MITSUBISHI

MOTION CONTROLLER (SV22) (VIRTUAL MODE)

Programming Manual

type A173UHCPU, A273UHCPU

MITSUBISHI ELECTRIC

INTORODUCTION

Thank you for purchasing the Mitsubishi Motion Controller.
This instruction manual describes the handing 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 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 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.

⚠ CAUTION
⚠ Use wires and cables within the length of the range described in user's manual or the instruction manual for the product you are using . ⚠ 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 assigment 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 encoder.
- ⚠ When transporting the control unit or servo amplifier, never hold the front case as it may fall off.
- ⚠ When transporting, installing or removing the control unit or servo amplifier, never hold the edges.
- ⚠ Install the unit according to user's manual, or the instruction manual for the product you are using in a place where the weight can be withstood.
- ⚠ Do not get on or place heavy objects on the product.
- ⚠ Always observe the installation direction.
- ⚠ Keep the designated clearance between the control unit or servo amplifier and control panel inner surface or the control unit and servo amplifier, control unit or servo amplifier and other devices.
- ⚠ Do not 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 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 (305 Feet) or less above sea level	
Vibration	According to each instruction manual	

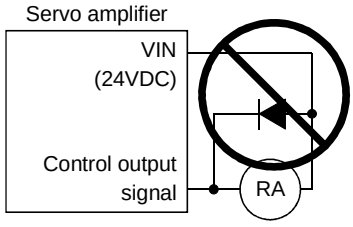
⚠ CAUTION

- ⚠ 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 encoder damage.
- ⚠ Do not apply a load larger than the tolerable load onto the servomotor shaft. Doing so may lead to shaft breakage.
- ⚠ When not using the unit for a long time, disconnect the power line from the control unit or servo amplifier.
- ⚠ Place the control unit and servo amplifier in static electricity preventing vinyl bags and store.
- ⚠ When storing for a long time, contact the System Service or Service Station.

(4) Wiring

⚠ CAUTION

- ⚠ Correctly and securely wire the wires. Reconfirm the connections for mistakes and the terminal screws for tightness after wiring. Failing to do so may lead to run away of the servomotor.
- ⚠ After wiring, install the protective covers such as the terminal covers to the original positions.
- ⚠ Do not install a phase advancing capacitor, surge absorber or radio noise filter (option FR-BIF) on the output side of the servo amplifier.
- ⚠ Correctly connect the output side (terminals U, V, W). Incorrect connections will lead the servomotor to operate abnormally.
- ⚠ Do not connect a commercial power supply to the servomotor, as this may lead to trouble.
- ⚠ Do not mistake the direction of the surge absorbing diode installed on the DC relay for the control signal output of brake signals, etc. Incorrect installation may lead to signals not being output when trouble occurs or the protective functions not functioning.



- ⚠ Do not connect or disconnect the connection cables between each unit, the encoder cable or PLC expansion cable while the power is ON.
- ⚠ Securely tighten the cable connector fixing screws and fixing mechanisms. Insufficient fixing may lead to the cables combing off during operation.
- ⚠ Do not bundle the power line or cables.

(5) Trial operation and adjustment

⚠ CAUTION

- ⚠ Confirm and adjust the program and each parameter before operation. Unpredictable movements may occur depending on the machine.
- ⚠ Extreme adjustments and changes may lead to unstable operation, so never make them.
- ⚠ If the absolute positioning system is used, zeroing is required after initial start up or after replacement of a controller or absolute positioning compatible motor.

(6) Usage methods

⚠ CAUTION

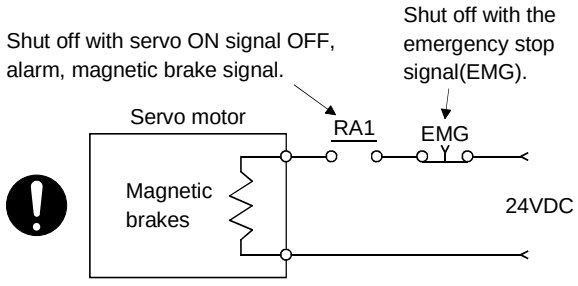
- ⚠ Immediately turn OFF the power if smoke, abnormal sounds or odors are emitted from the control unit, servo amplifier or servomotor.
- ⚠ Always execute a test operation before starting actual operations after the program or parameters have been changed or after maintenance and inspection.
- ⚠ The 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.
- ⚠ When using the CE mark-compatible equipment, refer to "EMC Installation Guidelines" (manual number IB(NA)-67339) for the motion controller and to the corresponding EMC Guideline data for the servo amplifier, inverter and other equipment.
- ⚠ Use the units with the following conditions.

Item	Conditions
Input power	According to A273UHCPU/A173UHCPU(-S1) user's manual
Input frequency	According to A273UHCPU/A173UHCPU(-S1) user's manual
Tolerable momentary power failure	According to A273UHCPU/A173UHCPU(-S1) user's manual

(7) Remedies for errors

⚠ CAUTION

- ⚠ If an error occurs in the self diagnosis of the control unit or servo amplifier, confirm the check details according to 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 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.

⚠ CAUTION

- ⚠ Do not place fingers or hands in the clearance when opening or closing any opening.
- ⚠ Periodically replace consumable parts such as batteries according to user's manual or the instruction manual for the product you are using.
- ⚠ 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.
- ⚠ 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 zeroing.
  1) PC write the servo data with the peripheral device, turn the power OFF and back ON, then conduct zeroing.
  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 System Service or Service Station.

(9) Disposal

⚠ CAUTION

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

(10) General cautions

⚠ CAUTION

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

Revisions

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

Print Date	*Manual Number	Revision
Jun.,2001	IB(NA)-0300029-A	First edition

CONTENTS

1. GENERAL DESCRIPTION

1. GENERAL DESCRIPTION

The A273UHCPU/A173UHCPU(-SI) (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-SV22U
- SW2SRX-SV22A

..... Abbreviated to “SV22”

This manual explains the mechanical system 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 REAL Mode)
Programming Manual (type A273UHCPU/A173UHCPU(-S1))..... IB-0300028

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
MR-H-BN/MR-J2S-B/MR-J2-B type servo amplifier	MR-□-B
AC motor drive module	ADU

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

⚠ CAUTION

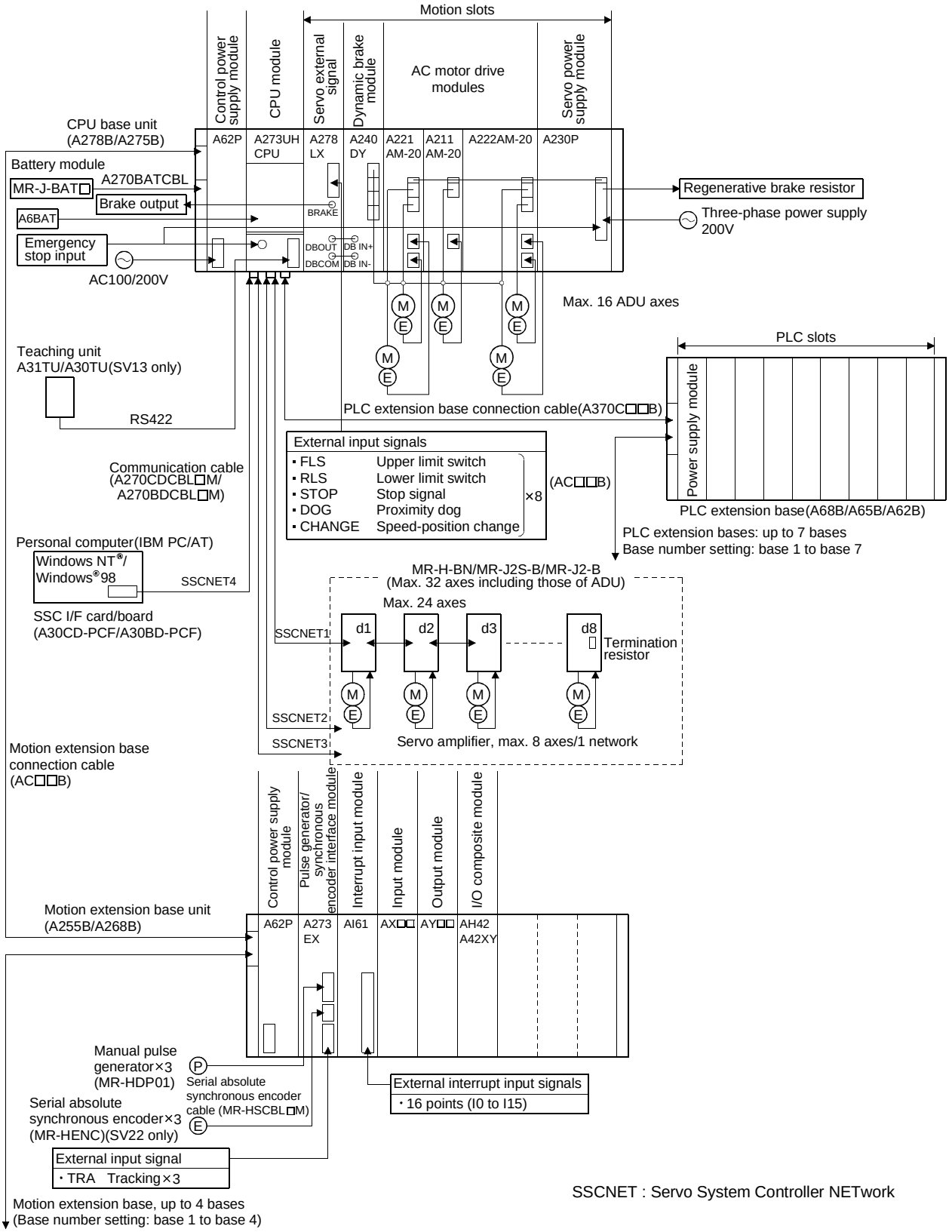
⚠ When designing the system, provide external protective and safety circuits for safety in the event of trouble with the motion controller.
⚠ Printed circuit boards have components susceptible to the effects of static electricity mounted on them: ground your body or the work bench before handling them.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

1. GENERAL DESCRIPTION

1.1 System Configuration

1.1.1 A273UHCPU System overall configuration

The following system configuration assumes use of the A273UHCPU.



NOTES

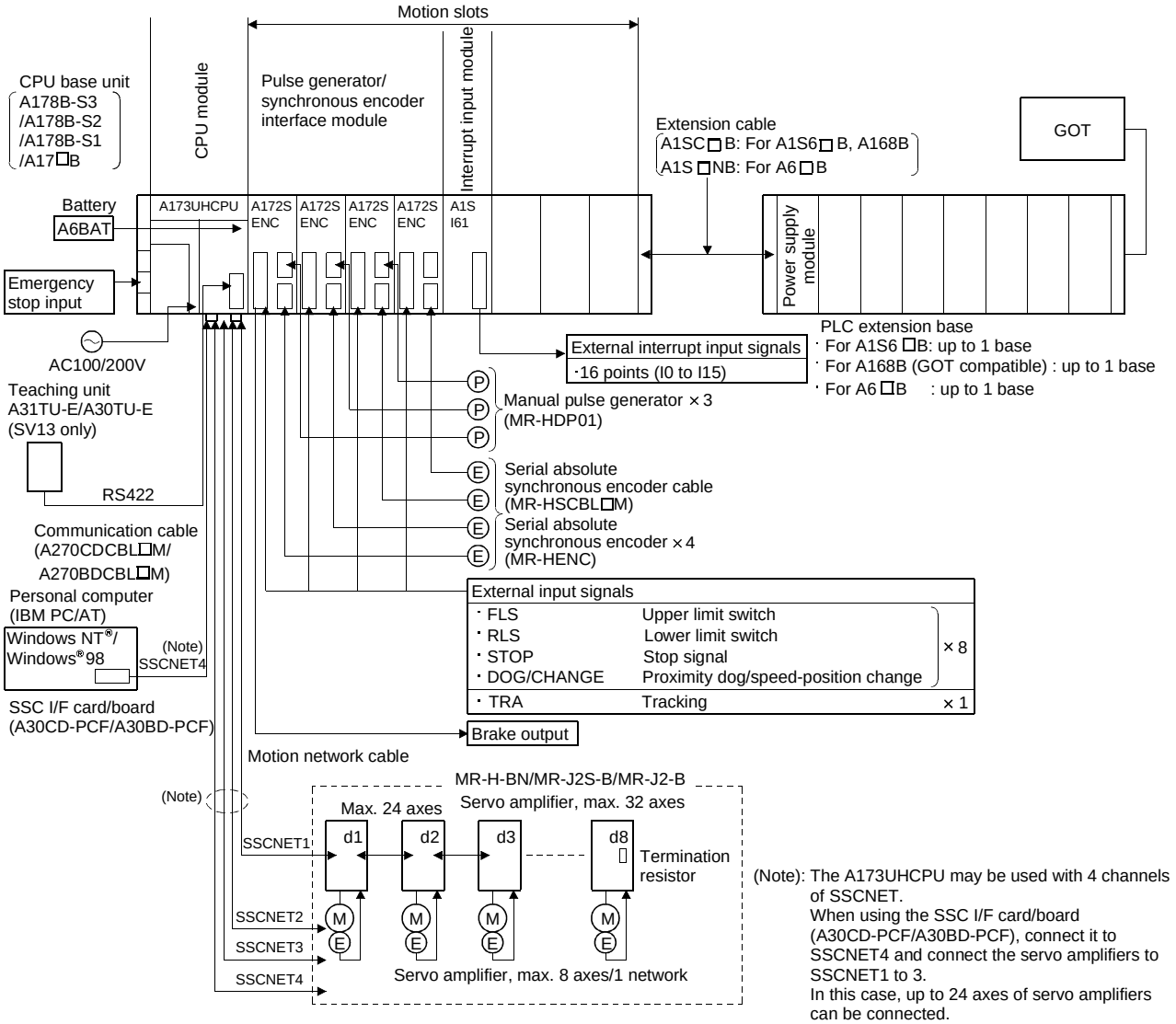
(1) A servo system CPU can be connected to a maximum of four motion extension base unit.

(2) The motion extension base units which can be used are indicated below.
- A255B (control power supply not required)
- A268B (control power supply required)

(3) When using a teaching unit A31TU-E with dead-man switch, a dedicated connecting cable A31TUCBL03M is required between the CPU module and A31TU-E connector. If the A31TU-E is connected directly to the RS422 connector of the CPU without using a dedicated cable, the A31TU-E will not operate at all.
After disconnecting the A31TU-E, attach a short-circuit connector A31TUSHORTCON for A31TUCBL.

(4) When the power supply to the servo system CPU is switched ON and OFF, erroneous process outputs may temporarily be made due to the delay between the servo system CPU power supply and the external power supply for processing (especially DC), and the difference in startup times. For example, if the power supply to the servo system CPU comes on after the external power supply for processing comes on at a DC output module, the DC output module may temporarily give erroneous outputs when the power to the servo system CPU comes on. Accordingly a circuit that ensures that the power supply to the servo system CPU comes on first should be constructed.

1.1.2 A173UHCPU(-S1) System overall configuration



(Note): The A173UHCPU may be used with 4 channels of SSCNET.
When using the SSC I/F card/board (A30CD-PCF/A30BD-PCF), connect it to SSCNET4 and connect the servo amplifiers to SSCNET1 to 3.
In this case, up to 24 axes of servo amplifiers can be connected.

NOTES

(1) Use the A168B when using the bus-connection type GOT.
(2) When using a teaching unit A31TU-E with dead-man switch, a dedicated connecting cable A31TUCBL03M is required between the CPU module and A31TU-E connector. If the A31TU-E is connected directly to the RS422 connector of the CPU without using a dedicated cable, the A31TU-E will not operate at all.
After disconnecting the A31TU-E, attach a short-circuit connector A31TUSHORTCON for A31TUCBL.
(3) The motion slots also accept PLC A1S I/O modules.
(4) The motion slots accept one A1SI61 interrupt input module.
This module is designed for only event/NMI input to the motion CPU and is irrelevant to PLC interrupt programs.
(5) The motion slots accept up to 256 I/O points.
(6) The I/O numbers of the I/O modules loaded in the motion slots should be later than the I/O numbers used with the PLC slots.

1.2 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:

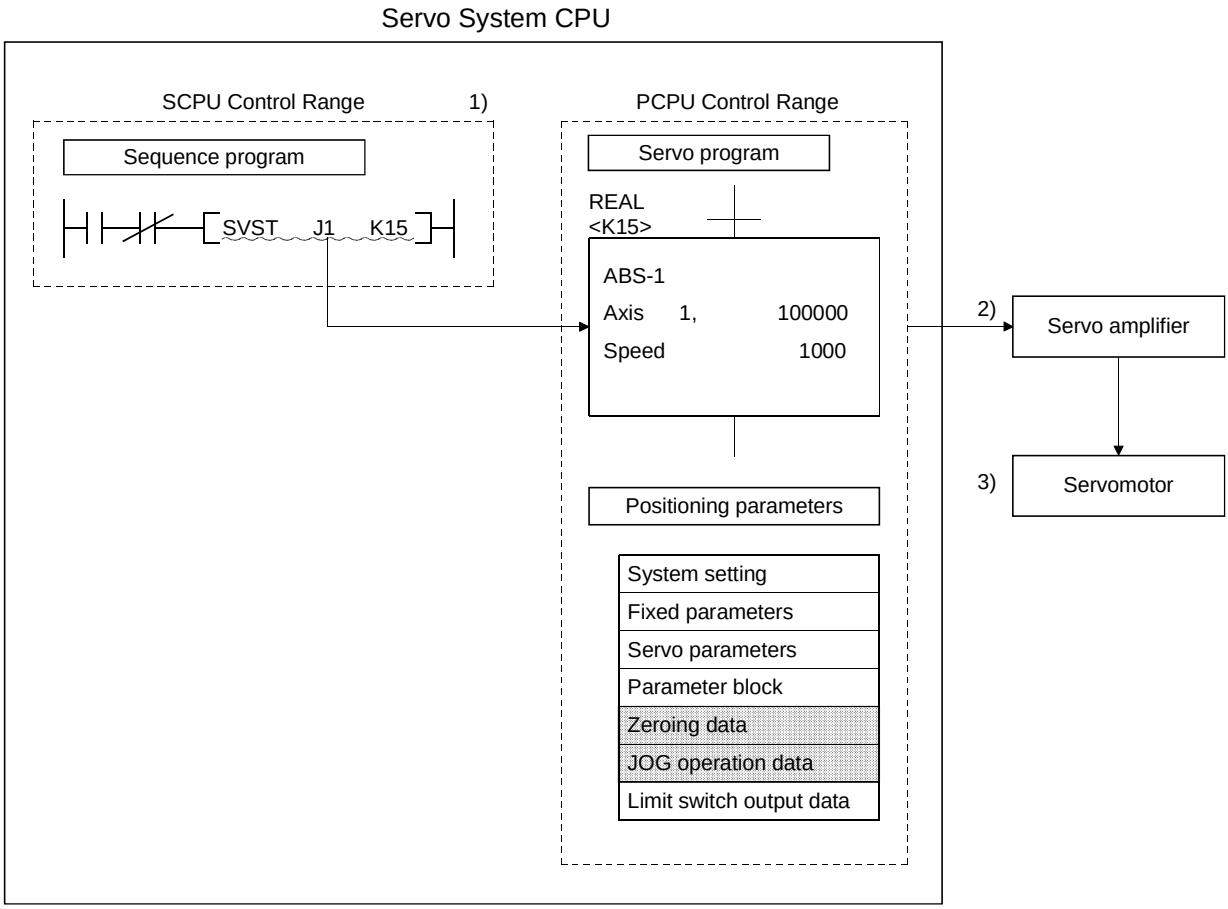
1) A REAL mode servo program "start request" is issued with a SVST instruction in the positioning sequence program.

↓

2) Positioning control occurs in accordance with the specified servo program. (Output to amplifier and servo amplifier modules.)

↓

3) Servomotor control is executed.



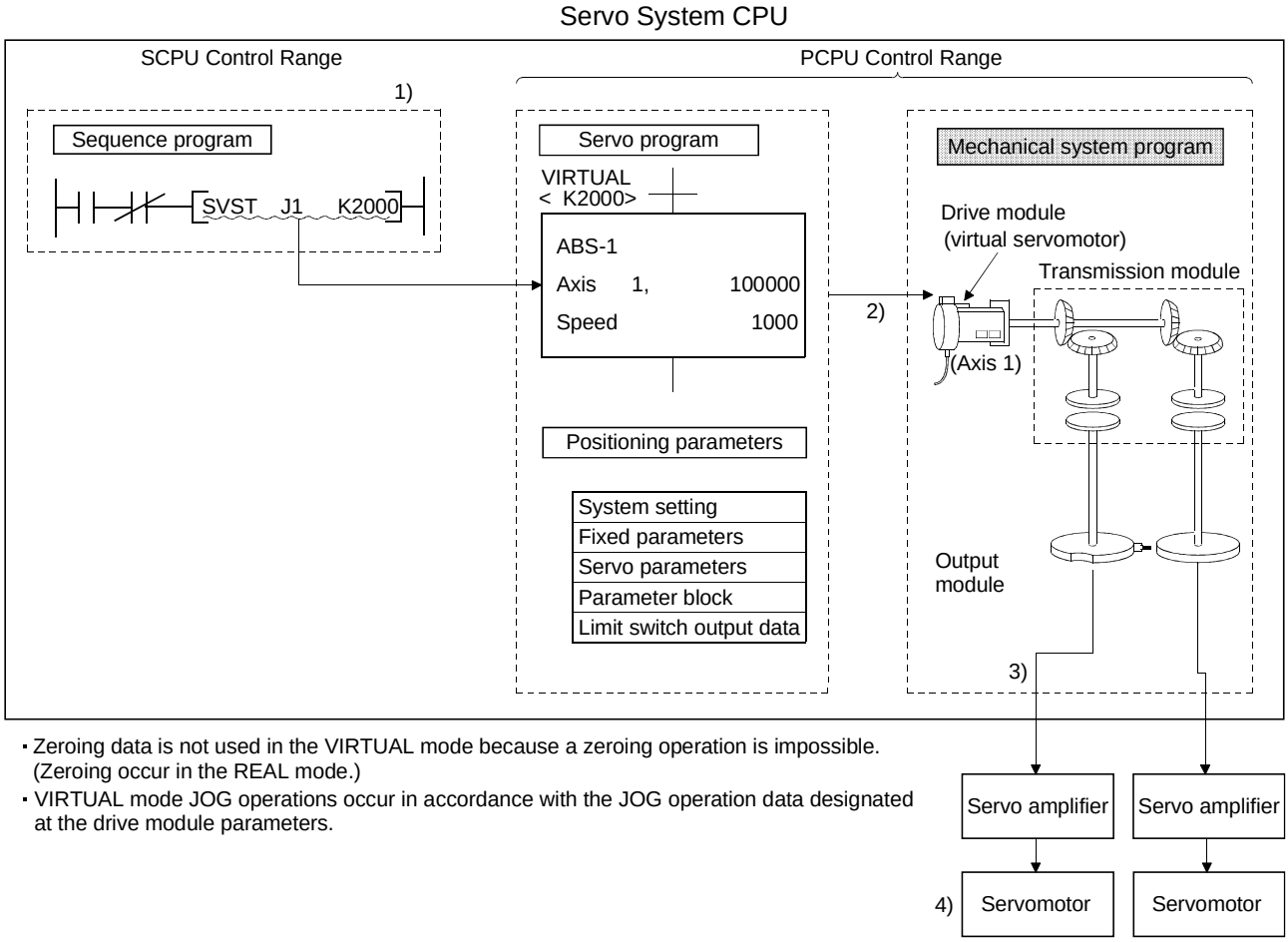
(2) VIRTUAL mode

(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 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.



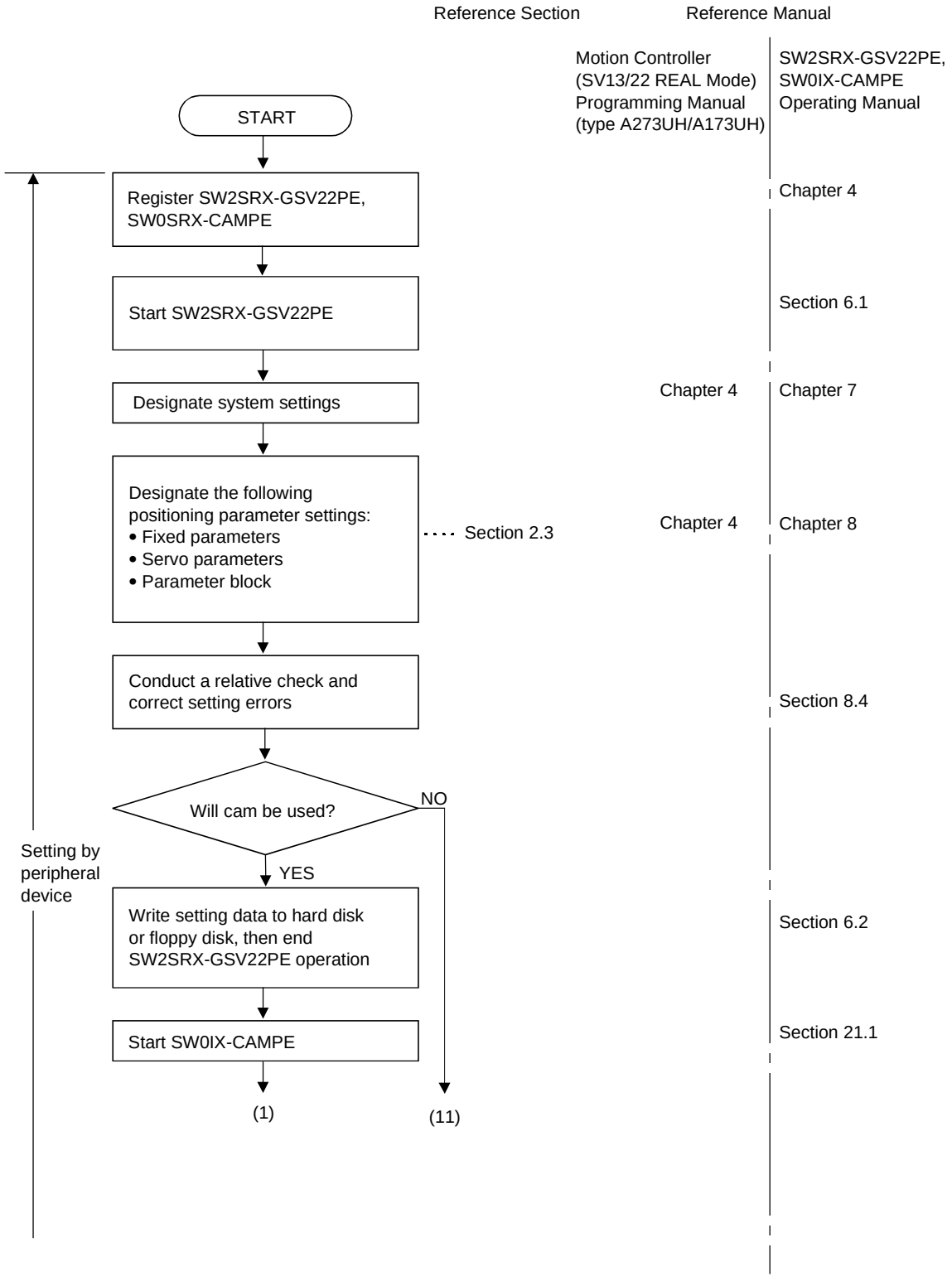
- Zeroing data is not used in the VIRTUAL mode because a zeroing operation is impossible. (Zeroing occur in the REAL mode.)
- VIRTUAL mode JOG operations occur in accordance with the JOG operation data designated at the drive module parameters.

2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

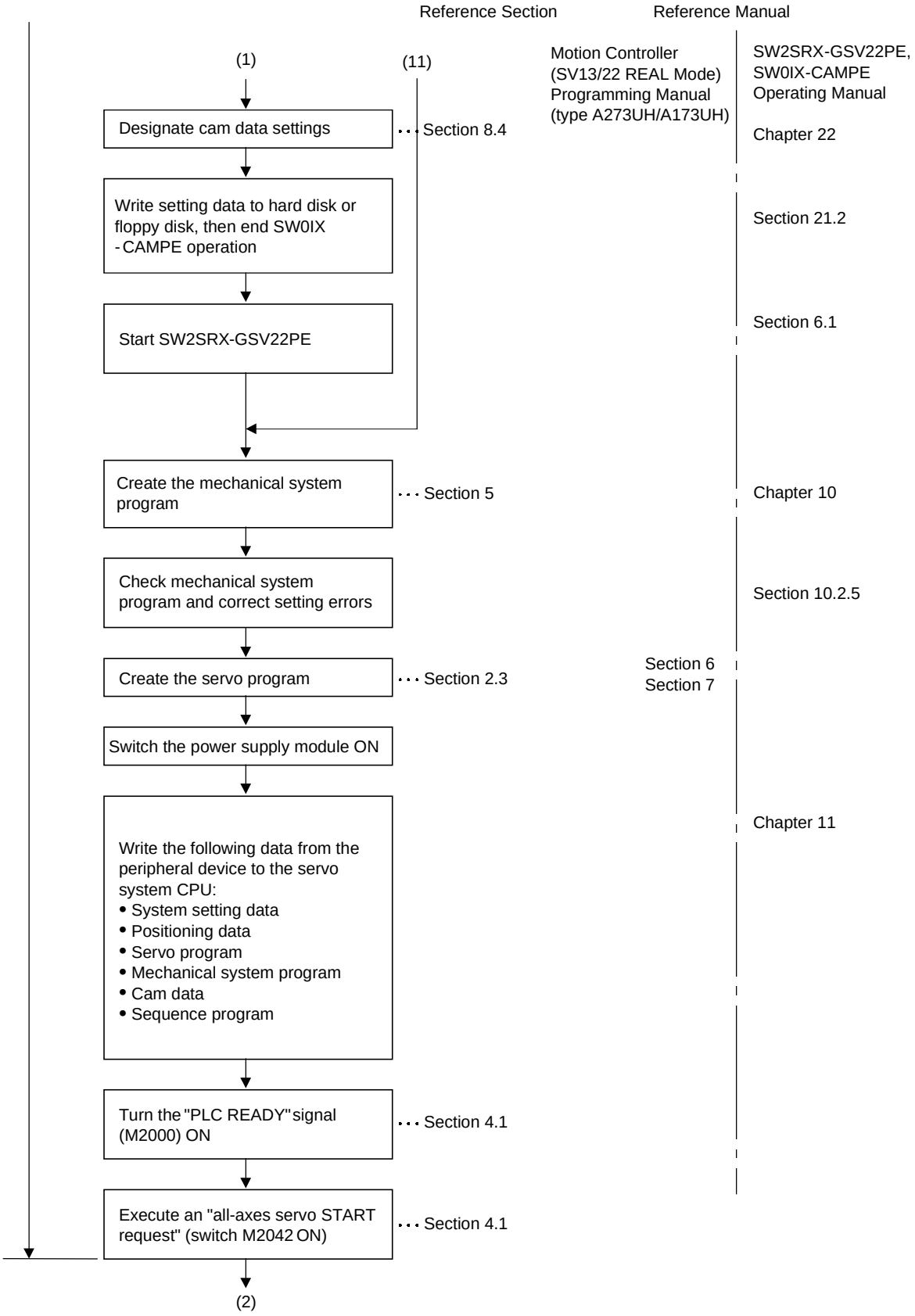
The procedure for VIRTUAL mode positioning control is discussed in this section.

2.1 System Start-Up

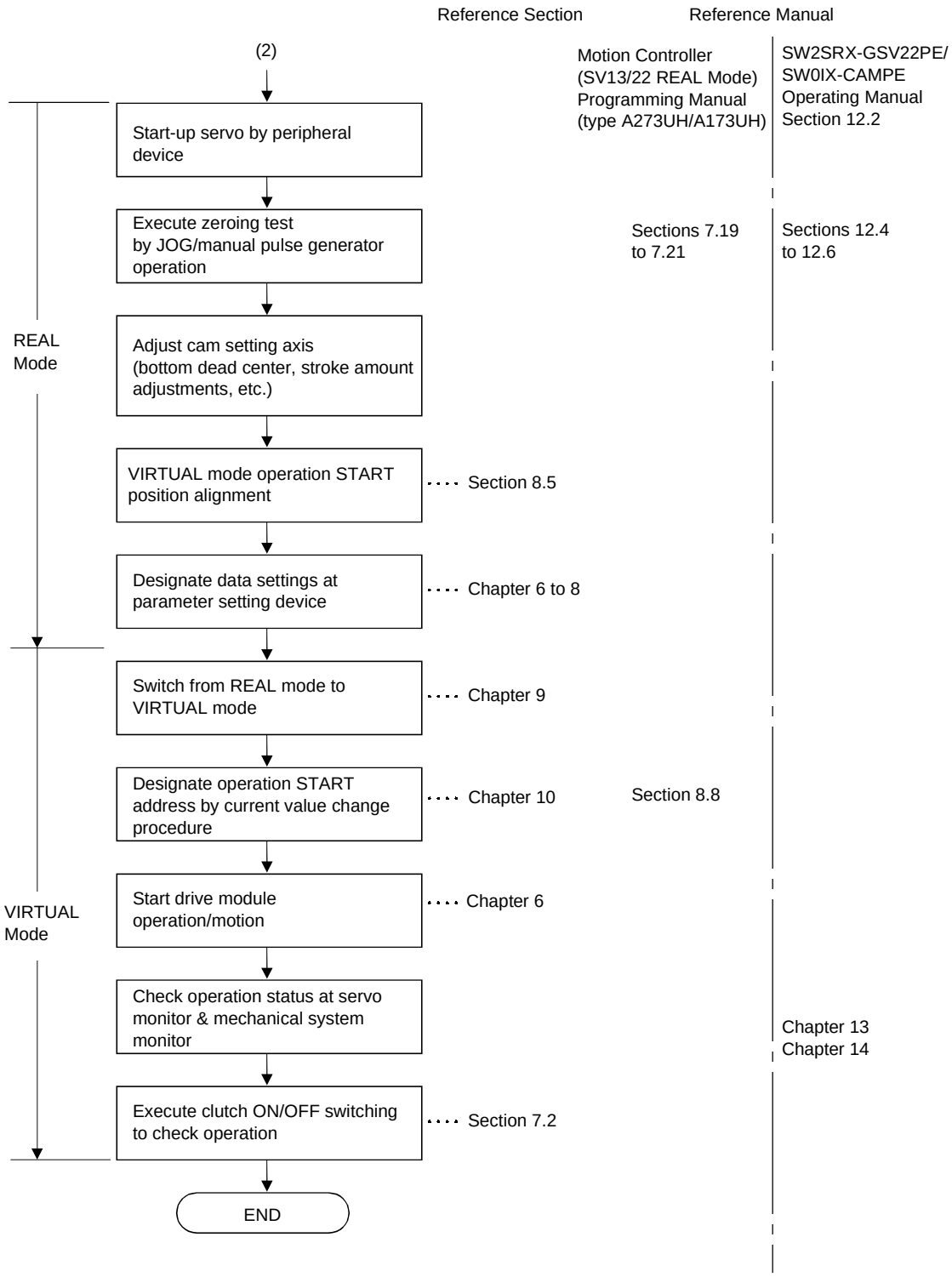
The procedure for a VIRTUAL mode system start-up is shown below.



2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL



2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL



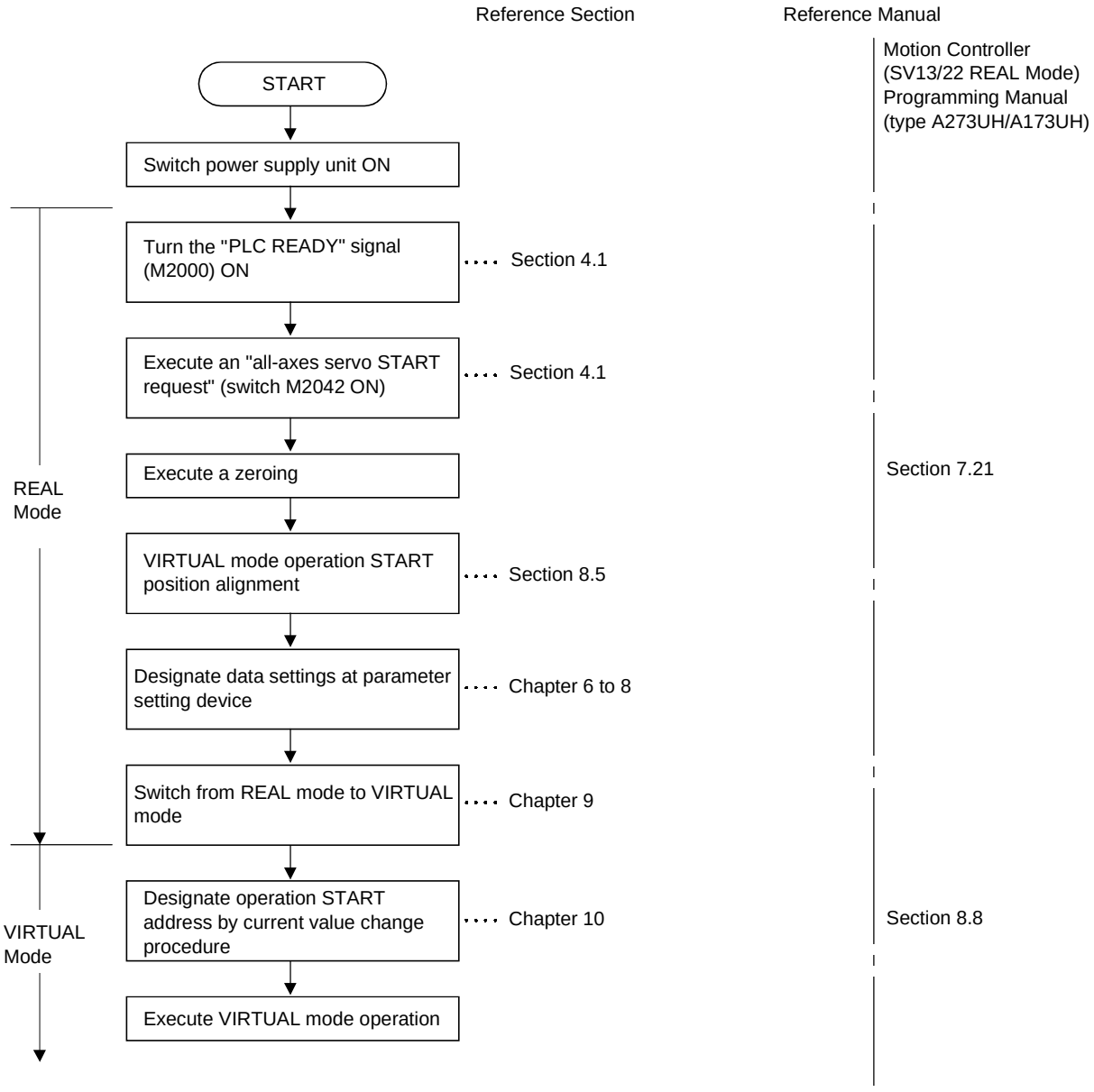
2. PROCEDURE FOR VIRTUAL MODE POSITIONING CONTROL

2.2 Operation

The preparation procedure for VIRTUAL mode operation is shown below.

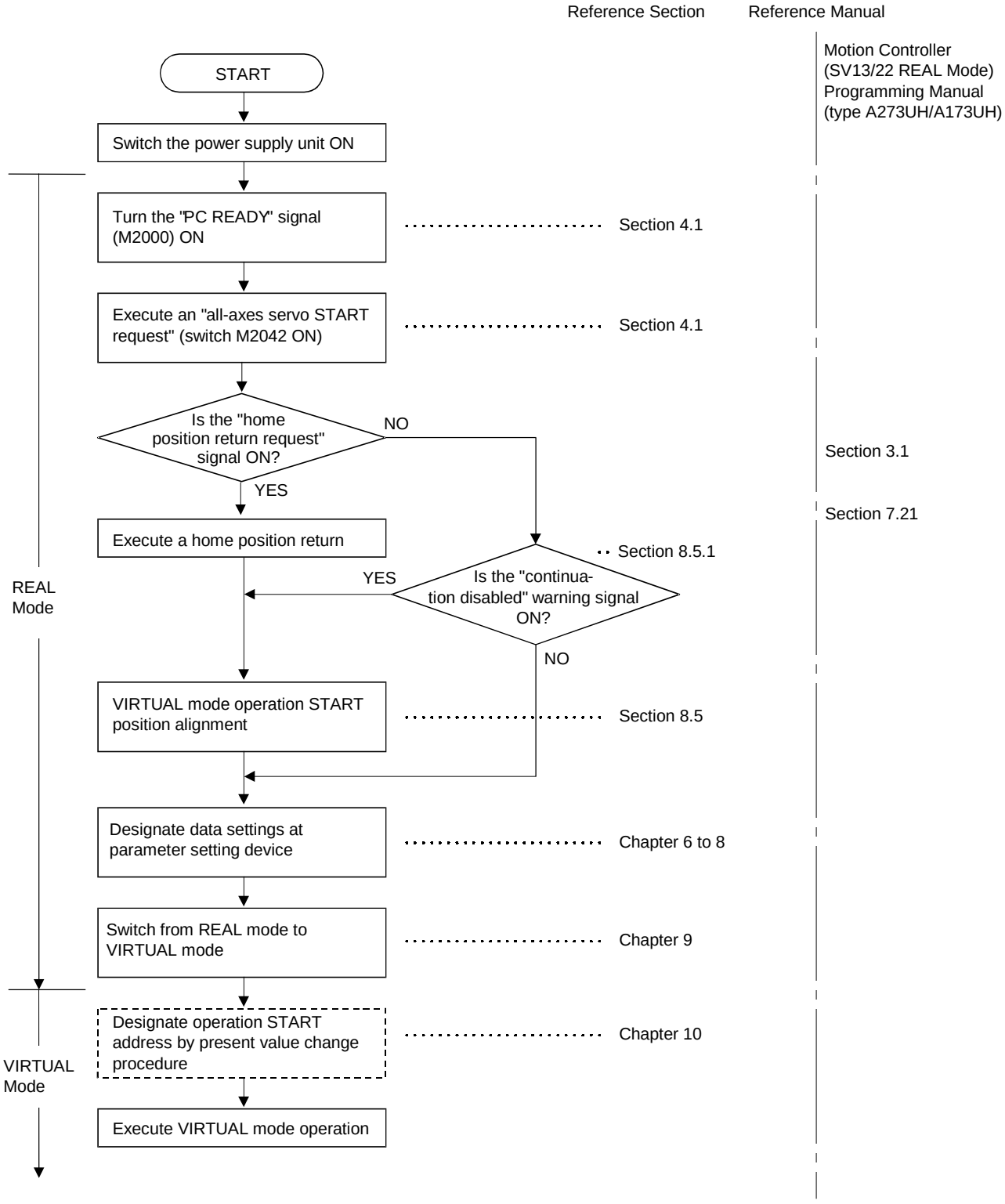
2.2.1 Operation with incremental system

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



2.2.2 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 REAL Mode) Programming Manual (type A273UH CPU/A173UHCPU(-S1)) 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	VIRTURL Mode	Remarks
System settings	○	○	
Fixed parameters	○	Δ	System-of-units varies according to the output module used
Servo parameters	○	○	
Parameter block	○	Δ	Use of "PULSE"only
Zeroing data	○	–	
JOG operation data	○	–	
Limit switch output data	○	Δ	

[○]:Used [ ]:Conditional use [–]:Not used

2.3.2 Positioning device

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

Table 2.2 Operating Range of Positioning Devices

Device Name	REAL Mode	VIRTURL Mode
Internal relays	M2000 to M3839	M2000 to M5487
Special relays	M9073 to M9079	
Data registers	D0 to D799	D0 to D1559
Special registers	D9180 to 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 zeroing, 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 REAL and VIRTUAL modes are shown in Table 2.3 below.

Table 2.3 Servo Instruction List for REAL & VIRTUAL Modes

Item			REAL Mode	VIRTURL Mode	Remarks
Servo instruction	Speed/ position control	VPF	○	×	
		VPR			
		VPSTART			
	Speed control(II)	VVF	○	×	
		VVR			
	Zeroing	ZERO	○	×	Switch to VIRTUAL mode after zeroing 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 (current value change & speed change)

When a control change is executed in the VIRTUAL mode, the drive module's feed current 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 2.4 below.

Table 2.4 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	
Current value change	○	○	Δ	×	×	×	Δ	The programming method for a synchronous encoder "current value change" is different (See Appendix 10.1.1)
Speed change	○	○	×	×(Note)				

REMARK

(1) The [○], [Δ], [×] symbols used in Table 2.4 indicate the following.
- [○] : Setting/execution possible
- [Δ] : Execution possible, but programming method is different
- [×] : Setting/execution impossible

(2) (Note): If the output module is a roller which uses a speed change gear, a speed change can be executed by changing the speed change gear ratio.

(3) For details regarding the drive and output modules, refer to the sections shown below.
- Drive module : Chapters 5 & 6
- Output module : Chapters 5 & 8

3. PERFORMANCE SPECIFICATIONS

3. Performance Specifications

Table 3.1 gives the performance specifications of the PCPU.

Table 3.1 PCPU Performance Specifications (VIRTUAL Mode)

Item			A273UHCPU	A173UHCPU	A173UHCPU-SI
Number of control axes			32 axes (simultaneous:2 to 4-axes, independent:32-axes)		
Control modes			Synchronous control, PTP(point to point), speed control, fixed-pitch feed, constant-speed control, position follow-up control, speed switching control		
Control units		Drive module	Virtual servo motor	PULSE	
			Synchronous encoder		
		Output module	Roller	mm·inch	
			Ball screw		
			Rotary table	Fixed as "degree"	
			Cam	mm·inch·PULSE	
Programming language			Dedicated instructions (servo programs + mechanical system programs)		
Servo program		Capacity	14k steps (14334 steps) * Capacity matching the servo program for the REAL mode		
		Number of points for positioning	Approx. 100 points/axis (These values vary depending on the programs. Positioning data can be designated indirectly.)		
Mechanical system program			Number of modules that can be set per CPU		
	Drive modules	VIRTUAL module	32-axes		
		Synchronous encoder	12-axes	4- axes	
	Virtual axes	Main shaft	32		
		Auxiliary input axis	32		
	Transmission modules	Gear	64		
		Clutch	64		
		Speed change gear	64		
		Differential gear	32		
		Differential gear for the main shaft	32		
	Output modules	Roller	32	Total of 32	
		Ball screw	32		
		Rotary table	32		
		Cam	32		
Program setting method			Setting with an IBM PC, running the SW2SRX-GSV22PE software		
Cam	Types		Max. 256	Max. 64	Max. 256
	Resolution per cycle		256·512·1024·2048		
	Memory capacity		132k bytes	Approx. 32k bytes	Approx. 132k bytes
	Storage memory for cam data and cam rotation mode limit		Strocked in block from No.10 of the memory cassette(Note-1) expansion file resister area.		
	Stroke resolution		32767		
	Control mode		Two-way cam/feed cam		
Cam data setting method			Setting with an IBM PC, running the SW0IX-CAMPE software		

3. PERFORMANCE SPECIFICATIONS

Table 3.1 PCPU Performance Specifications (VIRTUAL Mode) (Continued)

<table>
<tr><th colspan="3">Item</th><th>A273UHCPU</th><th>A173UHCPU</th><th>A173UHCPU-SI</th></tr>
<tr><td rowspan="9">Virtual servo motor</td><td colspan="2">Interpolation functions</td><td colspan="3">Linear interpolation (2 to 4-axes), circular interpolation (2-axes)</td></tr>
<tr><td colspan="2">Control modes</td><td colspan="3">PTP (point to point), speed control, fixed-pitch feed, constant-speed control, position follow-up control</td></tr>
<tr><td rowspan="3">Positioning</td><td>Method</td><td colspan="3">PTP :Selection of absolute data method or incremental method
Fixed pitch feed :Selection of incremental method
Constant speed control :The absolute method and incremental method can be used together
Position follow-up control :Absolute data method</td></tr>
<tr><td>Position command</td><td colspan="3">Address setting range –2147483648 to 2147483648 (PLS)</td></tr>
<tr><td>Speed command</td><td colspan="3">Speed setting range 1 to 10000000 (PLS/s)</td></tr>
<tr><td rowspan="2">Acceleration/ deceleration control</td><td>Automatic trapezoidal acceleration/ deceleration</td><td colspan="3"><table><tr><th>Acceleration–fixed acceleration/deceleration</th><th>Time–fixed acceleration/deceleration</th></tr><tr><td>Acceleration time: 1 to 65535 ms</td><td rowspan="2">Acceleration/deceleration time: 1 to 5000 ms
(Only constant-speed control is possible)</td></tr><tr><td>Deceleration time: 1 to 65535 ms</td></tr></table></td></tr>
<tr><td>S-curve acceleration/ deceleration</td><td colspan="3">S-curve ratio setting: 0 to 100%</td></tr>
<tr><td colspan="2">JOG operation function</td><td colspan="3">Provided</td></tr>
<tr><td colspan="2">M-function</td><td colspan="3">M-code output function provided, and M-code completion wait function provided</td></tr>
<tr><td colspan="2">Skip function</td><td colspan="3">Provided</td></tr>
<tr><td colspan="2">Manual pulse generator operation function(test mode only)</td><td colspan="2">• A maximum of three manual pulse generator can be connected.
• A maximum of three manual pulse generators can be operated.
• Setting of magnification : 1 to 100. It is possible to set the smoothing magnification.</td><td>• A maximum of three manual pulse generator can be connected.
• One A172SENC is required per piece.
• A maximum of three manual pulse generators can be operated.
• Setting of magnification : 1 to 100. It is possible to set the smoothing magnification.</td></tr>
<tr><td rowspan="3">Limit switch output function</td><td colspan="2">Number of output points</td><td colspan="3">8 points/axis</td></tr>
<tr><td colspan="2">Number of ON/OFF setting points</td><td colspan="3">10 points/axis</td></tr>
<tr><td colspan="2">Control mode</td><td colspan="3">Real current value mode/Cam axis current value in one revolution mode</td></tr>
<tr><td colspan="2" rowspan="2">High-speed reading of designated data</td><td>Number of input points (Note-2)</td><td>Max. 11 points
(TRA input of A273EX (3 point) + one motion slot PLC input module (8 points))</td><td colspan="2">Max. 9 points
(TRA input of A172SENC (1 point) + one motion slot PLC input module (8 points))</td></tr>
<tr><td>Data latch timing</td><td colspan="3">At leading edge of the TRA input signal
Within 0.8ms of the signal leading edge for the PLC input module</td></tr>
<tr><td colspan="3">Absolute position system</td><td colspan="3">Made compatible by fitting battery to servo amplifier.
(Possible to select the absolute method or incremental method for each axis)</td></tr>
</table>

(Note-1) When the cam is used in the virtual mode, only the following memory cassettes are usable.

For A273UHCPU

- A3NMCA16 (128k bytes)
- A3NMCA24 (192k bytes)
- A3NMCA40 (320k bytes)
- A3NMCA56 (448k bytes)
- A3AMCA96 (768k bytes)

Note that the A3NMCA16 is unusable when cam axis one-revolution mode limit switch output is provided in the virtual mode of SV22. (The A3NMCA24 or higher is required.)

(Note-2) When a TRA input signal is used as an "External input mode clutch" the high speed reading function can not be used.

4. SERVO SYSTEM CPU DEVICES

The servo system CPU devices for which positioning control is carried out using the VIRTUAL mode and the applications of these devices are explained in this chapter.
The signals which are sent from the PCPU to the SCPU indicate the PCPU device refresh cycle and the signals sent from the SCPU to the PCPU indicate the PCPU device fetch cycle.

4.1 Internal Relays

4.1.1 Internal relay list

A273UHCPU (○ Valid)

Device Number	Application	Real	Virtual
M0	User device (2000 points)		
M2000	Common device (320 points)	○	○
M2320	Unusable (80 points)	—	—
M2400	Axis status (20 points × 32 axes) Real mode ..... Axis Virtual mode ... Output module	○	○
M3040	Unusable (160 points)	—	—
M3200	Axis command signal (20 points × 32 axes) Real mode ..... Axis Virtual mode ... Output module	○	○
M3840	Unusable (60 points)	—	—
M4000 (Note-1)	Virtual servo motor axis status (20 points × 32 axes) (Note-2)	Backup	○
M4640 (Note-1)	Synchronous encoder axis status (4 points × 12 axes)	○	○
M4688 (Note-1)	Unusable (112 points)	—	—
M4800 (Note-1)	Virtual servo motor axis command signal (20 points × 32 axes) (Note-2)	×	○
M5440 (Note-1)	Synchronous encoder axis command signal (4 points × 12 axes)	×	○
M5488 (Note-1)	Unusable (113 points)	—	—
M5600 M8191	User device (2592 points)		

A173UHCPU(-SI) (○ Valid)

Device Number	Application	Real	Virtual
M0	User device (2000 points)		
M2000	Common device (320 points)	○	○
M2320	Unusable (80 points)	—	—
M2400	Axis status (20 points × 32 axes) Real mode ..... Axis Virtual mode ... Output module	○	○
M3040	Unusable (160 points)	—	—
M3200	Axis command signal (20 points × 32 axes) Real mode ..... Axis Virtual mode ... Output module	○	○
M3840	Unusable (60 points)	—	—
M4000 (Note-1)	Virtual servo motor axis status (20 points × 32 axes) (Note-2)	Backup	○
M4640 (Note-1)	Synchronous encoder axis status (4 points × 4 axes)	○	○
M4656 (Note-1)	Unusable (144 points)	—	—
M4800 (Note-1)	Virtual servo motor axis command signal (20 points × 32 axes) (Note-2)	×	○
M5440 (Note-1)	Synchronous encoder axis command signal (4 points × 4 axes)	×	○
M5456 (Note-1)	Unusable (32 points)	—	—
M5488 (Note-1) M8191	User device (2704 points)		

4. SERVO SYSTEM CPU DEVICES

POINTS

(Note-1) : When the VIRTUAL mode is used do not set M4000 to M5599 in the latch range.

(Note-2) : The virtual servo motor axis status signals/command signals occupy only the areas of the axes set in the mechanical system program. The area of an axis that is not set in the mechanical system program can be used by the user.

- Total number of points for the user devices

4592 points

4.1.2 Axis statuses

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

	Signal Name	Real	Virtual				Signal Direction	Refresh Cycle			Fetch Cycle		
			Roller	Ball screw	Rotary table	Cam		Preset number of axes (Note)			Preset number of axes (Note)		
								1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
								1 to 12	13 to24	25 to 32	1 to 12	13 to 24	25 to 32
0	Positioning start completion		OFF				SCPU ← PCPU	—					
1	Positioning completion												
2	In-position		○					3.5ms	7.1ms	14.2ms			
3	Command in-position		OFF					—					
4	Speed controlling							3.5ms	7.1ms	14.2ms			
5	Speed/position change latch												
6	Zero pass		○					Immediately					
7	Error detection												
8	Servo error detection	○						3.5ms	7.1ms	14.2ms			
9	Zeroing request							10ms	20ms				
10	Zeroing completion							3.5ms	7.1ms	14.2ms			
11	External signal FLS							10ms	20ms				
12	External signal RLS												
13	External signal STOP												
14	External signal DOG/CHANGE												
15	Servo ON/OFF status							3.5ms	7.1ms	14.2ms			
16	Torque limiting signal												
17	DOG/CHANGE signal							10ms	20ms				
18	Virtual mode continuation operation warning signal	○											
19	M-code outputting signal	○	OFF					—					

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.1.3 Axis command signal

Axis No.	Device Number	Signal Name															
1	M3200 to M3219	(○ Valid)															
2	M3220 to M3239		Signal Name	Real	Virtual				Signal Direction	Refresh Cycle			Fetch Cycle				
3	M3240 to M3259				Roller	Ball screw	Rotary table	Cam		Preset number of axes (Note)			Preset number of axes (Note)				
4	M3260 to M3279									1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32		
5	M3280 to M3299									1 to 12	13 to 24	25 to 32	1 to 12	13 to24	25 to 32		
6	M3300 to M3319	0	Stop command	○	×				SCPU → PCPU				—				
7	M3320 to M3339	1	Sudden stop command														
8	M3340 to M3359	2	Forward rotation JOG start														
9	M3360 to M3379	3	Reverse rotation JOG start														
10	M3380 to M3399	4	Completion signal OFF command														
11	M3400 to M3419																
12	M3420 to M3439	5	Speed/position change enable														
13	M3440 to M3459																
14	M3460 to M3479	6	Limit switch output enable		○								3.5ms	7.1ms	14.2ms		
15	M3480 to M3499	7	Error reset										10ms				
16	M3500 to M3519	8	Servo error reset														
17	M3520 to M3539	9	Start-time stop input/disable		×								—				
18	M3540 to M3559																
19	M3560 to M3579	10	Unusable	—	—												
20	M3580 to M3599	11	Unusable														
21	M3600 to M3619	12	Feed current value update command	○	×								At switching from real to virtual				
22	M3620 to M3639																
23	M3640 to M3659	13	Address clutch reference setting	×	×		○										
24	M3660 to M3679																
25	M3680 to M3699	14	Cam reference position setting		×			○									
26	M3700 to M3719																
27	M3720 to M3739	15	Servo OFF	○	○								3.5ms	7.1ms	14.2ms		
28	M3740 to M3759	16	Unusable	—	—								—				
29	M3760 to M3779	17	Unusable														
30	M3780 to M3799	18	Unusable														
31	M3800 to M3819	19	FIN signal	○	×								—				
32	M3820 to M3839																

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.1.4 Virtual servo motor axis statuses

Axis No.	Device Number	Signal Name
1	M4000 to M4019	(○ Valid)
2	M4020 to M4039	
3	M4040 to M4059	
4	M4060 to M4079	
5	M4080 to M4099	
6	M4100 to M4119	
7	M4120 to M4139	
8	M4140 to M4159	
9	M4160 to M4179	
10	M4180 to M4199	
11	M4200 to M4219	
12	M4220 to M4239	
13	M4240 to M4259	
14	M4260 to M4279	
15	M4280 to M4299	
16	M4300 to M4319	
17	M4320 to M4339	
18	M4340 to M4359	
19	M4360 to M4379	
20	M4380 to M4399	
21	M4400 to M4419	
22	M4420 to M4439	
23	M4440 to M4459	
24	M4460 to M4479	
25	M4480 to M4499	
26	M4500 to M4519	
27	M4520 to M4539	
28	M4540 to M4559	
29	M4560 to M4579	
30	M4580 to M4599	
31	M4600 to M4619	
32	M4620 to M4639	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note))			Fetch Cycle (Preset number of axes (Note))		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to24	19 to 32 / 25 to 32
0	Positioning start completion	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
1	Positioning completion									
2	Unusable		—		—					
3	Command in-position		○		3.5ms	7.1ms	14.2ms			
4	Speed controlling									
5	Unusable		—		—					
6	Unusable									
7	Error detection		○		Immediately					
8	Unusable		—		—					
9	Unusable									
10	Unusable									
11	Unusable									
12	Unusable									
13	Unusable									
14	Unusable									
15	Unusable									
16	Unusable									
17	Unusable									
18	Unusable									
19	M-code outputting signal		○		3.5ms	7.1ms	14.2ms			

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.1.5 Virtual servo motor axis command signals

Axis No.	Device Number	Signal Name
1	M4800 to M4819	(○ Valid)
2	M4820 to M4839	
3	M4840 to M4859	
4	M4860 to M4879	
5	M4880 to M4899	
6	M4900 to M4919	
7	M4920 to M4939	
8	M4940 to M4959	
9	M4960 to M4979	
10	M4980 to M4999	
11	M5000 to M5019	
12	M5020 to M5039	
13	M5040 to M5059	
14	M5060 to M5079	
15	M5080 to M5099	
16	M5100 to M5119	
17	M5120 to M5139	
18	M5140 to M5159	
19	M5160 to M5179	
20	M5180 to M5199	
21	M5200 to M5219	
22	M5220 to M5239	
23	M5240 to M5259	
24	M5260 to M5279	
25	M5280 to M5299	
26	M5300 to M5319	
27	M5320 to M5339	
28	M5340 to M5359	
29	M5360 to M5379	
30	M5380 to M5399	
31	M5400 to M5419	
32	M5420 to M5439	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note)) 1 to 8 / 1 to 12	Refresh Cycle (Preset number of axes (Note)) 9 to 18 / 13 to24	Refresh Cycle (Preset number of axes (Note)) 19 to 32 / 25 to 32	Fetch Cycle (Preset number of axes (Note)) 1 to 8 / 1 to 12	Fetch Cycle (Preset number of axes (Note)) 9 to 18 / 13 to24	Fetch Cycle (Preset number of axes (Note)) 19 to 32 / 25 to 32
0	Stop command	×	○	SCPU → PCPU				3.5ms	7.1ms	14.2ms
1	Sudden stop command									
2	Forward rotation JOG start							10ms		
3	Reverse rotation JOG start									
4	Completion signal OFF command									
5	Unusable	—	—					—		
6	Unusable									
7	Error reset	×	○					10ms	20ms	
8	Unusable	—	—					—		
9	Start-time stop input/disable	×	○					At start		
10	Unusable	—	—					—		
11	Unusable									
12	Unusable									
13	Unusable									
14	Unusable									
15	Unusable									
16	Unusable									
17	Unusable									
18	Unusable									
19	FIN signal	×	○					3.5ms	7.1ms	14.2ms

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.1.6 Synchronous encoder axis statuses

Axis No.	Device Number	
	A273UHCPU	A173UHCPU (-S1)
1	M4640 to M4643	M4640 to M4643
2	M4644 to M4647	M4644 to M4647
3	M4648 to M4651	M4648 to M4651
4	M4652 to M4655	M4652 to M4655
5	M4656 to M4659	
6	M4660 to M4663	
7	M4664 to M4667	
8	M4668 to M4671	
9	M4672 to M4675	
10	M4676 to M4679	
11	M4680 to M4683	
12	M4684 to M4687	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note))			Fetch Cycle (Preset number of axes (Note))		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32
0	Error detection	○	○	SCPU ← PCPU	Immediately					
1	External signal TRA				10ms	20ms				
2	Virtual mode continuation operation disable warning									
3	Unusable	—	—		—					

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.1.7 Synchronous encoder axis command signals

Axis No.	Device Number	
	A273UHCPU	A173UHCPU (-S1)
1	M5440 to M5443	M5440 to M5443
2	M5444 to M5447	M5444 to M5447
3	M5448 to M5451	M5448 to M5451
4	M5452 to M5455	M5452 to M5455
5	M5456 to M5459	
6	M5460 to M5463	
7	M5464 to M5467	
8	M5468 to M5471	
9	M5472 to M5475	
10	M5476 to M5479	
11	M5480 to M5483	
12	M5484 to M5487	

Signal Name

(○ Valid)

	Signal Name	Real	VirtualL	Signal Direction	Refresh Cycle (Preset number of axes (Note))			Fetch Cycle (Preset number of axes (Note))		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32
0	Error reset	×	○	SCPU → PCPU				10ms	20ms	
1	Unusable	—	—					—		
2	Unusable									
3	Unusable									

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.1.8 Common devices

Device Number	Signal Name	(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
M2000	PLC ready flag	○	○	SCPU→PCPU				10ms	20ms	
M2001	Axis 1	○	○	SCPU←PCPU	10ms					
M2002	Axis 2									
M2003	Axis 3									
M2004	Axis 4									
M2005	Axis 5									
M2006	Axis 6									
M2007	Axis 7									
M2008	Axis 8									
M2009	Axis 9									
M2010	Axis 10									
M2011	Axis 11									
M2012	Axis 12									
M2013	Axis 13									
M2014	Axis 14									
M2015	Axis 15									
M2016	Axis 16									
M2017	Axis 17									
M2018	Axis 18									
M2019	Axis 19									
M2020	Axis 20									
M2021	Axis 21									
M2022	Axis 22									
M2023	Axis 23									
M2024	Axis 24									
M2025	Axis 25									
M2026	Axis 26									
M2027	Axis 27									
M2028	Axis 28									
M2029	Axis 29									
M2030	Axis 30									
M2031	Axis 31									
M2032	Axis 32									
M2033	Unusable (1 point)	——	——	——	——			——		
M2034	Personal computer link communication error flag	○	○	SCPU←PCPU	10ms					
M2035	Unusable (5 points)	——	——	——	——			——		
M2036										
M2037										
M2038										
M2039										
M2040	Speed change point designation flag	○	○	SCPU→PCPU				At start		
M2041	System setting error flag			SCPU←PCPU	END					
M2042	All-axis servo ON command			SCPU→PCPU				3.5ms	7.1ms	14.2ms
M2043	Real/virtual mode change request									
M2044	Real/virtual mode change status									
M2045	Real/virtual mode change error detection			SCPU→PCPU	END (Note-2)					
M2046	Out-of-sync warning									
M2047	Motion slot fault detection flag				10ms					
M2048	JOG simultaneous start command			SCPU←PCPU				10ms	20ms	
M2049	All-axis servo ON acceptance flag			SCPU→PCPU	END (Note-2)					
M2050	Start buffer full									
M2051	Manual pulse generator 1 enable flag	○	×	SCPU→PCPU				10ms	20ms	
M2052	Manual pulse generator 2 enable flag									
M2053	Manual pulse generator 3 enable flag									
M2054	Unusable (2 points)	——	——	——	——			——		
M2055										
M2056	Cam/limit switch output data batch-change request flag	○	○	SCPU→PCPU						
M2057	Cam/limit switch output data batch-change completion flag			SCPU←PCPU	END (Note-2)					
M2058	Cam/limit switch output data batch-change error flag									
M2059	Unusable (2 points)	——	——	——	——			——		
M2060										
M2061	Axis 1	○	○	SCPU←PCPU	END (Note-2)					
M2062	Axis 2									
M2063	Axis 3									
M2064	Axis 4									
M2065	Axis 5									
M2066	Axis 6									
M2067	Axis 7									
M2068	Axis 8									
M2069	Axis 9									
M2070	Axis 10									
M2071	Axis 11									
M2072	Axis 12									
M2073	Axis 13									
M2074	Axis 14									
M2075	Axis 15									
M2076	Axis 16									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

Device Number	Signal Name	(○ Valid) Real	(○ Valid) Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32
M2077	Axis 17 Speed changing flag	○	○	SCPU←PCPU	END (Note-2)					
M2078	Axis 18									
M2079	Axis 19									
M2080	Axis 20									
M2081	Axis 21									
M2082	Axis 22									
M2083	Axis 23									
M2084	Axis 24									
M2085	Axis 25									
M2086	Axis 26									
M2087	Axis 27									
M2088	Axis 28									
M2089	Axis 29									
M2090	Axis 30									
M2091	Axis 31									
M2092	Axis 32									
M2093	Unusable (8 points)	——	——	——	——			——		
M2094										
M2095										
M2096										
M2097										
M2098										
M2099										
M2100										
M2101	Synchronous encoder Axis 1 Current value changing	×	○	SCPU←PCPU	END (Note-2)					
M2102	Axis 2									
M2103	Axis 3									
M2104	Axis 4									
M2105	Axis 5									
M2106	Axis 6									
M2107	Axis 7									
M2108	Axis 8									
M2109	Axis 9									
M2110	Axis 10									
M2111	Axis 11									
M2112	Axis 12									
M2113	Unusable (15 points)	——	——	——	——			——		
M2114										
M2115										
M2116										
M2117										
M2118										
M2119										
M2120										
M2121										
M2122										
M2123										
M2124										
M2125										
M2126										
M2127										
M2128	Axis 1 Automatically decelerating flag	○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
M2129	Axis 2									
M2130	Axis 3									
M2131	Axis 4									
M2132	Axis 5									
M2133	Axis 6									
M2134	Axis 7									
M2135	Axis 8									
M2136	Axis 9									
M2137	Axis 10									
M2138	Axis 11									
M2139	Axis 12									
M2140	Axis 13									
M2141	Axis 14									
M2142	Axis 15									
M2143	Axis 16									
M2144	Axis 17									
M2145	Axis 18									
M2146	Axis 19									
M2147	Axis 20									
M2148	Axis 21									
M2149	Axis 22									
M2150	Axis 23									
M2151	Axis 24									
M2152	Axis 25									
M2153	Axis 26									
M2154	Axis 27									
M2155	Axis 28									
M2156	Axis 29									
M2157	Axis 30									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time"

Device Number	Signal Name			(O Valid)		Signal Direction	Refresh Cycle			Fetch Cycle		
				Real	Virtual		Preset number of axes (Note-1)			Preset number of axes (Note-1)		
							1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
							1 to 12	13 to 24	25 to 32	1 to 12	13 to24	25 to 32
M2158	Axis 31	Automatically decelerating flag		○	○							
M2159	Axis 32											
M2160	Output axis 1	Main shaft side	Clutch status									
M2161		Auxiliary input axis side										
M2162	Output axis 2	Main shaft side										
M2163		Auxiliary input axis side										
M2164	Output axis 3	Main shaft side										
M2165		Auxiliary input axis side										
M2166	Output axis 4	Main shaft side										
M2167		Auxiliary input axis side										
M2168	Output axis 5	Main shaft side										
M2169		Auxiliary input axis side										
M2170	Output axis 6	Main shaft side										
M2171		Auxiliary input axis side										
M2172	Output axis 7	Main shaft side										
M2173		Auxiliary input axis side										
M2174	Output axis 8	Main shaft side										
M2175		Auxiliary input axis side										
M2176	Output axis 9	Main shaft side										
M2177		Auxiliary input axis side										
M2178	Output axis 10	Main shaft side										
M2179		Auxiliary input axis side										
M2180	Output axis 11	Main shaft side										
M2181		Auxiliary input axis side										
M2182	Output axis 12	Main shaft side										
M2183		Auxiliary input axis side										
M2184	Output axis 13	Main shaft side										
M2185		Auxiliary input axis side										
M2186	Output axis 14	Main shaft side										
M2187		Auxiliary input axis side										
M2188	Output axis 15	Main shaft side										
M2189		Auxiliary input axis side										
M2190	Output axis 16	Main shaft side										
M2191		Auxiliary input axis side										
M2192	Output axis 17	Main shaft side										
M2193		Auxiliary input axis side										
M2194	Output axis 18	Main shaft side										
M2195		Auxiliary input axis side										
M2196	Output axis 19	Main shaft side										
M2197		Auxiliary input axis side										
M2198	Output axis 20	Main shaft side										
M2199		Auxiliary input axis side										
M2200	Output axis 21	Main shaft side										
M2201		Auxiliary input axis side										
M2202	Output axis 22	Main shaft side										
M2203		Auxiliary input axis side										
M2204	Output axis 23	Main shaft side										
M2205		Auxiliary input axis side										
M2206	Output axis 24	Main shaft side										
M2207		Auxiliary input axis side										
M2208	Output axis 25	Main shaft side										
M2209		Auxiliary input axis side										
M2210	Output axis 26	Main shaft side										
M2211		Auxiliary input axis side										
M2212	Output axis 27	Main shaft side										
M2213		Auxiliary input axis side										
M2214	Output axis 28	Main shaft side										
M2215		Auxiliary input axis side										
M2216	Output axis 29	Main shaft side										
M2217		Auxiliary input axis side										
M2218	Output axis 30	Main shaft side										
M2219		Auxiliary input axis side										
M2220	Output axis 31	Main shaft side										
M2221		Auxiliary input axis side										
M2222	Output axis 32	Main shaft side										
M2223		Auxiliary input axis side		Backup	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
M2224	Unusable (16 points)			—	—	—	—			—		
M2225												
M2226												
M2227												
M2228												
M2229												
M2230												
M2231												
M2232												
M2233												
M2234												
M2235												
M2236												
M2237												
M2238												
M2239												

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time"

4. SERVO SYSTEM CPU DEVICES

Device Number	Signal Name	(O Valid)		Signal Direction	Refresh Cycle			Fetch Cycle		
		Real	Virtual		Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
M2240	Axis 1									
M2241	Axis 2									
M2242	Axis 3									
M2243	Axis 4									
M2244	Axis 5									
M2245	Axis 6									
M2246	Axis 7									
M2247	Axis 8									
M2248	Axis 9									
M2249	Axis 10									
M2250	Axis 11									
M2251	Axis 12									
M2252	Axis 13									
M2253	Axis 14									
M2254	Axis 15									
M2255	Axis 16									
M2256	Axis 17	Speed change "0" accepting flag	○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms		
M2257	Axis 18									
M2258	Axis 19									
M2259	Axis 20									
M2260	Axis 21									
M2261	Axis 22									
M2262	Axis 23									
M2263	Axis 24									
M2264	Axis 25									
M2265	Axis 26									
M2266	Axis 27									
M2267	Axis 28									
M2268	Axis 29									
M2269	Axis 30									
M2270	Axis 31									
M2271	Axis 32									
M2272										
M2273										
M2274										
M2275										
M2276										
M2277										
M2278										
M2279										
M2280										
M2281										
M2282										
M2283										
M2284										
M2285										
M2286										
M2287										
M2288										
M2289										
M2290										
M2291										
M2292										
M2293										
M2294										
M2295										
M2296	Unusable (48 points)	——	——	——	——			——		
M2297										
M2298										
M2299										
M2300										
M2301										
M2302										
M2303										
M2304										
M2305										
M2306										
M2307										
M2308										
M2309										
M2310										
M2311										
M2312										
M2313										
M2314										
M2315										
M2316										
M2317										
M2318										
M2319										

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time"

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

(a) This signal notifies the PCPU that SCPU operation is normal. It is switched ON and OFF by the sequence program.

1) When M2000 is ON, positioning or zeroing (REAL mode only) functions can be executed by the servo program specified by the sequence program, and JOG operations can be executed by the sequence program.

2) When a TEST mode has been established ("M9075" TEST mode in progress flag is ON) from a peripheral device, the functions described at item (1) above will be inoperative even if M2000 is switched ON.

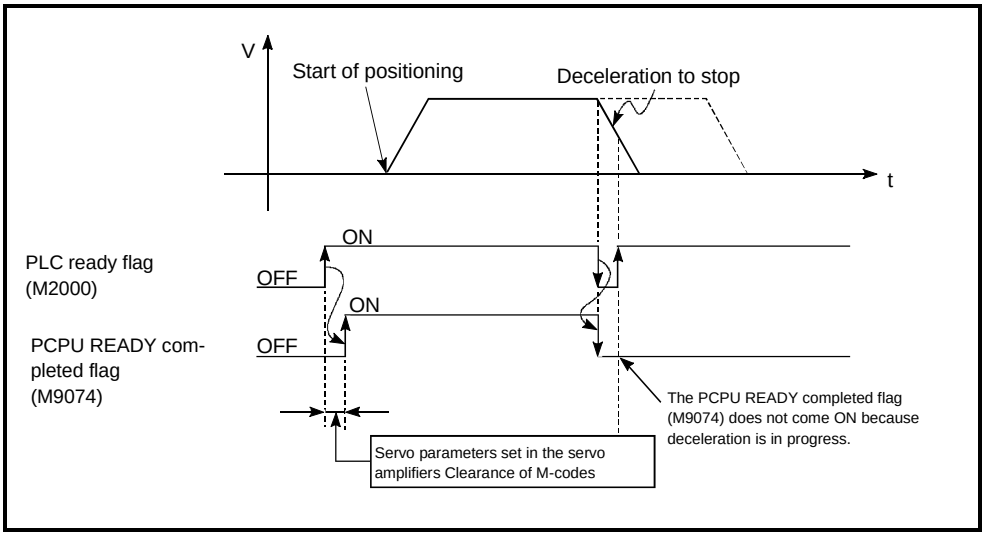
(b) The fixed parameters, servo parameters, and limit switch output parameters can only be changed using a peripheral device when M2000 is OFF.
If an attempt is made to change this data while M2000 is ON, an error will occur.

(c) When M2000 is switched from OFF to ON, the following processing occurs.

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

2) If there is an axis currently being driven, an error occurs, and the processing in (1), (c) above is not executed.

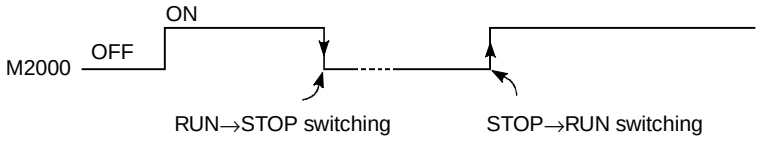
3) While the test mode is in effect, the processing in (1), (c) above is not executed.
When the test mode is cancelled, the processing in (1), (c) will be executed if M2000 is ON.



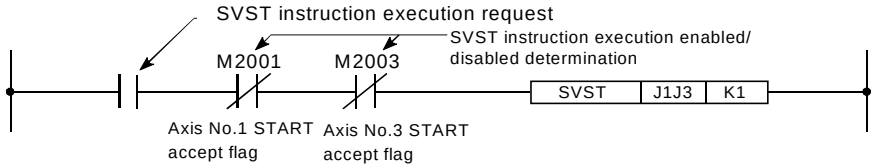
(d) When M2000 turns OFF, the following processing is executed.
1) Processing details
- The PCPU READY flag (M9074) is turned OFF.
- Operating axes are decelerated to a stop.

POINT

The PLC 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.

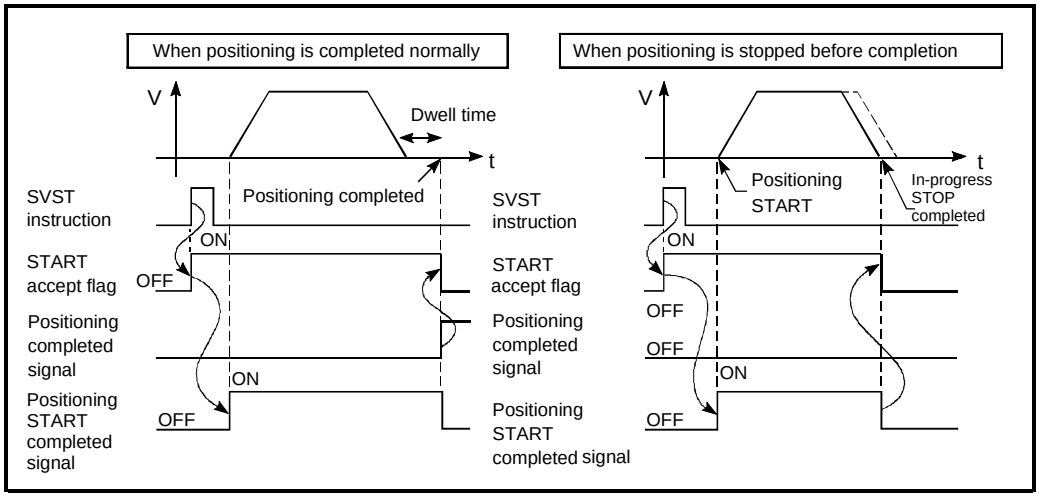


(2) Virtual servomotor START accept flags (M2001 to M2032)
.....Signals from PCPU to SCPU
(a) The START accept flag switches ON when the sequence program's positioning START instruction (SVST) is executed, and should be used for SVST enabled/disabled interlock purposes.

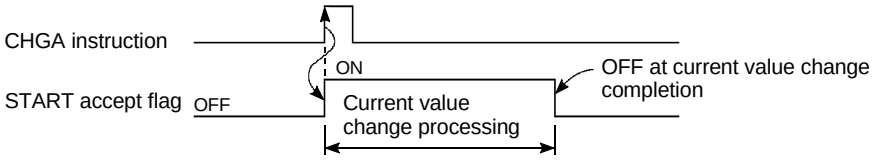


(b) START accept flag ON/OFF processing occurs as shown below.
1) When the sequence program's SVST instruction is executed, the START accept flag for the axis specified by the SVST instruction switches ON, and the switches OFF when positioning is completed. The START accept flag also switches OFF if positioning is stopped before completion.

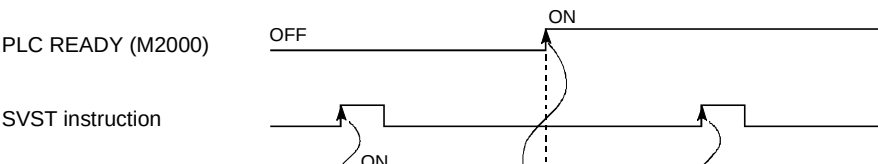
(The START accept flag ON, when positioning is stopped before completion by the speed change for speed “0”.)



2) When executing positioning by switching the JOG instruction ON, the START accept flag will switch OFF when positioning is stopped by a JOG instruction OFF.
3) The START accept flag is ON when the manual pulse generator is enabled (M2051 to M2053:ON), and is OFF when the manual pulse generator is disabled (M2051 to M2053:OFF).
4) The START accept flag is ON during a current value change being executed by a sequence program CHGA instruction.
The START accept flag will switch OFF when the current value change is completed.



5) When M2000 is OFF, execution of a SVST instruction causes the start accept flag to come ON; the flag goes OFF when M2000 comes ON.



CAUTION

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

(3) PC link communication error flag (M2034)

.....Signal sent from PCPU to SCPU

This flag comes ON when an error occurs during personal computer linking communication. When M2034 comes ON the error code is stored in the personal computer link communication error code storage register (D9196). The devices dedicated to personal computer communication are indicated below.

Table 4.1 PC link communication device list

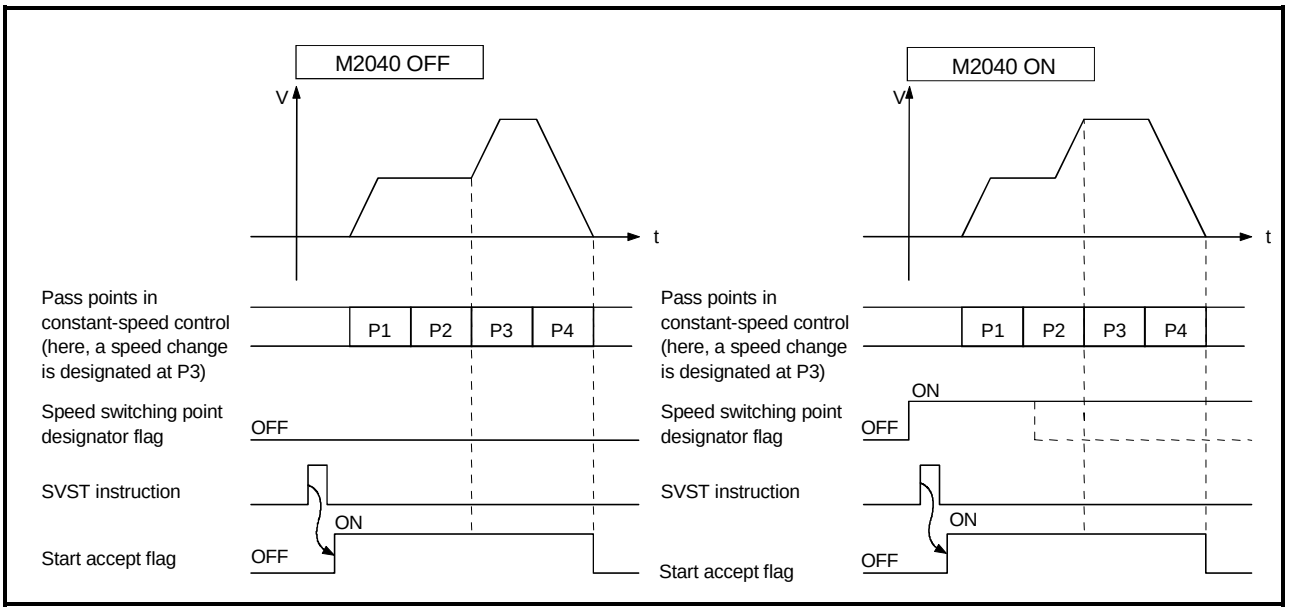
Device Name	Contents	Device Number
PC link communication error flag	OFF: No PC link communication error ON : PC link communication error detected (Flag changes to OFF if normal communication is restored.)	M2034
PC link communication error codes	00: No error 01: Receiving timing error 02: CRC error 03: Communication response code error 04: Receiving frame error 05: Communication task start error (Error codes are reset to 00 by normal communication restart.)	D9196

Table 4.2 PC link communication error code list

Error Codes stored in D9196	Error Contents	Correction Method
01	PC link communication receiving packet did not arrive. Receiving packet arrival timing was late.	· Confirm that the personal computer power is on. · Check the communication cable connection. · Check for communication cable burnout. · Confirm that A30BD-PCF/A30CD-PCF is properly placed.
02	The receiving packet CRC code is incorrect.	· Confirm that there is nothing causing noise in the vicinity. · Check the communication cable connection. · Check for communication cable burnout.
03	The receiving packet data ID is incorrect.	· Confirm that A30BD-PCF/A30CD-PCF is properly placed. · Replace the A30BD-PCF/A30CD-PCF.
04	The number of the frame received is incorrect.	· Check the communication cable connection. · Check for communication cable burnout. · Confirm that there is nothing causing noise in the vicinity.
05	The communication task on the personal computer side has not been started.	· Start the communication task on the personal computer side.

(4) 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.

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



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

(5) 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 CPU base unit and extension base units).

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

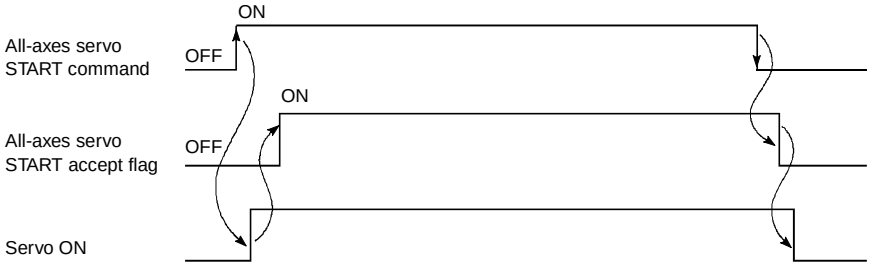
(a) The ERROR LED on the front of the CPU will switch ON when an error occurs. Moreover, a log of errors which have occurred can be referred to at a peripheral device (device running SW2SRX-GSV22PE).

(b) 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.

(6) 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 is OFF, and there are no active servo errors.
- Servo operation DISABLED ..... When M2042 switches ON, the servo OFF signal 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.

(7) 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.
(a) 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 D9193 error code storage error.

(b) 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 D9193 error code storage error.

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

(8) 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 current 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, current value change).

(9) 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 D9193.

(10) Synchronization discrepancy warning flag (M2046)

.....Signal sent from PCPU to SCPU

(a) 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

(b) 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.

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

1) Return to the REAL mode and eliminate the error cause.
↓
2) Synchronize the axes.
↓
3) Switch the synchronization discrepancy warning flag (M2046) OFF.
↓
4) Switch to the VIRTUAL mode.
↓
5) Resume operation.

(11) Motion slot module error detection flag (M2047)

.....Signal sent from PCPU to SCPU

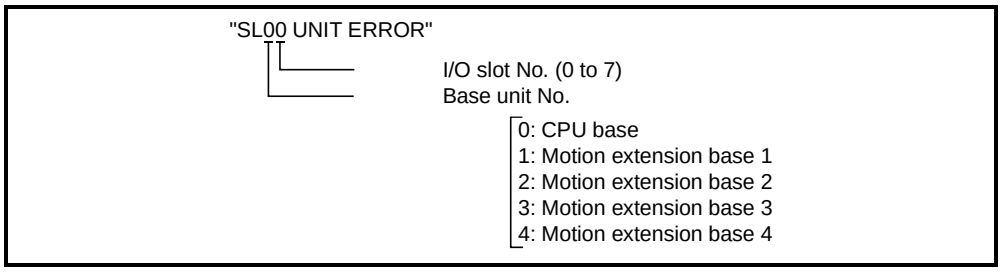
This flag indicates whether the status of modules mounted at the base unit and extension base units is normal or abnormal.

- 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.

(a) When M2047 switches ON, the A273UHCPU "ERROR" LED switches ON.

(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 a motion slot.

(12) JOG simultaneous START command (M2048)

.....Signal sent from SCPU to PCPU

(a) When M2048 switches ON, a JOG simultaneous START will occur at the JOG execution axis (axis-1 to axis-32) designated at the JOG simultaneous START Axis Area(D710 to D713).

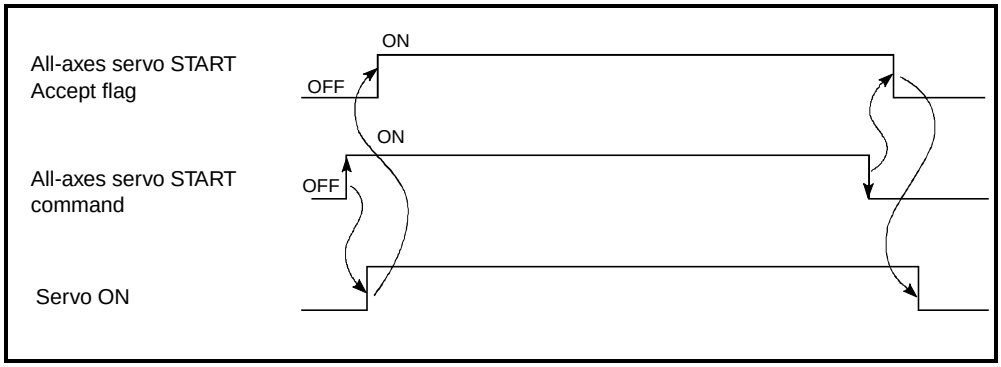
(b) When M2048 switches OFF, the JOG axis motion will decelerate and stop.

(13) All-Axes servo START accept flag (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.



(14) START buffer full (M2050) ..... Signal sent from PCPU to SCPU

(a) This signal switches ON when the PCPU fails to process the specified data within 65 seconds following a positioning START (SVST) instruction or a control change (CHGA/CHGV) instruction from the sequence program.

(b) A M2050 reset must be executed from the sequence program.

(15) Manual pulse generator enabled flag (M2051 to 2053)
..... Signal 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 P1 to P3(Note) of the A273EX or A172SENC.

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

REMARK

(Note): For details on the P1 to P3 connector of the A273EX or A172SENC, please refer to the Motion Controller A273UHCPU/A173UHCPU User's Manual.

(16) Cam data/limit switch output data batch-change request flag (M2056)
..... Signal from SCPU to PCPU

(a) The cam data/limit switch output data batch-change request flag is used to change the cam data/limit switch output data imported at power-on or servo system CPU reset into the other cam data/limit switch output data.
(Cam data/limit switch output data changes are valid in both the real and virtual modes.)

1) Turning M2056 from OFF to ON causes the cam data/limit switch output data (limit switch output data in cam axis within-one-revolution current value mode) which have been written to the extended file registers from No. 10 on to be imported to the PCPU.
Since the import of cam data is valid on the leading edge (OFF to ON) of M2056, it cannot be stopped if M2056 is turned OFF during import.

2) Make a reset at normal completion or error detection of the cam data/limit switch output data import.
- At normal completion ... M2057: ON
- At error detection ..... M2058: ON

(b) Refer to Section 8.4.6 and 8.4.7 for details of cam data/limit switch output data changes.

(17) Cam data/limit switch output data batch-change completion flag (M2057)
..... Signal from PCPU to SCPU

(a) This flag is used to confirm normal completion of cam data/limit switch output data changes.
1) The flag turns ON at normal completion of cam data/limit switch output data changes.
2) Turning M2056 OFF also turns M2057 OFF.

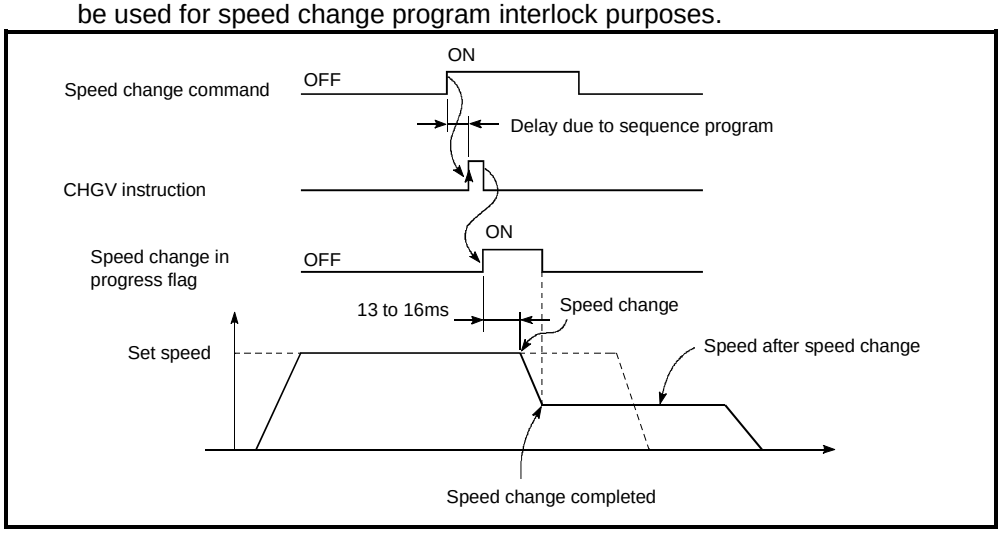
(b) While cam data/limit switch output data are being imported, the real mode cannot be switched to the virtual mode.
Use M2056 as an interlock for switching to the virtual mode.

(18) Cam data/limit switch output data batch-change error flag (M2058)
..... Signal from PCPU to SCPU

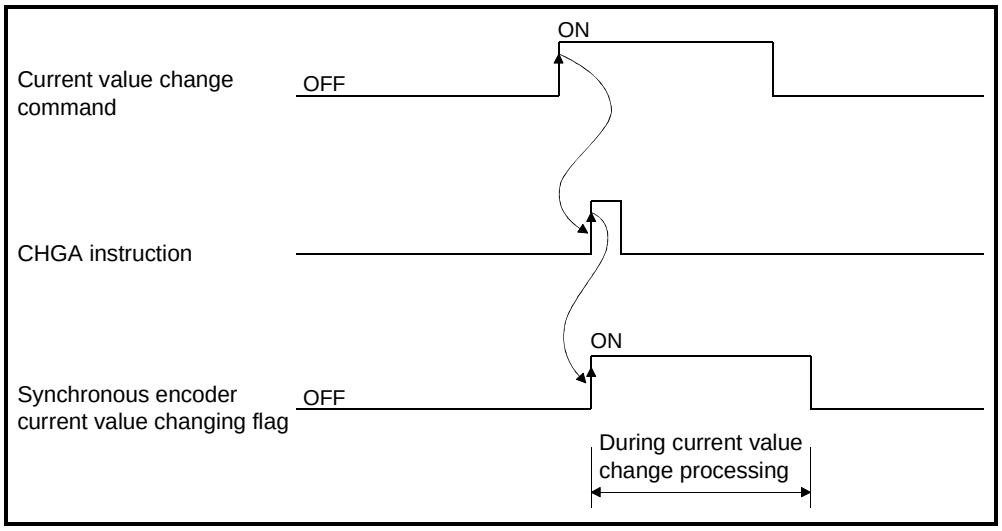
(a) This flag is used to check whether an error occurred or not when the cam data/limit switch output data were changed.
1) The flag remains OFF when there is no cam data/limit switch output data error.
2) The flag turns ON on detection of a cam data/limit switch output data error.

(b) Turning M2056 OFF also turns M2058 OFF.

(19) Speed change in progress flag (M2061 to M2092)
.....Signal sent from PCPU to SCPU
This flag switches ON when a speed change (designated by a control change (CHGV) instruction at the sequence program) is in progress. This flag should be used for speed change program interlock purposes.



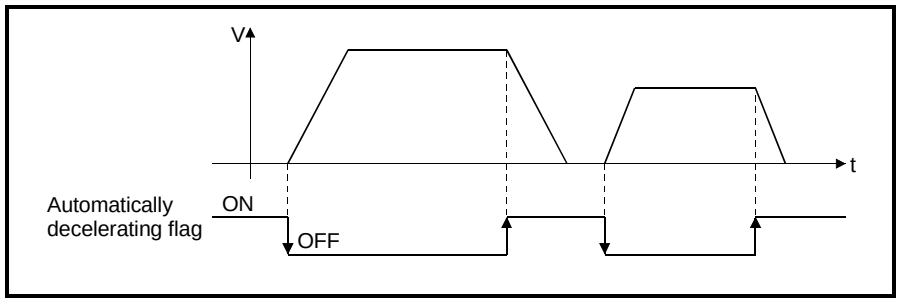
(20) Synchronous encoder current value changing flags (M2101 to M2112)
..... Signals from PCPU to SCPU
The synchronous encoder current value changing flag is ON while the current value of the synchronous encoder is being changed using the control change (CHGA) instruction of the sequence program.
Use this flag as an interlock for the synchronous encoder current value change program.



(21) Automatically decelerating flag (M2128 to M2159)
.....Signal from PCPU to SCPU
This signal is ON while automatic deceleration processing is performed under positioning control or position follow-up control.
(a) Under position follow-up control, this flag is ON during automatic deceleration to the command address, but turns OFF if the command address is changed during that time.

(b) Under control in any control system, this flag turns OFF on normal start completion.

(c) In any of the following cases, the automatically decelerating flag does not turn ON.
- During deceleration due to JOG signal turned OFF
- During manual pulse generator operation
- At midway deceleration due to stop command or stop cause occurrence
- When travel value is "0"



(d) The automatically decelerating flag list is given below.

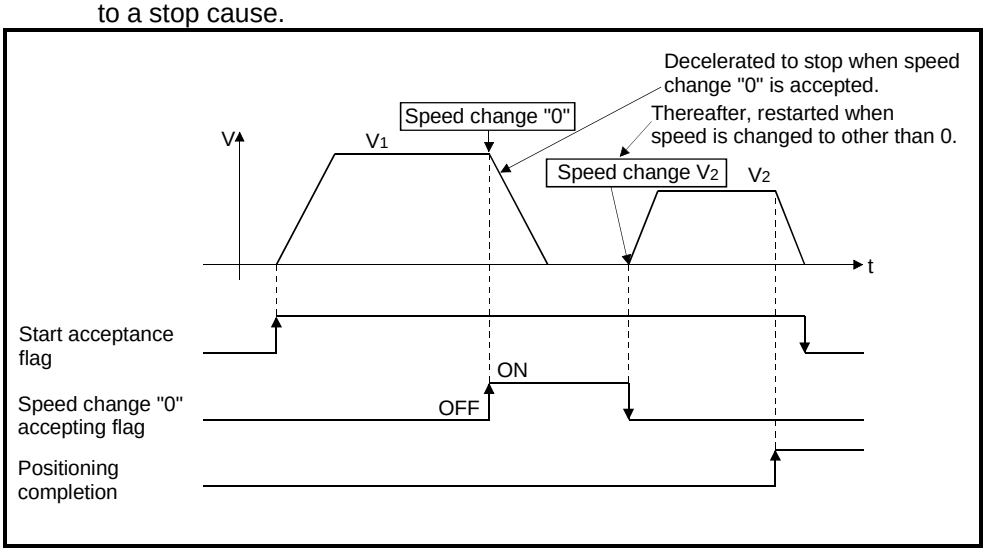
Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2128	9	M2136	17	M2144	25	M2152
2	M2129	10	M2137	18	M2145	26	M2153
3	M2130	11	M2138	19	M2146	27	M2154
4	M2131	12	M2139	20	M2147	28	M2155
5	M2132	13	M2140	21	M2148	29	M2156
6	M2133	14	M2141	22	M2149	30	M2157
7	M2134	15	M2142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

(22) Speed change "0" accepting flag (M2240 to M2271)

.....Signal from PCPU to SCPU

(a) The speed change "0" accepting flag is ON while a speed change request for speed "0" is being accepted.

(b) This signal turns ON when the speed change request for speed "0" is accepted during a start. After that, this signal turns OFF when a speed change to other than speed "0" is accepted or on completion of a stop due to a stop cause.



(c) The speed change "0" accepting flag list is given 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

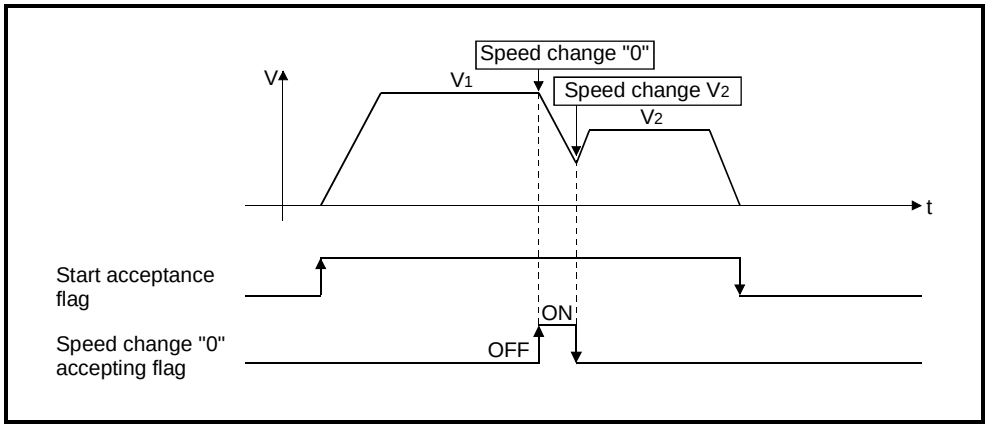
POINT

(1) Even during a stop, the ON status of the start acceptance flag (M2001 to M2032) indicates that the speed change "0" request is accepted. Check with this speed change "0" flag.

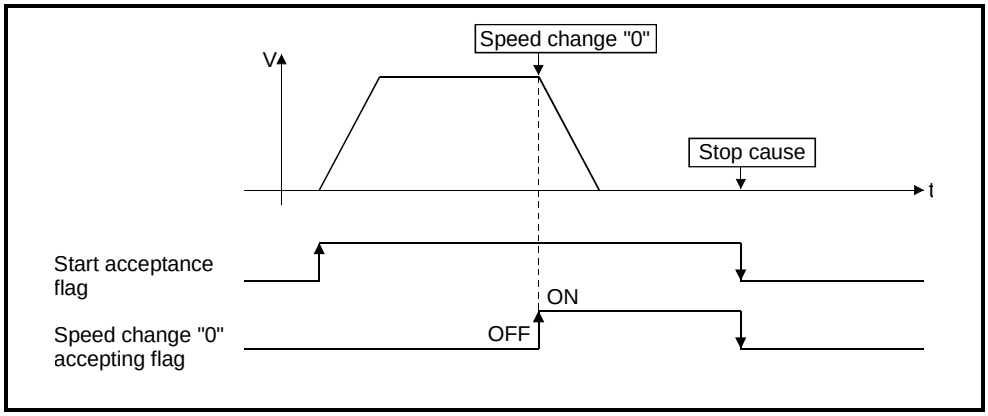
(2) During interpolation, the flags corresponding to the interpolation axes are set.

(3) In any of the following cases, the speed change "0" request is invalid.
- After deceleration due to JOG OFF
- During manual pulse generator operation
- After positioning automatic deceleration start
- After deceleration due to stop cause

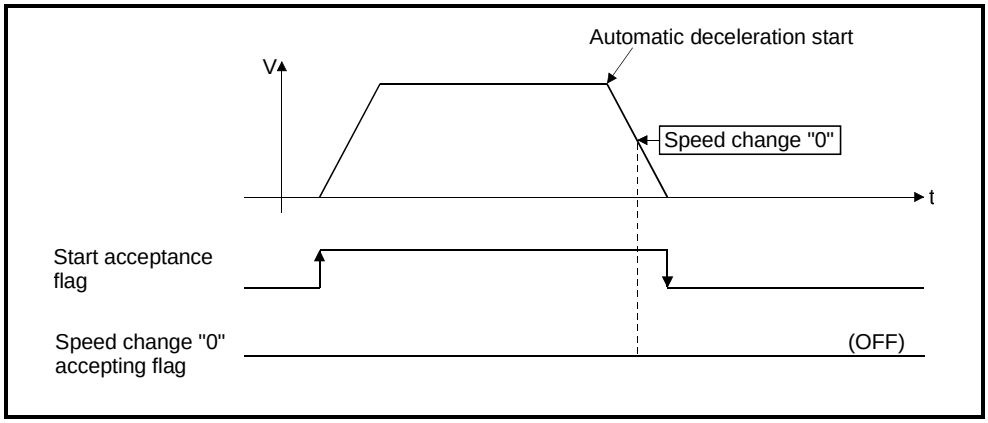
(d) The flag turns OFF if a speed change request for other than speed "0" occurs during deceleration to a stop due to speed change "0".



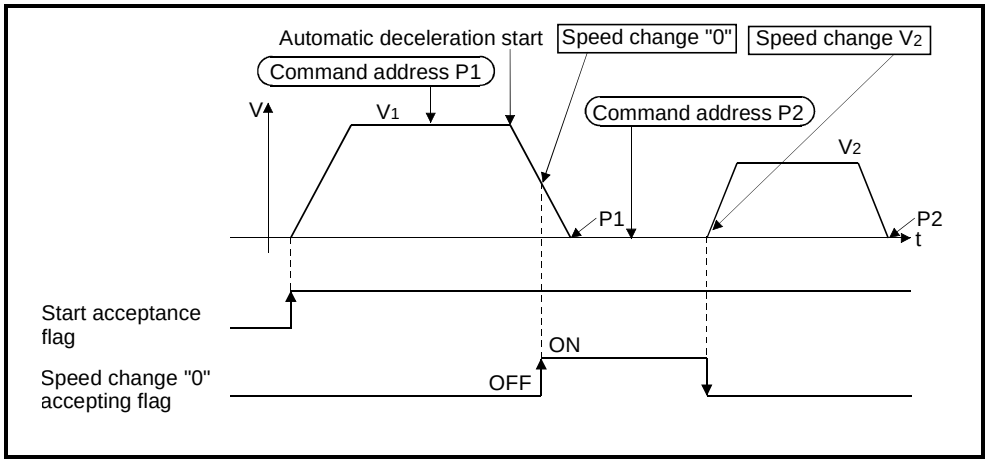
(e) The flag turns OFF if a stop cause occurs after speed change "0" acceptance.



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



(g) Under position follow-up control, the speed change "0" accepting flag turns ON if a speed change "0" occurs after an automatic deceleration start to the "specified address".



REMARK

Under position follow-up control, the axis will not start if the "command address" is changed during speed change "0" acceptance.

4.2 Data Registers

4.2.1 Data register list

A273UHCPU (○ Valid)

Device Number	Application	Real	Virtual
D0	Axis monitor device (20 points × 32 axes) Real mode .....Axis Virtual mode.....Output module	○	○
D640	Control change register (2 points × 32 axes)	○	○
D704	Common device (96 points)	○	○
D800	Virtual servo motor axis (Note) monitor device (6 points × 32 axes)	Back up	○
	Current value after virtual servo motor axis (Note) main shaft's differential gear (4 points × 32 axes)		
D1120	Synchronous encoder axis (Note) monitor device (6 points × 12 axes)		
	Current value after synchronous encoder axis main shaft's differential gear (4 points × 12 axes)		
D1240	Cam axis monitor device (Note) (10 points × 32 axes)		
D1600 D8191	User device (6632 points)		

A173UHCPU (-S1) (○ Valid)

Device Number	Application	Real	Virtual
D0	Axis monitor device (20 points × 32 axes) Real mode .....Axis Virtual mode.....Output module	○	○
D640	Control change register (2 points × 32axes)	○	○
D704	Common device (96 points)	○	○
D800	Virtual servo motor axis (Note) monitor device (6 points × 32 axes)	Back up	○
	Current value after virtual servo motor axis (Note) main shaft's differential gear (4 points × 32 axes)		
D1120	Synchronous encoder axis (Note) monitor device (6 points × 4 axes)		
	Current value after synchronous encoder axis main shaft's differential gear (4 points × 4 axes)		
D1160	Unusable	—	—
D1240	Cam axis monitor device (Note) (10 points × 32 axes)	Back up	○
D1600 D8191	User device (6632 points)		

POINT

(Note): The virtual servo motor axis / synchronous encoder axis / cam axis monitor device occupy only the areas of the axes set in the mechanical system program. The area of an axis that is not set in the mechanical system program can be used by the user.

· Total number of points for the user devices

6632 points

4.2.2 Axis monitor devices

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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0 1	Feed current value/roller cycle	○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2 3	Real current value									
4 5	Deviation counter value									
6	Minor error code				Immediately					
7	Major error code									
8	Servo error code				10ms	20ms				
9	Zeroing re-travel value		Backup		3.5ms	7.1ms	14.2ms			
10 11	Travel value after proximity dog ON				END (Note-2)					
12	Execution program No.		×		At start					
13	M-code				3.5ms	7.1ms	14.2ms			
14	Torque limit value		○							
15	Data set pointer for constant-speed control		×		At start/during start					
16 17	Travel value change register			SCPU→PCPU				3.5ms	7.1ms	14.2ms
18 19	STOP input-time real current value		Backup	SCPU←PCPU	END (Note-2)					

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

4.2.3 Control change registers

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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	JOG speed setting register	○	○	SCPU→PCPU				At start		

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.2.4 Virtual servo motor axis monitor devices

Axis No.	Device Number	Signal Name
1	D800 to D805	(○ Valid)
2	D810 to D815	
3	D820 to D825	
4	D830 to D835	
5	D840 to D845	
6	D850 to D855	
7	D860 to D865	
8	D870 to D875	
9	D880 to D885	
10	D890 to D895	
11	D900 to D905	
12	D910 to D915	
13	D920 to D925	
14	D930 to D935	
15	D940 to D945	
16	D950 to D955	
17	D960 to D965	
18	D970 to D975	
19	D980 to D985	
20	D990 to D995	
21	D1000 to D1005	
22	D1010 to D1015	
23	D1020 to D1025	
24	D1030 to D1035	
25	D1040 to D1045	
26	D1050 to D1055	
27	D1060 to D1065	
28	D1070 to D1075	
29	D1080 to D1085	
30	D1090 to D1095	
31	D1100 to D1105	
32	D1110 to D1115	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note-1))			Fetch Cycle (Preset number of axes (Note-1))		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	Feed current value	Backup	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2	Minor error code				Immediately					
3	Major error code									
4	Execution program No.				At start					
5	M-code				3.5ms	7.1ms	14.2ms			

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.2.5 Current values after virtual servo motor axis main shaft's differential gear

Axis No.	Device Number	Signal Name
1	D806 to D809	
2	D816 to D819	
3	D826 to D829	
4	D836 to D839	
5	D846 to D849	
6	D856 to D859	
7	D866 to D869	
8	D876 to D879	
9	D886 to D889	
10	D896 to D899	
11	D906 to D909	
12	D916 to D919	
13	D926 to D929	
14	D936 to D939	
15	D946 to D949	
16	D956 to D959	
17	D966 to D969	
18	D976 to D979	
19	D986 to D989	
20	D996 to D999	
21	D1006 to D1009	
22	D1016 to D1019	
23	D1026 to D1029	
24	D1036 to D1039	
25	D1046 to D1049	
26	D1056 to D1059	
27	D1066 to D1069	
28	D1076 to D1079	
29	D1086 to D1089	
30	D1096 to D1099	
31	D1106 to D1109	
32	D1116 to D1119	

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	Current value after virtual servo motor axis main shaft's differential gear	Backup	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2	Error search output axis No.									
3	Data set pointer for constant-speed control									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.2.6 Synchronous encoder axis monitor devices

Axis No.	Device Number A273UHCPU	Device Number A173UHCPU(-S1)
1	D1120 to D1125	D1120 to D1125
2	D1130 to D1135	D1130 to D1135
3	D1140 to D1145	D1140 to D1145
4	D1150 to D1155	D1150 to D1155
5	D1160 to D1165	
6	D1170 to D1175	
7	D1180 to D1185	
8	D1190 to D1195	
9	D1200 to D1205	
10	D1210 to D1215	
11	D1220 to D1225	
12	D1230 to D1235	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0	Current value	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
1										
2	Minor error code				Immediately					
3	Major error code									
4	Unusable	——	——		——					
5	Unusable									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.2.7 Current values after synchronous encoder axis main shaft's differential gear

Axis No.	Device Number A273UHCPU	Device Number A173UHCPU(-S1)
1	D1126 to D1129	D1126 to D1129
2	D1136 to D1139	D1136 to D1139
3	D1146 to D1149	D1146 to D1149
4	D1156 to D1159	D1156 to D1159
5	D1166 to D1169	
6	D1176 to D1179	
7	D1186 to D1189	
8	D1196 to D1199	
9	D1206 to D1209	
10	D1216 to D1219	
11	D1226 to D1229	
12	D1236 to D1239	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0 1	Current value after synchronous encoder axis main shaft's differential gear	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
2	Error detection output axis No.									
3	Unusable	——	——		——					

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.2.8 Cam axis monitor devices

Axis No.	Device Number	Signal Name
1	D1240 to D1249	(○ Valid)
2	D1250 to D1259	
3	D1260 to D1269	
4	D1270 to D1279	
5	D1280 to D1289	
6	D1290 to D1299	
7	D1300 to D1309	
8	D1310 to D1319	
9	D1320 to D1329	
10	D1330 to D1339	
11	D1340 to D1349	
12	D1350 to D1359	
13	D1360 to D1369	
14	D1370 to D1379	
15	D1380 to D1389	
16	D1390 to D1399	
17	D1400 to D1409	
18	D1410 to D1419	
19	D1420 to D1429	
20	D1430 to D1439	
21	D1440 to D1449	
22	D1450 to D1459	
23	D1460 to D1469	
24	D1470 to D1479	
25	D1480 to D1489	
26	D1490 to D1499	
27	D1500 to D1509	
28	D1510 to D1519	
29	D1520 to D1529	
30	D1530 to D1539	
31	D1540 to D1549	
32	D1550 to D1559	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note-1))			Fetch Cycle (Preset number of axes (Note-1))		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0	Unusable	—	—	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
1	Execution cam No.	Backup	○							
2 3	Execution stroke value									
4 5	Cam axis current value within one revolution									
6	Unusable	—	—		—					
7	Unusable									
8	Unusable									
9	Unusable									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

4.2.9 Common devices

Device Number	Signal Name	(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note-1)) 1 to 8 / 1 to 12	Refresh Cycle 9 to 18 / 13 to 24	Refresh Cycle 19 to 32 / 25 to 32	Fetch Cycle (Preset number of axes (Note-1)) 1 to 8 / 1 to 12	Fetch Cycle 9 to 18 / 13 to 24	Fetch Cycle 19 to 32 / 25 to 32
D704	Unusable (6 points)	—		—	—			—		
D705										
D706										
D707										
D708										
D709										
D710	JOG operation simultaneous start axis setting register	○	○	SCPU→PCPU				At start		
D711										
D712										
D713										
D714	Manual pulse generator axis 1 No. setting register									
D715										
D716	Manual pulse generator axis 2 No. setting register									
D717										
D718	Manual pulse generator axis 3 No. setting register									
D719										
D720	Axis 1							At manual PG enable leading edge		
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	Manual pulse generator's one-pulse input magnification setting register								
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									
D752	Manual pulse generator 1 smoothing magnification setting register									
D753	Manual pulse generator 2 smoothing magnification setting register									
D754	Manual pulse generator 3 smoothing magnification setting register									
D755	Unusable (5 points)	—		—	—			—		
D756										
D757										
D758										
D759										
D760	Limit switch output disable setting register	○	○	SCPU←PCPU				3.5ms	7.1ms	14.2ms
D761										
D762										
D763										
D764										
D765										
D766										
D767										
D768										
D769										
D770										
D771										
D772										
D773										
D774										
D775										
D776	Limit switch output status storage register									
D777										
D778										
D779										
D770										
D781										
D782										
D783										
D784										
D785										
D786										
D787										
D788										
D789										
D790										
D791										
D792	Servo amplifier type				At power ON					
D793										
D794										
D795										
D796										
D797										
D798										
D799										

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(1) JOG operation simultaneous start axis setting registers (D710 to D713)
..... Data from SCPU to PCPU

(a) These registers are used to set the virtual servomotor axis No. and directions of the axis whose JOG operation will be started simultaneously.

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

Make JOG operation simultaneous start axis setting with 1/0.
1 : Simultaneous start executed
0 : Simultaneous start not executed

(b) If "1" is set to both in the forward and reverse rotation JOG start bits of the same axis No., the corresponding axis results in a minor error and makes a forward rotation JOG start.

(c) Refer to Section 7.19.3 of the Motion Controller (SV13/SV22 REAL Mode) programming manual (type A273UH/A173UH) for details of simultaneous JOG operation start.

(2) Manual pulse generator-controlled axis No. setting registers (D714 to D719)
..... Data from SCPU to PCPU

(a) These registers store the virtual servomotor axis No. which will be controlled by manual pulse generators.

		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

Make manual pulse generator-controlled axis setting with 1/0.
1 : Specified axis
0 : Unspecified axis

(b) Refer to Section 7.20 of the Motion Controller (SV13/SV22 REAL Mode) programming manual (type A273UH/A173UH) for details of manual pulse generator operation.

(3) Manual pulse generator 1-pulse input magnification setting registers (D720 to D751)..... Data from SCPU to PCPU

(a) This register is used to set the magnification (1 to 100) per pulse of the input pulse count from the manual pulse generator for manual pulse generator operation.

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

(b) Refer to Section 7.20 of the Motion Controller (SV13/SV22 REAL Mode) programming manual (type A273UH/A173UH) for details of manual pulse generator operation.

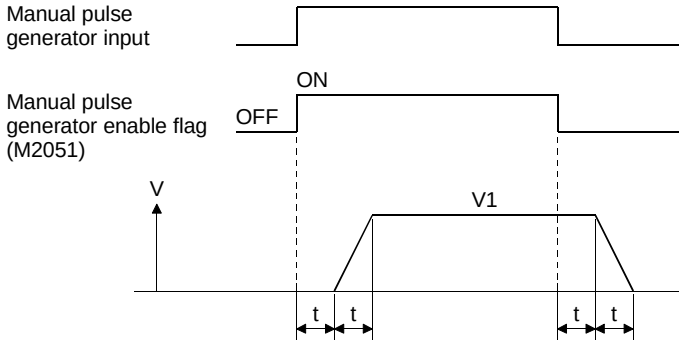
(4) Manual pulse generator smoothing magnification setting area
(D752 to D754) ..... Data from SCPU to PCPU

(a) These devices are used to set the smoothing time constants of manual pulse generators.

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

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

(c) Operation



Output speed (V1) = (number of input pulses/ms) × (manual pulse generator 1-pulse input magnification setting)

Travel value (L) = (travel value per pulse) × number of input pulses × (manual pulse generator 1-pulse input magnification setting)

REMARK

1) The travel value per pulse of the manual pulse generator is as indicated below.
   - Setting unit
     - mm : 0.1μm
     - inch : 0.00001inch
     - degree : 0.00001degree
     - PULSE : 1 PLS
2) The smoothing time constant is 56.8ms to 3408ms.

(5) Limit switch output disable setting registers (D760 to D775)

..... Data from SCPU to PCPU

(a) These registers are used to disable the external outputs of the limit switch outputs on a point by point basis. Set the corresponding bit to 1 to disable the limit switch output and turn OFF the external output.

	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) Specify 1 or 0 to set each bit.
   1: Disable ····· Limit switch output remains OFF.
   0: Enable ····· Limit switch output turns ON/OFF based on set data.
2) "LY" in LY00 to LYFF indicates limit switch output.

(6) Limit switch output status storage registers (D776 to D791)

..... Data from PCPU to SCPU

(a) The output states (ON/OFF) of the limit switch outputs set on the peripheral device and output to the A1SY42 and the AY42 are stored in terms of 1 and 0.

- ON 1
- OFF..... 0

(b) These registers can be used to export the limit switch output data in the sequence program, for example.

	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							

1 or 0 is stored into each bit of D776 to D791.
ON ·····1
OFF·····0

REMARK

LY in LY□□ of D776 to D791 indicates limit switch output.

(7) Servo amplifier type (D792 to D799) ..... Data from PCPU to SCPU
The servo amplifier types set in system settings are stored when the servo system CPU control power supply is switched on or reset.

	b15 to b12	b11 to b8	b7 to b4	b3 to b1
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 (CPU base)
- 2 ····· MR-□-B
- 5 ····· ADU (motion extension base)

4.3 Special Relays/Special Registers List

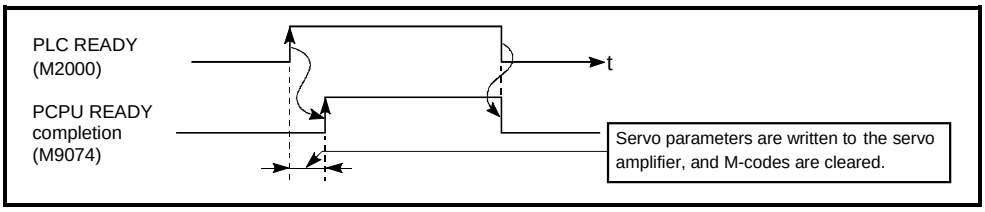
4.3.1 Special relays

Device No.	Signal Name	(O Valid)		Signal Direction	Refresh Cycle	Fetch Cycle
		REAL	VIRTUAL			
M9073	PCPU WDT error flag	O	O	SCPU←PCPU	END	
M9074	PCPU READY completed flag					
M9075	TEST mode ON flag					
M9076	External emergency stop input flag					
M9077	Manual pulse generator axis setting error flag					
M9078	TEST mode request flag					
M9079	Servo program setting error flag					

(1) PCPU 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 PCPU 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 WDT error cause (D9184)" storage area (see Section 4.3.2 (2)).

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

(b) The PCPU READY flag switches OFF when the PLC READY (M2000) signal switches OFF.



(3) TEST mode ON flag (M9075).....Signal sent from PCPU to SCPU
(a) 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 SVST instruction.
- OFF..... TEST mode is not in effect.
- ON ..... TEST mode is in effect.

(b) 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) 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.

(5) Manual Pulse Generator Axis Setting Error Flag (M9077)
.....Signal sent from PCPU to SCPU
(a) This flag indicates whether the setting designated at the manual pulse generator axis setting register (D714 to D719) is normal or abnormal.
- OFF..... All D714 to D719 settings are normal.
- ON ..... At least one D714 to D719 setting is abnormal.

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

(6) TEST Mode Request Error Flag (M9078).....Signal sent from PCPU to SCPU
(a) This flag switches ON if the TEST mode is not established in response to a TEST mode request from a peripheral device.

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

(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 SVST instruction is normal or abnormal.
- OFF .....Normal
- ON .....Abnormal

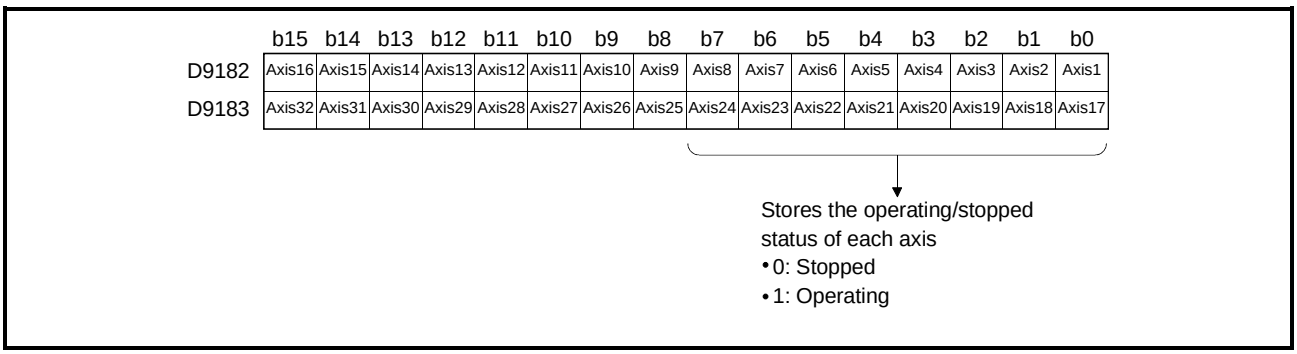
The content of a servo program error is stored at D9189 and D9190.

4.3.2 Special registers

<table>
<tr><th rowspan="3">Device Number</th><th rowspan="3">Signal Name</th><th colspan="2">(O Valid)</th><th rowspan="3">Signal Direction</th><th colspan="3">Refresh Cycle</th><th colspan="3">Fetch Cycle</th></tr>
<tr><th rowspan="2">Real</th><th rowspan="2">Virtual</th><th colspan="3">Preset number of axes (Note)</th><th colspan="3">Preset number of axes (Note)</th></tr>
<tr><th>1 to 8
1 to 12</th><th>9 to18
13 to 24</th><th>19 to 32
25 to 32</th><th>1 to 8
1 to 12</th><th>9 to18
13 to 24</th><th>19 to 32
25 to 32</th></tr>
<tr><td>D9180
D9181</td><td>Unusable</td><td>——</td><td>——</td><td>——</td><td colspan="3">——</td><td colspan="3">——</td></tr>
<tr><td>D9182
D9183</td><td>Test mode request error information</td><td rowspan="4">O</td><td rowspan="4">O</td><td rowspan="4">SCPU←PCPU</td><td colspan="3">At test mode request</td><td colspan="3" rowspan="3"></td></tr>
<tr><td>D9184</td><td>PCPU WDT error factor</td><td colspan="3">At PCPU WDT error occurrence</td></tr>
<tr><td>D9185
D9186
D9187</td><td>Manual pulse generator axis setting error information</td><td colspan="3">At manual PG enable leading edge</td></tr>
<tr><td>D9188</td><td>Unusable</td><td>——</td><td>——</td><td>——</td><td colspan="3">——</td><td colspan="3">——</td></tr>
<tr><td>D9189</td><td>Error program No.</td><td rowspan="6">O</td><td rowspan="6">O</td><td rowspan="6">SCPU←PCPU</td><td colspan="3">At start</td><td colspan="3" rowspan="5"></td></tr>
<tr><td>D9190</td><td>Error item information</td></tr>
<tr><td>D9191
D9192</td><td>Servo amplifier loading information</td><td colspan="3">At servo amplifier power-on</td></tr>
<tr><td>D9193
D9194
D9195</td><td>Real/virtual mode change error information</td><td colspan="3">At real/virtual mode change</td></tr>
<tr><td>D9196</td><td>Personal computer link communication error code</td><td>3.5ms</td><td>7.1ms</td><td>14.2ms</td></tr>
<tr><td>D9197
D9198
D9199</td><td>Unusable</td><td>——</td><td>——</td><td>——</td><td colspan="3">——</td><td colspan="3">——</td></tr>
</table>

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

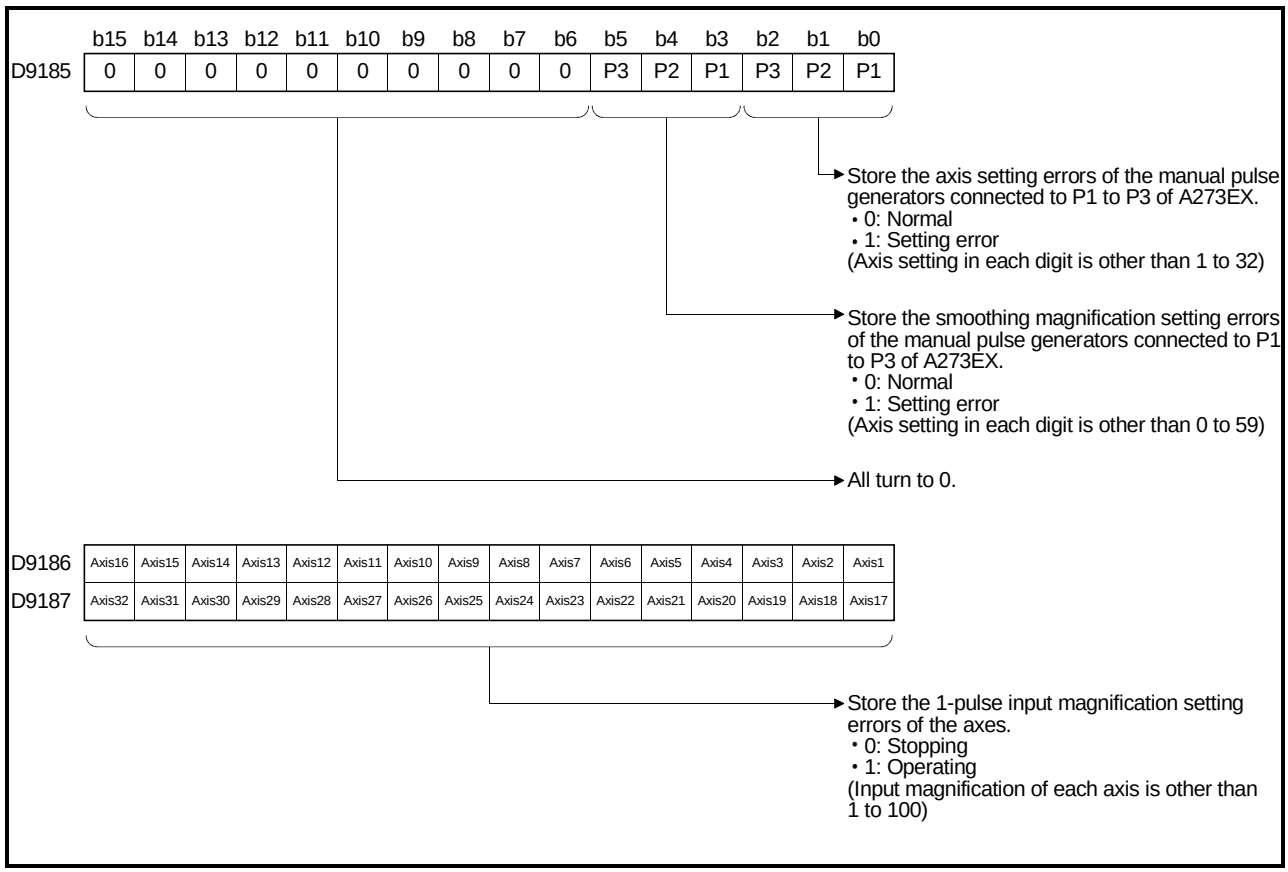
(1) Test mode request error (D9182, D9183)..... Data from PCPU to SCPU
When the TEST mode request error flag (M9078) switches ON, the axis data for axes in motion at that time will be stored.



(2) PCPU WDT error cause(D9184).....Data from the PCPU to the SCPU
When PCPU error occurs, the code of cause will be stored.

<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 fault 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 operation cycle time over</td></tr>
<tr><td>3</td><td>PCPU software fault 2</td></tr>
<tr><td>30</td><td>PCPU/SCPU hard ware fault</td></tr>
<tr><td>100 to 107
110 to 117
120 to 127
130 to 137
140 to 147</td><td>AC servo motor drive module CPU fault
100
Indicates the slot No.(0 to 7) where the AC motor drive module with the fault is loaded.
Indicates the stage No. of the base on which the AC motor drive module with the fault is loaded.
0: CPU base
1: Extension base 1st stage
2: Extension base 2nd stage
3: Extension base 3rd stage
4: Extension base 4th stage</td><td>The servo error detection flag (M2408+20n) of the corresponding axis turns ON, resulting in a servo-off status. After that, operation is performed in accordance with "ADU servo error-time processing setting" in system settings.</td><td>Perform reset with the key.
If the error occurs after reset, change the ADU module since it may be faulty.</td></tr>
<tr><td>200 to 207
210 to 217
220 to 227
230 to 237
240 to 247</td><td>Hardware fault of module loaded on motion CPU base unit or extension base unit.
200
Indicates the slot No.(0 to 7) where the module with the fault is loaded.
Indicates the stage No. of the base on which the module with the fault is loaded.
0: CPU base
1: Extension base 1st stage
2: Extension base 2nd stage
3: Extension base 3rd stage
4: Extension base 4th stage</td><td rowspan="4">All axes stop immediately, after which operation cannot be started.</td><td>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 to 253</td><td>Separate servo amplifier (MR-□-B) interface hardware fault
250
Faulty SSCNET No.
0: SSCNET 1
1: SSCNET 2
2: SSCNET 3
3: SSCNET 4</td><td></td></tr>
<tr><td>300</td><td>PCPU software fault 3</td><td>Reset with the reset key.</td></tr>
<tr><td>301</td><td>8 or more points of CPSTART instruction were used to start programs in excess of simultaneously startable programs.
<table>
<tr><th></th><th>Number of simultaneously startable programs</th></tr>
<tr><td>Conventional function version</td><td>20</td></tr>
<tr><td>Function added version</td><td>14</td></tr>
</table></td><td>Perform reset with the key.
Use 8 or more points of CPSTART instruction to start programs within the number of simultaneously startable programs.</td></tr>
</table>

(3) Manual pulse generator axis setting error information (D9185 to D9187)
..... Data from PCPU to SCPU
The corresponding axis setting resister (D714 to D719), the smoothing magnification setting register (D752 to D754) and the manual pulse generator 1-pulse input magnification setting register (D720 to D751) are checked on the leading edge of the manual pulse generator enable flag (M2051 to M2053), and if an error is founded, it is stored into manual pulse generator axis setting error corresponding.



(4) Error program No. (D9189).....Data from the PCPU to the SCPU
(a) When the servo program setting error flag (M9079) switches ON, the erroneous servo program No. (0 to 4095) will be stored.

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

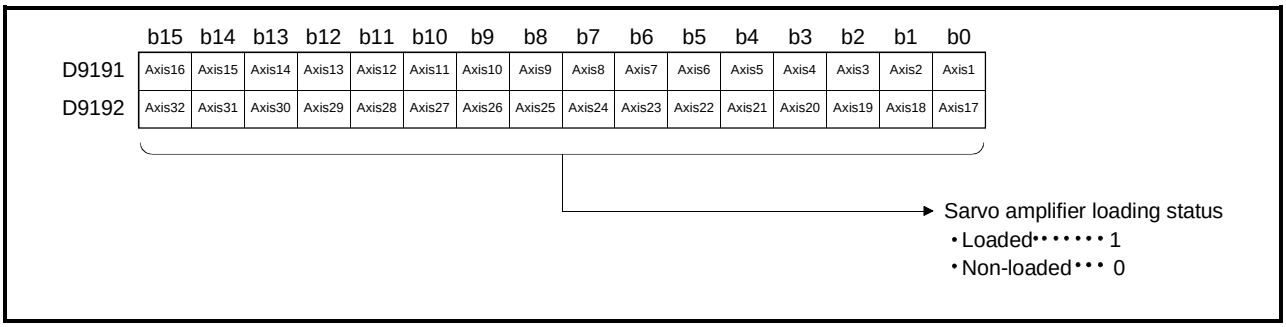
(5) Error item information (D9190) ..... Data sent from PCPU to SCPU
When the servo program setting error flag (M9079) switches ON, the error code corresponding to the erroneous setting item will be stored.

Error Code	Error Description
900	The servo program designated by the SVST instruction does not exist.
901	The axis No. designated by the 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, OSC) was designated.
906	An axis designated as "unused" at the system settings is used in the servo program designated by the SVST instruction.
Error item data	A setting item error exists in the servo program designated by the SVST instruction. (Note)

REMARK

(Note): For details regarding error item data, see Section 6.3 of the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH/A173UH).

(6) Servo amplifier loading information (D9191 to D9192)
.....Data from PCPU to SCPU
When the servo system CPU control power supply is switched on or reset, the servo amplifier and option slot loading states are checked and its results are stored.
The axis which turned from non-loading to loading status after power-on is handled as loaded. However, the axis which turned from loading to non-loading status remains as loaded.



(a) Servo amplifier installation status
1) Installed/not installed status
- "installed" status ..... The MR-□-B is normal (i.e. communication with the servo amplifier is normal)
- "not installed" status ..... No servo amplifier is installed. The servo amplifier power is OFF. Normal communication with the servo amplifier is not possible due, for example, to a connecting cable fault.

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

System Settings	ADU		MR-□-B	
	Loaded	Not loaded	Loaded	Not loaded
Used (axis No. setting)	1 is stored	Major error	1 is stored	0 is stored
Unused	0 is stored	0 is stored	0 is stored	0 is stored

(7) REAL/VIRTUAL mode switching error information (D9193 to D9195)
..... Data sent from PCPU to SCPU
When a mode switching error occurs in real-to -virtual or virtual-to-real mode switching, or a mode continuation error occurs in the virtual mode, its error information is stored.
Refer to Section 10.6 for details of the stored error code.

(8) PC link communication error codes (D9196)
..... Data sent from PCPU to SCPU
One of the following error codes are stored when an error occurs during PC link communication.

Error Code stored in D9196	Error Contents	Correction Method
01	PC link communication receiving packet did not arrive. Receiving packet arrival timing was late.	· Confirm that the personal computer power is on. · Check the communication cable connection. · Check for communication cable burnout. · Confirm that A30BD-PCF/A30CD-PCF is properly placed.
02	The receiving packet CRC code is incorrect.	· Confirm that there is nothing causing noise in the vicinity. · Check the communication cable connection. · Check for communication cable burnout.
03	The receiving packet data ID is incorrect.	· Confirm that A30BD-PCF/A30CD-PCF is properly placed. · Replace the A30BD-PCF/A30CD-PCF.
04	The number of the frame received is incorrect.	· Check the communication cable connection. · Check for communication cable burnout. · Confirm that there is nothing causing noise in the vicinity.
05	The communication task on the personal computer side has not been started.	· Start the communication task on the personal computer side.

5. MECHANICAL SYSTEM PROGRAM

5 MECHANICAL SYSTEM PROGRAM

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

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

- The mechanical module connection diagram shows the virtual mechanical system consisting of connected virtual mechanical modules.

- The mechanical module parameters are the parameters used at the mechanical module connection diagram for control of the mechanical modules.

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

5. MECHANICAL SYSTEM PROGRAM

5.1 Mechanical Module Connection Diagram

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

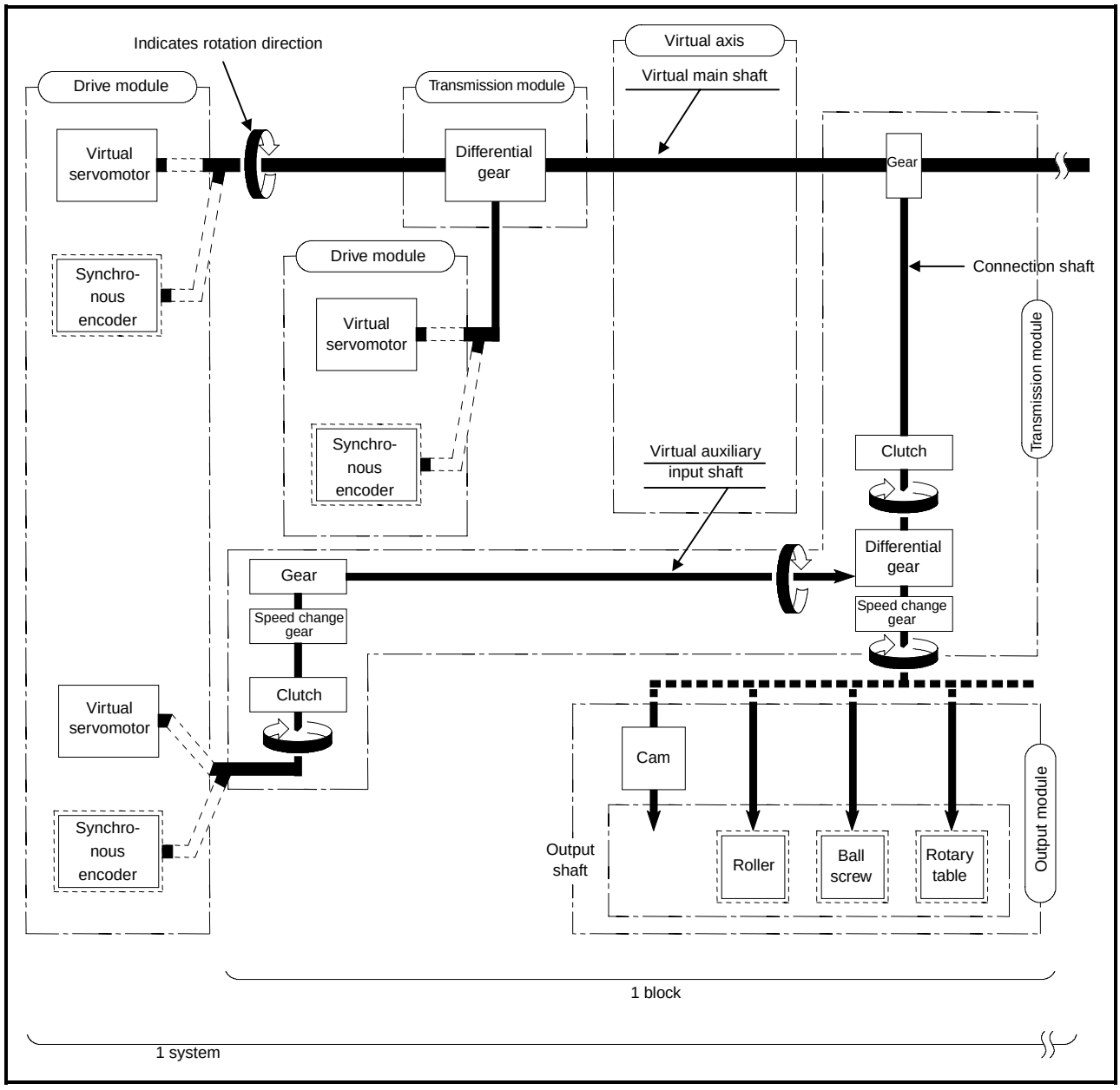


Fig. 5.1 Mechanical Module Connection Configuration

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

5. MECHANICAL SYSTEM PROGRAM

(1) Block

The term "block" refers to a single series of elements between and including a virtual transmission module (gear connected to the virtual main shaft) and an output module.

Refer to Table 5.1 to determine the number of mechanical modules which can be connected in one block.

(2) System

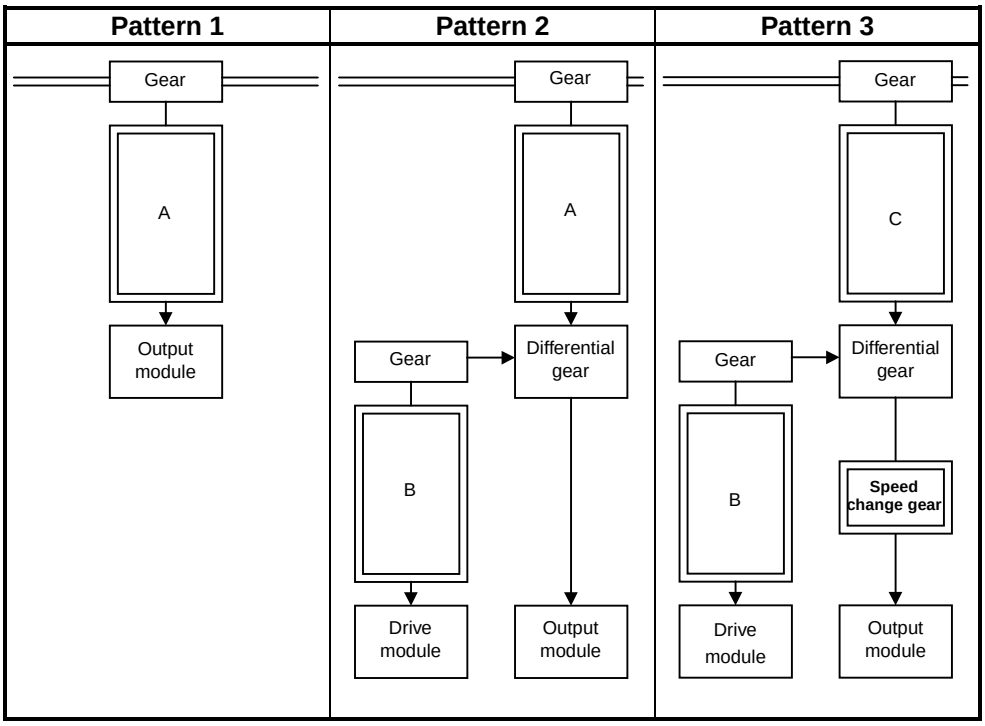
The term "system" refers to all the blocks which are connected to a single virtual main shaft.

One system can consist of up to 8 blocks.

(3) Transmission module connections

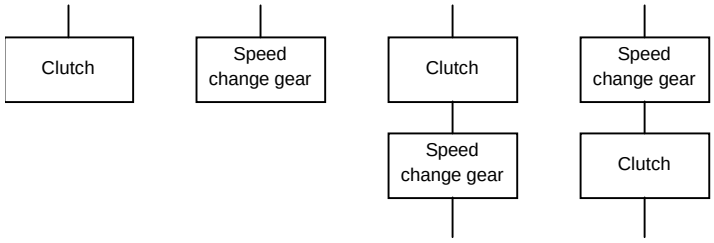
There are 3 transmission module connection patterns:

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



(a) Transmission modules which can be connected at "A" and "B" above

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



(b) Transmission module which can be connected at "C"

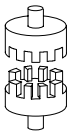
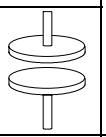
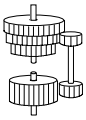
Only a clutch can be connected at "C".

5. MECHANICAL SYSTEM PROGRAM

5.2 Mechanical Module List

Summaries of mechanical modules used in VIRTUAL mode mechanical module connection diagrams are given in Tables 5.1.
For details regarding each mechanical module, see Chapters 5 to 8.

Table 5.1 Mechanical Module List

Classi-fication	Mechanical Module		Max. Number Used						Function Description	Reference Section
	Name	Appearance	Number Per Servo System CPU		Number Per System		Number Per Block			
							Connect-ion Shaft Side	Auxiliary Input Shaft Side		
Drive module	Virtual servo motor		32	Total A173UH 44 A273UH 36	32	Total A173UH 44 A273UH 36	—	—	• Used to drive the mechanical system program's virtual axis by servo program or JOG operation.	Section 6.1
	Synch-ronous encoder		A173UH 12 A273UH 4		A173UH 12 A273UH 4		—	—	• Used to drive the virtual axis by input pulses from an external synchronous encoder.	Section 6.2
Virtual axis	Virtual main shaft	—	32	Total 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.	—
Trans-mission 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 smoo-thing 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
	Smoo-thing 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
	Diffe-rential 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 32	32	Total 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
	Rotary table		32		32				• Used when angle control occurs at the final output shaft.	Section 8.3
	Cam		32		32				• 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

6. DRIVE MODULE

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

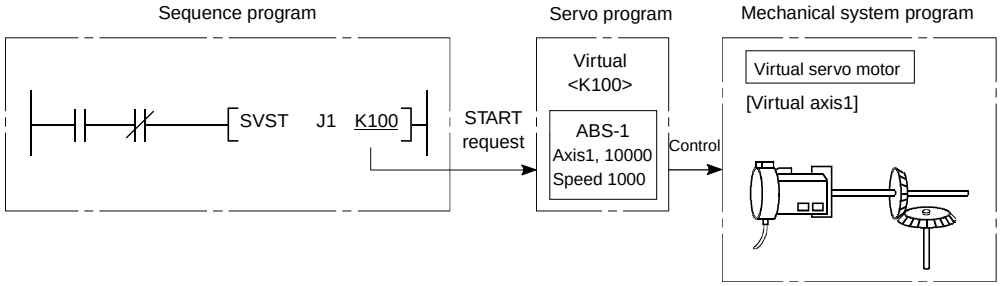
- Virtual servo motor.....See Section 6.1
- Synchronous encoder .....See Section 6.2

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 SVST instruction.
The start accept flag (Note) (M2001 to M2032) of the designated axis will then switch ON.



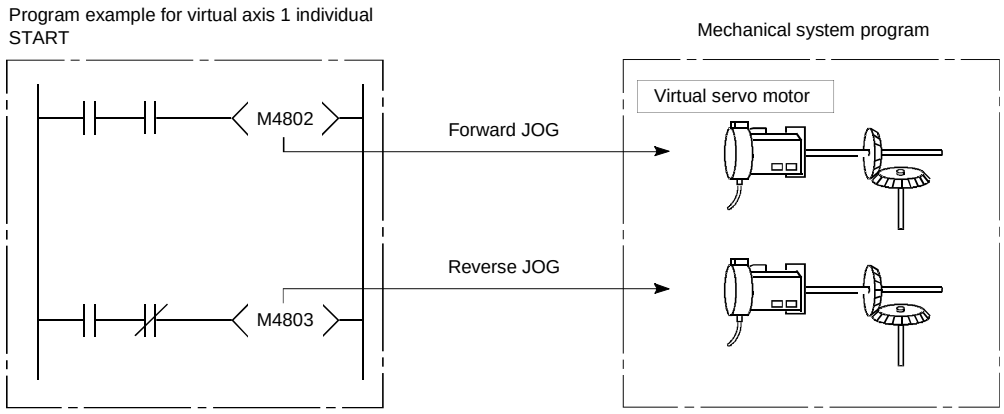
REMARK

(Note) .....For details regarding the START accept flag, see Section 4.1.8 (2).

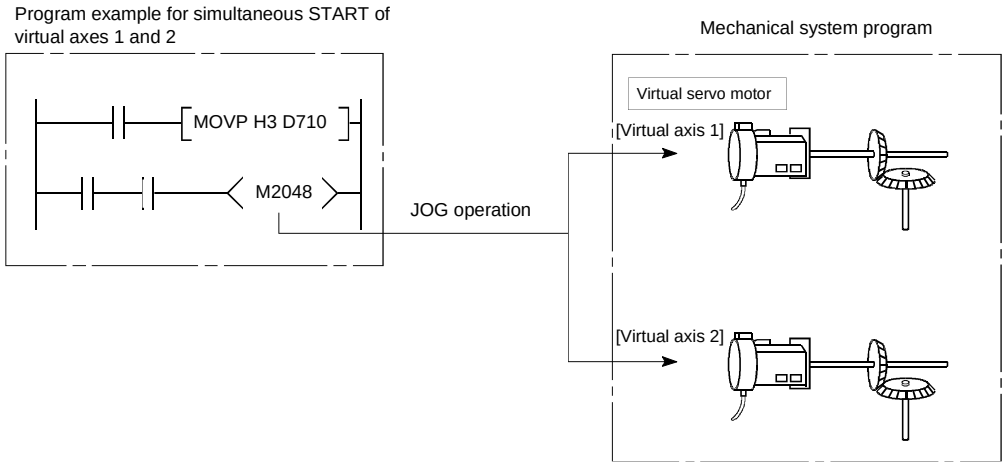
(b) START by JOG operation

An "individual" or "simultaneous" START can be executed at the JOG operation.(Note-1)

1) Individual START .....Each axis can be started by a forward/reverse JOG command (Note-2).



2) Simultaneous START.....The simultaneous START axis Nos. and rotation directions (forward/reverse) are designated at the JOG Simultaneous START Axis Setting Register (D710 to D713) (Note-3), and the axes are started when the JOG Simultaneous START Command Flag (M2048) (Note-3) switches ON.



REMARKS

(Note-1): For details regarding JOG operations refer to section 7.19 of the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH/A173UH).

(Note-2): For details regarding the forward/reverse JOG commands, see Section 6.1.3.

(Note-3): See Section 6.1.3 for details regarding the JOG Simultaneous START Register, and Section 4.1.8 (12) 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 real current value are not stored.

(c) The virtual servo motor's feed current 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. 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(Note) 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 current value must be corrected (using the "current 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:
- Current value change
- Speed change

Current value changes are executed by the CHGA instruction, and speed changes are executed by the CHGV instruction. (See Section 10.1)
For details regarding the CHGA and CHGV instructions, see Section 5.3 of the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH/A173UH).

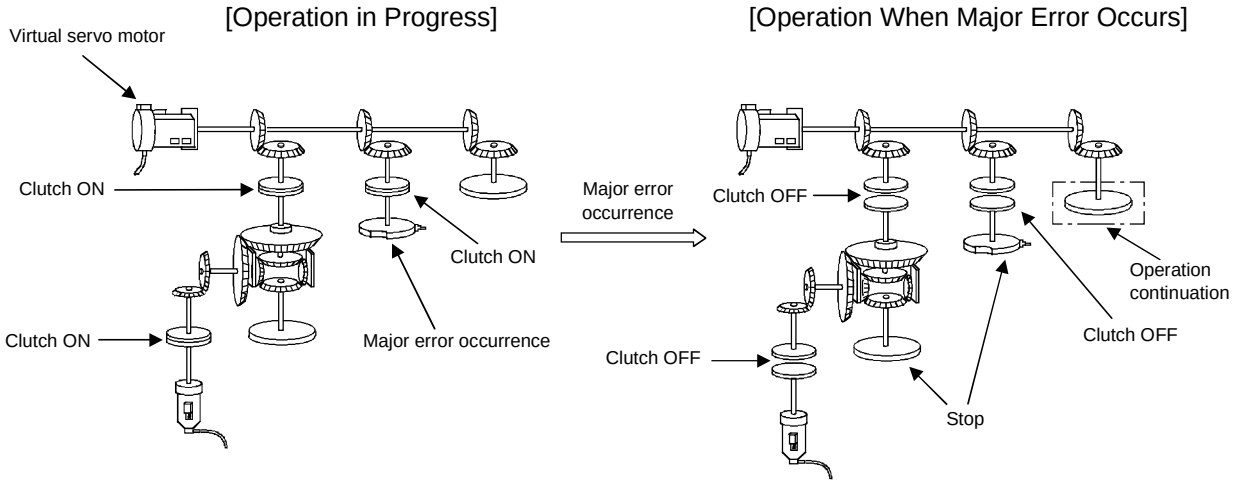
REMARK

(Note): For details regarding the "VIRTUAL mode continuation disabled" warning signal, see Section 8.5.1(2).

(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 (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 pro-gram, if required. To resume operation, eliminate the error cause, then switch the clutch ON/OFF command device ON.

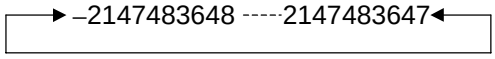


Operation With "Clutch OFF" Setting

(6) Virtual servo motor axis continuous operation

By setting the virtual servo motor stroke limit upper and lower limit parameters such that the upper stroke limit = lower stroke limit, the stroke limit can be disabled thereby allowing operation to continue indefinitely.

When the stroke limit is disabled it is also possible for the startup of the feed current value to take place in a direction that exceeds 32 bits. In such a case the feed current value is converted to a 32 bit ring address.



The following operations are possible depending on the control mode.

Control Mode	Control Contents
Positioning (Linear)	• When the ABS command is used for startup it proceeds in a direction within the 32 bit range. Startup will not proceed in a direction that exceeds the 32 bit range. • When the INC command is used for startup it proceeds in the direction that has been set thus also making it possible to move in a direction that exceeds 32 bits.
Speed switching	
Constant-speed (Linear)	
Fixed-pitch feed	• Startup proceeds in the set direction and thus it is possible to proceed in a direction that exceeds 32 bits.
Position follow-up	• The set address is controlled by the absolute method so that startup in a direction that exceeds 32 bits is not possible.
High-speed oscillation	
Speed	• Stroke is disabled. Moves in the set direction.
JOG	
Manual pulse generation	
Positioning (Circular)	• A start error (107, 108, 109) accompanies the ABS or INC command and startup is not possible.
Constant-speed (Circular)	

(7) Reverse return during positioning

By setting a negative speed and carrying out a speed change request using the CHGV instruction while startup is in progress, it is possible to initiate deceleration at that point and return in the reverse direction once deceleration is completed.

The following operations are possible via use of servo commands.

Control Mode	Servo Command	Operation
Linear control	ABS-1 INC-1 ABS-2 INC-2 ABS-3 INC-3 ABS-4 INC-4	The direction of movement is reversed when deceleration is complete, the servo returns to the positioning starting point using the absolute value of the set speed, and then stops (stand by). In the case of circular interpolation the servo returns along the circular orbit.
Circular interpolation control	ABS circular INC circular	
Fixed-pitch feed	FEED-1 FEED-2 FEED-3	
Constant-speed control	CPSTART 1 CPSTART 2 CPSTART 3 CPSTART 4	The direction of movement is reversed when deceleration is complete, the servo returns to the previous point using the absolute value of the set speed, and then stops (stand by).
Speed control (I)	VF VR	Deceleration is completed and the direction of movement is reversed using the absolute value of the set speed. It does not stop until the stop command is input.
Position follow-up control	PFSTART	Reverse return is not possible. This should be viewed as a normal speed change request. The minor error 305 results and the speed limit value is used for control.
Speed switching control	VSTART	
JOG operation		

(Remarks) Minor error 305: The set speed is out of range the from 0 to the speed limit.

[Control contents]

(1) If a speed change is made to a negative speed, control is carried out as indicated in the previous table in accordance with the control mode during startup.

(2) The command speed during return becomes the absolute value of the changed speed. If the speed limit value is exceeded the minor error 305 will result and control will use the speed limit value.

(3) The following hold true when the servo is in the stand by status at the return position.
   (a) Status of each signal
   - Start accept (M2001+n) ON (No change prior to CHGV execution)
   - Positioning start completed (M4000+20n) ON (No change prior to CHGV execution)
   - Positioning completed (M4001+20n) OFF
   - Command in-position (M4003+20n) OFF
   - Speed change "0" accepting in progress flag (M2240+n) ON

   (b) In the case of a restart carry out a speed change to the normal speed.

   (c) When positioning is completed set the stop command to ON.

   (d) If a negative speed change is carried out a second time it is ignored.

(4) The following are true during reverse return using the speed control mode.
   (a) If the direction of movement is returned a second time, carry out a speed change to the normal speed.

   (b) To stop set the stop command to ON.

   (c) If a negative speed change is carried out a second time, carry out speed change using the reverse return direction.

[Error contents]

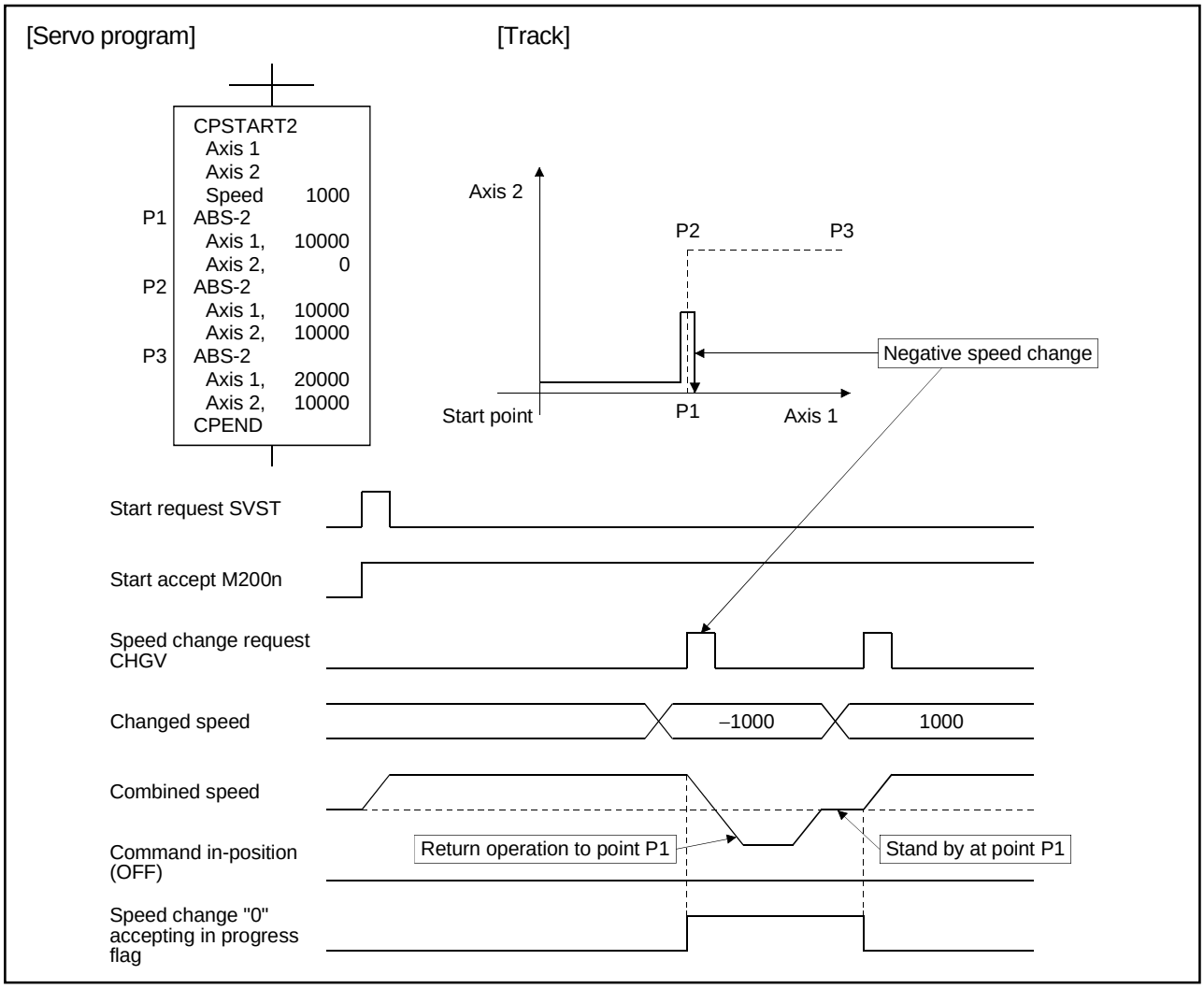
(1) During startup of reverse return in a valid control mode, if the absolute value of the negative changed speed exceeds the speed limit, the minor error 305 will occur and reverse return will be carried out using the speed limit value.

(2) During constant-speed control if the absolute value of the negative changed speed exceeds the speed set in the servo program, reverse return will be carried out using the speed set in the program. (Speed clamp control in relation to a speed change during constant-speed control) An error will not occur at this time.

(3) Not enabled after the initial automatic deceleration. Minor error 303 results.

[Operation example of constant-speed control]

The diagram below shows an example of operation when a reverse return request is carried out in relation to constant-speed control.

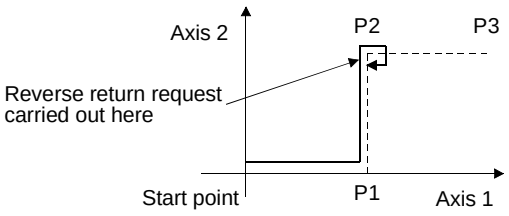


As shown above, when a speed change is carried out to a negative speed while execution of positioning at P2 is in progress, the system returns to P1 in accordance with the start set in the program and waits in stand by at P1.

POINTS

(1) If the M-code FIN wait function is used in constant-speed control and a reverse return request is carried out during FIN wait stoppage, the request will be ignored.

(2) In the above example, if the reverse return request return is carried out just prior to P2 and P2 is passed during deceleration, the system will return to P2.



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.		——	——	1 to 32	——
2	Stroke limit upper limit		2147483647	PLS	−2147483648 to 2147483647	PLS
3	Stroke limit lower limit		0	PLS	−2147483648 to 2147483647	PLS
4	Command in-position range		100	PLS	1 to 32767	PLS
5	JOG operation data	JOG speed limit	20000	PLS/s	1 to 10000000 (Note)	PLS/s
6		Parameter block	1	——	1 to 16	——
7	Operation mode when error occurs		Continuation	——	Continuation/Clutch OFF	——

(Note): The setting range has been expended from the previous range as a result of compatibility with the high resolution encoder.

(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
Designates the stroke range of the virtual servo motor axis.
(a) When the stroke limit lower limit is made effective:
Designate the stroke range in such a way that the stroke limit lower limit is less than the stroke limit upper limit.
The stroke limit check during start and its control take place as follows at start time.

Control Mode		Error check				Remarks
		startup	startup in progress			
		106	207	208	220	
Positioning	Linear	○	——	——	——	Startup in the return direction in a stroke from the stroke range is possible.
	Circular	○	○	○	——	
Fixed-pitch feed		○	——	——	——	
Speed switching		○	○	○	——	
Constant-speed		○	○	○	——	
Position follow-up		○	○	——	○	
Speed		——	——	——	——	The stroke is disabled. The feed present value does not become "0".
JOG		——	○	——	——	Startup in the return direction in a stroke from outside the stroke range is possible.
Manual pulse generation		——	○	○	——	

<Error check at startup>

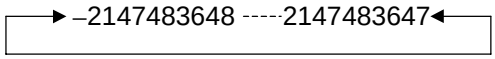
Error Code	Contents	Operation
106	Command position is outside of the stroke limit range at startup.	Does not start

<Error check with startup in progress>

Error Code	Contents	Operation
207	Feed current value is outside of the stroke limit range during startup.	Deceleration stop is initiated.
208	The feed current value of another axis is outside of the stroke limit range when circular interpolation starts.	
220	The command address is outside of the stroke limit range during position follow-up control.	

(b) When the stroke limit is disabled

Set such that the stroke limit lower limit = stroke limit upper limit.
When the stroke limit is disabled, feed current value startup in a direction that exceeds 32 bits is possible.
In such a case the feed current value is converted to a 32 bit ring address.



The following operations are possible depending on the control mode.

Control Mode	Control Contents
Positioning (Linear)	• When the ABS command is used for startup it proceeds in a direction within the 32 bit range. Startup will not proceed in a direction that exceeds the 32 bit range. • When the INC command is used for startup it proceeds in the direction that has been set thus also making it possible to move in a direction that exceeds 32 bits.
Speed switching	
Constant speed (Linear)	
Fixed-pitch feed	• Startup proceeds in the set direction and thus it is also possible to proceed in a direction that exceeds 32 bits.
Position follow-up	• The set address is controlled by the absolute method so that startup in a direction that exceeds 32 bits is not possible.
Speed	• Stroke is disabled. Moves in the direction set.
JOG	
Manual pulse generation	
Positioning (Circular)	• A start error (107, 108, 109) accompanies the ABS or INC command and startup is not possible.
Constant-speed (Circular)	

(3) Command in-position range
The term "command in-position" refers to the difference between the positioning address (command position) and current feed value.
The "command in-position" signal switches ON when the difference between the command position and the feed current value enters the setting range ([command in-position] – [feed current 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.)

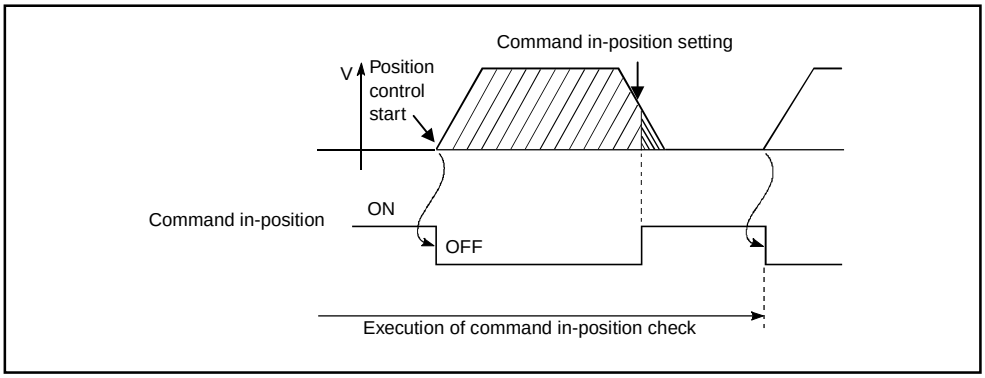


Fig. 6.1 Command In-position Range

(4) JOG speed limit and parameter block settings
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.

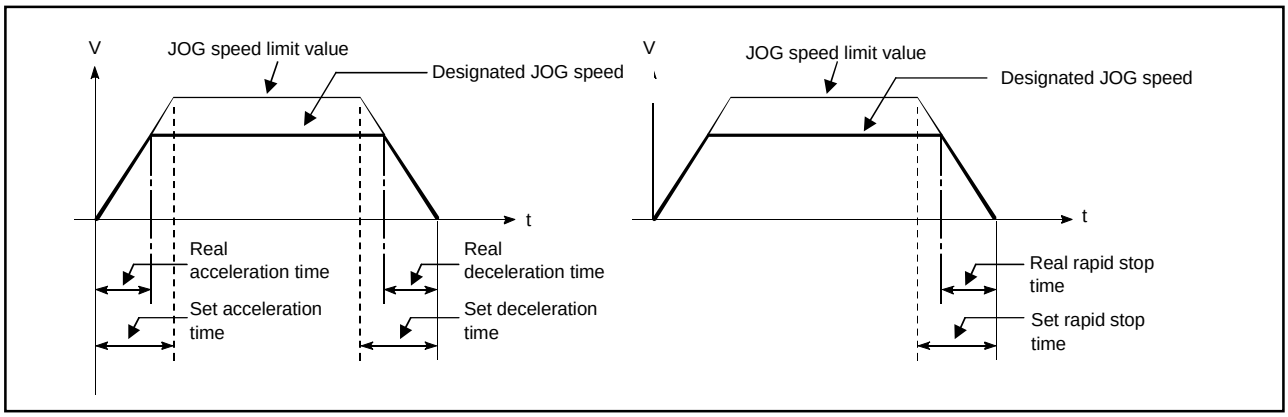


Fig. 6.2 Relationships between the JOG Speed Limit, Acceleration Time, Deceleration Time, and Rapid Stop Time

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.

6.1.3 Virtual servo motor axis devices (internal relays, data registers)

(1) Virtual servo motor axis status

Axis No.	Device Number	Signal Name
1	M4000 to M4019	(○ Valid)
2	M4020 to M4039	
3	M4040 to M4059	
4	M4060 to M4079	
5	M4080 to M4099	
6	M4100 to M4119	
7	M4120 to M4139	
8	M4140 to M4159	
9	M4160 to M4179	
10	M4180 to M4199	
11	M4200 to M4219	
12	M4220 to M4239	
13	M4240 to M4259	
14	M4260 to M4279	
15	M4280 to M4299	
16	M4300 to M4319	
17	M4320 to M4339	
18	M4340 to M4359	
19	M4360 to M4379	
20	M4380 to M4399	
21	M4400 to M4419	
22	M4420 to M4439	
23	M4440 to M4459	
24	M4460 to M4479	
25	M4480 to M4499	
26	M4500 to M4519	
27	M4520 to M4539	
28	M4540 to M4559	
29	M4560 to M4579	
30	M4580 to M4599	
31	M4600 to M4619	
32	M4620 to M4639	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note)			Fetch Cycle: Preset number of axes (Note)		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32
0	Positioning start completion	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
1	Positioning completion									
2	Unusable		—		—					
3	Command in-position		○		3.5ms	7.1ms	14.2ms			
4	Speed controlling									
5	Unusable		—		—					
6	Unusable									
7	Error reset		○		Immediately					
8	Unusable		—		—					
9	Unusable									
10	Unusable									
11	Unusable									
12	Unusable									
13	Unusable									
14	Unusable									
15	Unusable									
16	Unusable									
17	Unusable									
18	Unusable									
19	M-code outputting signal		○		3.5ms	7.1ms	14.2ms			

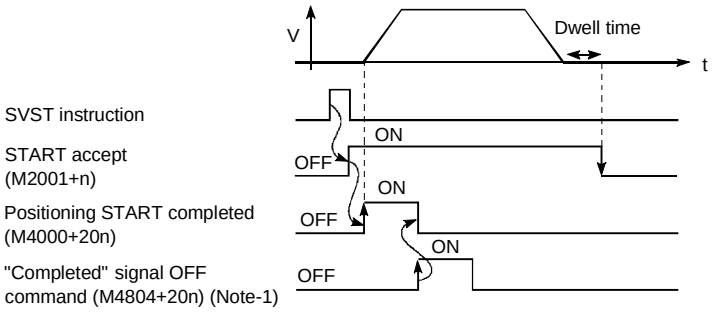
(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Positioning START completed signal (M4000+20n) (Note-1)

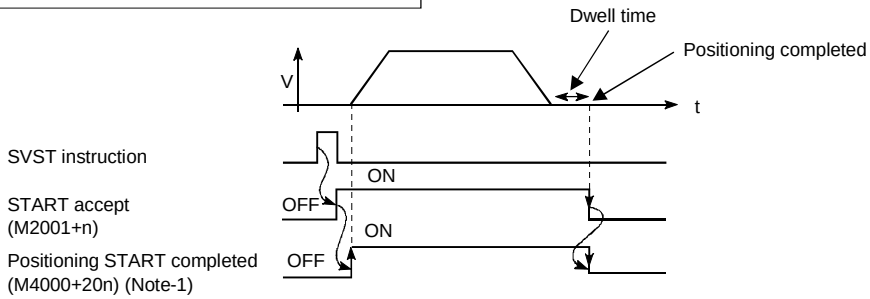
1) This signal switches ON when a positioning START is completed at the axis designated by a SVST instruction in the sequence program.
This signal is inoperative during JOG and speed control operations.
This signal can be used for M-code readouts, etc., when positioning is started. (Note-2)

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

1) At leading edge of "completed" signal OFF command (OFF→ON)



2) When positioning is completed



REMARK

(1) (Note-1): The "n" of M4000+n, M4804+20n, M1404+20n represents the numerical value corresponding to the virtual axis No.

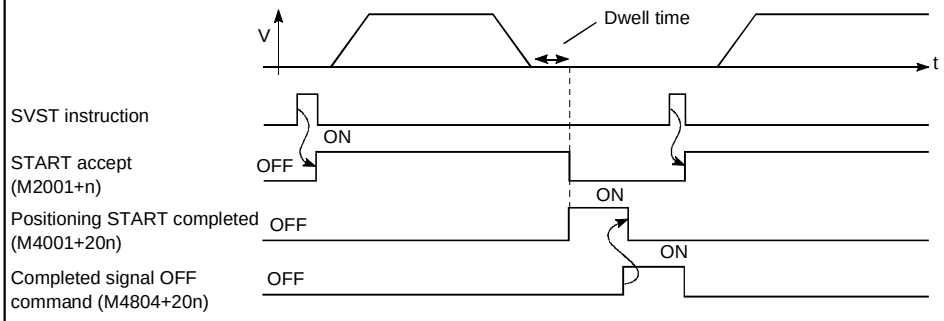
n	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Virtual axis No.	1	2	3	4	5	6	7	8
n	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Virtual axis No.	9	10	11	12	13	14	15	16
n	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Virtual axis No.	17	18	19	20	21	22	23	24
n	**24**	**25**	**26**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

(2) (Note-2): For details negarding the "M-code", see Section 8.2 of the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH/A173UH)

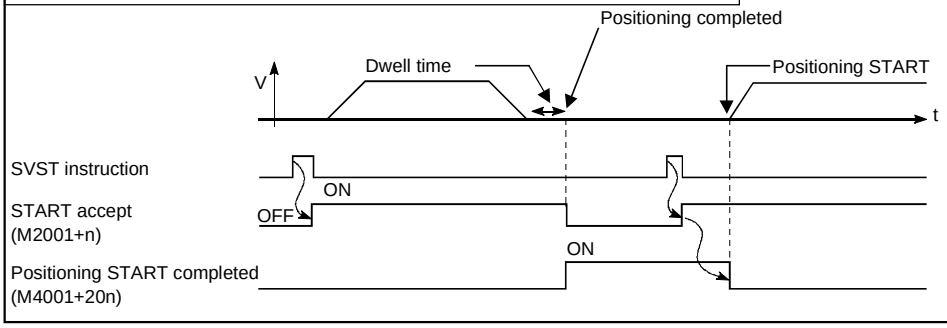
(b) Positioning completed signal (M4001+20n)

1) This signal switches ON when positioning is completed at the axis designated by a 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) The positioning completed signal will switch OFF at the leading edge (OFF→ON) of the "completed" signal OFF command (M4804+20n) or when a positioning START is completed.

1) At leading edge of Yn4 completed signal OFF command (OFF→ON)

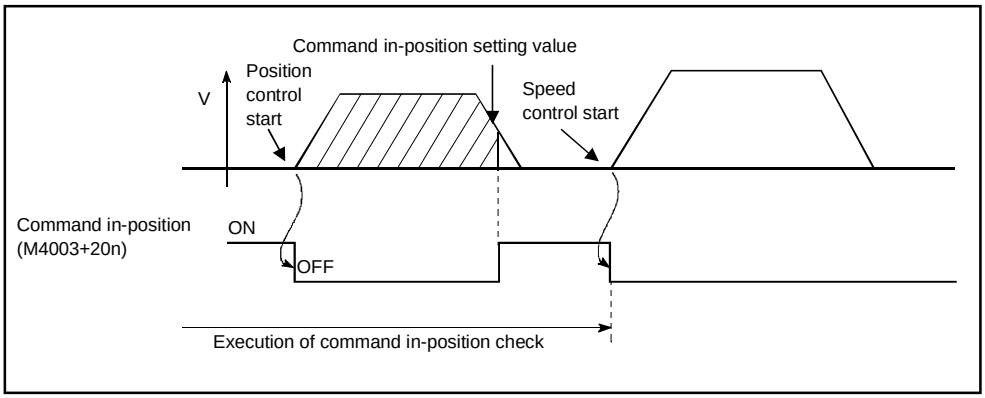


2) When next positioning control START is completed



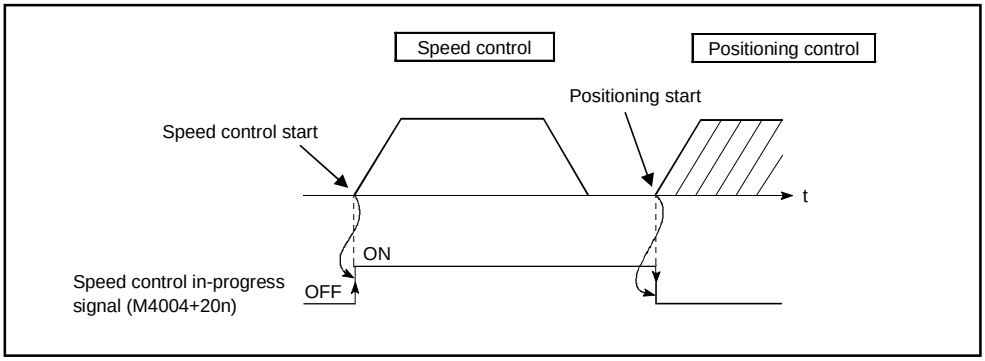
(c) Command in-position command (M4003+20n)

1) This signal switches ON when the absolute difference between the command position and the current 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.



(d) Speed control in-progress signal (M4004+20n)

1) Since the speed control in progress signal is ON while speed control is in progress this signal can be used to determine whether speed control is in progress or positioning is in progress.
   The speed control in progress signal that comes ON during speed control will go OFF when the next positioning control operation starts.
2) When the power is turned on or positioning control is in progress this signal will be OFF.



(e) Error detection signal (M4007+20n)

1) The error detection signal comes ON when a minor error or major error is detected in a virtual servo motor or output module connected to a virtual servo motor.
   The ON/OFF status of the error detection signal is used to distinguish whether or not an error exists.
2) When the error detection signal comes ON the corresponding error code is then stored in the error code storage area.
   - Minor error code (Note-1) ... Stored in the minor error code storage area (Note-2).
   - Major error code (Note-1) ... Stored in the major error code storage area (Note-2).

   The distinction as to whether the detected error is a virtual servo motor error or an output module error can be confirmed by the contents of the error code or by the ON/OFF status of the output module error detection signal.
3) When the virtual servo motor or output module connected to the virtual servo motor is in its normal status the error reset command (M4807 + 20n) is ON and the error detection signal is OFF.

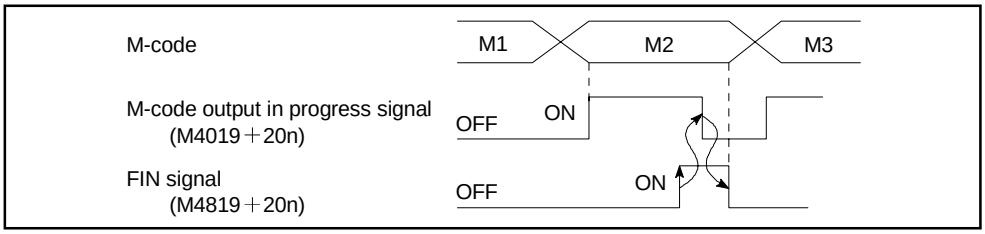
REMARKS

(1) (Note-1): Refer to section 11.3 for details regarding virtual servo motor minor/major error codes.
Refer to section 11.5 for details regarding output module minor/major error codes.

(2) (Note-2): Refer to section 6.1.3 for details concerning the minor error code storage area and major error code storage area.

(f) M-code output in progress signal (M4019+20n)

1) Signal indicating that M-code output is in progress.
2) This will be OFF when a stop command, cancel signal, skip signal, or FIN signal has been input.



POINTS

(1) The M-code output in progress signal is the signal for the FIN signal wait function.
(2) The M-code output in progress signal is only enabled when the FIN acceleration/deceleration speed has been set in the servo program. If it is not set the FIN signal wait function is disabled and the M-code output in progress signal does not come ON.

(2) Virtual servo motor axis command signals

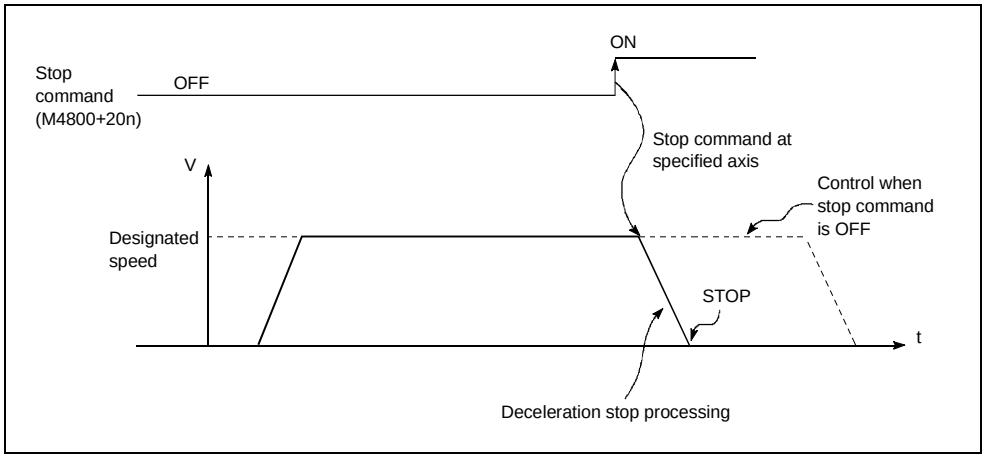
Axis No.	Device Number	Signal Name
1	M4800 to M4819	(○: Valid)
2	M4820 to M4839	
3	M4840 to M4859	
4	M4860 to M4879	
5	M4880 to M4899	
6	M4900 to M4919	
7	M4920 to M4939	
8	M4940 to M4959	
9	M4960 to M4979	
10	M4980 to M4999	
11	M5000 to M5019	
12	M5020 to M5039	
13	M5040 to M5059	
14	M5060 to M5079	
15	M5080 to M5099	
16	M5100 to M5119	
17	M5120 to M5139	
18	M5140 to M5159	
19	M5160 to M5179	
20	M5180 to M5199	
21	M5200 to M5219	
22	M5220 to M5239	
23	M5240 to M5259	
24	M5260 to M5279	
25	M5280 to M5299	
26	M5300 to M5319	
27	M5320 to M5339	
28	M5340 to M5359	
29	M5360 to M5379	
30	M5380 to M5399	
31	M5400 to M5419	
32	M5420 to M5439	

	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32
0	Stop command	×	○	SCPU→ PCPU				3.5 ms	7.1 ms	14.2 ms
1	Rapid stop command									
2	Forward JOG start							10ms		
3	Reverse JOG start									
4	Completed signal OFF command									
5	Unusable	——	——					——		
6	Unusable									
7	Error reset	×	○					10ms	20ms	
8	Unusable	——	——					——		
9	External STOP input valid/invalid when starting	×	○					At start		
10	Unusable	——	——					——		
11	Unusable									
12	Unusable									
13	Unusable									
14	Unusable									
15	Unusable									
16	Unusable									
17	Unusable									
18	Unusable									
19	FIN signal	×	○					3.5 ms	7.1 ms	14.2 ms

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Stop command (M4800+20n) (Note)

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.)



2) The stop command can also be used during speed control. (For details regarding speed control, see Section 7.12 of the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH/A173UH).
3) STOP processing which occurs in response to the stop command is shown in Table 6.2 below.

Table 6.2 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		

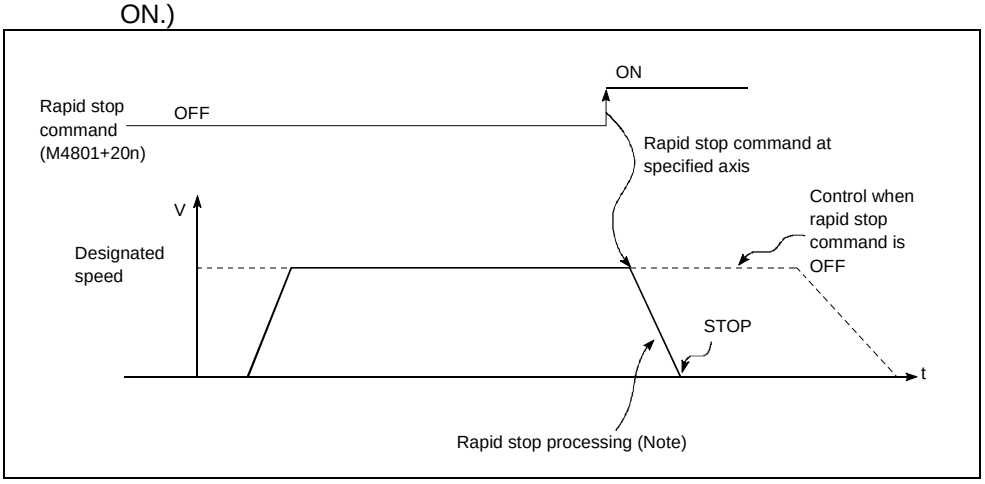
REMARK

(Note): The "n" in 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

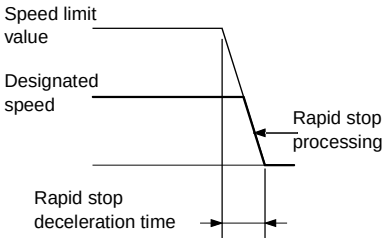
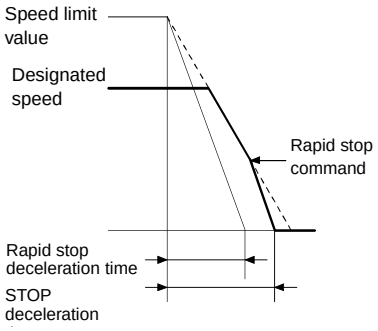
(b) Rapid stop command (M4801+20n)

1) This command is used to execute a rapid stop 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.)



2) The rapid stop processing which occurs when the rapid stop command switches ON is shown in Table 6.3 below.

Table 6.3 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 Speed control JOG operation	Rapid stop occurs 	Deceleration processing is aborted, and rapid stop processing begins. 

REMARKS

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

(c) Forward JOG start command (M4802+20n)/Reverse JOG start command (M4803+20n)

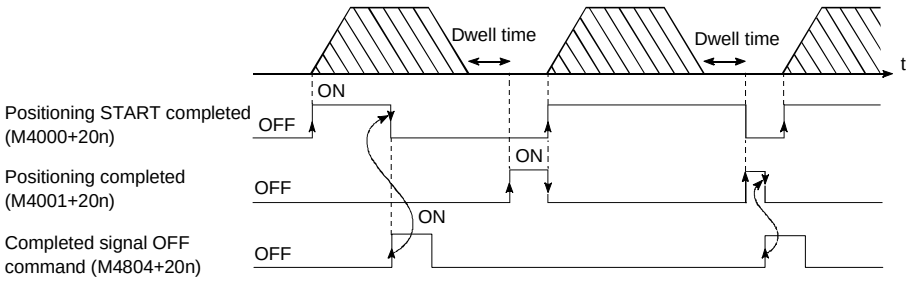
1) When the forward JOG start command (M4802+20n) is ON in the sequence program, JOG operation occurs in the forward direction (direction in which the address increases).
When the forward JOG start command (M4802+20n) is switched OFF, a deceleration and STOP will occur within the deceleration time designated at the parameter block.

2) When the reverse JOG start command (M4803+20n) 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 (M4803+20n) 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 (M4802+20n) and reverse (M4803+20n) JOG start commands from being switched ON simultaneously.

(d) Completed signal OFF command (M4804+20n)
This command is used to switch the "positioning START completed signal" (M4000+20n) and the "positioning completed signal" (M4001+20n) 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"(M4000+20n) and the "positioning completed signal" (M4001+20n) OFF.

(e) Error reset command (M4807+20n)
1) The error reset command is used to clear the minor or major error code storage area of the virtual servo motor for which an error has been detected and to reset the error detection signal.
2) The following processing is carried out when the error reset command comes ON.
- If the virtual servo motor and output module are normal the minor and major error code storage areas are cleared and the error detection signal is reset.
- If the virtual servo motor and output module error has not been canceled, the error code is again stored in the minor/major error code storage area.
In this case the error detection signal (M4007+20n) remains ON.

POINT

Do not turn the error reset command (M4807+20n) ON using the PLS command.
If it is set to ON using the PLS command it may not be possible to carry out error reset.

(f) External STOP input invalid command at START (M4809+20n)
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.

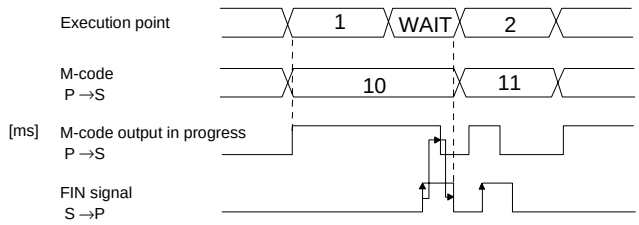
POINTS

After operation has been started by switching external STOP input invalid command at START (M4809+20n) 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.)

(g) FIN signal (M4819+20n)
When an M-code is set in a point during positioning, travel to the next block does not take place until the FIN signal state changes as follows:
OFF→ON→OFF
Positioning to the next block begins after the FIN signal state changes as above.

VIRTUAL
<K1000>

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



Timing Chart for Operation Description

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

POINTS

(1) The FIN signal and M-code output in progress signal are for the FIN signal wait function.
(2) The FIN signal and M-code output in progress signal are only enabled when the FIN acceleration/deceleration speed has been set in the servo program. If it is not set the FIN signal wait function is disabled and the M-code output in progress signal does not come ON.

(3) Virtual servo motor axis monitor device

Axis No.	Device Number	Signal Name
1	D800 to D805	
2	D810 to D815	
3	D820 to D825	
4	D830 to D835	
5	D840 to D845	
6	D850 to D855	
7	D860 to D865	
8	D870 to D875	
9	D880 to D885	
10	D890 to D895	
11	D900 to D905	
12	D910 to D915	
13	D920 to D925	
14	D930 to D935	
15	D940 to D945	
16	D950 to D955	
17	D960 to D965	
18	D970 to D975	
19	D980 to D985	
20	D990 to D995	
21	D1000 to D1005	
22	D1010 to D1015	
23	D1020 to D1025	
24	D1030 to D1035	
25	D1040 to D1045	
26	D1050 to D1055	
27	D1060 to D1065	
28	D1070 to D1075	
29	D1080 to D1085	
30	D1090 to D1095	
31	D1100 to D1105	
32	D1110 to D1115	

(○: Valid)

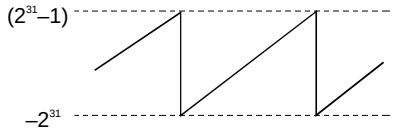
	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32
0 1	Feed current value	Backup	○	SCPU ← PCPU	3.5 ms	7.1 ms	14.2ms			
2	Minor error code				Immediately					
3	Major error code									
4	Execution program Number				At start					
5	M-code				3.5 ms	7.1 ms	14.2ms			

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Feed current value storage register(D800+10n) (Note-1)

..... 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 current value data is subjected to a stroke range check.
3) "-2^{31} PLS to $(2^{31}-1)$ PLS" ring address is established.



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

(b) Minor error code storage register (D802+10n)

..... Data sent from PCPU to SCPU

1) When a minor error occurs at the virtual servo motor or at the output module, the corresponding error code (see Section 11.3 and 11.5) 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 (Note-2).
   To clear error codes for minor errors which occurred at the output module, execute the output module error reset command (Note-3).

REMARKS

(1) (Note-1): The "n" in D800+10n represents the number 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) (Note-2): For details regarding the drive module error reset command, see Section 6.1.3.

(3) (Note-3): For details regarding the output module error reset command, see Section 8.5.1.

(c) Major error code storage register (D803+10n)
..... Data sent from PCPU to SCPU

1) When a major error occurs at the virtual servo motor or at the output module, the corresponding error code (see Section 11.3) 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 (Note-1).
To clear error codes for major errors which occurred at the output module, execute the output module error reset command (Note-2).

(d) Execution servo program No. storage register (D804+10n)
Data sent from PCPU to SCPU

1) The No. of the program being run is stored in this register when the SVST instruction is executed.
2) When the SVST instruction is not executed, the following value are stored in this register.
- JOG operation..... FFFFH
- At power ON FF00H
- When REAL → VIRTUAL mode switching occurs..... FF00H

(e) M-code storage register (D805+10n) ..... 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 PLC READY signal (M2000).

REMARKS

(1) (Note-1): For details regarding the drive module error reset command, see Section 6.3.1.

(2) (Note-2): For details regarding the output module error reset command, see Section 8.5.1.

(4) Current value after virtual servo motor axis main shaft differential gear

Axis No.	Device Number	Signal Name
1	D806 to D809	
2	D816 to D819	
3	D826 to D826	
4	D836 to D839	
5	D846 to D849	
6	D856 to D859	
7	D866 to D869	
8	D876 to D879	
9	D886 to D889	
10	D896 to D899	
11	D906 to D909	
12	D916 to D919	
13	D926 to D929	
14	D936 to D939	
15	D946 to D949	
16	D956 to D959	
17	D966 to D969	
18	D976 to D979	
19	D986 to D989	
20	D996 to D999	
21	D1006 to D1009	
22	D1016 to D1019	
23	D1026 to D1029	
24	D1036 to D1039	
25	D1046 to D1049	
26	D1056 to D1059	
27	D1066 to D1069	
28	D1076 to D1079	
29	D1086 to D1089	
30	D1096 to D1099	
31	D1106 to D1109	
32	D1116 to D1119	

(○: Valid)

	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note)			Preset number of axes (Note)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
01	Current value after virtual servo motor axis main shaft differential gear	Back up	○	SCPU← PCPU	3.5 ms	7.1 ms	14.2ms			
2	Error search output axis No.									
3	Data set pointer for constant-speed control									

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Current value storage register after virtual servo motor axis main shaft differential gear (D806+10n) (Note) .....Data sent from PCPU to SCPU
1) When switching the virtual mode the current value will be the same as the main shaft side drive module current value.
2) When a current value change is carried out in relation to the main shaft side drive module, the current value after the main shaft differential gear will also be changed to the set current value at the same time.
3) If the differential gear is not connected to the main shaft, the main shaft drive module current value will always be stored in the current value storage register after main shaft differential gear.

REMARKS

(1) (Note): The "n" in D806+10n represents the number 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

(b) Error search output axis No. storage register (D808+10n) ..... Data from SCPU to PCPU

1) This register is designed to store the axis number of the output module in error which was detected by the error search function in the virtual mode.

2) If there are no errors at the virtual servo motor axes of the main shaft and auxiliary input axis, the error occurrence output axis No. is stored into the error search output axis No. storage register of the corresponding drive module No. when a minor or major error occurs at the connected output axis.

3) Error search and error reset

a) Searching the main shaft for error

The output axes connected to the main shaft are searched for an error in order of lower to higher numbers. If either a minor or major error has occurred, the corresponding output axis No. is stored into the error search output axis No. storage register.

Resetting the error of the corresponding output axis stores the other error occurrence output axis No. connected to the same main shaft.

b) Searching the auxiliary input axis for error

If either a minor or major error has occurred at the output axis connected to the auxiliary input axis, the corresponding output axis No. is stored into the error search output axis No. storage register.

However, when the differential gear (for virtual main shaft connection) is used to provide auxiliary input to the main shaft, the output axis connected to the auxiliary input axis is not searched for an error. Use the main shaft side error search output axis No. storage register to confirm the error occurrence output axis No.

4) When error occurs at the drive module axis

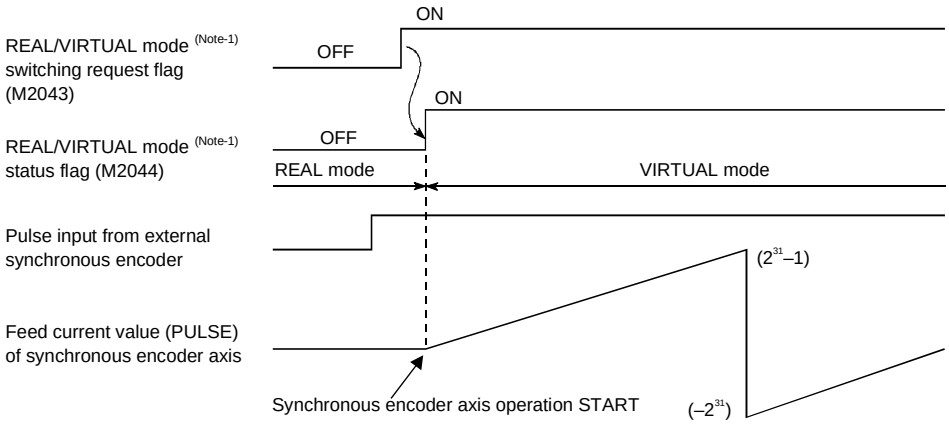
When an error occurs at the main shaft/auxiliary input axis to which the output axis is connected, "0" (no error) is stored into the error search output axis No. storage device if an error occurred at the output axis.

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 (TRA: synchronous encoder input START signal) (Note-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.

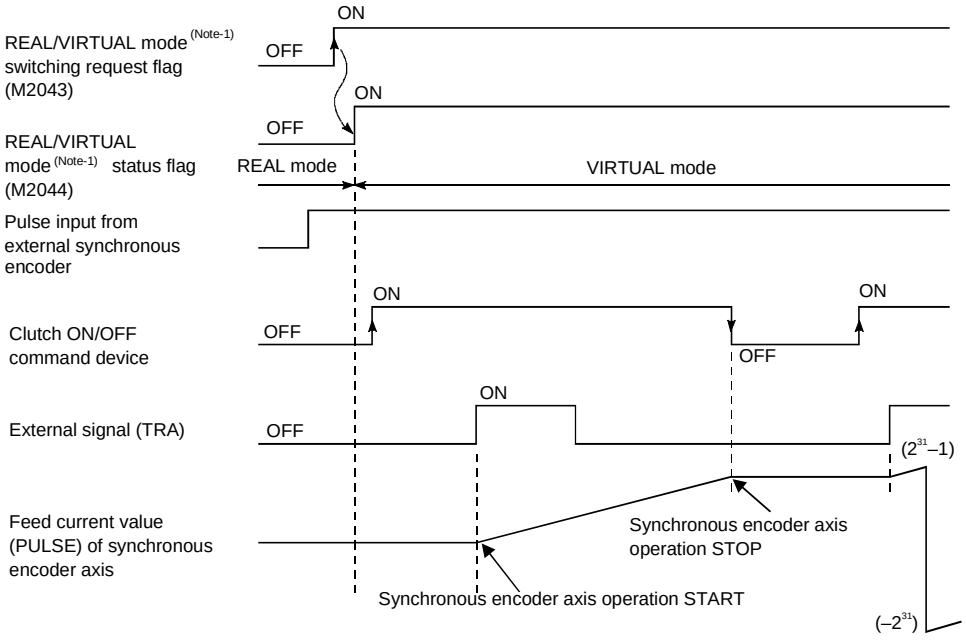


2) The clutch control mode (Note-3) operation will be identical to its operation in the ON/OFF mode and the address mode, and can be used with incremental or absolute type synchronous encoders.
3) Transmission of synchronous encoder operation to the output module will or will not occur depending on the 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 mode is switched from REAL mode to VIRTUAL mode while the clutch is ON, use the smoothing clutch.
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 (Note-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) (Note-1): For details regarding the REAL/VIRTUAL mode switching request flag and the REAL/VIRTUAL mode switching status flag, see Section 4.1.

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

(3) (Note-2): The synchronous encoder input START signal is input to the A273EX/A172SENC "TRA" terminal.
For details regarding the A273EX/A172SENC "TRA" terminal, refer to the Motion Controller [A173UHCPU/A273UHCPU] User's Manual.

(4) (Note-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 "real current value" are not stored in memory.

(b) The synchronous encoder's feed current 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. 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 current value must be corrected (using the "current 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:

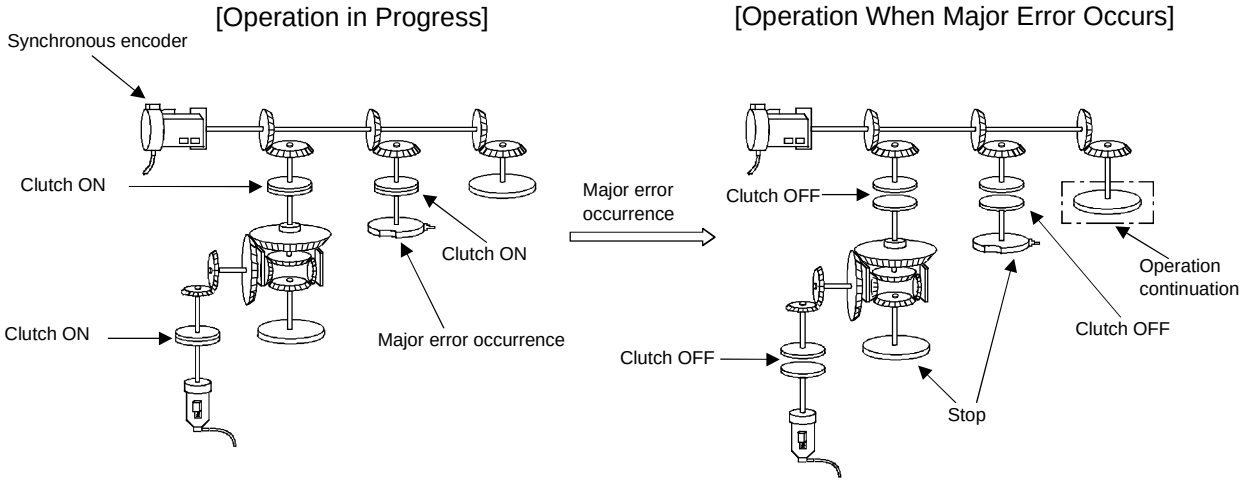
- Current value change

Current value changes are executed by the CHGA instruction.
For details regarding the CHGA instructions, see Section 5.3 of the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH /A173UH).

(6) 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 6.4) 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 (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

6.2.2 Parameter list

The synchronous encoder parameters are shown in Tables 6.4.
For details regarding the synchronous encoder parameter setting procedure, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual.

Table 6.4 Synchronous Encoder Parameter List

No.	Setting Item	Default Value	Setting Range
1	Encoder No.	—	1 to 12
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 and synchronous encoder interface.

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 to P12 : Connected to the manual pulse generator's input interface. This is for incremental type synchronous encoders.
E1 to E12 : Connected to the serial synchronous encoder interface. This is for absolute type synchronous encoders.

(Note): The absolute and incremental synchronous encoders can be used (set) together.

6.2.3 Synchronous encoder axis device (internal relay, data register)

(1) Synchronous encoder axis device

Axis No.	Device	
	A273UHCPU	A173UHCPU(S1)
1	M4640 to M4643	M4640 to M4643
2	M4644 to M4647	M4644 to M4647
3	M4648 to M4651	M4648 to M4651
4	M4652 to M4655	M4652 to M4655
5	M4656 to M4659	
6	M4660 to M4663	
7	M4664 to M4667	
8	M4668 to M4671	
9	M4672 to M4675	
10	M4676 to M4679	
11	M4680 to M4683	
12	M4684 to M4687	

Signal Name

(○: Valid)

	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32
0	Error detection	○	○	SCPU← PCPU	Immediately					
1	External signal TRA	○	○		10ms	20ms				
2	VIRTUAL mode continuation disabled warning	○	○							
3	Unusable	—	—		—					

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Error detection signal (M4640+4n)

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 (Note-1) …Stored at minor error code storage area (Note-2).
   - Major error code (Note-1)…Stored at major error code storage area (Note-2).

   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 (M5440+4n) is switched ON, the error detection signal will switch OFF.

(b) External signal TRA (M4641+4n)

1) The external signal TRA is used for clutch control in the external input mode. This signal switches ON when input occurs at the A273EX/A172SENC "TRA" input terminal, and indicates the TRA terminal's input ON/OFF status.

(c) VIRTUAL mode continuation disabled warning signal (M4642+4n)

1) As happens when the absolute type synchronous encoder is moved while power is OFF, this signal will switch ON when the current value read at power ON differs from that which was stored at power OFF (final current 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.

REMARKS

"n" in M4640+4n, M4641+4n and M4642+4n indicates the 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

(1) (Note-1): For details regarding drive module major and minor errors, see Section 11.3.
For details regarding output module major and minor errors, see Section 11.5.

(2) (Note-2): For details regarding the minor and major error code storage areas, see Section 6.2.3.

(2) Synchronous encoder axis command signal

Axis No.	Device	
	A273UHCPU	A173UHCPU(-S1)
1	M5440 to M5443	M5440 to M5443
2	M5444 to M5447	M5444 to M5447
3	M5448 to M5451	M5448 to M5451
4	M5452 to M5455	M5452 to M5455
5	M5456 to M5459	
6	M5460 to M5463	
7	M5464 to M5467	
8	M5468 to M5471	
9	M5472 to M5475	
10	M5476 to M5479	
11	M5480 to M5483	
12	M5484 to M5487	

Signal Name

(○: Valid)

	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note)			Preset number of axes (Note)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to24	25 to 32	1 to 12	13 to 24	25 to 32
0	Error reset	×	○	SCPU→ PCPU				10 ms	20 ms	
1	Unusable	—	—					—		
2	Unusable									
3	Unusable									

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Error reset command (M5440+4n)

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) 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 (M4640+4n) will remain ON.

POINT

Do not switch the error reset command (M5440+4n) ON with a PLS instruction since this can disable the error reset function.

(3) Synchronous encoder axis monitor device

Axis No.	Device	
	A273UHCPU	A173UHCPU(S1)
1	D1120 to D1125	D1120 to D1125
2	D1130 to D1135	D1130 to D1135
3	D1140 to D1145	D1140 to D1145
4	D1150 to D1155	D1150 to D1155
5	D1160 to D1165	
6	D1170 to D1175	
7	D1180 to D1185	
8	D1190 to D1195	
9	D1200 to D1205	
10	D1210 to D1215	
11	D1220 to D1225	
12	D1230 to D1235	

Signal Name

(○: Valid)

	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle: Preset number of axes (Note)			Fetch Cycle: Preset number of axes (Note)		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	18 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32
0 1	Current value	Back up	○	SCPU ← PCPU	3.5 ms	7.1 ms	14.2 ms			
2	Minor error code				Immediately					
3	Major error code									
4	Unusable	—	—		—					
5	Unusable									

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Current value storage register (D1120+10n, D1121+10n)
..... Data sent from PCPU to SCPU

1) The virtual drive module and synchronous encoder current values are stored in this register.
2) "–2147483648 (-2^{31}) PLS to 2147483647 ($2^{31}-1$)" ring address is established.
3) Data in the current value storage register is stored in a backup memory when a power OFF or servo system CPU reset occurs.

(b) Minor error code storage register (D1122+10n)
..... Data sent from PCPU to SCPU

1) When a minor error occurs at the synchronous encoder or at the output module, the corresponding error code (see Section 11.3 and 11.5) 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 (Note-1).
To clear error codes for minor errors which occurred at the output module, execute the output module error reset command (Note-2).

REMARKS

(1) (Note-1): For details regarding the drive module error reset command, see Section 6.2.3.
(2) (Note-2): For details regarding the output module error reset command, see Section 8.5.1.

(c) Major error code storage register (D1123+10n)
..... Data sent from PCPU to SCPU

1) When a major error occurs at the synchronous encoder or at the output module, the corresponding error code (see Section 11.3 and 11.5) 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.
To clear error codes for major errors which occurred at the output module, execute the output module error reset command.

(4) Current value after synchronous encoder axis main shaft differential gear

Axis No.	Device	
	A273UHCPU	A173UHCPU(S1)
1	D1126 to D1129	D1126 to D1129
2	D1136 to D1139	D1136 to D1139
3	D1146 to D1149	D1146 to D1149
4	D1156 to D1159	D1156 to D1159
5	D1166 to D1169	
6	D1176 to D1179	
7	D1186 to D1189	
8	D1196 to D1199	
9	D1206 to D1209	
10	D1216 to D1219	
11	D1226 to D1229	
12	D1236 to D1239	

Signal Name

(○: Valid)

	Signal Name	REAL	VIRTUAL	Signal Direction	Refresh Cycle: Preset number of axes (Note)			Fetch Cycle: Preset number of axes (Note)		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	18 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32
01	Current value after synchronous encoder axis main shaft's differential gear	Back up	○	SCPU ← PCPU	3.5 ms	7.1 ms	14.2 ms			
2	Error detection output axis No.									
3	Unusable	—	—		—					

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) Current value storage registers after synchronous encoder axis main shaft differential gear (D1126+10n, D1127+10n)..... PCPU→SCPU data

1) When switching the virtual mode the current value will be the same as the main shaft side drive module current value.
2) When a current value change is carried out in relation to the main shaft side drive module, the current value after the main shaft differential gear will also be changed to the set current value at the same time.
3) If the differential gear is not connected to the main shaft, the main shaft drive module current value will always be stored in current value storage register after the main shaft differential gear.

(b) Error search output axis No. storage register (D1128+10n) ..... Data from SCPU to PCPU

1) This register is designed to store the axis number of the output module in error which was detected by the error search function in the virtual mode.
2) If there are no errors at the synchronous encoder axes of the main shaft and auxiliary input axis, the error occurrence output axis No. is stored into the error search output axis No. storage register of the corresponding drive module No. when a minor or major error occurs at the connected output axis.
3) Error search and error reset
   a) Searching the main shaft for error
      The output axes connected to the main shaft are searched for an error in order of lower to higher numbers. If either a minor or major error has occurred, the corresponding output axis No. is stored into the error search output axis No. storage register.
      Resetting the error of the corresponding output axis stores the other error occurrence output axis No. connected to the same main shaft.
   b) Searching the auxiliary input axis for error
      If either a minor or major error has occurred at the output axis connected to the auxiliary input axis, the corresponding output axis No. is stored into the error search output axis No. storage register. However, when the differential gear (for virtual main shaft connection) is used to provide auxiliary input to the main shaft, the output axis connected to the auxiliary input axis is not searched for an error. Use the main shaft side error search output axis No. storage register to confirm the error occurrence output axis No.
4) When error occurs at the drive module axis
   When an error occurs at the main shaft/auxiliary input axis to which the output axis is connected, "0" (no error) is stored into the error search output axis No. storage device if an error occurred at the output axis.

6.3 Virtual Servo Motor/Synchronous Encoder Control Change

This section provides explanations regarding virtual servo motor current value changes, speed change JOG speed changes, and synchronous encoder current value changes.
Current value changes are carried out using the CHGA instruction and speed changes are conducted using the CHGV instruction/DSFLP instruction. Refer to the Motion Controller (SV13/SV22 REAL Mode) Programming Manual (type A273UH /A173UH)for details regarding the CHGA instruction and CHGV instruction.

6.3.1 Virtual servo motor control change

(1) Control change registers

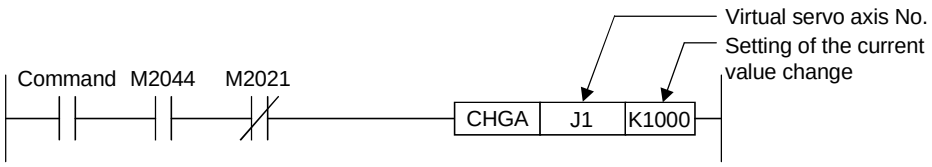
Axis No.	Device Number	Signal Name
1	D640, D641	(○ Valid)
2	D642, D643	
3	D644, D645	
4	D646, D647	
5	D648, D649	
6	D650, D651	
7	D652, D653	
8	D654, D655	
9	D656, D657	
10	D658, D659	
11	D660, D661	
12	D662, D663	
13	D664, D665	
14	D666, D667	
15	D668, D669	
16	D670, D671	
17	D672, D673	
18	D674, D675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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note)			Fetch Cycle: Preset number of axes (Note)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	JOG speed setting register	○	○	SCPU → PCPU				At driving		

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(a) JOG speed setting register (D960+2n) ..... 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 10000000 PLS/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 REAL Mode) Programming Manual (type A273UH /A173UH).

(2) Current value change
(a) Current value change by the CHGA instruction
A program example is illustrated below.
Virtual servo motor current value change program (when the virtual servo motor axis 1 feed current value is changed to 1000 PLS)



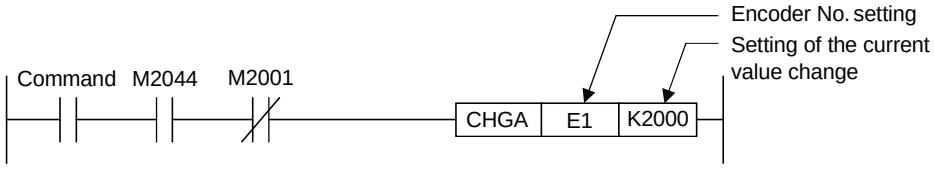
REMARK

(1) M2001: Start accept flag (see section 4.1.8(2))

(2) M2044: REAL mode/VIRTUAL mode status flag (see section 4.1.8(8))

6.3.2 Synchronous encoder control change

(1) Current value change by the CHGA instruction
A program example is given below.
Synchronous encoder current value change program (when encoder No. 1 is changed to a value of 20000 PLS)



(a) The change in the Current value and speed are set using the devices described below.
- Indirect setting ..... Data register (D), Link register (W), File register (R) } Double word
- Direct setting ..... Decimal constant (K)

(b) The encoder No. setting range is described below.
- Encoder No. 1 to No.12 … E1 to E12

(c) Precautions
- When a synchronous encoder current value change is carried out in the REAL mode an error will occur and the current value change will not be carried out.
- A synchronous encoder current value change can be executed in the VIRTUAL mode even while operation is in progress (during pulse input from the synchronous encoder).
  When the current value is changed the synchronous encoder current value will be continued from the changed value.
- Even if a synchronous encoder current value change is carried out, it will have no effect on the output module current value.

REMARK

(1) M2044: REAL mode/VIRTUAL mode status flag (see section 4.1.8 (8))

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

The following describes the device range and procedure for indirect setting of items by devices among transmission module parameters.

(1) Device range

The following shows the number of device words and device range during indirect setting.

<table>
<tr><th>Module</th><th>Item</th><th>Number of device words</th><th>Device setting range</th><th>Remark</th></tr>
<tr><td rowspan="6">Clutch</td><td>Clutch ON/OFF command device</td><td>Bit</td><td rowspan="2"><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>0000 to 1FFF</td></tr><tr><td>Y</td><td>0000 to 1FFF</td></tr><tr><td>M/L</td><td>0 to 8191</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>0000 to B1FFF</td></tr><tr><td>F</td><td>0 to F2047</td></tr><tr><td>TT (timer contact)</td><td>0 to 2047</td></tr><tr><td>TC (timer coil)</td><td>0 to 2047</td></tr><tr><td>CT (counter contact)</td><td>0 to 1023</td></tr><tr><td>CC (counter coil)</td><td>0 to 1023</td></tr></table></td><td rowspan="2"></td></tr>
<tr><td>Mode setting device</td><td>1</td></tr>
<tr><td>Clutch ON address setting device</td><td>2</td><td rowspan="4"><table><tr><th>Device</th><th>Range</th></tr><tr><td>D</td><td>800 to 3069
3080 to 8191</td></tr><tr><td>W</td><td>0000 to 1FFF</td></tr></table></td><td rowspan="4"></td></tr>
<tr><td>Clutch OFF address setting device</td><td>2</td></tr>
<tr><td>Slippage setting device</td><td>2</td></tr>
<tr><td rowspan="2">Gear</td><td>Number of input axis gear teeth</td><td>1</td></tr>
<tr><td>Number of output axis gear teeth</td><td>1</td></tr>
<tr><td>Speed change gear</td><td>Speed change ratio setting device</td><td>1</td><td></td><td></td></tr>
</table>

POINTS

- For items set using two words, always set an even numbered device. In addition, when setting data in the sequence program for that device, always use the DMOV (P) command.
- When a two word monitor device leads the sequence program, always acquire it in the user device using the DMOV (P) command. Use the fetched device for carrying out such things as upper/lower comparison and calculations.

(2) Device data fetch
When the data of a device that has been set indirectly is switched from the REAL to VIRTUAL mode, first acquire everything as default values and thereafter carry out fetch control during virtual mode operation for the corresponding module.
Shown in the table below are the fetch timing of each device and the refresh cycle of the set device.

Module	Item	Fetch Device	Refresh Device	Device Fetch Timing		Device Refresh Cycle
				REAL→ VIRTUAL Mode Switching	During VIRTUAL Mode Operation	
Clutch	Clutch ON/OFF command device	○	——	○	Fetched per calculation cycle (Note)	——
	Mode setting device	○	——	○		
	Clutch ON address setting device	○	——	○		
	Clutch OFF address setting device	○	——	○		
	Slippage setting device	○	——	○	——	
Gear	Number of input axis gear teeth	○	——	○	Fetched when the current value change of the connection source drive module (virtual servo motor axis/synchronous encoder axis) is executed (CHGA) and the gear ratio change is carried out	
	Number of output axis gear teeth	○	——	○		
Speed change gear	Speed change ratio setting device	○	——	○	Fetched per calculation cycle (Note)	

(Note): Calculation cycle 3.5ms when the preset number of axes is 1 to 8
7.1ms when the preset number of axes is 9 to 18
14.2ms when the preset number of axes is 19 to 32

7. TRANSMISSION MODULE

7.1 Gear

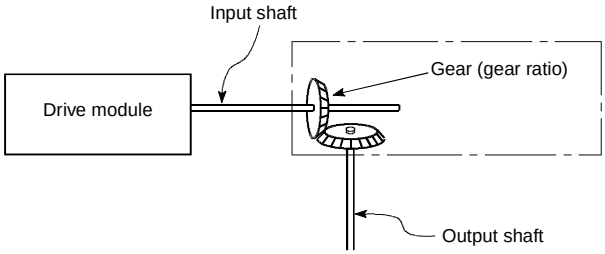
The operation of the gear and the parameters required to use a gear are explained here.

7.1.1 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 PULSE] = [Number of input shaft PULSE] × [gear ratio] (Units: PLS)

(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	Indirect Setting
1	Gear ratio	Number of gear teeth at input shaft (GI)	1	1 to 65535	D800 to D3069 (Note) D3080 to D8191
					W0 to W1FFF
		Number of gear teeth at output shaft (GO)	1	1 to 65535	D800 to D3069 (Note) D3080 to D8191
					W0 to W1FFF
2	Direction of rotation of output shaft		Forward	Forward Reverse	——

(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

7. TRANSMISSION MODULE

(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 (GI) and the number of gear teeth at the output shaft (GO).

$$\text{Gear ratio} = \frac{\text{Number of gear teeth at input shaft (GI)}}{\text{Number of gear teeth at output shaft (GO)}}$$

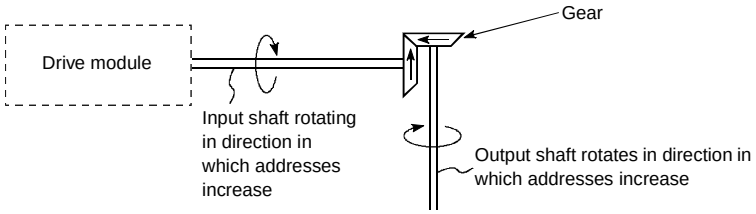
(2) Direction of rotation of output shaft

(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.

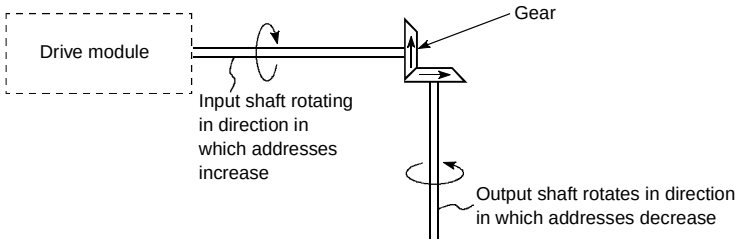
1) Forward

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.



POINT

If the gear ratio is specified indirectly, the gear ratio set in the sequence program is made valid is when:
1) The real mode is switched to the virtual mode; or
2) The current value of the drive module is changed in the virtual mode.

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.

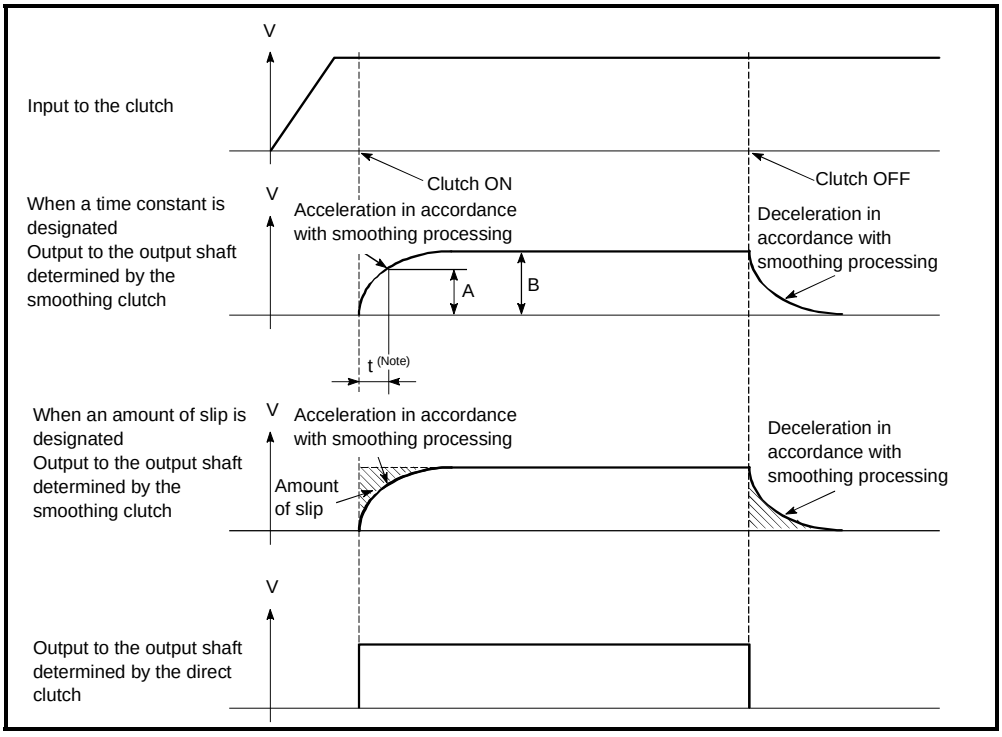
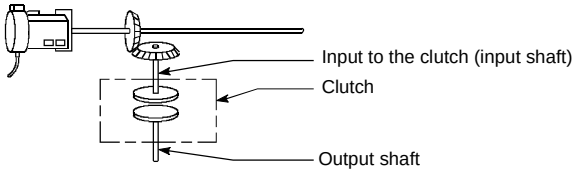


Fig. 7.1 Output to the Output Shaft Determined by the Smoothing Clutch and Direct Clutch

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.



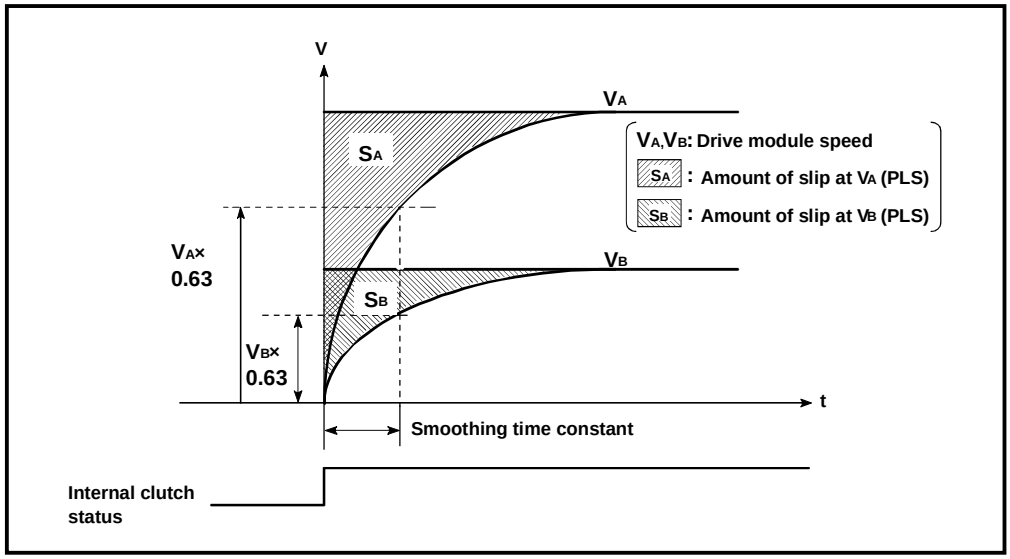
(2) (Note) t: Smoothing time constant "t" is the time taken to reach the following condition:

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

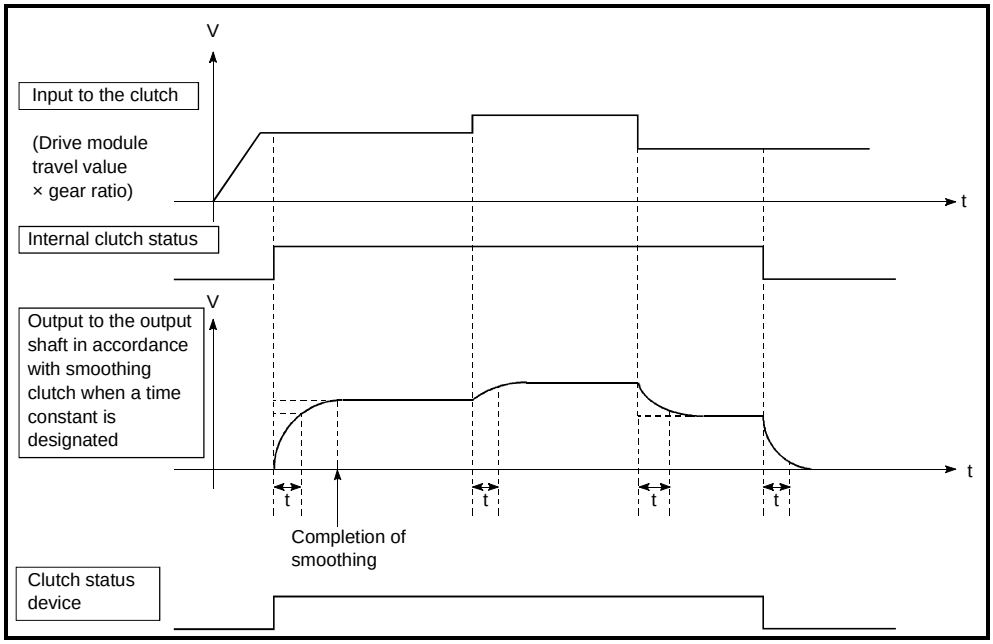
(2) Smoothing processing

(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.



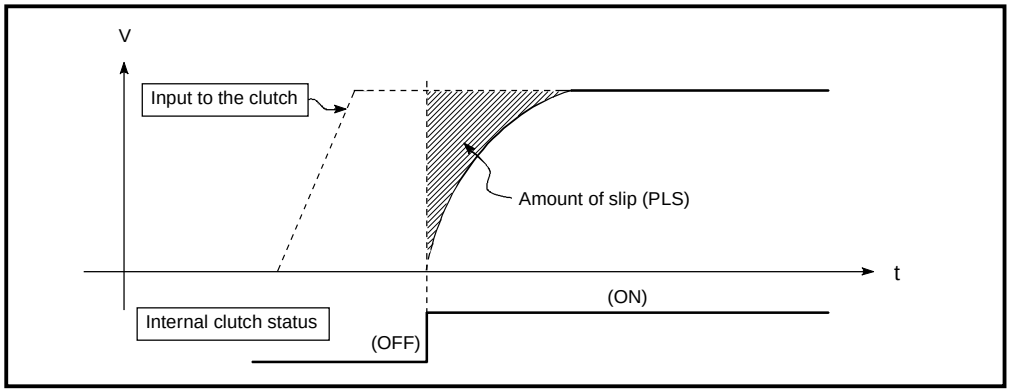
2) If the input to the clutch (drive module travel value × gear ratio) changes after completion of smoothing, smoothing processing is executed at that point also.



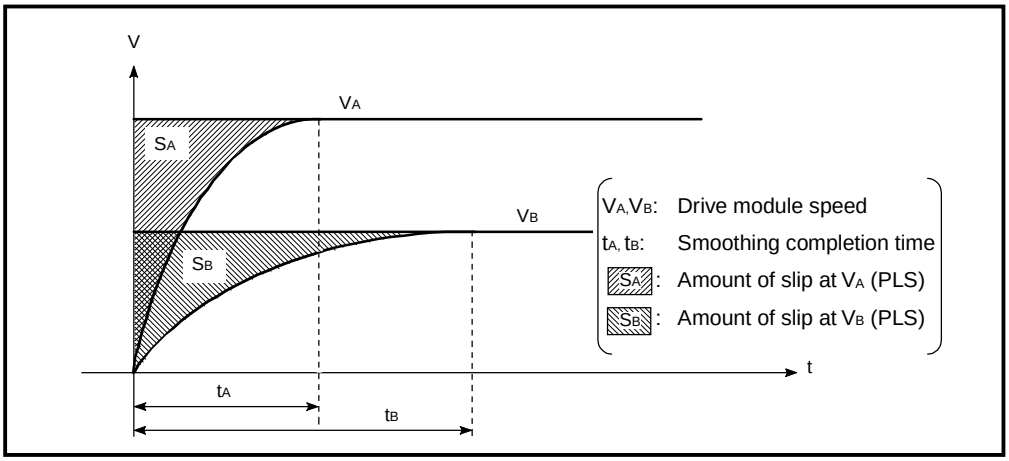
t : Smoothing time constant

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

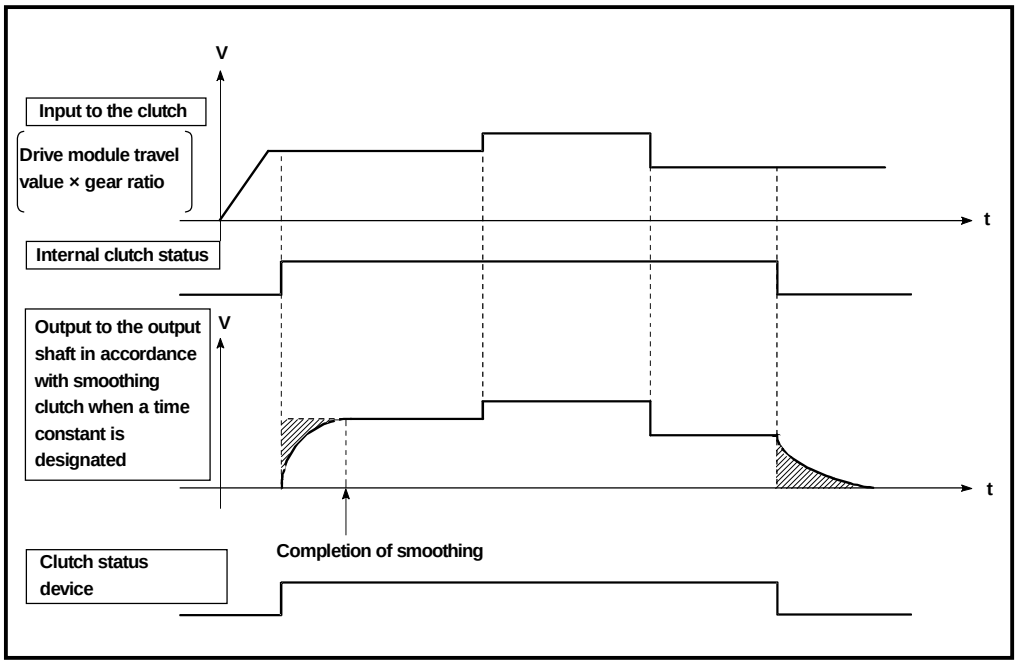
1) Designate the amount of slip indicated by the shaded area in the diagram below. You are recommended to designate an amount of slip that is greater than the input to the clutch (drive module travel value × gear ratio).



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 influ-ence from speed changes.



3) If the input to the clutch (drive module travel value × 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 five clutch modes:

- ON/OFF mode
- Address mode
- Address mode 2
- One-shot 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 7.1ms 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.

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

(d) See Appendix 2 for details about the refresh cycle of the clutch ON/OFF status device.

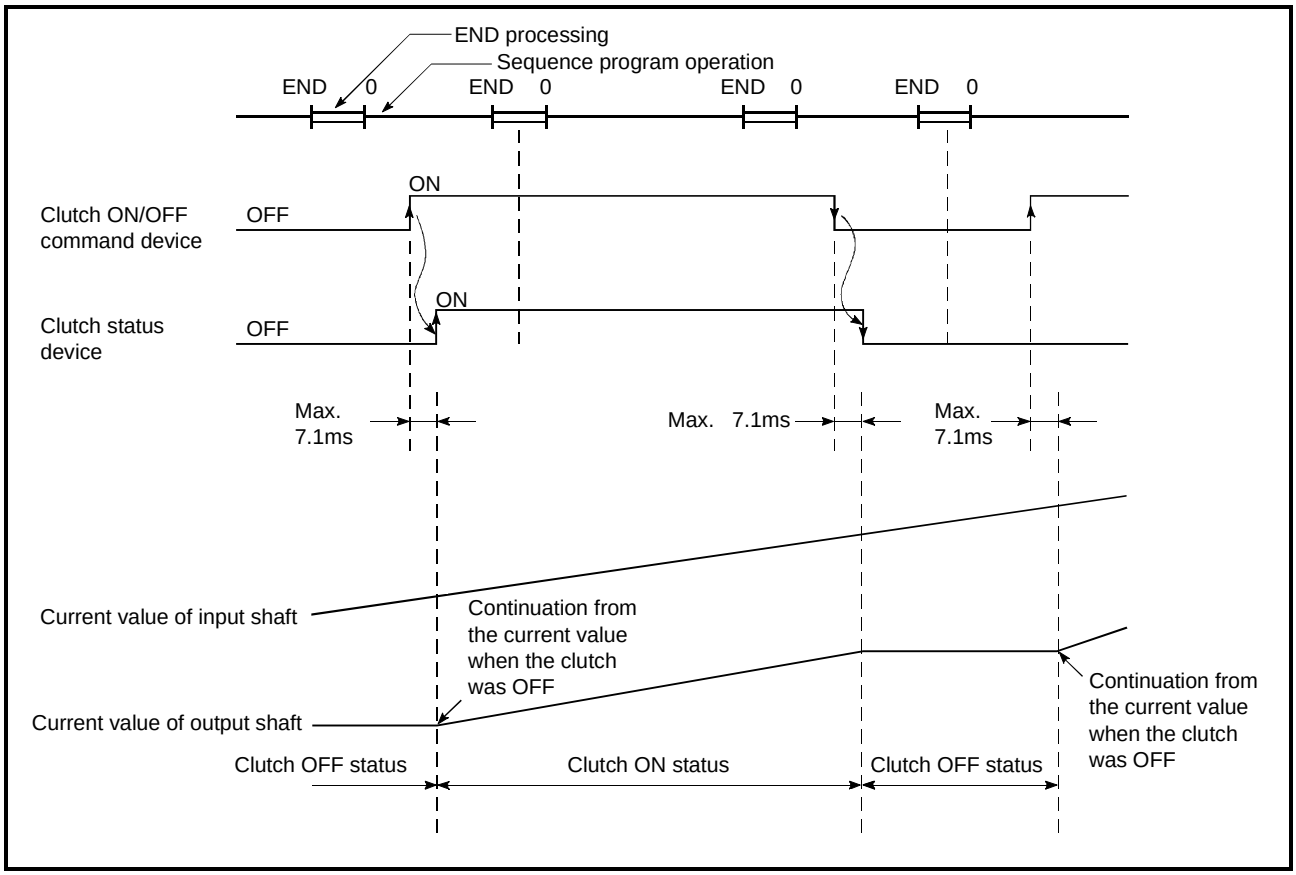


Fig. 7.2 Operation Timing for the ON/OFF Mode (When the preset number of axes is 8 or less)

(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 current 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 current value of the virtual axis.
If a differential gear is connected to the main shaft, ON/OFF control is executed in accordance with the current 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 current value in one revolution.
(See Rotary Tables and Cams in "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 current 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 2 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.

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

(e) See Appendix 2 for details about the refresh cycle of the clutch ON/OFF status device.

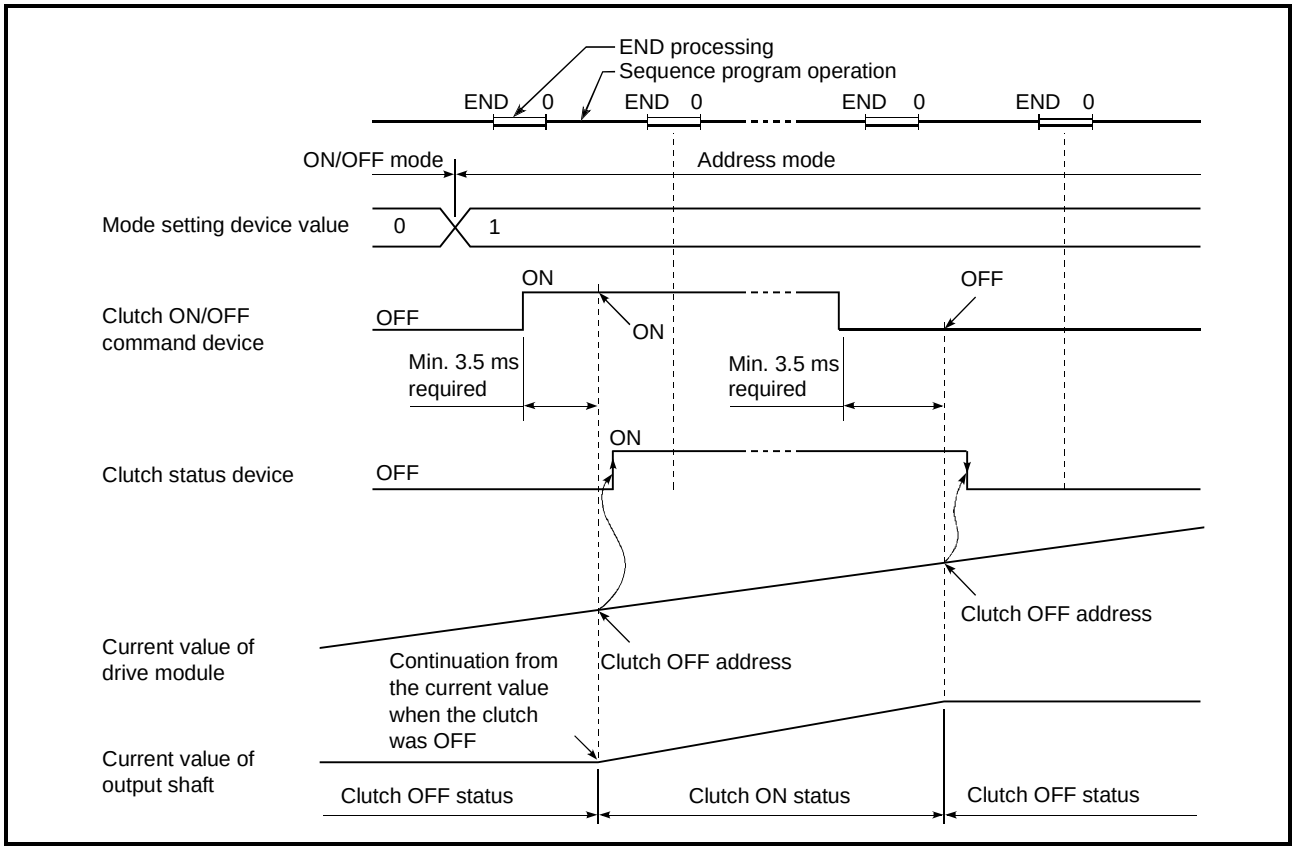


Fig. 7.3 Operation Timing for the Address Mode (When the preset number of axes is 8 or less)

POINT

(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 2 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) Address mode 2

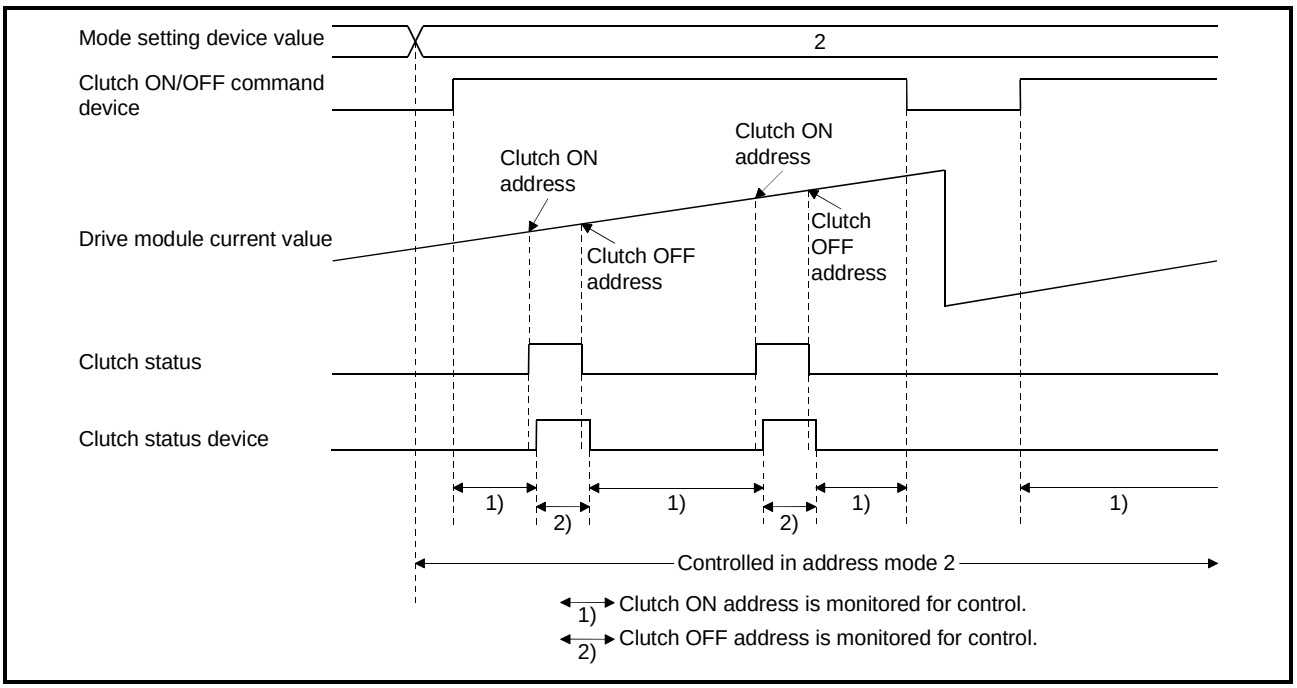
Control switches to that of the address mode 2 as soon as the "mode setting device" value changes to "2: Address mode 2".

(a) While the "clutch ON/OFF command device" is ON, the following control is exercised according to the current clutch status.

1) When the current clutch status is OFF
When the address set in the "clutch ON address setting device" is reached, the clutch turns ON. After that, the status in 2) is established.

2) When the current clutch status is ON
When the address set in the "clutch OFF address setting device" is reached, the clutch turns OFF. After that, the status in 1) is established.

(b) While the "clutch ON/OFF command device" is OFF, the clutch is OFF and the above control is not exercised. The above control is resumed by turning ON the "clutch ON/OFF command device".



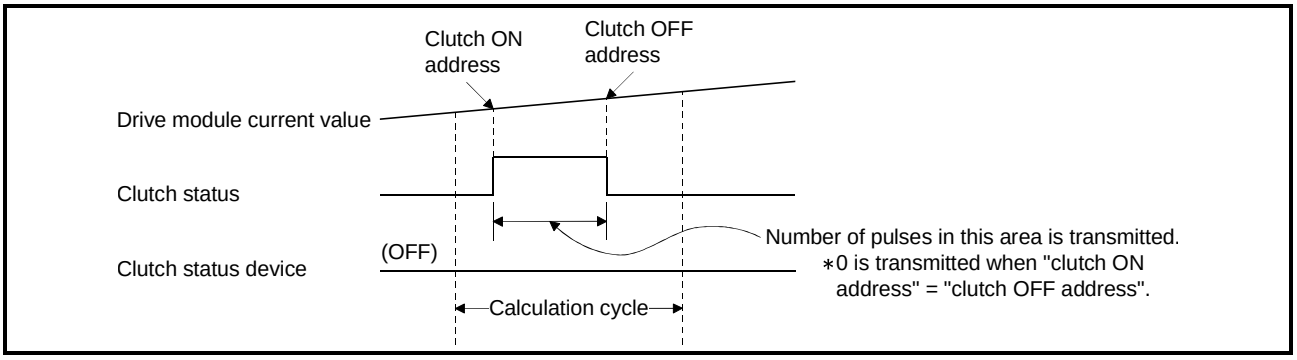
POINT

(1) The "clutch ON address setting device" and "clutch OFF address setting device" can be rewritten any time. Note that since they have 2-word data, always use the DMOV(P) instruction to make setting.

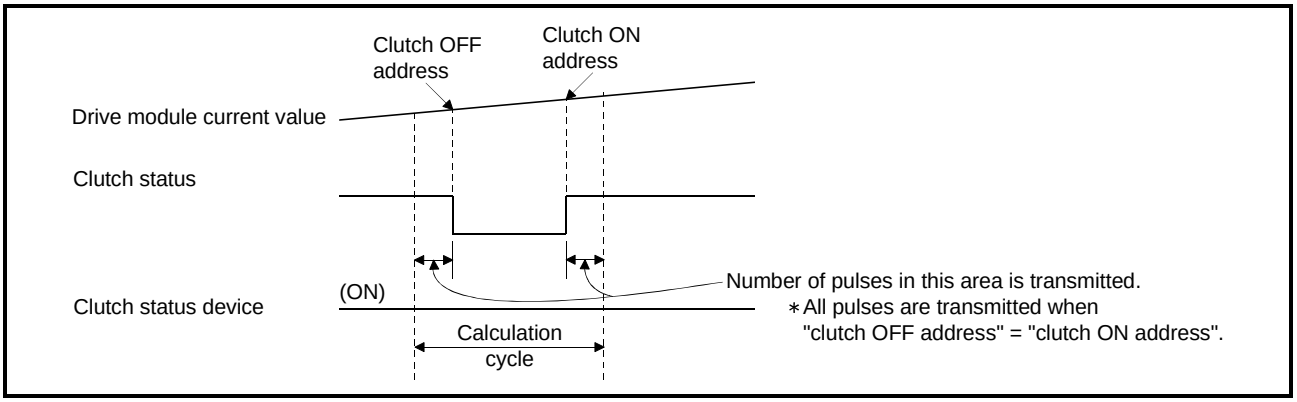
(2) Use this mode when the clutch ON time (clutch OFF time) is extremely short (shorter than the sequence scan time).

(c) Clutch ON/OFF control is exercised per calculation cycle. If both the ON and OFF addresses are passed through during one calculation cycle, internal control is performed properly but the clutch status device remains unchanged.

1) When the clutch status is OFF and both ON and OFF addresses are passed through



2) When the clutch status is ON and both ON and OFF addresses are passed through



(d) When "clutch OFF" is specified in the "error-time operation mode" parameter of the drive module, the Operating System turns the clutch OFF at occurrence of a major error in the output module. To resume operation after that, follow the procedure below.

1) Remove the major error factor.
2) Turn OFF the clutch ON/OFF command device.
   → Returns to the normal status.
3) Turn ON the clutch ON/OFF command device.
   → The clutch ON address is monitored and control is resumed.

(e) Follow the procedure below when giving the corresponding axis servo OFF command or powering OFF the servo amplifier during operation.

1) Turn OFF the clutch ON/OFF command device.
   → The clutch status turns OFF. After that, the corresponding axis servo OFF command is enabled.
2) Give the corresponding axis servo OFF command or power OFF the servo amplifier.

(f) Follow the procedure below when resuming operation after giving the corresponding axis servo OFF command or powering OFF the servo amplifier during operation.

1) Power ON the servo amplifier.
2) Give the corresponding axis servo ON command.
3) Turn ON the clutch ON/OFF command device.
   → The clutch ON address is monitored and control is resumed.

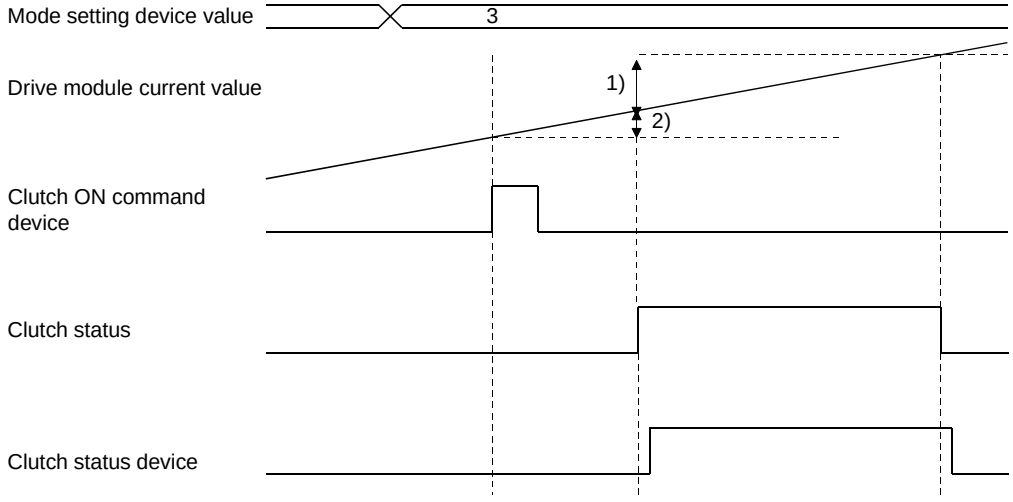
(4) One-shot mode

(a) Control switches to that of the one-shot mode as soon as the "mode setting device value" changes to "3: One-shot mode clutch ON command enable" or "4: One-shot mode clutch ON command disable".

(b) While the "mode setting device value" is "3", the clutch ON/OFF command device is valid, and the following control is exercised according to the clutch ON/OFF command device on the basis of the specified after-clutch ON travel value set in the "clutch ON address setting device" and the specified before-clutch ON travel value set in the "clutch OFF address setting device".

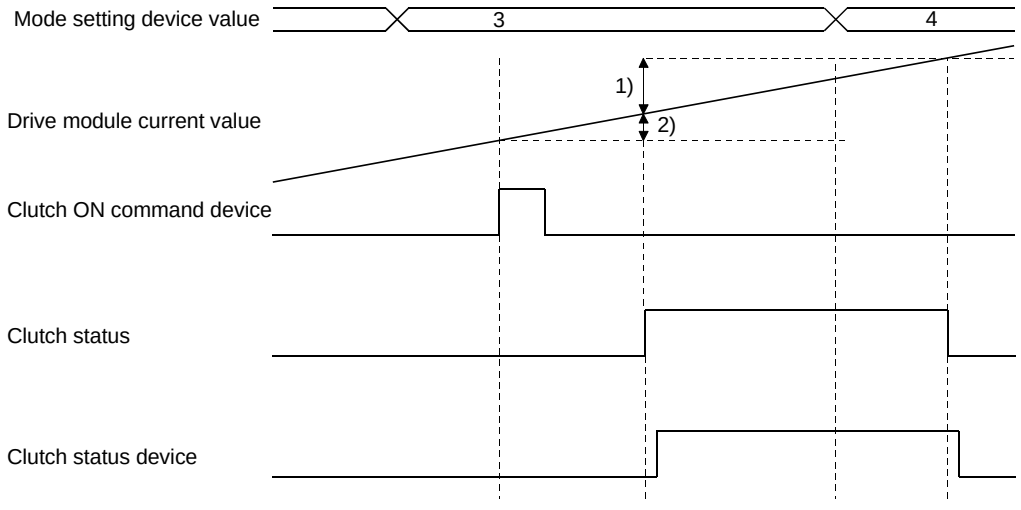
1) When the clutch ON/OFF command device turns from OFF to ON
When the clutch ON/OFF command device turns from OFF to ON, the clutch turns ON after movement of the travel value set as the specified before-clutch ON travel value, and the clutch is turned OFF after transmission of the travel value set as the specified after-clutch ON travel value.

2) When the clutch ON/OFF command device turns from ON to OFF
If the clutch ON/OFF command device turns from ON to OFF, it has no influence on the clutch processing. The clutch status is held as-is.



1) Specified after-clutch ON travel value, 2) Specified before-clutch ON travel value

(c) While the "mode setting device value" is "4", the clutch ON/OFF command device is invalid, and the clutch remains OFF. However, when the "mode setting device value" is changed from "3" to "4" during execution of the clutch ON/OFF processing started by turning ON the clutch ON/OFF command device, the clutch ON/OFF processing in execution is performed till the end and the clutch ON/OFF command is then made invalid from the next time on. Changing the "mode setting device value" to "3" makes the clutch ON/OFF command device valid.



∗1) Specified after-clutch ON travel value, 2) Specified before-clutch ON travel value

(d) The setting items are defined as described below.

Setting Item	Description
Clutch ON/OFF command device	This device acts as a clutch ON command device. When this device turns ON, execution of the clutch ON/OFF processing in the one-shot mode starts.
Clutch ON address setting device	Used to set the travel value transmitted by the connected drive module from when the clutch turns ON until it turns OFF (specified after-clutch ON travel value). A positive value is stored to indicate a positive direction travel value from the point of clutch ON, and a negative value to indicate a negative direction travel value. (Setting range ... -2147483648 (-2^{31}) to 2147483647 (2^{31}-1) PLS)
Clutch OFF address setting device	Used to set the travel value of the connected drive module from when the clutch ON/OFF command device turns ON until the clutch turns ON actually (specified before-clutch ON travel value). A positive value is stored to indicate a positive direction travel value from the point of clutch ON, and a negative value to indicate a negative direction travel value. (Setting range ... -2147483648 (-2^{31}) to 2147483647 (2^{31}-1) PLS)

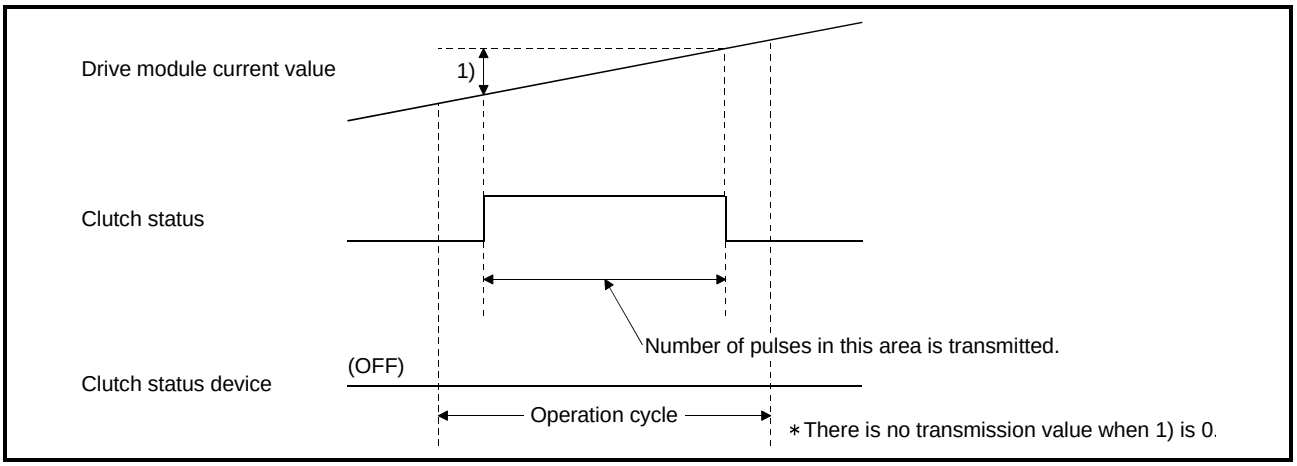
(Note) As soon as the clutch ON/OFF command device turns from OFF to ON at the specified before-clutch ON travel value of 0, the clutch also turns ON.

POINT

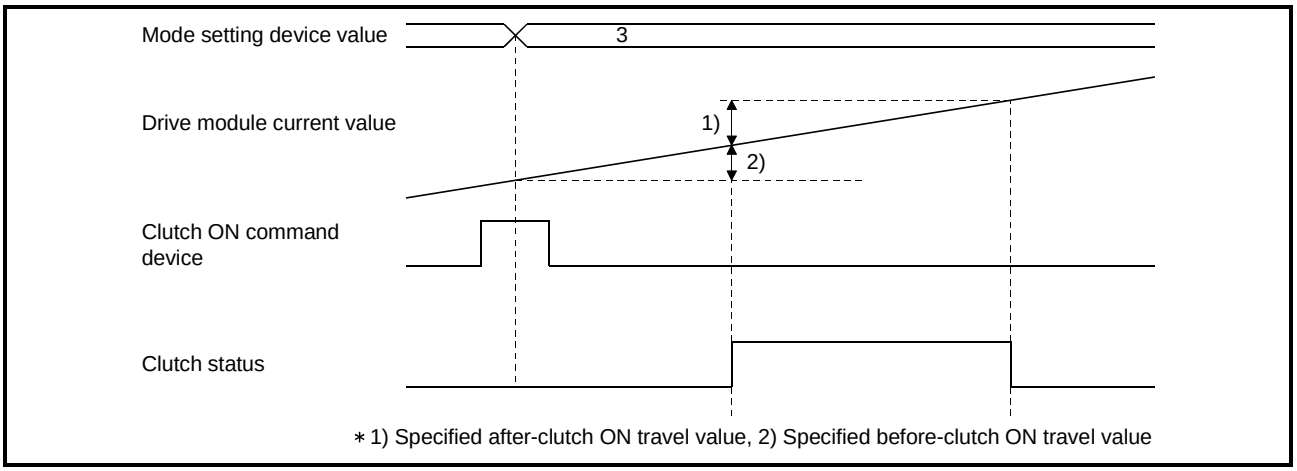
(1) The "clutch ON address setting device" and "clutch OFF address setting device" can be rewritten any time. Note that since they have 2-word data, always use the DMOV(P) instruction to make setting.

(2) A control mode change is valid any time.

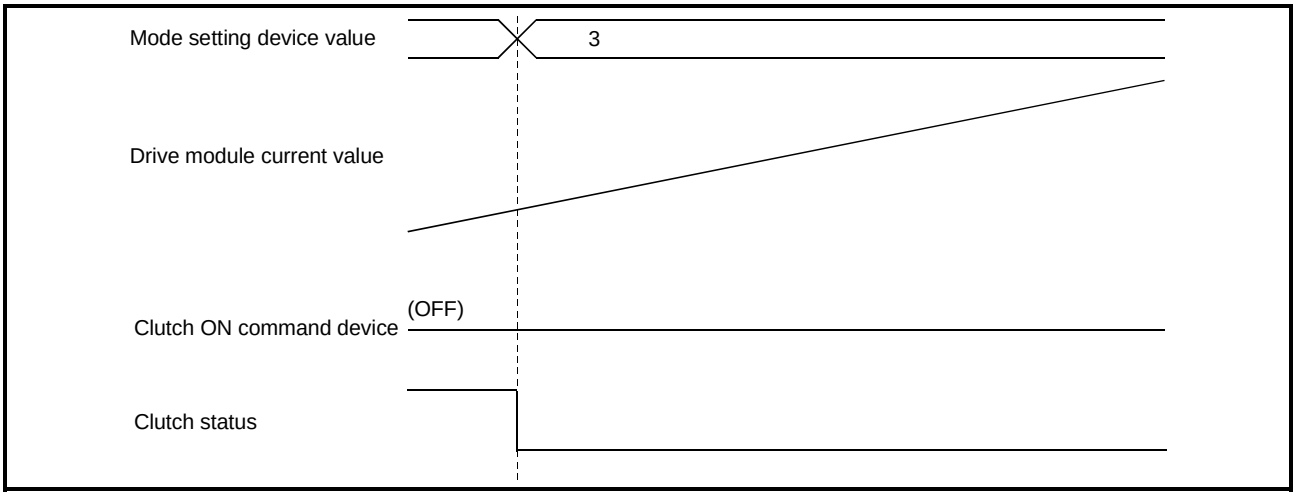
(e) Clutch ON/OFF control is exercised per operation cycle. For the specified travel value at which the clutch status turns from OFF to ON to OFF during one operation cycle, internal control is performed properly but the clutch status device remains unchanged.



(f) If the clutch ON/OFF command device is ON as soon as the "mode setting device" value changes to "3", clutch ON/OFF control is started in accordance with the preset data.



(g) If the clutch ON/OFF command device is OFF and the clutch status is ON as soon as the "mode setting device" value changes to "3", the clutch status turns OFF.



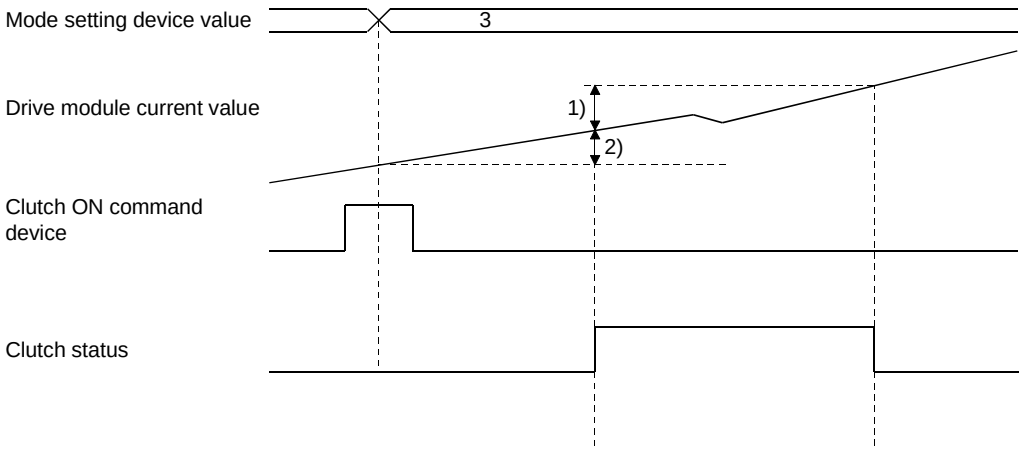
(h) When the "mode setting device" value changes from other than "3" to "4", the clutch status turns OFF independently of whether the clutch ON/OFF command device is ON or OFF.

(i) If the "clutch ON address setting device" or "clutch OFF address setting device" data is changed during one-shot clutch processing execution, the new data is made valid when the clutch ON/OFF command device turns from OFF to ON next time.

(j) If the drive module stops during execution of clutch ON/OFF processing started by turning ON the clutch ON/OFF command device or if the clutch ON/OFF command device is turned ON when the drive module is at a stop, the one-shot clutch is not terminated until the travel value condition set to the specified after-clutch ON travel value is satisfied.

(k) If a current value change is made to the drive module during execution of clutch ON/OFF processing started by turning ON the clutch ON/OFF command device, the clutch turns OFF at the position where the specified before-clutch ON travel value or specified after-clutch ON travel value from the clutch ON position is satisfied.

(l) If the moving direction of the drive module has changed during execution of clutch ON/OFF processing started by turning ON the clutch ON/OFF command device, not the travel value of the drive module but the position where the specified before-clutch ON travel value and specified after-clutch ON travel value are added to the position where the clutch ON command is given is used to perform clutch ON/OFF processing.



∗ 1) Specified after-clutch ON travel value, 2) Specified before-clutch ON travel value

(m) The specified before-clutch ON travel value and specified after-clutch ON travel value are as described below according to the output module connected.

1) When output module is ballscrew or roller
The travel value of the current value of the virtual axis connected is used to exercise ON/OFF control.
When a differential gear is connected to the main shaft, the travel value of the current value after the main shaft differential gear is used to exercise ON/OFF control.

2) When output module is rotary table or cam
The travel value of the within-one revolution current value of the virtual axis is used to exercise ON/OFF control. The specified travel value may be set outside the range of the within-one revolution current value of the virtual axis.

(n) If the moving direction set to the specified before-clutch ON travel value or specified after-clutch ON travel value does not match that of the virtual axis or virtual axis within-one revolution current value, note that the clutch will turn ON/OFF even if the condition is not satisfied when the data found by subtracting the travel value from the specified travel value comes out of the range -2147483648 to 2147483647 (PLS) and changes from + to - or from - to +.

(o) When "clutch OFF" is specified in the "error-time operation mode" parameter of the drive module, the Operating System turns the clutch OFF at occurrence of a major error in the output module. To resume operation after that, follow the procedure below.
1) Remove the major error factor.
2) Turn OFF the clutch ON/OFF command device.
→ Returns to the normal status.
3) Turn ON the clutch ON enable device.
→ One-shot clutch control is resumed.

(p) Follow the procedure below when giving the corresponding axis servo ON/OFF command or powering OFF the servo amplifier during operation.
1) Turn OFF the clutch ON/OFF command device, and if the clutch status is ON, wait until the clutch status turns OFF.
→ After the clutch status has turned OFF, the corresponding axis servo OFF command is enabled.
2) Give the corresponding axis servo OFF command or power OFF the servo amplifier.

(q) Follow the procedure below when resuming operation after giving the corresponding axis servo OFF command or powering OFF the servo amplifier during operation.
1) Power ON the servo amplifier.
2) Give the corresponding axis servo ON command.
3) Turn ON the clutch ON/OFF command device.
→ One-shot clutch control is resumed.

(5) 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 (TRA 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 two maximum operation cycles (Note).

(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 (TRA signal) comes ON.
In the external input mode, a two maximum calculation cycles (Note) 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 operation cycle (Note) intervals.

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

(Note) : The operation cycle is as follows.
3.5ms when the preset number of axes is 1 to 8
7.1ms when the preset number of axes is 9 to 18
14.2ms when the preset number of axes is 19 to 32

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

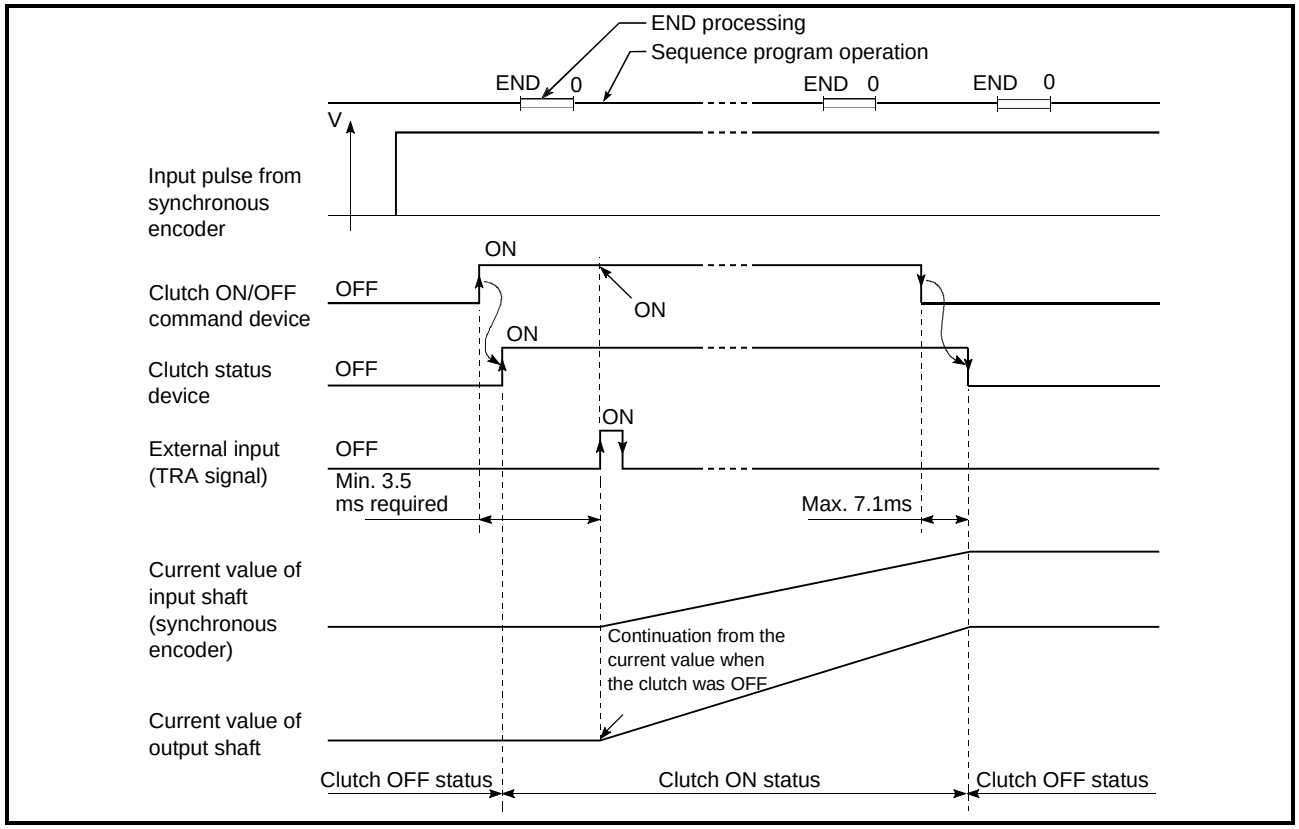


Fig. 7.4 Operation Timing for the External Input Mode(When the preset number of axes is 8 or less)

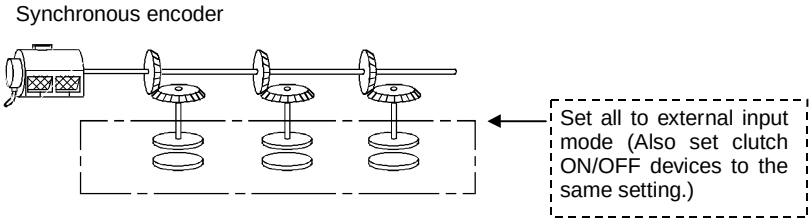
(e) When using the external input mode, only axes for which an incremental synchronous encoder (manual pulse generator) is set as the drive module can be used. Axes for which an absolute synchronous encoder is set as the drive module cannot be used.

(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.

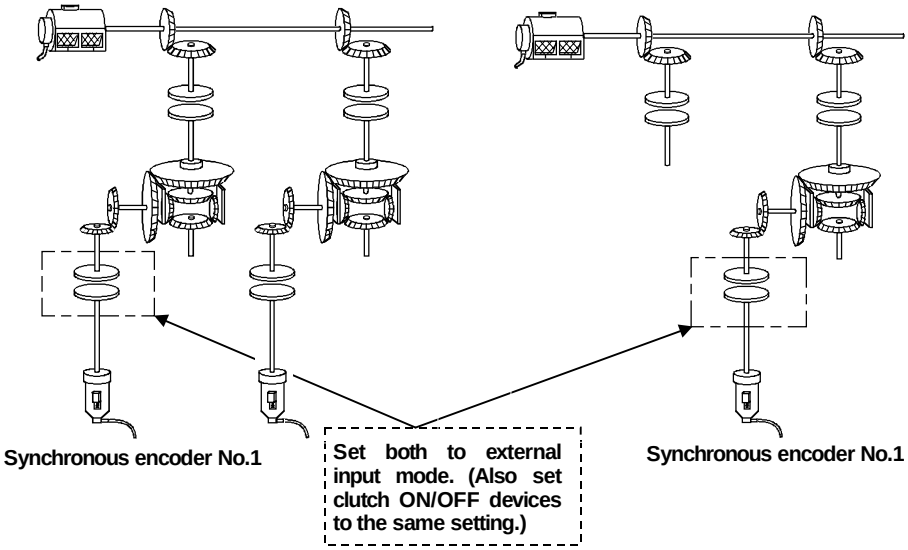
Synchronous Encoder	External Input (TRA Signal)	Synchronous Encoder	External Input (TRA Signal)
P1/E1	TRA 1	P7/E7	TRA 7
P2/E2	TRA 2	P8/E8	TRA 8
P3/E3	TRA 3	P9/E9	TRA 9
P4/E4	TRA 4	P10/E10	TRA 10
P5/E5	TRA 5	P11/E11	TRA 11
P6/E6	TRA 6	P12/E12	TRA 12

(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.)

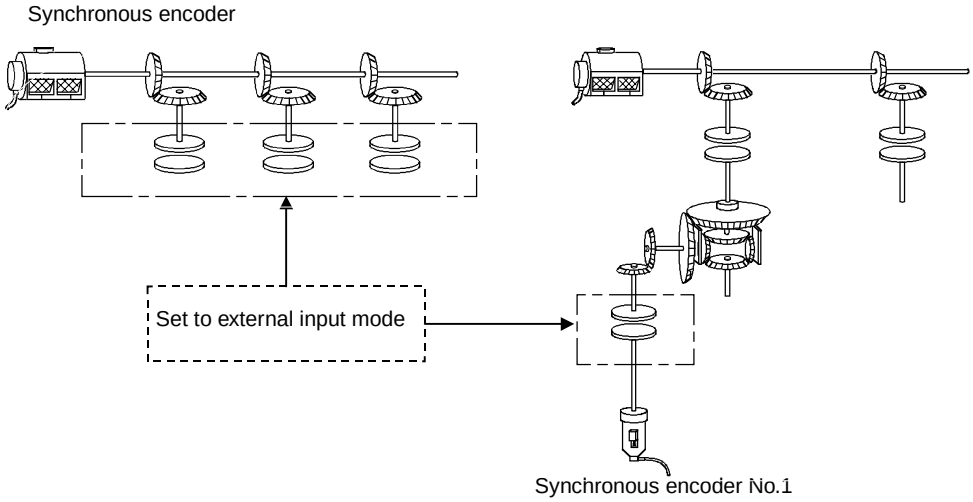


Example 2 **Synchronous encoder connected to auxiliary input shafts**
Set all the clutches connected to the same synchronous encoder set to the external input mode. (Also set clutch ON/OFF devices to the same setting.)



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)



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 Address mode 2 One-shot mode in conjuction	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 to 65535ms			——	○
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, address mode, address mode 2 and one-shot mode in conjunction
- External input mode

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

(b) 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/A172SENC.

A273EX/A172SENC Encoder Interface	Clutch Control Mode		
	ON/OFF Mode	Address Mode Address Mode 2 One-Shot 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, address mode, address mode 2 and one-shot 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
- 2 : Address mode 2
- 3,4 : One-shot mode

If a value other than 0 or 4 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.

Data register	(Note-1) D800 to D3069 (Note-2) D3080 to D8191
Link register	W0 to W1FFF

(Note-1) : If a cam is used at the output module, the area used for the cam cannot be set.

(Note-2) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

(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.

Input	X0 to X1FFF
Output	Y0 to Y1FFF
Internal relay/ latch relay	M/L0 to M/L8191
Special relay	M9000 to M9255
Timer	TC0 to TC2047 (timer coil)
	TT0 to TT2047 (timer contact)
Counter	CC0 to CC1023 (counter coil)
	CT0 to CT1023 (counter contact)
Link relay	B0 to B1FFF
Annunciator	F0 to F2047

(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:

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.
(Note-2) : The devices should be started with 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}) to 2147483647 ($2^{31}-1$) PLS
2) When the output module is a cam or rotary table
0 to number of pulses in one rotation−1 (PLS)

(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.

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.
(Note-2) : The devices should be started with an even number.

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

7.3 Speed Change Gear

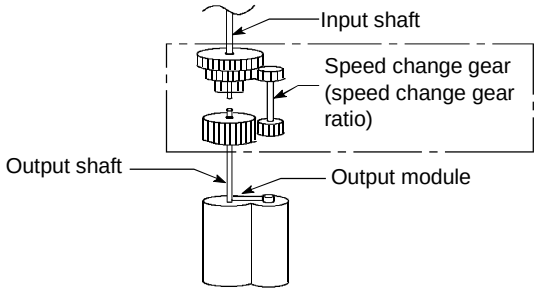
This section describes the operation of the speed change gear and the parameters required to use it.

7.3.1 Operation

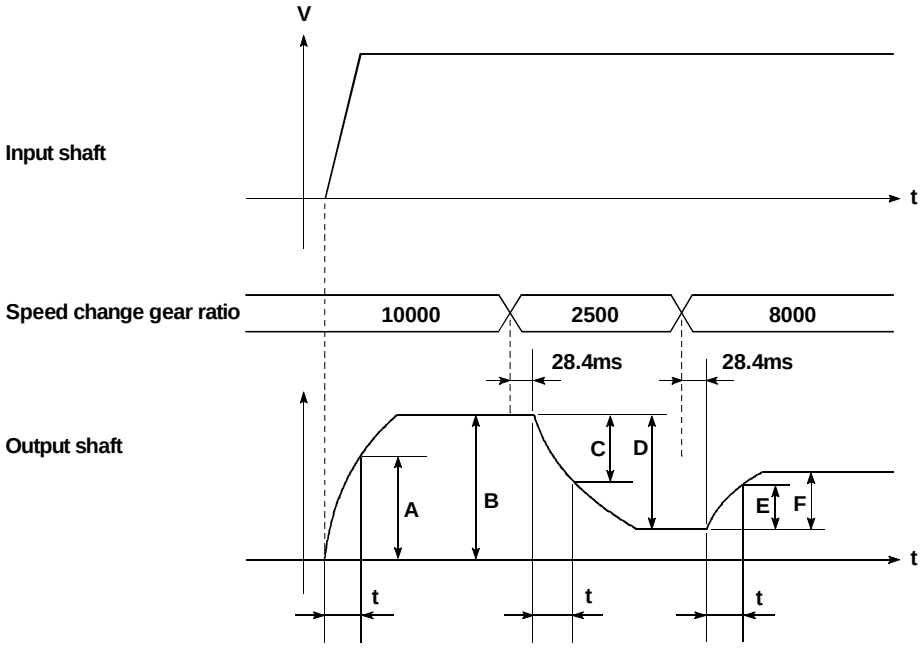
This section describes the operation of the speed-change gear.

(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.

$$[\text{Output shaft speed}] = [\text{input shaft speed}] \times \frac{[\text{speed change gear ratio}]}{10000} \text{ (Units: PLS)}$$



(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:

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

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.

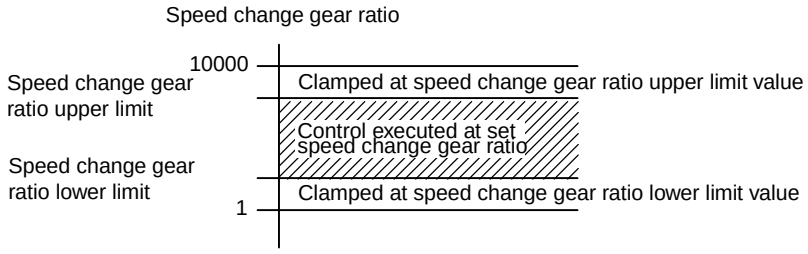
Table 7.3 Speed Change Gear Parameter List

No.	Setting Item	Default Value	Setting Range
1	Speed change gear ratio upper limit	10000	1 to 10000
2	Speed change gear ratio lower limit	1	1 to 10000
3	Speed change gear ratio setting device (1 word)	———	D800 to D3069 D3080 to D8191
			W0 to W1FFF
4	Smoothing time constant	0	0 to 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.

$$1 \leq \left\{ \begin{array}{c} \text{Speed change gear ratio} \\ \text{lower limit} \end{array} \right\} \leq \left\{ \begin{array}{c} \text{Speed change gear ratio} \\ \text{upper limit} \end{array} \right\} \leq 10000$$

(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.

Data register	(Note) D800 to D3069 D3080 to D8191
Link register	W0 to W1FFF

(Note) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

(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

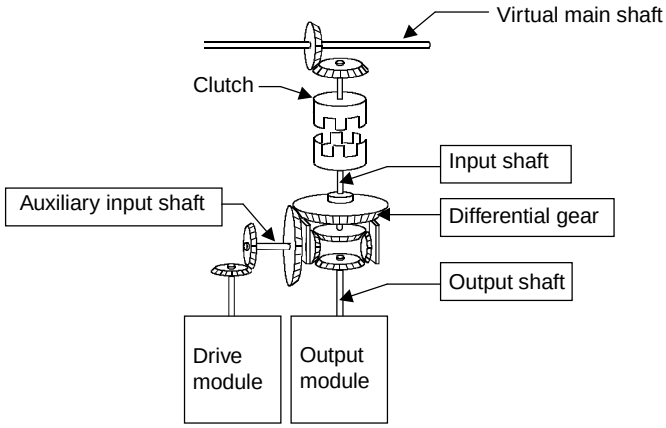
The differential gear is used for the following purposes;

- For shifting the output module phase or carrying out alignment of the operation start position
- For carrying out independent operation separated from the virtual main shaft

7.4.1 Operation

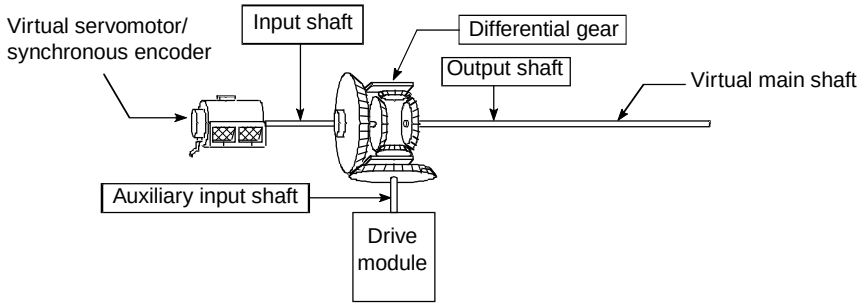
(1) When the input shaft clutch is engaged
The differential gear subtracts the auxiliary input shaft travel distance from the input shaft travel distance and transmits this to the output axis.

[Output shaft travel value]	=	[Input shaft travel value]	–	[Auxiliary input shaft travel value]	(Unit: PLS)



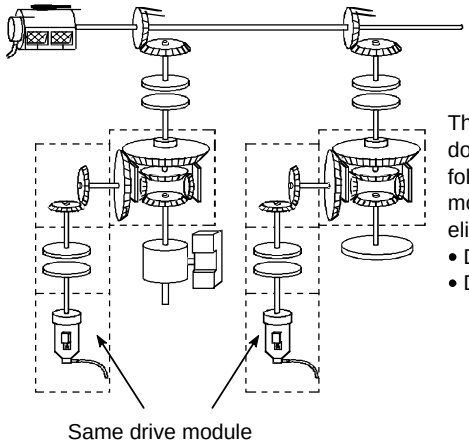
(2) When the input shaft clutch is disengaged
Independent operation is possible using the auxiliary input shaft since the differential gear transmits only the amount of travel from the auxiliary input shaft to the output shaft.

(3) When the differential gear is used to connect to the virtual main shaft
This is used for operation in which the main shaft is switched or when the same drive module is used as auxiliary input to control all blocks.



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

<Conventional mechanical system 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:
- Deferential gear 1
- Drive module at auxiliary shaft side .. 1

7.4.2 Parameters (setting not necessary)

No parameters need to be set for the differential gear.

8. OUTPUT MODULES

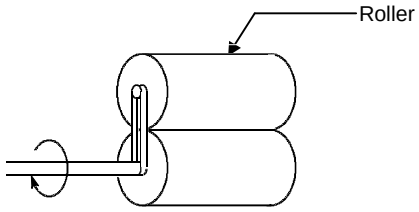
Determine which of the following categories the mechanism actually controlled by the output module falls under and set the parameters in accordance with that mechanism.

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

(1) Output module types

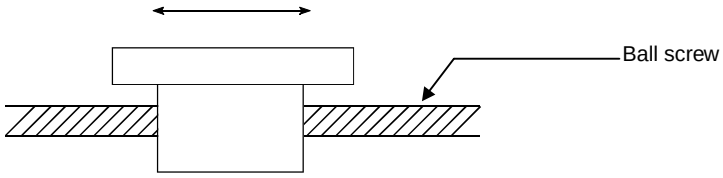
(a) Roller

This is set when the final output (axis) is used to carry out speed control.



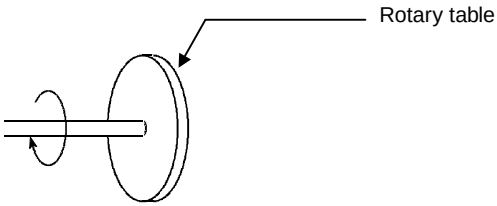
(b) Ball screw

This is set when the final output (axis) is used to carry out linear positioning control.



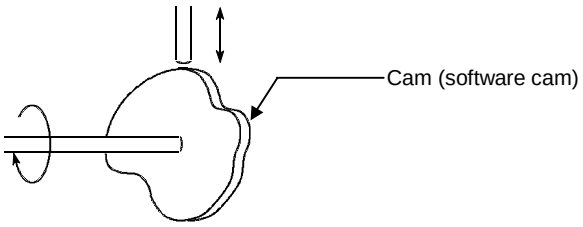
(c) Rotary table

This is set when the final output (axis) is used to carry out angle control.



(d) Cam

The cam settings are made when the last output (axis) is connected to a software cam and controlled.



(2) Device range and device data fetch of the output module parameters
Such things as the device range and setting method are indicated below for the output module parameters and items that are set indirectly using devices.
(a) Device range
The number of device words and device range utilized when an item is set indirectly are indicated below.

Module	Item	Number of Device Words	Device Setting Range	Remarks
Roller	Torque limit value setting device	1		
Ball screw	Torque limit value setting device	1		
Rotary table	Torque limit value setting device	1		
	Virtual axis current value within one revolution storage device (main shaft side)	2		
	Virtual axis current value within one revolution storage device (auxiliary input axis side)	2		
Cam	Cam No. setting device	1		
	Stroke setting device	2		
	Torque limit value setting device	1		
	Stroke lower limit value storage device	2		
	Virtual axis current value within one revolution storage device (main shaft side)	2		
	Virtual axis current value within one revolution storage device (auxiliary input axis side)	2		

Device	Range
D	800 to 3069 3080 to 8191
W	0 to 1FFF

POINTS

- For items set using two words, always set an even numbered device. In addition, when setting data in the sequence program for that device, always use the DMOV (P) command.
- When a two word monitor device leads the sequence program, always acquire it in the user device using the DMOV(P) command. Use the fetched device for carrying out such things as upper/lower comparison and calculations.

(b) Device data fetch

When the data of a device that has been set indirectly is switched from the REAL to VIRTUAL mode, first acquire everything as default values and thereafter carry out fetch control during virtual mode operation for the corresponding module.

Shown in the table below are the fetch timing of each device and the refresh cycle of the set device.

Module	Item	Fetch Device	Refresh Device	Device Fetch Timing		Device Refresh Cycle
				REAL→ VIRTUAL Mode Switching	During VIRTUAL Mode Operation	
Roller	Torque limit value setting device	○	——	○	Fetched per operation cycle (Note)	——
Ball screw	Torque limit value setting device	○	——	○		
Rotary table	Torque limit value setting device	○	——	○		
	Virtual axis current value within one revolution storage device (main shaft side)	——	○	——	——	(Note) Operation cycle
	Virtual axis current value within one revolution storage device (auxiliary input axis side)	——	○	——		
Cam	Cam No. setting device	○	——	○	Fetched per operation cycle (Note) However, the cam No. and stroke switching position pass point are enabled.	——
	Stroke setting device	○	——	○		
	Torque limit value setting device	○	——	○	Fetched per operation cycle (Note)	
	Stroke lower limit value storage device	——	○	——	——	(Note) Operation cycle
	Virtual axis current value within one revolution storage device (main shaft side)	——	○	——		
	Virtual axis current value within one revolution storage device (auxiliary input axis side)	——	○	——		

(Note): Operation cycle 3.5ms when the preset number of axes is 1 to 8
7.1ms when the preset number of axes is 9 to 18
14.2ms when the preset number of axes is 19 to 32

8. OUTPUT MODULES

8.1 Rollers

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

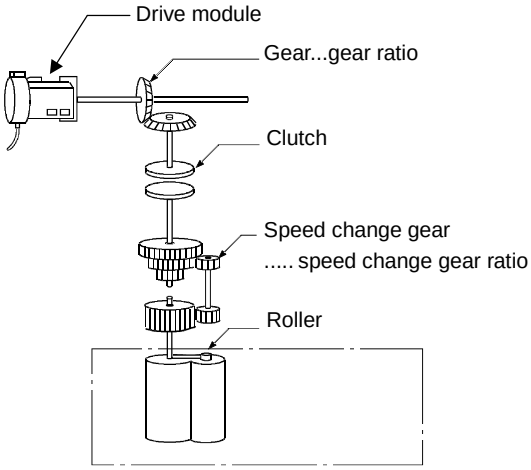
8.1.1 Roller operation

This section describes the operation of the roller.

(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.

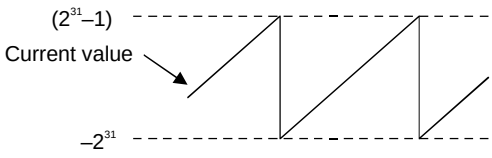
$$[\text{Roller speed}] = \left[\begin{array}{c}\text{Drive module speed}\\(\text{PLS/s})\end{array}\right] \times [\text{gear ratio}] \times \left[\begin{array}{c}\text{speed change}\\\text{gear ratio}\end{array}\right] \quad (\text{Units: PLS})$$



(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 current value.
However, when a switch is made from the virtual mode to the real mode, the current value corresponding to the position reached by travel in the virtual mode is established.
[The current value is a ring address in the range –2147483648 (-2^{31}) PLS to 2147483647 ($2^{31}-1$) PLS.]



(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.

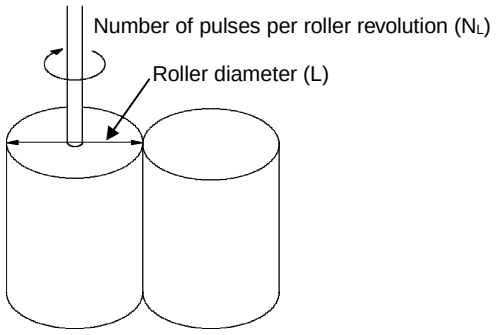
Table 8.1 Parameter List

No.	Setting	Default Value	Setting Range	
1	Output shaft number	0	1 to 32	
2	Unit setting	mm	mm	inch
3	Roller diameter (L)	0	0.1 to 214748364.7 μm	0.00001 to 21474.83647 inch
4	Number of pulses per roller revolution (N_L)	0	1 to 2147483647 PLS	
5	Permissible droop pulse value	65535	1 to 65535 PLS	
6	Speed limit value (V_L)	0	0.01 to 6000000.00 mm/inch	0.01 to 600000.000 inch/min
7	Torque limit value setting device (1 word)	——	–(300%) / word device	
8	Comment	None	32 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/PLS.

(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] $\times \frac{\pi \times L}{N_L}$
(mm/min)
L: mm

2) When the units are inches
[Roller periheral velocity]= [number of input per minute] $\times \frac{\pi \times L}{N_L}$
(inch/min)
L: inch

An integral value obtained by raising 10^n 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 (M2407+20n) comes ON.
However, since operation of the roller shaft continues, the user must execute the appropriate error processing.

(c) When the motor connected has feedback pulses of 131072 PLS, set the value which is found by dividing the actual permissible droop pulse value by 100.

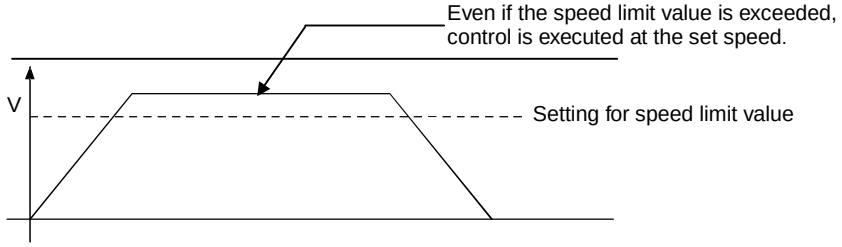
(4) Speed control limit (V_L)
(a) This is the setting for the maximum speed of the roller shaft.

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

$$1 \leq \frac{V_L \times N_L}{60 \times \pi \times L} \leq 1000000 \text{ [PLS/s]}$$

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 (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.

Data register	(Note) D800 to D3069 D3080 to D8191
Link register	W0 to W1FFF

(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

(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 characters long can be created.

8.2 Ball Screws

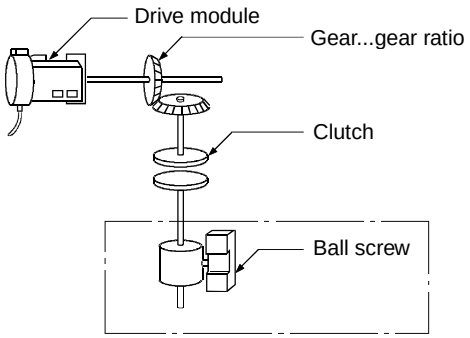
The operation of ball screws and the parameter settings required to use ball screws are explained here.

8.2.1 Ball screw operation

This section describes the operation of the ball screw.

(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.

$$[\text{Ball screw travel value}] = [\underline{\text{transmission module}}\ \text{travel value (PLS)}] \times [\text{gear ratio}] \quad (\text{Units: PLS})$$



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 current 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.

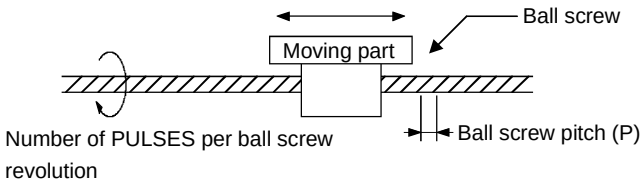
Table 8.2 Parameter List

No.	Setting	Default Value	Setting Range	
1	Output shaft number	0	1 to 32	
2	Unit setting	mm	mm	inch
3	Ball screw pith (P)	0	0.1 to 214748364.7 μm	0.00001 to 21474.83647inch
4	Number of pulses per ball screw revolution (N_P)	0	1 to 2147483647 PLS	
5	Permissible droop pulse value	65535	1 to 635535 PLS	
6	Stroke limit upper limit value	$2^{31}-1$	−214748364.8 to 214748364.7 μm	−21474.83648 to 21474.83647 inch
7	Stroke limit lower limit value	0		
8	Speed limit value (V_L)	——	0.01 to 6000000.00 mm/inch	0.01 to 600000.000 inch/min
9	Limit switch output	Not used	Used / Not used	
10	Torque control limit setting device (1 word)	——	−(300%) / word device	
11	Comment	None	32 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 (M2407+20n) comes ON.

(c) When the motor connected has feedback pulses of 131072 PLS, set the value which is found by dividing the actual permissible droop pulse value by 100.

(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 (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.

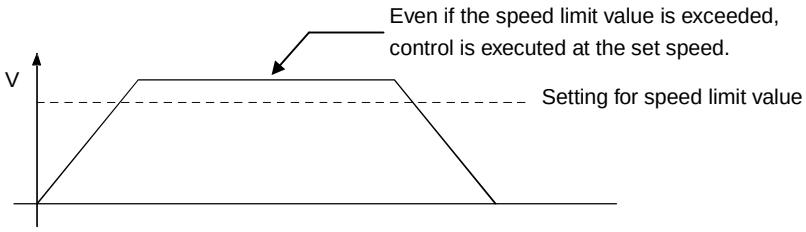
(b) Set the speed limit value within the following range.
1) When the units are millimeters

$$1 \leq \frac{V_L \times 10^4 \times N_P}{60 \times P} \leq 1000000 \text{ [PLS/s]}$$

2) When the units are inches

$$1 \leq \frac{V_L \times 10^5 \times N_P}{60 \times P} \leq 1000000 \text{ [PLS/s]}$$

(c) If the speed of the ball screw shaft exceeds the speed limit value, the error detection signal (M2407+20n) comes ON.
However, <u>the ball screw speed is not clamped.</u>



(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 real current 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.

Data register	(Note) D800 to D3069 D3080 to D8191
Link register	W0 to W1FFF

(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

(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 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.

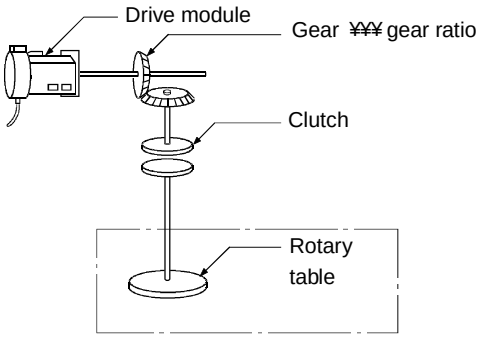
8.3.1 Rotary table operation

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.

$$[\text{Rotary table travel value}] = \left[\begin{array}{c}\text{transmission module}\\ \text{travel value (PLS)}\end{array}\right] \times [\text{gear ratio}] \quad (\text{Units: PLS})$$



(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 current 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.

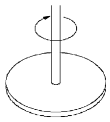
8.3.2 Parameter list

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	0	1 to 32
2	Number of PULSES per rotary table revolution (N_D)	——	1 to 2147483647 (PLS)
3	Permissible droop pulse value	65535	1 to 65535 (PLS)
4	Stroke limit upper limit value	0	0 to 359.99999 (degree)
5	Stroke limit lower limit value	0	0 to 359.99999 (degree)
6	Speed limit value (V_L)	0	0.01 to 2147483.647 (degree/min)
7	Limit switch output	Not used	Used / Not used
8	Torque control limit setting device (1 word)	——	–(300%) / word device
9	Comment	None	32 characters
10	Virtual axis current value in one revolution storage device (main shaft side) (2 word)	——	– / word device
11	Virtual axis current value in one revolution storage device (auxiliary input shaft side) (2 word)	——	– / 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.



Number of PULSES per rotary table revolution (N_D)

(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 (M2407+20n) comes ON.
However, since operation of the roller shaft continues, the user must execute the appropriate error processing.

(c) When the motor connected has feedback pulses of 131072 PLS, set the value which is found by dividing the actual permissible droop pulse value by 100.

(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 (M2407+20n) comes ON.
However, rotary table shaft stop processing is not executed.

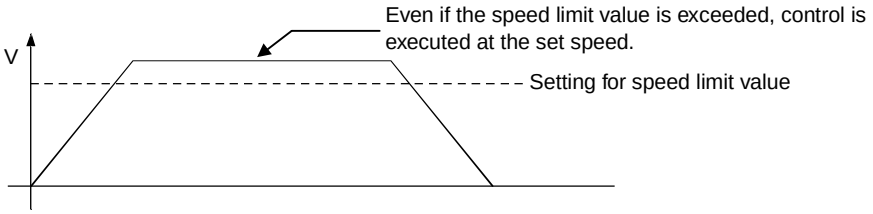
(4) Speed limit value (V_L)

(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:

$$1 \leq \frac{V_L \times 10^5 \times N_D}{60 \times 360 \times 10^5} \leq 1000000 \text{ [PLS/s]}$$

(c) If the speed of the rotary table shaft exceeds the speed limit value, the error detection signal (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 real current 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.

Data register	(Note) D800 to D3069 D3080 to D8191
Link register	W0 to W1FFF

(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

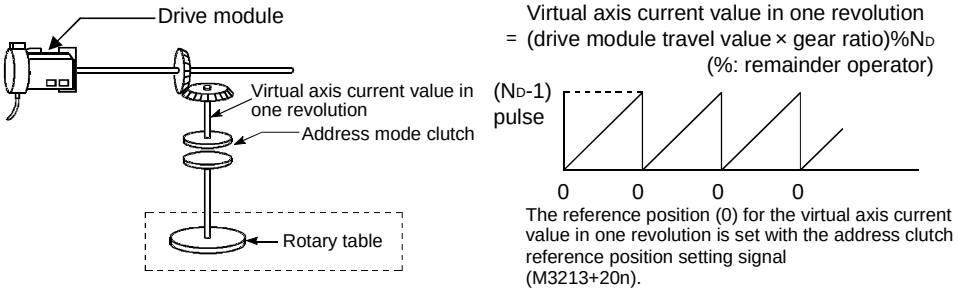
(c) The setting range for the torque limit value is 1 to 500%.

(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 characters long can be created.

(8) Virtual axis current 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.



(a) The virtual axis current 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 current value in one revolution storage device.

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

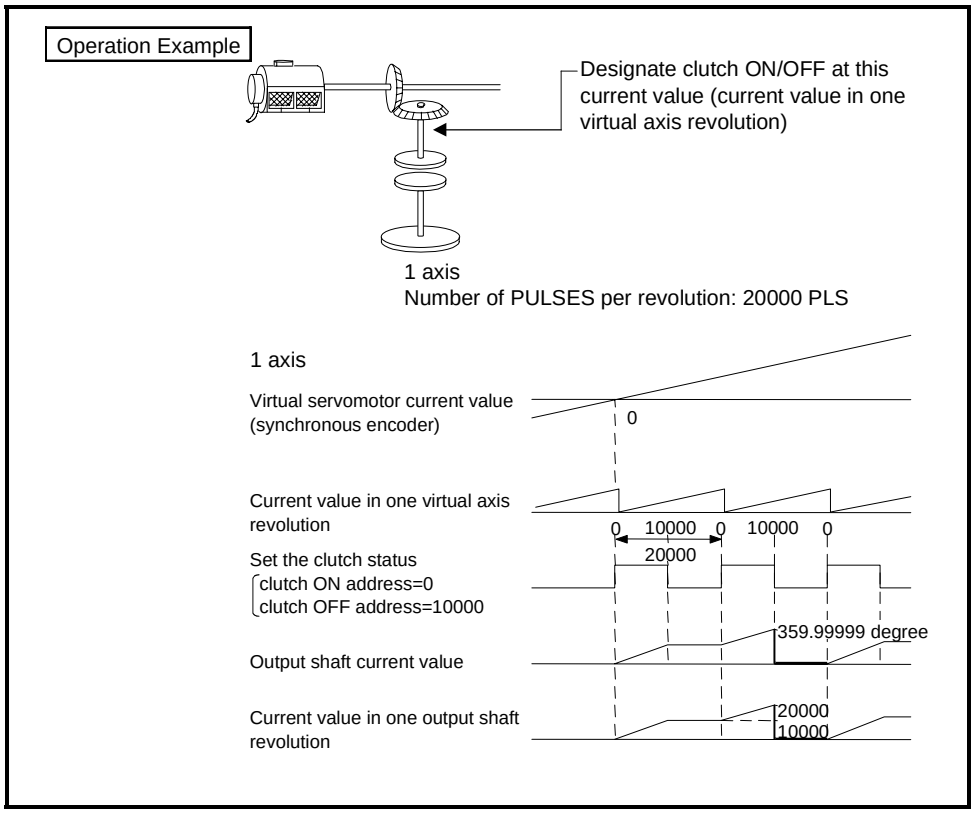
(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.
(Note-2) : The devices should be started with an even number.

(c) The applicable range for the virtual axis current value in one revolution is 0 to (ND-1) PLS.
(ND: number of PULSES per rotary table revolution)

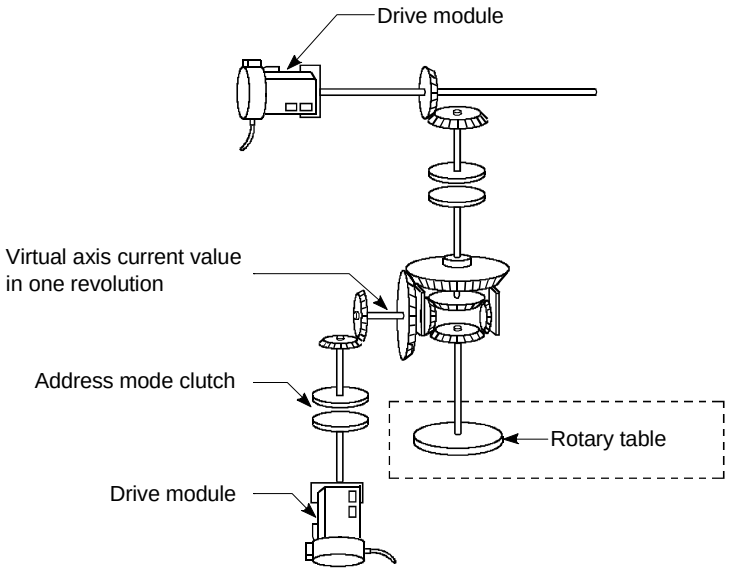
(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis current value in one revolution range: 0 to (ND-1) PLS.
Therefore, set the value in the clutch ON/OFF address setting device within the range 0 to (ND-1) PLS.

(e) The virtual axis current value in one revolution reference position "0" is set by turning M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.
This sets the virtual axis current 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 M3213+20n turned OFF, control continues from the virtual axis current 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.



(9) Virtual axis current 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 current value in one revolution for the auxiliary input shaft of the rotary table in the set device, the current value in one revolution of the virtual axis is stored.

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

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.
(Note-2) : The devices should be started with an even number.

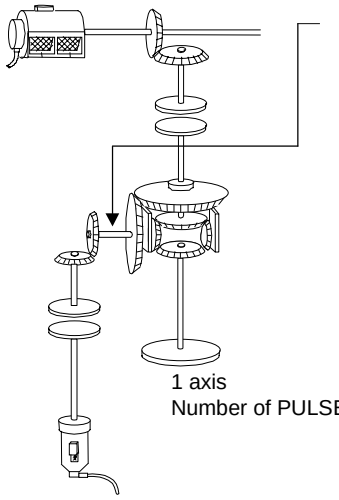
(c) The applicable range for the virtual axis current value in one revolution is 0 to (ND-1) PLS.
(ND: number of PULSES per rotary table revolution)

(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis current value in one revolution range: 0 to (ND-1) PLS.
Therefore, set the value in the clutch ON/OFF address setting device within the range 0 to (ND-1) PLS.

(e) The setting for the virtual axis current value in one revolution reference position "0" is made by turning M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.
This sets the virtual axis current 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 M3213+20n turned OFF, control continues from the virtual axis current value in one revolution that was effective last time the virtual mode was in effect.

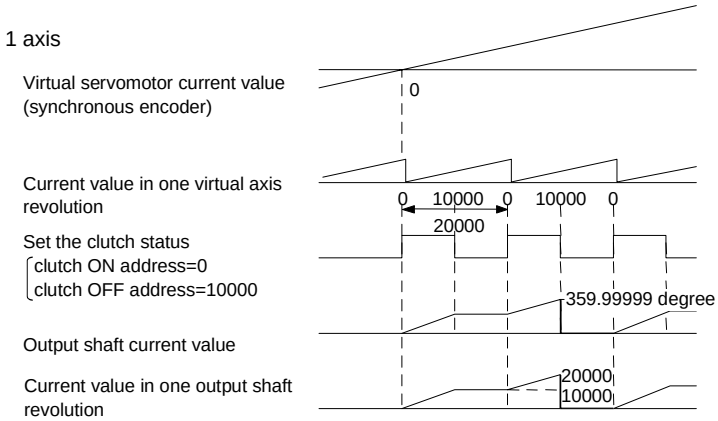
(f) An example of the operation of an address mode clutch is shown below.

Operation Example



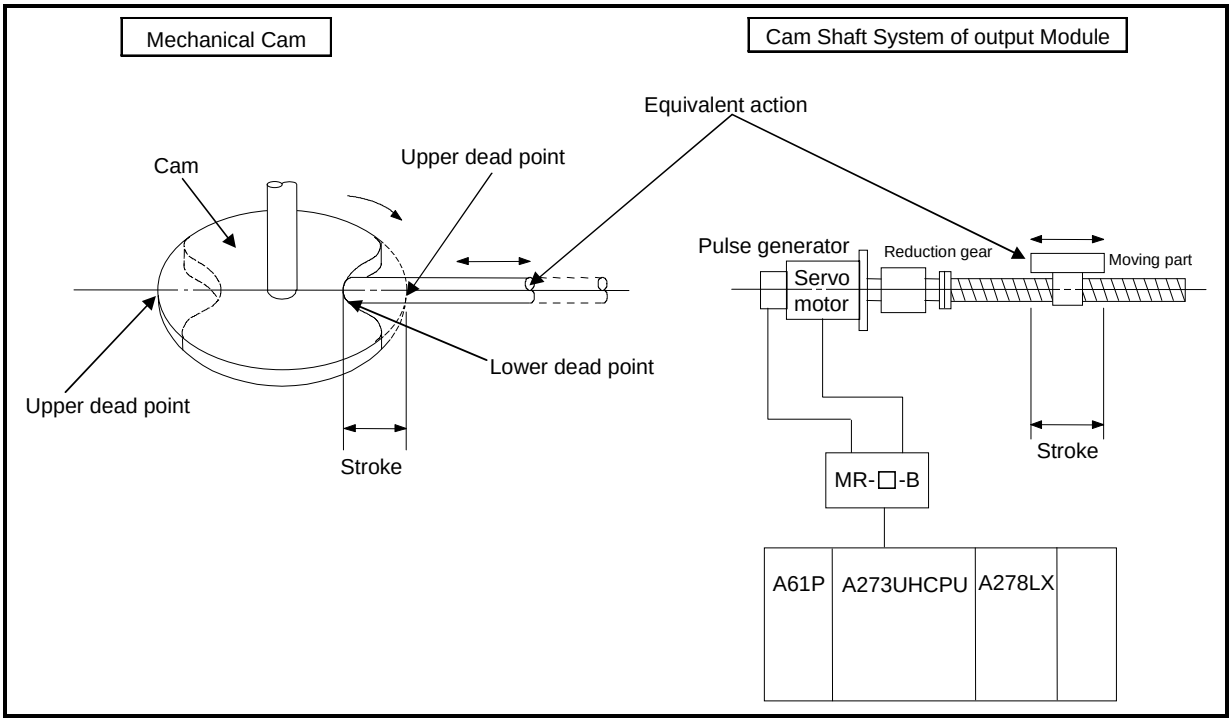
Designate clutch ON/OFF at this current value (current value in one virtual axis revolution)

1 axis
Number of PULSES per revolution: 20000 PLS



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.



(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 system 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 (M3214+20n) ON/OFF as required.
(See Section 8.5.1(2) (q))

↓

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

↓

(c) Start operation based on the cam pattern, stroke and cam 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 current value in one revolution is indexed based on the cam reference position setting signal (M3214+20n), the feed current value, the stroke lower limit value, the stroke and cam No. (cam pattern), at that time.

(3) Operation
A value based on the cam shaft current value in one revolution and calculated using the stroke ratio in the cam data table is output.
[(Feed current value) = (stroke lower limit value) + (stroke) × (stroke ratio)]
The cam shaft current 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.

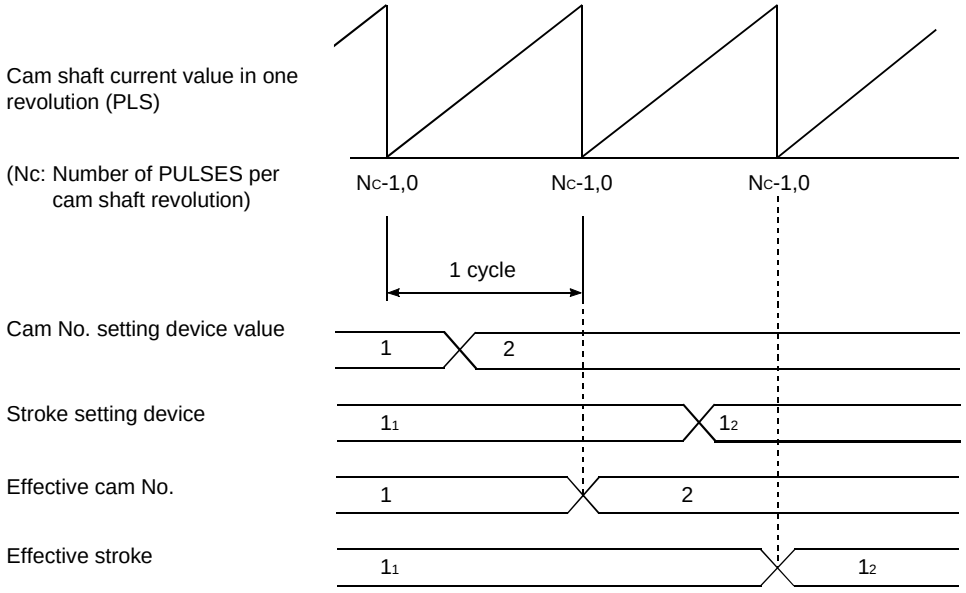
(4) Switching the stroke and cam No. during operation

(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 I1 and stroke I2 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 (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 ≤ 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 (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.

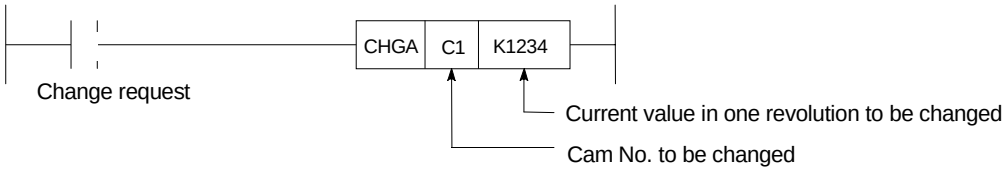
(b) Backlash compensation processing is not executed in the case of cam shafts only. (If necessary, take this into account when creating the cam pattern.)

(c) No stroke limit upper limit value/lower limit value check or speed limit check is executed.

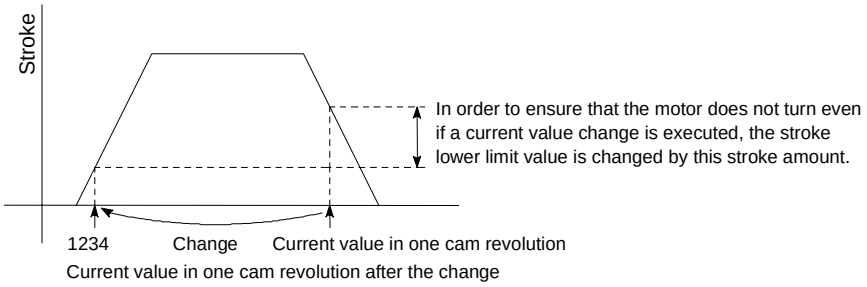
(6) Changing control

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 current value change is executed using the CHGA instruction.
See Section 10.1.

[Example sequence program]

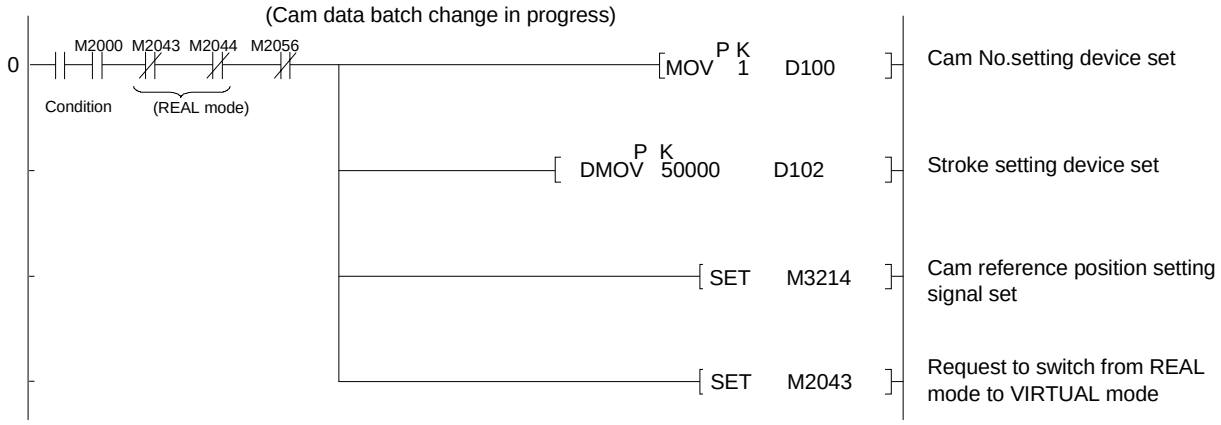


[Operation]

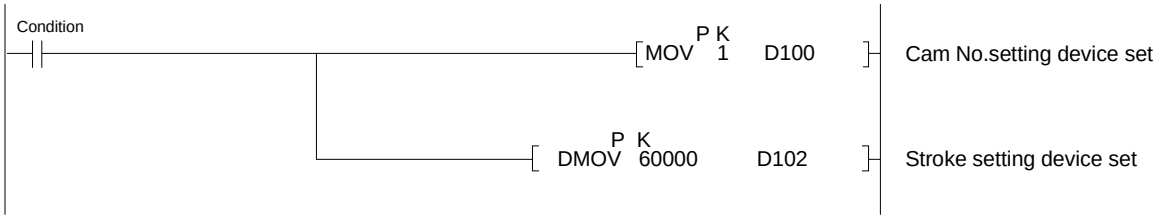


(7) Example sequence program

[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.	——	See (1)
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 to 32767

(1) Cam No.
This is the setting for the number of the created cam data.
The set cam No. specified in the sequence program is determined by the machine name sequence registered on the mechanical system editing screen.

Machine Name Sequence	Set Cam No.
1	1 to 64
2	101 to 164
3	201 to 264
4	301 to 364

(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:

Operation cycle × (set resolution)

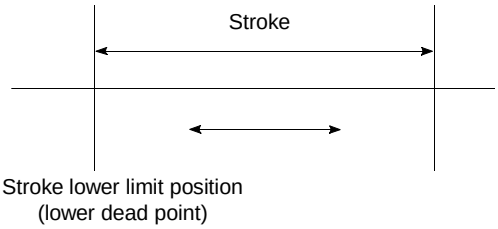
(3) Stroke/cam No. change point
(a) This is the setting for the position at which the stroke/cam No. is switched during operation.

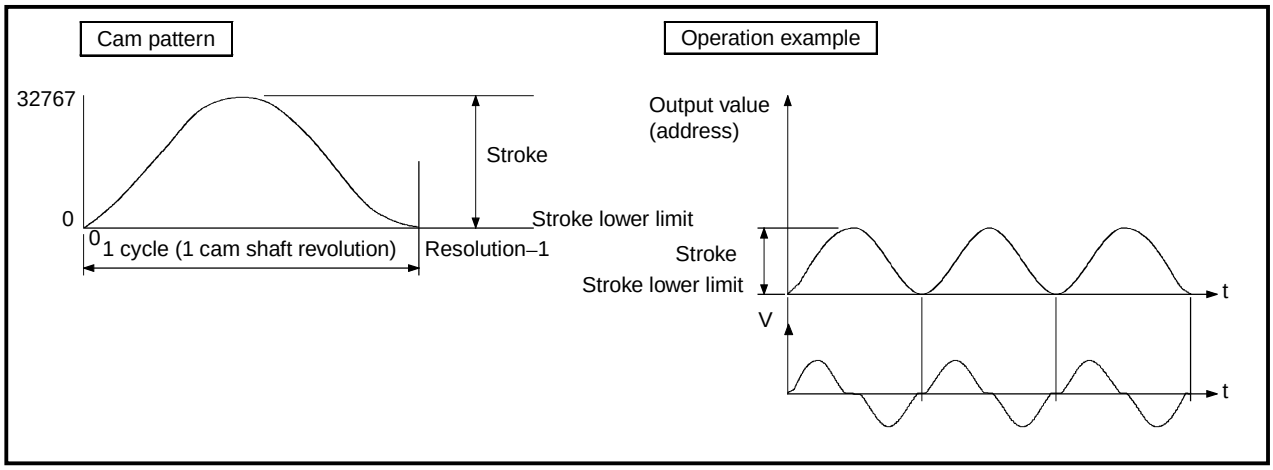
(b) When the set switching position [range: 0 to (resolution –1)] is reached, a switch is made to the set stroke and cam No., provided the stroke and cam No. are normal.

(4) Control mode

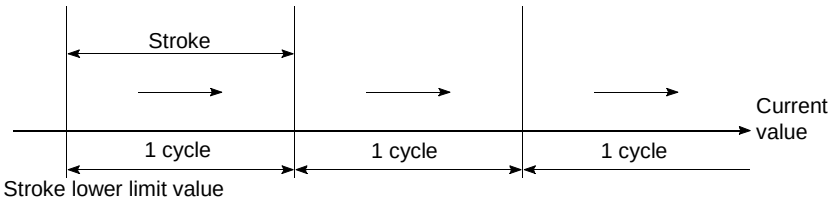
(a) This is the setting for the two-way cam mode or feed cam mode.

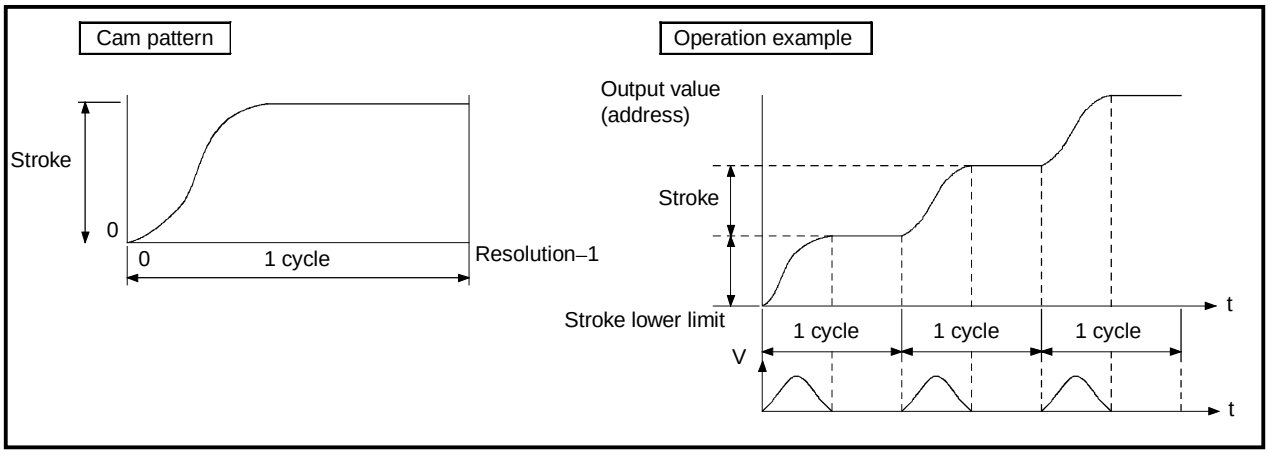
1) Two-way cam mode .....A two-way operation is repeated between the stroke lower limit position (lower dead point) and the range set for the stroke.





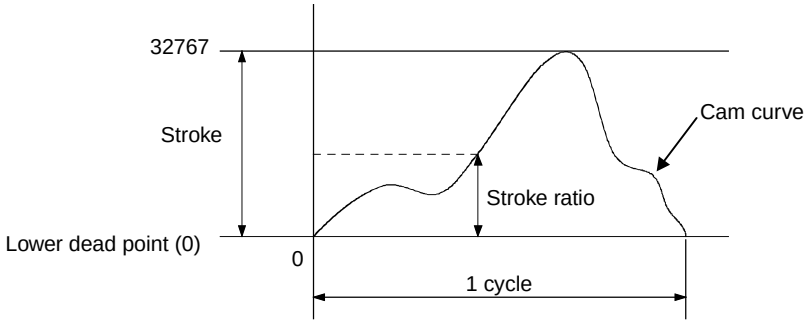
2) Feed cam mode .....With the stroke lower limit value (lower dead point) as the operation start position, positioning is executed by feeding one stroke length per cycle in a fixed direction.





(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.

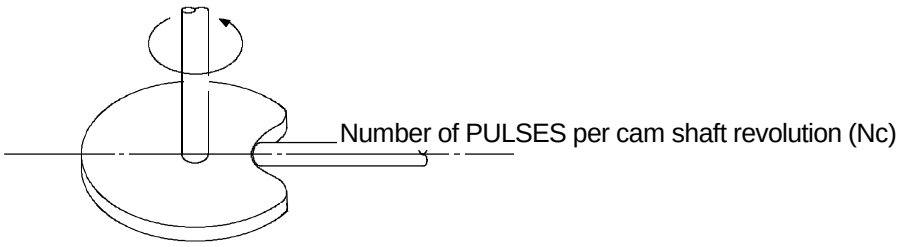
8.4.3 Parameter list

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	0	1 to 32		
2	Number of pulses per cam shaft revolution	0	2147483647 PLS		
3	Used cam No.	——	——		
4	Cam No. setting device (1 word) (Nc)	——	Word device		
5	Permissible droop pulse value	65535 PLS	1 to 65535 PLS		
6	Unit setting	mm	mm	inch	PLS
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 characters		
11	Stroke lower limit value storage device	——	–/ word device		
12	Current value in one virtual axis revolution storage device (main shaft side, 2 words)	——	–/ word device		
13	Current 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.

Data register	(Note) D800 to D3069 D3080 to D8191
Link register	W0 to W1FFF

(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

(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 (M2407+20n) comes ON.
However, since operation of the cam continues, the user must execute the appropriate error processing.

(c) When the motor connected has feedback pulses of 131072 PLS, set the value which is found by dividing the actual permissible droop pulse value by 100.

(5) Unit setting

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

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

(Note-2) : The devices should be started with 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 ≤ 2147483647 × 10^{-1} μm
  inch : Stroke lower limit value + stroke ≤ 2147483647 × 10^{-5} inch
  PULSE : Stroke lower limit value + stroke ≤ 2147483647 PLS
- Setting range in the feed cam mode
  mm : 0 < stroke ≤ 2147483647 × 10^{-1} μm
  inch : 0 < stroke ≤ 2147483647 × 10^{-5} inch
  PULSE : 0 < stroke ≤ 2147483647 PLS

(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 real current value mode/1 cam shaft revolution real current value mode.
The selection of the real current value mode or 1 cam shaft revolution current 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 : Real current value
2 : 1 cam shaft revolution current value

The default is 1: Real current value

Using the numeric keys, enter the limit switch output mode to be selected (1 or 2).
For details on the real current value mode and the 1 cam shaft revolution current 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.

Data register	(Note) D800 to D3069 D3080 to D8191
Link register	W0 to W1FFF

(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

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

(b) Comments up to 32 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 current stroke lower limit value.

(b) The following devices can be used as the stroke lower limit value storage device.

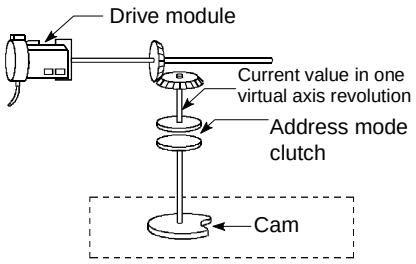
Data register	(Note) D800 to D3068 (Note) D3080 to D8190
Link register	W0 to W1FFE

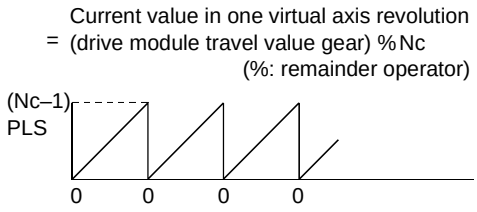
(Note): D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.
The devices should be started with an even number.

(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 $\times 10^{-1}\mu$m
inch : Stroke lower limit value $\times 10^{-5}$ inch
PULSE : Stroke lower limit value $\times$ 1 PLS

(11) Virtual axis current value in one 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.





(a) The current 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 current value in one virtual axis revolution storage device.

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.

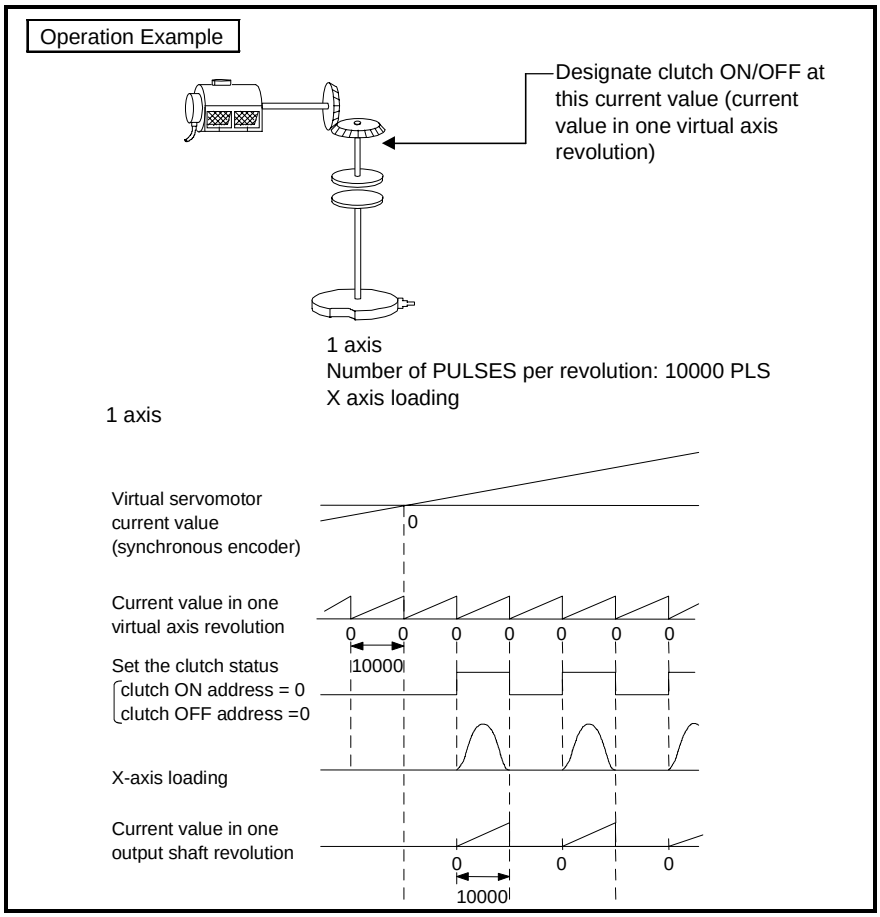
(Note-2) : The devices should be started with an even number.

(c) The setting range for the current value in one virtual axis revolution is 0 to (Nc –1) PLS.
(Nc: number of PULSES in one cam shaft revolution)

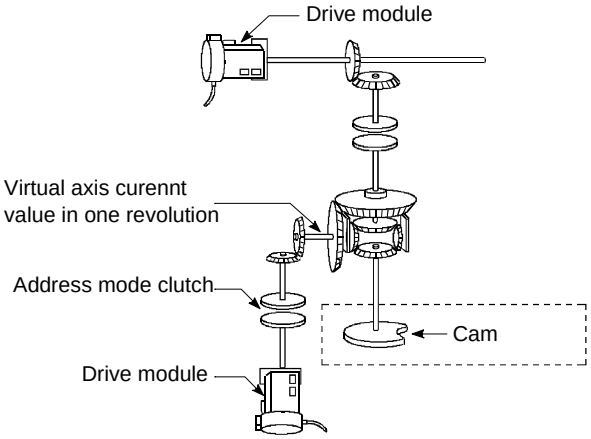
(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis current value in one revolution range: 0 to (Nc–1) PLS. Therefore, set a value in the range 0 to (Nc–1) PLS in the clutch ON/OFF address setting device.

(e) The virtual axis current value in one revolution reference position "0" is set by turning M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.
This sets the virtual axis current 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 M3213+20n turned OFF, control continues from the virtual axis current 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.



(12) Virtual axis current 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 current value in one revolution for the auxiliary input shaft of the cam, the current value in one revolution of the virtual axis is stored.

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

Data register	(Note-1) D800 to D3068 (Note-2) D3080 to D8190
Link register	(Note-2) W0 to W1FFE

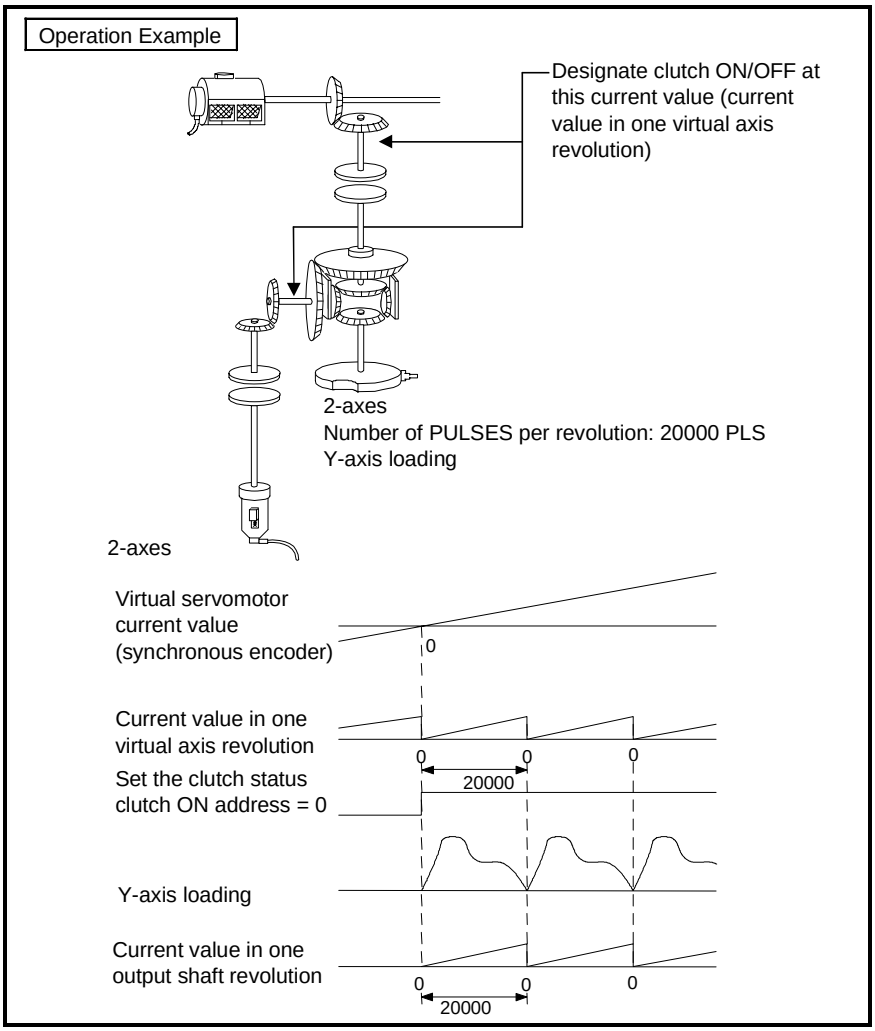
(Note-1) : D800 to D1559 are devices dedicated to the virtual servo motor axes, synchronous encoder axes and output module "cams" in the virtual mode. The areas of the unused virtual servo motor, synchronous encoder and cam axes are available for the user.
(Note-2) : The devices should be started with an even number.

(c) The applicable range for the virtual axis current value in one revolution is 0 to (Nc−1) PLS.

(d) The address mode clutch is turned ON and OFF at designated addresses in the virtual axis current value in one revolution range: 0 to (Nc−1) PLS. Therefore, set the value in the clutch ON/OFF address setting device within the range 0 to (Nc−1) PLS.

(e) The setting for the virtual axis current value in one revolution reference position "0" is made by turning M3213+20n (address clutch reference setting signal) ON and switching to the virtual mode.
This sets the virtual axis current 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 M3213+20n turned OFF, control continues from the virtual axis current 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.



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.

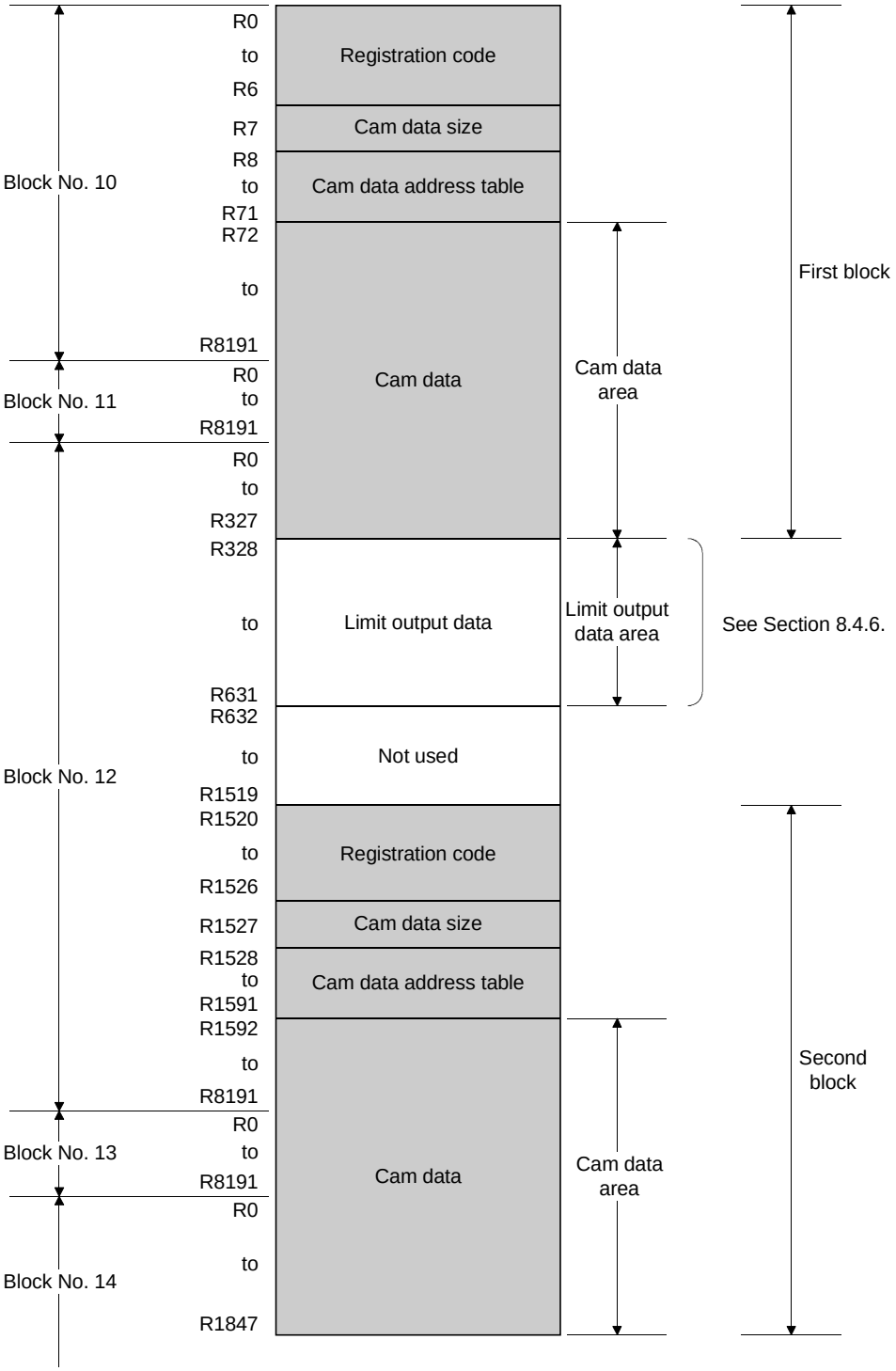
8.4.5 Creation of cam data by user

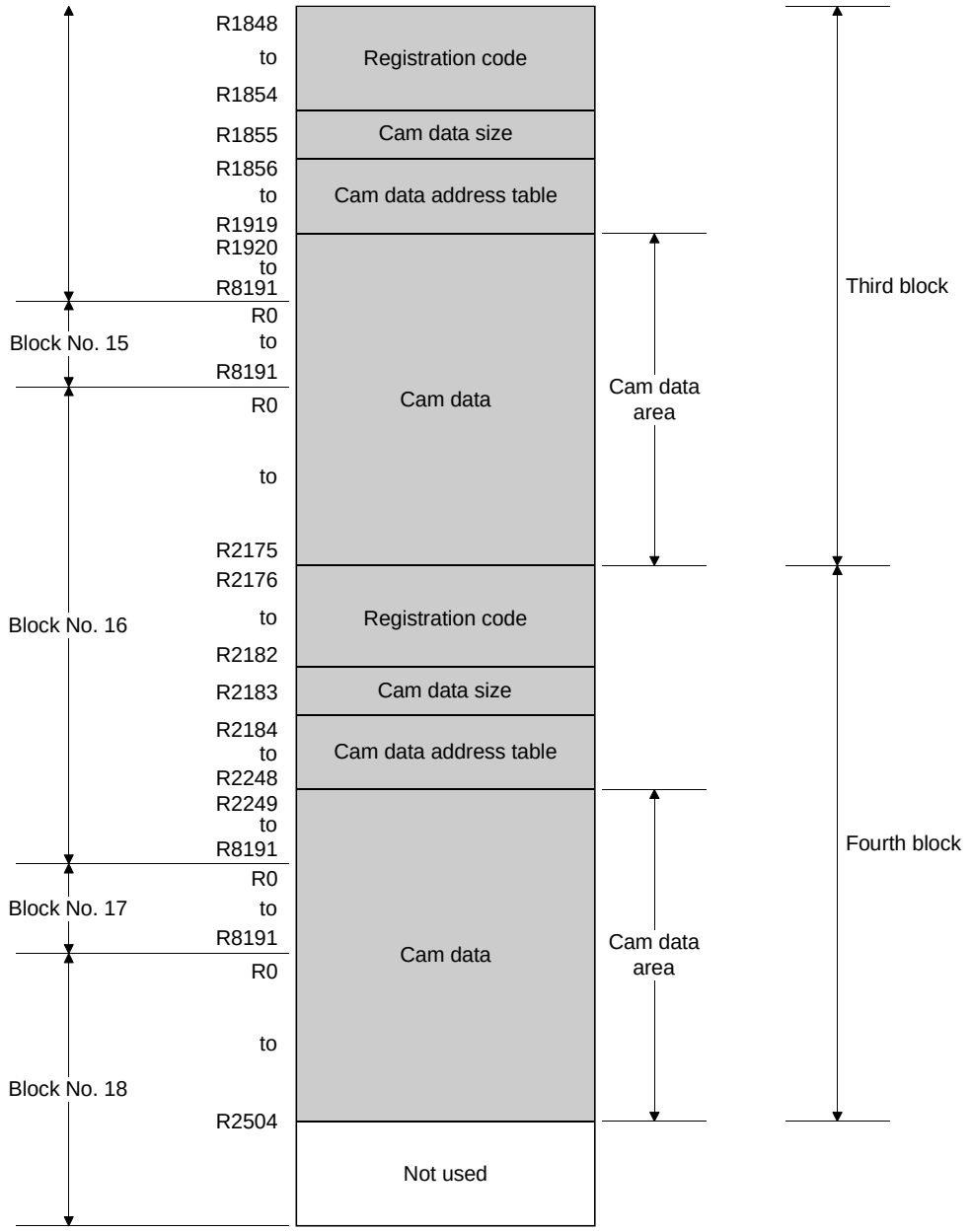
There are two ways to create of cam data by user.
- Creating cam data at IBM PC started up with SW0IX-CAMPE.
- Creating cam data at personal computer other than IBM PC. (hereafter referred to as PC)

(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 which have been started up with the SW0IX-CAMPE software, refer to the SW2SRX-GSV22PE/SW0IX-CAMPE Operation Manual.

(2) Creating cam data at PC other than IBM PC.
Cam data is created in accordance with the format of cam data stored in the block No. 10 to No. 18 of the extended file register area of the memory cassette.

(a) Cam data format
The following is the format of cam data stored in the block No. 10 to No. 18 of the extended file register area.




R1848
to
R1854
Registration code
R1855
Cam data size
R1856
to
R1919
Cam data address table
R1920
to
R8191
Cam data
Cam data area
Third block
R0
to
R8191
Block No. 15
R0
to
R2175
R2176
to
R2182
Registration code
R2183
Cam data size
R2184
to
R2248
Cam data address table
R2249
to
R8191
Cam data
Cam data area
Fourth block
Block No. 16
R0
to
R8191
Block No. 17
R0
to
R2504
Block No. 18
Not used

(b) Registration code

This code is used to judge whether cam data is stored or not.

1) First block

As the registration code, store the following data into R0 to R6.

R0	00FF$_H$
R1	11EE$_H$
R2	22DD$_H$
R3	33CC$_H$
R4	44BB$_H$
R5	55AA$_H$
R6	6699$_H$

Registration code

2) Second block

As the registration code, store the following data into R1520 to R1526.

R1520	00FF$_H$
R1521	11EE$_H$
R1522	22DD$_H$
R1523	33CC$_H$
R1524	44BB$_H$
R1525	55AA$_H$
R1526	6699$_H$

Registration code

3) Third block

As the registration code, store the following data into R1848 to R1854.

R1848	00FF$_H$
R1849	11EE$_H$
R1850	22DD$_H$
R1851	33CC$_H$
R1852	44BB$_H$
R1853	55AA$_H$
R1854	6699$_H$

Registration code

4) Fourth block

As the registration code, store the following data into R2176 to R2184.

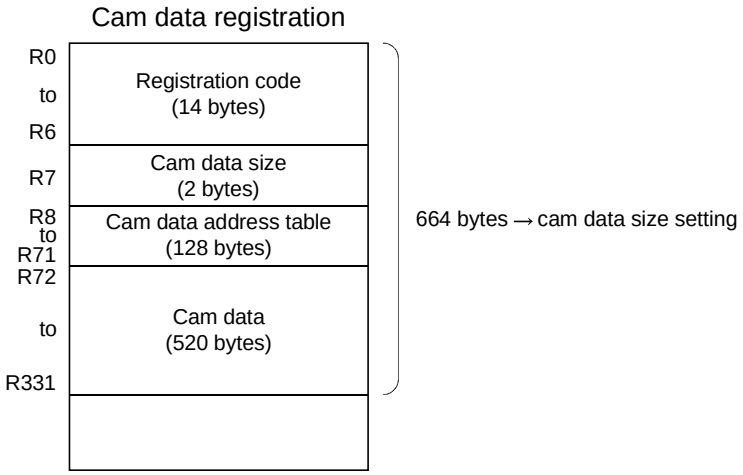
R2176	00FF$_H$
R2177	11EE$_H$
R2178	22DD$_H$
R2179	33CC$_H$
R2180	44BB$_H$
R2181	55AA$_H$
R2182	6699$_H$

Registration code

(c) Cam data size

Set the full byte length of the file registers where the cam data are stored. Make setting after converting the file registers from R0 to the file register No. of the last data into bytes.
(One file register = 2 bytes)

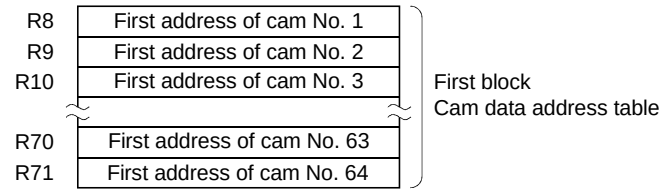
Example When the cam data whose resolution is 256 are stored, the cam data size is as follows.



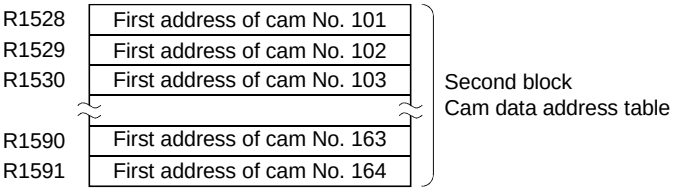
(d) Cam data address table

Set the first address from where the cam data (max. 4 blocks) are stored. Make setting after converting the first address of each cam No. into the number of bytes starting from R0. Set "0" as the first address of the unregistered cam No.

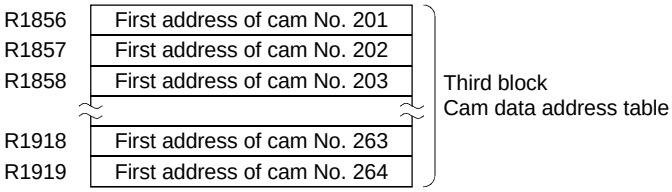
1) First block



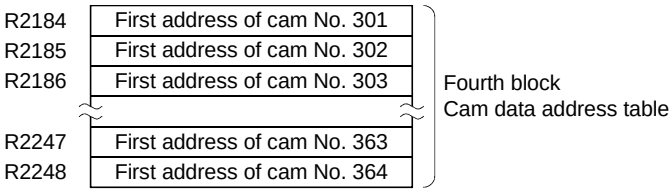
2) Second block



3) Third block



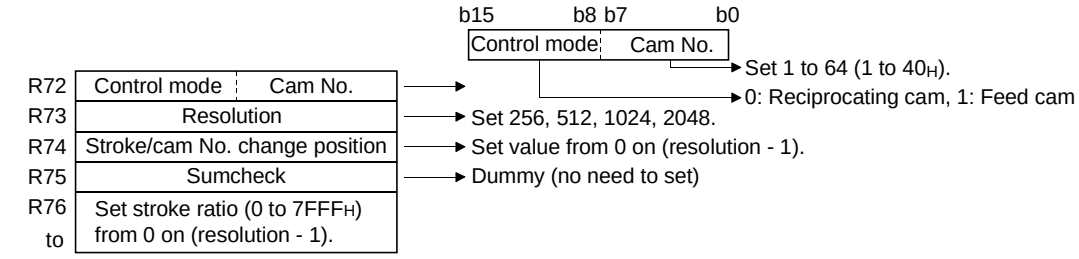
4) Fourth block



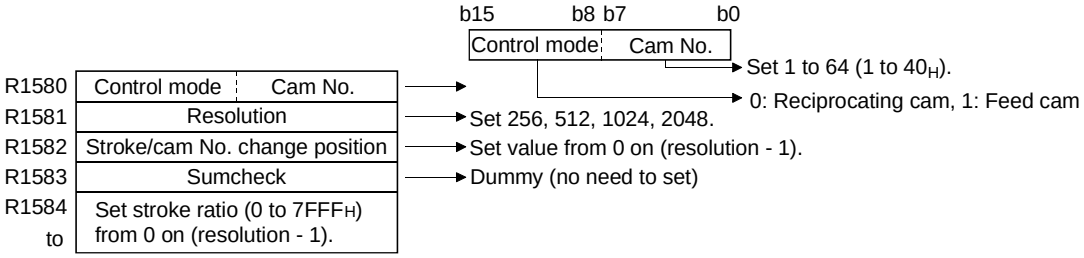
(e) Cam data

- Set the cam data (max. 4 blocks).
  The order of storing the cam data need not be in the order of the cam Nos.
- Set each cam data as the stroke ratio (integer) of 0 to 7FFF$_H$ (32767).
  Also, the cam data requires "0" and "7FFF$_H$ (32767)" points.
  In the beginning of the cam data, store the control mode, cam No., resolution, and stroke/cam No. change position. (Refer to Section 8.4.2)

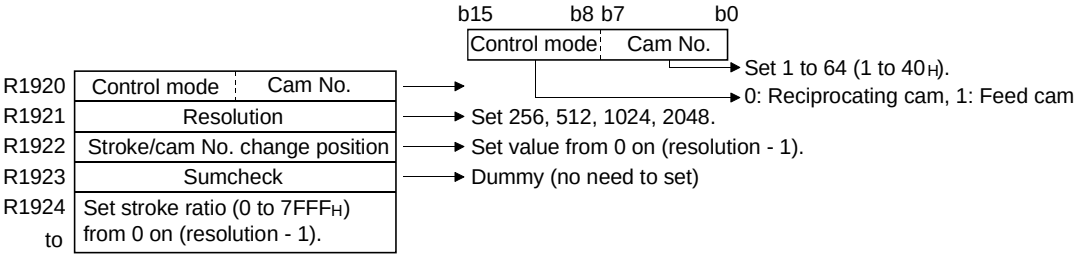
1) First block



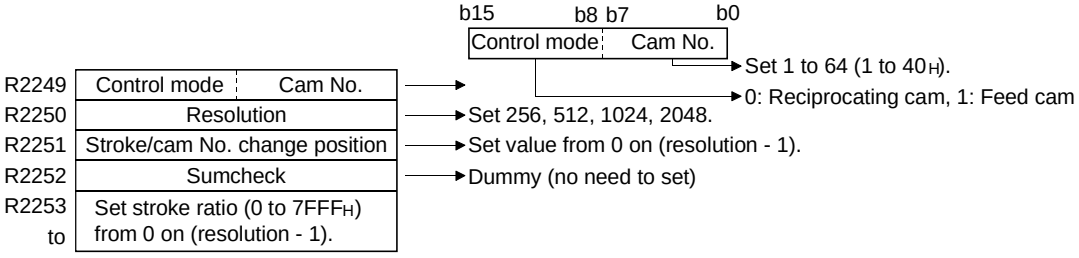
2) Second block



3) Third block



4) Fourth block



REMARKS

As the memory cassette, the A3NMCA16 (128k bytes) or more is required.

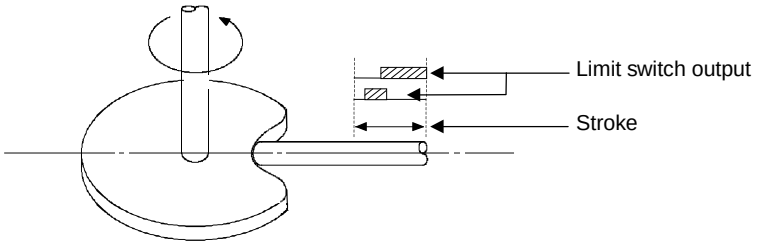
8.4.6 Limit switch outputs in current value mode & real current value in 1 cam revolution mode

There are 2 types of limit switch outputs:

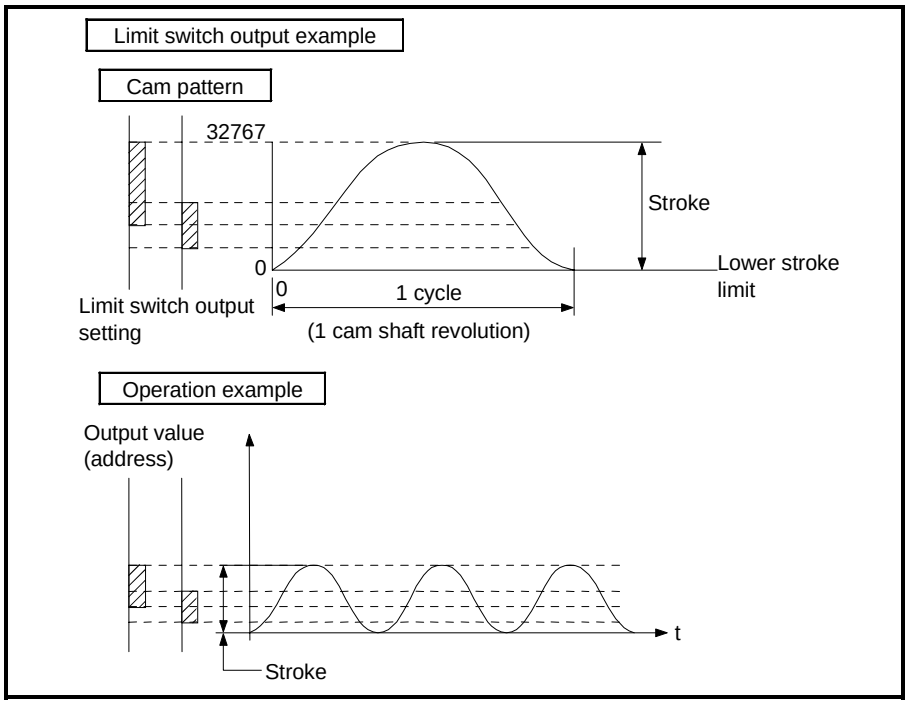
- Limit switch outputs in real current value mode.
- Limit switch outputs in real current value in 1 cam revolution mode.

(1) Limit switch outputs in real current value mode.
Limit switch outputs occur in accordance with the cam's real current value (stroke).

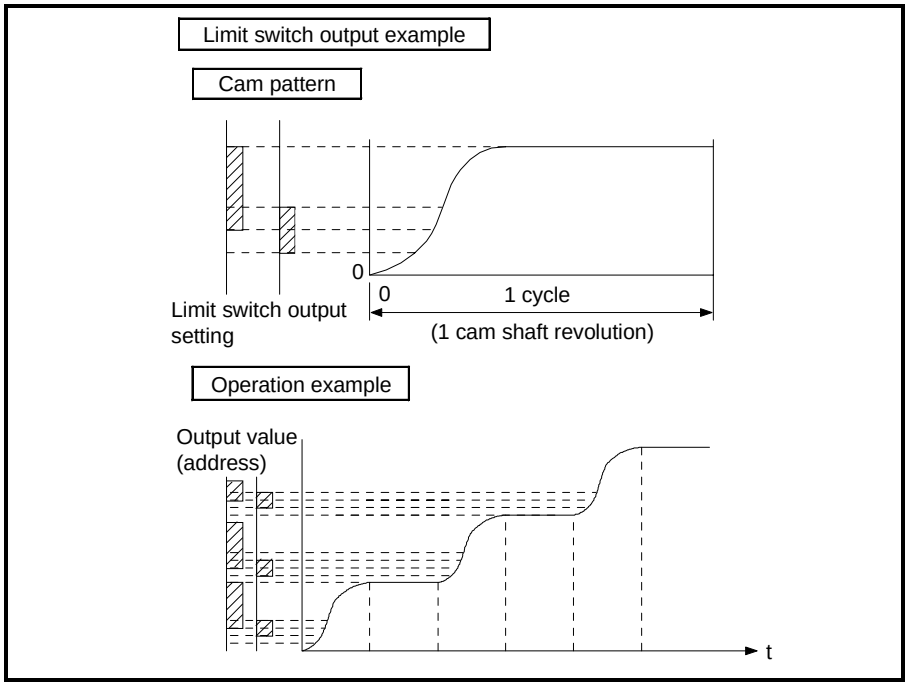
[Cam]



(a) For two-way cam
The limit switch output pattern is identical for both directions.

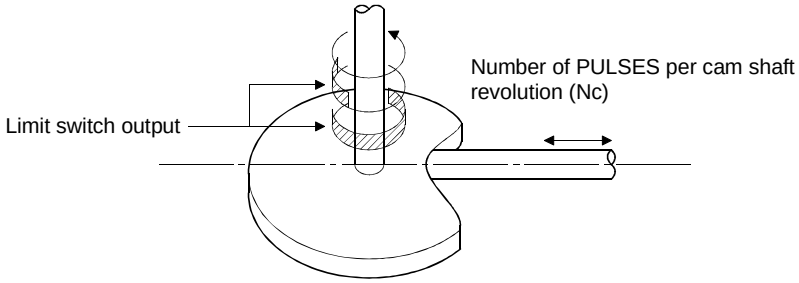


(b) For feed cam

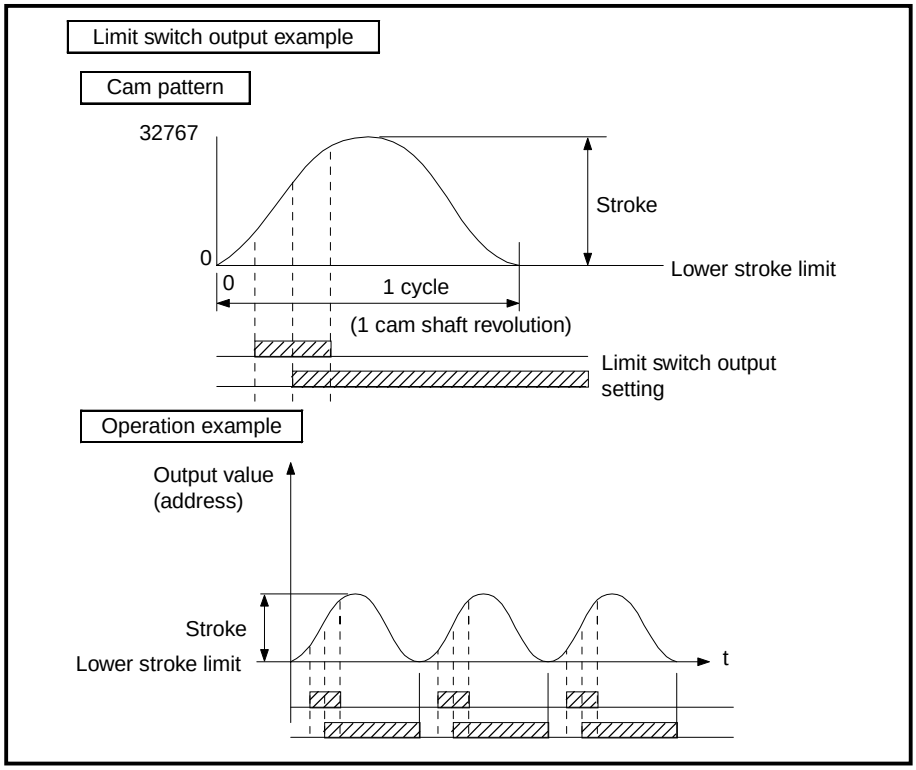


(2) Limit switch outputs in 1 cam shaft revolution current value
Limit switch outputs occur in accordance with the current value within 1 cam shaft revolution (0 to Nc−1).

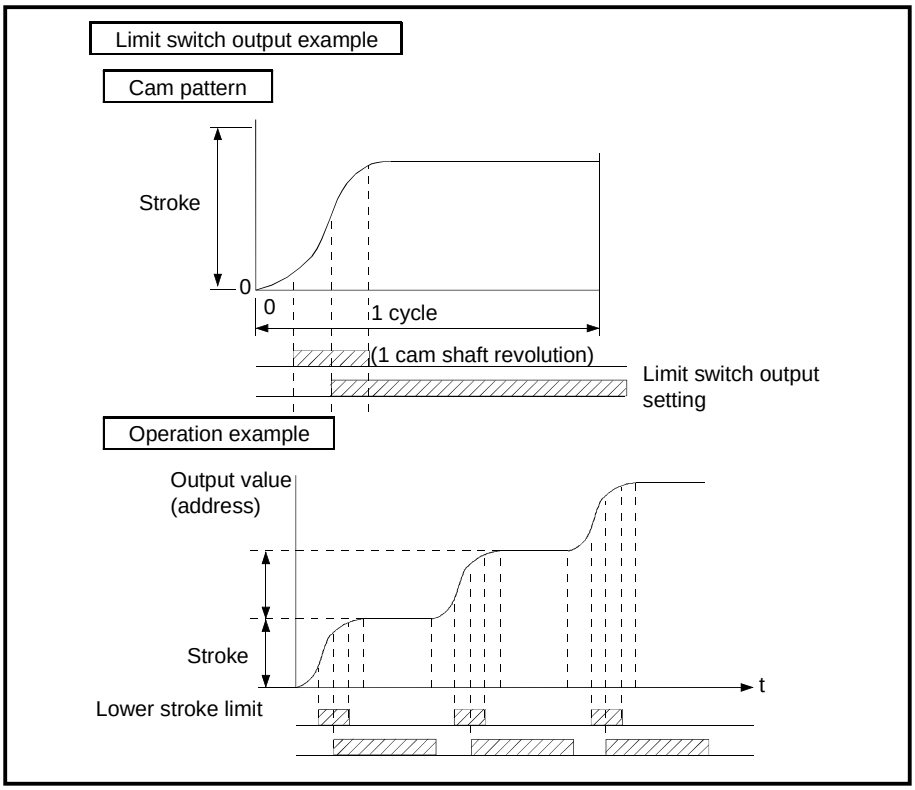
[Cam]



(a) For two-way cam
Different limit switch output patterns can be used for the feed and return strokes.



(b) For feed cam



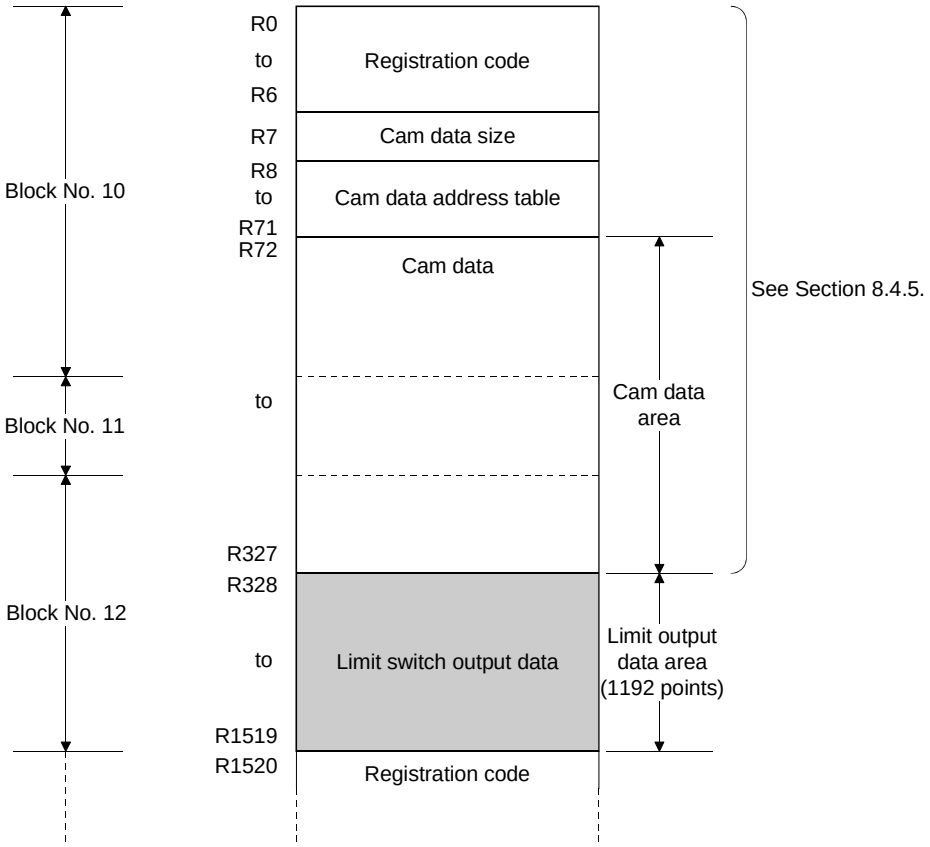
8.4.7 Limit switch output data in current value within 1 cam revolution mode

Limit switch output data can be created by the user at IBM PC 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 of the axis set to the cam axis within-one-revolution current value mode (see Section 8.4.3 (11), (12)) are stored into block No. 12 of the memory cassette's extended file register area. (The limit switch output data not in the cam axis within-one-revolution current value mode are stored into the internal memory.)

(b) The following is the format of the limit switch output data stored into block No. 12 of the file register area.



(c) The limit switch output data of the file register area are imported when the real mode is switched to the virtual mode.
If the limit switch output data are normal, the limit switch output of the axis set to the cam axis within-one-revolution current value mode is controlled on the basis of those data.

(b) Executing "write of servo setting data to PC" from the peripheral device writes the limit switch output data of the cam axis within-one-revolution current value mode to block No. 12 (R328 to R1519) of the extended file register area.
When some of multiple limit switch output data are to be written, transfer the data written from the peripheral device to another device once, and write them as required to the file register area. (Refer to Section 8.4.8)

REMARKS

1) As the memory cassette, the A3NMCA24 (192k bytes) or more is required.

8.4.8 Batch-changing the cam data/limit switch output data

The cam data/limit switch output data stored in block No. 10 to No. 18 of the memory cassette's extended file register area are imported by the PCPU of the A273UHCPU/A173UHCPU (-S1) at power-on or reset to exercise control.

Using the sequence program, the cam data/limit switch output data imported by the PCPU can be batch-changed.

Change the cam data/limit switch output data in the following procedure.

1) Write the cam data/limit switch output data to block No. 10 - No. 18 of the extended file register area. (Note-1)

↓

2) Make a batch change request of the cam data/limit switch output data (M2056: OFF→ON) (Note-2)

↓

3) Batch-change processing of the cam data/limit switch output data is executed.

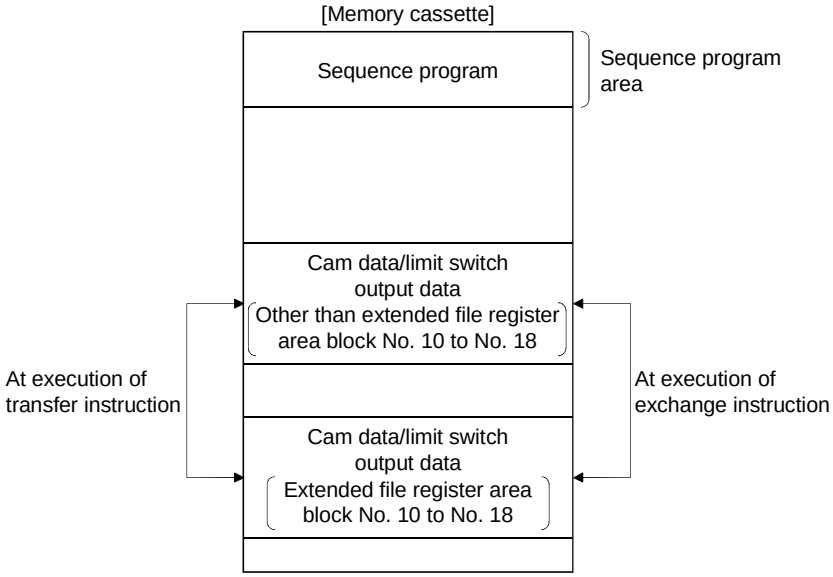
↓

4) Reset the batch change request of the cam data/limit switch output data (M2056).

⚠CAUTION
⚠(Note-1) : In any of the following cases, do not change the cam data/limit switch output data (data in block No. 10 to No. 18 of the extended file register area). • During write of cam data to PC from peripheral device (cam data area) • During write of servo setting data to PC from peripheral device (limit switch output data area) • At real mode to virtual mode change request (M2043: OFF→ON) (limit switch output data area) • During cam data/limit switch output data batch-changing (M2056: OFF→ON)
⚠(Note-2) : In the following case, do not make a batch change request of the cam data/limit switch output data (M2056: OFF→ON). • During write of cam data to PC from peripheral device In other than the above case, you can make a batch change request of the cam data/limit switch output data (M2056: OFF→ON) in either of the real and virtual modes.

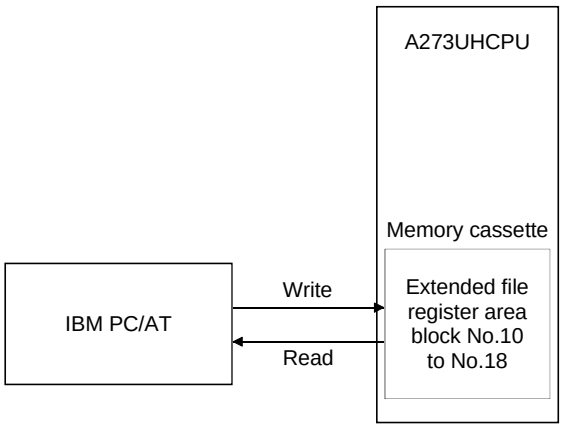
(1) Write of cam data/limit switch output data to block No. 10 to No. 18 of extended file register area
Cam data can be written using:
- Sequence program
- Peripheral device
- Personal computer

(a) Write using sequence program
Using the transfer or exchange instruction for the cam data/limit switch output data stored in another extended file register, rewrite the cam data/limit switch output data in block No. 10 to No. 18 of the extended file register area.



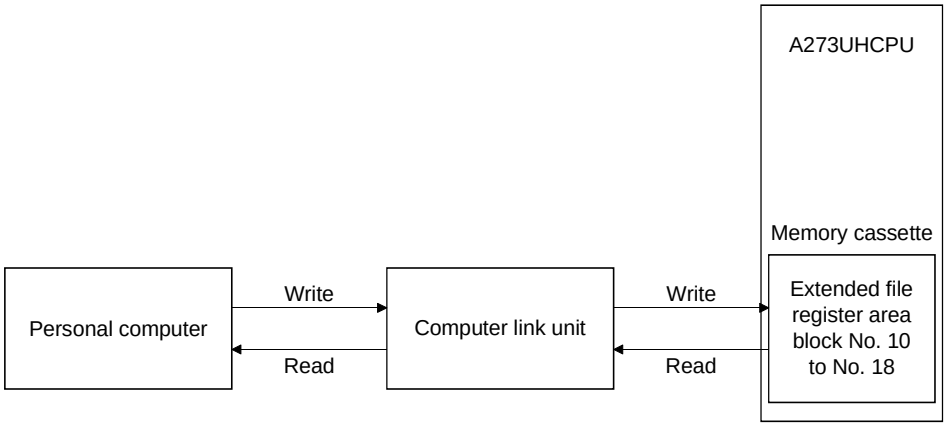
Write can be executed using the dedicated instruction.

(b) Write using peripheral device
Using the IBM PC booted with SW2SRX-GSV22PE, write the cam data/limit switch output data.
For operations of the IBM PC, refer to the SW2SRX-GSV22PE or SW0IX-CAMPE Operating Manual.



(c) Write using personal computer

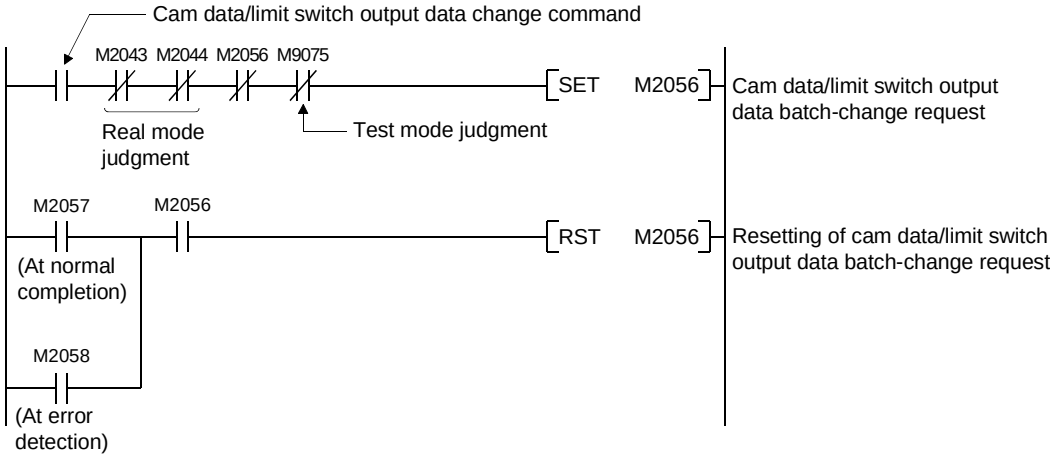
Write the cam data/limit switch output data stored in a personal computer or like to block No. 10 to No. 18 of the extended file register area via computer link.



Read the limit switch output data in block No. 12 of the extended file register area using the personal computer or like, and write the limit switch output data stored in the hard disk or like to block No. 12 of the extended file register area via computer link.

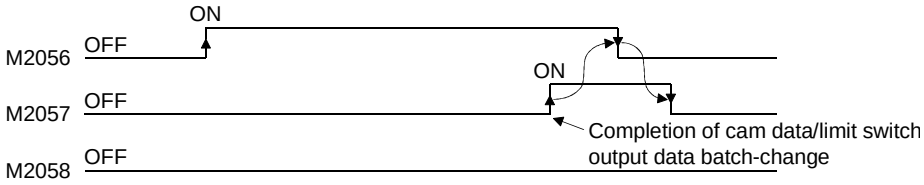
(2) Cam data/limit switch output data batch-change program
The following is the sequence program used to write the cam data/limit switch output data stored in block No. 10 to No. 18 of the extended file register area to the PCPU.

[Sequence program]

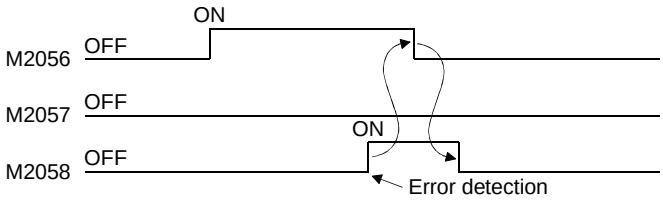


[Operation timing]

• At normal completion



• At error detection



(3) Instructions

(a) In the test mode using the peripheral device, a cam data/limit switch output data batch-change request is invalid.

⚠CAUTION
⚠ As an interlock, provide test mode judgment (M9075) in the cam data/limit switch output data batch-change request program.

(b) While the cam data/limit switch output data are being imported to the PCPU (while M2056 is ON), the real mode cannot be switched to the virtual mode. As an interlock, provide the cam data batch-change request flag (M2056) in the real mode to virtual mode change program.

(4) Error factors

The following are the error factors in a cam data/limit output data batch-change request (M2056: OFF → ON).

(a) Cam data is being written from peripheral device

(b) Registration code of file register's registration code storage area is not normal

(c) Cam data size in file register's cam data size storage area is outside the range 144 to 33434 or odd bytes.

8.5 Common Devices (Input/Output, Internal Relays, Data Registers)

The I/Os, internal relays and data registers used in the output modules are explained here.

8.5.1 Internal relays (M)

(1) Internal relay (M) list
(a) Status of each axis

Axis No.	Device Number	Signal Name														
1	M2400 to M2419	(○ Valid)														
2	M2420 to M2439		Signal Name	Real	Virtual				Signal Direction	Refresh Cycle			Fetch Cycle			
3	M2440 to M2459				Roller	Ball screw	Rotary table	Cam		Preset number of axes (Note)			Preset number of axes (Note)			
4	M2460 to M2479									1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
5	M2480 to M2499									1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
6	M2500 to M2519	0	Positioning start completion		OFF					—						
7	M2520 to M2539	1	Positioning completion													
8	M2540 to M2559	2	In-position		○					3.5ms	7.1ms	14.2ms				
9	M2560 to M2579	3	Command in-position		OFF					—						
10	M2580 to M2599	4	Speed controlling							3.5ms	7.1ms	14.2ms				
11	M2600 to M2619	5	Speed/position change latch													
12	M2620 to M2639	6	Zero pass	○	○				SCPU ← PCPU							
13	M2640 to M2659	7	Error detection							Immediately						
14	M2660 to M2679	8	Servo error detection							3.5ms	7.1ms	14.2ms				
15	M2680 to M2699	9	Zeroing request							10ms	20ms					
16	M2700 to M2719	10	Zeroing completion							3.5ms	7.1ms	14.2ms				
17	M2720 to M2739	11	External signal FLS							10ms	20ms					
18	M2740 to M2759	12	External signal RLS													
19	M2760 to M2779	13	External signal STOP													
20	M2780 to M2799	14	External signal DOG/CHANGE													
21	M2800 to M2819	15	Servo ON/OFF status							3.5ms	7.1ms	14.2ms				
22	M2820 to M2839	16	Torque limiting signal													
23	M2840 to M2859	17	DOG/CHANGE signal							10ms	20ms					
24	M2860 to M2879	18	Virtual mode continuation operation warning signal													
25	M2880 to M2899	19	M-code outputting signal		OFF					3.5ms	7.1ms	14.2ms				
26	M2900 to M2919															
27	M2920 to M2939															
28	M2940 to M2959															
29	M2960 to M2979															
30	M2980 to M2999															
31	M3000 to M3019															
32	M3020 to M3039															

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(b) Command signals for each axis

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

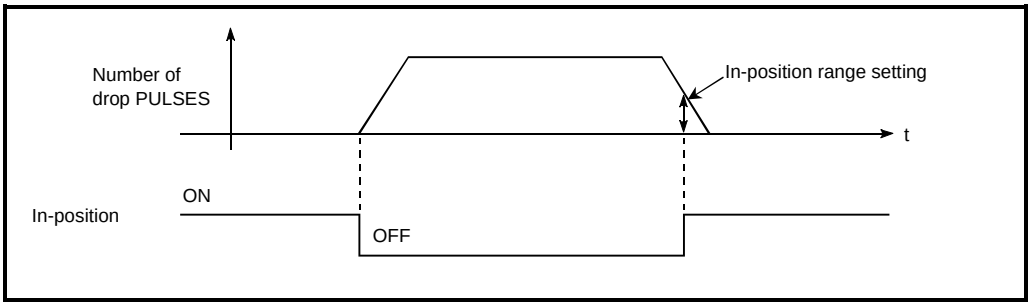
	Signal Name	Real	Virtual: Roller	Virtual: Ball screw	Virtual: Rotary table	Virtual: Cam	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0	Stop command	○	×				SCPU → PCPU				—		
1	Sudden stop command												
2	Forward rotation JOG start												
3	Reverse rotation JOG start												
4	Completion signal OFF command												
5	Speed/position change enable												
6	Limit switch output enable		×	○							3.5ms	7.1ms	14.2ms
7	Error reset		○								10ms		
8	Servo error reset		×								—		
9	Start-time stop input/ disable		×								—		
10	Unusable	—	—										
11	Unusable												
12	Feed current value update command	○	×										
13	Address clutch reference setting	×	×		○						At switching from real to virtual		
14	Cam reference position setting		×			○							
15	Servo OFF	○	○								3.5ms	7.1ms	14.2ms
16	Unusable	—	—								—		

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(2) Internal relay (M) details

(a) In-position signal (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 proximity dog comes ON during zeroing
- After deceleration is started by a stop command
- Speed change to zero speed

During REAL mode operation

- Constant check ..... During VIRTUAL mode operation

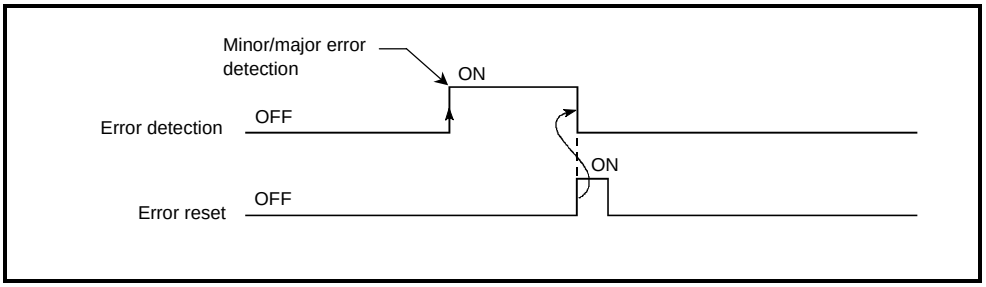
(b) Zero pass signal (M2406+20n)

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 (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.

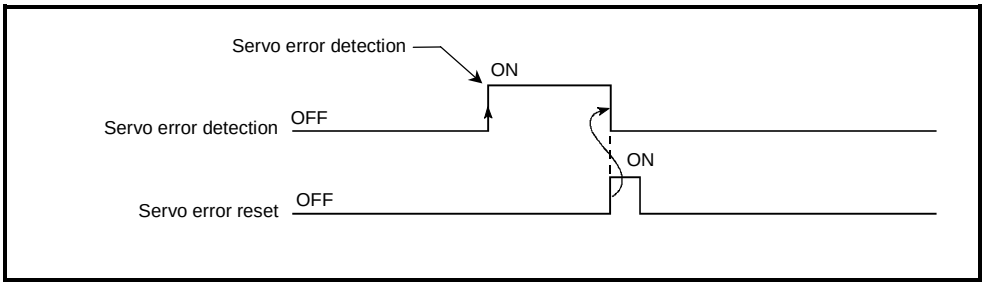
2) The error detection signal goes OFF when the error reset signal (M3207+20n) is switched ON.



(d) Servo error detection signal (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 (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) Zeroing request signal (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 zeroing request signal switches ON at the following times.
      - At power ON, and on resetting the servo system CPU
      - During zeroing
   ii) The zeroing request signal switches OFF when the zeroing is completed.
2) Absolute position system
   i) The zeroing request signal switches ON at the following times.
      - During zeroing
      - When a sum check error occurs (at power ON) for the backup data (reference values).
   ii) The zeroing request signal switches OFF when the zeroing is completed.

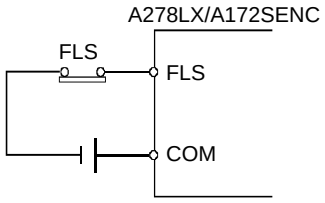
(f) Zeroing Completed Signal (M2410+20n)

1) This signal switches ON when a zeroing 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 zeroing is attempted (by the servo program) while this zeroing completed signal is ON, the "consecutive zeroing start" error will be activated, and the zeroing operation will not be started. (Proximity dog type zeroing only.)

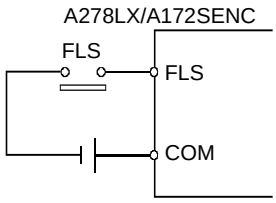
(g) FLS signal (M2411+20n)

1) The FLS signal is controlled according to the ON/OFF status of upper limit switch inputs (FLS) to the A278LX or A172SENC 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



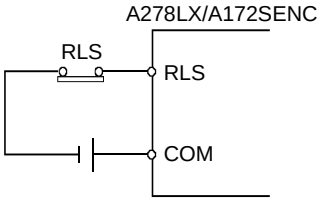
When FLS signal is OFF



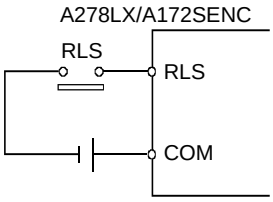
(h) RLS Signal (M2412+20n)

1) The RLS signal is controlled according to the ON/OFF status of lower limit switch inputs (RLS) to the A278LX or A172SENC 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



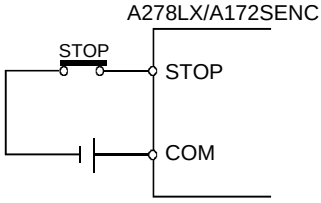
When RLS signal is OFF



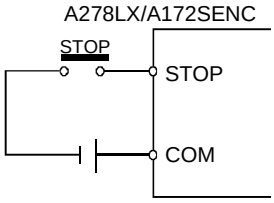
(i) STOP signal (M2413+20n)

1) The STOP signal is controlled according to the ON/OFF status of STOP signal inputs to the A278LX or A172SENC 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 signal (M2414+20n)
1) The DOG signal is controlled according to the ON/OFF status proximity dog inputs to the A278LX, A172SENC from an external source.
2) Regardless whether "N/O input" or "N/C input" is designated in the system settings, the DOG signal turns ON when the proximity dog signal is ON, and the proximity dog signal turns OFF.
3) If "N/O input" is designated in the system settings, the proximity dog input turns ON when the proximity dog signal turns ON. If "N/C input" is designated in the system settings, the proximity dog input turns ON when the proximity dog signal turns OFF.

(k) Servo READY signal (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 M3215+20n
- When a servo error occurs

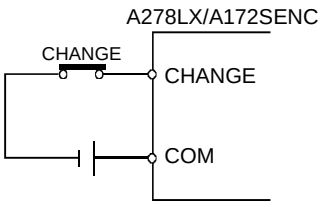
See Section 11.4 "Servo Errors" for details.

(l) Torque control in progress signal (M2416+20n)
This signal switches ON at axes where torque control is being executed.

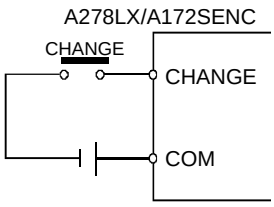
(m) CHANGE signal (M2417+20N)
1) The CHANGE signal is controlled according to the ON/OFF of the external speed/position control change input (CHANGE) to the A278LX/A172SENC.
- Speed/position switching input is OFF ..... CHANGE signal: OFF
- Speed/position switching input is ON ..... CHANGE signal: ON

2) The status of the speed change switch (CHANGE) when the CHANGE signal is ON/OFF is shown below.

CHANGE signal: ON

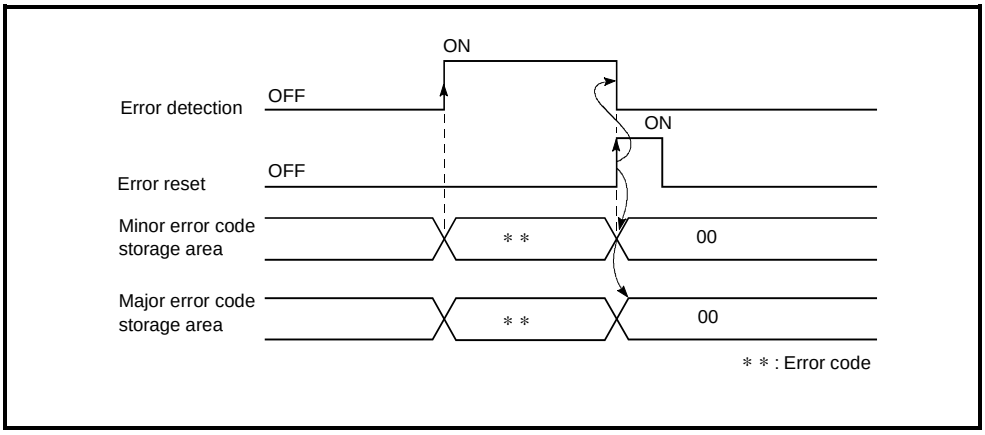


CHANGE signal: OFF



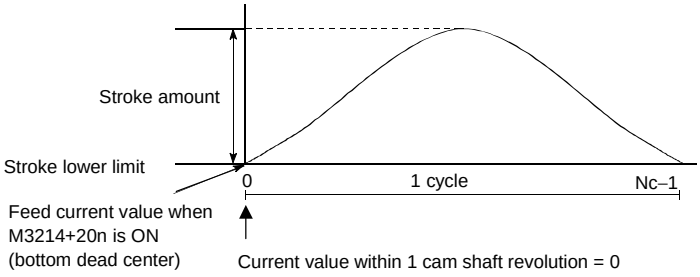
(n) Limit switch output enabled command (M3206+20n)
The limit switch output enable command is used to enable limit switch output.
- ON ..... The limit switch output's ON/OFF pattern is output from AY42.
- OFF .... The limit switch output is switched OFF from AY42.

(o) Error reset command (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 (M2407+20n: ON) and to reset the error detected signal (M2407+20n).



(p) Address clutch reference setting signal (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 current 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 (M3213+20n) is ON
VIRTUAL mode operation will begin with the current 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 (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 current 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 current value in 1 virtual axis revolution value calculated from the encoder's current value.

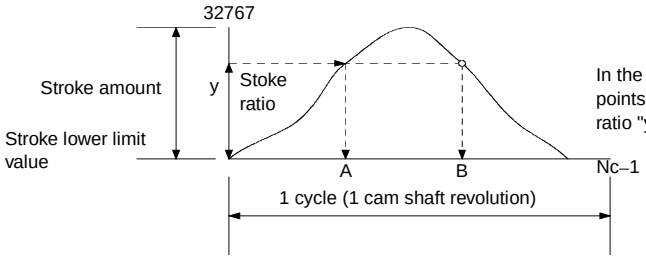
(q) Cam reference position setting signal (M3214+20n)
This command signal is only operative when the output module is a cam, and it is used to designate the cam's reference position.
When a REAL to VIRTUAL mode switching request occurs, processing will be as shown below, depending on the ON/OFF status of the cam reference position setting signal.
1) When the cam reference position setting signal (M3214+20n) is ON
- The current value becomes the cam's reference position.
- The current feed current 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 current value in 1 cam shaft revolution.



- After the system is started and 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 M3214+20n 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 (M3214+20n) is OFF
   - When the following condition exists, operation is continued with the stroke lower limit value and current value in 1 cam shaft revolution from the previous VIRTUAL mode operation adopted.
     (Final servo command value in previous VIRTUAL mode operation) – (current servo current 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 current value in 1 cam shaft revolution calculated based on the current feed current value.

[Current value in 1 cam shaft revolution calculation]
The stroke ratio (y) is first calculated as follows:
(Feed current 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 current value in 1 cam shaft revolution which corresponds to the relevant point is calculated.
Because the search for the current 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.)



(r) Servo OFF command (M3215+20n)
The servo OFF command is used to switch the servo OFF (free run status).
- M3215+20n: OFF ..... Servo ON
- M3215+20n: 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.

(s) VIRTUAL mode continuation disabled warning(M3218+20n)
If, for an ABS axis, the difference between the final servo command value in the last operation in the VIRTUAL mode and the servo current 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 zeroing is executed. (2) When a current 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.

8.5.2 Data registers (D)

(1) Data register (D) list

(a) Monitor devices of each axis

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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0 1	Feed current value/roller cycle	○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2 3	Real current value									
4 5	Deviation counter value									
6	Minor error code				Immediately					
7	Major error code									
8	Servo error code				10ms	20ms				
9	Zeroing re-travel value		Backup		3.5ms	7.1ms	14.2ms			
10 11	Travel value after proximity dog ON				END					
12	Execution program No.		×		At start					
13	M-code				3.5ms	7.1ms	14.2ms			
14	Torque limit value		○							
15	Data set pointer for constant-speed control		×		At start/during start					
16 17	Travel value change register			SCPU→PCPU				3.5ms	7.1ms	14.2ms
18 19	STOP input-time real current value			SCPU←PCPU	END (Note-2)					

(Note-1): Upper: A273UHCPU, lower: A173UHCPU (-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

(b) Control change registers

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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	JOG speed setting register	○	○	SCPU→PCPU				At start		

(Note-1): Upper: A273UHCPU, lower: A173UHCPU (-S1)

(c) Cam shaft monitor device

Axis No.	Device Number	Signal Name
1	D1240 to D1249	(○ Valid)
2	D1250 to D1259	
3	D1260 to D1269	
4	D1270 to D1279	
5	D1280 to D1289	
6	D1290 to D1299	
7	D1300 to D1309	
8	D1310 to D1319	
9	D1320 to D1329	
10	D1330 to D1339	
11	D1340 to D1349	
12	D1350 to D1359	
13	D1360 to D1369	
14	D1370 to D1379	
15	D1380 to D1389	
16	D1390 to D1399	
17	D1400 to D1409	
18	D1410 to D1419	
19	D1420 to D1429	
20	D1430 to D1439	
21	D1440 to D1449	
22	D1450 to D1459	
23	D1460 to D1469	
24	D1470 to D1479	
25	D1480 to D1489	
26	D1490 to D1499	
27	D1500 to D1509	
28	D1510 to D1519	
29	D1520 to D1529	
30	D1530 to D1539	
31	D1540 to D1549	
32	D1550 to D1559	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0	Unusable	—	—	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
1	Execution cam No.	Backup	○							
2 3	Execution stroke value									
4 5	Cam axis current value within one revolution									
6	Unusable	—	—		—					
7	Unusable									
8	Unusable									
9	Unusable									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU (-S1)

(2) Data register (D) details

(a) Effective cam No. register (D1241+10n) ..... 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.

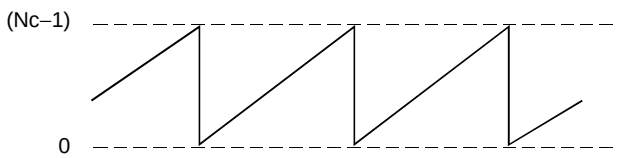
2) The cam No. stored at the effective cam No. register is saved until operation at another cam is executed. (A stored cam No. is not cleared when control at that cam is ended.)

(b) Effective stroke register (D1242+10n, D1243+10n)
..... Data sent from PCPU to SCPU

1) The current control stroke is stored in binary code at this register.

(c) Current value in 1 cam shaft revolution register (D1244+10n, D1245+10n)
..... Data sent from PCPU to SCPU

1) The current value in 1 cam shaft revolution designated by the parameter setting is stored at this register.
The current value is a ring address in the range "0 to [number of PULSES per cam shaft revolution (Nc)–1]".



(d) Feed current value/Roller peripheral velocity register (D0+20n, D1+20n)
..... 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 current value data.
3) Roller peripheral velocity is stored.
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 to 600000000	0.01 to 6000000.00 mm/min
inch		0.001 to 600000.000 inch/min

(e) Real current value register (D2+20n, D3+20n)
..... Data sent from PCPU to SCPU
1) The current value obtained from real travel (feed current value minus the deviation counter's droop pulse count) is stored at this register.
2) When a STOP status is in effect, the current feed value is equal to the real current value.

(f) Deviation counter value register(D4+20n, D5+20n)
..... Data sent from PCPU to SCPU
The difference between the feed current value and the real current value is stored at this register.

(g) Minor error code register(D6+20n) ..... 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 (M3207+20n).

(h) Major error code register(D7+20n) ..... 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 (M3207+20n).

(i) Servo error code register(D8+20n)..... 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.

(j) Torque limit value register(D14+20n) ..... 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 PLC 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 switching 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 current 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 (REAL/VIRTUAL mode switching error detection flag) will switch ON, and the error code will be stored at the D9193 to D9195 (REAL/VIRTUAL mode switching error information storage register) register.
Refer to section 11.6 for details regarding the error codes which are stored at D9193 to D9195.

9. REAL & VIRTUAL MODE SWITCHING AND STOP/RESTART

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 PLC READY (M2000) and PCPU READY completed (M9074) flags ON?	○	○	○	○	ON	OFF
2	• Are all axes stopped? (M2001 to 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 (M2408+20n) signal OFF at all the axes?	○	○	○	○	YES	NO
10	• Is the zeroing request (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 (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 current value within the stroke range?	—	○	○	—	YES	NO
	• Is the feed current 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 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 current 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 (M2407+20n) will switch ON, and the error code will be stored in the minor/major error code storage 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 A273EX/A172SENC 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 ON→OFF) 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 D9193 to D9195 register. (See section 11.6)

Table 9.4 Checklist for VIRTUAL to REAL Mode Switching

Check Sequence	Check Item	Normal Condition	Abnormal Condition
1	• Are all axes stopped?(M2001 to 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 (M2408+20n) switches ON at any axis.
- When the PLC READY (M2000) signal switches OFF.
- If an alarm occurs in the 24V DC power supply to the A278LX/A172SENC (major error 15010 occurs) while the servos are ON at all axes and the A278LX/A172SENC brake has been set for use.

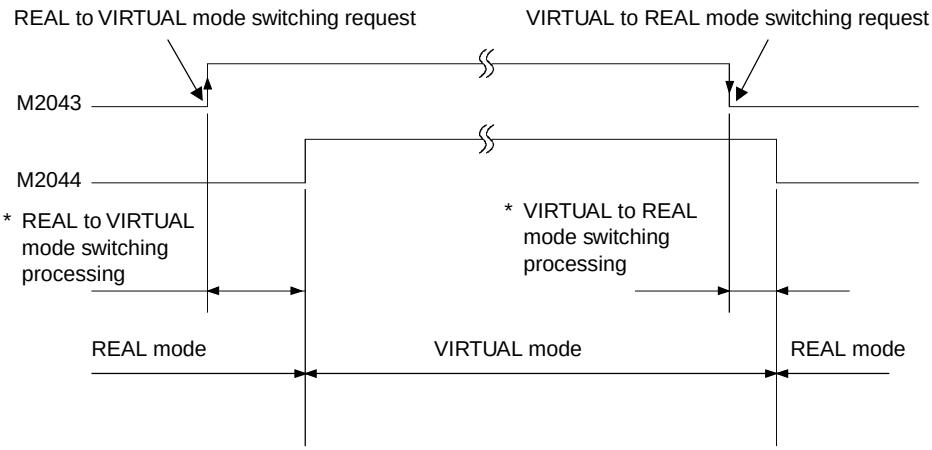
(2) If any of the above conditions occur, the OS will switch back to the REAL mode, and the resulting error code will be stored in the D9193 to D9195 register. M2045 will not switch ON at this time.

9.3 Precautions When Switching between REAL and VIRTUAL Modes

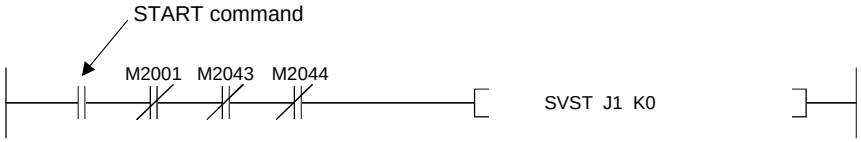
The precautions when switching between the REAL and VIRTUAL modes are described below.

(1) The SVST and 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 SVST and CHGA/CHGV instructions, M2043 and M2044 should be used as an interlock function.

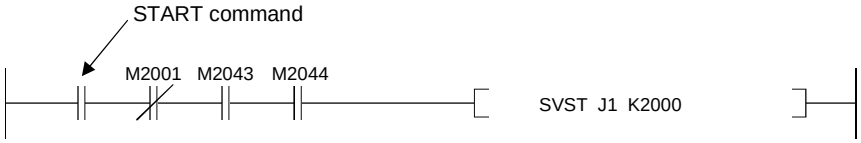
[Timing Chart]



[Program Example]
(a) Servo program START request at REAL mode



(b) Servo program START request at VIRTUAL mode



REMARKS

1) For details regarding the SVST and CHGA/CHGV instructions, refer to the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH /A173UH) IB-0300028.
2) The M2043 and M2044 names are as follows.
   - M2043..... REAL/VIRTUAL mode switching request flag
   - M2044..... REAL/VIRTUAL mode status flag

   (See Section 4.1)

(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.

9. REAL & VIRTUAL MODE SWITCHING AND STOP/RESTART

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	Synchroni-zation 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	PLC 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 PLC 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 All ADU or MR-□-B axes are brought to an immediate stop, resulting in a servo OFF status. • 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.

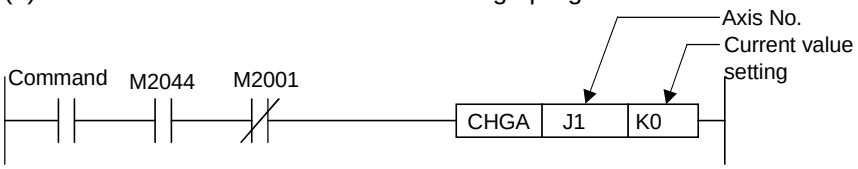
10. AUXILIARY / APPLIED FUNCTIONS

10.1 Current Value Change / Speed Change

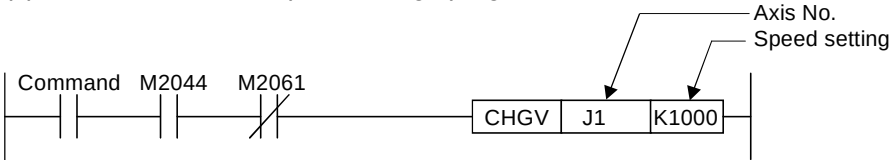
Virtual servo motor current value changes, speed changes, and synchronous encoder current value changes are explained here.
Current value changes are carried out using the CHGA instruction while speed changes are performed using the CHGV instruction.
For details regarding the CHGA and CHGV instructions, refer to the Motion Controller (SV13/22 REAL Mode) Programming Manual (type A273UH/A173UH).

10.1.1 Current value change by CHGA instruction and speed change by CHGV instruction

Program examples are illustrated below.
(1) Virtual servo motor current value change program



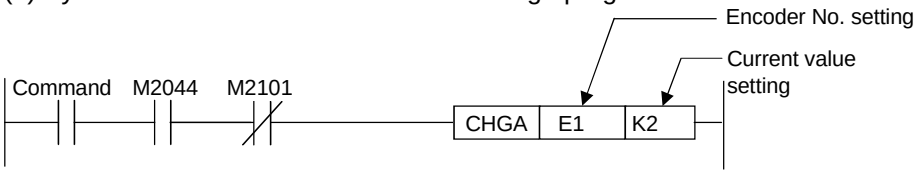
(2) Virtual servo motor speed change program



REMARKS

(1) M2001: Start accept flag {see section 4.1.8 (2)}
(2) M2044: REAL mode/VIRTUAL mode status flag {see section 4.1.8 (8)}
(3) M2061: Speed change in progress flag {see section 4.1.8 (19)}

(3) Synchronous encoder current value change program



(a) The change in the current value and speed are set using the devices described below.

- Indirect setting.....Data register (D), Link register (W), File register (R) } Double word
- Direct setting.....Decimal constant (K)

(b) The encoder No. setting range is described below.

- E1 to E2

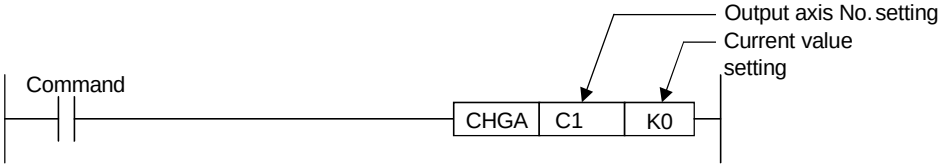
(c) Precautions

- When a synchronous encoder current value change is carried out in the REAL mode, an error will occur and the current value change will not be carried out.
- A synchronous encoder current value change can be executed in the VIRTUAL mode even while operation is in progress (during pulse input from the synchronous encoder).
  When the current value is changed the synchronous encoder feed current value will be continued from the changed value.
- Even if a synchronous encoder current value change is carried out, it will have no effect on the output module current value.

REMARK

(1) M2044: REAL mode/VIRTUAL mode status flag {see section 4.1.8 (8)}
M2101: Synchronous encoder current value change in progress flag {see section 4.1.8 (20)}

(4) Cam axis current value change in one revolution program (when cam axis 1 is used)



(a) The change in the current value and speed are set using the devices described below.

- Indirect setting.....Data register (D), Link register (W), File register (R) } Double word
- Direct setting.....Decimal constant (K)

(b) The cam axis No. setting range is described below.

- 1 to 32

(c) Precautions

- If the current value that has been changed is out of the one revolution range {0 – (number of PULSES per revolution –1)}, an error will result (error code: 6120) and the current value change will not be carried out.

10.2 Improved Current Value Management

By adding the functions described below, current 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 3.5ms 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 current value history monitor has enabled monitoring of the following data at a peripheral device.

- Encoder current value/servo command value/monitor current value when the power is switched ON.
- Encoder current value/servo command value/monitor current value when the power is switched OFF.
- Encoder current value/servo command value/monitor current 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.

<table>
<tr><th>Positioning OS Version</th><th>Positioning Software Package Version</th><th>Restrictions</th></tr>
<tr><td rowspan="2">V or later</td><td>R or later (Note-1)</td><td>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.)</td></tr>
<tr><td>Q or earlier (Note-2)</td><td>• Current 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 zeroing. (Note-3)</td></tr>
<tr><td rowspan="2">U or earlier</td><td>R or later (Note-1)</td><td rowspan="2">None of the function upgrades can be used</td></tr>
<tr><td>Q or earlier (Note-2)</td></tr>
</table>

(Note-1): Allowable travel while the power is OFF can be set.

(Note-2): Allowable travel while the power is OFF cannot be set.

(Note-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-BN: BCD-B13W000-B2 or later MR-J2S-B: All models 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-BN: BCD-B13W000-B1 or earlier MR-J2-B: BCD-B20W200-A0 or earlier 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 current value.)
	Q or earlier	None of the function upgrades can be used.

11. 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 error occurrence program is recorded in the error program No. storage 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 error..... These errors are caused by the sequence program or servo program. The error code range for these errors is 1 to 999 for drive modules, and 4000 to 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 to 1999 for drive modules, and 10000 to 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 to 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 to 99	4000 to 4990
	At START	100 to 199	5000 to 5990
	During operation	200 to 299	6000 to 6990
	At control change	300 to 399	—
Major error	At START	1000 to 1099	10000 to 10990
	During operation	1100 to 1199	11000 to 11990
	System	—	—
		—	15000 to 15990
Servo error	Servo amplifier	—	2000 to 2799 (2100 to 2499 are warnings)
	Servo power supply module		2800 to 2999 (2900 to 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 storage register.

		Error Code Storage 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 Storage 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 Storage 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

(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

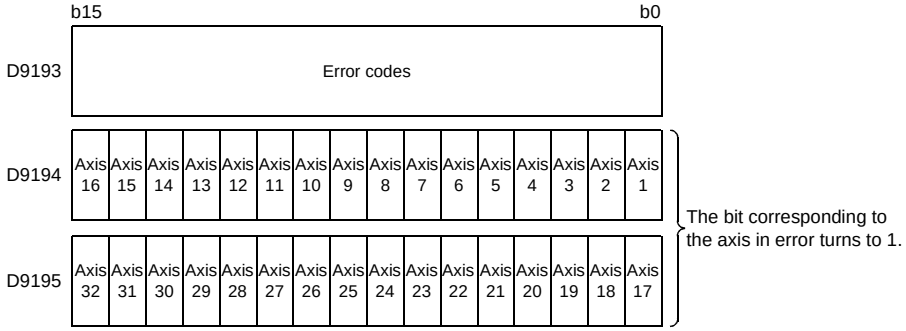
(1) When a servo error occurs, there are cases where the same servo error code will be stored again even after a servo error reset (M3208+20n: ON) is executed.
(2) When a servo error occurs, eliminate the error cause, then execute a servo error reset.

(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 current mode will be maintained.
- The REAL/VIRTUAL mode switching error detection flag (M2045) switches ON.
- The corresponding error code will be stored in the REAL/VIRTUAL mode switching error information register (D9193 to D9195).

POINT

(1) The error codes stored in the D9193 to D9195 storage registers which apply to axis errors are shown below.



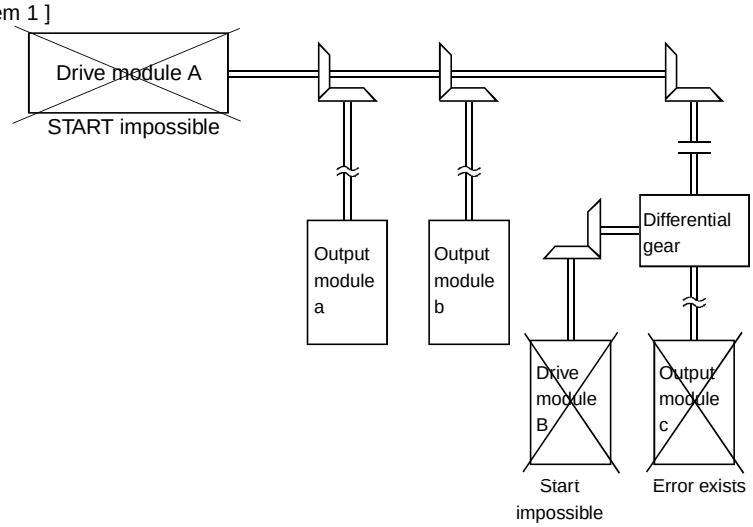
11. ERROR CODES STORED AT THE PCPU

11.1 Related Systems & Error Processing

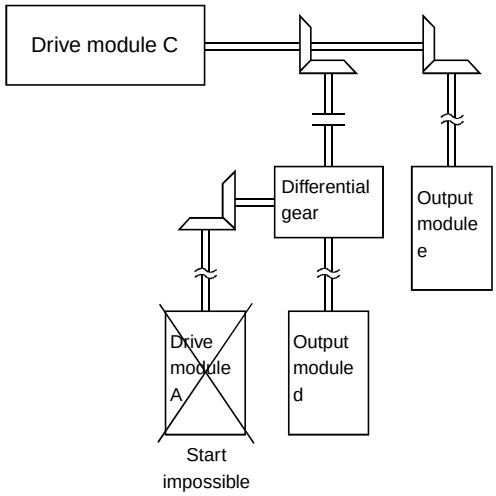
The following 2 types of related systems exist in the VIRTUAL mode.
(1) System consisting of a drive module and output module.
(2) Multiple systems using the same drive module.

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.

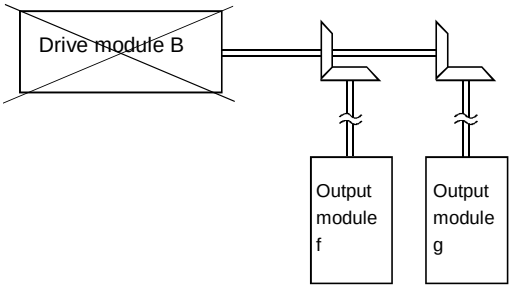
[System 1]



[System 2]



[System 3]



(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.

11.2 Servo Program Setting Errors

The error codes, error descriptions, and corrective actions for servo program setting errors are shown in Table 11.1 below. The "n" in the asterisked error codes in Table 11.1 indicates the axis number (1 to 32).

Table 11.1 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 to 64 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 to 64 range.</td></tr>
<tr><td>n03*</td><td>Address/travel value setting error (excluding speed control)</td><td>At incremental method positioning control, the travel value setting is as follows: -2147483648 (H80000000)</td><td>(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>The travel value setting should be designated with a 0 to ±2147483647 range.</td></tr>
<tr><td>4</td><td>Commanded speed error</td><td>(1) The commanded speed violated the "1 to speed limit" range.
(2) The commanded speed violated the setting range.<table><tr><td>System-of-units</td><td colspan="2">Address setting range</td></tr><tr><td>PULSE</td><td>1 to 1000000</td><td>PLS/s</td></tr></table></td><td>(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>(1) Designate the commanded speed with the "1 to speed limit" range.</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>n08*</td><td>Auxiliary point setting error (at auxiliary point designation at circular interpolation)</td><td>In incremental method positioning control, the auxiliary point setting is as follows: -2147483648 (H80000000)</td><td>START is disabled.</td><td>The auxiliary point setting should be designated within the range 0 to ±2147483647.</td></tr>
<tr><td>n09*</td><td>Radius setting error (radius setting for circular interpolation)</td><td>In incremental method positioning control, the radius setting is as follows: -2147483648 (H80000000)</td><td>START is disabled.</td><td>The radius setting should be designated within the range 0 to ±2147483647.</td></tr>
</table>

Table 11.1 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>n10*</td><td>Center point setting error (center point setting for circular interpolation)</td><td>At incremental method positioning control, the center point setting is as follows: −2147483648 (H80000000)</td><td>START is disabled.</td><td>The center point setting should be designated within the range 0 to ± 2147483647.</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 PLS/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>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>Address setting range</th></tr><tr><td>PULSE</td><td>0 to 10000000</td></tr></table></td><td>The default value of "100 PLS" 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>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></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></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 the reference 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 to 100% range.</td><td>An S-curve ratio of "100%" is adopted.</td><td>Designate an S-curve ratio within the 0 to 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.</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 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 instruction is different from that designated by servo program.</td><td>START is disabled.</td><td>Designate the correct axis No.</td></tr>
</table>

Table 11.1 Servo Program Setting Error List (Continued)

Error Codes Stored at D9190	Error Name	Description	Error Processing	Corrective Action
902	Servo program instruction code error	The instruction code at the designated servo program cannot be decoded due to an instruction code error.	START is disabled.	Read out the servo program, check it, and make the necessary corrections.
903	START error	A VIRTUAL mode program was started when in the REAL mode.	START is disabled.	Check the program's mode allocation.
904	START error	A REAL mode program was started when in the VIRTUAL mode.	START is disabled.	Check the program's mode allocation.
905	START error	An instruction that cannot be executed in the VIRTUAL mode (VPF, VPR, VPSTART, ZERO, VVF, VVR, OSC) was designated.	START is disabled.	Correct the servo program.
906	START error	An axis listed as "not used" was designated while in the VIRTUAL mode.	START is disabled.	Designate the correct axis No. at the system settings.
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.	START is disabled.	

11.3 Drive Module Errors

Table 11.2 Drive Module Error List (100 to 1199)

Error Class	Error Code	Virtual Servo Axis Control Item										Error Cause	Processing	Corrective Action
		Positioning	Fixed pitch Feed	Speed	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Synchronous Encoder	Position Follow-Up				
Minor Errors	100	○	○	○	○	○	○	○		○		• The PLC READY (M2000) or PCPU READY completed (M9074) signal is OFF.	START is disabled.	• Set the servo system CPU to RUN. • Switch the PLC READY (M2000) signal ON.
	101	○	○	○	○	○	○	○		○		• The relevant axis' "START accept" signal (M2001 to 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 (M4800+20n) is ON.		• Switch the stop command (M4800+20n) OFF, then execute a START.
	104	○	○	○	○	○	○	○		○		• The relevant axis' rapid stop command (M4801+20n) is ON.		• Switch the stop command (M4801+20n) OFF, then execute a START.
	105	○				○				○		• On starting, the feed current 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 current 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 produces 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.

* : During interpolation operations, this error code is stored at all relevant interpolation axis storage areas.

Table 11.2 Drive Module Error List (100 to 1199) (Continued)

Error Class	Error Code	Virtual Servo Axis Control Item										Error Cause	Processing	Corrective Action
		Positioning	Fixed pitch Feed	Speed	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Synchronous Encoder	Position Follow-Up				
Minor Errors	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.
	151	○	○	○	○	○	○	○				• In the VIRTUAL mode, 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 PLC 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 PLC READY (M2000) signal ON.
	204	○	○	○	○	○	○	○	○	○		• The PLC READY (M2000) signal was switched ON again during a deceleration to stop which was occurring in response to the PLC READY (M2000) signal being switched OFF.	Ignored	• After all axes have stopped, switch the PLC READY (M2000) signal ON. (PLC READY (M2000) OFF→ON switching during a deceleration to stop is ignored.)
	207	○				○				○		• The feed current 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 current 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 in puts are ignored until a stop occurs.	• Execute manual pulse generator operation after the axis motion has stopped.

Table 11.2 Drive Module Error List (100 to 1199) (Continued)

Error Class	Error Code	Virtual Servo Axis Control Item										Error Cause	Processing	Corrective Action
		Positioning	Fixed pitch Feed	Speed	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Synchronous Encoder	Position Follow-Up				
Minor Errors	215				○							• The address of the speed switching point exceeds the END point address.	Rapid stop occurs.	• Designate the speed switching point somewhere between the previous speed switching point address and the END point address.
												• An address was designated which causes opposite direction positioning during speed switching control.		
												• 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 to 35999999 range.
												• The address designated for position follow-up control is outside the stroke limit range.		• Set the address in the stroke limit range.
	225					○						• During constant speed control, the speed at an intermediate point violated the speed limit value.	Operation occurs at the speed limit speed.	• Designate speed within the "1 to speed limit value" range.
	300	○	○	○	○	○	○	○		○		• A current value change was designated while motion was in progress at the relevant axis.	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 to M2032) OFF. (2) Servo START signal (M2415+20n) ON.
												• A current value change was designated at an axis which hasn't been started.		
												• A current value change was designated at an axis where the servo is OFF.		
	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 (M4802+20n, M4803+20n) being switched OFF.		• Do not make speed changes during deceleration which is occurring in response to the JOG START signal(M4802+20n, 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	• Designated the post-change speed within the "0 to speed limit value" range.
		○	○	○		○						• The absolute value of the speed following a speed change violated the "0 to speed limit value" range.	Operation will occur at the speed limit speed.	• Designated the absolute value of the post-change speed within the "0 to speed limit value" range.
	309											• Current 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								○			• A273EX/A172SENC or encoder hardware fault	Immediate input stop	• Check the A273EX/ A172SENC or the encoder (H/W replacement).
												• Discontinuity in encoder cable		• Check the encoder cable.
	1152								○			• Low voltage at A273EX battery.	Operation is continued.	• Replace the battery.
	1153								○			• No battery or disconnected battery at A273EX.		• Replace battery, or check the hardware at the A273EX

11.4 Servo Errors

Servo errors are classified into servo amplifier errors and servo power supply module errors.
You can set to each system what processing will be performed at servo error detection. (Only servo errors detected by the ADU (when the A273UHCPU is used))
Set the processing and system in the system settings of the peripheral device.

	Setting	Control Exercised
1	System-based servo OFF (Default)	• If a servo error occurs at any one ADU axis, all axes in that system result in servo off. (Same control as at servo-off of all axes is exercised.)
2	Only own-axis servo off	• Only the ADU axis where a servo error occurred results in servo off and the other axes are not affected. • Note that: 1) For the type which has two axes in one module, both axes result in servo off even at occurrence of a servo error at one axis. 2) Occurrence of any of the following servo errors will result in a system-based servo off status. Overcurrent (2032) Undervoltage (2810) Overregeneration (2830) Overvoltage (2833) Amplifier power supply overheat (2847)

(1) Servo amplifier errors (2000 to 2799)

The servo amplifier errors are errors detected by the servo amplifier and are assigned error codes 2000 to 2799.
In the following tables, the types of servo amplifier are indicated for ADU and for MR-□-B.
For the servo amplifier types, the ADU is abbreviated to Ⓐ and the MR-□-B as Ⓜ.
The servo error detection signal (M2408+20n) comes ON when a servo error occurs. Eliminate the cause of the error, reset the error by turning ON the servo error reset signal (M3208+20n), and reset operation. (Note that the servo error detection signal will not come ON in response to error codes in the range 2100 to 2499 because these codes are for warnings.)
(Note-1): When an excessive regeneration error (code 2030), or overload 1 or 2 error (codes 2050, 2051) occurs, the state that applied when the error occurred is stored in the servo amplifier even after the protection circuit has operated. The memory contents are cleared if the external power supply is turned OFF, but are not cleared by the reset signal.
(Note-2): Repeated resetting by turning OFF the external power supply after occurrence of error code 2030, 2050, or 2051, may cause devices to be destroyed by overheating. Only restart operation after eliminating the cause of the error.
Details of servo errors are given in Table 11.3.

⚠ CAUTION

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

11. ERROR CODES STORED AT THE PCPU

Table 11.3 Servo Amplifier Error List (2000 to 2799)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2010	Ⓐ	P-N non-wiring	• P-N of the servo power supply module are not wired to P-N of the ADU.	At any time during operation.	Immediate stop	• Reconsider wiring.
	Ⓜ	Low voltage	• The power supply voltage is less than 160 VAC. (320VAC or less for 400VAC series servo) • A momentary power, interruption of 15ms or longer has occurred. • The power supply voltage dropped, for example when motion control started, due to insufficient power capacity.			• Measure the input voltage (R, S, T) with a voltmeter. • Monitor with an oscilloscope to check whether a momentary power interruption has occurred. • Review the power capacity.
2012	Ⓐ	Internal memory alarm	• ADU's SRAM fault.	• At power-on of servo amplifier		• Change the ADU.
	Ⓜ	Memory error 1	• Servo amplifier SRAM is faulty. • Servo amplifier EPROM check sum error.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2013	Ⓜ	Clock error	• Servo amplifier clock fault.	At any time during operation		• Replace the servo amplifier.
2014	Ⓐ	Watchdog	• Servo control system fault • ADU fault			• Reset and recheck the servo system CPU. • Change the ADU.
	Ⓜ		• Servo amplifier hardware fault • Servo system CPU hardware fault			• Replace the servo amplifier. • Replace the servo system CPU.
2015	Ⓐ	2-port memory alarm	• ADU's 2-port memory fault.	• At power-on of servo amplifier • At servo error reset		• Reset and recheck the servo system CPU. • Change the ADU.
	Ⓜ	Memory error 2	• Servo amplifier EEPROM fault	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2016	Ⓐ	Encoder error 1	• At initialization, communication with encoder is not normal. • The encoder type (ABS/INC) set in system settings differs from the actual encoder type.	• At power-on of servo amplifier • At servo error reset		• Reset and recheck the servo system CPU. • Change the servo motor (encoder). • Reconsider the system settings.
	Ⓜ		• Fault in communication with the encoder	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Check the encoder cable connector for disconnection. • Change the servo motor. • Change the encoder cable. • Check the combination of encoder cable type (2-wire/4-wire type) and servo parameter.
2017	Ⓐ	PCB error	• ADU's analog-to-digital converter is faulty.	• At power-on of servo amplifier • At servo error reset		• Reset and recheck the servo system CPU. • Change the ADU.
	Ⓜ		• Faulty device in the servo amplifier PCB.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2019	Ⓜ	Memory error 3	• Servo amplifier flash ROM check sum error	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2020	Ⓐ	Encoder error 2	• During operation, communication with the encoder is not normal.	At any time during operation	Immediate stop	• Check wiring between the encoder and ADU. • Change the servo motor (encoder).
	Ⓜ		• Fault in communication with the encoder			• Check the encoder cable connector for disconnection. • Change the servo motor. • Change the encoder cable.
2021	Ⓜ	Converter RD off (400VAC series servo only)	• The servo-on (SON) signal turned ON when the ready signal (RD) of the converter is OFF. 1. Bus voltage is low. 2. Alarm occurring in converter.			• Remove the cause of the converter alarm. Deactivate the alarm.
2024	Ⓜ	Output ground fault	• U, V, or W of the servo amplifier output grounded			• Check if the servomoton and cable have been grounded. • Correct the grounded. • Replace the servomotor.
2025	Ⓐ	Absolute position erase	• In the absolute value encoder, the voltage of the super capacitor in the encoder is less than 2.5±0.2V. • In the absolute value encoder, speed was 500rpm or higher during a power failure.	• At power-on of servo amplifier • At servo error reset		• Change the battery (MR-JBAT□). • Check the wiring encoder for all ADU.
	Ⓜ	Battery alarm	• The voltage of the supercapacitor inside the absolute value encoder has dropped.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Turn the power ON for 2 to 3 minutes to charge the supercapacitor, switch the power OFF then ON again, and execute a zeroing.
			• The battery voltage is low.			• Turn the servo amplifier power OFF, then measure the battery voltage.
			• Failure of battery cable or battery. (Zeroing must be re-executed after clearing the error.)			• Replace the servo amplifier battery.
2026	Ⓐ	Module mismatch	• The servo parameter (system settings) does not match the real servo amplifier.	• At power-on of servo amplifier • At servo error reset		• Reconsider the system settings.
2030	Ⓜ	Excessive regeneration	• The frequency of ON/OFF switching of the power transistor for regeneration is too high. (Caution is required since the regenerative resistor could overheat.)	At any time during operation		• Reduce the frequency of acceleration and deceleration or feed speed while checking the servo monitor regeneration level (%). • Reduce the load. • Increase the servomotor capacity.
			• Servo parameter (system settings) setting error			• Check the servo parameters (regenerative resistor and motor type settings in the system settings).
			• Incorrect wiring of regenerative resistor			• Connect the regenerative resistor correctly.
			• Failure of regenerative resistor			• Replace the regenerative resistor.
			• Power transistor for regeneration damaged by short circuit			• Replace the servo amplifier.
2031	Ⓐ	Overspeed	• The command speed is too high.			• Reconsider the command speed.
			• Overshoot occurred during acceleration.			• Reconsider the servo parameter.
			• Encoder fault.			• Change the encoder.
			• Encoder cable fault or wiring mistake.			• Check the wiring between encoder and ADU.
	Ⓜ		• The motor rpm has exceeded 115% of the rated rpm.			• Check the motor rpm in the servo parameters. • Check if the number of pulses per revolution and travel value per revolution in the fixed parameters match the machine specifications.
			• An overshoot has occurred because the acceleration time constant is too small.			• If an overshoot occurs during acceleration, check the acceleration time and deceleration time in the fixed parameters.
			• An overshoot has occurred because the servo system is unstable.			• If overshoot occurs, increase the speed integral compensation by adjusting the position loop gain / position control gain 1, 2, speed loop gain / speed control gain 1, 2 in the servo parameters.
			• Encoder fault.			• Check the encoder cable for wire breakage. • Change the servo motor.

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2032	Ⓐ	Overcurrent	• The servo motor connected is not as set.	• At power-on of servo amplifier • At servo error reset	Immediate stop	• Reconsider the system settings.
			• The U, V, and W phases of the ADU output resulted in a short circuit or ground fault.			• Check the servo motor cable.
			• Wiring mistake of the U, V, and W phases of the ADU output.			• Correct the servo motor wiring.
			• Damage to the ADU's transistor module. • ADU fault.			• Change the ADU.
			• Coupling fault of servo motor and encoder.			• Change the servo motor.
			• The servo motor oscillated.			• Reconsider the servo parameters.
	Ⓜ		• U, V, W in the servo amplifier outputs have short circuited with each other.	At any time during operation		• Check if there is a short circuit between U, V, W of the servo amplifier outputs.
			• U, V, W in the servo amplifier outputs have shorted to ground.			• Check if U, V, W of the servo amplifier outputs have been grounded to the ground terminal. Check if U, V, W of the servomotor are grounded to the core. If grounding is found, replace the servo amplifier and/or motor.
			• Incorrect wiring of U, V, W phases in the servo amplifier outputs.			• Correct the wiring.
			• The servo amplifier transistor is damaged.			• Replace the servo amplifier.
			• Failure of coupling between servomotor and encoder			• Replace the servomotor.
			• Encoder cable failure			• Replace the encoder cable.
			• A servomotor that does not match the setting has been connected.			• Check the connected motor set in the system settings.
			• The servomotor oscillated.			• Check and adjust the gain value set in the servo parameters.
			• Noise entered the overcurrent detection circuit.			• Check if any relays or valves are operating in the vicinity.
2033	Ⓜ	Overvoltage	• The converter bus voltage has reached 400 V or more. (800VAC or more for 400VAC series servo) • The frequency of acceleration and deceleration was too high for the regenerative ability. • The regenerative resistor has been connected incorrectly.			• Increase the acceleration time and deceleration time in the fixed parameters. • Check the connection between C and P of the terminal block for the terminal block for regenerative resistance.
			• The regenerative resistor in the servo amplifier is destroyed.			• Measure between C and P of the terminal block for regenerative resistance with a multimeter; if abnormal, replace the servo amplifier. (Measure about 3 minutes after the charge lamp has gone out.)
			• The power transistor for regeneration is damaged.			• Replace the servo amplifier.
			• The power supply voltage is too high.			• Measure the input voltage (R, S, T) with a voltmeter.
2034	Ⓜ	Communications error	• Error in data received from the servo system CPU			• Check the connection of the motion bus cable. • Check if there is a disconnection in the motion us cable. • Check if the motion bus cable is clamped correctly.

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

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

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2050	Ⓐ	Overload	• The rated current of the servo motor is exceeded. • Reduce the load. • Hunting due to parameter setting mistake.	At any time during operation	Immediate stop	• Load inertia or friction is too large. • Reconsider the servo parameters.
	Ⓜ	Overload 1	• An overload current of about 200% has been continuously supplied to the servo amplifier and servomotor.			• Check if there has been a collision at the machine. • If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load. • If hunting occurs, adjust the position loop gain in the servo parameters. • Check the connection of U, V, W of the servo amplifier and servomotor. • Check for disconnection of the encoder cable. • Replace the servomotor.
2051	Ⓜ	Overload 2	• The servo amplifier and servomotor were overloaded at a torque close to the maximum torque (95% or more of the current control value).			• Check if there has been a collision at the machine. • If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load. • If hunting occurs, adjust the position loop gain / position control gain 1, 2, speed loop gain/ speed control gain 1, 2 in the servo parameters. • Check the connection of U, V, W of the servo amplifier and servomotor. • Check for disconnection of the encoder cable. • Replace the servomotor. • If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier.

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2052	Ⓐ	Excessive error	• The deviation counter value exceeded the specified value. • Inertia is too large to make enough acceleration.	At any time during operation	Immediate stop	• Reconsider the servo parameters.
			• Encoder or cable fault.			• Change the encoder or cable.
	Ⓜ		• The droop pulses of the deviation counter exceeded the error excessive alarm level set in the servo parameters.			• Check if there has been a collision at the machine. • Increase the time constant for acceleration and deceleration. • Increase the position loop gain / position control gain 1, 2, in the servo parameters. • Check the encoder cable for wire breakage. • Replace the servomotor. • If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier.
2057	Ⓐ	Hardware alarm	• ADU hardware fault.			• Change the ADU.
2086	Ⓜ	RS232 communication error	• Parameter unit communication error		Operation continues	• Check for disconnection of the parameter unit cable. • Replace the parameter unit.
2102	Ⓐ	Battery warning	• The absolute value encoder battery voltage dropped.			• Change the battery (MR-JBAT-□).
	Ⓜ		• The voltage of the battery installed in the servo amplifier has become low.			• Replace the battery.
2103	Ⓜ	Battery disconnection warning	• The power supply voltage to the absolute position sensor has become low.			• Replace the battery. • Check the encoder cable for wire breakage. • Replace the servomotor. • Replace the servo amplifier.
2140	Ⓜ	Excessive regeneration warning	• An excessive regeneration error (2030) is likely to occur (regeneration of 85% of the maximum load capacity for the regenerative resistor has been detected).			• Refer to the details on the excessive regeneration error (2030).
2141	Ⓐ	Overload warning	• The 80% level of the overload error (2050) level was detected.			• Refer to details of the overload error (2050).
	Ⓜ		• An overload error (2050, 2051) is likely to occur (85% of overload level detected).			• Refer to the details on the overload errors (2050, 2051).
2143	Ⓐ	Absolute value counter warning	• Encoder fault.			• Change the encoder.
2146	Ⓜ	Servo emergency stop	• The connection between 1A and 1B (emergency stop input) of CN6 of the servo amplifier encoder has been broken.			• Establish a short circuit between 1A and 1B of CN6 of the servo amplifier encoder.
2147	Ⓐ	Emergency stop	• Brought to an emergency stop.		Immediate stop	• Release the emergency stop.
	Ⓜ		• An emergency stop (EMG) signal has been input from the servo system CPU.			
2149	Ⓜ	Main circuit OFF warning	• The servo ON (SON) signal was turned ON while the contactor was OFF. • The main circuit bus voltage fell to 215 V or lower at 50 rpm or lower.		Operation continues	• Turn the main circuit contactor or circuit power supply ON.
2196	Ⓜ	Home position setting error warning	• After a home position set command, the droop pulses did not come within the in-position range.			• Re-attempt zeroing.

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2201
to
2224</td><td>Ⓐ</td><td>Parameter warning</td><td>• The parameter that was set is unauthorized.<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 rotation torque limit value</td></tr><tr><td>2210</td><td>Reverse rotation 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>Error excessive 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 zone compensation</td></tr><tr><td>2219</td><td>Feed forward gain</td></tr><tr><td>2220</td><td>Unbalance torque compensation</td></tr><tr><td>2221</td><td>Dither command</td></tr><tr><td>2222</td><td>Gain operation time</td></tr><tr><td>2223</td><td>Servo response level setting</td></tr><tr><td>2224</td><td>—</td></tr></table></td><td>At any time during operation</td><td>Operation continues</td><td>• Reconsider the system settings and servo parameters.</td></tr>
</table>

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2336</td><td>Ⓜ</td><td>Parameter alarm</td><td>• The servo parameter value is outside the setting range. (Any unauthorized parameter is ignored and the value before setting is retained.)<table>
<tr><td>2301</td><td>Amplifier setting</td></tr>
<tr><td>2302</td><td>Regenerative resistance</td></tr>
<tr><td>2303</td><td>Motor type</td></tr>
<tr><td>2304</td><td>Motor capacity</td></tr>
<tr><td>2305</td><td>Motor rpm</td></tr>
<tr><td>2306</td><td>Number of feedback pulses</td></tr>
<tr><td>2307</td><td>Rotating direction setting</td></tr>
<tr><td>2308</td><td>Automatic tuning setting</td></tr>
<tr><td>2309</td><td>Servo responsibility</td></tr>
<tr><td>2310</td><td>Torque limit (forward)</td></tr>
<tr><td>2311</td><td>Torque limit (reverse)</td></tr>
<tr><td>2312</td><td>Load inertia ratio</td></tr>
<tr><td>2313</td><td>Position control gain 1</td></tr>
<tr><td>2314</td><td>Speed control gain 1</td></tr>
<tr><td>2315</td><td>Position control gain 2</td></tr>
<tr><td>2316</td><td>Speed control gain 2</td></tr>
<tr><td>2317</td><td>Speed integral compensation</td></tr>
<tr><td>2318</td><td>Notch filter</td></tr>
<tr><td>2319</td><td>Feed forward coefficient</td></tr>
<tr><td>2320</td><td>In-position range</td></tr>
<tr><td>2321</td><td>Electromagnetic brake sequence output</td></tr>
<tr><td>2322</td><td>Monitor output mode selection</td></tr>
<tr><td>2323</td><td>Optional function 1</td></tr>
<tr><td>2324</td><td>Optional function 2</td></tr>
<tr><td>2325</td><td>Optional function 3</td></tr>
<tr><td>2326</td><td>Optional function 4</td></tr>
<tr><td>2327</td><td>Monitor output 1 offset</td></tr>
<tr><td>2328</td><td>Monitor output 2 offset</td></tr>
<tr><td>2329</td><td>Pre-alarm data selection</td></tr>
<tr><td>2330</td><td>Zero speed</td></tr>
<tr><td>2331</td><td>Excessive error alarm level</td></tr>
<tr><td>3232</td><td>Optional function 5</td></tr>
<tr><td>3233</td><td>Optional function 6</td></tr>
<tr><td>2334</td><td>PI-PID switching position droop</td></tr>
<tr><td>2335</td><td>Torque limit compensation factor</td></tr>
<tr><td>2336</td><td>Speed integral compensation (actual speed differential compensation)</td></tr>
</table></td><td>At any time during operation</td><td>Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
</table>

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2324</td><td>Ⓐ</td><td>Parameter alarm</td><td>• The servo parameter value is outside the setting range. (Any unauthorized parameter is ignored and the value before setting is retained.)<table><tr><td>2301</td><td>Amplifier setting</td></tr><tr><td>2302</td><td>Motor type</td></tr><tr><td>2303</td><td>Motor capacity</td></tr><tr><td>2304</td><td>Number of feedback pulses</td></tr><tr><td>2305</td><td>In-position range</td></tr><tr><td>2306</td><td>Position control gain 2 (actual position gain)</td></tr><tr><td>2307</td><td>Speed control gain 2 (actual speed gain)</td></tr><tr><td>2308</td><td>Speed integral compensation</td></tr><tr><td>2309</td><td>Forward rotation torque limit value</td></tr><tr><td>2310</td><td>Reverse rotation torque limit value</td></tr><tr><td>2311</td><td>Emergency stop time delay</td></tr><tr><td>2312</td><td>Position control gain 1 (model position gain)</td></tr><tr><td>2313</td><td>Speed control gain 1 (model speed gain)</td></tr><tr><td>2314</td><td>Load inertia ratio</td></tr><tr><td>2315</td><td>Error excessive alarm level</td></tr><tr><td>2316</td><td>Special compensation processing</td></tr><tr><td>2317</td><td>Special servo processing</td></tr><tr><td>2318</td><td>Td dead zone compensation</td></tr><tr><td>2319</td><td>Feed forward gain</td></tr><tr><td>2320</td><td>Unbalance torque compensation</td></tr><tr><td>2321</td><td>Dither command</td></tr><tr><td>2322</td><td>Gain operation time</td></tr><tr><td>2323</td><td>Servo response level setting</td></tr><tr><td>2324</td><td>—</td></tr></table></td><td>At any time during operation</td><td rowspan="2">Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
<tr><td>2500</td><td>Ⓐ</td><td>Parameter alarm</td><td>Among the servo parameters, any of the following items is unauthorized.
• Amplifier
• External regenerative brake resistor setting
• Motor type
• Motor capacity</td><td>• At power-on of servo amplifier
• At servo error reset</td><td>• Reconsider the system settings and servo parameters.</td></tr>
</table>

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2501
to
2524</td><td>Ⓐ</td><td>Parameter alarm</td><td>• The parameter that was set is unauthorized.<table><tr><td>2501</td><td>Amplifier setting</td></tr><tr><td>2502</td><td>Motor type</td></tr><tr><td>2503</td><td>Motor capacity</td></tr><tr><td>2504</td><td>Number of feedback pulses</td></tr><tr><td>2505</td><td>In-position range</td></tr><tr><td>2506</td><td>Position control gain 2 (actual position gain)</td></tr><tr><td>2507</td><td>Speed control gain 2 (actual speed gain)</td></tr><tr><td>2508</td><td>Speed integral compensation</td></tr><tr><td>2509</td><td>Forward rotation torque limit value</td></tr><tr><td>2510</td><td>Reverse rotation torque limit value</td></tr><tr><td>2511</td><td>Emergency stop time delay</td></tr><tr><td>2512</td><td>Position control gain 1 (model position gain)</td></tr><tr><td>2513</td><td>Speed control gain 1 (model speed gain)</td></tr><tr><td>2514</td><td>Load inertia ratio</td></tr><tr><td>2515</td><td>Error excessive alarm level</td></tr><tr><td>2516</td><td>Special compensation processing</td></tr><tr><td>2517</td><td>Special servo processing</td></tr><tr><td>2518</td><td>Td dead zone compensation</td></tr><tr><td>2519</td><td>Feed forward gain</td></tr><tr><td>2520</td><td>Unbalance torque compensation</td></tr><tr><td>2521</td><td>Dither command</td></tr><tr><td>2522</td><td>Gain operation time</td></tr><tr><td>2523</td><td>Servo response level setting</td></tr><tr><td>2524</td><td>—</td></tr></table></td><td>• At power-on of servo amplifier
• On PLC ready (M2000) leading edge
• At servo error reset</td><td>Operation continues</td><td>• Reconsider the system settings and servo parameters.</td></tr>
</table>

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2601
to
2636</td><td>Ⓜ</td><td>Initial parameter alarm</td><td>• The parameter setting is wrong.
• The parameter data was corrupted.
<table><tr><td>2601</td><td>Amplifier setting</td></tr><tr><td>2602</td><td>Regenerative resistance</td></tr><tr><td>2603</td><td>Motor type</td></tr><tr><td>2604</td><td>Motor capacity</td></tr><tr><td>2605</td><td>Motor rpm</td></tr><tr><td>2606</td><td>Number of feedback pulses</td></tr><tr><td>2607</td><td>Rotating direction setting</td></tr><tr><td>2608</td><td>Automatic tuning setting</td></tr><tr><td>2609</td><td>Servo responsibility</td></tr><tr><td>2610</td><td>Torque limit (forward)</td></tr><tr><td>2611</td><td>Torque limit (reverse)</td></tr><tr><td>2612</td><td>Load inertia ratio</td></tr><tr><td>2613</td><td>Position control gain 1</td></tr><tr><td>2614</td><td>Speed control gain 1</td></tr><tr><td>2615</td><td>Position control gain 2</td></tr><tr><td>2616</td><td>Speed control gain 2</td></tr><tr><td>2617</td><td>Speed integral compensation</td></tr><tr><td>2618</td><td>Notch filter</td></tr><tr><td>2619</td><td>Feed forward coefficient</td></tr><tr><td>2620</td><td>In-position range</td></tr><tr><td>2621</td><td>Electromagnetic brake sequence output</td></tr><tr><td>2622</td><td>Monitor output mode selection</td></tr><tr><td>2623</td><td>Optional function 1</td></tr><tr><td>2624</td><td>Optional function 2</td></tr><tr><td>2625</td><td>Optional function 3</td></tr><tr><td>2626</td><td>Optional function 4</td></tr><tr><td>2627</td><td>Monitor output 1 offset</td></tr><tr><td>2628</td><td>Monitor output 2 offset</td></tr><tr><td>2629</td><td>Pre-alarm data selection</td></tr><tr><td>2630</td><td>Zero speed</td></tr><tr><td>2631</td><td>Excessive error alarm level</td></tr><tr><td>3632</td><td>Optional function 5</td></tr><tr><td>3633</td><td>Optional function 6</td></tr><tr><td>2634</td><td>PI-PID switching position droop</td></tr><tr><td>2635</td><td>Torque limit compensation factor</td></tr><tr><td>2636</td><td>Speed integral compensation (real speed differential compensation)</td></tr></table></td><td>• At power-on of servo amplifier
• On PLC ready (M2000) leading edge
• At servo error reset
• At power-on of servo system CPU</td><td>Immediate stop</td><td>• After checking and correcting the parameter setting, turn the servo system CPU power OFF, then ON, reset the servo system CPU with the key, or turn PLC ready (M2000) OFF, then ON.</td></tr>
</table>

Table 11.3 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2601
to
2624</td><td>Ⓐ</td><td>Initial parameter alarm</td><td>• The parameter setting is wrong.
• The parameter data was corrupted.<table><tr><td>2601</td><td>Amplifier setting</td></tr><tr><td>2602</td><td>Motor type</td></tr><tr><td>2603</td><td>Motor capacity</td></tr><tr><td>2604</td><td>Number of feedback pulses</td></tr><tr><td>2605</td><td>In-position range</td></tr><tr><td>2606</td><td>Position control gain 2 (actual position gain)</td></tr><tr><td>2607</td><td>Speed control gain 2 (actual speed gain)</td></tr><tr><td>2608</td><td>Speed integral compensation</td></tr><tr><td>2609</td><td>Forward rotation torque limit value</td></tr><tr><td>2610</td><td>Reverse rotation torque limit value</td></tr><tr><td>2611</td><td>Emergency stop time delay</td></tr><tr><td>2612</td><td>Position control gain 1 (model position gain)</td></tr><tr><td>2613</td><td>Speed control gain 1 (model speed gain)</td></tr><tr><td>2614</td><td>Load inertia ratio</td></tr><tr><td>2615</td><td>Error excessive alarm level</td></tr><tr><td>2616</td><td>Special compensation processing</td></tr><tr><td>2617</td><td>Special servo processing</td></tr><tr><td>2618</td><td>Td dead zone compensation</td></tr><tr><td>2619</td><td>Feed forward gain</td></tr><tr><td>2620</td><td>Unbalance torque compensation</td></tr><tr><td>2621</td><td>Dither command</td></tr><tr><td>2622</td><td>Gain operation time</td></tr><tr><td>2623</td><td>Servo response level setting</td></tr><tr><td>2624</td><td>—</td></tr></table></td><td>• At power-on of servo amplifier
• On PLC ready (M2000) leading edge
• At servo error reset
• At power-on of servo system CPU</td><td>Immediate stop</td><td>• After checking and correcting the parameter setting, turn the servo system CPU power OFF, then ON, reset the servo system CPU with the key, or turn PLC ready (M2000) OFF, then ON.</td></tr>
</table>

(2) Servo power supply module errors (2800 to 2999)

The servo power supply module errors are detected by the servo amplifier and assigned error codes 2800 to 2999.

When any of the servo errors occurs, the servo error detection signal (M2408+20n) turns ON. Eliminate the error cause and turn ON the servo error reset (M3208+20n) to reset the servo error, and make a restart. (However, the servo error detection signal will not turn ON for any of the error codes 2900 to 2999 as they are warning.)

(Note) 1. For regenerative alarm protection (error code 2830), the status when the protective circuit was activated is still retained in the servo amplifier after activation. The data stored is cleared when the external power is switched OFF, but is not cleared by the RESET signal.

2. If the external power is switched OFF repeatedly to reset the error code 2830, overheat may lead to damage to the devices. Therefore, resume operation after removing the cause without fail.

The servo power supply module error definitions are given in Table 11.4.

⚠ CAUTION

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

Table 11.4 Servo Power Supply Module Error (2800 to 2999) List

Error Code	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2810	Undervoltage	• The power supply voltage of the servo power supply module fell below 170VAC. • Instantaneous power failure occurred.	At any time during operation	Immediate stop	• Reconsider the power supply equipment.
		• Load is too large.			• Reconsider the power supply capacity.
2830	Excessive regeneration	• High-duty operation or continuous regenerative operation caused the max. load capacity of the regenerative brake resistor to be exceeded.			• Reconsider the operation pattern, e.g. decrease the acceleration/deceleration frequencies or reduce the speed.
		• Regenerative power transistor was damaged.			• Change the servo power supply module.
		• Regenerative brake resistor setting mistake in system settings			• Reconsider the system settings.
		• Regenerative brake resistor wiring mistake.			• Correct the wiring.
2833	Overvoltage	• Regenerative brake resistor connection mistake.			• Correct the wiring.
		• Regenerative power transistor was damaged.			• Change the servo power supply module.
		• Regenerative brake resistor is dead.			• Change the regenerative brake resistor.
		• Power supply voltage is high.			• Reconsider the power supply equipment.
2847	Amplifier power supply overheat	• The servo power supply module fan is at a stop.			• Change the fan.
		• The continuous output current of the servo power supply module is exceeded.			• Reduce the load.
		• Thermal sensor fault.			• Change the servo power supply module.
2940	Excessive regeneration warning	• 80% level of the excessive regeneration error (2830) was detected.		Operation continues	• Refer to details of the excessive regeneration error (2830).

11.5 Output Module Errors

(1) Output module errors at REAL→VIRTUAL mode switching (4000 to 5990)

Table 11.5 Output Module Error List (4000 to 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 current 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 PLC READY signal OFF, then correct and register the clutch setting.
	4070	407□	○	○	○	○	• The connected clutch is in the external input mode for a A273EX/A172SENC set for high-speed reading.		• Do not used the clutch in the external input mode for a A273EX/A172SENC set for high-speed reading.
	5000	500□		○	○	○	• The "feed current value" is outside the applicable range. • For cams, the feed current value is outside the "stroke lower limit to stroke" range. (When in the 2-way cam mode.) (Current value cannot be calculated within 1 cam revolution.)		• Return to the REAL mode and position within the stroke range.
	5060	506□				○	• The "feed current value" is within the stroke range, but the current 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 "7FFF$_H$" are included in the cam data table. Designate 0 to 7FFF$_H$ 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.
	5100	510□				○	• Although the limit switch output is set to the "current 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 "current 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 "current 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 to 2147483647).	A smoothing amount of "0" (direct clutch) is adopted.	• Designate a value within the range 0 to 2147483647.

Table 11.5 Output Module Error List (4000 to 5990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Minor Errors	5260	526□				○	• Stroke setting device is out of range.	Related systems inoperative	• Set in the range 1 to (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□			○	○	• Current value in one virtual axis revolution storage device (main shaft side) is out of range.	Monitoring of current value in one virtual axis revolution (main shaft side) not possible	• Correct the current value in one virtual axis revolution (main shaft side) setting.
	5360	536□			○	○	• Current value in one virtual axis revolution storage device (auxiliary input shaft side) storage device is out of range.	Monitoring of current value in one virtual axis revolution (auxiliary input shaft side) not possible	• Correct the current value in one virtual axis revolution (auxiliary input shaft side) setting.
	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 to 6990)

Table 11.6 Output Module Error List (6000 to 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	6000	600□	○	○	○	○	• The servo OFF command (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 PULSE" 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 current 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 (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 current value in one cam axis revolution was changed to an out-of-range value.	The current 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 current value was changed.	The gear ratio is unchanged.	• Designate a value within the range 1 to 65535.
	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 current value was changed.		

(3) Output module errors when clutch OFF and clutch OFF command issued (6500 to 6990)

Table 11.6 Output Module Error List (6500 to 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 current value violated the stroke range when a cam axis servo OFF command(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 (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 zeroing request signal (M2409+20n) was ON when a clutch ON command occurred. (Incremental axis MR-□-B power switched from OFF to ON.)	Clutch remains OFF.	• Return to the REAL mode, execute a zeroing, then switch back to the VIRTUAL mode.
	6540	654□				○	• When a servo ON command was executed, the feed current value was within the stroke limit range, but the current 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 to 9990)

Table 11.7 Output Module Error List (9000 to 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 to 10990)

Table 11.8 Output Module Error List (10000 to 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 zeroing return request (M2409 + 20n) is ON.	START disabled at related systems.	• Return to the REAL mode and execute a zeroing. • If position is not established after executing a zeroing at all axes, VIRTUAL mode operation will be disabled.
	10010	1001□	○	○	○	○	• The servo error detection signal (M2408 + 20n) is ON.		• Execute a servo error reset in the REAL mode.
	10020	1002□	○	○	○	○	• A servo OFF (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 to 11990)

Table 11.9 Output Module Error List (11000 to 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 (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 11.4).
	11010	1101□	○	○	○	○	• A servo OFF status (M2415+20n ON) occurred during operation. • MR-□-B power supply was interrupted.	• 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.		
	11030	1103□	○	○	○	○	• The upper limit LS signal (FLS) switched OFF during forward (address increase direction) travel.		
	11040	1104□	○	○	○	○	• The lower limit LS signal (RLS) switched OFF during reverse (address decrease direction) travel.		

(7) Errors when using an absolute position system (12000 to 12990)

Table 11.10 Output Module Error List (12000 to 12990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
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). • Zeroing not conducted.	Zeroing requires turns ON.	• Return to the REAL mode and execute zeroing.
	12120*	1202□	○	○	○	○	• When the servo amplifier power is turned ON, a communication error in communication between the servo amplifier and encoder occurs.	Zeroing requires turns ON.	• Check the motor and encoder cables and perform zeroing again.
	12030*	1203□	○	○	○	○	• During operation, the amount of change in the encoder present value complies with the following expression: "Amount of change in encoder current value/3.5 ms >180° of motor revolution" After the servo amplifier power has been turned ON, a continual check is performed (in both servo ON and OFF states).	No processing	• Check the motor and encoder cables.
	12040*	1204□	○	○	○	○	• During operation, the following expression holds: "Encoder current value (PLS) ≠ feedback present value (PLS) (number of bits in encoder's feedback current 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-BN and MR-J2-B servo amplifiers.

(8) System errors at all-axes servo ON (15000 to 15990)

Table 11.11 Output Module Error List (15000 to 15990) (Continued)

Error Class	Error Code		Output Module				Error Cause	Processing	Corrective Action
	Output Module	Drive Module	Roller	Ball Screw	Rotary Table	Cam			
Major Errors	15000	1500□	○	○	○	○	• When the all-axis servo ON command is given, three-phase 200V is not supplied to the A230P or the A230P failed.	Servo is not switched ON on all axes.	• Error is set on only the ADU axis in the system using ADU.
	15010	1501□	○	○	○	○	• 24 VDC is not being supplied when an 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. •The LED display of the A273UHCPU shows "SYS ERR150□ 0 or 1 (**)".

11.6 Errors At REAL ↔ VIRTUAL Mode Switching

Table 11.12 REAL↔VIRTUAL Mode Switching Error Code List

Error Codes Stored at D9193		Error Description	Corrective Action
Decimal Display	Hexadecimal Display		
1	0001	• M2043 OFF → ON switching occurred when all axes were not stopped.	• Execute M2043 OFF → ON switching when M2001 to M2032 are all OFF.
256	0100	• M2043 ON → OFF switching occurred when all axes were not stopped.	• Execute M2043 ON → OFF switching when M2001 to M2032 are all OFF.
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	• M2043 OFF → ON switching occurred when the sequencer READY signal (M2000) or the PCPU READY signal (M9074) was OFF.	• After switching the PLC READY and PCPU READY signals ON, execute M2043 OFF → ON switching.
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	• 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	• M2043 OFF → ON switching occurred during servo START processing which was occurring in response to an ADU axis servo error reset command (M3208+20n).	• When a servo error reset occurred by switching the M3208+20n signal ON, switch the servo error detection signal (M2408+20n) OFF, then execute M2043 OFF → ON switching.
519*	0207	• M2043 was turned from OFF → ON during cam data batch-change (M2056: ON) processing in the sequence program.	• When M2056 was turned ON to make cam data changes, turn M2043 from OFF → ON after the cam data batch-change completion flag (M2057) has turned ON.
768	0300	• M2043 was turned from OFF → ON with the zeroing request signal ON on the axis whose output module is other than the roller.	• Perform zeroing (execute ZERO in the servo program), and after M2409+20n has turned OFF, turn M2043 from OFF → ON.
1024	0400	• M2043 was turned from OFF → ON without all ADU and MR-□-B axes being normal (M2408+20n: ON).	• Check the ADU, MR-□-B, servo motors, wiring ,etc.
1280	0500	• M2043 was turned from OFF → ON with the units set to the fixed parameter and output module being different on the axis whose output module is other than the roller.	• Correct the unit setting of the fixed parameter or output module and write the correct unit to the servo system CPU.
1536	0600	• M2043 was turned from OFF → ON without cam data being registered although the cam is set to the output module.	• Write the cam data to the servo system CPU.
2048	0800	• M2043 was turned from OFF → ON without the cam No. being set to the cam No. setting device. (When the cam No. setting device is 0)	• Turn M2043 from OFF → ON after writing the cam No. set in the cam's used cam No. parameter to the cam No. setting device.
2304	0900	• The cam's stroke value setting device setting is outside the range 1 to (2^{31}-1).	• Turn M2043 from OFF → ON after setting the value within the range 1 to (2^{31}-1) to the cam's stroke value setting device.
2816	0B00	• The cam's stroke value setting device does not have an even number.	• Set an even number to the cam's stroke value setting device.

For the errors marked *, the error axis No. information is not set at D9194 and D9195.

Table 11.12 REAL↔VIRTUAL Mode Switching Error Code List (Continued)

Error Codes Stored at D9193		Error Description	Corrective Action
Decimal Display	Hexadecimal Display		
− 4094	F002	• During VIRTUAL mode operation, the PLC 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	• During VIRTUAL mode operation, the servo error signal (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 11.4).
− 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.

For the errors marked *, the error axis No. information is not set at D9194 and D9195.

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 ($0 \le T \le 0.5$)

$A = 4 + C0$

Section II ($0.5 < T \le 1$)

$A = -4 + C0$

(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 ($0 \le T \le Ta$)

$$A = Am\sin \frac{\pi}{2Ta} T + C0$$

Section II ($Ta < T \le 0.5 - Ta$)

$A = Am + C0$

Section III ($0.5 - Ta < T \le 0.5 + Ta$)

$$A = Am\overline{\cos} \frac{\pi(T - 0.5 + Ta)}{2Ta} + C0$$

Section IV ($0.5 - Ta < T \le 1 - Ta$)

$A = -Am + C0$

Section V ($1 - Ta < T \le 1$)

$$A = -Am\overline{\cos} \frac{\pi(T - 1 + Ta)}{2Ta} + C0$$

4) Distorted sine curve

$$Ta = \frac{1}{8}$$

$$Am = \frac{1}{\frac{2Ta}{\pi} + \frac{2 - 8Ta}{\pi^2}}$$

Section I ($0 \le T \le Ta$)

$$A = Amsin\ \frac{\pi T}{2Ta} + C0$$

Section II ($Ta < T \le 1 - Ta$)

$$A = Am\overline{cos}\ \frac{\pi(T - Ta)}{1 - 2Ta} + C0$$

Section III ($1 - Ta < T \le 1$)

$$A = -Am\overline{cos}\ \frac{\pi(T - 1 + Ta)}{2Ta} + C0$$

5) Distorted constant speed curve

$$Ta = \frac{1}{16}$$

$$Ta = \frac{1}{4}$$

$$Am = \frac{1}{\frac{2}{\pi}\left\{(2 - \frac{8}{\pi})TaTb + (\frac{4}{\pi} - 2)\,Tb^2 + Tb\right\}}$$

Section I ($0 \le T \le Ta$)

$$A = Amsin\ \frac{\pi T}{2Ta} + C0$$

Section II ($Ta < T \le Tb$)

$$A = Am\overline{cos}\ \frac{\pi(T - Ta)}{2(Tb - Ta)} + C0$$

Section III ($Tb < T \le 1 - Tb$)

$$A = 0 + A0$$

Section IV ($1 - Tb < T \le 1 - Ta$)

$$A = -Amsin\ \frac{\pi(T - 1 + Ta)}{2(Tb - Ta)} + C0$$

Section V ($1 - Ta < T \le 1$)

$$A = -Am\overline{cos}\ \frac{\pi(T - 1 + Ta)}{2Ta} + C0$$

(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 ($0 \le T \le Ta$)

$$A = Amsin\ \frac{\pi T}{2Ta} + C0$$

Section II ($Ta < T \le Tb$)

$A = Am + C0$

Section III ($Tb < T \le Tc$)

$$A = Am\overline{cos}\ \frac{\pi(T - T6)}{2Ta} + C0$$

Section IV ($Tc < T \le 1$)

$$A = -Am\overline{cos}\ \frac{\pi(T - Tc)}{2(1 - Tc)} + C0$$

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 ($0 \le T \le 1 - Tc$)

$$A = Am\overline{cos}\ \frac{\pi(1 - Tc - T)}{2\,(1 - Tc)} + C0$$

Section II (1−Tc<T≤1−Tb)

$$A = -Amc\overline{os}\ \frac{\pi(1-Tb-T)}{2Ta} + C0$$

Section III (1−Tb<T≤1−Ta)

$$A = -Am + C0$$

Section IV (1−Ta<T≤1)

$$A = Amsin\ \frac{\pi(1-T)}{2Ta} + C0$$

(d) One-side stationary curve

1) Multiple hypotenuse curve

$$A = \frac{\pi^2}{2}\ (cos\pi T - c\overline{os}2\pi T) + C0$$

(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 Processing Time List

Shown below are each processing time signal and command when position control is carried out in relation to the servo system CPU.

(1) Motion operation cycle (ms)

CPU	A273UHCPU			A173UHCPU(-S1)		
Number of set axes	**1 to 8**	**9 to 18**	**19 to 32**	**1 to 12**	**13 to 24**	**25 to 32**
Operation cycle	3.5ms	7.1ms	14.2ms	3.5ms	7.1ms	14.2ms

(2) SCPU instruction processing times (μs)

Number of set axes		**1 to 32**
SVST	1 axis started	35
	2 to 3 axes started	70
	Error	150
CHGV		20
CHGA		25
CHGT		20
END		5000

(3) CPU processing time (ms)

CPU	A273UHCPU			A173UHCPU(-S1)		
Number of set axes	**1 to 8**	**9 to 18**	**19 to 32**	**1 to 12**	**13 to 24**	**25 to 32**
Servo program start processing time (Note-1)	4 to 11	10 to 8	14 to 21	4 to 11	10 to 18	14 to 21
Speed change response	0 to 4	0 to 8	0 to 14	0 to 4	0 to 8	0 to 14
Torque limit value change response	0 to 4	0 to 4	0 to 4	0 to 4	0 to 4	0 to 4
Simultaneous start processing time (Note-2)	7 to 17	10 to 24	14 to 28	7 to 17	10 to 24	14 to 28
Time from PLC ready flag (M2000) ON to PCPU ready completed flag (M9074) ON	8 to 100	90 to 400	100 to 800	8 to 100	90 to 400	100 to 800

(Note-1) The FEED instruction varies greatly depending on the condition (whether other axes are operating or being stopped).

(Note-2) This processing time varies depending on the commands to be started simultaneously. Use this time merely for reference.

(4) Virtual servo motor axis / synchronous encoder axis calculation cycle

CPU	A273UHCPU			A173UHCPU(-S1)		
Number of output axes set	**1 to 8**	**9 to 18**	**19 to 32**	**1 to 12**	**13 to 24**	**25 to 32**
Number of axes used by virtual servo motor	3.5ms	7.1ms	14.2ms	3.5ms	7.1ms	14.2ms
Number of axes used by synchronous encoder	3.5ms	7.1ms	14.2ms	3.5ms	7.1ms	14.2ms

(5) Each axis status

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

	Signal Name	Real	Virtual				Signal Direction	Refresh Cycle			Fetch Cycle		
			Roller	Ball screw	Rotary table	Cam		Preset number of axes (Note)			Preset number of axes (Note)		
								1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
								1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0	Positioning start completion	○	×				SCPU ← PCPU	—					
1	Positioning completion												
2	In-position		○					3.5ms	7.1ms	14.2ms			
3	Command in-position		×					—					
4	Speed controlling							3.5ms	7.1ms	14.2ms			
5	Speed/position change latch												
6	Zero pass		○					Immediately					
7	Error detection							3.5ms	7.1ms	14.2ms			
8	Servo error detection							10ms	20ms				
9	Zeroing request							3.5ms	7.1ms	14.2ms			
10	Zeroing completion							10ms	20ms				
11	External signal FLS												
12	External signal RLS							3.5ms	7.1ms	14.2ms			
13	External signal STOP							10ms	20ms				
14	External signal DOG/CHANGE												
15	Servo ON/OFF status							3.5ms	7.1ms	14.2ms			
16	Torque limiting signal												
17	DOG/CHANGE signal							10ms	20ms				
18	Virtual mode continuation operation warning signal												
19	M-code outputting signal		×					—					

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(6) Command signals of each axis

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

Signal Name

(○ Valid)

	Signal Name	Real	Virtual				Signal Direction	Refresh Cycle			Fetch Cycle		
			Roller	Ball screw	Rotary table	Cam		Preset number of axes (Note)			Preset number of axes (Note)		
								1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
								1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0	Stop command	○	×				SCPU → PCPU				—		
1	Sudden stop command												
2	Forward rotation JOG start												
3	Reverse rotation JOG start												
4	Completion signal OFF command												
5	Speed/position change enable												
6	Limit switch output enable		○								3.5ms	7.1ms	14.2ms
7	Error reset										10ms		
8	Servo error reset												
9	Start-time stop input/disable		×								—		
10	Unusable	—	—										
11	Unusable												
12	Feed current value update command	○	×										
13	Address clutch reference setting	×	×		○						At switching from real to virtual		
14	Cam reference position setting		×			○							
15	Servo OFF	○	○								3.5ms	7.1ms	14.2ms
16	Unusable	—	—								—		
17	Unusable												
18	Unusable												
19	FIN signal	○	×								—		

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(7) Virtual servo motor axis status

Axis No.	Device Number	Signal Name
1	M4000 to M4019	(○ Valid)
2	M4020 to M4039	
3	M4040 to M4059	
4	M4060 to M4079	
5	M4080 to M4099	
6	M4100 to M4119	
7	M4120 to M4139	
8	M4140 to M4159	
9	M4160 to M4179	
10	M4180 to M4199	
11	M4200 to M4219	
12	M4220 to M4239	
13	M4240 to M4259	
14	M4260 to M4279	
15	M4280 to M4299	
16	M4300 to M4319	
17	M4320 to M4339	
18	M4340 to M4359	
19	M4360 to M4379	
20	M4380 to M4399	
21	M4400 to M4419	
22	M4420 to M4439	
23	M4440 to M4459	
24	M4460 to M4479	
25	M4480 to M4499	
26	M4500 to M4519	
27	M4520 to M4539	
28	M4540 to M4559	
29	M4560 to M4579	
30	M4580 to M4599	
31	M4600 to M4619	
32	M4620 to M4639	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32
0	Positioning start completion	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
1	Positioning completion		○		3.5ms	7.1ms	14.2ms			
2	Unusable		—		—					
3	Command in-position		○		3.5ms	7.1ms	14.2ms			
4	Speed controlling		○		3.5ms	7.1ms	14.2ms			
5	Unusable		—		—					
6	Unusable		—		—					
7	Error reset		○		Immediately					
8	Unusable		—		—					
9	Unusable		—		—					
10	Unusable		—		—					
11	Unusable		—		—					
12	Unusable		—		—					
13	Unusable		—		—					
14	Unusable		—		—					
15	Unusable		—		—					
16	Unusable		—		—					
17	Unusable		—		—					
18	Unusable		—		—					
19	M-code outputting signal		○		3.5ms	7.1ms	14.2ms			

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(8) Virtual servo motor axis command signals

Axis No.	Device Number	Signal Name
1	M4800 to M4819	(○ Valid)
2	M4820 to M4839	
3	M4840 to M4859	
4	M4860 to M4879	
5	M4880 to M4899	
6	M4900 to M4919	
7	M4920 to M4939	
8	M4940 to M4959	
9	M4960 to M4979	
10	M4980 to M4999	
11	M5000 to M5019	
12	M5020 to M5039	
13	M5040 to M5059	
14	M5060 to M5079	
15	M5080 to M5099	
16	M5100 to M5119	
17	M5120 to M5139	
18	M5140 to M5159	
19	M5160 to M5179	
20	M5180 to M5199	
21	M5200 to M5219	
22	M5220 to M5239	
23	M5240 to M5259	
24	M5260 to M5279	
25	M5280 to M5299	
26	M5300 to M5319	
27	M5320 to M5339	
28	M5340 to M5359	
29	M5360 to M5379	
30	M5380 to M5399	
31	M5400 to M5419	
32	M5420 to M5439	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note) 19 to 32 / 25 to 32
0	Stop command	×	○	SCPU → PCPU				3.5ms	7.1ms	14.2ms
1	Sudden stop command									
2	Forward rotation JOG start							10ms		
3	Reverse rotation JOG start									
4	Completion signal OFF command									
5	Unusable	—	—					—		
6	Unusable									
7	Error reset	×	○					10ms	20ms	
8	Unusable	—	—					—		
9	Start-time stop input/disable	×	○					At start		
10	Unusable	—	—					—		
11	Unusable									
12	Unusable									
13	Unusable									
14	Unusable									
15	Unusable									
16	Unusable									
17	Unusable									
18	Unusable									
19	FIN signal	×	○					3.5ms	7.1ms	14.2ms

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(9) Synchronous encoder axis status

Axis No.	Device Number	
	A273UHCPU	A173UHCPU(S1)
1	M4640 to M4643	M4640 to M4643
2	M4644 to M4647	M4644 to M4647
3	M4648 to M4651	M4648 to M4651
4	M4652 to M4655	M4652 to M4655
5	M4656 to M4659	
6	M4660 to M4663	
7	M4664 to M4667	
8	M4668 to M4671	
9	M4672 to M4675	
10	M4676 to M4679	
11	M4680 to M4683	
12	M4684 to M4687	
10	M4676 to M4679	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0	Error detection	○	○	SCPU ← PCPU	Immediately					
1	External signal TRA									
2	Virtual mode continuation operation disable warning				10ms	20ms				
3	Unusable	—	—		—					

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(10) Synchronous encoder axis command signals

Axis No.	Device Number	
	A273UHCPU	A173UHCPU(S1)
1	M5440 to M5443	M5440 to M5443
2	M5444 to M5447	M5444 to M5447
3	M5448 to M5451	M5448 to M5451
4	M5452 to M5455	M5452 to M5455
5	M5456 to M5459	
6	M5460 to M5463	
7	M5464 to M5467	
8	M5468 to M5471	
9	M5472 to M5475	
10	M5476 to M5479	
11	M5480 to M5483	
12	M5484 to M5487	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0	Error reset	×	○	SCPU → PCPU				10ms	20ms	
1	Unusable	—	—					—		
2	Unusable									
3	Unusable									

(Note): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(11) Common devices

Device Number	Signal Name	(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-2) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note-2) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note-2) 19 to 32 / 25 to 32
M2000	PLC ready flag	O	O	SCPU→PCPU				10ms	20ms	
M2001	Axis 1									
M2002	Axis 2									
M2003	Axis 3									
M2004	Axis 4									
M2005	Axis 5									
M2006	Axis 6									
M2007	Axis 7									
M2008	Axis 8									
M2009	Axis 9									
M2010	Axis 10									
M2011	Axis 11									
M2012	Axis 12									
M2013	Axis 13									
M2014	Axis 14									
M2015	Axis 15									
M2016	Axis 16									
M2017	Axis 17	START accept flag	O	O	SCPU←PCPU	10ms				
M2018	Axis 18									
M2019	Axis 19									
M2020	Axis 20									
M2021	Axis 21									
M2022	Axis 22									
M2023	Axis 23									
M2024	Axis 24									
M2025	Axis 25									
M2026	Axis 26									
M2027	Axis 27									
M2028	Axis 28									
M2029	Axis 29									
M2030	Axis 30									
M2031	Axis 31									
M2032	Axis 32									
M2033	Unusable (1 point)	—	—	—	—			—		
M2034	PC link communication error flag	O	O	SCPU←PCPU	10ms					
M2035	Unusable (5 points)	—	—	—	—			—		
M2036										
M2037										
M2038										
M2039										
M2040	Speed change point designation flag	O	O	SCPU→PCPU				At start		
M2041	System setting error flag			SCPU←PCPU	END (Note-2)					
M2042	All-axis servo ON command			SCPU→PCPU				3.5ms	7.1ms	14.2ms
M2043	Real/virtual mode change request									
M2044	Real/virtual mode change status			SCPU←PCPU	END (Note-2)					
M2045	Real/virtual mode change error detection									
M2046	Out-of-sync warning									
M2047	Motion slot fault detection flag				10ms					
M2048	JOG simultaneous start command			SCPU→PCPU				10ms	20ms	
M2049	All-axis servo ON acceptance flag			SCPU←PCPU	END (Note-2)					
M2050	Start buffer full									
M2051	Manual pulse generator 1 enable flag	O	×	SCPU→PCPU				10ms	20ms	
M2052	Manual pulse generator 2 enable flag									
M2053	Manual pulse generator 3 enable flag									
M2054	Unusable (2 points)	—	—	—	—			—		
M2055										
M2056	Cam/limit switch output data batch-change request flag	O	O	SCPU→PCPU						
M2057	Cam/limit switch output data batch-change completion flag			SCPU←PCPU	END (Note-2)					
M2058	Cam/limit switch output data batch-change error flag									
M2059	Unusable (2 points)	—	—	—	—			—		
M2060										
M2061	Axis 1									
M2062	Axis 2									
M2063	Axis 3									
M2064	Axis 4									
M2065	Axis 5									
M2066	Axis 6									
M2067	Axis 7									
M2068	Axis 8									
M2069	Axis 9	Speed changing flag	O	O	SCPU←PCPU	END (Note-2)				
M2070	Axis 10									
M2071	Axis 11									
M2072	Axis 12									
M2073	Axis 13									
M2074	Axis 14									
M2075	Axis 15									
M2076	Axis 16									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)
(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

Device Number	Signal Name			(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle (Preset number of axes (Note-1)) 1 to 8 / 1 to 12	Refresh Cycle (Preset number of axes (Note-1)) 9 to 18 / 13 to 24	Refresh Cycle (Preset number of axes (Note-1)) 19 to 32 / 25 to 32	Fetch Cycle (Preset number of axes (Note-1)) 1 to 8 / 1 to 12	Fetch Cycle (Preset number of axes (Note-1)) 9 to 18 / 13 to 24	Fetch Cycle (Preset number of axes (Note-1)) 19 to 32 / 25 to 32
M2077	Axis 17											
M2078	Axis 18											
M2079	Axis 19											
M2080	Axis 20											
M2081	Axis 21											
M2082	Axis 22											
M2083	Axis 23											
M2084	Axis 24											
M2085	Axis 25	Speed changing flag		○	○	SCPU←PCPU	END (Note-2)					
M2086	Axis 26											
M2087	Axis 27											
M2088	Axis 28											
M2089	Axis 29											
M2090	Axis 30											
M2091	Axis 31											
M2092	Axis 32											
M2093	Unusable (8 points)			—	—	—	—			—		
M2094												
M2095												
M2096												
M2097												
M2098												
M2099												
M2100												
M2101	Synchronous encoder	Axis 1	Current value changing	×	○	SCPU←PCPU	END (Note-2)					
M2102		Axis 2										
M2103		Axis 3										
M2104		Axis 4										
M2105		Axis 5										
M2106		Axis 6										
M2107		Axis 7										
M2108		Axis 8										
M2109		Axis 9										
M2110		Axis 10										
M2111		Axis 11										
M2112		Axis 12										
M2113	Unusable (15 points)			—	—	—	—			—		
M2114												
M2115												
M2116												
M2117												
M2118												
M2119												
M2120												
M2121												
M2122												
M2123												
M2124												
M2125												
M2126												
M2127												
M2128	Axis 1											
M2129	Axis 2											
M2130	Axis 3											
M2131	Axis 4											
M2132	Axis 5											
M2133	Axis 6											
M2134	Axis 7											
M2135	Axis 8											
M2136	Axis 9											
M2137	Axis 10											
M2138	Axis 11											
M2139	Axis 12											
M2140	Axis 13											
M2141	Axis 14											
M2142	Axis 15											
M2143	Axis 16	Automatically decelerating flag		○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
M2144	Axis 17											
M2145	Axis 18											
M2146	Axis 19											
M2147	Axis 20											
M2148	Axis 21											
M2149	Axis 22											
M2150	Axis 23											
M2151	Axis 24											
M2152	Axis 25											
M2153	Axis 26											
M2154	Axis 27											
M2155	Axis 28											
M2156	Axis 29											
M2157	Axis 30											

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

Device Number	Signal Name			(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle Preset number of axes (Note-1) 9 to 18 / 13 to 24	Refresh Cycle Preset number of axes (Note-1) 19 to 32 / 25 to 32	Fetch Cycle Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle Preset number of axes (Note-1) 9 to 18 / 13 to 24	Fetch Cycle Preset number of axes (Note-1) 19 to 32 / 25 to 32
M2158	Axis 31	Automatically decelerating flag		○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
M2159	Axis 32											
M2160	Output axis 1	Main shaft side	Clutch status	Backup	○							
M2161		Auxiliary input axis side										
M2162	Output axis 2	Main shaft side										
M2163		Auxiliary input axis side										
M2164	Output axis 3	Main shaft side										
M2165		Auxiliary input axis side										
M2166	Output axis 4	Main shaft side										
M2167		Auxiliary input axis side										
M2168	Output axis 5	Main shaft side										
M2169		Auxiliary input axis side										
M2170	Output axis 6	Main shaft side										
M2171		Auxiliary input axis side										
M2172	Output axis 7	Main shaft side										
M2173		Auxiliary input axis side										
M2174	Output axis 8	Main shaft side										
M2175		Auxiliary input axis side										
M2176	Output axis 9	Main shaft side										
M2177		Auxiliary input axis side										
M2178	Output axis 10	Main shaft side										
M2179		Auxiliary input axis side										
M2180	Output axis 11	Main shaft side										
M2181		Auxiliary input axis side										
M2182	Output axis 12	Main shaft side										
M2183		Auxiliary input axis side										
M2184	Output axis 13	Main shaft side										
M2185		Auxiliary input axis side										
M2186	Output axis 14	Main shaft side										
M2187		Auxiliary input axis side										
M2188	Output axis 15	Main shaft side										
M2189		Auxiliary input axis side										
M2190	Output axis 16	Main shaft side										
M2191		Auxiliary input axis side										
M2192	Output axis 17	Main shaft side										
M2193		Auxiliary input axis side										
M2194	Output axis 18	Main shaft side										
M2195		Auxiliary input axis side										
M2196	Output axis 19	Main shaft side										
M2197		Auxiliary input axis side										
M2198	Output axis 20	Main shaft side										
M2199		Auxiliary input axis side										
M2200	Output axis 21	Main shaft side										
M2201		Auxiliary input axis side										
M2202	Output axis 22	Main shaft side										
M2203		Auxiliary input axis side										
M2204	Output axis 23	Main shaft side										
M2205		Auxiliary input axis side										
M2206	Output axis 24	Main shaft side										
M2207		Auxiliary input axis side										
M2208	Output axis 25	Main shaft side										
M2209		Auxiliary input axis side										
M2210	Output axis 26	Main shaft side										
M2211		Auxiliary input axis side										
M2212	Output axis 27	Main shaft side										
M2213		Auxiliary input axis side										
M2214	Output axis 28	Main shaft side										
M2215		Auxiliary input axis side										
M2216	Output axis 29	Main shaft side										
M2217		Auxiliary input axis side										
M2218	Output axis 30	Main shaft side										
M2219		Auxiliary input axis side										
M2220	Output axis 31	Main shaft side										
M2221		Auxiliary input axis side										
M2222	Output axis 32	Main shaft side										
M2223		Auxiliary input axis side										
M2224	Unusable (16 points)			—	—	—	—			—		
M2225												
M2226												
M2227												
M2228												
M2229												
M2230												
M2231												
M2232												
M2233												
M2234												
M2235												
M2236												
M2237												
M2238												
M2239												

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)
(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

Device Number	Signal Name		(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32
M2240	Axis 1	Speed change "0" accepting flag	○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
M2241	Axis 2										
M2242	Axis 3										
M2243	Axis 4										
M2244	Axis 5										
M2245	Axis 6										
M2246	Axis 7										
M2247	Axis 8										
M2248	Axis 9										
M2249	Axis 10										
M2250	Axis 11										
M2251	Axis 12										
M2252	Axis 13										
M2253	Axis 14										
M2254	Axis 15										
M2255	Axis 16										
M2256	Axis 17										
M2257	Axis 18										
M2258	Axis 19										
M2259	Axis 20										
M2260	Axis 21										
M2261	Axis 22										
M2262	Axis 23										
M2263	Axis 24										
M2264	Axis 25										
M2265	Axis 26										
M2266	Axis 27										
M2267	Axis 28										
M2268	Axis 29										
M2269	Axis 30										
M2270	Axis 31										
M2271	Axis 32										
M2272	Unusable (48 points)		—	—	—	—			—		
M2273											
M2274											
M2275											
M2276											
M2277											
M2278											
M2279											
M2280											
M2281											
M2282											
M2283											
M2284											
M2285											
M2286											
M2287											
M2288											
M2289											
M2290											
M2291											
M2292											
M2293											
M2294											
M2295											
M2296											
M2297											
M2298											
M2299											
M2300											
M2301											
M2302											
M2303											
M2304											
M2305											
M2306											
M2307											
M2308											
M2309											
M2310											
M2311											
M2312											
M2313											
M2314											
M2315											
M2316											
M2317											
M2318											
M2319											

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)
(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

(12) Monitor devices of each axis

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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0 1	Feed current value/roller cycle	○	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2 3	Real current value									
4 5	Deviation counter value									
6	Minor error code				Immediately					
7	Major error code									
8	Servo error code				10ms	20ms				
9	Zeroing re-travel value		Backup		3.5ms	7.1ms	14.2ms			
10 11	Travel value after proximity dog ON				END (Note-2)					
12	Execution program No.		×		At start					
13	M-code				3.5ms	7.1ms	14.2ms			
14	Torque limit value		○							
15	Data set pointer for constant-speed control		×		At start/during start					
16 17	Travel value change register			SCPU→PCPU				3.5ms	7.1ms	14.2ms
18 19	Real current value when STOP is input		Backup	SCPU←PCPU	END (Note-2)					

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)
(Note-2): The refresh cycle "END"s in the longer time of "50ms" and "sequence program scan time".

(13) Control change registers

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

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	JOG speed setting register	○	○	SCPU→PCPU				At start		

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(14) Virtual servo motor axis monitor devices

Axis No.	Device Number	Signal Name
1	D800 to D805	(O Valid)
2	D810 to D815	
3	D820 to D825	
4	D830 to D835	
5	D840 to D845	
6	D850 to D855	
7	D860 to D865	
8	D870 to D875	
9	D880 to D885	
10	D890 to D895	
11	D900 to D905	
12	D910 to D915	
13	D920 to D925	
14	D930 to D935	
15	D940 to D945	
16	D950 to D955	
17	D960 to D965	
18	D970 to D975	
19	D980 to D985	
20	D990 to D995	
21	D1000 to D1005	
22	D1010 to D1015	
23	D1020 to D1025	
24	D1030 to D1035	
25	D1040 to D1045	
26	D1050 to D1055	
27	D1060 to D1065	
28	D1070 to D1075	
29	D1080 to D1085	
30	D1090 to D1095	
31	D1100 to D1105	
32	D1110 to D1115	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
0 1	Feed current value	Backup	O	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2	Minor error code				Immediately					
3	Major error code									
4	Execution program No.				At start					
5	M-code				3.5ms	7.1ms	14.2ms			

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(15) Virtual servo motor axis main shaft differential gear present value

Axis No.	Device Number	Signal Name
1	D806 to D809	
2	D816 to D819	
3	D826 to D829	
4	D836 to D839	
5	D846 to D849	
6	D856 to D859	
7	D866 to D869	
8	D876 to D879	
9	D886 to D889	
9	D886 to D889	
10	D896 to D899	
11	D906 to D909	
12	D916 to D919	
13	D926 to D929	
14	D936 to D939	
15	D946 to D949	
16	D956 to D959	
17	D966 to D969	
18	D976 to D979	
19	D986 to D989	
20	D996 to D999	
21	D1006 to D1009	
22	D1016 to D1019	
23	D1026 to D1029	
24	D1036 to D1039	
25	D1046 to D1049	
26	D1056 to D1059	
27	D1066 to D1069	
28	D1076 to D1079	
29	D1086 to D1089	
30	D1096 to D1099	
31	D1106 to D1109	
32	D1116 to D1119	

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle			Fetch Cycle		
					Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32
					1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32
01	Current value after virtual servo motor axis main shaft's differential gear	Backup	○	SCPU←PCPU	3.5ms	7.1ms	14.2ms			
2	Error search output axis No.									
3	Data set pointer for constant-speed control									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(16) Synchronous encoder axis monitor devices

Axis No.	Device Number A273UHCPU	Device Number A173UHCPU(S1)
1	D1120 to D1125	D1120 to D1125
2	D1130 to D1135	D1130 to D1135
3	D1140 to D1145	D1140 to D1145
4	D1150 to D1155	D1150 to D1155
5	D1160 to D1165	
6	D1170 to D1175	
7	D1180 to D1185	
8	D1190 to D1195	
9	D1200 to D1205	
10	D1210 to D1215	
11	D1220 to D1225	
12	D1230 to D1235	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0 1	Feed current value	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
2	Minor error code				Immediately					
3	Major error code									
4	Unusable	—	—		—					
5	Unusable									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(17) Synchronous encoder axis main shaft differential gear current value

Axis No.	Device Number A273UHCPU	Device Number A173UHCPU(S1)
1	D1126 to D1129	D1126 to D1129
2	D1136 to D1139	D1136 to D1139
3	D1146 to D1149	D1146 to D1149
4	D1156 to D1159	D1156 to D1159
5	D1166 to D1169	
6	D1176 to D1179	
7	D1186 to D1189	
8	D1196 to D1199	
9	D1206 to D1209	
10	D1216 to D1219	
11	D1226 to D1229	
12	D1236 to D1239	

Signal Name

(○ Valid)

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
0 1	Current value after synchronous encoder axis main shaft's differential gear	Backup	○	SCPU ← PCPU	3.5ms	7.1ms	14.2ms			
2	Error detection output axis No.									
3	Unusable	—	—		—					

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(18) Cam axis monitor devices

Axis No.	Device Number	Signal Name
1	D1240 to D1249	(O Valid)
2	D1250 to D1259	
3	D1260 to D1269	
4	D1270 to D1279	
5	D1280 to D1289	
6	D1290 to D1299	
7	D1300 to D1309	
8	D1310 to D1319	
9	D1320 to D1329	
10	D1330 to D1339	
11	D1340 to D1349	
12	D1350 to D1359	
13	D1360 to D1369	
14	D1370 to D1379	
15	D1380 to D1389	
16	D1390 to D1399	
17	D1400 to D1409	
18	D1410 to D1419	
19	D1420 to D1429	
20	D1430 to D1439	
21	D1440 to D1449	
22	D1450 to D1459	
23	D1460 to D1469	
24	D1470 to D1479	
25	D1480 to D1489	
26	D1490 to D1499	
27	D1500 to D1509	
28	D1510 to D1519	
29	D1520 to D1529	
30	D1530 to D1539	
31	D1540 to D1549	
32	D1550 to D1559	

	Signal Name	Real	Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Refresh Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: Preset number of axes (Note-1) 9 to 18 / 13 to 24	Fetch Cycle: Preset number of axes (Note-1) 19 to 32 / 25 to 32
0	Unusable	—	—	SCPU←PCPU	—	—	—			
1	Execution cam No.	Backup	O		3.5ms	7.1ms	14.2ms			
2 3	Execution stroke value									
4 5	Cam axis current value within one revolution									
6	Unusable	—	—		—					
7	Unusable									
8	Unusable									
9	Unusable									

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(19) Common devices

Device Number	Signal Name	(O Valid) Real	(O Valid) Virtual	Signal Direction	Refresh Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Refresh Cycle: 9 to 18 / 13 to 24	Refresh Cycle: 19 to 32 / 25 to 32	Fetch Cycle: Preset number of axes (Note-1) 1 to 8 / 1 to 12	Fetch Cycle: 9 to 18 / 13 to 24	Fetch Cycle: 19 to 32 / 25 to 32
D704 to D709	Unusable (6 points)	—		—	—			—		
D710 to D713	JOG operation simultaneous start axis setting register	○	○	SCPU→PCPU				At start		
D714 to D715	Manual pulse generator axis 1 No. setting register							At manual PG enable leading edge		
D716 to D717	Manual pulse generator axis 2 No. setting register									
D718 to D719	Manual pulse generator axis 3 No. setting register									
D720	Axis 1									
D721	Axis 2									
D722	Axis 3									
D723	Axis 4									
D724	Axis 5									
D725	Axis 6									
D726	Axis 7									
D727	Axis 8									
D728	Axis 9									
D729	Axis 10									
D730	Axis 11									
D731	Axis 12									
D732	Axis 13									
D733	Axis 14									
D734	Axis 15									
D735	Axis 16									
D736	Axis 17									
D737	Axis 18									
D738	Axis 19									
D739	Axis 20									
D740	Axis 21									
D741	Axis 22									
D742	Axis 23									
D743	Axis 24									
D744	Axis 25									
D745	Axis 26									
D746	Axis 27									
D747	Axis 28									
D748	Axis 29									
D749	Axis 30									
D750	Axis 31									
D751	Axis 32									
	Manual pulse generator's one-pulse input magnification setting register									
D752	Manual pulse generator axis 1 No. setting register									
D753	Manual pulse generator axis 2 No. setting register									
D754	Manual pulse generator axis 3 No. setting register									
D755 to D759	Unusable (5 points)	—		—	—			—		
D760 to D775	Limit switch output disable setting register	○	○	SCPU←PCPU				3.5ms	7.1ms	14.2ms
D776 to D791	Limit switch output status storage register									
D792 to D799	Servo amplifier type				At power ON					

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

(20) Special Relays

Device No.	Signal Name	(O Valid)		Signal Direction	Refresh Cycle	Fetch Cycle
		REAL	VIRTUAL			
M9073	PCPU WDT error flag					
M9074	PCPU READY completed flag					
M9075	TEST mode ON flag					
M9076	External emergency stop input flag	O	O	SCPU←PCPU	END	
M9077	Manual pulse generator axis setting error flag					
M9078	TEST mode request flag					
M9079	Servo program setting error flag					

(21) Special Registers

Device Number	Signal Name	(O Valid)		Signal Direction	Refresh Cycle			Fetch Cycle		
		Real	Virtual		Preset number of axes (Note-1)			Preset number of axes (Note-1)		
					1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32	1 to 8 / 1 to 12	9 to 18 / 13 to 24	19 to 32 / 25 to 32
D9180	Unusable	—		—	—			—		
D9181										
D9182	Test mode request error	O	O	SCPU←PCPU	At test mode request					
D9183										
D9184	PCPU WDT error cause				At PCPU WDT error occurrence					
D9185	Manual pulse generator axis setting error				At manual PG enable leading edge					
D9186										
D9187										
D9188	Unusable	—		—	—			—		
D9189	Error program number	O	O	SCPU←PCPU	At start					
D9190	Error item information									
D9191	Servo amplifier loading information				At servo amplifier power-on					
D9192										
D9193	REAL/VIRTUAL mode switching error information				At real/virtual mode change					
D9194										
D9195										
D9196	PC link communication error code				3.5ms	7.1ms	14.2ms			
D9197	Unusable	—			—			—		
D9198										
D9199										

(Note-1): Upper: A273UHCPU, lower: A173UHCPU(-S1)

APPENDIX 3 Setting Range of Indirect Setting Devices

Appendix 3.1 Servo program

All settings by servo programs (positioning address, commanded speed, M-code, etc.) can be designated indirectly by PLC devices, excluding the axis numbers.

(1) Device ranges
The number of device words and device range in indirect designation are shown below.

<table>
<tr><th colspan="2">Item</th><th>Number of Device Words</th><th>Device Setting Range</th><th>Remarks</th></tr>
<tr><td rowspan="6">Common</td><td>Address/travel</td><td>2</td><td rowspan="18"><table><tr><th>Device</th><th>Range</th></tr><tr><td>D</td><td>800 to 3069
3089 to 8191</td></tr><tr><td>W</td><td>0000 to 1FFF</td></tr></table></td><td rowspan="14"></td></tr>
<tr><td>Command speed</td><td>2</td></tr>
<tr><td>Dwell time</td><td>1</td></tr>
<tr><td>M-code</td><td>1</td></tr>
<tr><td>Torque limit value</td><td>1</td></tr>
<tr><td>Parameter block number</td><td>1</td></tr>
<tr><td rowspan="3">Arc</td><td>Auxiliary point</td><td>2</td></tr>
<tr><td>Radius</td><td>2</td></tr>
<tr><td>Center</td><td>2</td></tr>
<tr><td rowspan="9">Parameter block</td><td>Control unit</td><td>1</td></tr>
<tr><td>Speed limit value</td><td>2</td></tr>
<tr><td>Acceleration time</td><td>1</td></tr>
<tr><td>Deceleration time</td><td>1</td></tr>
<tr><td>Rapid stop deceleration time</td><td>1</td></tr>
<tr><td>Torque limit value</td><td>1</td></tr>
<tr><td>STOP input deceleration</td><td>1</td></tr>
<tr><td>Circular interpolation error allowance range</td><td>2</td></tr>
<tr><td>S-curve comparison</td><td>1</td></tr>
<tr><td rowspan="6">Other</td><td>Program number</td><td>1</td><td>Simultaneous start</td></tr>
<tr><td>FIN acceleration/deceleration time</td><td>1</td><td></td></tr>
<tr><td>Start program number</td><td>1</td><td>Cancel & start</td></tr>
<tr><td>Repeat condition (number of repetitions)</td><td>1</td><td></td></tr>
<tr><td>Repeat condition (ON/OFF)</td><td>Bit</td><td><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>0000 to 1FFF</td></tr><tr><td>Y</td><td>0000 to 1FFF</td></tr><tr><td>M/L</td><td>0 to 1999
4000 to 4639 (Note)
4800 to 5439
5488 to 8191</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>0000 to B1FFF</td></tr><tr><td>F</td><td>0 to F2047</td></tr></table></td><td></td></tr>
<tr><td>Skip command</td><td>Bit</td><td rowspan="2"><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>0000 to 1FFF</td></tr><tr><td>Y</td><td>0000 to 1FFF</td></tr><tr><td>M/L</td><td>0 to 1999
4000 to 4639 (Note)
4800 to 5439
5488 to 8191</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>0000 to B1FFF</td></tr><tr><td>F</td><td>0 to F2047</td></tr><tr><td>TT (Timer contact)</td><td>0 to 2047</td></tr><tr><td>TC (Timer coil)</td><td>0 to 2047</td></tr><tr><td>CT (Counter contact)</td><td>0 to 1023</td></tr><tr><td>CC (Counter coil)</td><td>0 to 1023</td></tr></table></td><td rowspan="2"></td></tr>
<tr><td>Cancel command</td><td>Bit</td></tr>
</table>

(Note): The synchronous encoder axis area cannot be set.

POINT

· Be sure to designate even-numbered devices for 2-word designation items. Be sure to use the DMOV(P) instruction when setting data in these devices by sequence programs.

(2) Device data fetch

Data for indirectly designated devices is fetched by the PCPU at the start of the servo program.

For this reason, set data in the devices before starting the servo program, and never change the devices unless servo program start is complete.

The following describes the procedures by start method for setting data in devices and the points to note.

Start Method	Setting Method	Notes
Start by SVST instruction	Indirectly designate data in devices. ↓ Start by SVST.	Don't change the indirectly designated device until the positioning start completion signal of the start axis goes ON.
Automatic start by cancel & start	Set data in the indirectly designated device chosen by the start program. ↓ Turns the cancel command device ON.	
Designating loop (FOR to NEXT) point data in the CPSTART instruction indirectly	Designate initial command data in the indirectly designated device ↓ Start by SVST (or set the cancel command device to ON). ↓ Read the value of constant speed control data set pointer of the started axis, and update the data fetched by PCPU.	For details, see the positioning signal data register "Monitoring data Area".

Appendix 3.2 Mechanical system program

The device range and setting method for items indirectly set by devices in the parameters of each module of the mechanical system program are given here.

(1) Device ranges
The number of device words and device ranges when settings are made indirectly are given in the table below.

<table>
<tr><th>Module</th><th>Item</th><th>Number of Device Words</th><th>Device Setting Range</th><th>Remarks</th></tr>
<tr><td rowspan="11">Clutch</td><td>Clutch ON/OFF command device</td><td>Bit</td><td rowspan="12"><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>0000 to 1FFF</td></tr><tr><td>Y</td><td>0000 to 1FFF</td></tr><tr><td>M/L</td><td>0 to 1999
4000 to 4639 (Note)
4800 to 5439
5488 to 8191</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>0000 to B1FFF</td></tr><tr><td>F</td><td>0 to F2047</td></tr><tr><td>TT (Timer contact)</td><td>0 to 2047</td></tr><tr><td>TC (Timer coil)</td><td>0 to 2047</td></tr><tr><td>CT (Counter contact)</td><td>0 to 1023</td></tr><tr><td>CC (Counter coil)</td><td>0 to 1023</td></tr></table></td><td rowspan="12"></td></tr>
<tr><td>Mode setting device</td><td>1</td></tr>
<tr><td>Clutch ON address setting device</td><td>2</td></tr>
<tr><td>Clutch OFF address setting device</td><td>2</td></tr>
<tr><td>Slippage amount setting device</td><td>2</td></tr>
<tr><td rowspan="2">Gear</td><td>Number of input axis gear teeth</td><td>1</td></tr>
<tr><td>Number of output axis gear teeth</td><td>1</td></tr>
<tr><td>Speed change gear</td><td>Speed change ratio setting device</td><td>1</td></tr>
<tr><td>Roller</td><td>Torque limit value setting device</td><td>1</td></tr>
<tr><td>Ball screw</td><td>Torque limit value setting device</td><td>1</td></tr>
<tr><td rowspan="3">Rotary table</td><td>Torque limit value setting device</td><td>1</td></tr>
<tr><td>Virtual axis current value within one revolution storage device (main shaft side)</td><td>2</td></tr>
<tr><td>Virtual axis current value within one revolution storage device (auxiliary input axis side)</td><td>2</td></tr>
<tr><td rowspan="6">Cam</td><td>Cam No. setting device</td><td>1</td></tr>
<tr><td>Stroke setting device</td><td>2</td></tr>
<tr><td>Torque limit value setting device</td><td>1</td></tr>
<tr><td>Stroke lower limit value storage device</td><td>2</td></tr>
<tr><td>Virtual axis current value within one revolution storage device (main shaft side)</td><td>2</td></tr>
<tr><td>Virtual axis current value within one revolution storage device (auxiliary input axis side)</td><td>2</td></tr>
<tr><td colspan="2"><table><tr><th>Device</th><th>Range</th></tr><tr><td>D</td><td>800 to 3069
3080 to 8191</td></tr><tr><td>W</td><td>0000 to 1FFF</td></tr></table></td></tr>
</table>

(Note): The synchronous encoder axis area cannot be set.

POINTS

- For items set using two words, always set an even numbered device. In addition, when setting data in the sequence program for that device, always use the DMOV (P) command.
- When a two word monitor device leads the sequence program, always acquire it in the user device using the DMOV (P) command. Use the fetched device for carrying out such things as upper/lower comparison and calculations.

(2) Device data fetch

When the data of a device that has been set indirectly is switched from the REAL to VIRTUAL mode, first acquire everything as default values and thereafter carry out fetch control during virtual mode operation for the corresponding module.

Shown in the table below are the fetch timing of each device and the refresh cycle of the set device.

Module	Item	Fetch Device	Refresh Device	Device Fetch Timing		Device Refresh Cycle
				REAL → VIRTUAL Mode Switching	During VIRTUAL Mode Operation	
Clutch	Clutch ON/OFF command device	○	——	○	Fetched every operation cycle (Note)	——
	Mode setting device	○	——	○		
	Clutch ON address setting device	○	——	○		
	Clutch OFF address setting device	○	——	○		
	Slippage setting device	○	——	○	——	
Gear	Number of input axis gear teeth	○	——	○	Fetched when the current value change of the connection source drive module (virtual servo motor axis/synchronous encoder axis) is executed (CHGA) and the gear ratio change is carried out	
	Number of output axis gear teeth	○	——	○		
Speed change gear	Speed ratio setting device	○	——	○	Fetched every operation cycle (Note)	
Roller	Torque limit value setting device	○	——	○		
Ball screw	Torque limit value setting device	○	——	○		
Rotary table	Torque limit value setting device	○	——	○		
	Virtual axis current value within one revolution storage device (main shaft side)	——	○	——	——	Operation cycle (Note)
	Virtual axis current value within one revolution storage device (auxiliary input axis side)	——	○	——		
Cam	Cam No. setting device	○	——	○	Fetched every operation cycle (Note). However, the cam No. and stroke switching position pass point are enabled.	——
	Stroke setting device	○	——	○		
	Torque limit value setting device	○	——	○	Fetched every operation cycle (Note).	
	Stroke lower limit storage device	——	○	——	——	Operation cycle (Note)
	Virtual axis current value within one revolution storage device (main shaft side)	——	○	——		
	Virtual axis current value within one revolution storage device (auxiliary input axis side)	——	○	——		

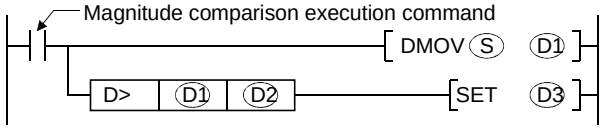
(Note): Refer to Appendix 2 (1).

APPENDIX 4 Magnitude Comparison and Four Fundamental Operations of 32-Bit Monitor Data

When a machine value, real current value or deviation counter value is used to perform magnitude comparison or four fundamental operations, the value must be transferred to another device memory once and the device memory of the transfer destination be used to perform processing as described below.

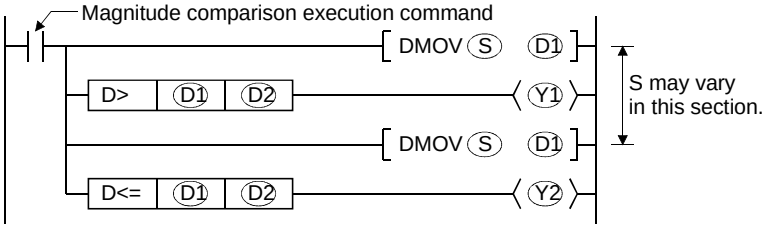
(1) Magnitude comparison example

(a) To set the device when the machine value has become more than the set value

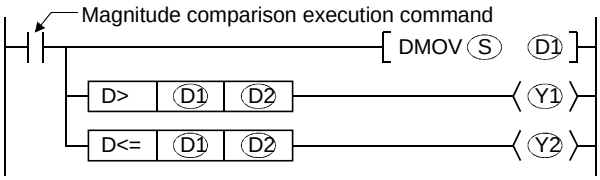


1) S, D1, D2 and D3 indicate the following.
   S : Machine value
   D1 : Device memory for temporary storage
   D2 : Set value for magnitude comparison
   D3 : Device for setting magnitude comparison result

(b) When one piece of monitor data is referred to many times to perform comparison processing, intended operation may not be performed if the monitor data is transferred every processing as shown in program example 1. In program example 1, neither Y1 nor Y2 may turn ON. (This also applies to the case of 16-bit monitor data.)
This is because the S value varies asynchronously with the sequence scan. To perform such processing, transfer the monitor data to another device memory once, and after that, use that value to perform comparison processing as shown in program example 2.
[Program example 1]

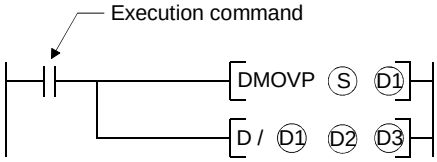


[Program example 2]



1) S, D1, D2, Y1 and Y2 indicate the following.
   S : Machine value
   D1 : Device memory for temporary storage
   D2 : Set value for magnitude comparison
   Y1 : Magnitude comparison result output device (Result: more than)
   Y2 : Magnitude comparison result output device (Result: Equal to or less than)

(2) Four fundamental operations example
To divide the real current value by the set value



1) S, D1, D2 and D3 indicate the following.
S : Real current value
D1 : Device memory for temporary storage
D2 : Division
D3 : Operation result storage device

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