	Are PC READY (M2000) and PCPU READY (M9074) flags ON?	○	○	○	○	ON	OFF
2	Are all axes stopped? (M2001 - M2004/M2001 - M2008/ M2001 - M2032 are OFF)	○	○	○	○	YES	NO
3	Has cam data been changed by the sequence program?	○	○	○	○	NO	YES
4	Has the mechanical system program been registered?	○	○	○	○	YES	NO
	Does the axis No. designated in the system settings match the output shaft designated in the mechanical system program?	○	○	○	○	YES	NO
5	Is the all-axes servo ON command (M2042) ON?	○	○	○	○	ON	OFF
6	Is servo START processing in progress due to a servo error reset at the amplifier module axis?	○	○	○	○	Servo START completed	Servo START processing in progress
7	Is external encoder normal?	○	○	○	○	YES	NO
8	Is an external emergency stop (EMG) input in effect?	○	○	○	○	NO	YES
9	Is the servo error detection (M1608+20n/Xn8/M2408+20n) signal OFF at all the axes?	○	○	○	○	YES	NO
10	Is the home position return request (M1609+20n/Xn9/ M2409+20n) signal OFF for all the axes? (excluding roller axis)	–	○	○	○	YES	NO
11	Does the system-of-units designated in the fixed parameters match that designated at the output module?	–	○	○	○	YES	NO
12	Has the cam data been registered?	–	–	–	○	YES	NO
13	Has the cam No. been designated at the "cam No. setting device" (cam parameters)?	–	–	–	○	YES	NO
14	Has the stroke (1 to $2^{31}-1$) been designated at the "stroke setting device" (cam parameters)?	–	–	–	○	YES	NO
15	Is the cam's "stroke setting device" No. an even number?	–	–	–	○	YES	NO

(2) Output module check

(a) The items shown in Table 9.2 below are checked to determine the output module status. If an error is found, switching to the VIRTUAL mode will not occur, and the corresponding system cannot be started. When an error exists, switch back to the REAL mode and correct the error cause, then switch to the VIRTUAL mode again.

(b) When an error is found, the corresponding output module's error detection signal (M1607+20n/Xn7/M2407+20n) will switch ON, and the error code will be stored in the minor/major error code register.

Table 9.2 Output Module Checklist

Check Sequence	Check Item	Output Module Checked				Normal Condition	Abnormal Condition
		Roller	Ball Screw	Rotary Table	Cam		
1	Is the feed present value within the stroke range?	–	○	○	–	YES	NO
	Is the feed present value within the range "[lower stroke limit value] to [stroke]"?	–	–	–	○		
2	When in the two-way cam mode, does "[lower stroke limit value] + [stroke]" exceed $2^{31}-1$?	–	–	–	○	NO	YES
3	[Drive module] When the clutch connected to the synchronous encoder is in an "external input mode", are the clutch's ON/OFF bit devices the same device?	○	○	○	○	YES	NO
	[Drive module] When the clutch connected to the synchronous encoder is in an "external input mode", is the encoder interface input a manual pulse generator input?	○	○	○	○	YES	NO (serial encoder (ABS) input)
4	Does a servo ON status (M1615+20n/XnF/M2415+20n is ON) exist at an output module where either a "no clutch" or "clutch ON command" is in effect for the virtual main shaft or the virtual auxiliary input shaft?	○	○	○	○	YES	NO
	Is the external input "STOP" signal OFF at an output module where either a "no clutch" status or "clutch ON command" is in effect for the virtual main shaft or the virtual auxiliary input axis?	○	○	○	○	YES	NO
5	When in the two-way cam mode, can the present value be calculated within 1 cam revolution?	–	–	–	○	YES	NO
6	Is the No. of the clutch ON/OFF address setting device (for address mode clutch) an even number?	○	○	○	○	YES	NO

(3) Synchronous encoder axis check

(a) The items shown in Table 9.3 below are checked to determine the synchronous encoder status. If an error is found, switching to the VIRTUAL mode will not occur. Error causes can only be corrected by switching back to the REAL mode.

(b) When an error is found, the corresponding output module's error detection signal (M1607+20n/Xn7/M2407+20n) will switch ON, and the error code will be stored in the minor/major error code register.

Table 9.3 Synchronous Encoder Axis Checklist

Check Sequence	Check Item	Output Module Checked		Normal Condition	Abnormal Condition
		External Synchronous Encoder	Output Module		
1	Is the synchronous encoder connected to an A171SENC/A273EX unit?	○	–	Connected	Not connected
					Cable break

9.2 Switching from the VIRTUAL to REAL Mode

VIRTUAL to REAL mode switching can be conducted by the user or by the OS.

- By user .... Switch M2043 OFF
- By OS .... Switching occurs automatically when a servo error is detected.

9.2.1 VIRTUAL to REAL mode switching by user

(1) When a VIRTUAL to REAL mode switching request (M2043 OFF → ON) occurs, the item shown in Table 9.4 is checked. If normal, switching to the REAL mode will occur. Before switching M2043 OFF, make sure that this item's status is normal.

(2) If an error is detected, M2045 will switch ON, and the error code will be stored at the D9195/D9195/D9193 - D9195 register. (See section 10.6)

Table 9.4 Checklist for VIRTUAL to REAL Mode Switching

Check Sequence	Check Item	Normal Condition	Abnormal Condition
1	Are all axes stopped? (M2001 - M2004/M2001 - M2008/M2001 - M2032 are OFF)	YES	NO

9.2.2 VIRTUAL to REAL mode switching by OS

(1) If any of the following conditions are detected during VIRTUAL mode operation, the OS will automatically switch back to the REAL mode.

- When an external emergency stop (EMG) input occurs.
- When the servo error detection signal (M1608+20n/Xn8/M2408+20n) switches ON at any axis.
- When the PC READY (M2000) signal switches OFF.
- When an error occurs in the 24 DC power supply to the A171SENC/A278LX while servos are ON at all axes (major error: 15010).
  (This condition applies when an A171SENC brake is designated at the A171SCPU, or when an A278LX brake is designated at the A273UHCPU (8/32-axis specification).

(2) If any of the above conditions occur, the OS will switch back to the REAL mode, and the resulting error code will be stored in the D9195/D9195/D9193 - D9195 register. M2045 will not switch ON at this time.

REMARK

*1: The proper names of M2045 and D9195/D9195/D9193 - D9195 are given below.

- M2045 .... REAL/VIRTUAL mode switching error detection flag
- D9195/D9195/D9193 - D9195 .. REAL/VIRTUAL mode switching error information register.

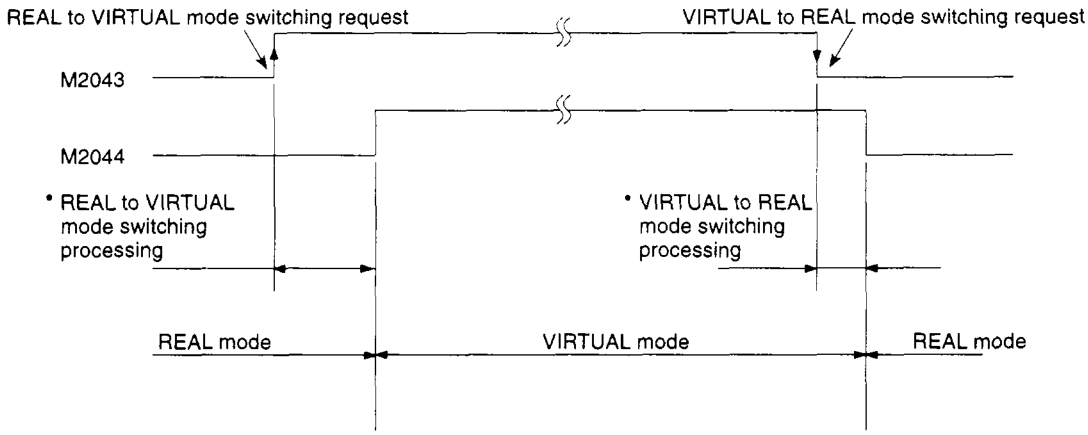
9.3 Precautions When Switching between REAL and VIRTUAL Modes

The precautions when switching between the REAL and VIRTUAL modes are described below.

(1) The DSFRP/SVST, DSFLP/CHGA/CHGV instructions are inoperative during REAL/VIRTUAL mode switching processing (indicated by asterisks * in the timing chart below). If one of these instructions is attempted at such a time, an error will occur at the START point.

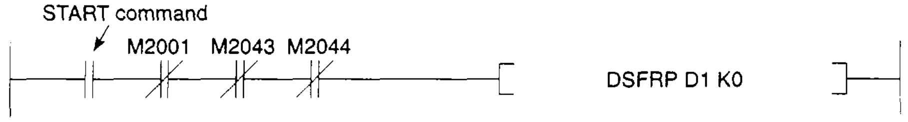
In order to execute the DSFRP/SVST and DSFLP/CHGA/CHGV instructions, M2043 and M2044 should be used as an interlock function.

[Timing Chart]

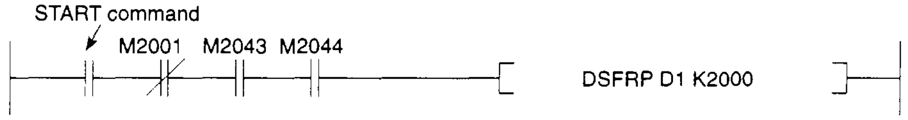


[Program Example]

(a) Servo program START request at REAL mode (for A273UHCPU 8-axis specification)



(b) Servo program START request at VIRTUAL mode (for A273UHCPU 8-axis specification)



REMARKS

1) For details regarding the DSFRP/SVST and DSFLP/CHGA/CHGV instructions, refer to the Motion Controller (SV13/22) Programming Manual (REAL Mode) IB-67265.

2) The M2043 and M2044 names are as follows:

- M2043 .... REAL/VIRTUAL mode switching request flag
- M2044 .... REAL/VIRTUAL mode status flag

(See Section 4.2)

(2) During TEST mode operation, M2043 ON/OFF (REAL/VIRTUAL mode switching request) switching from a peripheral device is ignored.

During TEST mode operation, REAL/VIRTUAL mode switching can be executed from a peripheral device.

M2044 will switch ON/OFF in accordance with the REAL/VIRTUAL mode status.

REMARK

When REAL/VIRTUAL mode switching is executed from a peripheral device, the data which is checked is identical to that checked at M2043 OFF → ON and ON → OFF. (See Sections 9.1 and 9.2)

9.4 STOP & RESTART

The basic method for stopping the system (output module) during VIRTUAL mode operation is to stop the main shaft. If an auxiliary input shaft is being used, that shaft should also be stopped.

(1) Virtual Axis STOP

The procedures for stopping and restarting the virtual shaft, and the stop processing details are discussed below. A virtual servo motor axis can be stopped by the 3 types of stop processing shown below. This processing is also valid for interpolation axes during interpolation operations.

1. Deceleration to stop ..... A deceleration to stop occurs in accordance with the parameter block's "stop deceleration time" setting.
2. Rapid stop .... A deceleration to stop occurs in accordance with the parameter block's "rapid stop deceleration time" setting.
3. Immediate stop .... An immediate stop occurs without deceleration.

Because an immediate input stop occurs for synchronous encoder axes, operation should be executed only after the synchronous encoder axis has been stopped by an external input, except for abnormal stops such as an emergency stop or a servo error occurrence, etc.

([Ex]: Switch M2000 OFF, or execute an all-axes servo OFF command, etc.)

(An immediate stop at output modules connected to the synchronous encoder will result in a servo error, and possibly, a synchronization discrepancy.)

When the stop cause is such that a synchronization discrepancy occurs, a synchronization discrepancy warning (M2046) will switch ON. In this case, re-align the axes in the REAL mode, switch M2046 OFF, then continue with the VIRTUAL mode operation.

The stop procedure/stop causes, and restarting procedure are shown in the following Table.

No.	Stop Procedure or Stop Causes during Operation	Affected Virtual Axis			Stop Processing		Return to REAL Mode by OS after All Virtual Axes Stop Completed	Synchronization Discrepancy Warning (M2046) Set
		Virtual Servo Motor Axis	Synchronous Encoder Axis	All Axes Batch	Virtual Servo Motor Axis	Synchronous Encoder Axis		
1	Stop command ON	○ (Relevant axis)	–	–	Deceleration to stop	–	–	–
2	Rapid stop command ON	○ (Relevant axis)	–	–	Rapid stop	–	–	–
3	All-axes servo OFF command (M2042 OFF Command from peripheral device when in TEST mode)	–	–	○	Deceleration to stop	Immediate input stop	–	–
4	PC READY (M2000) OFF	–	–	○	Deceleration to stop	Immediate input stop	○	–
5	Servo system CPU stop	–	–	○	Deceleration to stop	Immediate input stop	○	–
6	All-axes rapid stop by key input from peripheral device	–	–	○	Rapid stop	Immediate input stop	–	–
7	Stop by key input from peripheral device during TEST mode	○ (All axes)	–	–	Deceleration to stop	–	–	–
8	External emergency stop (EMG) input (emergency stop from teaching module)	–	–	○	Rapid stop	Immediate input stop	○	○
9	Servo error at any output module	–	–	○	Rapid stop	Immediate input stop	○	○
10	SCPU WDT error	–	–	○	Deceleration to stop	Immediate input stop	–	–
11	PCPU WDT error	–	–	○	Immediate stop	Immediate input stop	–	–
12	Servo system CPU reset	–	–	○	Immediate stop	Immediate input stop	–	–
13	Servo system CPU power OFF	–	–	○	Immediate stop	Immediate input stop	–	–
14	Other errors during virtual axis operation	○	–	–	Deceleration to stop	–	–	–
15	Error at absolute synchronous encoder axis	–	○	–	–	Immediate input stop	–	–

Error Set	Output Module Operation	Operation Continuation ENABLED (○)/ DISABLED (×)	Restarting after a Stop
–	• Deceleration to stop based on smoothing time constant.	○	• Resume operation by switching the stop command OFF (not necessary when ON) and executing a START.
–	• Deceleration to stop based on smoothing time constant.	○	• Resume operation by switching the stop command OFF (not necessary when ON) and executing a START.
–	• After a deceleration to stop based on the smoothing time constant, the servo OFF status is established.	○	• Resume operation by turning all clutches OFF → all axes servo ON → clutch ON. (However, there must be no motor movement during the servo OFF status. Moreover, clutch OFF/ON switching occurs only as required by the user.) • For synchronous encoder axes, switch to the REAL mode, then back to the VIRTUAL mode to resume inputs.
Minor error (200) set (virtual axis)	• Deceleration to stop based on smoothing time constant.	○	• After PC READY (M2000) switches ON, execute a REAL to VIRTUAL mode switching request (M2047 ON) to enable operation.
Minor error (200) set (virtual axis)	• Deceleration to stop based on smoothing time constant.	○	• After a servo system CPU "RUN" status is established, execute a REAL to VIRTUAL mode switching request (M2047 ON) to enable operation.
–	• Deceleration to stop based on smoothing time constant.	○	• After a stop occurs, execute a START to resume operation. • For synchronous encoder axes, switch to the REAL mode, then back to the VIRTUAL mode to resume inputs.
–	• Deceleration to stop based on smoothing time constant.	○	• After a stop occurs, execute a START to resume operation.
–	• Servo switches OFF after immediate stop.	×	• Operation cannot be resumed due to a synchronization discrepancy between the virtual axis and output module which occurs at the stop. • After canceling the emergency stop, re-align the output module in the REAL mode, switch the synchronization discrepancy warning (M2046) OFF, then switch back to the VIRTUAL mode to resume operation.
Relevant output module (Servo error, servo error code set)	• Servo error at ADU axis: An immediate stop occurs at all ADU axes or MR-[ ]-B axes, and a servo OFF status is established. • Servo error at MR-[ ]-B axis: An immediate stop occurs only at the axis where the error occurred, and a servo OFF status is established. All other axes are synchronized with the virtual axis and are then stopped.	×	• After executing a servo error reset in the REAL mode, re-align the axes, switch the synchronization discrepancy warning (M2046) OFF, then switch back to the VIRTUAL mode to resume operation.
–	• Deceleration to stop based on smoothing time constant.	×	• After the stop, reset the servo system CPU in the REAL mode to resume operation.
M9073 (PCPU WDT error) ON	• Servo switches OFF after immediate stop.	×	• Operation cannot be resumed due to a synchronization discrepancy between the virtual axis and output module which occurs at the stop. • After resetting the servo system CPU, re-align the output module, then switch to the VIRTUAL mode to resume operation.
–	• Servo switches OFF after immediate stop.	×	• Operation cannot be resumed due to a synchronization discrepancy between the virtual axis and output module which occurs at the stop. • After resetting the servo system CPU, re-align the output module, then switch to the VIRTUAL mode to resume operation.
–	• Servo switches OFF after immediate stop.	×	• Operation cannot be resumed due to a synchronization discrepancy between the virtual axis and output module which occurs at the stop. • After resetting the servo system CPU, re-align the output module, then switch to the VIRTUAL mode to resume operation.
Relevant error set	• Deceleration to stop based on smoothing time constant.	○	• Eliminate the error cause to enable a START.
Relevant error set	• Deceleration to stop based on smoothing time constant.	×	• Return to the REAL mode, re-align the axes, then switch to the VIRTUAL mode to resume operation.

10. ERROR CODES STORED AT THE PCPU

Errors detected at the PCPU include servo program setting errors, positioning errors, and control mode switching errors.

(1) Servo program setting errors

Servo program setting errors consist of errors in the positioning data designated at the servo program. A check occurs for these errors each time a servo program is started. When positioning data is designated indirectly, an error will occur if the designated data violates the prescribed range.

When an error is activated, the following occur:

- The servo program setting error flag (M9079) switches ON.
- The program No. where the error occurred is recorded in the error program No. register (D9189).
- The error code is recorded in the error information storage register (D9190).

(2) Positioning errors

(a) Positioning errors occur at positioning START, or during the positioning operation. There are three types of positioning error: minor errors, major errors, and servo errors.

1) Minor errors .... These errors are caused by the sequence program or servo program. The error code range for these errors is 1 - 999 for drive modules, and 4000 - 9990 for output modules. The cause of these errors can be eliminated by correcting the sequence program or servo program in accordance with the error code.

2) Major errors .... These errors are caused by external input signals or by control commands from the SCPU. The error code range for these errors is 1000 - 1999 for drive modules, and 10000 - 11990 for output modules. Eliminate the cause of these errors in accordance with the error code.

3) Servo errors .... These are errors detected by the servo amplifier or servo power supply module. The error code range for these errors is 2000 - 2999. Eliminate the cause of these errors in accordance with the error code.

Error Class	Error Occurrence Point	Applicable Modules	
		Drive Module	Output Module
Minor error	Setting data	1 - 99	4000 - 4990
	At START	100 - 199	5000 - 5990
	During operation	200 - 299	6000 - 6990
	At control change	300 - 399	–
Major error	At START	1000 - 1099	10000 - 10990
	During operation	1100 - 1199	11000 - 11990
	System	–	–
		–	15000 - 15990
Servo error	Servo amplifier	–	2000 - 2799 (2100 - 2499 are warnings)
	Servo power supply module		2800 - 2999 (2900 - are warnings)

(b) When an error occurs, the error detection signal for the axis in question will switch ON, and the corresponding error code will be recorded in the minor error code, major error code, or servo error code register.

1) When A171SCPU is used

		Error Code Registers				Error Detection Signal	Error Reset Flag
		Axis 1	Axis 2	Axis 3	Axis 4		
Virtual servo motor	Minor error code	D702	D708	D714	D720	M1207+20n	M1407+20n
	Major error code	D703	D709	D715	D721		
Synchronous encoder	Minor error code	D750				M1360	M1560
	Major error code	D751					
Output module	Minor error code	D806	D826	D846	D866	M1607+20n	M1807+20n
	Major error code	D807	D827	D847	D867		
	Servo error code	D808	D828	D848	D868	M1608+20n	M1808+20n (Reset is also valid for REAL mode errors)

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

		Error Code Registers								Error Detection Signal	Error Reset Flag
		Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8		
Virtual servo motor	Minor error code	D702	D708	D714	D720	D726	D732	D738	D744	X1n7	Y1n7
	Major error code	D703	D709	D715	D721	D727	D733	D739	D745		
Synchronous encoder	Minor error code	D750	D754	D758						X0E0 - X0E2	Y0E0 - Y0E2
	Major error code	D751	D755	D759							
Output module	Minor error code	D806	D826	D846	D866	D886	D906	D926	D946	X0n7	Y0n7
	Major error code	D807	D827	D847	D867	D887	D907	D927	D947		
	Servo error code	D808	D828	D848	D868	D888	D908	D928	D948	X0n8	Y0n8 (Reset is also valid for REAL mode errors)

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

		Error Code Registers											
		Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12
Virtual servo motor	Minor error code	D802	D812	D822	D832	D842	D852	D862	D872	D882	D892	D902	D912
	Major error code	D803	D813	D823	D833	D843	D853	D863	D873	D883	D893	D903	D913
Synchronous encoder	Minor error code	D1122	D1132	D1142	D1152	D1162	D1172	D1182	D1192	D1202	D1212	D1222	D1232
	Major error code	D1123	D1133	D1143	D1153	D1163	D1173	D1183	D1193	D1203	D1213	D1223	D1233
Output module	Minor error code	D6	D16	D26	D36	D46	D56	D66	D76	D86	D96	D106	D116
	Major error code	D7	D17	D27	D37	D47	D57	D67	D77	D87	D97	D107	D117
	Servo error code	D8	D18	D28	D38	D48	D58	D68	D78	D88	D98	D108	D118

		Error Code Registers											
		Axis 13	Axis 14	Axis 15	Axis 16	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
Virtual servo motor	Minor error code	D922	D932	D942	D952	D962	D972	D982	D992	D1002	D1012	D1022	D1032
	Major error code	D923	D933	D943	D953	D963	D973	D983	D993	D1003	D1013	D1023	D1033
Synchronous encoder	Minor error code												
	Major error code												
Output module	Minor error code	D126	D136	D146	D156	D166	D176	D186	D196	D206	D216	D226	D236
	Major error code	D127	D137	D147	D157	D167	D177	D187	D197	D207	D217	D227	D237
	Servo error code	D128	D138	D148	D158	D168	D178	D188	D198	D208	D218	D228	D238

		Error Code Registers								Error Detection Signal	Error Reset Flag
		Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32		
Virtual servo motor	Minor error code	D1042	D1052	D1062	D1072	D1082	D1092	D1102	D1112	M4007+20n	M4807+20n
	Major error code	D1043	D1053	D1063	D1073	D1083	D1093	D1103	D1113		
Synchronous encoder	Minor error code									M4640+4n	M5440+4n
	Major error code										
Output module	Minor error code	D246	D256	D266	D276	D286	D296	D306	D316	M2407+20n	M3207+20n
	Major error code	D247	D257	D267	D277	D287	D297	D307	D317		
	Servo error code	D248	D258	D268	D278	D288	D298	D308	D318	M2408+20n	M3208+20n (Reset is also valid for REAL mode errors)

(c) Each time an error occurs, the previously stored error code will be replaced (deleted) by the new error code. However, a log of errors can be recorded for reference purposes at a peripheral device (IBM PC running the SW2SRX-GSV22PE software).

(d) The error detection flag and error code are saved until the error reset signal or the servo error reset signal is switched ON.

POINTS

(1) When a servo error occurs, there are cases where the same servo error code will be stored again even after a servo error reset (M1808+20n/Yn8/M3208+20n: ON) is executed.

(2) When a servo error occurs, eliminate the error cause, then execute a servo error reset.

(3) REAL/VIRTUAL mode switching errors

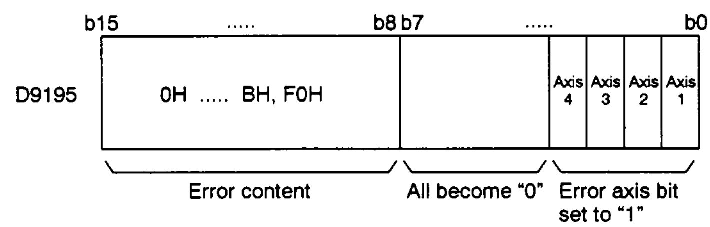
A check for REAL/VIRTUAL mode switching errors occurs when the REAL/VIRTUAL mode switching request flag (M2043) switches from OFF to ON, and from ON to OFF. (See Sections 9.1 and 9.2 for the check content.) If an error is found, the following occur:

- REAL/VIRTUAL mode switching will not occur, and the present mode will be maintained.
- The REAL/VIRTUAL mode switching request flag (M2045) switches ON.
- The corresponding error code will be stored in the REAL/VIRTUAL mode switching error information register (D9195/D9195/D9193 - D9195).

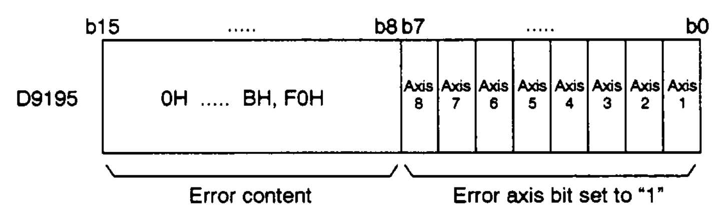
POINT

(1) The error codes stored in the D9195/D9195/D9193 - D9195 storage registers which apply to axis errors are shown below.

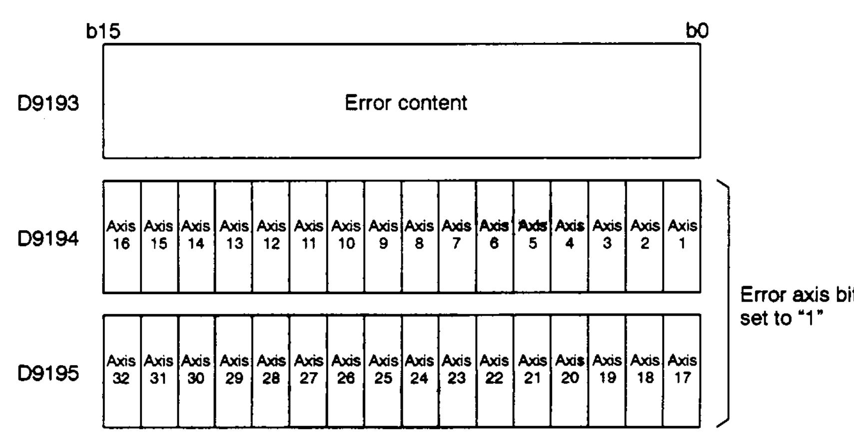
(a) When A171SCPU is used



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



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



10. ERROR CODES STORED AT THE PCPU

10.1 Related Systems & Error Processing

The following 2 types of related systems exist in the VIRTUAL mode.

(1) System consisting of a drive module and output module.

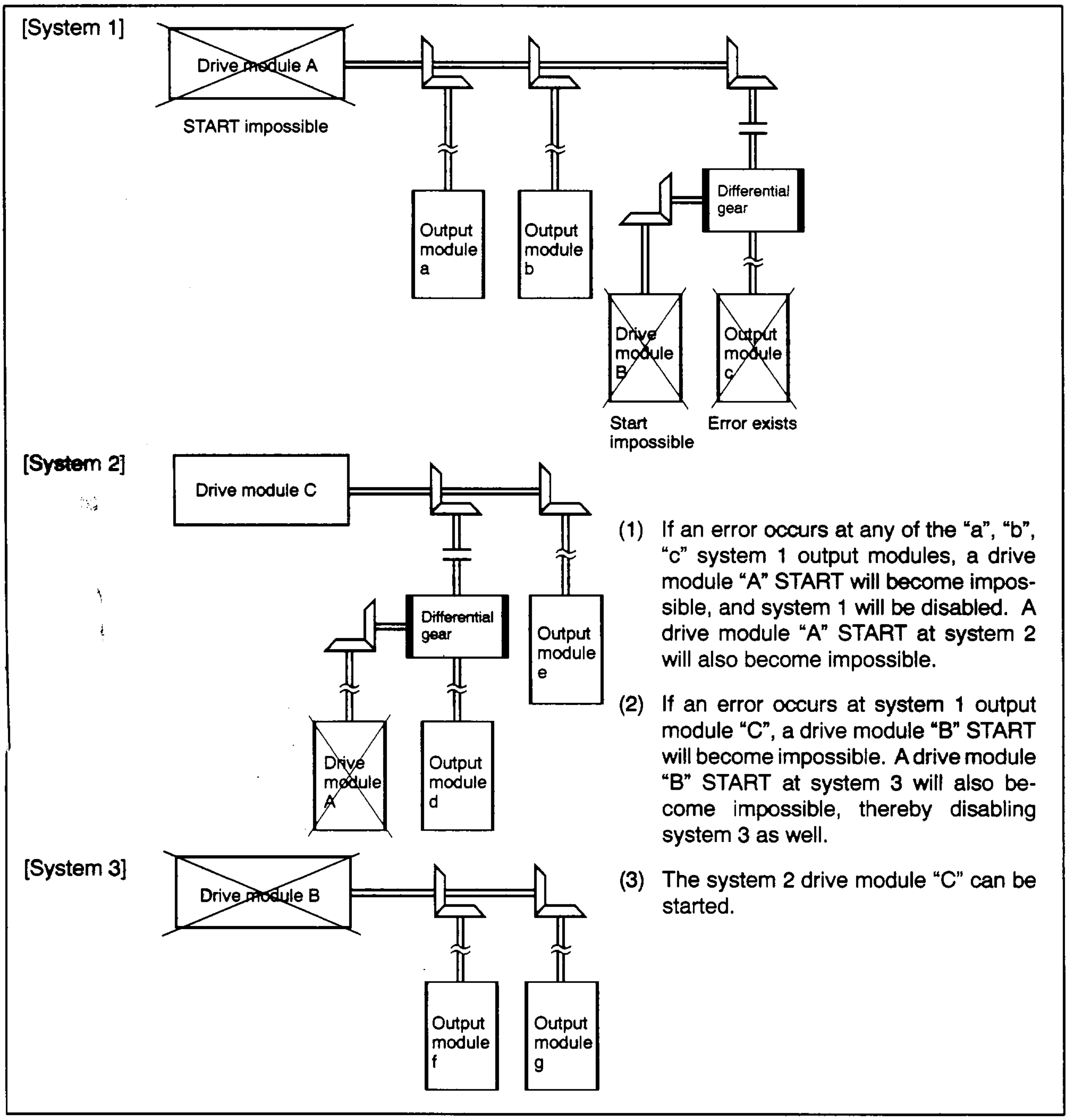
(2) Multiple systems using the same drive module.

The following occurs when an error is detected at an output module.

(1) If an error is detected at any output module, a drive module START will be impossible, and that system will be disabled.

The auxiliary input shaft operation for that output module will also be disabled.

(2) Other systems which use the drive module which was disabled by the output module error will also be disabled.



(1) If an error occurs at any of the "a", "b", "c" system 1 output modules, a drive module "A" START will become impossible, and system 1 will be disabled. A drive module "A" START at system 2 will also become impossible.

(2) If an error occurs at system 1 output module "C", a drive module "B" START will become impossible. A drive module "B" START at system 3 will also become impossible, thereby disabling system 3 as well.

(3) The system 2 drive module "C" can be started.

10.2 Servo Program Setting Errors

The error codes, error descriptions, and corrective actions for servo program setting errors are shown in Table 10.1 below. The "n" in the asterisked error codes in Table 10.1 indicates the axis number (1 - 4/1 - 8/1 - 32).

Table 10.1 Servo Program Setting Error List

<table>
<tr><th>Error Codes Stored at D9190</th><th>Error Name</th><th>Description</th><th>Error Processing</th><th>Corrective Action</th></tr>
<tr><td>1</td><td>Parameter block No. setting error</td><td>The parameter block No. setting is outside the 1 - 16 (1 - 64 range for A273UHCPU (32-axis specification)) range.</td><td>The default parameter block No. of "1" will be adopted for servo program operation.</td><td>Designate a parameter block No. within the 1 - 16 (1 - 64) range.</td></tr>
<tr><td rowspan="2">n03*</td><td rowspan="2">Address/travel value setting error (excluding speed control)</td><td>(1) Address outside the setting range was designated at absolute method positioning control.
<table><tr><th>System-of-units</th><th colspan="2">Address setting range</th></tr><tr><td>degree</td><td>0 - 35999999</td><td>× 10⁻⁵ degree</td></tr></table></td><td rowspan="2">(1) START is disabled. (at all interpolation axes during interpolation control.)
(2) If an error is detected during speed switching control or constant speed control, a deceleration to stop will occur.
(3) When a simultaneous START is in effect, an error at any servo program will disable all servo programs.</td><td>(1) When "degrees" is designated as the system-of-units, the address setting should be within a 0 - 35999999 range.</td></tr>
<tr><td>(2) At incremental method positioning control, the travel value setting is as follows: −2147483648 (H80000000)</td><td>(2) The travel value setting should be designated with a 0 - ±2147483647 range.</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Commanded speed error</td><td>(1) The commanded speed violated the "1 to speed limit" range.</td><td rowspan="2">(1) START will be disabled if a setting of 0 or less is designated.
(2) When the setting exceeds the speed limit, the speed limit value will be adopted.</td><td rowspan="2">(1) Designate the commanded speed with the "1 to speed limit" range.</td></tr>
<tr><td>(2) The commanded speed violated the setting range.
<table><tr><th>System-of-units</th><th colspan="2">Address setting range</th></tr><tr><td>mm</td><td>1 - 600000000</td><td>× 10⁻² mm/min</td></tr><tr><td>inch</td><td>1 - 600000000</td><td>× 10⁻³ inch/min</td></tr><tr><td>degree</td><td>1 - 600000000</td><td>× 10⁻³ degree/min</td></tr><tr><td>pulse</td><td>1 - 1000000</td><td>PLS/sec</td></tr></table></td></tr>
<tr><td>5</td><td>Dwell time setting error</td><td>The dwell time setting violated the 0 to 5000 range.</td><td>The default value of "0" will be adopted.</td><td>Designate the dwell time setting within the 0 to 5000 range.</td></tr>
<tr><td>6</td><td>M code setting error</td><td>The M code setting violated the 0 to 255 range.</td><td>The default value of "0" will be adopted.</td><td>Designate the M code setting within the 0 to 255 range.</td></tr>
<tr><td>7</td><td>Torque limit setting error</td><td>The torque limit value violated the 1 to 500 range.</td><td>The torque limit for the designated parameter block will be adopted.</td><td>Designate a torque limit value within the 1 to 500 range.</td></tr>
<tr><td rowspan="3">n08*</td><td rowspan="3">Auxiliary point setting error (at auxiliary point designation at circular interpolation)</td><td>(1) Address outside the setting range was designated at absolute method positioning control.
<table><tr><th>System-of-units</th><th colspan="2">Address setting range</th></tr><tr><td>degree</td><td>0 - 35999999</td><td>× 10⁻⁵ degree</td></tr></table></td><td rowspan="3">START is disabled.</td><td>(1) When "degrees" is designated as the system-of-units, the address setting should be within a 0-35999999 range.</td></tr>
<tr><td>(2) In incremental method positioning control, the travel value setting is as follows: −2147483648 (H80000000)</td><td>(2) The travel value setting should be designated within the range 0 to ±2147483647.</td></tr>
<tr><td>(3) [START point] = [auxiliary point], or [auxiliary point] = [END point].</td><td>(3) Set as follows: [START point] ≠ [auxiliary point] ≠ [END point].</td></tr>
</table>

Table 10.1 Servo Program Setting Error List (Continued)

<table>
<tr><th>Error Codes Stored at D9190</th><th>Error Name</th><th>Description</th><th>Error Processing</th><th>Corrective Action</th></tr>
<tr><td>n08*</td><td>Auxiliary point setting error (at auxiliary point designation at circular interpolation)</td><td>(4) The auxiliary point is located on the straight line which connects the START and END points.</td><td>START is disabled.</td><td>(4) Designate an auxiliary point value which is not located on the straight line connecting the START and END points.</td></tr>
<tr><td rowspan="4">n09*</td><td rowspan="4">Radius setting error (radius setting for circular interpolation)</td><td>(1) Address outside the setting range was designated in absolute method positioning control.
<table><tr><th>System-of-units</th><th colspan="2">Address setting range</th></tr><tr><td>degree</td><td>0 - 35999999</td><td>× 10^{-5} degree</td></tr></table></td><td rowspan="4">START is disabled.</td><td>(1) When "degrees" is designated as the system-of-units, the address setting should be within the range 0 to 35999999.</td></tr>
<tr><td>(2) In incremental method positioning control, the travel value setting is as follows: −2147483648 (H80000000)</td><td>(2) The travel value setting should be designated within the range 0 to ±2147483647.</td></tr>
<tr><td>(3) [START point] = [END point]</td><td>(3) Set as follows: [START point] ≠ [END point].</td></tr>
<tr><td>(4) The distance between the START and END points is larger than the diameter.</td><td>(4) Set so that the relationship between the START point to END point distance (L) and the radius (R) is as follows:
$\frac{L}{2R} \leqq 1$</td></tr>
<tr><td rowspan="2">n10*</td><td rowspan="2">Center point setting error (center point setting for circular interpolation)</td><td>(1) Address outside the setting range was designated in absolute method positioning control.
<table><tr><th>System-of-units</th><th colspan="2">Address setting range</th></tr><tr><td>degree</td><td>0 - 35999999</td><td>× 10^{-5} degree</td></tr></table></td><td rowspan="2">START is disabled.</td><td>(1) When "degrees" is designated as the system-of-units, the address setting should be within the range 0 to 35999999.</td></tr>
<tr><td>(2) At incremental method positioning control, the travel value setting is as follows: −2147483648 (H80000000)</td><td>(2) The travel value setting should be designated within the range 0 to ±2147483647.</td></tr>
<tr><td>11</td><td>Interpolation control system-of-units error</td><td>The interpolation system-of-units was other than 0 - 3.</td><td>The default value of "3" is adopted.</td><td>Designate a 0 - 3 interpolation system-of-units setting.</td></tr>
<tr><td>12</td><td>Speed limit setting error</td><td>The speed limit setting violates the setting range.</td><td>The default value of "200000 pulse/s" is adopted.</td><td>Designate a speed limit value within the setting range.</td></tr>
<tr><td>13</td><td>Acceleration time setting error</td><td>The acceleration time is "0".</td><td rowspan="3">The default value of "1000" is adopted.</td><td>Designate an acceleration time within the range 1 to 65535.</td></tr>
<tr><td>14</td><td>Deceleration time setting error</td><td>The deceleration time is "0".</td><td>Designate a deceleration time within the range 1 to 65535.</td></tr>
<tr><td>15</td><td>Rapid stop deceleration time setting error</td><td>The rapid stop deceleration time is "0".</td><td>Designate a rapid stop deceleration time setting within the range 1 to 65535.</td></tr>
<tr><td>16</td><td>Torque limit setting error</td><td>The torque limit value violates the range 1 to 500.</td><td>The default value of "300%" is adopted.</td><td>Designate a torque limit setting within the range 1 to 500.</td></tr>
</table>

Table 10.1 Servo Program Setting Error List (Continued)

<table>
<tr><th>Error Codes Stored at D9190</th><th>Error Name</th><th>Description</th><th>Error Processing</th><th>Corrective Action</th></tr>
<tr><td>17</td><td>"Allowable error range for circular interpolation" setting error</td><td>The "allowable error range for circular interpolation" setting violates the prescribed setting range.
<table>
<tr><th>System-of-units</th><th colspan="2">Address setting range</th></tr>
<tr><td>mm</td><td rowspan="4">0 - 100000</td><td>× 10^{-1} μm</td></tr>
<tr><td>inch</td><td>× 10^{-5} inch</td></tr>
<tr><td>degree</td><td>× 10^{-5} degree</td></tr>
<tr><td>pulse</td><td>PLS</td></tr>
</table></td><td>The default value of "100PLS" is adopted.</td><td>Designate the "allowable error range for circular interpolation" setting within the prescribed setting range.</td></tr>
<tr><td>18</td><td>"Number of repeats" setting error</td><td>The "number of repeats" setting violates the prescribed setting range 1 to 32767.</td><td>A "number of repeats" setting of "1" is adopted.</td><td>Designate the "number of repeats" setting within the range 1 to 32767.</td></tr>
<tr><td rowspan="3">19</td><td rowspan="3">START instruction setting error</td><td>(1) The servo program designated by the START instruction does not exist.</td><td rowspan="3">START is disabled.</td><td>(1) Create the servo program No. designated by the START command.</td></tr>
<tr><td>(2) A START instruction exists in the designated servo program.</td><td>(2) Delete the servo program which contains a START command.</td></tr>
<tr><td>(3) Duplicate START axes exist in the designated servo program.</td><td>(3) Designate the START axes without duplications.</td></tr>
<tr><td>20</td><td>Point setting error</td><td>During constant speed control, there is no point designation in the instruction.</td><td>START is disabled.</td><td>Designate a point between the CPSTART and CPEND instructions.</td></tr>
<tr><td>21</td><td>Reference axis speed setting error</td><td>During a reference axis speed designation in linear interpolation, a non-interpolation axis was designated as thereference axis.</td><td>START is disabled.</td><td>Designate one of the interpolation axes as the reference axis.</td></tr>
<tr><td>22</td><td>S-curve ratio setting error</td><td>When designating the S-curve acceleration/deceleration speed, the S-curve ratio violated the 0 - 100% range.</td><td>An S-curve ratio of "100%" is adopted.</td><td>Designate an S-curve ratio within the 0 - 100% range.</td></tr>
<tr><td>23</td><td>VSTART setting error</td><td>No speed switching points were designated between the VSTART and VEND instructions, or between the FOR and NEXT instructions. (Applies only at A273UHCPU 8/32-axis specification)</td><td>START is disabled.</td><td>Designate a speed switching point between the VSTART and VEND instructions, or between the FOR and NEXT instructions.</td></tr>
<tr><td>24</td><td>Cancel function start program number error</td><td>Cancel function start program number is not in the range 0 to 4095.</td><td>START is disabled.</td><td>Set the cancel function start program number in the range 0 to 4095, and start again.</td></tr>
<tr><td>900</td><td>START instruction setting error</td><td>The servo program designated by the SVST/DSFRP instruction does not exist.</td><td>START is disabled.</td><td>Designate the correct servo program.</td></tr>
<tr><td>901</td><td>START instruction setting error</td><td>The axis No. designated by the SVST/DSFRP instruction is different from that designated by servo program.</td><td>START is disabled.</td><td>Designate the correct axis No.</td></tr>
<tr><td>902</td><td>Servo program instruction code error</td><td>The instruction code at the designated servo program cannot be decoded due to an instruction code error.</td><td>START is disabled.</td><td>Read out the servo program, check it, and make the necessary corrections.</td></tr>
<tr><td>903</td><td>START error</td><td>A VIRTUAL mode program was started when in the REAL mode.</td><td>START is disabled.</td><td>Check the program's mode allocation.</td></tr>
<tr><td>904</td><td>START error</td><td>A REAL mode program was started when in the VIRTUAL mode.</td><td>START is disabled.</td><td>Check the program's mode allocation.</td></tr>
<tr><td>905</td><td>START error</td><td>An instruction that cannot be executed in the VIRTUAL mode (VPF, VPR, VPSTART, ZERO) was designated.</td><td>START is disabled.</td><td>Correct the servo program.</td></tr>
<tr><td>906</td><td>START error</td><td>An axis listed as "not used" was designated while in the VIRTUAL mode.</td><td>START is disabled.</td><td>Designate the correct axis No. at the system settings.</td></tr>
</table>

Table 10.1 Servo Program Setting Error List (Continued)

Error Codes Stored at D9190	Error Name	Description	Error Processing	Corrective Action
907	START error	A START occurred while switching from the REAL to VIRTUAL mode.	START is disabled.	Use the M2034 (REAL/ VIRTUAL mode switching request) and M2044 (REAL/ VIRTUAL mode status) signals to create a START interlock condition.
908	START error	A START occurred while switching from the VIRTUAL to REAL mode.		

10.3 Drive Module Errors

Table 10.2 Drive Module Error List (100 - 1199)

Error Class	Error Code	Virtual Servo Axis Control Item: Positioning	Fixed-Pitch Feed	Speed	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Synchronous Encoder	Position Follow-Up		Error Cause	Processing	Corrective Action
Minor Errors	100	○	○	○	○	○	○	○		○		• The PC READY (M2000) or PCPU READY (M9074) signal is OFF.	START is disabled.	• Set the servo system CPU to RUN. • Switch the PC READY (M2000) signal ON.
	101	○	○	○	○	○	○	○		○		• The relevant axis' "START accept" signal (M2001 - M2004/ M2001 - M2008/ M2001 - M2032) is ON.		• Set an interlock condition at the program to prevent a START from being designated at an axis which is in motion. (Designate the relevant axis and a "START accept OFF" in the START conditions.)
	103	○	○	○	○	○	○	○		○		• The relevant axis' stop command (M1400+20n/Y1n0/ M4800+20n) is ON.		• Switch the stop command (M1400+20n/Y1n0/ M4800+20n) OFF, then execute a START.
	104	○	○	○	○	○	○	○		○		• The relevant axis' rapid stop command (M1401+20n/Y1n1/ M4801+20n) is ON.		• Switch the stop command (M1401+20n/Y1n1/ M4801+20n) OFF, then execute a START.
	105	○				○				○		• On starting, the feed present value is outside the stroke limit range.		• Return to within the stroke limit range using jog operation. • Move inside the stroke limit range by performing a present value change.
	106*	○	○			○				○		• Positioning violates the stroke limit range.		• Execute positioning back to within the stroke limit range.
	107	○				○						• At the auxiliary point designation for circular interpolation, an address was designated which will not produce a circle. (Problem with START point, auxiliary point, and END point addresses.)		• Correct the address at the servo program.
	108*	○				○						• At the radius designation for circular interpolation, an address was designated which will not produce a circle. (Problem with START point, radius, and END point addresses.)		
	109	○				○						• At the center point designation for circular interpolation, an address was designated which will not produce a circle. (Problem with START point, center point, and END point addresses.)		
	110*	○				○						• During circular interpolation, the difference between the END point address and the ideal END point exceeds the "allowable error range for circular interpolation".		
	116						○					• The designated JOG speed is "0".		• Designate a speed setting within the prescribed setting range.
												• The designated JOG speed exceeds the JOG speed limit.	The JOG speed limit value is adopted.	
	117						○					• At a JOG simultaneous START, a forward and reverse setting are designated for the same axis.	A forward START will occur at the relevant axis only.	• Designate the setting correctly.
	140	○										• At the reference axis designation for linear interpolation, the reference axis travel value is "0".	START is disabled.	• Do not select an axis where the travel value is "0" as the reference axis.
	141									○		• The position command device No. at position follow-up control is an odd No.		• Designate an even number as the position command device No.

*: During interpolation operations, this error code is stored at all relevant interpolation axis storage areas.

Table 10.2 Drive Module Error List (100 - 1199) (Continued)

Error Class	Error Code	Virtual Servo Axis Control Item: Positioning	Fixed-Pitch Feed	Speed	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Synchronous Encoder	Position Follow-Up		Error Cause	Processing	Corrective Action
Minor Errors	151	○	○	○	○	○	○	○				• In the VIRTUAL mode, a START was designated at an inoperative axis. (Error occurred at REAL to VIRTUAL mode switching, and system START was disabled.)	START is disabled.	• After correcting the error cause in the REAL mode, switch back to the VIRTUAL mode and start operation.
	152	○	○	○	○	○	○	○				• A START was designated during a deceleration to stop which was occurring in response to an all-axes servo OFF (M2042 OFF).		• After correcting the error cause in the REAL mode, switch back to the VIRTUAL mode and start operation.
	153	○	○	○	○	○	○	○				• A START was designated during a deceleration to stop which was occurring in response to a servo error at the output module.		
	200	○	○	○	○	○	○	○	○	○		• The PC READY (M2000) signal was switched OFF during a START which was occurring in response to a START request from the sequence program.	Deceleration to stop	• After all axes have stopped, switch the programmable controller READY (M2000) signal ON.
	204	○	○	○	○	○	○	○	○	○		• The PC READY (M2000) signal was switched ON again during a deceleration to stop which was occurring in response to the PC READY (M2000) signal being switched OFF.	Ignored	• After all axes have stopped, switch the PC READY (M2000) signal ON. (PC READY (M2000) OFF → ON switching during a deceleration to stop is ignored.)
	207	○				○				○		• The feed present value violated the stroke limit range during operation. In circular interpolation operations, the error code will be stored only at the axis where the stroke limit range was violated. In linear interpolation operations, the error code will be stored at all interpolation axes.	Deceleration to stop	• Correct the stroke limit range or the travel value setting to ensure that positioning control remains within the stroke limit range.
	208	○				○		○				• During circular interpolation or manual pulse generator simultaneous operation, the feed present value of another axis violated the stroke limit range. (For other axis error detection.)		
	211					○						• When the final positioning address was identified during a positioning operation, an overrun occurred due to a deceleration distance which was insufficient for the output speed.		(1) Designate a speed which will not cause an overrun. (2) Designate a travel value which will not cause an overrun.
	214							○				• The manual pulse generator status was switched to "enabled" during axis motion, and manual pulse generator operation was attempted.	Manual pulse generator inputs are ignored until a stop occurs.	• Execute manual pulse generator operation after the axis motion has stopped.
	215				○							• The address of the speed switching point exceeds the END point address. • An address was designated which causes opposite direction positioning during speed switching control.	Rapid stop occurs.	• Designate the speed switching point somewhere between the previous speed switching point address and the END point address.
												• The same servo program operation was designated again.		• Correct the sequence program.
	220									○	○	• During position follow-up control with "degrees" set as the system-of-units, the commanded address violated the 0 to 35999999 range.	Deceleration to stop. (M200□ OFF)	• When the control system-of-units is "degrees", designate an address within the 0-35999999 range.
												• The address designated for position follow-up control is outside the stroke limit range.		• Set the address in the stroke limit range.

Table 10.2 Drive Module Error List (100 - 1199) (Continued)

Error Class	Error Code	Virtual Servo Axis Control Item: Positioning	Fixed-Pitch Feed	Speed	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Synchronous Encoder	Position Follow-Up		Error Cause	Processing	Corrective Action
Minor Errors	225					○						• During constant speed control, the speed at an intermediate point violated the speed limit value.	Operation occurs at the speed limit speed.	• Designate a speed within the "1 to speed limit value" range.
	300	○	○	○	○	○	○	○		○		• A present value change was designated while motion was in progress at the relevant axis. • A present value change was designated at an axis which hasn't been started. • A present value change was designated at an axis where the servo is OFF.	The present value will not be changed.	• Establish an interlock condition for the devices shown below, and avoid present value changes during axis motion. (1) Relevant axis' START accept signal (M2001 - M2004/M2001 - M2008/ M2001 - M2032) OFF. (2) Servo START signal (M1615+20n/XnF/ M2415+20n) ON.
	302	○										• A speed change was designated at an axis where circular interpolation is in progress.	The speed will not be changed.	• Do not make speed changes during circular interpolation.
	303	○	○		○	○				○		• A speed change was designated following the start of automatic deceleration during positioning.		• Do not make speed changes following the start of positioning deceleration.
	304						○		○			• A speed change was attempted during deceleration which was occurring in response to the JOG START signal (M1402+20n/Y1n2/ M4802+20n, M1403+20n/ Yn3/M4803+20n) being switched OFF.		• Do not make speed changes during deceleration which is occurring in response to the JOG START signal (M1402+20n/Y1n2/ M4802+20n, M1403+20n/ Yn3/M4803+20n) being switched OFF.
	305	○	○	○	○	○	○			○		• The speed following a speed change violated the "0 to speed limit value" range.	Operation will occur at the speed limit speed.	• Designate the post-change speed within the "0 to speed limit value" range.
	309											• A present value change which violated the range 0 to 35999999 ($\times 10^{-5}$ degrees) was designated at a "degrees" axis.	The present value will not be changed.	• Designate a value within the 0 to 35999999 ($\times 10^{-5}$ degrees) range.
Major Errors	1151								○			• A171SENC/A273EX or encoder hardware fault • Discontinuity in encoder cable	Immediate input stop	• Check the A171SENC/ A273EX, or the encoder (H/W replacement). • Check the encoder cable.
	1152								○			• Low voltage at A171SENC/A273EX battery.	Operation is continued.	• Replace the battery.
	1153								○			• No battery or disconnected battery at A171SENC/A273EX.		• Replace battery, or check the hardware at the A171SENC/A273EX.

10.4 Servo Errors

The servo errors consist of servo amplifier errors and servo power supply module errors (A273UHCPU (8-/32-specification) only).

[For A273UHCPU (32-specification)]

When the A273UHCPU (32-specification) is used, the error processing when a servo error is detected can be set independently for each system. (Settings are valid only for a servo error detected by the ADU.)

The error processing and the system are set in the peripheral device system settings.

	Setting	Control
1	Each system axes off (default)	• If a servo error occurs in any ADU axis, the servos are turned OFF for all axes in the system. (Identical to all servo axes OFF control.)
2	Only error axis off	• The servo is turned OFF for only the ADU axis where the servo error occurred. Other axes are unaffected. • However: (1) If units control 2 axes, servos for both axes turn OFF when a servo error occurs for one axis. (2) All axes in the system turn OFF if any of the following servo errors occurs: Overcurrent (2032) Low voltage (2810) Over-regeneration (2830) Overvoltage (2833) Overheated amplifier power supply (2847)

(1) Servo amplifier errors (2000 - 2799)

Servo amplifier errors (error codes 2000 - 2799) are detected by the servo amplifier.

Servo amplifier errors include ADU errors (for A273UHCPU 8/32-axis specification only), and MR-[ ]-B errors. ADU type servo amplifiers are abbreviated as Ⓐ, and MR-[ ]-B type servo amplifiers are abbreviated as Ⓜ. When a servo amplifier error occurs, the servo error detection signal (M1608+20n/Xn8/M2408+20n) switches ON. After eliminating the error cause, switch the servo error reset signal (M1808+20n/Yn8/M3208+20n) ON to execute a servo error reset, then re-start the operation. (However, as error codes 2100 - 2499 are only warnings, the servo error detection signal will not switch ON.)

Note: (1) Even after the protective circuit operation is completed, the regenerative error protection (error code 2030) and overload protection 1 & 2 (error codes 2050 & 2051) functions save the status of the interrupted operation at the servo amplifier. The memory content will be cleared by an external power OFF, but not by the RESET signal.

(2) Error codes 2030, 2050, and 2051 are reset by an external power OFF. As repeated external power OFFs can cause failure of devices due to overheating, be sure to eliminate the error cause before restarting operation.

Servo errors are described in Table 10.3 below.

⚠ CAUTION
⚠ When motion controller or servo amplifier self-diagnosis errors occur, check the error content and restore operation in accordance with the instructions in this manual.

Table 10.3 Servo Amplifier Error List (2000 - 2799)

Error Code	Amplifier Type	Error Cause		Error Check Timing	Processing	Corrective Action
		Name	Description			
2010	Ⓐ	P-N not wired	• The servo power supply module P-N is not wired to the ADU P-N.	Constant check	Immediate stop	• Check the wiring.
	Ⓜ	Insufficient voltage	• Power supply voltage is 160VAC or less.			• Use a voltmeter to measure the input voltage (R,S,T).
			• Momentary power interruption lasting 15 msec or longer occurred.			• Use an oscilloscope to determine if a momentary power interruption occurred.
			• Voltage drop at START, etc., due to insufficient power supply capacity.			• Provide an adequate power supply capacity.
2012	Ⓐ	Internal memory error	• Error at ADU SRAM.	• Checked at power ON		• Replace the ADU.
	Ⓜ	Memory error 1	• Error at servo amplifier SRAM. • Check sum error at servo amplifier EPROM.	• Checked at power ON • Check at leading edge of PC READY (M2000) signal. • Checked at servo error reset • Checked at servo system CPU power ON		• Replace the servo amplifier.
2013	Ⓜ	Clock error	• Error at servo amplifier clock.	Constant check		• Replace the servo amplifier.
2014	Ⓐ	Watchdog	• Servo control system error.			• Reset the servo system CPU, then re-check.
			• ADU failure.			• Replace the ADU.
	Ⓜ		• Servo amplifier hardware fault • Servo system CPU hardware fault			• Replace the servo amplifier. • Replace the servo system CPU.
2015	Ⓐ	2-port memory error	• Error at ADU's 2-port memory.	• Checked at servo amplifier power ON. • Checked at servo error reset.		• Reset the servo system CPU, then re-check. • Replace the ADU.
	Ⓜ	Memory error 2	• Error at servo amplifier EEPROM.	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset. • Checked at servo system CPU power ON.		• Replace the servo amplifier.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2016	A	Position sensor error 1	• Abnormal communication with encoder when initializing is executed. • Connected encoder type (ABS/INC) is different from that designated at the system settings.	• Checked at servo amplifier power ON. • Checked at servo error reset.	Immediate stop	• Reset the servo system CPU, then re-check. • Replace the servo motor (encoder). • Check/correct the system settings.
2016	M	Position sensor error 1	• Abnormal communication with encoder.	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset. • Checked at servo system CPU power ON.	Immediate stop	• Check for disconnected position sensor cable. • Replace the servo motor. • Replace the position sensor cable.
2017	A	PCB error	• Error at ADU's A/D converter.	• Checked at servo amplifier power ON. • Checked at servo error reset.	Immediate stop	• Reset the servo system CPU, then re-check. • Replace the ADU.
2017	M	PCB error	• Error at servo amplifier PCB element.	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset. • Checked at servo system CPU power ON.	Immediate stop	• Replace the servo amplifier.
2019	M	Memory error 3	• Check sum error at servo amplifier's flash ROM.	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset. • Checked at servo system CPU power ON.	Immediate stop	• Replace the servo amplifier.
2020	A	Position sensor error 2	• Abnormal communication with encoder occurred during operation.	Constant check	Immediate stop	• Check the encoder and ADU connection. • Replace the servo motor (encoder).
2020	M	Position sensor error 2	• Abnormal communication with encoder.	Constant check	Immediate stop	• Check for disconnected position sensor cable. • Replace the servo motor. • Replace the position sensor cable.
2024	M	Output side is grounded	• Servo amplifier's U,V,W are grounded.	Constant check	Immediate stop	• Check with a multimeter between terminal U,V,W phases and grounds. • Check with a multimeter and megger between terminal U,V,W phases and cores.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2025	Ⓐ	Absolute position lost	• A voltage level of 2.5 ± 0.2V or less occurred at the absolute type encoder's internal super capacitor.	• Check occurs at servo amplifier ON. • Check occurs at servo error reset.	Immediate stop	• Replace the battery (MR-JBAT-□). • Check the encoder and ADU connection.
			• Rotation of 500 rpm or higher occurred at the absolute type encoder during a power interruption.			
	Ⓜ	Battery error	• A low voltage condition occurred at the absolute position sensor's internal super capacitor.	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset. • Checked at servo system CPU power ON.		• Switch the power ON for 2 - 3 minutes to charge the super capacitor, then switch the power OFF and back ON again, and execute a home position return.
			• Low battery voltage.			• After switching the servo amplifier power OFF, measure the battery voltage.
			• Battery cable or battery failure. (Another home position return is required after canceling the error.)			• Replace the servo amplifier battery.
2026	Ⓐ	Unit mismatch	• A mismatch exists between the servo parameter (system settings) setting and the servo amplifier being used.	• Checked at servo amplifier power ON. • Checked at servo error reset.		• Check/correct the system settings.
2030	Ⓜ	Excessive regeneration	• ON/OFF switching of the regenerating power transistor is occurring too frequently. (Regenerative resistor could overheat.)	Constant check		• Check the servo motor's regenerating level (%), and decrease the number of accelerations/decelerations, or reduce the feed speed accordingly. • Reduce the load. • Increase the motor capacity.
			• Incorrect servo parameter (system settings) setting.			• Check the servo parameter settings ("regenerative resistor", and "motor type" items in the system settings).
			• Regenerative resistor wiring error.			• Connect the regenerative resistor correctly.
			• Regenerative resistor failure.			• Replace the regenerative resistor.
			• Regenerating power transistor was shorted and damaged.			• Replace the servo amplifier.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2031	A	Excessive speed	• Commanded speed is too fast.	Constant check	Immediate stop	• Check/correct the commanded speed.
			• Overshooting occurred during acceleration.			• Check/correct the servo parameter setting.
			• Encoder failure.			• Replace the encoder.
			• Encoder cable failure, or incorrect wiring.			• Check the encoder and ADU connection.
	M		• Motor rpm exceeded the rated speed by 115% or more.			• Check the "motor rpm" servo parameter setting. • Check the "number of pulses per revolution" and "travel value per revolution" fixed parameter settings to see if they conform to the machine specifications.
			• Overshooting occurred at acceleration/deceleration because the time constant value was too low.			• If overshooting occurs at acceleration/deceleration, check the "acceleration time" and "deceleration time" fixed parameter settings.
			• Overshooting occurred due to servo system instability.			• If overshooting occurs, adjust the "position loop gain/position control gain 1 & 2" and the "speed loop gain/speed control gain 1 & 2" servo parameter settings, and increase the speed integral compensation.
			• Position sensor error.			• Check for a disconnected position sensor cable. • Replace the servo motor.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2032	Ⓐ	Overcurrent	• A servo motor different from that specified by the setting has been connected.	• Checked at servo amplifier power ON. • Checked at servo error reset.	Immediate stop	• Check/correct the system settings.
			• The ADU output's U,V,W phases have mutually shorted or grounded.			• Check the servomotor cable.
			• Incorrect ADU output U,V,W phase wiring.			• Correct the servomotor wiring.
			• Damaged ADU transistor module. • ADU failure.			• Replace the ADU.
			• Servomotor and encoder coupling failure.			• Replace the servomotor.
			• Servomotor oscillation occurred.			• Check/correct the servo parameter settings.
	Ⓜ		• The servo amplifier output's U,V,W phases have mutually shorted.	Constant check		• Check the servo amplifier output's U,V,W terminals for mutual shorting.
			• The servo amplifier output's U, V, W phases have been grounded.			• Check for grounding at the servo amplifier U,V,W terminals, and at the ground. Check for grounding at the servomotor U,V,W terminals. If grounded, replace the servo amplifier and servomotor.
			• Incorrect servo amplifier output U,V,W phase wiring.			• Correct the wiring.
			• Damaged servo amplifier transistor.			• Replace the servo amplifier.
			• Servo motor and encoder coupling failure.			• Replace the servomotor.
			• Damaged encoder cable.			• Replace the encoder cable.
			• A servo motor different from that specified by the setting has been connected.			• Check the "connected motor" item in the system settings.
			• Servo motor oscillation occurred.			• Check the "gain" servo parameter setting, and adjust it.
			• Noise entered the overcurrent detection circuit.			• Check for relays, valves, etc., which may be operating nearby.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2033	Ⓜ	Overvoltage	• Voltage at the converter bus exceeded 400V. • Regenerating capacity was exceeded because of too many accelerations/decelerations. • Incorrect regenerative resistor connection.	Constant check	Immediate stop	• Increase the acceleration time and deceleration time in the fixed parameters. • Check the C-P connection at the regeneration terminal board.
			• Servo amplifier's internal regenerative resistor is OFF.			• Measure between C & P (at regeneration terminal board) with a multimeter. If abnormal, replace the servo amplifier. (Conduct measurement approx. 3 minutes after the charge lamp goes OFF.)
			• The regenerative resistor's power transistor has been damaged.			• Replace the servo amplifier.
			• Excessive power supply voltage.			• Measure the input voltage (R,S,T) using a voltmeter.
2034	Ⓜ	Communication error	• Error in data received from servo system CPU.			• Check the motion bus cable connection. • Check for disconnected motion bus cable. • Verify that the motion bus cable is properly clamped.
2035	Ⓐ	Data error	• Commanded speed is too fast.			• Check/correct the commanded speed.
			• Servo system CPU failure.			• Replace the servo system CPU.
	Ⓜ		• Excessive change amount in position command from servo system CPU, or commanded speed is too fast.			• Check the commanded speed, and the "number of pulses per revolution" and "travel value per revolution" fixed parameter settings.
			• Noise entered the command from the servo system CPU.			• Check the motion bus cable connector connection. • Check for disconnected motion bus cable. • Verify that the motion bus cable is properly clamped. • Check for relays, valves, etc., which may be operating nearby.
2036	Ⓐ	Transfer error	• Servo system CPU failure.			• Replace the servo system CPU.
	Ⓜ		• Error in communication with servo system CPU.			• Check the motion bus cable connector connection. • Check for disconnected motion bus cable. • Verify that the motion bus cable is properly clamped.
2042	Ⓜ	Feedback error	• Encoder signal error.			• Replace the servomotor.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2045	Ⓐ	Amplifier fin overheat	• ADU fan has stopped.	Constant check	Immediate stop	• Replace the ADU fan.
			• Operation which exceeds the ADU continuous output current has occurred.			• Reduce the load.
			• ADU thermal sensor failure.			• Replace the ADU.
	Ⓜ	Fin overheat	• The servo amplifier's heat sink has overheated. • Amplifier error (rated output exceeded). • Repeated ON/OFF switching occurred under overload conditions. • Cooling error.			• If the servomotor's effective torque is large, reduce the load. • Reduce the number of accelerations/decelerations. • Check the amplifier fan to see if it has stopped. (MR-H150B or higher) • Check for ventilation obstructions. • Check for excessive temperatures (0 - +55°C) in the enclosure. • Check to see if the electromagnetic brake has been actuated by an external signal during operation. • Replace the servo amplifier.
2046	Ⓐ	Servomotor overheat	• Malfunction of servomotor's internal thermal protector.			• Replace the servomotor.
			• Operation which exceeds the servo motor's continuous output has occurred.			• Reduce the load.
	Ⓜ		• A servomotor overload has occurred.			• If the servomotor's effective torque is large, reduce the load.
			• Servomotor and regenerating option overheating has occurred.			• Check the servomotor's ambient temperature (0 to +40°C).
			• Malfunction at encoder's internal thermal protector.			• Replace the servomotor.
2050	Ⓐ	Overload	• Servomotor's rated current was exceeded. • Excessive load inertia or friction.			• Reduce the load.
			• Hunting caused by incorrect parameter setting.			• Check/correct the servo parameter settings.
	Ⓜ	Overload 1	• A continuous overload current of approx. 200% reached the servo amplifier and servomotor.			• Check for machine collisions. • If the load inertia is excessively high, either increase the acceleration/deceleration time constant, or reduce the load. • If hunting occurs, adjust the "position loop gain" in the servo parameters. • Check the U,V,W connections at the servo amplifier and servomotor. • Check for a disconnected position sensor cable. • Replace the servomotor.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2051	Ⓜ	Overload 2	• A servo amplifier and servomotor overload occurred near the maximum torque (95% or more of the current limit value).	Constant check	Immediate stop	• Check for machine collisions. • If the load inertia is excessively high, either increase the acceleration/deceleration time constant, or reduce the load. • If hunting occurs, adjust the following at the servo parameters: position loop gain/position control gain/position control gain 1 & 2, speed loop gain/speed control gain 1 & 2. • Check the U,V,W connections at the servo amplifier and servomotor. • Check for a disconnected position sensor cable. • Replace the servomotor. • If a low voltage condition exists at the servomotor's bus (charge lamp is OFF), replace the servo amplifier.
2052	Ⓐ	Excessive error	• Deviation counter value exceeds the stipulated value. • Acceleration impossible due to excessive inertia.	Constant check	Immediate stop	• Check/correct the servo parameters.
2052	Ⓐ	Excessive error	• Encoder or cable failure.	Constant check	Immediate stop	• Replace the encoder or cable.
2052	Ⓜ	Excessive error	• The difference between the servo amplifier pulse and the feedback pulse exceeded 80000 pulses.	Constant check	Immediate stop	• Check for machine collisions. • Increase the acceleration/deceleration time constant. • Increase the position loop gain/position control gain 1 & 2 servo parameter settings. • Check for a disconnected position sensor cable. • Replace the servomotor. • If a low voltage condition exists at the servomotor's bus (charge lamp is OFF), replace the servo amplifier.
2057	Ⓐ	Hardware fault	• ADU hardware fault.	Constant check	Immediate stop	• Replace the ADU.
2086	Ⓜ	RS232 communication error	• Parameter module communication error.	Constant check	Operation continues	• Check for disconnected parameter module cable. • Replace the parameter module.
2102	Ⓐ	Battery warning	• Absolute encoder battery voltage is low.	Constant check	Operation continues	• Replace the battery (MR-JBAT-□).
2102	Ⓜ	Battery warning	• Servo amplifier battery voltage is low.	Constant check	Operation continues	• Replace the battery.
2103	Ⓜ	Battery disconnection warning	• Low power supply voltage at absolute position sensor.	Constant check	Operation continues	• Replace the battery. • Check for disconnected position sensor cable. • Replace the servo motor. • Replace the servo amplifier.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2140	Ⓜ	Over-regeneration warning	• An over-regeneration error (2030) may have occurred. (85% of regenerative resistor's maximum load capacity was detected.)	Constant check	Operation continues	• Refer to the over-regeneration error (2030) description.
2141	Ⓐ	Overload warning	• 80% of the overload error (2050) level was detected.			• Refer to the overload error (2050) description.
	Ⓜ		• An overload error (2050, 2051) may have occurred. (85% of overload level detected.)			• Refer to the overload error (2050, 2051) description.
2143	Ⓐ	Absolute value counter warning	• Encoder failure.			• Replace the encoder.
2146	Ⓜ	Servo emergency stop	• Open circuit between 1A and 1B at the servo amplifier CN6 connector.			• Establish a short circuit between 1A and 1B of the servo amplifier CN6 connector.
2147	Ⓐ	Emergency stop	• An emergency stop occurred.		Immediate stop	• Execute an emergency stop reset.
	Ⓜ		• An emergency stop signal (EMG) input occurred from the servo system CPU.		Operation continues	• Execute an emergency stop reset.
2149	Ⓜ	Main circuit OFF warning	• The servo ON signal (SON) was switched ON when the connector was OFF. • The main circuit bus voltage fell below 215 V at 50 rpm or lower.			• Switch the main circuit connector or main circuit power ON.
2196	Ⓜ	Incorrect home position setting warning	• The droop pulse was not within the in-position range following a home position set command.			• Execute another home position return.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Ampli-fier Type</th><th colspan="2">Error Cause</th><th rowspan="2">Error Check Timing</th><th rowspan="2">Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2201
-
2224</td><td>Ⓐ</td><td>Parameter warning</td><td>• An incorrect parameter setting was designated.
<table>
<tr><td>2201</td><td>Amplifier setting</td></tr>
<tr><td>2202</td><td>Motor type</td></tr>
<tr><td>2203</td><td>Motor capacity</td></tr>
<tr><td>2204</td><td>Number of feedback pulses</td></tr>
<tr><td>2205</td><td>In-position range</td></tr>
<tr><td>2206</td><td>Position control gain 2 (actual position gain)</td></tr>
<tr><td>2207</td><td>Speed control gain 2 (actual speed gain)</td></tr>
<tr><td>2208</td><td>Speed integral compensation</td></tr>
<tr><td>2209</td><td>Forward torque limit value</td></tr>
<tr><td>2210</td><td>Reverse torque limit value</td></tr>
<tr><td>2211</td><td>Emergency stop time delay</td></tr>
<tr><td>2212</td><td>Position control gain 1 (model position gain)</td></tr>
<tr><td>2213</td><td>Speed control gain 1 (model speed gain)</td></tr>
<tr><td>2214</td><td>Load inertia ratio</td></tr>
<tr><td>2215</td><td>Excessive error alarm level</td></tr>
<tr><td>2216</td><td>Special compensation processing</td></tr>
<tr><td>2217</td><td>Special servo processing</td></tr>
<tr><td>2218</td><td>Td dead-band compensation</td></tr>
<tr><td>2219</td><td>Feed forward gain</td></tr>
<tr><td>2220</td><td>Unbalanced torque compensation</td></tr>
<tr><td>2221</td><td>Dither command</td></tr>
<tr><td>2222</td><td>Gain operating time</td></tr>
<tr><td>2223</td><td>Servo responsibility</td></tr>
<tr><td>2224</td><td>-</td></tr>
</table></td><td>Constant check</td><td>Operation continues</td><td>• Check/correct the system settings and servo parameters.</td></tr>
</table>

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2301 - 2336	Ⓜ	Parameter error	• Servo parameter value is outside the applicable range. (Incorrect parameters are ignored, and the previously set value is maintained.) 2301 Amplifier setting 2302 Regenerative resistor setting 2303 Motor type 2304 Motor capacity 2305 Motor rpm 2306 Number of feedback pulses 2307 Rotation direction setting 2308 Automatic tuning setting 2309 Servo responsibility 2310 Forward torque limit value 2311 Reverse torque limit value 2312 Load inertia ratio 2313 Position control gain 1 2314 Speed control gain 1 2315 Position control gain 2 2316 Speed control gain 2 2317 Speed integral compensation 2318 Notch filter selection 2319 Feed forward gain 2320 In-position range 2321 Electromagnetic brake sequence output 2322 Monitor output mode selection 2323 Optional function 1 2324 Optional function 2 2325 Optional function 3 2326 Optional function 4 2327 Monitor output 1 offset 2328 Monitor output 2 offset 2329 Pre-alarm data selection 2330 Zero speed 2331 Excessive error alarm level 2332 Optional function 5 2333 Optional function 6 2334 PI-PID switching position droop 2335 Torque limit compensation coefficient 2336 Speed differential compensation (actual speed differential compensation)	Constant check	Operation continues	• Verify the servo parameter setting range.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause		Error Check Timing	Processing	Corrective Action
		Name	Description			
2301 - 2324	Ⓐ	Parameter error	• Servo parameter value is outside the applicable range. (Incorrect parameters are ignored, and the previously set parameters are maintained.) 2301 Amplifier setting 2302 Motor type 2303 Motor capacity 2304 Number of feedback pulses 2305 In-position range 2306 Position control gain 2 (actual position gain) 2307 Speed control gain 2 (actual speed gain) 2308 Speed integral compensation 2309 Forward torque limit value 2310 Reverse torque limit value 2311 Emergency stop time delay 2312 Position control gain 1 (model position gain) 2313 Speed control gain 1 (model speed gain) 2314 Load inertia ratio 2315 Excessive error alarm level 2316 Special compensation processing 2317 Special servo processing 2318 Td dead-band compensation 2319 Feed forward gain 2320 Unbalanced torque compensation 2321 Dither command 2322 Gain operating time 2323 Servo responsibility 2324 -	Constant check	Operation continues	• Verify the servo parameter setting range.
2500	Ⓐ	Parameter error	• The following servo parameter items are incorrect: • Amplifier and external regenerative resistor setting • Motor type • Motor capacity	• Checked at servo amplifier power ON. • Checked at servo error reset.		• Check/correct the system settings and servo parameters.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	Error Check Timing	Processing	Corrective Action
2501 - 2524	Ⓐ	Parameter error	• Incorrect parameter setting value. 2501 Amplifier setting 2502 Motor type 2503 Motor capacity 2504 Number of feedback pulses 2505 In-position range 2506 Position control gain 2 (actual position gain) 2507 Speed control gain 2 (actual speed gain) 2508 Speed integral compensation 2509 Forward torque limit value 2510 Reverse torque limit value 2511 Emergency stop time delay 2512 Position control gain 1 (model position gain) 2513 Speed control gain 1 (model speed gain) 2514 Load inertia ratio 2515 Excessive error alarm level 2516 Special compensation processing 2517 Special servo processing 2518 Td dead-band compensation 2519 Feed forward gain 2520 Unbalanced torque compensation 2521 Dither command 2522 Gain operating time 2523 Servo responsibility 2524 –	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset.	Operation continues	• Check/correct the system settings and servo parameters.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

Error Code	Amplifier Type	Error Cause		Error Check Timing	Processing	Corrective Action
		Name	Description			
2601 - 2636	Ⓜ	Initial parameter error	• An incorrect parameter setting was designated. • Parameter data has been lost. 2601 Amplifier setting 2602 Regenerative resistor setting 2603 Motor type 2604 Motor capacity 2605 Motor rpm 2606 Number of feedback pulses 2607 Rotation direction setting 2608 Automatic tuning setting 2609 Servo responsibility 2610 Forward torque limit value 2611 Reverse torque limit value 2612 Load inertia ratio 2613 Position control gain 1 2614 Speed control gain 1 2615 Position control gain 2 2616 Speed control gain 2 2617 Speed integral compensation 2618 Notch filter selection 2619 Feed forward gain 2620 In-position range 2621 Electromagnetic brake sequence output 2622 Monitor output mode selection 2623 Optional function 1 2624 Optional function 2 2625 Optional function 3 2626 Optional function 4 2627 Monitor output 1 offset 2628 Monitor output 2 offset 2629 Pre-alarm data selection 2630 Zero speed 2631 Excessive error alarm level 2632 Optional function 5 2633 Optional function 6 2634 PI-PID switching position droop 2635 Torque limit compensation coefficient 2636 Speed differential compensation (actual speed differential compensation)	• Checked at servo amplifier power ON. • Checked at leading edge of PC READY (M2000) signal. • Checked at servo error reset. • Checked at servo system CPU power ON.	Immediate stop	• After checking/correcting the parameter setting value, execute one of the following: • Switch the servo system CPU OFF and back ON again. • Press the reset key, and switch the programmable controller READY signal (M2000) OFF and back ON again.

Table 10.3 Servo Amplifier Error List (2000 - 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Ampli-fier Type</th><th colspan="2">Error Cause</th><th rowspan="2">Error Check Timing</th><th rowspan="2">Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2601 - 2624</td><td>A</td><td>Initial parameter error</td><td>• An incorrect parameter setting was designated.
2601 Amplifier setting
2602 Motor type
2603 Motor capacity
2604 Number of feedback pulses
2605 In-position range
2606 Position control gain 2 (actual position gain)
2607 Speed control gain 2 (actual speed gain)
2608 Speed integral compensation
2609 Forward torque limit value
2610 Reverse torque limit value
2611 Emergency stop time delay
2612 Position control gain 1 (model position gain)
2613 Speed control gain 1 (model speed gain)
2614 Load inertia ratio
2615 Excessive error alarm level
2616 Special compensation processing
2617 Special servo processing
2618 Td dead-band compensation
2619 Feed forward gain
2620 Unbalanced torque compensation
2621 Dither command
2622 Gain operating time
2623 Servo responsibility
2624 -</td><td>• Checked at servo amplifier power ON.
• Checked at leading edge of PC READY (M2000) signal.
• Checked at servo error reset.
• Checked at servo system CPU power ON.</td><td>Immediate stop</td><td>• After checking/correcting the parameter setting value, execute one of the following:
• Switch the servo system CPU OFF and back ON again.
• Press the reset key, and switch the programmable controller READY signal (M2000) OFF and back ON again.</td></tr>
</table>

(2) Servo power supply module errors
(2800 - 2999: For A273UHCPU 8/32-axis specification only)

Servo power supply module errors (2800 - 2999) are detected by the servo amplifier.

When a servo error occurs, the servo error detection signal (M1608+20n/Xn8/M2408+20n) switches ON. After eliminating the error cause, switch the servo error reset signal (M1808+20n/Yn8/M3208+20n) ON to execute a servo error reset, then re-start the operation. (However, as error codes 2900 - 2999 are only warnings, the servo error detection signal will not switch ON.)

Note: (1) Even after the protective circuit operation is completed, the regenerative error protection (error code 2830) function saves the status of the interrupted operation at the servo amplifier.
The memory content will be cleared by an external power OFF, but not by the RESET signal.

(2) Error code 2830 is reset by an external power OFF. As repeated external power OFFs can cause failure of devices due to overheating, be sure to eliminate the error cause before restarting operation.

Servo power supply module errors are described in Table 10.4 below.

⚠ CAUTION

⚠ When motion controller or servo amplifier self-diagnosis errors occur, check the error content and restore operation in accordance with the instructions in this manual.

Table 10.4 Servo Power Supply Module Error List (2800 - 2999)

<table>
<tr><th rowspan="2">Error Code</th><th colspan="2">Error Cause</th><th rowspan="2">Error Check Timing</th><th rowspan="2">Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td rowspan="2">2810</td><td rowspan="2">Undervoltage</td><td>• Voltage at servo power supply module fell below 170VAC.
• A momentary power interruption occurred.</td><td rowspan="10">Constant check</td><td rowspan="10">Immediate stop</td><td>• Check/correct the power supply equipment.</td></tr>
<tr><td>• Excessive load.</td><td>• Check/correct the power capacity.</td></tr>
<tr><td rowspan="4">2830</td><td rowspan="4">Excessive regeneration</td><td>• Regenerative resistor's maximum load capacity was exceeded due to frequent operation or continuous regeneration operation.</td><td>• Check/correct the operation pattern by reducing the number of accelerations/decelerations, or by reducing the speed, etc.</td></tr>
<tr><td>• Regeneration power transistor has been damaged.</td><td>• Replace the servo power supply module.</td></tr>
<tr><td>• Incorrect regenerative resistor setting in system settings.</td><td>• Check/correct the system settings.</td></tr>
<tr><td>• Incorrect regenerative resistor wiring.</td><td>• Correct the wiring.</td></tr>
<tr><td rowspan="4">2833</td><td rowspan="4">Overvoltage</td><td>• Incorrect regenerative resistor connection.</td><td>• Correct the wiring.</td></tr>
<tr><td>• Regeneration power transistor has been damaged.</td><td>• Replace the servo power supply module.</td></tr>
<tr><td>• Regenerative resistor is OFF.</td><td>• Replace the regenerative resistor.</td></tr>
<tr><td>• Power supply voltage too high.</td><td>• Check/correct the power supply equipment.</td></tr>
</table>

Table 10.4 Servo Power Supply Module Error List (2800 - 2999) (Continued)

Error Code	Error Cause		Error Check Timing	Processing	Corrective Action
	Name	Description			
2847	Amplifier power supply overheat	• Servo power supply module amplifier has stopped.	Constant check	Immediate stop	• Replace the fan.
		• The servo power supply module's continuous output current rating was exceeded during operation.			• Reduce the load.
		• Thermal sensor failure.			• Replace the servo power supply module.
2940	Excessive regeneration warning	• A regeneration level of 80% of the excessive regeneration error (2830) level was detected.		Operation continues	• Refer to the "excessive regeneration error (2830) description.

10.5 Output Module Errors

(1) Output module errors at REAL → VIRTUAL mode switching (4000 - 5990)

Table 10.5 Output Module Error List (4000 - 5990)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Minor Errors	4050	405□				○	• The [stroke lower limit setting device value] + [stroke setting device value] exceeded $2^{31}-1$ (set system-of-units). (In 2-way cam mode.)	START disabled at related systems.	• Because the present value cannot be calculated within 1 cam shaft revolution, return to the REAL mode and designate a correct No. at the device.
	4060	406□	○	○	○	○	• When the drive module is the synchronous encoder connected to the manual pulse generator inputs, and the connected clutch is in the "external input mode", multiple settings existed at the ON/OFF command bit device. Or, the external input mode clutch setting is incorrect.		• A one-to-one setting should be designated for the external input mode clutch and the synchronous encoder. • Return to the REAL mode, switch the programmable controller READY signal OFF, then correct and register the clutch setting.
	4070	407□	○	○	○	○	• The connected clutch is in the external input mode for a A273EX/A171SENC set for high-speed reading.		• Do not used the clutch in the external input mode for a A273EX/A171SENC set for high-speed reading.
	5000	500□		○	○	○	• The "feed present value" is outside the applicable range. • For cams, the feed present value is outside the "stroke lower limit to stroke" range. (When in the 2-way cam mode.) (Present value cannot be calculated within 1 cam revolution.)		• Return to the REAL mode and position within the stroke range.
	5060	506□				○	• The "feed present value" is within the stroke range, but the present value cannot be calculated within 1 cam shaft revolution. (cam table error)		• Correct the cam table. • Make sure that stroke ratios of both "0" and "7FFFH" are included in the cam data table. Designate 0 to 7FFFH points in the cam table.
	5080	508□	○	○	○	○	• Torque limit setting range violation.	The default setting of 300% will be adopted.	• Designate the torque limit value within the stipulated setting range.

Table 10.5 Output Module Error List (4000 - 5990) (Continued)

Error Class	Error Code: Output Module	Error Code: Drive Module	Output Module: Roller	Output Module: Ball Screw	Output Module: Rotary Table	Output Module: Cam	Error Cause	Processing	Corrective Action
Minor Errors	5100	510□				○	• Although the limit switch output is set to the "present value within 1 cam axis revolution" mode, there is no limit switch output data registered at the file register area.	Operation continues with limit switch output OFF.	• Check the limit switch output data. • Verify that the installed memory cassette is a model A3NMCA-24 or newer.
	5200	520□				○	• Stroke lower limit storage devices start with an odd-numbered device.	Operation is enabled, but monitoring is impossible.	• Designate an even number as the first device number.
	5210	521□	○	○	○	○	• The clutch ON address setting devices start with an odd-numbered device.	START disabled at related systems.	
	5220	522□	○	○	○	○	• The clutch OFF address setting devices start with an odd-numbered device.		
	5230	523□			○	○	• The "present value within 1 virtual axis revolution" storage devices (at main shaft side) start with an odd-numbered device.	Operation is enabled, but monitoring is impossible.	
	5240	524□			○	○	• The "present value within 1 virtual axis revolution" storage devices (at auxiliary input shaft side) start with an odd-numbered device.		
	5250	525□	○	○	○	○	• When "amount of slip designation" is set as the clutch smoothing method, the "amount of slip setting device" value is outside the applicable range (0 - 2147483647).	A smoothing amount of "0" (direct clutch) is adopted.	• Designate a value within the range 0 - 2147483647.
	5260	526□				○	• Stroke setting device is out of range.	Related systems inoperative	• Set in the range 1 – (2^{31}–1)
	5270	527□				○	• Cam number setting device is out of range.		• Correct the cam number setting.
	5280	528□	○	○	○	○	• Clutch mode setting device is out of range.		• Correct the clutch mode setting.
	5290	529□	○	○	○	○	• Clutch ON address setting device is out of range.		• Correct the clutch ON address setting.
	5300	530□	○	○	○	○	• Clutch OFF address setting device is out of range.		• Correct the clutch OFF address setting.
	5310	531□	○	○	○	○	• Clutch ON/OFF command device is out of range.		• Correct the clutch ON/OFF command.
	5320	532□	○	○	○	○	• Speed change gear ratio setting device is out of range.		• Correct the speed change gear ratio setting.
	5330	533□	○	○	○	○	• Amount of slip setting device is out of range.	Amount of slip = 0 (controlled as direct clutch)	• Correct the amount of slip setting.
	5340	534□	○	○	○	○	• Torque control limit setting device is out of range.	Controlled with 300% offset	• Correct the torque control limit setting.
	5350	535□			○	○	• Present value in one virtual axis revolution storage device (main shaft side) is out of range.	Monitoring of present value in one virtual axis revolution (main shaft side) not possible	• Correct the present value in one virtual axis revolution (main shaft side) setting.
	5360	536□			○	○	• Present value in one virtual axis revolution storage device (auxiliary input shaft side) storage device is out of range.	Monitoring of present value in one virtual axis revolution (auxiliary input shaft side) not possible	• Correct the present value in one virtual axis revolution (auxiliary input shaft side) setting.

Table 10.5 Output Module Error List (4000 - 5990) (Continued)

Error Class	Error Code: Output Module	Error Code: Drive Module	Output Module: Roller	Output Module: Ball Screw	Output Module: Rotary Table	Output Module: Cam	Error Cause	Processing	Corrective Action
Minor Errors	5370	537□				○	• Stroke lower-limit value storage device is out of range.	Monitoring of stroke lower-limit value not possible	• Correct the stroke lower-limit value setting.
	5380	538□	○	○	○	○	• Number of gear teeth at input shaft setting device is out of range.	Related systems inoperative	• Correct the number of gear teeth at input shaft setting.
	5390	539□	○	○	○	○	• Number of gear teeth at output shaft setting device is out of range.		• Correct the number of gear teeth at output shaft setting.
	5400	540□	○	○	○	○	• Number of gear teeth at input shaft setting device is set to zero.		• Correct the number of gear teeth at input shaft setting.
	5410	541□	○	○	○	○	• Number of gear teeth at output shaft setting device is set to zero.		• Correct the number of gear teeth at output shaft setting.

(2) "No-clutch/clutch ON/clutch status ON" output module errors (6000 - 6990)

Table 10.5 Output Module Error List (6000 - 6990)

Error Class	Error Code: Output Module	Error Code: Drive Module	Output Module: Roller	Output Module: Ball Screw	Output Module: Rotary Table	Output Module: Cam	Error Cause	Processing	Corrective Action
Minor Errors	6000	600□	○	○	○	○	• The servo OFF command (M1815+20n/YnF/M3215+20n) switched ON during operation.	Operation continues. The servo ON status is maintained.	• The servo ON status is maintained. • Switch the clutch OFF, then establish the servo OFF status.
	6010	601□	○	○	○		• The output speed exceeded the speed limit value during operation. (Speed clamp processing in accordance with the speed limit value is not executed.)		• Correct the drive module's speed, gear ratio, and speed change ratio so that the speed remains within the speed limit.
	6020	602□	○	○	○	○	• The deviation counter value exceeded the "permissible number of droop pulses" value during operation.		• Stop the drive module, then correct the drive module's speed, gear ratio, and speed change gear ratio so that the speed remains within the speed limit.
	6030	603□		○	○		• The feed present value violated the stroke limit range during operation.		• Stop the drive module, then correct the drive module's speed, gear ratio, and speed change gear ratio so that the speed remains within the speed limit.
	6040	604□				○	• The cam No. setting device value violates the "used cam Nos" range. (Operation continues with the current cam No.)		• Correct the cam No. setting.
	6050	605□				○	• The stroke setting device value violates the "1 to $2^{31}-1$" range. • The designated value doesn't conform to the following requirement: [stroke lower limit] + [stroke] ≦ [$2^{31}-1$]. (Operation continues with the current stroke)	Operation continues with the current cam No. and stroke.	• Correct the stroke setting.
	6060	606□				○	• A control mode (feed/2-way) discrepancy occurred at cam No. switching.	Operation continues	• Stop the drive module and correct the control mode setting.
	6080	608□	○	○	○	○	• The torque limit setting device value violates the stipulated range.	The default value of 300% is adopted.	• Designate a torque limit value within the setting range.
	6090	609□	○	○	○	○	• After servo amplifier (MR-[ ]-B) power ON, and when a servo OFF command (M1815+20n/YnF/M3215+20n OFF) is executed, the designated axis is a no-clutch axis, or a clutch ON status exists.	Servo ON will be disabled.	• After designating a clutch OFF command, designate a servo OFF command.
	6120	612□				○	• The present value in one cam axis revolution was changed to an out-of-range value.	The present value is unchanged.	• Designate a value within the range 1 to (pulses in one cam axis revolution – 1).
	6130	613□	○	○	○	○	• The number of gear teeth at input shaft is set by indirect device setting, and the device value became zero when the drive module present value wa schanged.	The gear ratio is unchanged.	• Designate a value within the range 1 - 65535.

Table 10.5 Output Module Error List (6000 - 6990)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Minor Errors	6140	614□	○	○	○	○	• The number of gear teeth at output shaft is set by indirect device setting, and the device value became zero when the drive module present value was changed.	The gear ratio is unchanged.	• Designate a value within the range 1 - 65535.

(3) Output module errors when clutch OFF and clutch OFF command issued (6500 - 6990)

Table 10.5 Output Module Error List (6500 - 6990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Minor Errors	6500	650□	○	○	○	○	• A servo OFF status existed when a clutch ON command occurred.	Clutch remains OFF.	• Return to the clutch OFF command, and repeat the clutch ON command after executing a servo ON command.
	6510	651□				○	• The feed present value violated the stroke range when a cam axis servo OFF command (M1815+20n/YnF/M3215+20n OFF) was executed. (In the 2-way cam mode) • The stroke range was violated during a follow-up operation.	Servo remains ON.	• After returning to within the stroke range, execute the servo OFF command again.
	6520	652□				○	• The [stroke lower limit] + [stroke] ≦ [2^{31}−1] condition was not satisfied when a cam axis servo OFF command (M1815+20n/YnF/M3215+20n OFF) was executed. (In the 2-way cam mode)		• Designate a value which satisfies the [stroke lower limit] + [stroke] ≦ [2^{31}−1] condition.
	6530	653□		○	○	○	• The home position return request signal (M1609+20n/Xn9/M2409+20n) was ON when a clutch ON command occurred. (Incremental axis MR-H-B/MR-J-B power switched from OFF to ON.)	Clutch remains OFF.	• Return to the REAL mode, execute a home position return, then switch back to the VIRTUAL mode.
	6540	654□				○	• When a servo ON command was executed, the feed present value was within the stroke limit range, but the present value couldn't be calculated within 1 cam axis revolution. (Cam table error)	Servo remains ON.	• Return to the REAL mode, then correct the cam data settings. • Designate the setting for the stroke from the stroke lower limit as a ratio in the range 0 to 7FFFH. Designate 0 to 7FFFH points at the cam table.

(4) System error (9000 - 9990)

Table 10.5 Output Module Error List (9000 - 9990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Minor Errors	9000	900□	○	○	○	○	• When the servo amplifier power was turned on, the motor type actually installed was different from the motor type set in the system settings. (Checked only when MR-J2-B is used)	Further operation is impossible.	• Correct the motor type setting in the system settings.
	9010	901□	○	○	○	○	• When the servo amplifier power is turned on, the amount of motor travel while the power was OFF is found to have exceeded the "POWER OF ALLOWED TRAVELING POINTS" in the system settings.	The "VIRTUAL mode continuation disabled warning device" comes ON. Further operation is impossible.	• Check the position. Check encoder battery.

(5) Output module errors at VIRTUAL servo mode axis START (10000 - 10990)

Table 10.5 Output Module Error List (10000 - 10990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Major Errors	10000	1000□		○	○	○	• The home position return request (M1609+20n/Xn9/M2409+20n) is ON.	START disabled at related systems.	• Return to the REAL mode and execute a home position return. • If position is not established after executing a home position return at all axes, VIRTUAL mode operation will be disabled.
	10010	1001□	○	○	○	○	• The servo error detection signal (M1608+20n/Xn8/M2408+20n) is ON.		• Execute a servo error reset in the REAL mode.
	10020	1002□	○	○	○	○	• A servo OFF (M1615+20n/XnF/M2415+20n ON) status exists at an output module where a "clutch ON" or "no clutch" setting is designated at either the main shaft or auxiliary input shaft.		• Switch the clutch OFF, then establish the servo ON status.
	10030	1003□	○	○	○	○	• An external input signal (STOP) is ON at an output module where a "clutch ON" or "no clutch" setting is designated at either the main shaft or auxiliary input shaft.		• Switch the stop signal (STOP) OFF.

(6) "No-clutch/clutch ON/clutch status ON" output module errors (11000 - 11990)

Table 10.5 Output Module Error List (11000 - 11990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Major Errors	11000	1100□	○	○	○	○	• The servo error detection signal (M1608+20n/Xn8/M2408+20n) switched ON during operation.	After an immediate stop at the relevant output module, the servo will be switched OFF.	• Eliminate the servo error cause (see section 10.4).
	11010	1101□	○	○	○	○	• A servo OFF status (M1615+20n/XnF/M2415+20n ON) occurred during operation. • MR-[ ]-B power supply was interrupted. • A servo error occurred at another ADU axis.	• Operation continues at "no-clutch" axes. • At axes with clutches, control is executed in accordance with the operation mode at the time of the error. • Operation continues. • All clutches switch OFF at the relevant systems.	• When an "operation continuation" setting is designated, execute stop processing at the user's sequence program.
	11020	1102□	○	○	○	○	• The stop signal (STOP) switched ON.		
	11300	1130□	○	○	○	○	• The upper limit LS signal (FLS) switched OFF during forward (address increase direction) travel.		
	11400	1140□	○	○	○	○	• The lower limit LS signal (RLS) switched OFF during reverse (address decrease direction) travel.		

(7) Errors when using an absolute position system (12000 - 12990)

Table 10.5 Output Module Error List (12000 - 12990) (Continued)

Error Class	Error Code: Output Module	Error Code: Drive Module	Output Module: Roller	Output Module: Ball Screw	Output Module: Rotary Table	Output Module: Cam	Error Cause	Processing	Corrective Action
Major Errors	12010	1201□	○	○	○	○	• When the separate amplifier power supply was turned ON in the VIRTUAL mode, a sum-check error occurred in the back-up data (reference values). • Home position return not conducted.	Home position return requires turns ON.	• Return to the REAL mode and execute home position return.
	12020*	1202□	○	○	○	○	• When the servo amplifier power is turned ON, a communication error in communication between the servo amplifier and encoder occurs.	Home position return requires turns ON.	• Check the motor and encoder cables and perform home position return again.
	12030*	1203□	○	○	○	○	• During operation, the amount of change in the encoder present value complies with the following expression: "Amount of change in encoder present value/3.5 ms > 180° of motor revolution" After the servo amplifier power has been turned ON, a continual check is performed (in both servo ON and OFF states).	No processing	• Check the motor and encoder cables.
	12040*	1204□	○	○	○	○	• During operation, the following expression holds: "Encoder present value (PLS) ≠ feedback present value (PLS) (number of bits in encoder's feedback present value counting range)". After the servo amplifier power has been turned ON, a continual check is performed (in both servo ON and OFF states).		

*: These errors occur only when using MR-H-B and MR-J2-B servo amplifiers.

(8) System errors at all-axes servo ON (15000 - 15990)

Table 10.5 Output Module Error List (15000 - 15990) (Continued)

Error Class	Error Code: Output Module	Error Code: Drive Module	Output Module: Roller	Output Module: Ball Screw	Output Module: Rotary Table	Output Module: Cam	Error Cause	Processing	Corrective Action
Major Errors	15000	1500□	○	○	○	○	• 3-phase 200V is not being supplied to A230P at an all-axes servo ON command, or, A230P is damaged.	All-axes servo ON will not occur.	• Error occurs only at the ADU axis in systems using ADU.
	15010	1501□	○	○	○	○	• 24 VDC is not being supplied when an A171SENC/A278LX brake setting is designated.	All-axes ON will not occur in response to an all-axes servo ON command. If the error occurs while an all-axes servo ON status is in effect, an emergency stop will occur, and the system will return to the REAL mode OS.	• Check at the all-axes servo ON command, and while an all-axes servo ON status is in effect. "SYS ERR 150□[†] (**)" will be displayed at the A273UHCPU's LED display. †: □ = "0" or "1"

10.6 Errors At REAL ↔ VIRTUAL Mode Switching

Table 10.6 REAL ↔ VIRTUAL Mode Switching Error Code List

Error Codes Stored at D9195 (A171SCPU/A273UHCPU 8-axis Specification)		Error Codes Stored in D9193 (A273UHCPU 32-axis Specification)		Error Description	Corrective Action
Decimal Display	Hexadecimal Display	Decimal Display	Hexadecimal Display		
1 - 255	0001 - 00FF	1	0001	• M2043 OFF → ON switching occurred when all axes were not stopped.	• Execute M2043 OFF → ON switching when M2001-M2008 are all OFF.
257 - 511	0101 - 01FF	256	0100	• M2043 ON → OFF switching occurred when all axes were not stopped.	• Execute M2043 ON → OFF switching when M2001-M2008/M2001-M2008/M2001-M2032 are all OFF.
512	0200	512	0200	• M2043 OFF → ON switching occurred when no mechanical system program was registered.	• Write a mechanical system program to the servo system CPU.
				• M2043 OFF → ON switching occurred when a discrepancy existed between the axis No. designated at the system settings, and that designated at the mechanical system program (output shaft No.).	• Designate the same axis No. at both the system settings and the mechanical system program, then write the data to the servo system CPU.
513	0201	513*	0201	• M2043 OFF → ON switching occurred when the programmable controller READY signal (M2000) or the PCPU READY signal (M9074) was OFF.	• After switching the PC READY and PCPU READY signals ON, execute M2043 OFF → ON switching.
514	0202	514*	0202	• M2043 OFF → ON switching occurred when the all-axes servo START command flag (M2042) was OFF.	• Switch M2042 ON, switch the all-axes servo START accept flag ON, then execute M2043 OFF → ON switching.
515	0203	515*	0203	• M2043 OFF → ON switching occurred when the external emergency stop (EMG) signal was ON.	• Switch the external emergency stop signal OFF, then execute M2043 OFF → ON switching.
516	0204	516*	0204	• M2043 OFF → ON switching occurred during servo START processing which was occurring in response to an ADU axis servo error reset command (M1808+20n/Yn8/M3208+20n).	• When a servo error reset occurred by switching the M1808+20n/Yn8/M3208+20n signal ON, switch the servo error detection signal (M1608+20n/Xn8/M2408+20n) OFF, then execute M2043 OFF → ON switching.
519	0207	519*	0207	• M2043 OFF → ON switching occurred during batch change processing (M2016/M2056: ON) of cam data by the sequence program.	• When cam data was changed by switching M2016/M2056 ON, execute M2043 OFF → ON switching after the cam data batch change completed flag (M2017/M2057) switches ON.
769 - 1023	0301 - 03FF	768	0300	• M2043 OFF → ON switching occurred when the home position return request signal was ON at an axis whose output module is not a roller.	• After executing a home position return (servo program "zero execute"), and switching M1609+20n/Xn9/M2409+20n OFF, execute M2043 OFF → ON switching.
1025 - 1279	0401 - 04FF	1024	0400	• M2043 OFF → ON switching occurred when an all-axes normal status (M1608+20n/Xn8/M2408+20n: ON) did not exist at the ADU and MR-[ ]-B.	• Check the ADU, MR-H-B/MR-J-B, servo motor, and the wiring.

*: Error axis No. information will not be stored at D9194/D9195 for error codes indicated by an asterisk.

Table 10.6 REAL ↔ VIRTUAL Mode Switching Error Code List (Continued)

Error Codes Stored at D9195 (A171SCPU/A273UHCPU 8-axis Specification)		Error Codes Stored in D9193 (A273UHCPU 32-axis Specification)		Error Description	Corrective Action
Decimal Display	Hexadecimal Display	Decimal Display	Hexadecimal Display		
1281 - 1535	0501 - 05FF	1280	0500	• M2043 OFF → ON switching occurred when a system-of-units setting discrepancy existed between the fixed parameter and output module settings for an axis whose output module is not a roller.	• Correct the fixed parameter or output module system-of-units setting, then write the data to the servo system CPU.
1537 - 1791	0601 - 06FF	1536	0600	• M2043 OFF → ON switching occurred when a cam is set as the output module, but no cam data has been registered.	• Write the cam data to the servo system CPU.
2049 - 2303	0801 - 08FF	2048	0800	• M2043 OFF → ON switching occurred when no cam No. has been designated at the cam No. setting device. (When setting in cam No. setting device is "0".)	• After writing the cam No. (No. used at cam parameters) to the cam No. setting device, execute M2043 OFF → ON switching.
2305 - 2559	0901 - 09FF	2304	0900	• The setting value at the cam stroke setting device violates the "1 to ($2^{31}-1$)" range.	• After designating a cam stroke setting device value within the "1 to ($2^{31}-1$)" range, execute M2043 OFF → ON switching.
2817 - 3071	0B01 - 0BFF	2716	0B00	• An odd number has been designated at the cam stroke setting device.	• Designate an even number at the cam stroke setting device.
-4094	F002	-4094*	F002	• During VIRTUAL mode operation, the programmable controller READY signal (M2000) switched OFF, and the system returned to the REAL mode. • The servo system CPU stopped during VIRTUAL mode operation.	• Switch M2000 ON. • Designate the servo system CPU "RUN" status.
-4095	F001	-4095*	F001	• During VIRTUAL mode operation, the servo error signal (M1608+20n/Xn8/M2408+20n) switched ON, and the system returned to the REAL mode.	• Check the servo error code register to determine the error cause at the axis in question, then eliminate the error cause (see section 10.4).
-4096	F000	-4096*	F000	• During VIRTUAL mode operation, the external emergency stop (EMG) signal switched ON, and the system returned to the REAL mode.	• Switch the external emergency stop signal OFF.

*: Error axis No. information will not be stored at D9194/D9195 for error codes indicated by an asterisk.

MEMO

APPENDICES

APPENDIX 1 CAM CURVES

The cam acceleration curve formulas used in the VIRTUAL mode are shown below.

(1) Acceleration curve formula

<Symbols used>

- A : Dimensionless acceleration
- Am : Dimensionless maximum acceleration
- T : Dimensionless time
- Ta, Tb, Tc : T borderlines when section divisions are used

(a) Discontinuous curve

1) Constant speed curve

$$A = C0$$

2) Uniform acceleration curve

Section I ($0 \leqq T \leqq 0.5$)

$$A = 4 + C0$$

Section II ($0.5 < T \leqq 1$)

$$A = -4 + C0$$

(b) Both-side stationary symmetrical curve

1) 5th curve

$$A = 120T^3 - 180T^2 + 60T + C0$$

2) Cycloid curve

$$Am = 2\pi$$
$$A = 2\pi \sin 2t\pi T + C0$$

3) Distorted trapezoid curve

$$Ta = \frac{1}{8}$$
$$Am = \frac{1}{\frac{1}{4} - Ta + \frac{2}{\pi}Ta}$$

Section I ($0 \leqq T \leqq Ta$)

$$A = Am\sin\frac{\pi}{2Ta}T + C0$$

Section II ($Ta < T \leqq 0.5 - Ta$)

$$A = Am + C0$$

Section III ($0.5 - Ta < T \leqq 0.5 + Ta$)

$$A = Am\cos\frac{\pi(T - 0.5 + Ta)}{2Ta} + C0$$

Section IV ($0.5 - Ta < T \leqq 1 - Ta$)

$$A = -Am + C0$$

Section V ($1 - Ta < T \leqq 1$)

$$A = -Am\cos\frac{\pi(T - 1 + Ta)}{2Ta} + C0$$

4) Distorted sine curve

$$Ta = \frac{1}{8}$$

$$Am = \frac{1}{\frac{2Ta}{\pi} + \frac{2-8Ta}{\pi^2}}$$

Section I ($0 \leqq T \leqq Ta$)

$$A = Am\sin\frac{\pi T}{2Ta} + C0$$

Section II ($Ta < T \leqq 1 - Ta$)

$$A = Am\cos\frac{\pi(T-Ta)}{1-2Ta} + C0$$

Section III ($1 - Ta < T \leqq 1$)

$$A = -Am\cos\frac{\pi(T-1+Ta)}{2Ta} + C0$$

5) Distorted constant speed curve

$$Ta = \frac{1}{16}$$

$$Tb = \frac{1}{4}$$

$$Am = \frac{1}{\frac{2}{\pi}\{(2-\frac{8}{\pi})TaTb + (\frac{4}{\pi}-2)Tb^2 + Tb\}}$$

Section I ($0 \leqq T \leqq Ta$)

$$A = Am\sin\frac{\pi T}{2Ta} + C0$$

Section II ($Ta < T \leqq Tb$)

$$A = Am\cos\frac{\pi(T-Ta)}{2(Tb-Ta)} + C0$$

Section III ($Tb < T \leqq Tb$)

$$A = 0 + A0$$

Section IV ($1 - Tb < T \leqq 1 - Ta$)

$$A = -Am\sin\frac{\pi(T-1+Tb)}{2(Tb-Ta)} + C0$$

Section V ($1 - Ta < T \leqq 1$)

$$A = -Am\cos\frac{\pi(T-1+Ta)}{2Ta} + C0$$

(c) Both-side stationary asymmetrical curve

1) Trapecloid curve

$$Ta = \frac{1}{8}$$
$$Tb = \frac{2 - 6Ta + \pi Ta}{2 + \pi}$$
$$Tc = \frac{2-2Ta + 3\pi Ta}{2 + \pi}$$
$$Am = \frac{1}{(-\frac{3}{2} + \frac{4}{\pi} + \frac{4}{\pi^2})T^2a + (1 + \frac{2}{\pi})TaTb + \frac{1}{2}T^2b + (\frac{2}{\pi}-\frac{4}{\pi^2})(1-Tc)^2}$$

Section I ($0 \leqq T \leqq Ta$)

$$A = Amsin\frac{\pi T}{2Ta} + C0$$

Section II ($Ta < T \leqq Tb$)

$$A= Am + C0$$

Section III ($Tb < T \leqq Tc$)

$$A = Am\bar{c}\bar{o}s\frac{\pi(T - T6)}{2Ta} + C0$$

Section IV ($Tc < T \leqq 1$)

$$A = -Am\bar{c}\bar{o}s\frac{\pi(T- Tc)}{2(1 - Tc)} + C0$$

2) Reverse trapecloid curve

$$Ta = \frac{1}{8}$$
$$Tb = \frac{2 - 6Ta + \pi Ta}{2 + \pi}$$
$$Tc = \frac{2-2Ta + 3\pi Ta}{2 + \pi}$$
$$Am = \frac{1}{(-\frac{3}{2} + \frac{4}{\pi} + \frac{4}{\pi^2})T^2a + (1 + \frac{2}{\pi})TaTb + \frac{1}{2}T^2b + (\frac{2}{\pi}-\frac{4}{\pi^2})(1-Tc)^2}$$
$$Va = \frac{2TaAm}{\pi}$$
$$Vb = Am(Tb - Ta) + Va$$
$$Sa = \frac{2T^2aAm}{\pi} - \frac{4T^2aAm}{\pi^2}$$
$$Sb = \frac{Am}{2}(Tb - Ta)^2 + Va(Tb - Ta) + Sa$$
$$Sc = \frac{8T^2aAm}{\pi^2} + 2VbTa + Sb$$

Section I ($0 \leqq T \leqq 1 - Tc$)

$$A = -Am\bar{c}\bar{o}s\frac{\pi(1 - Tc - T)}{2(1 - Tc)} + C0$$

Section II ($1 - Tc < T \leqq 1 - Tb$)

$$A = Amsin\frac{\pi T}{2Ta} + C0$$

Section III ($1 - Tb < T \leqq 1 - Ta$)

$$A= Am + C0$$

Section IV ($1 - Ta < T \leqq 1$)

$$A = Amsin\frac{\pi(1 - T)}{2Ta} + C0$$

(d) One-side stationary curve

1) Multiple hypotenuse curve

$$A = \frac{\pi^2}{2}(\cos\pi T - \cos 2\pi T) + C0$$

(e) Non-stationary curve

1) Single hypotenuse curve

$$A = \frac{\pi^2}{2}\cos\pi T + C0$$

(2) Cam curve coefficient

Distorted trapezoid
Section I
0 < Section I < 0.25 (1/4) Default value: 0.125 (1/8)

Distorted sine
Section I
0 < Section I < 0.5 (1/2) Default value: 0.125 (1/8)

Distorted constant speed
Section I
0 < Section I < 0.125 (1/4) Default value: 0.0625 (1/16)
Section II
0 < Section II < 0.5 (1/2) Default value: 0.25 (1/4)

Trapecloid
Section I
0 < Section I < 0.25 (1/4) Default value: 0.125 (1/8)

Reverse trapecloid
Section I
0 < Section I < 0.25 (1/4) Default value: 0.125 (1/8)

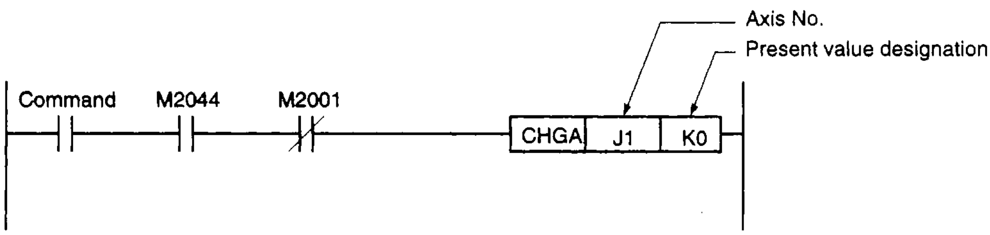
APPENDIX 2 PRESENT VALUE CHANGE & SPEED CHANGE

The procedures for changing the virtual servomotor's present value and speed, and for changing the synchronous encoder's present value are discussed in this section. The CHGA instruction is used for present value changes, and the CHGV instruction is used for speed changes. Moreover, when the A171SCPU/A273UHCPU (8-axis specification) is used, present value and speed changes can also be executed using the DSFLP instruction. For details regarding the CHGA, CHGV, and DSFLP instructions, refer to the Motion Controller (SV13/22) Programming Manual (REAL Mode).

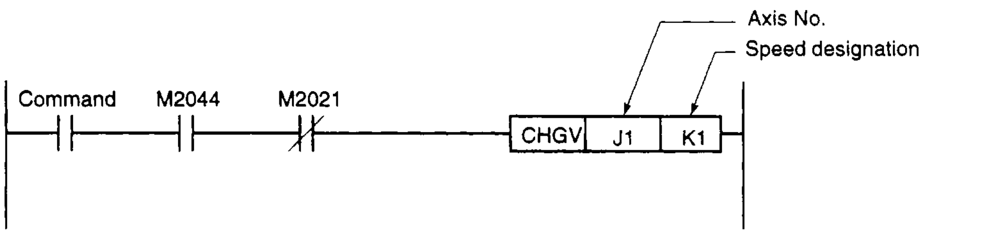
2.1 Present Value Change by CHGA Instruction and Speed Change by CHGV Instruction

Program examples are shown below.

(1) Virtual servomotor present value change program (axis 1, A273UHCPU 8-axis specification):



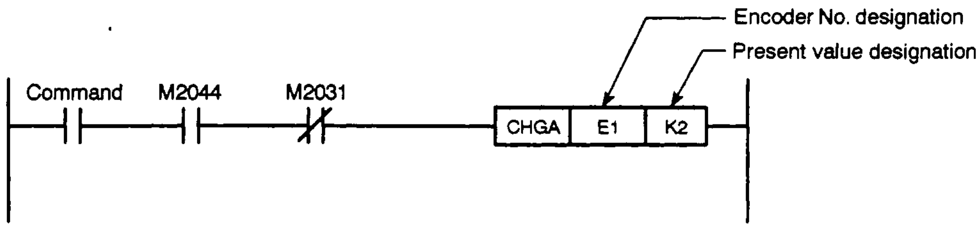
(2) Virtual servomotor speed change program (axis 1, A273UHCPU 8-axis specification):



REMARKS

1. M2001: Start accept flag (see Section 4.2.2).
2. M2044: REAL/VIRTUAL mode status flag (see Section 4.2.20).
3. M2021: Speed change in progress flag (see Section 4.2.13).

(3) Synchronous encoder present value change program (encoder No. 1, A273UHCPU 8-axis specification):



(a) The present value and speed to be change are set in the following devices.

- Indirect designation .... Data register (D), Link register (W), File register (R) — Double-word
- Direct designation .... Decimal constant (K)

(b) The encoder No. setting ranges are as shown below.

- For A171SCPU E1
- For A273UHCPU (8-axis specification) .... E1 to E3
- For A273UHCPU (32-axis specification) .... E1 to E12

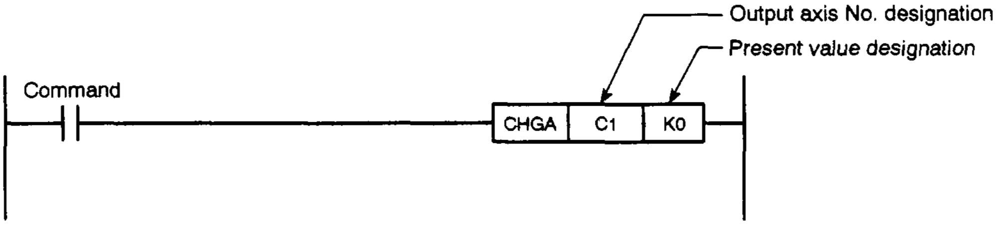
(c) Cautions

- If a synchronous encoder present value change is attempted while in the REAL mode, an error will occur, and the change will not be executed.
- Synchronous encoder present value changes can also be executed during VIRTUAL mode operation (during pulse input from synchronous encoder). When a present value change occurs, the synchronous encoder's present value will be continued from the new value.
- Present value changes at the synchronous encoder do not affect the output module's present value.

REMARKS

1. M2044: REAL/VIRTUAL mode status flag (see Section 4.2.20).
2. M2031: Synchronous encoder (P1) axis present value change in progress flag (see Section 4.2.13).

(4) Present value in one cam axis revolution change program (for cam 1)



(a) The present value and speed to be changed are set in the following devices.

- Indirect designation .... Data register (D), Link register (W), File register (R) — Double-word
- Direct designation .... Decimal constant (K)

(b) The cam No. setting ranges are as shown below.

- For A171SCPU .... C1 to C4
- For A273UHCPU (8-axis specification) .... C1 to C8
- For A273UHCPU (32-axis specification) .... C1 to C32

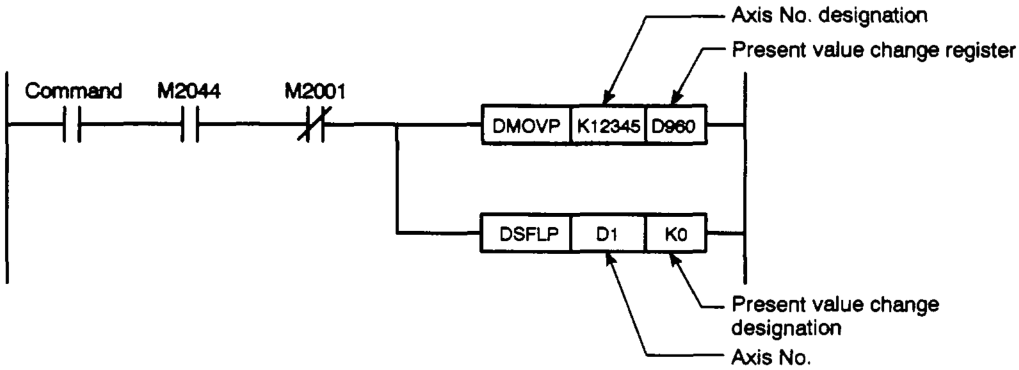
(c) Cautions

- If the present value in one cam axis revolution is designated outside the range 0 to (pulses in one cam axis revolution – 1), an error (error code: 6120) occurs and the present value remains unchanged.

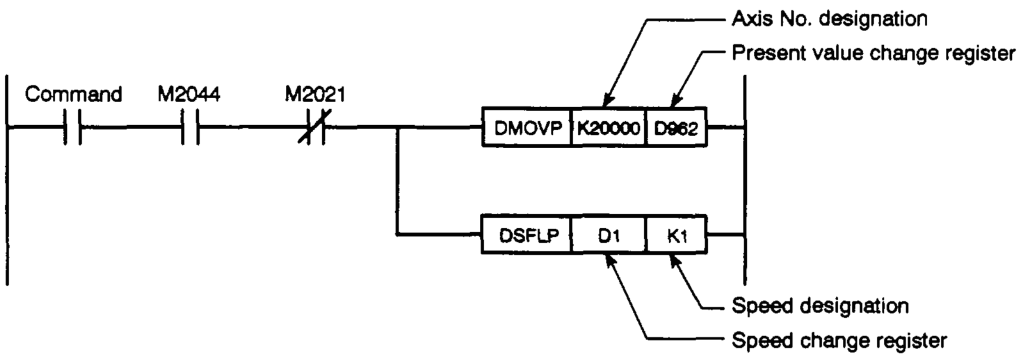
2.2 Present Value & Speed Changes by DSFLP Instruction

Program examples are shown below.

(1) Virtual servomotor present value change program (axis 1, A273UHCPU 8-axis specification):



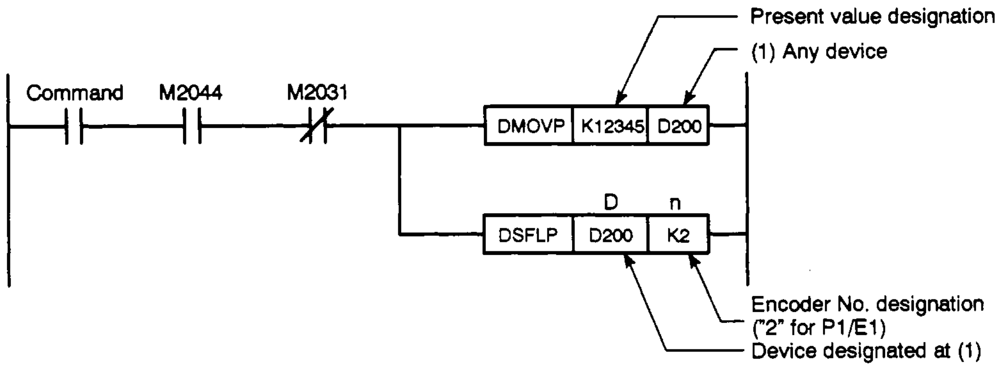
(2) Virtual servomotor speed change program (axis 1, A273UHCPU 8-axis specification):



REMARKS

1. M2001: Start accept flag (see Section 4.2.2).
2. M2044: REAL/VIRTUAL mode status flag (see Section 4.2.20).
3. M2021: Speed change in progress flag (see Section 4.2.13).

(3) Synchronous encoder present value change program (encoder No. 1, A273UHCPU 8-axis specification):



(a) The devices which can be used at "D" and "n" in the above program are as follows:

- D .. Data register (D)

  Link register (W)

  File register (R)

  Timer (T)

  Counter (C)

- n .. Decimal constant (K)

  Hexadecimal constant (H)

(b) The encoder No. is designated as follows:

- Encoder No. 1...K2/H2
- Encoder No. 2...K3/H3
- Encoder No. 3...K4/H4

(c) Cautions

- If the synchronous encoder present value change is attempted while in the REAL mode, an error will occur, and the change will not be executed.
- Synchronous encoder present value changes can also be executed during VIRTUAL mode operation (during pulse input from synchronous encoder). When a present value change occurs, the synchronous encoder's present value will be continued from the new value.
- Present value changes at the synchronous encoder do not affect the output module's present value.

REMARKS

1. M2044: REAL/VIRTUAL mode status flag (see Section 4.2.20).
2. M2031: Synchronous encoder (P1) axis present value change in progress flag (see Section 4.2.13).

APPENDIX 3 NUMBER OF CONNECTABLE MECHANICAL MODULES

The number of mechanical modules which can be connected is not restricted by the processing time.

APPENDIX 4 POSITIONING SIGNAL LIST

4.1 Common Devices

Table APP.1 Axis Input/Output Signal List

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

Table APP.2 Internal Relay List

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

Table APP.3 Data Register List

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

*1: Signal direction is "SCPU → PCPU" for the travel value setting register only.

Table APP.4 Special Register List

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

4.2 Internal Relays (M)

(1) Drive module

(a) When A171SCPU is used

Table APP.5 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 M2014	Unusable	–
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	

Table APP.6 Internal Relay (I/O) List (for A171SCPU)

	Device					Signal Name	Virtual Servomotor	Synchronous Encoder
	Synchronous Encoder	Virtual Servomotor						
	P1/E1	Axis 1	Axis 2	Axis 3	Axis 4			
Input	M1360	–	–	–	–	Error detection	–	○
	M1361	–	–	–	–	External signal TREN		
	M1362	–	–	–	–	Virtual mode continuation disabled warning signal		
	–	M1200	M1220	M1240	M1260	Positioning start completed	○	–
		M1201	M1221	M1241	M1261	Positioning completed		
		M1202	M1222	M1242	M1262	Unusable		
		M1203	M1223	M1243	M1263	Command in-position		
		M1204	M1224	M1244	M1264	Speed control in progress		
		M1205	M1225	M1245	M1265	Unusable		
		M1206	M1226	M1246	M1266			
		M1207	M1227	M1247	M1267	Error detection		
		M1208 - M1219	M1228 - M1239	M1248 - M1259	M1268 - M1279	Unusable		
Output	M1560	–	–	–	–	Error reset	–	○
	–	M1400	M1420	M1440	M1460	Stop command	○	–
		M1401	M1421	M1441	M1461	Rapid stop command		
		M1402	M1422	M1442	M1462	Forward JOG start		
		M1403	M1423	M1443	M1463	Reverse JOG start		
		M1404	M1424	M1444	M1464	Complete signal OFF command		
		M1405	M1425	M1445	M1465	Unusable		
		M1406	M1426	M1446	M1466			
		M1407	M1427	M1447	M1467	Error reset		
		M1408	M1428	M1448	M1468	Unusable		
		M1409	M1429	M1449	M1469	Stop input enable/disable		
		M1410 - M1419	M1430 - M1439	M1450 - M1459	M1470 - M1479	Unusable		

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

Table APP.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	M2007	Virtual axis No. 7 start accept flag	PCPU → SCPU
M1985	Virtual axis No. 1 auxiliary input shaft clutch ON/OFF status		M2008	Virtual axis No. 8 start accept flag	
M1986	Virtual axis No. 2 drive clutch ON/OFF status		M2009	All-axes servo start accept flag	
M1987	Virtual axis No. 2 auxiliary input shaft clutch ON/OFF status		M2012	Manual pulse generator No. 1 enabled flag	SCPU → PCPU
M1988	Virtual axis No. 3 drive clutch ON/OFF status		M2013	Manual pulse generator No. 2 enabled flag	
M1989	Virtual axis No. 3 auxiliary input shaft clutch ON/OFF status		M2014	Manual pulse generator No. 3 enabled flag	
M1990	Virtual axis No. 4 drive clutch ON/OFF status		M2015	JOG simultaneous start command	
M1991	Virtual axis No. 4 auxiliary input shaft clutch ON/OFF status		M2016	Cam & limit switch output data batch change request flag	
M1992	Virtual axis No. 5 drive clutch ON/OFF status		M2017	Cam & limit switch output data batch change completed flag	PCPU → SCPU
M1993	Virtual axis No. 5 auxiliary input shaft clutch ON/OFF status		M2018	Cam & limit switch output data batch change error flag	
M1994	Virtual axis No. 6 drive clutch ON/OFF status		M2020	START buffer full	
M1995	Virtual axis No. 6 auxiliary input shaft clutch ON/OFF status		M2021	Virtual axis No. 1 speed change in progress flag	
M1996	Virtual axis No. 7 drive clutch ON/OFF status		M2022	Virtual axis No. 2 speed change in progress flag	
M1997	Virtual axis No. 7 auxiliary input shaft clutch ON/OFF status		M2023	Virtual axis No. 3 speed change in progress flag	
M1998	Virtual axis No. 8 drive clutch ON/OFF status		M2024	Virtual axis No. 4 speed change in progress flag	
M1999	Virtual axis No. 8 auxiliary input shaft clutch ON/OFF status		M2025	Virtual axis No. 5 speed change in progress flag	
M2000	PC READY	SCPU → PCPU	M2026	Virtual axis No. 6 speed change in progress flag	
M2001	Virtual axis No. 1 start accept flag	PCPU → SCPU	M2027	Virtual axis No. 7 speed change in progress flag	
M2002	Virtual axis No. 2 start accept flag		M2028	Virtual axis No. 8 speed change in progress flag	
M2003	Virtual axis No. 3 start accept flag		M2029	Unusable	–
M2004	Virtual axis No. 4 start accept flag		M2030		
M2005	Virtual axis No. 5 start accept flag		M2031	Synchronous encoder (P1) axis present value change in progress	PCPU → SCPU
M2006	Virtual axis No. 6 start accept flag		M2032	Synchronous encoder (P2) axis present value change in progress	

Table APP.7 Internal Relay List (for A273UHCPU 8-axis Specification) (Continued)

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

Table APP.8 I/O Relay List (for A273UHCPU 8-axis Specification)

	Device											Signal Name	Virtual Servo-motor	Syn-chro-nous Encoder
	Synchronous Encoder			Virtual Servomotor										
	P1/E1	P2/E1	P3/E1	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8			
Input	XE0	XE1	XE2	–	–	–	–	–	–	–	–	Error detection	–	O
	XE3	XE4	XE5	–	–	–	–	–	–	–	–	External signal TREN		
	XF8	XF9	XFA	–	–	–	–	–	–	–	–	Virtual mode continuation disabled warning signal	–	
	–	–	–	X100	X110	X120	X130	X140	X150	X160	X170	Positioning start completed	O	–
				X101	X111	X121	X131	X141	X151	X161	X171	Positioning completed		
				X102	X112	X122	X132	X142	X152	X162	X172	Unusable		
				X103	X113	X123	X133	X143	X153	X163	X173	Command in-position		
				X104	X114	X124	X134	X144	X154	X164	X174	Speed control in progress		
				X105	X115	X125	X135	X145	X155	X165	X175	Unusable		
				X106	X116	X126	X136	X146	X156	X166	X176			
				X107	X117	X127	X137	X147	X157	X167	X177	Error detection		
				X108 - X10F	X118 - X11F	X128 - X12F	X138 - X13F	X148 - X14F	X158 - X15F	X168 - X16F	X178 - X17F	Unusable		
Output	YE0	YE1	YE2	–	–	–	–	–	–	–	–	Error reset		O
	–	–	–	Y100	Y110	Y120	Y130	Y140	Y150	Y160	Y170	Stop command	O	–
				Y101	Y111	Y121	Y131	Y141	Y151	Y161	Y171	Rapid stop command		
				Y102	Y112	Y122	Y132	Y142	Y152	Y162	Y172	Forward JOG start		
				Y103	Y113	Y123	Y133	Y143	Y153	Y163	Y173	Reverse JOG start		
				Y104	Y114	Y124	Y134	Y144	Y154	Y164	Y174	Complete signal OFF command		
				Y105	Y115	Y125	Y135	Y145	Y155	Y165	Y175	Unusable		
				Y106	Y116	Y126	Y136	Y146	Y156	Y166	Y176			
				Y107	Y117	Y127	Y137	Y147	Y157	Y167	Y177	Error reset		
				Y108	Y118	Y128	Y138	Y148	Y158	Y168	Y178	Unusable		
				Y109	Y119	Y129	Y139	Y149	Y159	Y169	Y179	Stop input enable/disable		
				Y10A - Y19F	Y11A - Y11F	Y12A - Y12F	Y13A - Y13F	Y14A - Y14F	Y15A - Y15F	Y16A - Y16F	Y17A - Y17F	Unusable		

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

Table APP.9 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	
M2018	Virtual axis No. 18 start accept flag		M2048	JOG simultaneous start command	SCPU → PCPU
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	

Table APP.9 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	

Table APP.9 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	

Table APP.9 Internal Relay List (for A273UHCPU 32-axis Specification) (Continued)

Device No.	Singal Name	Signal Direction	Device No.	Singal 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	

Table APP.9 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				

Table APP.10 Internal Relay List (Synchronous Encoder) (for A273UHCPU (32-axis Specification))

	Device						Signal Name
	P1/E1	**P2/E2**	**P3/E3**	**P4/E4**	**P5/E5**	**P6/E6**	
Input	M4640	M4644	M4648	M4652	M4656	M4660	Error detection
	M4641	M4645	M4649	M4653	M4657	M4661	External signal TREN
	M4642	M4646	M4650	M4654	M4658	M4662	Virtual mode continuation disabled warning signal
	M4643	M4647	M4651	M4655	M4659	M4663	Unusable
	P7/E7	**P8/E8**	**P9/E9**	**P10/E10**	**P11/E11**	**P12/E12**	
	M4664	M4668	M4672	M4676	M4680	M4684	Error detection
	M4665	M4669	M4673	M4677	M4681	M4685	External signal TREN
	M4666	M4670	M4674	M4678	M4682	M4686	Virtual mode continuation disabled warning signal
	M4667	M4671	M4675	M4679	M4683	M4687	Unusable
Output	**P1/E1**	**P2/E2**	**P3/E3**	**P4/E4**	**P5/E5**	**P6/E6**	
	M5440	M5444	M5448	M5452	M5456	M5460	Error reset
	M5441	M5445	M5449	M5453	M5457	M5461	Unusable
	M5442	M5446	M5450	M5454	M5458	M5462	
	M5443	M5447	M5451	M5455	M5459	M5463	
	P7/E7	**P8/E8**	**P9/E9**	**P10/E10**	**P11/E11**	**P12/E12**	
	M5464	M5468	M5472	M5476	M5480	M5484	Error reset
	M5465	M5469	M5473	M5477	M5481	M5485	Unusable
	M5466	M5470	M5474	M5478	M5482	M5486	
	M5467	M5471	M5475	M5479	M5483	M5487	

Table APP.10 Internal Relay List (Virtual Servomotor) (for A273UHCPU (32-axis Specification))

	Device								Signal Name
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	
Input	M4000	M4020	M4040	M4060	M4080	M4100	M4120	M4140	Positioning start completed
	M4001	M4021	M4041	M4061	M4081	M4101	M4121	M4141	Positioning completed
	M4002	M4022	M4042	M4062	M4082	M4102	M4122	M4142	Unusable
	M4003	M4023	M4043	M4063	M4083	M4103	M4123	M4143	Command in-position
	M4004	M4024	M4044	M4064	M4084	M4104	M4124	M4144	Speed control in progress
	M4005	M4025	M4045	M4065	M4085	M4105	M4125	M4145	Unusable
	M4006	M4026	M4046	M4066	M4086	M4106	M4126	M4146	
	M4007	M4027	M4047	M4067	M4087	M4107	M4127	M4147	Error detection
	M4008 - M4019	M4028 - M4039	M4048 - M4059	M4068 - M4079	M4088 - M4099	M4108 - M4119	M4128 - M4139	M4148 - M4159	Unusable
Output	M4800	M4820	M4840	M4860	M4880	M4900	M4920	M4940	Stop command
	M4801	M4821	M4841	M4861	M4881	M4901	M4921	M4941	Rapid stop command
	M4802	M4822	M4842	M4862	M4882	M4902	M4922	M4942	Forward JOG start
	M4803	M4823	M4843	M4863	M4883	M4903	M4923	M4943	Reverse JOG start
	M4804	M4824	M4844	M4864	M4884	M4904	M4924	M4944	Complete signal OFF command
	M4805	M4825	M4845	M4865	M4885	M4905	M4925	M4945	Unusable
	M4806	M4826	M4846	M4866	M4886	M4906	M4926	M4946	
	M4807	M4827	M4847	M4867	M4887	M4907	M4927	M4947	Error reset
	M4808	M4828	M4848	M4868	M4888	M4908	M4928	M4948	Unusable
	M4809	M4829	M4849	M4869	M4889	M4909	M4929	M4949	Stop input enable/disable
	M4810 - M4819	M4830 - M4839	M4850 - M4859	M4870 - M4879	M4890 - M4899	M4910 - M4911	M4930 - M4939	M4950 - M4959	Unusable
	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	
Input	M4160	M4180	M4200	M4220	M4240	M4260	M4280	M4300	Positioning start completed
	M4161	M4181	M4201	M4221	M4241	M4261	M4281	M4301	Positioning completed
	M4162	M4182	M4202	M4222	M4242	M4262	M4282	M4302	Unusable
	M4163	M4183	M4203	M4223	M4243	M4263	M4283	M4303	Command in-position
	M4164	M4184	M4204	M4224	M4244	M4264	M4284	M4304	Speed control in progress
	M4165	M4185	M4205	M4225	M4245	M4265	M4285	M4305	Unusable
	M4166	M4186	M4206	M4226	M4246	M4266	M4286	M4306	
	M4167	M4187	M4207	M4227	M4247	M4267	M4287	M4307	Error detection
	M4168 - M4179	M4188 - M4199	M4208 - M4219	M4228 - M4239	M4248 - M4259	M4268 - M4279	M4288 - M4299	M4308 - M4319	Unusable
Output	M4960	M4980	M5000	M5020	M5040	M5060	M5080	M5100	Stop command
	M4961	M4981	M5001	M5021	M5041	M5061	M5081	M5101	Rapid stop command
	M4962	M4982	M5002	M5022	M5042	M5062	M5082	M5102	Forward JOG start
	M4963	M4983	M5003	M5023	M5043	M5063	M5083	M5103	Reverse JOG start
	M4964	M4984	M5004	M5024	M5044	M5064	M5084	M5104	Complete signal OFF command
	M4965	M4985	M5005	M5025	M5045	M5065	M5085	M5105	Unusable
	M4966	M4986	M5006	M5026	M5046	M5066	M5086	M5106	
	M4967	M4987	M5007	M5027	M5047	M5067	M5087	M5107	Error reset
	M4968	M4988	M5008	M5028	M5047	M5068	M5088	M5108	Unusable
	M4969	M4989	M5009	M5029	M5049	M5069	M5089	M5109	Stop input enable/disable
	M4970 - M4979	M4990 - M4999	M5010 - M5019	M5030 - M5039	M5050 - M5059	M5070 - M5079	M5090 - M5099	M5110 - M5119	Unusable

Table APP.10 Internal Relay List (Virtual Servomotor) (for A273UHCPU (32-axis Specification)) (Continued)

	Device								Signal Name
	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24	
Input	M4320	M4340	M4360	M4380	M4400	M4420	M4440	M4460	Positioning start completed
	M4321	M4341	M4361	M4381	M4401	M4421	M4441	M4461	Positioning completed
	M4322	M4342	M4362	M4382	M4402	M4422	M4442	M4462	Unusable
	M4323	M4343	M4363	M4383	M4403	M4423	M4443	M4463	Command in-position
	M4324	M4344	M4364	M4384	M4404	M4424	M4444	M4464	Speed control in progress
	M4325	M4345	M4365	M4385	M4405	M4425	M4445	M4465	Unusable
	M4326	M4346	M4366	M4386	M4406	M4426	M4446	M4466	
	M4327	M4347	M4367	M4387	M4407	M4427	M4447	M4467	Error detection
	M4328 - M4339	M4348 - M4359	M4368 - M4379	M4388 - M4399	M4408 - M4419	M4428 - M4439	M4448 - M4459	M4468 - M4479	Unusable
Output	M5120	M5140	M5160	M5180	M5200	M5220	M5240	M5260	Stop command
	M5121	M5141	M5161	M5181	M5201	M5221	M5241	M5261	Rapid stop command
	M5122	M5142	M5162	M5182	M5202	M5222	M5242	M5262	Forward JOG start
	M5123	M5143	M5163	M5183	M5203	M5223	M5243	M5263	Reverse JOG start
	M5124	M5144	M5164	M5184	M5204	M5224	M5244	M5264	Complete signal OFF command
	M5125	M5145	M5165	M5185	M5205	M5225	M5245	M5265	Unusable
	M5126	M5146	M5166	M5186	M5206	M5226	M5246	M5266	
	M5127	M5147	M5167	M5187	M5207	M5227	M5247	M5267	Error reset
	M5128	M5148	M5168	M5188	M5208	M5228	M5248	M5268	Unusable
	M5129	M5149	M5169	M5189	M5209	M5229	M5249	M5269	Stop input enable/disable
	M5130 - M5139	M5150 - M5159	M5170 - M5179	M5190 - M5199	M5210 - M5219	M5230 - M5239	M5250 - M5259	M5270 - M5279	Unusable
	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	
Input	M4480	M4500	M4520	M4540	M4560	M4580	M4600	M4620	Positioning start completed
	M4481	M4501	M4521	M4541	M4561	M4581	M4601	M4621	Positioning completed
	M4482	M4502	M4522	M4542	M4562	M4582	M4602	M4622	Unusable
	M4483	M4503	M4523	M4543	M4563	M4583	M4603	M4623	Command in-position
	M4484	M4504	M4524	M4544	M4564	M4584	M4604	M4624	Speed control in progress
	M4485	M4505	M4525	M4545	M4565	M4585	M4605	M4625	Unusable
	M4486	M4506	M4526	M4546	M4566	M4586	M4606	M4626	
	M4487	M4507	M4527	M4547	M4567	M4587	M4607	M4627	Error detection
	M4488 - M4499	M4508 - M4519	M4528 - M4539	M4548 - M4559	M4568 - M4579	M4588 - M4599	M4608 - M4619	M4628 - M4639	Unusable
Output	M5280	M5300	M5320	M5340	M5360	M5380	M5400	M5420	Stop command
	M5281	M5301	M5321	M5341	M5361	M5381	M5401	M5421	Rapid stop command
	M5282	M5302	M5322	M5342	M5362	M5382	M5402	M5422	Forward JOG start
	M5283	M5303	M5323	M5343	M5363	M5383	M5403	M5423	Reverse JOG start
	M5284	M5304	M5324	M5344	M5364	M5384	M5404	M5424	Complete signal OFF command
	M5285	M5305	M5325	M5345	M6365	M5385	M5405	M5425	Unusable
	M5286	M5306	M5326	M5346	M5366	M5386	M5406	M5426	
	M5287	M5307	M5327	M5347	M5367	M5387	M5407	M5427	Error reset
	M5288	M5308	M5328	M5348	M5368	M5388	M5408	M5428	Unusable
	M5289	M5309	M5329	M5349	M5369	M5389	M5409	M5429	Stop input enable/disable
	M5290 - M5299	M5310 - M5319	M5330 - M5339	M5350 - M5359	M5370 - M5379	M5390 - M5399	M5410 - M5419	M5430 - M5439	Unusable

(2) Output module

(a) When A171SCPU is used

Table APP.11 Internal Relay (I/O) List (for A171SCPU)

	Device				Signal Name		Roller	Ball Screw	Rotary Table	Cam
	Axis 1	Axis 2	Axis 3	Axis 4						
Inputs	M1219	M1239	M1259	M1279	M code output in progress signal		O	O	O	O
	M1600	M1620	M1640	M1660	Vacant (OFF)		–	–	–	–
	M1601	M1621	M1641	M1661						
	M1602	M1622	M1642	M1662	In-position		O	O	O	O
	M1603	M1623	M1643	M1663	Vacant (OFF)		–	–	–	–
	M1604	M1624	M1644	M1664						
	M1605	M1625	M1645	M1665						
	M1606	M1626	M1646	M1666	Zero-point pass		O	O	O	O
	M1607	M1627	M1647	M1667	Error detection		O	O	O	O
	M1608	M1628	M1648	M1668	Servo error detection		O	O	O	O
	M1609	M1629	M1649	M1669	Home position return request		O	O	O	O
	M1610	M1630	M1650	M1670	Home position return completed		O	O	O	O
	M1611	M1631	M1651	M1671	External signals	FLS	O	O	O	O
	M1612	M1632	M1652	M1672		RLS	O	O	O	O
	M1613	M1633	M1653	M1673		STOP	O	O	O	O
	M1614	M1634	M1654	M1674		DOG	O	O	O	O
	M1615	M1635	M1655	M1675	Servo ON/OFF status		O	O	O	O
	M1616	M1636	M1656	M1676	Torque limit in progress signal		O	O	O	O
	M1617	M1637	M1657	M1677	Vacant (OFF)		–	–	–	–
	M1618	M1638	M1658	M1678	VIRTUAL mode continuation disabled warning signal		O	O	O	O
	M1619	M1639	M1659	M1679	Vacant (OFF)		–	–	–	–
Outputs	M1419	M1439	M1459	M1479	FIN signal		O	O	O	O
	M1800	M1820	M1840	M1860	Vacant		–	–	–	–
	M1801	M1821	M1841	M1861						
	M1802	M1822	M1842	M1862						
	M1803	M1823	M1843	M1863						
	M1804	M1824	M1844	M1864						
	M1805	M1825	M1845	M1865						
	M1806	M1826	M1846	M1866	Limit switch output enabled		–	O	O	O
	M1807	M1827	M1847	M1867	Error reset		O	O	O	O
	M1808	M1828	M1848	M1868	Servo error reset		O	O	O	O
	M1809	M1829	M1849	M1869	Vacant		–	–	–	–
	M1810	M1830	M1850	M1870						
	M1811	M1831	M1851	M1871						
	M1812	M1832	M1852	M1872						
	M1813	M1833	M1853	M1873	Address clutch reference setting		–	–	O	O
	M1814	M1834	M1854	M1874	Cam reference position setting		–	–	–	O
	M1815	M1835	M1855	M1875	Servo OFF		O	O	O	O
	M1816	M1836	M1856	M1876	Vacant		–	–	–	–
	M1817	M1837	M1857	M1877						
	M1818	M1838	M1858	M1878						
	M1819	M1839	M1859	M1879						

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

Table APP.12 Input/Output List (for A273UHCPU 8-axis Specification)

	Device								Signal Name		Roller	Ball Screw	Rotary Table	Cam
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8						
Inputs	X0	X10	X20	X30	X40	X50	X60	X70	Vacant (OFF)		–	–	–	–
	X1	X11	X21	X31	X41	X51	X61	X71						
	X2	X12	X22	X32	X42	X52	X62	X72	In-position		O	O	O	O
	X3	X13	X23	X33	X43	X53	X63	X73	Vacant (OFF)		–	–	–	–
	X4	X14	X24	X34	X44	X54	X64	X74						
	X5	X15	X25	X35	X45	X55	X65	X75						
	X6	X16	X26	X36	X46	X56	X66	X76	Zero-point pass		O	O	O	O
	X7	X17	X27	X37	X47	X57	X67	X77	Error detection		O	O	O	O
	X8	X18	X28	X38	X48	X58	X68	X78	Servo error detection		O	O	O	O
	X9	X19	X29	X39	X49	X59	X69	X79	Home position return request		O	O	O	O
	XA	X1A	X2A	X3A	X4A	X5A	X6A	X7A	Home position return completed		O	O	O	O
	XB	X1B	X2B	X3B	X4B	X5B	X6B	X7B	FLS	FLS	O	O	O	O
	XC	X1C	X2C	X3C	X4C	X5C	X6C	X7C		RLS	O	O	O	O
	XD	X1D	X2D	X3D	X4D	X5D	X6D	X7D		STOP	O	O	O	O
	XE	X1E	X2E	X3E	X4E	X5E	X6E	X7E		DOG	O	O	O	O
	XF	X1F	X2F	X3F	X4F	X5F	X6F	X7F	Servo ON/OFF status		O	O	O	O
	XD0	XD1	XD2	XD3	XD4	XD5	XD6	XD7	Torque limit in progress signal		O	O	O	O
	XD8	XD9	XDA	XDB	XDC	XDD	XDE	XDF	External signal	CHANGE	O	O	O	O
	XF0	XF1	XF2	XF3	XF4	XF5	XF6	XF7	VIRTUAL mode continuation disabled warning signal		O	O	O	O
	X10F	X11F	X12F	X13F	X14F	X15F	X16F	X17F	M code output in progress signal		O	O	O	O
Outputs	Y0	Y10	Y20	Y30	Y40	Y50	Y60	Y70	Vacant		–	–	–	–
	Y1	Y11	Y21	Y31	Y41	Y51	Y61	Y71						
	Y2	Y12	Y22	Y32	Y42	Y52	Y62	Y72						
	Y3	Y13	Y23	Y33	Y43	Y53	Y63	Y73						
	Y4	Y14	Y24	Y34	Y44	Y54	Y64	Y74						
	Y5	Y15	Y25	Y35	Y45	Y55	Y65	Y75						
	Y6	Y16	Y26	Y36	Y46	Y56	Y66	Y76	Limit switch output enabled		–	O	O	O
	Y7	Y17	Y27	Y37	Y47	Y57	Y67	Y77	Error reset		O	O	O	O
	Y8	Y18	Y28	Y38	Y48	Y58	Y68	Y78	Servo error reset		O	O	O	O
	Y9	Y19	Y29	Y39	Y49	Y59	Y69	Y79	Vacant		–	–	–	–
	YA	Y1A	Y2A	Y3A	Y4A	Y5A	Y6A	Y7A						
	YB	Y1B	Y2B	Y3B	Y4B	Y5B	Y6B	Y7B						
	YC	Y1C	Y2C	Y3C	Y4C	Y5C	Y6C	Y7C						
	YD	Y1D	Y2D	Y3D	Y4D	Y5D	Y6D	Y7D	Address clutch reference setting		–	–	O	O
	YE	Y1E	Y2E	Y3E	Y4E	Y5E	Y6E	Y7E	Cam reference position setting		–	–	–	O
	YF	Y1F	Y2F	Y3F	Y4F	Y5F	Y6F	Y7F	Servo OFF		O	O	O	O
	Y10F	Y11F	Y12F	Y13F	Y14F	Y15F	Y16F	Y17F	FIN signal		O	O	O	O

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

Table APP.13 Internal Relay (I/O) List (for A273UHCPU 32-axis Specification)

	Signal Name		Roller	Ball Screw	Rotary Table	Cam	Device No.					
							Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
Inputs	Vacant (OFF)		–	–	–	–	M2400	M2420	M2440	M2460	M2480	M2500
							M2401	M2421	M2441	M2461	M2481	M2501
	In-position		○	○	○	○	M2402	M2422	M2442	M2462	M2482	M2502
	Vacant (OFF)		–	–	–	–	M2403	M2423	M2443	M2463	M2483	M2503
							M2404	M2424	M2444	M2464	M2484	M2504
							M2405	M2425	M2445	M2465	M2485	M2505
	Zero-point pass		○	○	○	○	M2406	M2426	M2446	M2466	M2486	M2506
	Error detection		○	○	○	○	M2407	M2427	M2447	M2467	M2487	M2507
	Servo error detection		○	○	○	○	M2408	M2428	M2448	M2468	M2488	M2508
	Home position return request		○	○	○	○	M2409	M2429	M2449	M2469	M2489	M2509
	Home position return completed		○	○	○	○	M2410	M2430	M2450	M2470	M2490	M2510
	FLS	FLS	○	○	○	○	M2411	M2431	M2451	M2471	M2491	M2511
		RLS	○	○	○	○	M2412	M2432	M1652	M2472	M2492	M2512
		STOP	○	○	○	○	M2413	M2433	M2453	M2473	M2493	M2513
		DOG	○	○	○	○	M2414	M2434	M2454	M2474	M2494	M2514
	Servo ON/OFF status		○	○	○	○	M2415	M2435	M2455	M2475	M2495	M2515
	Torque limit in progress signal		○	○	○	○	M2416	M2436	M2456	M2476	M2496	M2516
	External signal CHANGE		○	○	○	○	M2417	M2437	M2457	M2477	M2497	M2517
	VIRTUAL mode continuation disabled warning signal		○	○	○	○	M2418	M2438	M2458	M2478	M2498	M2518
	Vacant		○	○	○	○	M2419	M2439	M2459	M2479	M2499	M2519
	M code output in progress signal		○	○	○	○	M4019	M4039	M4059	M4079	M4099	M4119
Outputs	Vacant		–	–	–	–	M3200	M3220	M3240	M3260	M3280	M3300
							M3201	M3221	M3241	M3261	M3281	M3301
							M3202	M3222	M3242	M3262	M3282	M3302
							M3203	M3223	M3243	M3263	M3283	M3303
							M3204	M3224	M3244	M3264	M3284	M3304
							M3205	M3225	M3245	M3265	M3285	M3305
	Limit switch output enabled		–	○	○	○	M3206	M3226	M3246	M3266	M3286	M3306
	Error reset		○	○	○	○	M3207	M3227	M3247	M3267	M3287	M3307
	Servo error reset		○	○	○	○	M3208	M3228	M3248	M3268	M3288	M3308
	Vacant		–	–	–	–	M3209	M3229	M3249	M3269	M3289	M3309
							M3210	M3230	M3250	M3270	M3290	M3310
							M3211	M3231	M3251	M3271	M3291	M3311
							M3212	M3232	M3252	M3272	M3292	M3312
	Address clutch reference setting		–	–	○	○	M3213	M3233	M3253	M3273	M3293	M3313
	Cam reference position setting		–	–	–	○	M3214	M3234	M3254	M3274	M3294	M3314
	Servo OFF		○	○	○	○	M3215	M3235	M3255	M3275	M3295	M3315
	Vacant		○	○	○	○	M3216	M3236	M3256	M3276	M3296	M3316
			○	○	○	○	M3217	M3237	M3257	M3277	M3297	M3317
			○	○	○	○	M3218	M3238	M3258	M3278	M3298	M3318
			○	○	○	○	M3219	M3239	M3259	M3279	M3299	M3319
	FIN signal		○	○	○	○	M4819	M4839	M4859	M4879	M4899	M4919

Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	Signal Direction
M2520	M2540	M2560	M2580	M2600	M2620	M2640	M2660	M2680	M2700	–
M2521	M2541	M2561	M2581	M2601	M2621	M2641	M2661	M2681	M2701	
M2522	M2542	M2562	M2582	M2602	M2622	M2642	M2662	M2682	M2702	PCPU → SCPU
M2523	M2543	M2563	M2583	M2603	M2623	M2643	M2663	M2683	M2703	–
M2524	M2544	M2564	M2584	M2604	M2624	M2644	M2664	M2684	M2704	
M2525	M2545	M2565	M2585	M2605	M2625	M2645	M2665	M2685	M2705	
M2526	M2546	M2566	M2586	M2606	M2626	M2646	M2666	M2686	M2706	PCPU → SCPU
M2527	M2547	M2567	M2587	M2607	M2627	M2647	M2667	M2687	M2707	
M2528	M2548	M2568	M2588	M2608	M2628	M2648	M2668	M2688	M2708	
M2529	M2549	M2569	M2589	M2609	M2629	M2649	M2669	M2689	M2709	
M2530	M2550	M2570	M2590	M2610	M2630	M2650	M2670	M2690	M2710	
M2531	M2551	M2571	M2591	M2611	M2631	M2651	M2671	M2691	M2711	
M2532	M2552	M2572	M2592	M2612	M2632	M2652	M2672	M2692	M2712	
M2533	M2553	M2573	M2593	M2613	M2633	M2653	M2673	M2693	M2713	
M2534	M2554	M2574	M2594	M2614	M2634	M2654	M2674	M2694	M2714	
M2535	M2555	M2575	M2595	M2615	M2635	M2655	M2675	M2695	M2715	
M2536	M2556	M2576	M2596	M2616	M2636	M2656	M2676	M2696	M2716	
M2537	M2557	M2577	M2597	M2617	M2637	M2657	M2677	M2697	M2717	
M2538	M2558	M2578	M2598	M2618	M2638	M2658	M2678	M2698	M2718	
M2539	M2559	M2579	M2599	M2619	M2639	M2659	M2679	M2699	M2719	–
M4139	M4159	M4179	M4199	M4219	M4239	M4259	M4279	M4299	M4319	PCPU → SCPU
M3320	M3340	M3360	M3380	M3400	M3420	M3440	M3460	M3480	M3500	–
M3321	M3341	M3361	M3381	M3401	M3421	M3441	M3461	M3481	M3501	
M3322	M3342	M3362	M3382	M3402	M3422	M3442	M3462	M3482	M3502	
M3323	M3343	M3363	M3383	M3403	M3423	M3443	M3463	M3483	M3503	
M3324	M3344	M3364	M3384	M3404	M3424	M3444	M3464	M3484	M3504	
M3325	M3345	M3365	M3385	M3405	M3425	M3445	M3465	M3485	M3505	
M3326	M3346	M3366	M3386	M3406	M3426	M3446	M3466	M3486	M3506	SCPU → PCPU
M3327	M3347	M3367	M3387	M3407	M3427	M3447	M3467	M3487	M3507	
M3328	M3348	M3368	M3388	M3408	M3428	M3448	M3468	M3488	M3508	
M3329	M3349	M3369	M3389	M3409	M3429	M3449	M3469	M3489	M3509	–
M3330	M3350	M3370	M3390	M3410	M3430	M3450	M3470	M3490	M3510	
M3331	M3351	M3371	M3391	M3411	M3431	M3451	M3471	M3491	M3511	
M3332	M3352	M3372	M3392	M3412	M3432	M3452	M3472	M3492	M3512	
M3333	M3353	M3373	M3393	M3413	M3433	M3453	M3473	M3493	M3513	SCPU → PCPU
M3334	M3354	M3374	M3394	M3414	M3434	M3454	M3474	M3494	M3514	
M3335	M3355	M3375	M3395	M3415	M3435	M3455	M3475	M3495	M3515	
M3336	M3356	M3376	M3396	M3416	M3436	M3456	M3476	M3496	M3516	–
M3337	M3357	M3377	M3397	M3417	M3437	M3457	M3477	M3497	M3517	
M3338	M3358	M3378	M3398	M3418	M3438	M3458	M3478	M3498	M3518	
M3339	M3359	M3379	M3399	M3419	M3439	M3459	M3479	M3499	M3519	
M4939	M4959	M4979	M4999	M5019	M5039	M5059	M5079	M5099	M5119	SCPU → PCPU

Table APP.13 Internal Relay (Input/Output) List (for A273UHCPU 32-axis Specification) (Continued)

	Signal Name		Roller	Ball Screw	Rotary Table	Cam	Device No.					
							Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22
Inputs	Vacant (OFF)		–	–	–	–	M2720	M2740	M2760	M2780	M2800	M2820
							M2721	M2741	M2761	M2781	M2801	M2821
	In-position		O	O	O	O	M2722	M2742	M2762	M2782	M2802	M2822
	Vacant (OFF)		–	–	–	–	M2723	M2743	M2763	M2783	M2803	M2823
							M2724	M2744	M2764	M2784	M2804	M2824
							M2725	M2745	M2765	M2785	M2805	M2825
	Zero-point pass		O	O	O	O	M2726	M2746	M2766	M2786	M2806	M2826
	Error detection		O	O	O	O	M2727	M2747	M2767	M2787	M2807	M2827
	Servo error detection		O	O	O	O	M2728	M2748	M2768	M2788	M2808	M2828
	Home position return request		O	O	O	O	M2729	M2749	M2769	M2789	M2809	M2829
	Home position return completed		O	O	O	O	M2730	M2750	M2770	M2790	M2810	M2830
	FLS	FLS	O	O	O	O	M2731	M2751	M2771	M2791	M2811	M2831
		RLS	O	O	O	O	M2732	M1652	M2772	M2792	M2812	M2832
		STOP	O	O	O	O	M2733	M2753	M2773	M2793	M2813	M2833
		DOG	O	O	O	O	M2734	M2754	M2774	M2794	M2814	M2834
	Servo ON/OFF status		O	O	O	O	M2735	M2755	M2775	M2795	M2815	M2835
	Torque limit in progress signal		O	O	O	O	M2736	M2756	M2776	M2796	M2816	M2836
	External signal CHANGE		O	O	O	O	M2737	M2757	M2777	M2797	M2817	M2837
	VIRTUAL mode continuation disabled warning signal		O	O	O	O	M2738	M2758	M2778	M2798	M2818	M2838
	Vacant		O	O	O	O	M2739	M2759	M2779	M2799	M2819	M2839
	M code output in progress signal		O	O	O	O	M4339	M4359	M4379	M4399	M4419	M4439
Out-puts	Vacant		–	–	–	–	M3520	M3540	M3560	M3580	M3600	M3620
							M3521	M3541	M3561	M3581	M3601	M3621
							M3522	M3542	M3562	M3582	M3602	M3622
							M3523	M3543	M3563	M3583	M3603	M3623
							M3524	M3544	M3564	M3584	M3604	M3624
							M3525	M3545	M3565	M3585	M3605	M3625
	Limit switch output enabled		–	O	O	O	M3526	M3546	M3566	M3586	M3606	M3626
	Error reset		O	O	O	O	M3527	M3547	M3567	M3587	M3607	M3627
	Servo error reset		O	O	O	O	M3528	M3548	M3568	M3588	M3608	M3628
	Vacant		–	–	–	–	M3529	M3549	M3569	M3589	M3609	M3629
							M3530	M3550	M3570	M3580	M3610	M3630
							M3531	M3551	M3571	M3581	M3611	M3631
							M3532	M3552	M3572	M3582	M3612	M3632
	Address clutch reference setting		–	–	O	O	M3533	M3553	M3573	M3583	M3613	M3633
	Cam reference position setting		–	–	–	O	M3534	M3554	M3574	M3584	M3614	M3634
	Servo OFF		O	O	O	O	M3535	M3555	M3575	M3585	M3615	M3635
	Vacant		O	O	O	O	M3536	M3556	M3576	M3586	M3616	M3636
			O	O	O	O	M3537	M3557	M3577	M3587	M3617	M3637
			O	O	O	O	M3538	M3558	M3578	M3588	M3618	M3638
			O	O	O	O	M3539	M3559	M3579	M3589	M3619	M3639
	FIN signal		O	O	O	O	M5139	M5159	M5179	M5199	M5219	M5239

Axis 23	Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	Signal Direction
M2840	M2860	M2880	M2900	M2920	M2940	M2960	M2980	M3000	M3020	–
M2841	M2861	M2881	M2901	M2921	M2941	M2961	M2981	M3001	M3021	
M2842	M2862	M2882	M2902	M2922	M2942	M2962	M2982	M3002	M3022	PCPU → SCPU
M2843	M2863	M2883	M2903	M2923	M2943	M2963	M2983	M3003	M3023	–
M2844	M2864	M2884	M2904	M2924	M2944	M2964	M2984	M3004	M3024	
M2845	M2865	M2885	M2905	M2925	M2945	M2965	M2985	M3005	M3025	
M2846	M2866	M2886	M2906	M2926	M2946	M2966	M2986	M3006	M3026	PCPU → SCPU
M2847	M2867	M2887	M2907	M2927	M2947	M2967	M2987	M3007	M3027	
M2848	M2868	M2888	M2908	M2928	M2948	M2968	M2988	M3008	M3028	
M2849	M2869	M2889	M2909	M2929	M2949	M2969	M2989	M3009	M3029	
M2850	M2870	M2890	M2910	M2930	M2950	M2970	M2990	M3010	M3030	
M2851	M2871	M2891	M2911	M2931	M2951	M2971	M2991	M3011	M3031	
M2852	M2872	M2892	M2912	M2932	M2952	M2972	M2992	M3012	M3032	
M2853	M2873	M2893	M2913	M2933	M2953	M2973	M2993	M3013	M3033	
M2854	M2874	M2894	M2914	M2934	M2954	M2974	M2994	M3014	M3034	
M2855	M2875	M2895	M2915	M2935	M2955	M2975	M2995	M3015	M3035	
M2856	M2876	M2896	M2916	M2936	M2956	M2976	M2996	M3016	M3036	
M2857	M2877	M2897	M2917	M2937	M2957	M2977	M2997	M3017	M3037	
M2858	M2878	M2898	M2918	M2938	M2958	M2978	M2998	M3018	M3038	
M2859	M2879	M2899	M2919	M2939	M2959	M2979	M2999	M3019	M3039	–
M4459	M4479	M4499	M4519	M4539	M4559	M4579	M4599	M4619	M4639	PCPU → SCPU
M3640	M3660	M3680	M3700	M3720	M3740	M3760	M3780	M3800	M3820	–
M3641	M3661	M3681	M3701	M3721	M3741	M3761	M3781	M3801	M3821	
M3642	M3662	M3682	M3702	M3722	M3742	M3762	M3782	M3802	M3822	
M3643	M3663	M3683	M3703	M3723	M3743	M3763	M3783	M3803	M3823	
M3644	M3664	M3684	M3704	M3724	M3744	M3764	M3784	M3804	M3824	
M3645	M3665	M3685	M3705	M3725	M3745	M3765	M3785	M3805	M3825	
M3646	M3666	M3686	M3706	M3726	M3746	M3766	M3786	M3806	M3826	SCPU → PCPU
M3647	M3667	M3687	M3707	M3727	M3747	M3767	M3787	M3807	M3827	
M3648	M3668	M3688	M3708	M3728	M3748	M3768	M3788	M3808	M3828	
M3649	M3669	M3689	M3709	M3729	M3749	M3769	M3789	M3809	M3829	–
M3650	M3670	M3690	M3710	M3730	M3750	M3770	M3790	M3810	M3830	
M3651	M3671	M3691	M3711	M3731	M3751	M3771	M3791	M3811	M3831	
M3652	M3672	M3692	M3712	M3732	M3752	M3772	M3792	M3812	M3832	
M3653	M3673	M3693	M3713	M3733	M3753	M3773	M3793	M3813	M3833	SCPU → PCPU
M3654	M3674	M3694	M3714	M3734	M3754	M3774	M3794	M3814	M3834	
M3655	M3675	M3695	M3715	M3735	M3755	M3775	M3795	M3815	M3835	
M3656	M3676	M3696	M3716	M3736	M3756	M3776	M3796	M3816	M3836	–
M3657	M3677	M3697	M3717	M3737	M3757	M3777	M3797	M3817	M3837	
M3658	M3678	M3698	M3718	M3738	M3758	M3778	M3798	M3818	M3838	
M3659	M3679	M3699	M3719	M3739	M3759	M3779	M3799	M3819	M3839	
M5259	M5279	M5299	M5319	M5339	M5359	M5379	M5399	M5419	M5439	SCPU → PCPU

4.3 Data Registers (D)

(1) Drive module

(a) When A171SCPU is used

Table APP.14 Data Register List (for A171SCPU)

Signal Name	Device				
	Synchro-nous Encoder	Virtual Servo Motor			
	P1/E1	Axis 1	Axis 2	Axis 3	Axis 4
Present value following main shaft's differential gear	D686	D670	D672	D674	D676
	D687	D671	D673	D675	D677
Feed present value	–	D700	D706	D712	D718
		D701	D707	D713	D719
Minor error code		D702	D708	D714	D720
Major error code		D703	D709	D715	D721
Execution program No.		D704	D710	D716	D722
M-code		D705	D711	D717	D723
Present value	D748	–	–	–	–
	D749	–	–	–	–
Minor error code	D750	–	–	–	–
Major error code	D751	–	–	–	–
Present value change	–	D960	D966	D972	D978
		D961	D967	D973	D979
Speed change		D962	D968	D974	D980
		D963	D969	D975	D981
JOG operation setting		D964	D970	D976	D982
		D965	D971	D977	D983
Manual pulse generator axis setting	D1012	–	–	–	–
JOG simultaneous start axis setting	–	D1015			
Manual pulse generator 1-pulse input magnification setting	–	D1016	D1017	D1018	D1019

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

Table APP.15 Data Register List (for A273UHCPU 8-axis Specification)

Signal Name	Device										
	Synchronous Encoder			Virtual Servo Motor							
	P1/E1	P2/E2	P3/E3	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Present value following main shaft's differential gear	D686	D688	D690	D670	D672	D674	D676	D678	D680	D682	D684
	D687	D689	D691	D671	D673	D675	D677	D679	D681	D683	D685
Feed present value	–	–	–	D700	D706	D712	D718	D724	D730	D736	D742
				D701	D707	D713	D719	D725	D731	D737	D743
Minor error code				D702	D708	D714	D720	D726	D732	D738	D744
Major error code				D703	D709	D715	D721	D727	D733	D739	D745
Execution program No.				D704	D710	D716	D722	D728	D734	D740	D746
M-code				D705	D711	D717	D723	D729	D735	D741	D747
Present value	D748	D752	D756	–	–	–	–	–	–	–	–
	D749	D753	D757	–	–	–	–	–	–	–	–
Minor error code	D750	D754	D758	–	–	–	–	–	–	–	–
Major error code	D751	D755	D759	–	–	–	–	–	–	–	–
Present value change	–	–	–	D960	D966	D972	D978	D984	D990	D996	D1002
				D961	D967	D973	D979	D985	D991	D997	D1003
Speed change				D962	D968	D974	D980	D986	D992	D998	D1004
				D963	D969	D975	D981	D987	D993	D999	D1005
JOG operation setting				D964	D970	D976	D982	D988	D994	D1000	D1006
				D965	D971	D977	D983	D989	D995	D1001	D1007
Manual pulse generator axis setting	D1012	D1013	D1014	–	–	–	–	–	–	–	–
JOG simultaneous start axis setting	–	–	–	D1015							
Manual pulse generator 1-pulse input magnification setting	–	–	–	D1016	D1017	D1018	D1019	D1020	D1021	D1022	D1023

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

Table APP.16 Data Register List (for A273UHCPU 32-axis Specification)

Signal Name	Device No.								
	Synchronous Encoder								
	P1/E1	P2/E2	P3/E3	P4/E4	P5/E5	P6/E6	Axis 1	Axis 2	Axis 3
JOG speed setting	–	–	–	–	–	–	D640 D641	D642 D643	D644 D645
JOG simultaneous start axis setting									D710,
Manual pulse generator axis setting	D714 - D719						–	–	–
Manual pulse generator 1-pulse input magnification setting	–	–	–	–	–	–	D720	D721	D722
Feed present value							D800 D801	D810 D811	D820 D821
Present value	D1120 D1121	D1130 D1131	D1140 D1141	D1150 D1151	D1160 D1161	D1170 D1171	–	–	–
Minor error code	D1122	D1132	D1142	D1152	D1162	D1172	D802	D812	D822
Major error code	D1123	D1133	D1143	D1153	D1163	D1173	D803	D813	D823
Execution program No.	–	–	–	–	–	–	D804	D814	D824
M-code							D805	D815	D825
Unusable	D1124 D1125	D1134 D1135	D1144 D1145	D1154 D1155	D1164 D1165	D1174 D1175	–	–	–
Present value following main shaft's differential gear	D1126 D1127	D1136 D1137	D1146 D1147	D1156 D1157	D1166 D1167	D1176 D1177	D806 D807	D816 D817	D826 D827
Error search output shaft No.	D1128	D1138	D1148	D1158	D1168	D1178	D808	D818	D828
Constant speed control data set pointer	–	–	–	–	–	–	D809	D819	D829
Unusable	D1129	D1139	D1149	D1159	D1169	D1179	–	–	–

Signal Name	Device No.								
	Synchronous Encoder								
	P7/E7	P8/E8	P9/E9	P10/E10	P11/E11	P12/E12	Axis 17	Axis 18	Axis 19
JOG speed setting	–	–	–	–	–	–	D672 D673	D674 D675	D676 D677
JOG simultaneous start axis setting									D710,
Manual pulse generator axis setting	D714 - D719						–	–	–
Manual pulse generator 1-pulse input magnification setting	–	–	–	–	–	–	D736	D737	D738
Feed present value							D960 D961	D970 D971	D980 D981
Present value	D1180 D1181	D1190 D1191	D1200 D1201	D1210 D1211	D1220 D1221	D1230 D1231	–	–	–
Minor error code	D1182	D1192	D1202	D1212	D1222	D1232	D962	D972	D982
Major error code	D1183	D1193	D1203	D1213	D1223	D1233	D963	D973	D983
Execution program No.	–	–	–	–	–	–	D964	D974	D984
M-code							D965	D975	D985
Unusable	D1184 D1185	D1194 D1195	D1204 D1205	D1214 D1215	D1224 D1225	D1234 D1235	–	–	–
Present value following main shaft's differential gear	D1186 D1187	D1196 D1197	D1206 D1207	D1216 D1217	D1226 D1227	D1236 D1237	D966 D967	D976 D977	D986 D987
Error search output shaft No.	D1188	D1198	D1208	D1218	D1228	D1238	D968	D978	D988
Constant speed control data set pointer	–	–	–	–	–	–	D969	D979	D989
Unusable	D1189	D1199	D1209	D1219	D1229	D1239	–	–	–

Virtual Servo Motor													Signal Direction
Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	
D646	D648	D650	D652	D654	D656	D658	D660	D662	D664	D666	D668	D670	SCPU → PCPU
D647	D649	D651	D653	D655	D657	D659	D661	D663	D665	D667	D669	D671	
D711, 712, 713													
–	–	–	–	–	–	–	–	–	–	–	–	–	
D723	D724	D725	D726	D727	D728	D729	D730	D731	D732	D733	D734	D735	
D830	D840	D850	D860	D870	D880	D890	D900	D910	D920	D930	D940	D950	PCPU → SCPU
D831	D841	D851	D861	D871	D881	D891	D901	D911	D921	D931	D941	D951	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D832	D842	D852	D862	D872	D882	D892	D902	D912	D922	D932	D942	D952	PCPU → SCPU
D833	D843	D853	D863	D873	D883	D893	D903	D913	D923	D933	D943	D953	
D834	D844	D854	D864	D874	D884	D894	D904	D914	D924	D934	D944	D954	
D835	D845	D855	D865	D875	D885	D895	D905	D915	D925	D935	D945	D955	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D836	D846	D856	D866	D876	D886	D896	D906	D916	D926	D936	D946	D956	PCPU → SCPU
D837	D847	D857	D867	D877	D887	D897	D907	D917	D927	D937	D947	D957	
D838	D848	D858	D868	D878	D888	D898	D908	D918	D928	D938	D948	D958	
D839	D849	D859	D869	D879	D889	D899	D909	D919	D929	D939	D949	D959	
–	–	–	–	–	–	–	–	–	–	–	–	–	–

Virtual Servo Motor													Signal Direction
Axis 20	Axis 21	Axis 22	Axis 23	Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	
D678	D680	D682	D684	D686	D688	D690	D692	D694	D696	D698	D700	D702	SCPU → PCPU
D679	D681	D683	D685	D687	D689	D691	D693	D695	D697	D699	D701	D703	
D711, 712, 713													
–	–	–	–	–	–	–	–	–	–	–	–	–	
D739	D740	D741	D742	D743	D744	D745	D746	D747	D748	D749	D750	D751	
D990	D1000	D1010	D1020	D1030	D1040	D1050	D1060	D1070	D1080	D1090	D1100	D1110	PCPU → SCPU
D991	D1001	D1011	D1021	D1031	D1041	D1051	D1061	D1071	D1081	D1091	D1101	D1111	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D992	D1002	D1012	D1022	D1032	D1042	D1052	D1062	D1072	D1082	D1092	D1102	D1112	PCPU → SCPU
D993	D1003	D1013	D1023	D1033	D1043	D1053	D1063	D1073	D1083	D1093	D1103	D1113	
D994	D1004	D1014	D1024	D1034	D1044	D1054	D1064	D1074	D1084	D1094	D1104	D1114	
D995	D1005	D1015	D1025	D1035	D1045	D1055	D1065	D1075	D1085	D1095	D1105	D1115	
–	–	–	–	–	–	–	–	–	–	–	–	–	–
D996	D1006	D1016	D1026	D1036	D1046	D1056	D1066	D1076	D1086	D1096	D1106	D1116	PCPU → SCPU
D997	D1007	D1017	D1027	D1037	D1047	D1057	D1067	D1077	D1087	D1097	D1107	D1117	
D998	D1008	D1018	D1028	D1038	D1048	D1058	D1068	D1078	D1088	D1098	D1108	D1118	
D999	D1009	D1019	D1029	D1039	D1049	D1059	D1069	D1079	D1089	D1099	D1109	D1119	
–	–	–	–	–	–	–	–	–	–	–	–	–	–

(2) Output module

(a) When A171SCPU is used

Table APP.17 Data Register List (for A171SCPU)

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device			
					Axis 1	Axis 2	Axis 3	Axis 4
Effective cam No.	–	–	–	○	D760	D765	D770	D775
Effective stroke	–	–	–	○	D761	D766	D771	D776
					D762	D767	D772	D777
Present value in 1 cam shaft revolution	–	–	–	○	D763	D768	D773	D778
					D764	D769	D774	D779
Roller peripheral velocity	○	–	–	–	D800	D820	D840	D860
					D801	D821	D841	D861
Feed present value	–	○	○	○	D800	D820	D840	D860
					D801	D821	D841	D861
Present value	–	○	○	○	D802	D822	D842	D862
					D803	D823	D843	D863
Deviation counter value	○	○	○	○	D804	D824	D844	D864
					D805	D825	D845	D865
Minor error code	○	○	○	○	D806	D826	D846	D866
Major error code	○	○	○	○	D807	D827	D847	D867
Servo error code	○	○	○	○	D808	D828	D848	D868
(Travel value after DOG ON)	REAL mode data stored				D809	D829	D849	D869
					D810	D830	D850	D870
(Home position return second travel value)					D811	D831	D851	D871
(Execution program No.)	No change when "0"				D812	D832	D852	D872
(M-code)					D813	D833	D853	D873
Torque limit value	○	○	○	○	D814	D834	D854	D874
(Travel value change register)	Ignored				D815	D835	D855	D875
					D816	D836	D856	D876
(Actual present value at STOP input)	REAL mode data stored				D817	D837	D857	D877
					D818	D838	D858	D878
Vacant	–				D819	D839	D859	D879

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

Table APP.18 Data Register List (for A273UHCPU 8-axis Specification)

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device							
					Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Effective cam No.	–	–	–	○	D760	D765	D770	D775	D780	D785	D791	D795
Effective stroke	–	–	–	○	D761	D766	D771	D776	D781	D786	D792	D796
					D762	D767	D772	D777	D782	D787	D793	D797
Present value in 1 cam shaft revolution	–	–	–	○	D763	D768	D773	D778	D783	D788	D794	D798
					D764	D769	D774	D779	D784	D789	D795	D799
Roller peripheral velocity	○	–	–	–	D800	D820	D840	D860	D880	D900	D920	D940
					D801	D821	D841	D861	D881	D901	D921	D941
Feed present value	–	○	○	○	D800	D820	D840	D860	D880	D900	D920	D940
					D801	D821	D841	D861	D881	D901	D921	D941
Present value	–	○	○	○	D802	D822	D842	D862	D882	D902	D922	D942
					D803	D823	D843	D863	D883	D903	D923	D943
Deviation counter value	○	○	○	○	D804	D824	D844	D864	D884	D904	D924	D944
					D805	D825	D845	D865	D885	D905	D925	D945
Minor error code	○	○	○	○	D806	D826	D846	D866	D886	D906	D926	D946
Major error code	○	○	○	○	D807	D827	D847	D867	D887	D907	D927	D947
Servo error code	○	○	○	○	D808	D828	D848	D868	D888	D908	D928	D948
(Travel value after DOG ON)	REAL mode data stored				D809	D829	D849	D869	D889	D909	D929	D949
					D810	D830	D850	D870	D890	D910	D930	D950
(Home position return second travel value)					D811	D831	D851	D871	D891	D911	D931	D951
(Execution program No.)	No change when "0"				D812	D832	D852	D872	D892	D912	D932	D952
(M-code)					D813	D833	D853	D873	D893	D913	D933	D953
Torque limit value	○	○	○	○	D814	D834	D854	D874	D894	D914	D934	D954
(Travel value change register)	Ignored				D815	D835	D855	D875	D895	D915	D935	D955
					D816	D836	D856	D876	D896	D916	D936	D956
(Actual present value at STOP input)	REAL mode data stored				D817	D837	D857	D877	D897	D917	D937	D957
					D818	D838	D858	D878	D898	D918	D938	D958
Vacant	–				D819	D839	D859	D879	D899	D919	D939	D959

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

Table APP.19 Data Register List (for A273UHCPU 32-axis Specification)

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device No.							
					Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Vacant	–				D1240	D1250	D1260	D1270	D1280	D1290	D1300	D1310
Effective cam No.	–	–	–	O	D1241	D1251	D1261	D1271	D1281	D1291	D1301	D1311
Effective stroke	–	–	–	O	D1242	D1252	D1262	D1272	D1282	D1292	D1302	D1312
					D1243	D1253	D1263	D1273	D1283	D1293	D1303	D1313
Present value in 1 cam shaft revolution	–	–	–	O	D1244	D1254	D1264	D1274	D1284	D1294	D1304	D1314
					D1245	D1255	D1265	D1275	D1285	D1295	D1305	D1315
Roller peripheral velocity	O	–	–	–	D0	D20	D40	D60	D80	D100	D120	D140
					D1	D21	D41	D61	D81	D101	D121	D141
Feed present value	–	O	O	O	D0	D20	D40	D60	D80	D100	D120	D140
					D1	D21	D41	D61	D81	D101	D121	D141
Present value	–	O	O	O	D2	D22	D42	D62	D82	D102	D122	D142
					D3	D23	D43	D63	D83	D103	D123	D143
Deviation counter value	O	O	O	O	D4	D24	D44	D64	D84	D104	D124	D144
					D5	D25	D45	D65	D85	D105	D125	D145
Minor error code	O	O	O	O	D6	D26	D46	D66	D86	D106	D126	D146
Major error code	O	O	O	O	D7	D27	D47	D67	D87	D107	D127	D147
Servo error code	O	O	O	O	D8	D28	D48	D68	D88	D108	D128	D148
(Home position return second travel value)	REAL mode data stored				D9	D29	D49	D69	D89	D109	D129	D149
(Travel value after DOG/CHANGE ON)					D10	D30	D50	D70	D10	D110	D130	D150
					D11	D31	D51	D71	D11	D111	D131	D151
(Execution program No.)	No change when "0"				D12	D32	D52	D72	D92	D112	D132	D152
(M-code)					D13	D33	D53	D73	D93	D113	D133	D153
Torque limit value	O	O	O	O	D14	D34	D54	D74	D94	D114	D134	D154
Constant speed control data set pointer	No change when "0"				D15	D35	D55	D75	D95	D115	D135	D155
					D16	D36	D56	D76	D96	D116	D136	D156
(Travel value change register)	Ignored				D17	D37	D57	D77	D97	D117	D137	D157
					D18	D38	D58	D78	D98	D118	D138	D158
(Actual present value at STOP input)	REAL mode data stored				D19	D39	D59	D79	D99	D119	D139	D159

Signal Name	Roller	Ball Screw	Rotary Table	Cam	Device No.							
					Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32
Vacant	–				D1480	D1490	D1500	D1510	D1520	D1530	D1540	D1550
Effective cam No.	–	–	–	O	D1481	D1491	D1501	D1511	D1521	D1531	D1541	D1551
Effective stroke	–	–	–	O	D1482	D1492	D1502	D1512	D1522	D1532	D1542	D1552
					D1483	D1493	D1503	D1513	D1523	D1533	D1543	D1553
Present value in 1 cam shaft revolution	–	–	–	O	D1484	D1494	D1504	D1514	D1524	D1534	D1544	D1554
					D1485	D1495	D1505	D1515	D1525	D1535	D1545	D1555
Roller peripheral velocity	O	–	–	–	D480	D500	D520	D540	D560	D580	D600	D620
					D481	D501	D521	D541	D561	D581	D601	D621
Feed present value	–	O	O	O	D480	D500	D520	D540	D560	D580	D600	D620
					D481	D501	D521	D541	D561	D581	D601	D621
Present value	–	O	O	O	D482	D502	D522	D542	D562	D582	D602	D622
					D483	D503	D523	D543	D563	D583	D603	D623
Deviation counter value	O	O	O	O	D484	D504	D524	D544	D564	D584	D604	D624
					D485	D505	D525	D545	D565	D585	D605	D625
Minor error code	O	O	O	O	D486	D506	D526	D546	D566	D586	D606	D626
Major error code	O	O	O	O	D487	D507	D527	D547	D567	D587	D607	D627
Servo error code	O	O	O	O	D488	D508	D528	D548	D568	D588	D608	D628
(Home position return second travel value)	REAL mode data stored				D489	D509	D529	D549	D569	D589	D609	D629
(Travel value after DOG/CHANGE ON)					D490	D510	D530	D550	D570	D590	D610	D630
					D491	D511	D531	D551	D571	D591	D611	D631
(Execution program No.)	No change when "0"				D492	D512	D532	D552	D572	D592	D612	D632
(M-code)					D493	D513	D533	D553	D573	D593	D613	D633
Torque limit value	O	O	O	O	D494	D514	D534	D554	D574	D594	D614	D634
Constant speed control data set pointer	No change when "0"				D495	D415	D535	D555	D575	D595	D615	D635
					D496	D416	D536	D556	D576	D596	D616	D636
(Travel value change register)	Ignored				D497	D417	D537	D557	D577	D597	D617	D637
					D498	D418	D538	D558	D578	D598	D618	D638
(Actual present value at STOP input)	REAL mode data stored				D499	D419	D539	D559	D579	D599	D619	D639

Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
D1320	D1330	D1340	D1350	D1360	D1370	D1380	D1390	D1400	D1410	D1420	D1430	D1440	D1450	D1460	D1470
D1321	D1331	D1341	D1351	D1361	D1371	D1381	D1391	D1401	D1411	D1421	D1431	D1441	D1451	D1461	D1471
D1322	D1332	D1342	D1352	D1362	D1372	D1382	D1392	D1402	D1412	D1422	D1432	D1442	D1452	D1462	D1472
D1323	D1333	D1343	D1353	D1363	D1373	D1383	D1393	D1403	D1413	D1423	D1433	D1443	D1453	D1463	D1473
D1324	D1334	D1344	D1354	D1364	D1374	D1384	D1394	D1404	D1414	D1424	D1434	D1444	D1454	D1464	D1474
D1325	D1335	D1345	D1355	D1365	D1375	D1385	D1395	D1405	D1415	D1425	D1435	D1445	D1455	D1465	D1475
D160	D180	D200	D220	D240	D260	D280	D300	D320	D340	D360	D380	D400	D420	D440	D460
D161	D181	D201	D221	D241	D261	D281	D301	D321	D341	D361	D381	D401	D421	D441	D461
D160	D180	D200	D220	D240	D260	D280	D300	D320	D340	D360	D380	D400	D420	D440	D460
D161	D181	D201	D221	D241	D261	D281	D301	D321	D341	D361	D381	D401	D421	D441	D461
D162	D182	D202	D222	D242	D262	D282	D302	D322	D342	D362	D382	D402	D422	D442	D462
D163	D183	D203	D223	D243	D263	D283	D303	D323	D343	D363	D383	D403	D423	D443	D463
D164	D184	D204	D224	D244	D264	D284	D304	D324	D344	D364	D384	D404	D424	D444	D464
D165	D185	D205	D225	D245	D265	D285	D305	D325	D345	D365	D385	D405	D425	D445	D465
D166	D186	D206	D226	D246	D266	D286	D306	D326	D346	D366	D386	D406	D426	D446	D466
D167	D187	D207	D227	D247	D267	D287	D307	D327	D347	D367	D387	D407	D427	D447	D467
D168	D188	D208	D228	D248	D268	D288	D308	D328	D348	D368	D388	D408	D428	D448	D468
D169	D189	D209	D229	D249	D269	D289	D309	D329	D349	D369	D389	D409	D429	D449	D469
D170	D190	D210	D230	D250	D270	D290	D310	D330	D350	D370	D390	D410	D430	D450	D470
D171	D191	D211	D231	D251	D271	D291	D311	D331	D351	D371	D391	D411	D431	D451	D471
D172	D192	D212	D232	D252	D272	D292	D312	D332	D352	D372	D392	D412	D432	D452	D472
D173	D193	D213	D233	D253	D273	D293	D313	D333	D353	D373	D393	D413	D433	D453	D473
D174	D194	D214	D234	D254	D274	D294	D314	D334	D354	D374	D394	D414	D434	D454	D474
D175	D195	D215	D235	D255	D275	D295	D315	D335	D355	D375	D395	D415	D435	D455	D475
D176	D196	D216	D236	D256	D276	D296	D316	D336	D356	D376	D396	D416	D436	D456	D476
D177	D197	D217	D237	D257	D277	D297	D317	D337	D357	D377	D397	D417	D437	D457	D477
D178	D198	D218	D238	D258	D278	D298	D318	D338	D358	D378	D398	D418	D438	D458	D478
D179	D199	D219	D239	D259	D279	D299	D319	D339	D359	D379	D399	D419	D439	D459	D479

APPENDIX 5 TABLES OF PROCESSING TIMES

This section lists the signal and instruction processing times for positioning control with a servo system CPU.

(1) Operation period of each servo system CPU

The processing time for the execution of positioning control operation by each servosystem CPU is indicated below.

	A171SCPU		A273UHCPU		
Set Axes	1 - 2	3 - 4	1 - 8	9 - 18	19 - 32
Operation period	3.5 ms	7.1 ms	3.5 ms	7.1 ms	14.2 ms

(2) PCPU operation period

The table below shows the processing times for the PCPU after the start request signal and PC ready (M2000) signal are detected ON.

	A171S CPU	A273UHCPU (8-axis Specification)		A273UHCPU		
Axes Used	4 Axes	4 Axes	8 Axes	8 Axes	16 Axes	32 Axes
Servoprogram processing time	7 - 14 ms*1	4 - 11 ms		4 - 11 ms	10 - 18 ms	14 - 21 ms
Speed change response time	7 - 14 ms	0 - 4 ms		0 - 4 ms	0 - 8 ms	0 - 14 ms
Time between PC ready flag (M2000) ON and PCPU ready flag (M9074) ON.	100 - 300 ms	80 - 100 ms		8 - 100 ms	90 - 400 ms	100 - 800 ms
Simultaneous start processing time	7 - 17 ms*2	7 - 17 ms		7 - 17 ms	10 - 24 ms	14 - 28 ms

*1: FEED varies greatly according to other conditions.
If other axes are stopped, operation period becomes 14 to 28 ms.

*2: Consider 7 to 17 ms as a guideline only.

(3) Common Devices

The table below shows the common device processing times for each axis during positioning control. The notification period from PCPU to SCPU is shown for signals with PCPU → SCPU signal direction. The notification period from SCPU to PCPU or the PCPU detection period is shown for signals with SCPU → PCPU signal direction.

Signal Name	Device Number			Signal Direction	A171SCPU		A273UHCPU			
							8-axis Specification	32-axis Specification		
	A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)		Set Axes		Set Axes	Set Axes		
					1 - 2	3 - 4	1 - 8	1 - 8	9 - 18	19 - 32
Clutch ON/OFF status	M1984 - M1991	M1964 - M1999	M2160 - M2223	PCPU → SCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Axis start accept flag	M2001 - M2004	M2001 - M2008	M2001 - M2032		10 ms	10 ms	10 ms	10 ms	10 ms	10 ms
All-axes start accept flag	M2009	M2009	M2049		10 ms	10 ms	10 ms	END*1	END*1	END*1
Cam & limit switch output data batch change completed flag	–	M2017	M2057	SCPU → PCPU	–	–	END*1	END*1	END*1	END*1
Cam & limit switch output data batch change error flag	–	M2018	M2058		–	–	END*1	END*1	END*1	END*1
Speed change in progress flag	M2021 - M2024	M2021 - M2028	M2061 - M2092	PCPU → SCPU	END*1	END*1	END*1	END*1	END*1	END*1
Synchronous encoder axis present value change in progress flag	M2031	M2031 - M2033	M2101 - M2112		END*1	END*1	END*1	END*1	END*1	END*1
System setting error flag	M2041	M2041	M2041		END*1	END*1	END*1	END*1	END*1	END*1
REAL/VIRTUAL mode switching request flag	M2044	M2044	M2044		END*1	END*1	END*1	END*1	END*1	END*1
REAL/VIRTUAL mode switching error detection flag	M2045	M2045	M2045		END*1	END*1	END*1	END*1	END*1	END*1
Synchronization discrepancy warning flag	M2046	M2046	M2046		END*1	END*1	END*1	END*1	END*1	END*1
Motion slot error detection flag	M2047	M2047	M2047		END*1	END*1	END*1	END*1	END*1	END*1
Automatic deceleration in progress flag	–	–	M2128 - M2159		–	–	–	3.5 ms	7.1 ms	14.2 ms
Speed change "0" accept flag	–	–	M2240 - M2271		–	–	–	3.5 ms	7.1 ms	14.2 ms
Limit switch output status storage area	D9180 - D9181	D9180 - D9183	D776 - D791		3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Manual pulse generator smoothing magnification storage area	D9192	D9192 - D9194	D752 - D754	SCPU → PCPU	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge
Limit switch output enabled/disabled setting	D1008 - D1009	D1008 - D1011	D760 - D775		3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Manual pulse generator axis setting	D1012	D1012 - D1014	D714 - D719		At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge
JOG simultaneous axis setting	D1015	D1015	D710 - D713		At start	At start	At start	At start	At start	At start

END *1: For A171SCPU : 80 ms or sequence program scan time, whichever is longer
For A273UHCPU : 50 ms or sequence program scan time, whichever is longer

Signal Name	Device Number: A171SCPU	Device Number: A273UHCPU (8-axis Specification)	Device Number: A273UHCPU (32-axis Specification)	Signal Direction	A171SCPU Set Axes 1 - 2	A171SCPU Set Axes 3 - 4	A273UHCPU 8-axis Specification Set Axes 1 - 8	A273UHCPU 32-axis Specification Set Axes 1 - 8	A273UHCPU 32-axis Specification Set Axes 9 - 18	A273UHCPU 32-axis Specification Set Axes 19 - 32
Manual pulse generator 1-pulse input magnification setting	D1016 - D1019	D1016 - D1023	D720 - D751	SCPU → PCPU	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge	At manual pulse generator enabled signal rising edge
Present value change register	D960 - D1007	D960 - D1007	–		At DSFLP instruction execution	At DSFLP instruction execution	At DSFLP instruction execution	–	–	–
Speed change register			–		At DSFLP instruction execution	At DSFLP instruction execution	At DSFLP instruction execution	–	–	–
JOG speed setting register			D640 - D703		At start	At start	At start	At start	At start	At start

(4) Individual Device

The table below shows the processing times for the individual devices for each axis during positioning control. The notification period from PCPU to SCPU is shown for signals with PCPU → SCPU signal direction. The notification period from SCPU to PCPU or the PCPU detection period is shown for signals with SCPU → PCPU signal direction.

Signal Name		Device Number: A171SCPU	Device Number: A273UHCPU (8-axis Specification)	Device Number: A273UHCPU (32-axis Specification)	Signal Direction	A171SCPU Set Axes 1 - 2	A171SCPU Set Axes 3 - 4	A273UHCPU 8-axis Specification Set Axes 1 - 8	A273UHCPU 32-axis Specification Set Axes 1 - 8	A273UHCPU 32-axis Specification Set Axes 9 - 18	A273UHCPU 32-axis Specification Set Axes 19 - 32
Output module devices	In-position	M1600 - M1759	X000 - X0FF	M2400 - M3039	PCPU → SCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Zero-point pass					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Servo error detection					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Home position return completed					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Servo ON/OFF status					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Torque limit in progress signal (for output module)					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Limit switch output enabled	M1400 - M1559	Y000 - Y07F	M3200 - M3839	SCPU → PCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Address clutch reference setting					At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching
	Cam reference position setting					At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching
	Servo OFF					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Effective cam No.	D760 - D799	D760 - D799	D1240 - D1559	PCPU → SCPU	END*1	END*1	END*1	3.5 ms	7.1 ms	14.2 ms
	Effective stroke					END*1	END*1	END*1	3.5 ms	7.1 ms	14.2 ms
	Present value in 1 cam shaft revolution					END*1	END*1	END*1	3.5 ms	7.1 ms	14.2 ms
	Roller peripheral velocity	D800 - D959	D800 - D959	D0 - D639		END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Feed present value					END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Present value					END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Deviation counter value					END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Torque limit value					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms

*1: For A171SCPU : 80 ms or sequence program scan time, whichever is longer
For A273UHCPU : 50 ms or sequence program scan time, whichever is longer

Signal Name				Device Number A171SCPU	Device Number A273UHCPU (8-axis Specification)	Device Number A273UHCPU (32-axis Specification)	Signal Direction	A171SCPU Set Axes 1 - 2	A171SCPU Set Axes 3 - 4	A273UHCPU 8-axis Specification Set Axes 1 - 8	A273UHCPU 32-axis Specification Set Axes 1 - 8	A273UHCPU 32-axis Specification Set Axes 9 - 18	A273UHCPU 32-axis Specification Set Axes 19 - 32
Virtual servo-motor axis device	Positioning start completed			M1200 - M1359	X100 - X17F	M4000 - M4639	PCPU → SCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Positioning completed							3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Command in-position							3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Speed control in progress							3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Stop command			M1400 - M1599	X100 - X17F	M4800 - M5439	SCPU → PCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Rapid stop command							3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Stop input enable/disable							At start	At start	At start	At start	At start	At start
	Feed present value	Set virtual servo axes	1 - 8	D700 - D747	D700 - D747	D800 - D1119	PCPU → SCPU	–	–	3.5 ms	3.5 ms	7.1 ms	14.2 ms
			9 - 16					–	–	7.1 ms	7.1 ms	7.1 ms	14.2 ms
			17 - 32					–	–	14.2 ms	14.2 ms	14.2 ms	28.4 ms
			1 - 4					END	END	–	–	–	–
	Execution program No.							At start	At start	At start	At start	At start	At start
	M-code	Set virtual servo axes	1 - 8					–	–	3.5 ms	3.5 ms	7.1 ms	14.2 ms
			9 - 16					–	–	7.1 ms	7.1 ms	7.1 ms	14.2 ms
			17 - 32					–	–	14.2 ms	14.2 ms	14.2 ms	28.4 ms
			1 - 4					3.5 ms	7.1 ms	–	–	–	–
	Present value following main shaft's differential gear	Set virtual servo axes	1 - 8	D670 - D685	D670 - D685			–	–	3.5 ms	3.5 ms	7.1 ms	14.2 ms
			9 - 16					–	–	7.1 ms	7.1 ms	7.1 ms	14.2 ms
			17 - 32					–	–	14.2 ms	14.2 ms	14.2 ms	28.4 ms
			1 - 4					END	END	–	–	–	–
Syn-chro-nous encod-er axis device	Present value	Set syn-chro-nous encod-er axes	1 - 6	D748 - D759	D748 - D759	D1120 - D1239		–	–	3.5 ms	3.5 ms	7.1 ms	14.2 ms
			7 - 11					–	–	7.1 ms	7.1 ms	14.2 ms	14.2 ms
			1					END	END	–	–	–	–
	Present value following main shaft's differential gear	Set syn-chro-nous encod-er axes	1 - 6	D686 - D691	D686 - D691			–	–	3.5 ms	3.5 ms	7.1 ms	14.2 ms
			7 - 12					–	–	7.1 ms	7.1 ms	14.2 ms	14.2 ms
			1					END	END	–	–	–	–

*1: For A171SCPU : 80 ms or sequence program scan time, whichever is longer
For A273UHCPU : 50 ms or sequence program scan time, whichever is longer

(5) Mechanical system module parameters

Setting Item		Default Value	Setting Range	Setting Possible		A171SCPU		A273UHCPU			
								8-axis Specification	32-axis Specification		
				Direct Clutch	Smoothing Clutch	Set Axes		Set Axes	Set Axes		
						1 - 2	3 - 4	1 - 8	1 - 8	9 - 18	19 - 32
Clutch	Mode setting device	–	Word device *1	○	○	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Clutch ON/OFF command device	–	Bit device	○	○	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Clutch ON address setting device Clutch OFF address setting device	–	Word device *1	○	○	END *2	END *2	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Amount of slip setting device	–	Word device	–	○	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching	At REAL to VIRTUAL switching

*1: Enabled only when ON/OFF mode/address mode are both used.

*2: For A171SCPU : 80 ms or sequence program scan time, whichever is longer
For A273UHCPU : 50 ms or sequence program scan time, whichever is longer

Setting Item			Default Value	Device Number			A171SCPU		A273UHCPU			
									8-axis Specification	32-axis Specification		
				A171SCPU	A273UHCPU (8-axis Specification)	A273UHCPU (32-axis Specification)	Set Axes		Set Axes	Set Axes		
							1 - 2	3 - 4	1 - 8	1 - 8	9 - 18	19 - 32
Gear-box	Speed change gear ratio setting device		–	D0 - D799 W000 - W3FF	D0 - D799 D1824 - D3069 D3080 - D8191 W000 - W1FFF	D800 - D3069 D3080 - D8191 W000 - W1FFF	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Output module	Roller	Torque limit value setting device	–	–(300%)/word device			3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Ball-screw	Torque limit value setting device	–	–(300%)/word device			3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Rotary Table	Torque limit value setting device	–	–(300%)/word device			3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Virtual axis present value in one revolution storage device (main shaft side)	–	–/word device			END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Virtual axis present value in one revolution storage device (auxiliary input shaft side)	–	–/word device			END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
	Cam	Cam No. setting device	–	word device			3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Stroke setting device	–	word device			END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Torque control limit setting device	–	–(300%)/word device			3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Stroke lower limit value setting device	–	–/word device			END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Present value in one virtual axis revolution storage device (main shaft side)	–	–/word device			END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
		Present value in one virtual axis revolution storage device (auxiliary input shaft side)	–	–/word device			END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms

*1: For A171SCPU : 80 ms or sequence program scan time, whichever is longer
For A273UHCPU : 50 ms or sequence program scan time, whichever is longer

(6) Virtual axis/synchronous encoder processing time

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">A171SCPU</th><th colspan="3">A273UHCPU</th></tr>
<tr><th>1 Axis</th><th>2 Axes</th><th>3 - 4 Axes</th><th>1 - 8 Axes</th><th>9 - 18 Axes</th><th>9 - 32 Axes</th></tr>
<tr><td colspan="2">Servo Motor Axes</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Number of virtual servomotors</td><td>1 - 2</td><td>3.5 ms</td><td>3.5 ms</td><td>7.1 ms</td><td rowspan="4">3.5 ms</td><td rowspan="4">7.1 ms</td><td rowspan="4">14.2 ms</td></tr>
<tr><td>3 - 4</td><td>3.5 ms</td><td>3.5 ms</td><td>7.1 ms</td></tr>
<tr><td>5 - 6</td><td>–</td><td>7.1 ms</td><td>7.1 ms</td></tr>
<tr><td>7 - 8</td><td>–</td><td>–</td><td>7.1 ms</td></tr>
<tr><td>9 - 16</td><td>–</td><td>–</td><td>–</td><td>7.1 ms</td><td>7.1 ms</td><td>14.2 ms</td></tr>
<tr><td>17 - 32</td><td>–</td><td>–</td><td>–</td><td>14.2 ms</td><td>14.2 ms</td><td>28.4 ms</td></tr>
<tr><td rowspan="2">Number of synchronous encoders</td><td>1 - 6</td><td>–</td><td>–</td><td>–</td><td>3.5 ms</td><td>7.1 ms</td><td>14.2 ms</td></tr>
<tr><td>7 - 12</td><td>–</td><td>–</td><td>–</td><td>7.1 ms</td><td>14.2 ms</td><td>14.2 ms</td></tr>
</table>

(7) DSFRP, SVST, DSFLP, END instruction processing time

The table below shows the processing times for the sequence program instructions used to start positioning control, etc.

Refer to the ACPU Programming Manual (Common Instructions) (IB-66250) for the processing times of sequence program instructions not listed below.

A171SCPU : Same as A1SCPU processing times
A273UHCPU : Same as A3UCPU processing times

<table>
<tr><th colspan="3"></th><th>A171SCPU</th><th colspan="2">A273UHCPU (8-axis Specification)</th><th colspan="4">A273UHCPU (32-axis Specification)</th></tr>
<tr><th colspan="2"></th><th>Axes Used</th><th>4 Axis</th><th>4 Axis</th><th>8 Axis</th><th>4 Axis</th><th>8 Axis</th><th>16 Axis</th><th>32 Axis</th></tr>
<tr><td rowspan="3">DSFRP</td><td colspan="2">Start 1 axis</td><td>180 μs</td><td colspan="2">25 μs</td><td colspan="4">–</td></tr>
<tr><td colspan="2">Start 2, 3 axes</td><td>200 μs</td><td colspan="2">25 μs</td><td colspan="4">–</td></tr>
<tr><td colspan="2">Error</td><td>850 μs</td><td colspan="2">120 μs</td><td colspan="4">–</td></tr>
<tr><td rowspan="4">DSFLP</td><td rowspan="2">Change present value</td><td>Normal</td><td>120 μs</td><td colspan="2">10 μs</td><td colspan="4">–</td></tr>
<tr><td>Error</td><td>770 μs</td><td colspan="2">25 μs</td><td colspan="4">–</td></tr>
<tr><td rowspan="2">Speed control</td><td>Normal</td><td>80 μs</td><td colspan="2">15 μs</td><td colspan="4">–</td></tr>
<tr><td>Error</td><td>700 μs</td><td colspan="2">30 μs</td><td colspan="4">–</td></tr>
<tr><td rowspan="3">SVST</td><td colspan="2">Start 1 axis</td><td>190 μs</td><td colspan="2">35 μs</td><td colspan="4">35 μs</td></tr>
<tr><td colspan="2">Start 2, 3, 4 axes</td><td>700 μs</td><td colspan="2">70 μs</td><td colspan="4">70 μs</td></tr>
<tr><td colspan="2">Error</td><td>900 μs</td><td colspan="2">150 μs</td><td colspan="4">150 μs</td></tr>
<tr><td colspan="3">END</td><td>7600 μs</td><td colspan="2">5000 μs</td><td colspan="4">5000 μs</td></tr>
</table>

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