MITSUBISHI

Changes for the Better

Mitsubishi Programmable
Logic Controller

Training Manual

QD75 Positioning course(Q-series)

MELSEC

• SAFETY PRECAUTIONS •

(Always read these instructions before the exercise.)

When designing the system, always read the relevant manuals and give sufficient consideration to safety.
During the exercise, pay full attention to the following points and handle the product correctly.

[EXERCISE PRECAUTIONS]

⚠ WARNING

- Do not touch the terminals while the power is on to prevent electric shock.
- When opening the safety cover, turn off the power or conduct a sufficient check of safety before operation.

⚠ Caution

- Follow the instructor's direction during the exercise.
- Do not remove the module of the demonstration machine or change wirings without permission.
  Doing so may cause failures, malfunctions, personal injuries and/or a fire.
- Turn off the power before installing or removing the module.
  Failure to do so may result in malfunctions of the module or electric shock.
- When the demonstration machine (X/Y table, etc.) emits abnormal odor/sound, press "Power switch" or "Emergency switch" to turn off.
- When a problem occurs, notify the instructor as soon as possible.

REVISIONS

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

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INTRODUCTION

This textbook is a school textbook that allows you to easily understand the 1-axis and multiple axes control by the positioning module of MELSEC-Q series.
For a good understanding of the QD75 positioning module features, this textbook describes the data settings for positioning, the sequence program creating method, the monitoring operation and the test operation by using the QD75D4 positioning module and the Windows version (QD75P, GPPW) software packages for a demonstration machine.
As this textbook avoids any mention of the advanced positioning control (block start, etc.), refer to the user's manual for them.

The related manuals are shown below.

(1) QD75 Positioning Module User's Manual
Type QD75P/QD75D Positioning Module
User's Manual ..... SH(NA)-080058

(2) Operating Manual
GX Configurator-QP Operating Manual ..... SH(NA)-080172
GX Developer Version8 Operating Manual.....SH(NA)-080373E

(3) QCPU (Q mode) User's Manual
QCPU User's Manual
(Function Explanation,Program Fundamentals) .....SH(NA)-080484ENG

(4) Servo
MR-H□AN Instruction Manual ..... SH(NA)-3190
MR-J2-03A5 Instruction Manual ..... SH(NA)-3200
MR-J2S-□A Instruction Manual..... SH(NA)-030006
MR-C□A Instruction Manual..... SH(NA)-3167
Servo Motor Instruction Manual ..... SH(NA)-3181

MEMO

CHAPTER1 PRODUCT OUTLINE

1.1 Positioning Control

1.1.1 Features of QD75

The features of the QD75 are shown below.

(1) Availability of modules for one-, two- and four- axis controls

(a) There are three models available for both the open collector system pulse output (QD75P1, QD75P2, and QD75P4) and differential driver system pulse output (QD75D1, QD75D2, and QD75D4).
An optimum model can be selected by the drive unit type and the number of axes.

(b) For connecting any of the QD75 modules to the base unit, a single slot and 32 I/O points are required.
Within the limit imposed by the maximum I/O points of the PLC CPU, up to 64 modules can be used.

(2) Positioning control function

(a) A wide variety of positioning control functions for positioning systems is supported.

1) Up to 600 positioning data to each of which information such as positioning address, control system, and operation pattern can be specified can be set for each axis.
As all positioning data are stored in a buffer memory, they can be read/written freely.

2) For independent control of each axis, linear control is executable simultaneously over four axes.
Such control can either be the independent positioning control using a single positioning data or the continuous positioning control enabled by the continuous processing of multiple positioning data.

3) For coordinated control over multiple axes, the QD75 allows the linear interpolation through the speed or position control of two to four axes or the circular interpolation on two axes.
Such control can either be the independent positioning control using a single positioning data or the continuous positioning control enabled by the continuous processing of multiple positioning data.

(b) For each positioning data, the user can specify any of the following control methods: position control, fixed-feed control, speed control, speed-position switching control, position-speed switching control, and so on.

(c) Enhanced zero return (OPR) control

1) Six different machine OPR methods are provided: the zeroing dog method (one method), stopper methods (three methods) and count methods (two methods).

2) The OPR retry function facilitates the machine OPR control from an arbitrary position.
(The machine OP is a premier reference position in positioning control, and is set by the machine OPR mentioned in 1) above.)

(d) Two acceleration/deceleration methods (selectable by users) are provided: automatic trapezoidal acceleration/deceleration and S-curve acceleration/deceleration. (The S-curve acceleration/deceleration control is disabled if stepping motors are used.)

(3) Quick startup

A positioning operation starts up quickly taking as little as 6 ms to 7 ms.
When operation using simultaneous start function (independent operation, interpolation operation) is executed, the axes start without delay. (Quick startup of the AD75 takes 20ms.)

(4) Faster pulse output and longer maximum distance to drive unit

The differential driver type modules (QD75D1, QD75D2 and QD75D4) incorporate the following improvements in the pulse output speed and the maximum distance to the drive unit.

- For the differential driver type module, QD75D1/QD75D2/QD75D4: 1 Mpulse/s, 10m max.
- For the open collector type, QD75P1/QD75P2/QD75P4: 200 kpulse/s, 2m max. (For the differential driver type module AD75: 400 kpulse/s, 10m max.)

(5) Easy maintenance

Each QD75 positioning module incorporates the following improvements in maintainability:

(a) Data such as the positioning data and parameters can be stored on a flash ROM inside the QD75, eliminating the need of a battery for retaining data.

(b) Error contents are classified in more detail to facilitate the initial fault diagnosis.

(c) The module retains 16 error data and 16 warning data, offering easier confirmation of error and warning histories.

(6) Support of intelligent function module dedicated instructions

Dedicated instructions such as the positioning start instruction and teaching instruction are provided.
The use of such dedicated instruction simplifies sequence programs.

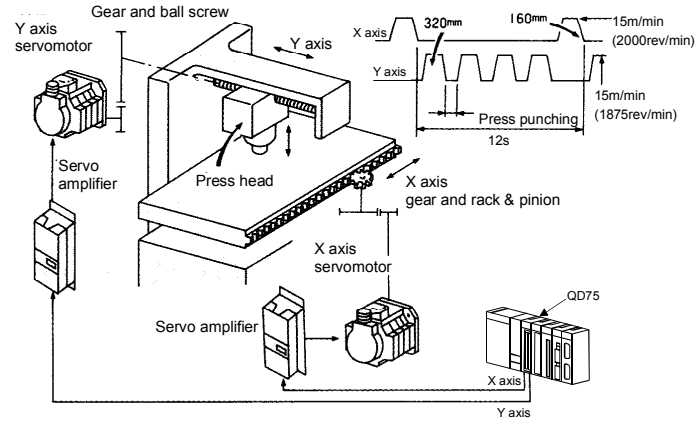
(7) Support of setting, monitoring and testing with a software package for positioning

Using a software package for positioning (SW□D5C-QD75P), the user can set the QD75 parameters and positioning data without considering the buffer memory addresses.
Moreover, the software package has a test function which allows the user to check the wiring before creating a sequence program for positioning control, or to test the QD75 using set parameters and positioning data for checking their integrity.
The control monitor function allows the user to debug programs efficiently.

1.1.2 Purpose and applications of positioning control

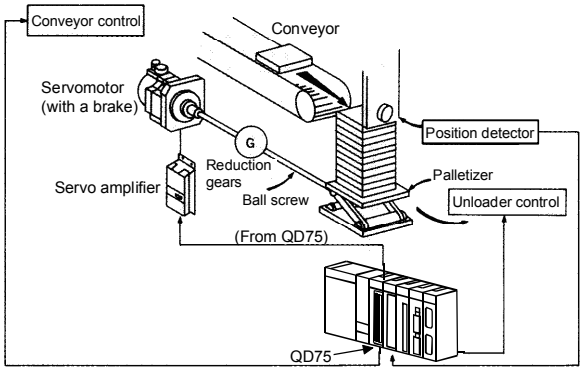
"Positioning" refers to moving a moving body, such as a workpiece or tool (hereinafter called "workpiece"), at a designated speed, and accurately stopping it at the target position. The main application examples are shown below.

■ Punch press (X, Y feed positioning)



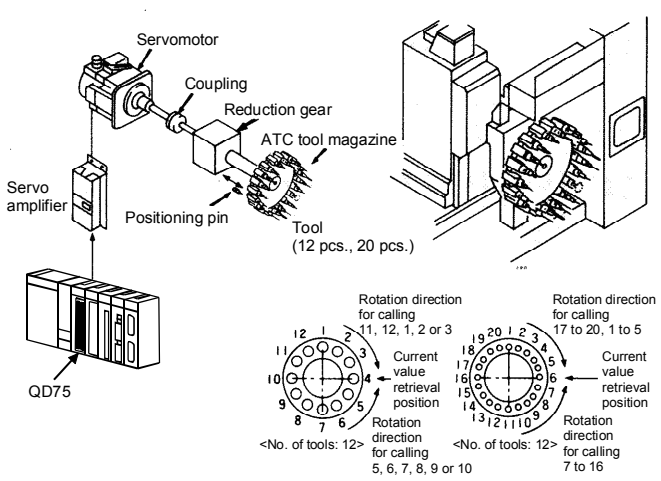
- To punch an insulation material, leather, etc., in the same shape at a high yield, positioning is carried out with the X axis and Y axis servos.
- After positioning the table with the X axis servo, the press head is positioned with the Y axis servo to punch the workpiece with the press
- When the material type or shape changes, the press. head die and the positioning pattern must be changed.

■ Palletizer



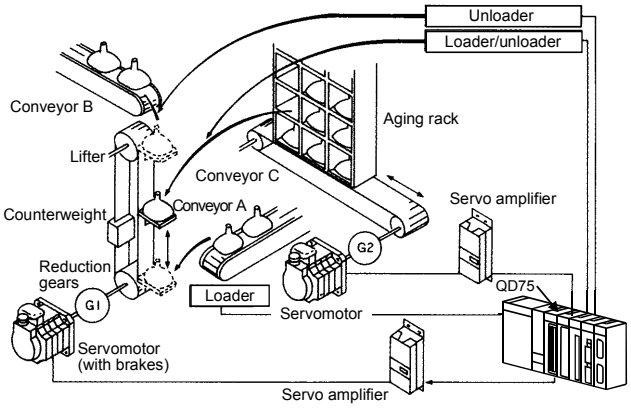
- Using the 1-axis servo, the palletizer is positioned at a high accuracy.
- The amount to lower the palletizer according to the material thickness is saved.

■ Compact machining center (ATC magazine positioning)



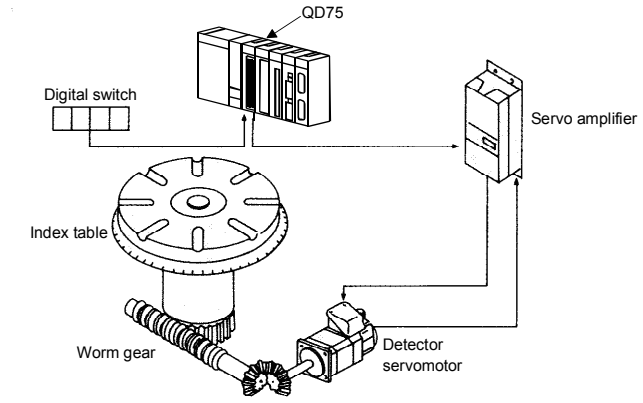
- The ATC tool magazine for a compact machining center is positioned.
- The relation between the magazine's current value and target value is calculated so the positioning is performed in the forward or reverse direction, whichever is shorter access.

■ Lifter (Storage of Braun tubes onto aging rack)



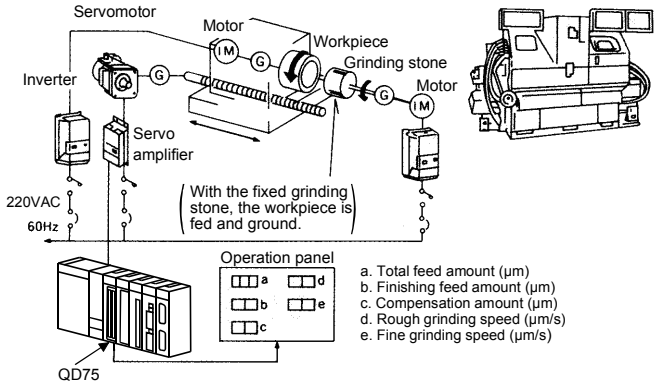
- For the aging process, CRTs are stored onto the rack by positioning with the AC servo.
- The lifter is vertically positioned with the 1-axis servo, and the aging rack is horizontally positioned with the 2-axis servo.

■ Index table (High-accuracy indexing of angles)



- The index table is positioned at a high accuracy using the 1-axis servo.

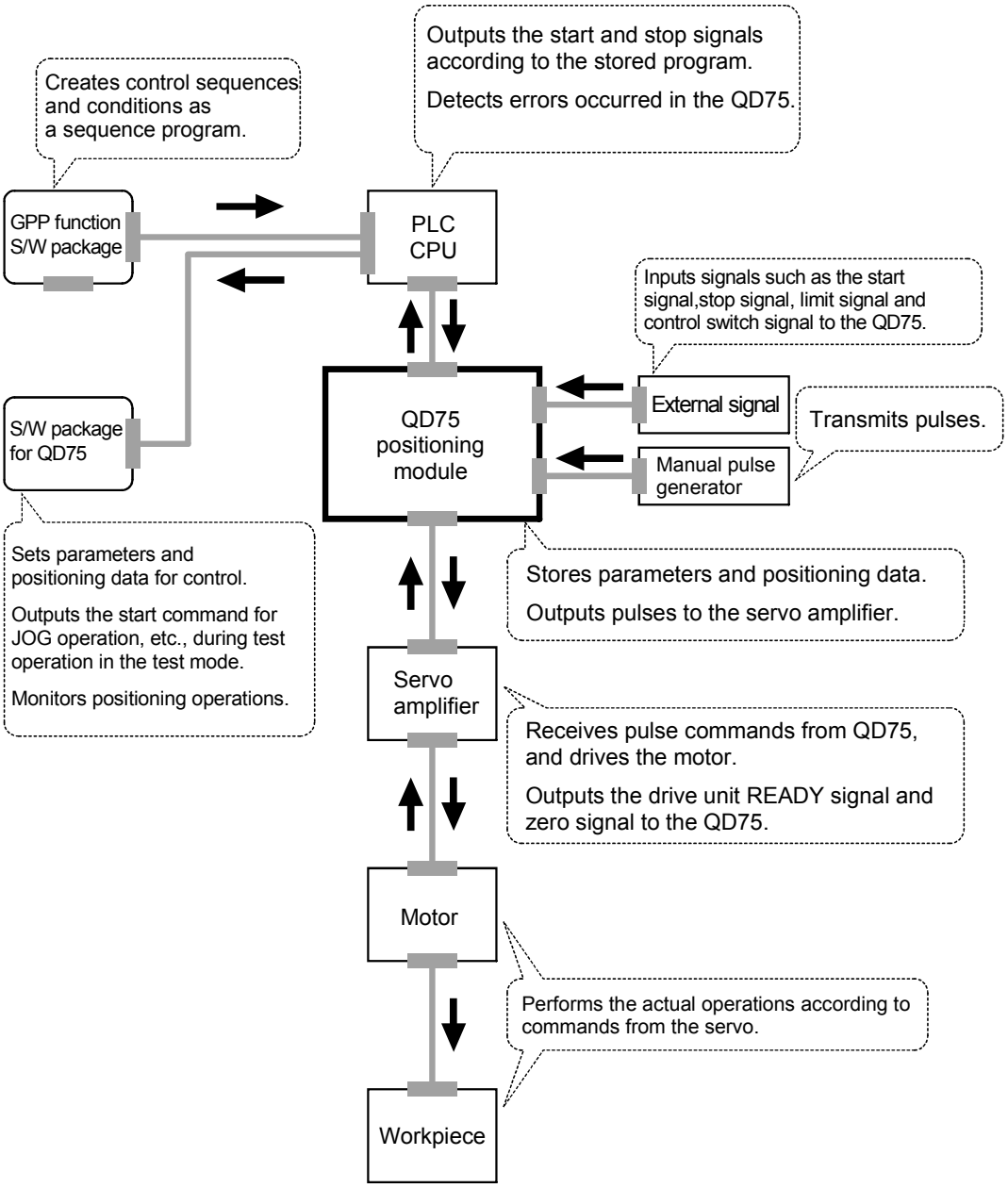
■ Inner surface grinder



- The grinding of the workpiece's inner surface is controlled with the servo and the inverter.
- Rotation of the workpiece is controlled with the 1-axis inverter, and that of the grinding stone is controlled with the 2-axis inverter. The workpiece is fed and ground with the 3-axis servo.

1.1.3 Mechanism of positioning control

Positioning control using the QD75 is carried out with "pulse signals". (The QD75 is a pulse-generating module.)
In the positioning system using the QD75, software packages for the QD75 and the GPP functions and external devices are used as shown in the diagram below.
Controlled by a PLC CPU, the QD75 realizes complicated positioning control, by reading in various signals, parameters and positioning data.



(1) Principe of position commands

The total No. of pulses required to move the designated distance is obtained in the following manner.

$$\left(\begin{array}{l}\text{Total No. of pulses required to}\\ \text{move designated distance}\end{array}\right) = \frac{\left(\text{Designated distance}\right)}{\left(\begin{array}{l}\text{Machine (load) side moving distance}\\ \text{for each motor rotation}\end{array}\right)} \times \left(\begin{array}{l}\text{No. of pulses required}\\ \text{for motor to rotate once}\end{array}\right)$$

*The No. of pulses required for the motor to rotate once is the "encoder resolution" shown in the motor catalog specifications.

When this total No. of pulses is issued from the QD75 to the servo amplifier, control to move the designated distance can be executed.
The machine side moving amount produced by outputting one pulse to the servo amplifier is called the "moving amount per pulse". This value is the minimum value for the workpiece motion, and represents the electrical positioning accuracy.

(2) Principe of speed commands

A speed command is controlled by the frequency of pulses output from the QD75 to a drive unit.

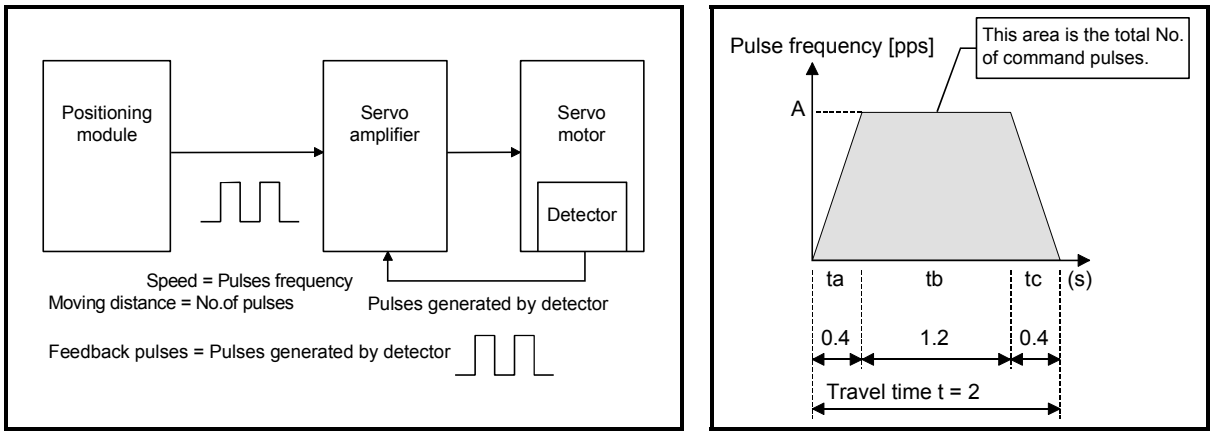


Fig. 1.1 Relationship between position control and speed control

POINT
The QD75 controls positions with "total No. of pulses" and speeds with "pulse frequency".

1.1.4 Outline design of positioning system

The outline of the positioning system operation and design, using the QD75, is shown below.

(1) Positioning system using QD75

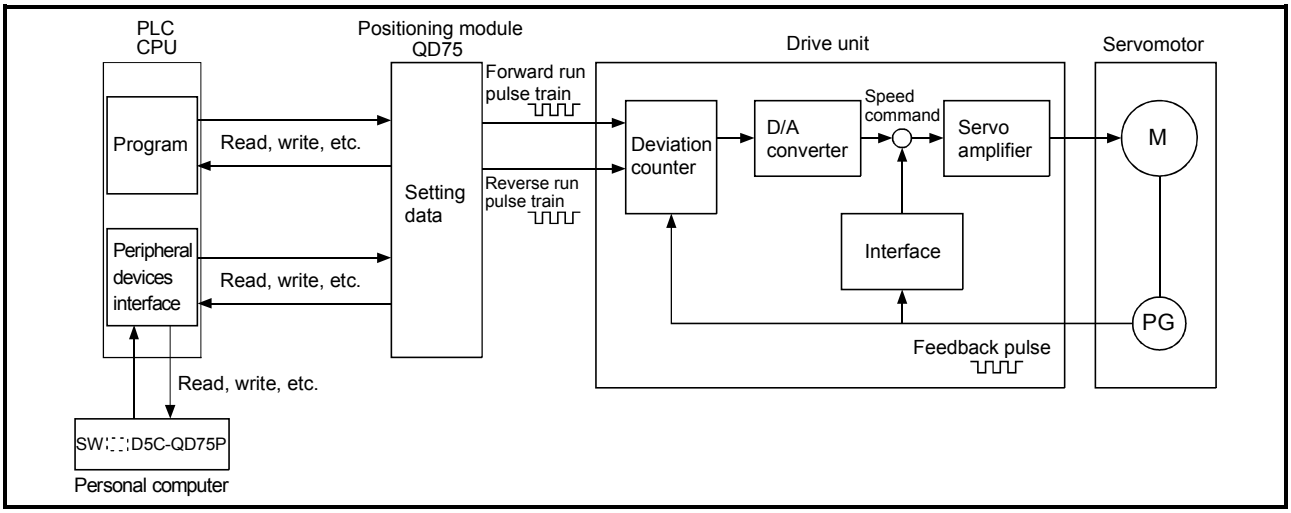


Fig. 1.2 Outline of the operation of positioning system using QD75

(a) Positioning operation by the QD75

1) The QD75 output is a pulse train.
The pulse train output by the QD75 is counted by and stored in the deviation counter in the drive unit.
The D/A converter outputs an analog DC current proportionate to the count maintained by the deviation counter (called "pulse droop"). The analog DC current serves as the servomotor speed control signal.

2) The motor rotation is controlled by the speed control signal from the drive unit.
As the motor rotates, the pulse generator (PG) attached to the motor generates feedback pulses, the frequency of which is proportionate to the rotation speed.
The feedback pulses are fed back to the drive unit and decrements the pulse droop, the pulse count maintained by the deviation counter.
The motor keeps on rotating as the pulse droop is maintained at a certain level.

3) After the QD75 terminates the output of a pulse train, the motor decelerates as the pulse droop decreases, and stops when the count drops to zero.
Thus, the motor rotation speed is proportionate to the command pulse frequency, while the overall motor rotation angle is proportionate to the total number of command pulses output by the QD75.
Therefore, when a movement amount per pulse is given, the overall movement amount can be determined by the number of pulses in the pulse train.
The pulse frequency, on the other hand, determines the motor rotation speed (feed speed).

(b) Pulse train output from the QD75

1) As shown in Fig. 1.3, the pulse frequency increases as the motor accelerates. The pulses are sparse when the motor starts and more frequent when the motor speed comes close to the target speed.
2) The pulse frequency stabilizes when the motor speed equals the target speed.
3) The QD75 decreases the pulse frequency (sparser pulses) to decelerate the motor before it finally stops the output.
   There will be a little time delay between the decrease in the pulse frequency and the actual deceleration and stopping of the motor.
   This difference, called "the stop settling time", is required for gaining a stopping accuracy.

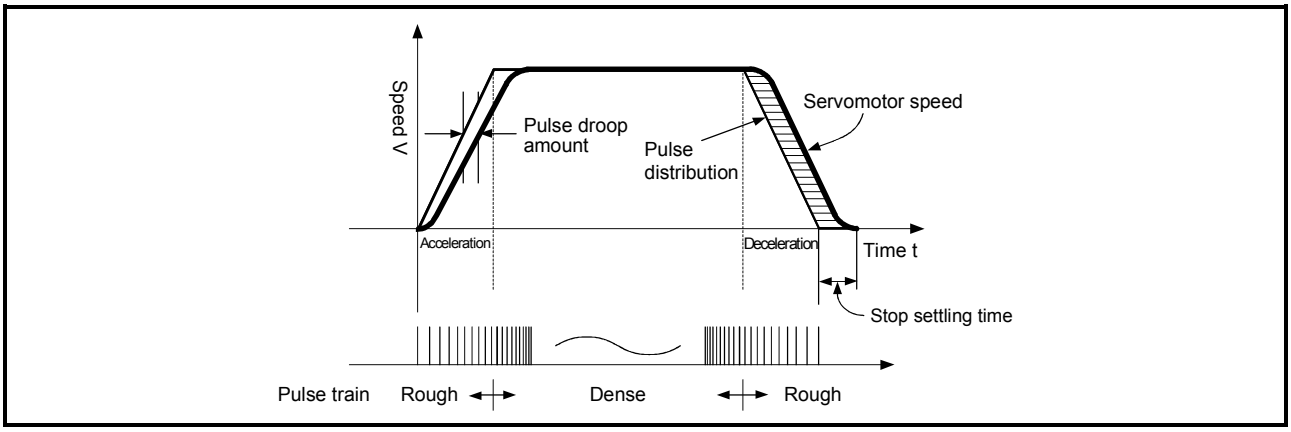
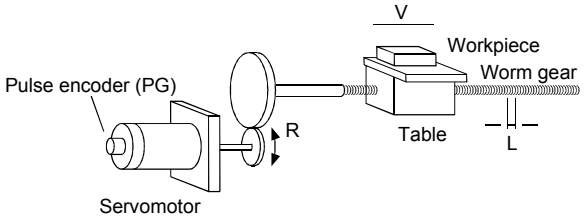


Fig. 1.3 QD75 output pulses

(2) Movement amount and speed in a system using worm gears



A : Position detection unit (mm/pulse)
Vs : Command pulse frequency (pulse/s)
n : Number of pulse generator's slits (number of pulses) (pulse/rev)
L : Worm gear lead (mm/rev)
R : Deceleration ratio
V : Movable section speed (mm/s)
N : Motor speed (r/min)
K : Position loop gain (1/s)
ε : Deviation counter droop pulse amount

Fig. 1.4 System using worm gears

(a) In the system shown in Fig. 1.4, the position detection unit, command pulse frequency, and the deviation counter droop pulse amount are determined as follows:

1) Position detection unit

The position detection unit is determined by the worm gear lead, deceleration ratio, and the number of pulse generator's slits.

The movement amount per pulse in the QD75 is a position detection unit.

The movement amount, therefore, is given as follows: (Number of output pulses) x (Position detection unit).

$$A = \frac{L}{R \times n} \text{ [mm/pulse]}$$

2) Command pulse frequency

The command pulse frequency is determined by the speed of the moving part and position detection unit:

$$Vs = \frac{V}{A} \text{ [Pulse/s]}$$

3) Deviation counter droop pulse amount.

The deviation counter droop pulse amount is determined by the command pulse frequency and position loop gain.

$$\varepsilon = \frac{Vs}{K} \text{ [Pulse]}$$

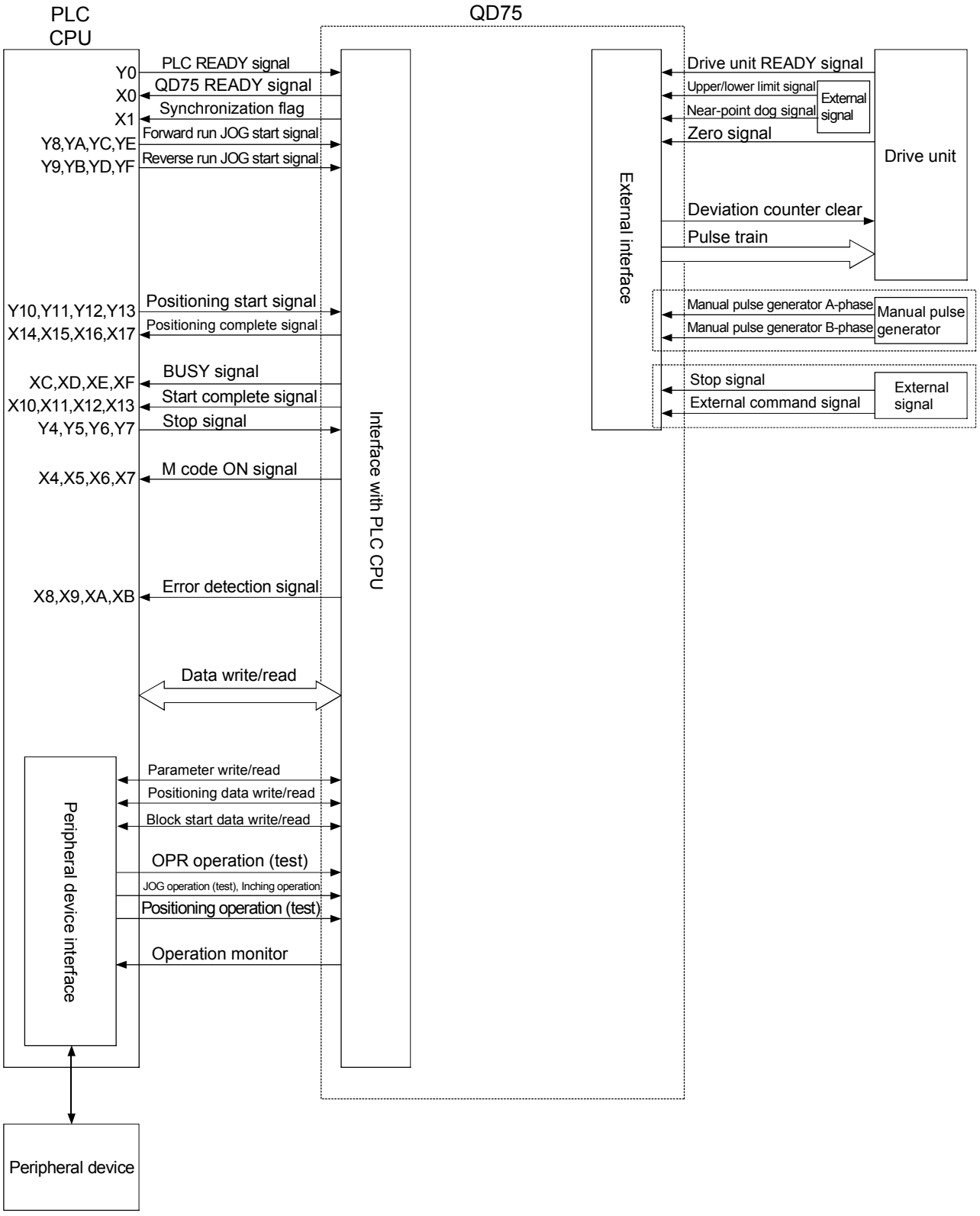
(b) The QD75 allows the user to select from the following four units as the unit used by positioning commands to any of axes (1 to 4, if the module supports four axes): mm, inch, degree, and pulse.

The unit selected for one axis can be different from the unit selected for another axis.

When data such as the movement amount per pulse, acceleration/deceleration time, positioning speed, and positioning address are correctly set in consideration of the chosen unit, the QD75 can calculate the number of pulses required for a movement amount to the target positioning address and execute the positioning by outputting the pulse train of the calculated number of pulses.

1.1.5 Communicating signals between QD75 and each module

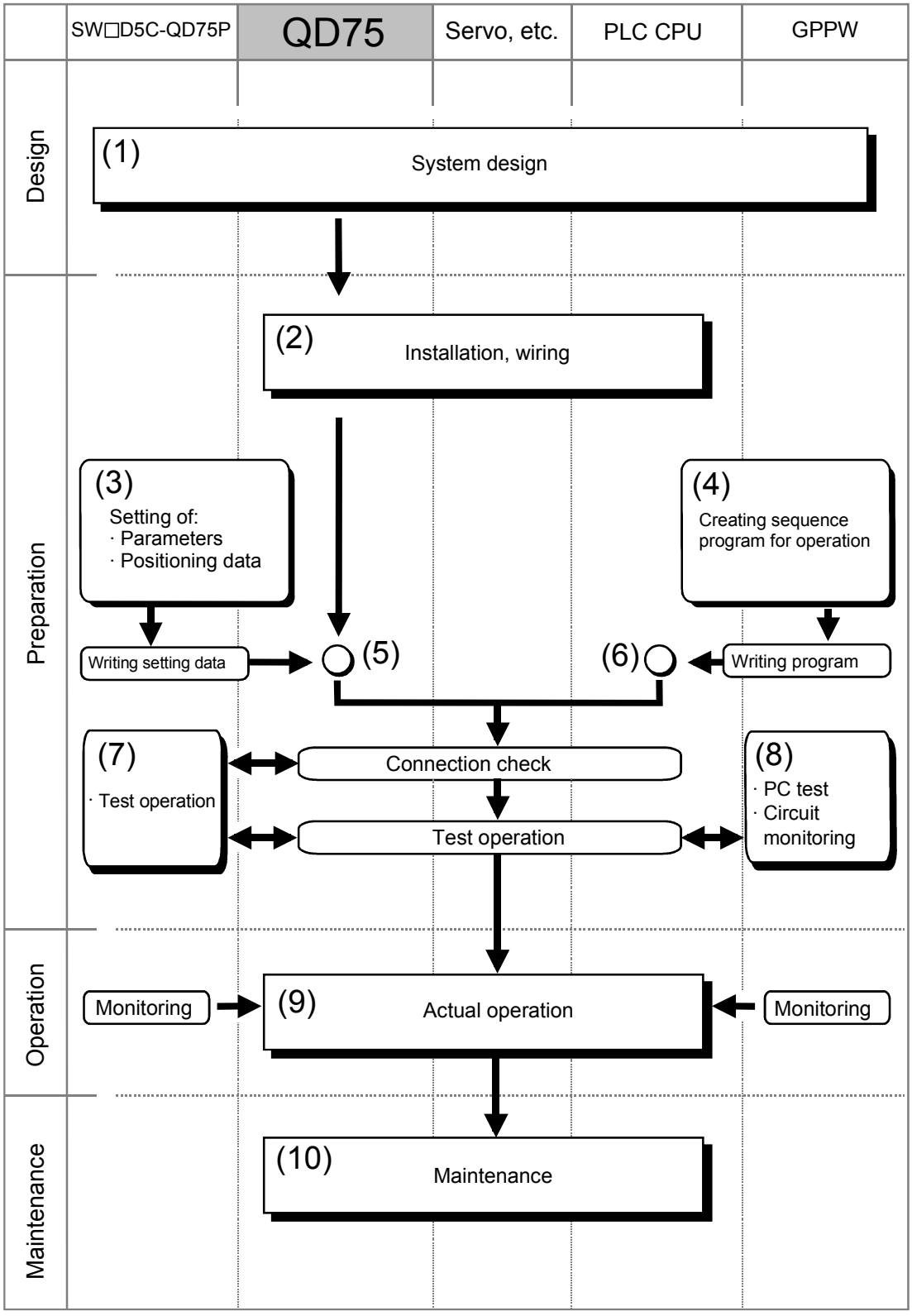
The outline of the signal communication between the QD75 and PLC CPU, peripheral device and drive unit, etc., is shown below.
(A peripheral device communicates with the QD75 via the PLC CPU to which it is connected)



1.2 Flow of System Operation

1.2.1 Flow of the entire processes

The positioning control processes, using the QD75, are shown below.



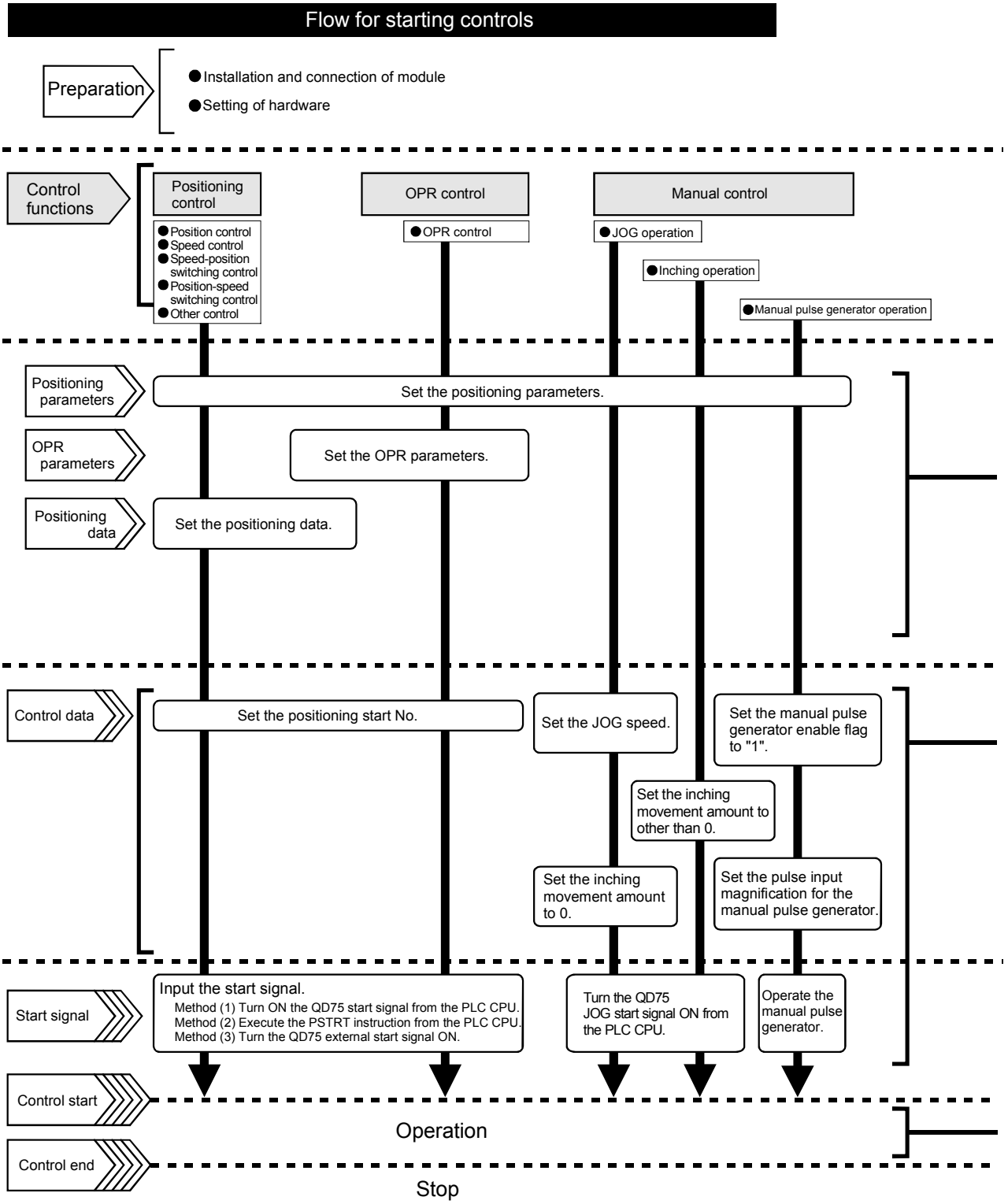
The following operations are performed for the processes shown on the previous page.

	Description	Reference
1)	Understand the product functions and usage, and related devices and specifications required for positioning control, to determine the operation method and design the system.	
2)	Install the QD75 onto the base unit, wire the QD75 and external devices (drive unit, etc.), and connect the PLC CPU to peripheral devices.	• QD75 User's Manual (Details)
3)	Using the S/W package for the QD75, set parameters and positioning data required for the positioning control to be executed.	• S/W Package for QD75 Operating Manual
4)	Using the GPP function S/W package, create a sequence program required for positioning operation.	• GPP Function S/W Package Operating Manual
5)	Write the parameters and positioning data, etc., created with the S/W package into the QD75.	• S/W Package for QD75 Operating Manual
6)	Using the GPP function S/W package, write the created sequence program into the PLC CPU.	• GPP Function S/W Package Operating Manual
7)	Check the connection between the QD75 and external devices, and test the system to check whether the designated positioning operation is executed correctly.	• S/W Package for QD75 Operating Manual
8)	Carry out test operation to confirm that the designated positioning operation is executed correctly.	• GPP Function S/W Package Operating Manual
9)	Actually operate the positioning operation. At this time, monitor the operation state as required. If an error or warning occurs, take corrective actions.	• QD75 User's Manual (Details) • S/W Package for QD75 Operating Manual • GPP Function S/W Package Operating Manual
10)	Inspect and service the QD75 as required.	• QD75 User's Manual

1.2.2 Outline for start

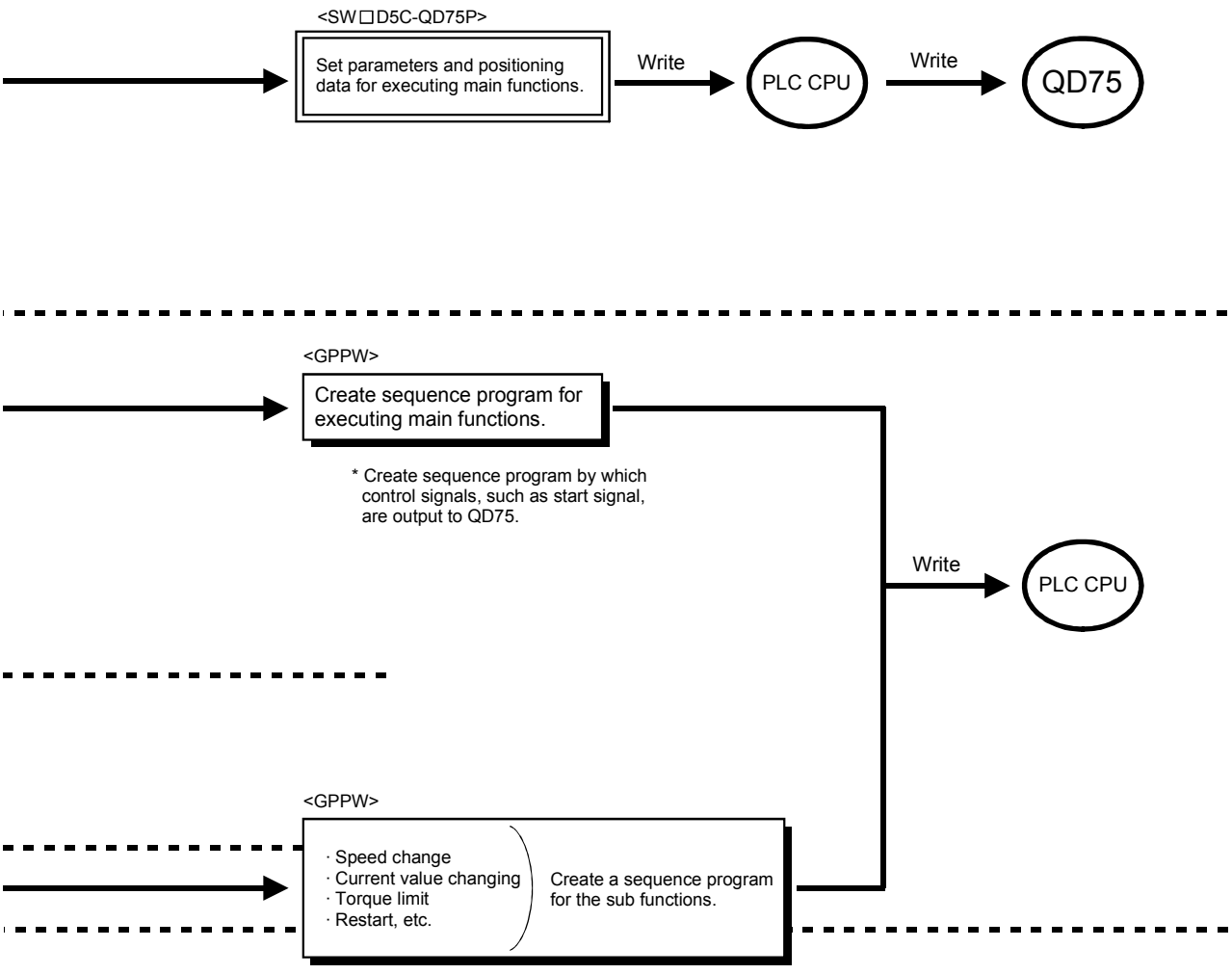
The outline for starting each control is shown in the following flowchart.

* The following chart is made on the premise that each module installation and required system configuration has been completed.



Setting method

: Indicates the sequence program that must be created.



1.2.3 Outline for stop

Each control may be stopped in the following cases.

(1) When each control is completed normally.
(2) When the drive unit READY signal is turned OFF.
(3) When the PLC READY signal is turned OFF.
(A stop error such as "parameter error" or "watchdog timer error" occurred.)
(4) When an error occurred in the QD75.
(5) When control is intentionally stopped by turning on the stop signal from PLC CPU or the stop signal from an external device.

The outline for the stop processing in these cases is shown below.
(Excluding (1), the case of normal stop.)

Stop factor		Stop axis	Axis operation status after stop	Stop processing				
				OPR control		Positioning control	Manual control	
				Machine OPR control	Fast OPR control		Inching operation JOG operation	Manual pulse generator operation
Forced stop	Drive unit READY signal OFF	Each axis	Error	Immediate stop				Deceleration stop
Fatal stop (Stop group 1)	Hardware stroke limit signal ON	Each axis	Error	Deceleration stop/sudden stop (Select from "sudden stop group1 sudden stop selection")				Deceleration stop
Emergency stop (Stop group 2)	I/O reset PLC READY signal OFF Error in test mode	All axes	Error	Deceleration stop/sudden stop (Select from "sudden stop group2 sudden stop selection")				Deceleration stop
Relatively safe stop (Stop group 3)	Axis error detection (Error other than stop group 1 or 2) "Stop signal" from peripheral device	Each axis	Error	Deceleration stop/sudden stop (Select from "sudden stop group3 sudden stop selection")				Deceleration stop
Intentional stop (Stop group 3)	"Stop signal" ON from external source "Axis stop signal" from PLC CPU turns ON.	Each axis	Stop (While waiting)					

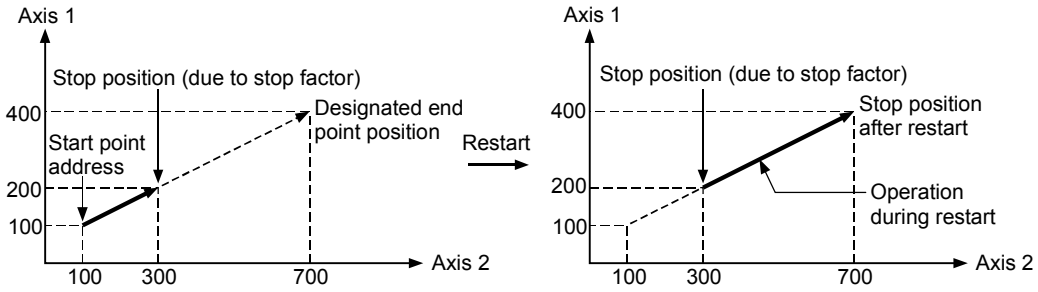
1.2.4 Outline for restart

When a stop is caused by a stop factor during position control, the positioning can be restarted from the stop position to the end point specified in the positioning data by using the "restart command".
For the case of continuous positioning or continuous path control operation, the positioning is restarted from the stop position shown in the positioning data No. associated with the moment when the movement was stopped.

(1) If the "axis operation status" is "stop", positioning to the end point of the positioning data will be restarted from the stop position regardless of using the absolute system or the incremental system.

(2) When "axis operation status" is not "stop", the warning "restart not possible" (warning code: 104) will be output, and the restart command will be ignored.

(3) The following shows the restart operation when the axis 1 movement amount is 300 and the axis 2 movement amount is 600.



1.3 Cautions for Using a Stepping Motor

Pay attention to the following when using a stepping motor:

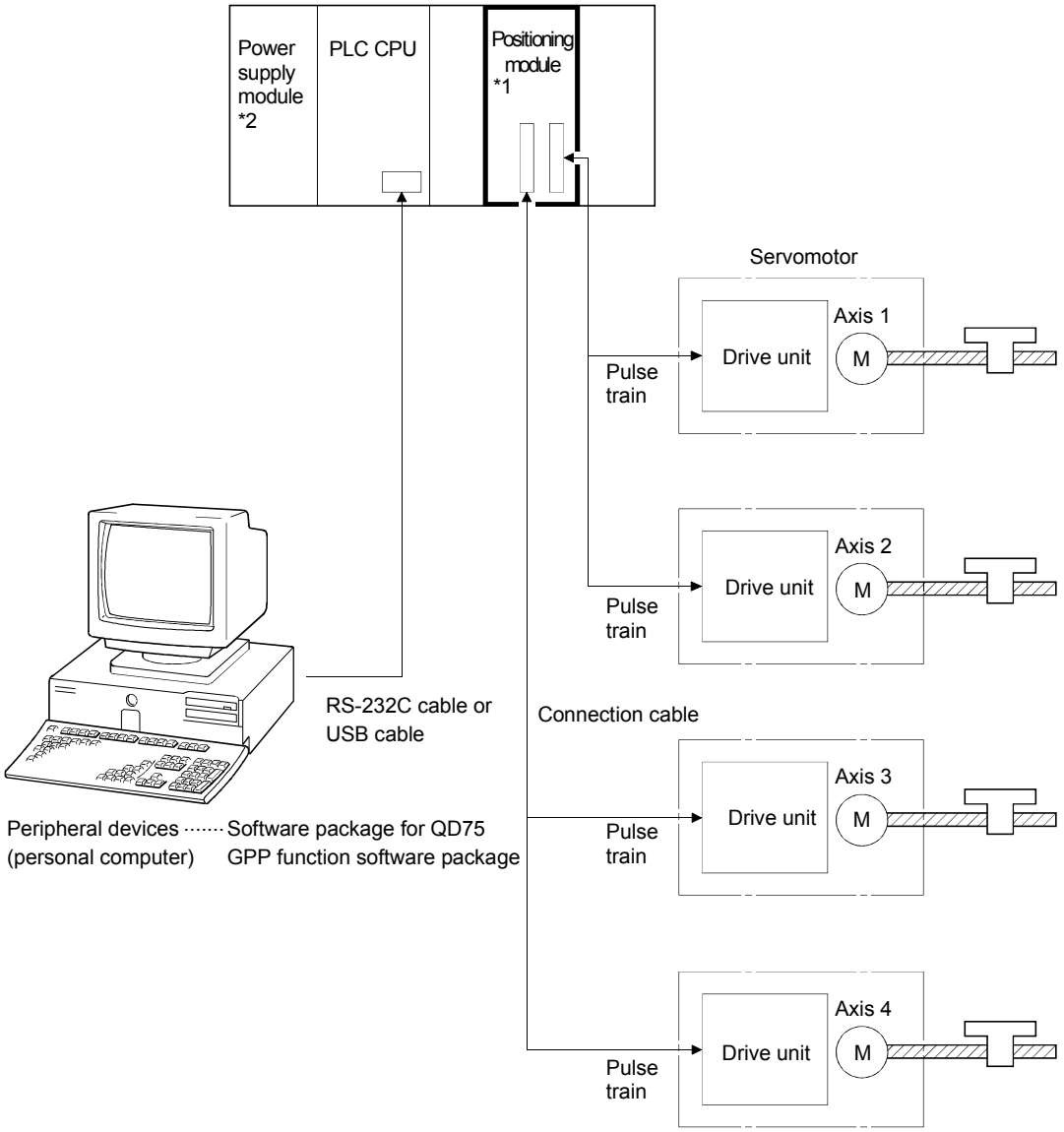
(1) The S-curve acceleration/deceleration is not available in systems where stepping motors are used.
To employ the S-curve acceleration/deceleration, a servomotor is needed.

(2) The circular interpolation control is not available in systems where stepping motors are used.
(To employ the circular interpolation control, servomotors are needed for both of two controlled axes.)

CHAPTER 2 SYSTEM CONFIGURATION

2.1 System Overview

The entire system including the QD75, a PLC CPU and peripheral devices is shown below.



*1: This is an example of a four-axis module (QD75P4, QD75D4).

*2: The capacity of the power supply module should exceed the inclusive sum of internal current consumption of all modules on the base unit and extension base units (without power supply).

2.2 Device List

The positioning system using the QD75 is composed of the following devices.

Product name	Type	Remarks
Positioning module	QD75P1 QD75P2 QD75P4 QD75D1 QD75D2 QD75D4	QD75□□ └ No. of control axes └ · P ------- Open collector output system · D ------- Differential driver output system
Software package for QD75	SW□D5C-QD75P	Software package for Windows 95, Windows 98, Windows NT 4.0J
Peripheral device (Personal computer)	PC9800 series, IBM PC/AT personal computer	(Prepared by users) Refer to the relevant GPPW Operating Manual for details.
RS-232C cable	QC30R2	(Prepared by users) Used for connecting a CPU module to a PC9800 series or IBM PC/AT personal computer. Refer to SW□D5C-QD75P Operating Manual for details.
USB cable	—	(Prepared by users) Used for connecting a CPU module to a PC9800 series or IBM PC/AT personal computer. Refer to SW□D5C-QD75P Operating Manual for details.
Drive unit	—	(Prepared by users)
Connection cable*1 (For connection between QD75 and drive unit)	—	(Prepared by users) Needed to connect the QD75 to the drive unit, manual pulse generator, and input devices in the machine system. (Produce cables referring to the manuals for the connected devices and information given in 3.4 of this manual.)

*1: The following cables for connection between the QD75 and the drive unit are manufactured by Mitsubishi Electric Engineering Co., Ltd.

Model	Connectable QD75	Remarks
FA-CBLQ75M2H(-P)	QD75D1 QD75D2 QD75D4	MR-HA series (Mitsubishi Electric)
FA-CBLQ75M2J2(-P)		MR-J2/J2SA series (Mitsubishi Electric)
FA-CBLQ75M2C(-P)		MR-C series (Mitsubishi Electric)
FA-CBLQ75Y2ΣⅡ(-P)		Σ-Ⅱ series (YASKAWA Electric)
FA-CBLQ75P2A(-P)		MINAS A series (MATSUSHITA Electric)
FA-CBLQ75S2PY(-P)		PYO series (SANYO DENKI)
FA-CBLQ75G2(-P)	QD75P1 QD75P2 QD75P4 QD75D1 QD75D2 QD75D4	Untied wire type for the other end (For connection between the QD75 and a stepping motor manufactured by Oriental Motor Co., Ltd.)

Cable length is 2m and one cable supports up to 2 axes.
Please contact Mitsubishi Electric Engineering Co., Ltd for the inquiry about cables.

2.3 Applicable System

The QD75 can be used in the following system.

(1) Applicable CPU modules
The QD 75 is applicable to CPU modules that can be operated in the Q mode.
Q02CPU, Q02HCPU, Q06HCPU,
Q12HCPU, Q25HCPU

(2) Number of installable modules
Within the I/O point range of the PLC CPU, up to 64 modules can be used.

(3) Mounting slot
The QD 75 can be installed in any slot position in a base unit or extension unit.
When installing the QD75, always consider the power supply capacity since it may be insufficient depending on the combination with other installed modules and the number of these modules.

CHAPTER 3 SPECIFICATIONS AND FUNCTIONS

3.1 Performance Specifications

Table 3.1 Performance specifications

Item \ Model		QD75P1 *1 QD75D1	QD75P2 *1 QD75D2	QD75P4 *1 QD75D4
No. of control axes		1 axis	2 axes	4 axes
Interpolation function (Explained in Chapter 7)		None	2-axis linear interpolation 2-axis circular interpolation	2-, 3-, or 4-axis linear interpolation 2-axis circular interpolation
Control system		PTP (Point to Point) control, path control (both linear and arc can be set), speed control, speed-position switching control, position-speed switching control		
Control unit		mm, inch, degree, pulse		
Positioning data		600 data (positioning data Nos. 1 to 600)/axis (Can be set with peripheral device or sequence program.)		
Backup		Parameters, positioning data, and block start data can be saved on flash ROM (battery-less backup)		
Positioning	Positioning system	PTP control : Incremental system/absolute system Speed-position switching control : Incremental system Position-speed switching control : Incremental system Path control : Incremental system/absolute system		
	Positioning range	In absolute system • - 214748364.8 to 214748364.7 (μm) • - 21474.83648 to 21474.83647 (inch) • 0 to 359.99999 (degree) • - 2147483648 to 2147483647 (pulse) In incremental system • - 214748364.8 to 214748364.7 (μm) • - 21474.83648 to 21474.83647 (inch) • - 21474.83648 to 21474.83647 (degree) • - 2147483648 to 2147483647 (pulse) In speed-positioning switching control/positioning-speed switching control • 0 to 214748364.7 (μm) • 0 to 21474.83647 (inch) • 0 to21474.83647 (degree) • 0 to 2147483647 (pulse)		
	Speed command	0.01 to 20000000.00 (mm/min) 0.001 to 2000000.000 (inch/min) 0.001 to 2000000.000 (degree/min) 1 to 1000000 (pulse/s)		
	Acceleration/deceleration process	Automatic trapezoidal acceleration/deceleration, S-curve acceleration/deceleration		
	Acceleration/deceleration time	1 to 8388608 (ms) Four patterns can be set for each of acceleration time and deceleration time		
	Sudden stop deceleration time	1 to 8388608 (ms)		

*1: QD75P□represents the open collector output system, and QD75D□represents the differential driver output system.

Table 3.1 Performance specifications (Continued)

Item \ Model	QD75P1 *1 QD75D1	QD75P2 *1 QD75D2	QD75P4 *1 QD75D4
Starting time (ms)	1-axis linear control: 6 1-axis speed control: 6 2-axis linear interpolation control (Composite speeds): 7 2-axis linear interpolation control (Reference axis speed): 7 2-axis circular interpolation control: 7 2-axis speed control: 6 3-axis linear interpolation control (Composite speed): 7 3-axis linear interpolation control (Reference axis speed): 7 3-axis speed control: 6 4-axis linear interpolation control: 7 4-axis speed control: 7	Factors in starting time extension The following times will be added to the starting time in the described conditions: • S-curve acceleration/ deceleration is selected : 0.5 • Other axis is in operation : 1.5 • During continuous positioning control : 0.2 • During continuous path control : 1.0	
External wiring connection system	40-pin connector		
Applicable wire size	0.3mm^2 (for A6CON1), AWG#24 (for A6GON2)		
Applicable connector for external device	A6CON1, A6CON2(sold separately)		
Max. output pulse	QD75P1,QD75P2,QD75P4: 200kbps QD75D1,QD75D2,QD75D4: 1Mbps		
Max. connection distance between servos	QD75P1,QD75P2,QD75P4: 2m QD75D1,QD75D2,QD75D4: 10m		
Internal current consumption (5VDC)	QD75P1: 0.40A QD75D1: 0.52A	QD75P2: 0.46A QD75D2: 0.56A	QD75P4: 0.58A QD75D4: 0.82A
No. of occupied I/O points	32 points (I/O assignment: 32 points for intelligent function module)		
External dimensions	98(H)×27.4(W)×90(D)		
Weight (kg)	0.15	0.15	0.16

*1: QD75P□ represents the open collector output system, and QD75D□ represents the differential driver output system.

3.2 List of Functions

3.2.1 QD75 control functions

The QD75 has several functions. In this manual, the QD75 functions are categorized and explained as follows.

(1) Main functions

1) OPR control

"OPR control" is a function that establishes the start point for carrying out positioning control, and carries out positioning toward that start point. This is used to return a workpiece, located at a position other than the OP when the power is turned ON or after positioning stop, to the OP.

2) Positioning control

This control is carried out using the "positioning data" stored in the QD75. Positioning control, such as position control and speed control, is executed by setting the required items in this "positioning data" and starting that positioning data.

3) Manual control

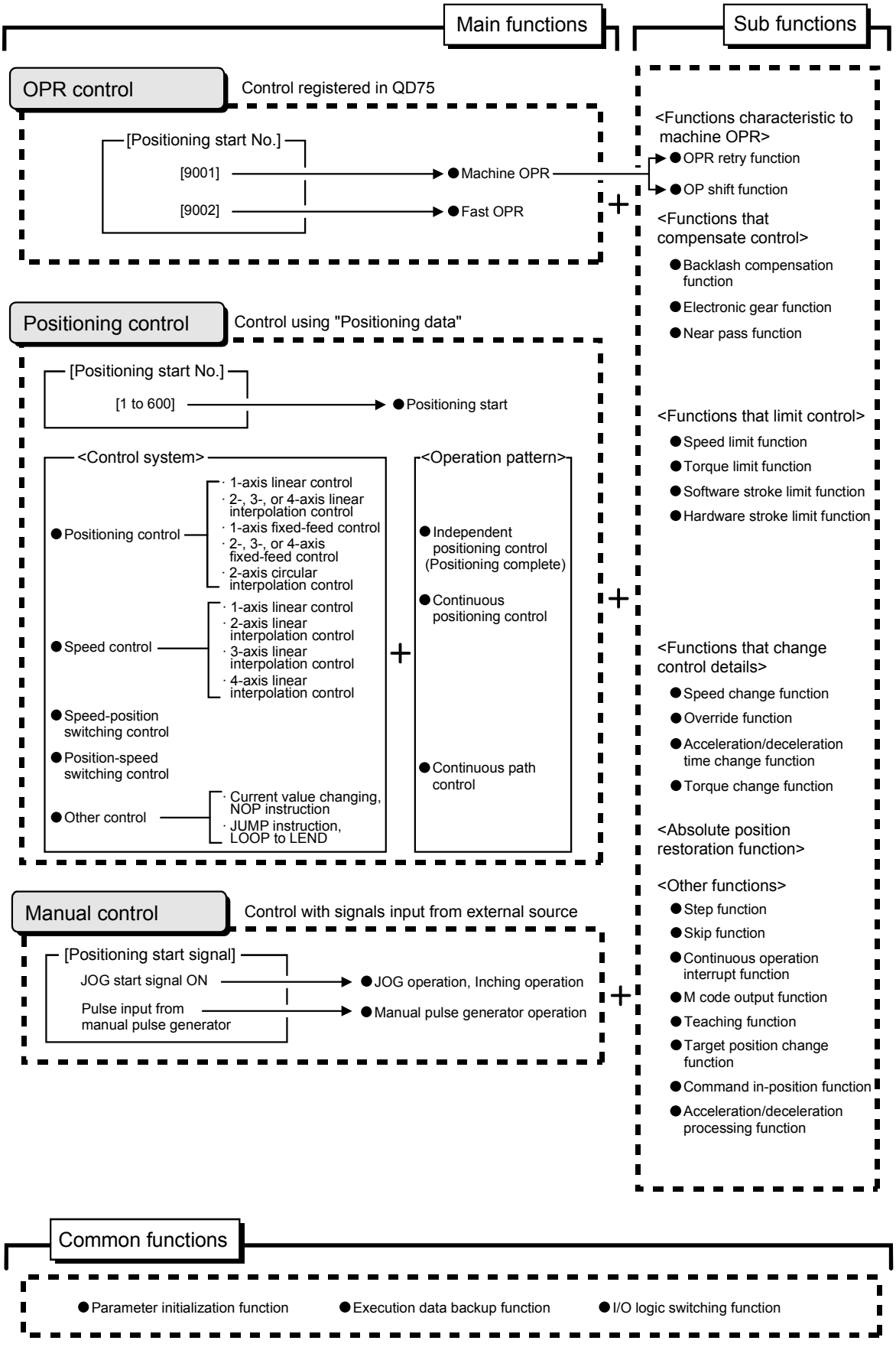
By inputting a signal into the QD75 from an external source, the QD75 will output a random pulse train and carry out control. Use this manual control to move the workpiece to a random position (JOG operation), and to finely adjust the positioning (inching operation, manual pulse generator operation), etc.

(2) Sub functions

Control compensation, control limits and various functions can be added.

(3) Common functions

Common control using the QD75 such as "parameter initialization" or "backup of execution data" can be carried out.


Main functions
Sub functions
OPR control
Control registered in QD75
[Positioning start No.]
[9001]
Machine OPR
[9002]
Fast OPR
Positioning control
Control using "Positioning data"
[Positioning start No.]
[1 to 600]
Positioning start
<Control system>
Positioning control
· 1-axis linear control
· 2-, 3-, or 4-axis linear interpolation control
· 1-axis fixed-feed control
· 2-, 3-, or 4-axis fixed-feed control
· 2-axis circular interpolation control
Speed control
· 1-axis linear control
· 2-axis linear interpolation control
· 3-axis linear interpolation control
· 4-axis linear interpolation control
Speed-position switching control
Position-speed switching control
Other control
· Current value changing, NOP instruction
· JUMP instruction, LOOP to LEND
<Operation pattern>
Independent positioning control (Positioning complete)
Continuous positioning control
Continuous path control
Manual control
Control with signals input from external source
[Positioning start signal]
JOG start signal ON
JOG operation, Inching operation
Pulse input from manual pulse generator
Manual pulse generator operation
<Functions characteristic to machine OPR>
OPR retry function
OP shift function
<Functions that compensate control>
Backlash compensation function
Electronic gear function
Near pass function
<Functions that limit control>
Speed limit function
Torque limit function
Software stroke limit function
Hardware stroke limit function
<Functions that change control details>
Speed change function
Override function
Acceleration/deceleration time change function
Torque change function
<Absolute position restoration function>
<Other functions>
Step function
Skip function
Continuous operation interrupt function
M code output function
Teaching function
Target position change function
Command in-position function
Acceleration/deceleration processing function
Common functions
Parameter initialization function
Execution data backup function
I/O logic switching function

3.2.2 QD75 main functions

The outline of the main functions for positioning control with the QD75 is described below.
(Refer to QD75 User's Manual for details on each function.)

Main functions			Details
OPR control	Machine OPR control		Mechanically establishes the positioning start point using a zeroing dog or stopper. (Positioning start No. 9001)
	Fast OPR control		Positions a target to the OP address (Machine feed value) stored in the QD75 using machine OPR. (Positioning start No. 9002)
Positioning control	Position control	Linear control (1-axis linear control) (2-axis linear interpolation control) (3-axis linear interpolation control) (4-axis linear interpolation control)	Positions a target using a linear path to the address set in the positioning data or to the position designated with the movement amount.
		Fixed-feed control (1-axis fixed-feed control) (2-axis fixed-feed control) (3-axis fixed-feed control) (4-axis fixed-feed control)	Positions a target by the movement amount designated with the amount set in the positioning data. (With fixed-feed control, the current feed value is set to "0" when the control is started. With 2-, 3-, or 4-axis fixed-feed control, the fixed-feed is fed along a linear path obtained by interpolation.)
		2-axis circular interpolation control	Positions a target using an arc path to the address set in the positioning data, or to the position designated with the movement amount, sub point or center point.
	Speed control	Linear control (1-axis linear control) (2-axis linear interpolation control) (3-axis linear interpolation control) (4-axis linear interpolation control)	Continuously outputs the pulses corresponding to the command speed set in the positioning data.
	Speed-position switching control:		First, carries out speed control, and then carries out position control (positioning with designated movement amount) by turning the "speed-position switching signal" ON.
	Position-speed switching control:		First, carries out position control, and then carries out speed control (continuous output of the pulses corresponding to the designated command speed) by turning the "position-speed switching signal" ON.
	Other control	Current value changing	Changes the current feed value to the address set in the positioning data. The following two methods can be used. (The machine feed value cannot be changed.) • Current value changing using the control system • Current value changing using the current value changing start No. (No.9003)
		NOP instruction	Non execution control system. When NOP instruction is set, this instruction is not executed and the operation of the next data is started.
		JUMP instruction	Unconditionally or conditionally jumps to designated positioning data No.
		LOOP	Carries out loop control with repeated LOOP to LEND.
		LEND	Returns to the beginning of the loop control with repeated LOOP to LEND.

Main functions		Details
Manual control	JOG operation	Outputs a pulse while the JOG start signal is ON.
	Inching operation	Outputs pulses corresponding to minute movement amount by manual operation. (Performs fine adjustment with the JOG start signal.)
	Manual pulse generator operation	Outputs pulses sent from the manual pulse generator to servo amplifier. (Carries out fine adjustment, etc., at the pulse level.)

Operation pattern	Details
Independent positioning control (Positioning complete)	When "independent positioning control" is set for the operation pattern of the started positioning data, only the designated positioning data will be executed, and then the positioning will end.
Continuous positioning control	When "continuous positioning control" is set for the operation pattern of the started positioning data, after the designated positioning data is executed, the program will stop once, and then the next following positioning data will be executed.
Continuous path control	When "continuous path control" is set for the operation pattern of the started positioning data, the designated positioning data will be executed, and then without decelerating, the next following positioning data will be executed.

3.2.3 QD75 sub functions and common functions

(1) Sub functions

The functions that assist positioning control using the QD75 are described below. (Refer to QD75 User's Manual for details on each function.)

Sub function		Details
Functions characteristic to machine OPR	OPR retry function	This function retries the machine OPR with the upper/lower limit switches during machine OPR. This allows machine OPR to be carried out even if the axis is not returned to before the zeroing dog with JOG operation, etc.
	OP shift function	After returning to the machine OP, this function compensates the position by the designated distance from the machine OP position and sets that position as the OP address.
Functions that compensate control	Backlash compensation function	This function compensates the mechanical backlash. Feed pulses equivalent to the set backlash amount are output each time the movement direction changes.
	Electronic gear function	By setting the movement amount per pulse, this function can freely change the machine movement amount per commanded pulse. When the movement amount per pulse is set, a flexible positioning system that matches the machine system can be structured.
	Near pass function*1	This function suppresses the machine vibration when the speed changes during continuous path control in the interpolation control.
Functions that limit control	Speed limit function	If the command speed exceeds "speed limit value" during control, this function limits the commanded speed to within the "speed limit value" setting range.
	Torque limit function*2	If the torque generated by the servomotor exceeds "torque limit setting value" during control, this function limits the generated torque to within the "torque limit setting value" setting range.
	Software stroke limit function	If a command outside of the upper/lower limit stroke limit setting range, set in the parameters, is issued, this function will not execute positioning for that command.
	Hardware stroke limit function	This function carries out deceleration stop with the limit switch connected to the QD75 external device connector.
Functions that change control details	Speed change function	This function changes the speed during positioning. Set the new speed in the speed change buffer memory (New speed value), and change the speed with the speed change request.
	Override function	This function changes the speed within a percentage of 1 to 300 during positioning. This is executed using "positioning operation speed override".
	Acceleration/deceleration time change function	This function changes the acceleration/deceleration time during speed change.
	Torque change function	This function changes the "torque limit value" during control.

*1: The near pass function is featured as standard and is valid only for position control. It cannot be set invalid with parameters.

*2: Using "torque limit function" requires a "D/A conversion module" and a "drive unit capable of issuing torque limit commands with analog voltages".

Sub function		Details
Other functions	Step function	This function temporarily stops the operation to confirm the positioning operation during debugging, etc. The operation can be stopped at each "automatic deceleration" or "positioning data".
	Skip function	This function stops (decelerates to a stop) the positioning being executed when the skip signal is input, and carries out the next positioning.
	M code output function	This function issues a command for a sub work (clamp or drill stop, tool change, etc.) corresponding to the M code No. (0 to 65535) that can be set for each positioning data.
	Teaching function	This function stores the address positioned with manual control into the positioning address having the designated positioning data No.
	Target position change function	This function changes the target position during positioning. Position and speed can be changed simultaneously.
	Command in-position function	At each automatic deceleration, this function calculates the remaining distance for the QD75 to reach the positioning stop position. When the value is less than the set value, the "command in-position flag" is set to "1". When using another auxiliary work before ending the control, use this function as a trigger for the sub work.
	Acceleration/ deceleration process function	This function adjusts the control acceleration/deceleration.
	Continuous operation interrupt function	This function interrupts continuous operation. When this request is accepted, the operation stops when the execution of the current positioning data is completed.

(2) Common functions

The outline of the functions executed as necessary is described below.
(Refer to QD75 User's Manual for details on each function.)

Common functions	Details
Parameter initialization function	This function returns the "parameters" stored in the QD75 buffer memory and flash ROM to the default values. The following two methods can be used. 1) Method using a sequence program 2) Method using SW□D5C-QD75P
Execution data backup function	This function stores the "setting data", currently being executed, into the flash ROM. The following two methods can be used. 1) Method using a sequence program 2) Method using SW□D5C-QD75P
I/O signal logic switching function	This function switches I/O signal logic according to externally connected devices. This function enables the use of the system that does not use normally close signals, such as the drive unit READY or upper/lower limit signal, by setting parameters to positive logic.

3.3 Specifications of Input/Output Signals with PLC CPU

3.3.1 List of input/output signals with PLC CPU

The QD75 uses 32 input points and 32 output points for exchanging data with the PLC CPU.
The input/output signals when the QD75 is mounted in slot No. 0 of the main base unit are shown below.

Device X refers to the input signals from the QD75 to the PLC CPU, and device Y refers to the output signals from the PLC CPU to the QD75.

Table 3.2 List of Input/output signals

Signal direction: QD75→PLC CPU			Signal direction: PLC CPU→QD75			
Device No.	Signal name		Device No.	Signal name		
X0	QD75 READY	ON : READY OFF : Not READY/Watch dog timer error	Y0	PLC READY		OFF : PLC READY OFF ON : PLC READY ON
X1	Synchronization flag	OFF : Module access disabled ON : Module access enabled	Y1	Use prohibited		
X2	Use prohibited		Y2			
X3			Y3			
X4	Axis 1	OFF : M code is not set ON : M code is set	Y4	Axis 1	Axis stop	OFF : Axis stop not requested ON : Axis stop requested
X5	Axis 2		Y5	Axis 2		
X6	Axis 3		Y6	Axis 3		
X7	Axis 4		Y7	Axis 4		
X8	Axis 1	OFF : No error ON : Error occurrence	Y8	Axis 1	Forward run JOG start	OFF : JOG not started ON : JOG started
X9	Axis 2		Y9	Axis 1	Reverse run JOG start	
XA	Axis 3		YA	Axis 2	Forward run JOG start	
XB	Axis 4		YB	Axis 2	Reverse run JOG start	
XC	Axis 1	OFF : Not BUSY ON : BUSY	YC	Axis 3	Forward run JOG start	
XD	Axis 2		YD	Axis 3	Reverse run JOG start	
XE	Axis 3		YE	Axis 4	Forward run JOG start	
XF	Axis 4		YF	Axis 4	Reverse run JOG start	
X10	Axis 1	OFF : Start incomplete ON : Start complete	Y10	Axis 1	Positioning start	OFF : Positioning start not requested ON : Positioning start requested
X11	Axis 2		Y11	Axis 2		
X12	Axis 3		Y12	Axis 3		
X13	Axis 4		Y13	Axis 4		
X14	Axis 1	OFF : Positioning incomplete ON : Positioning complete	Y14	Use prohibited		
X15	Axis 2		Y15			
X16	Axis 3		Y16			
X17	Axis 4		Y17			
X18	Use prohibited		Y18			
X19			Y19			
X1A			Y1A			
X1B			Y1B			
X1C			Y1C			
X1D			Y1D			
X1E			Y1E			
X1F			Y1F			

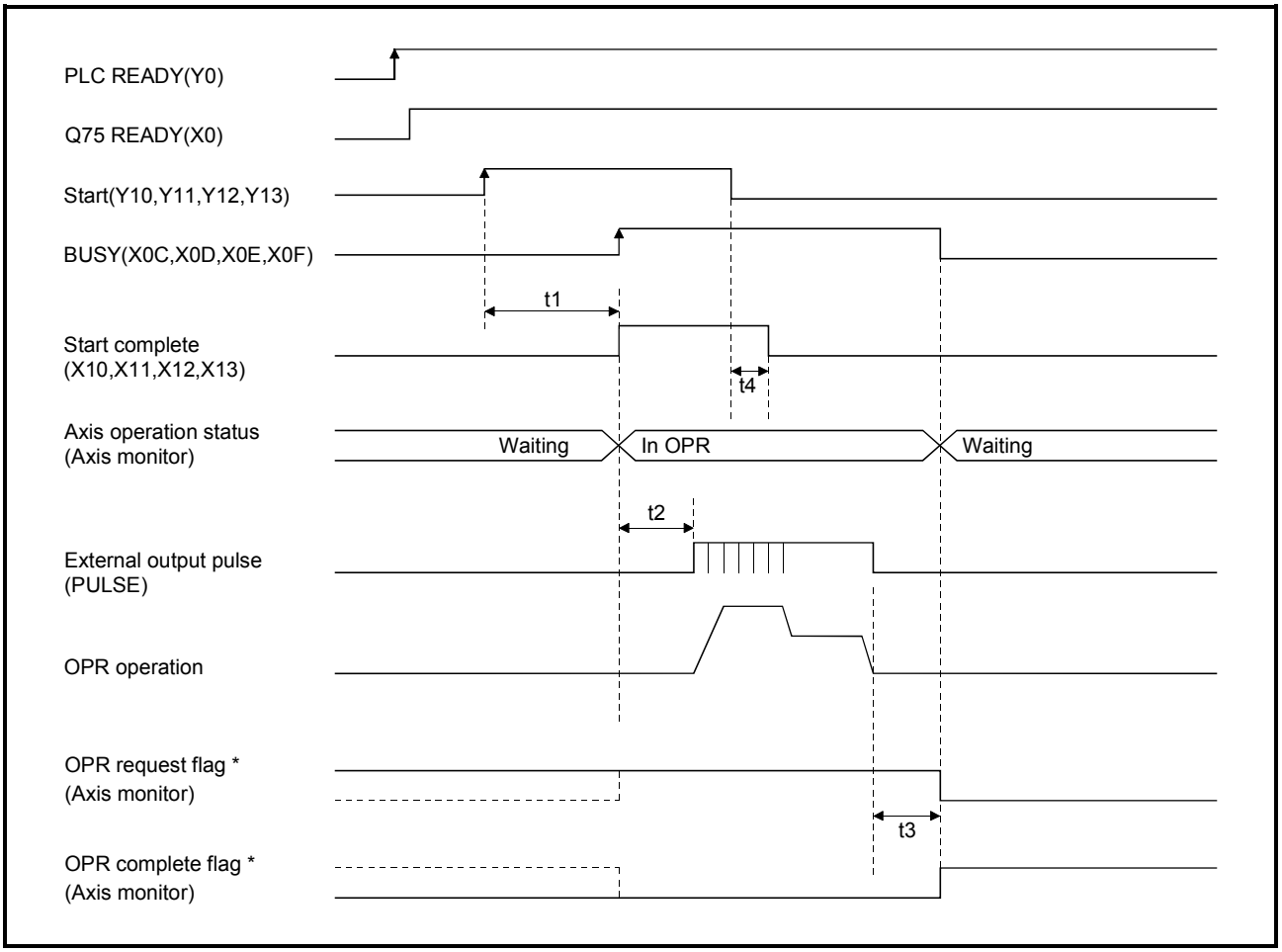
IMPORTANT

[Y1 to Y3], [Y18 to Y1F], [X2, X3], and [X18 to X1F] are used by the system, and cannot be used by users.
If these devices are used, the operation of the QD75 will not be guaranteed.

3.3.2 Input/output signal timing

The following shows the Input/output signal timing at OPR, positioning operation, JOG operation and manual pulse generator operation.

(1) Input/output signal timing at OPR



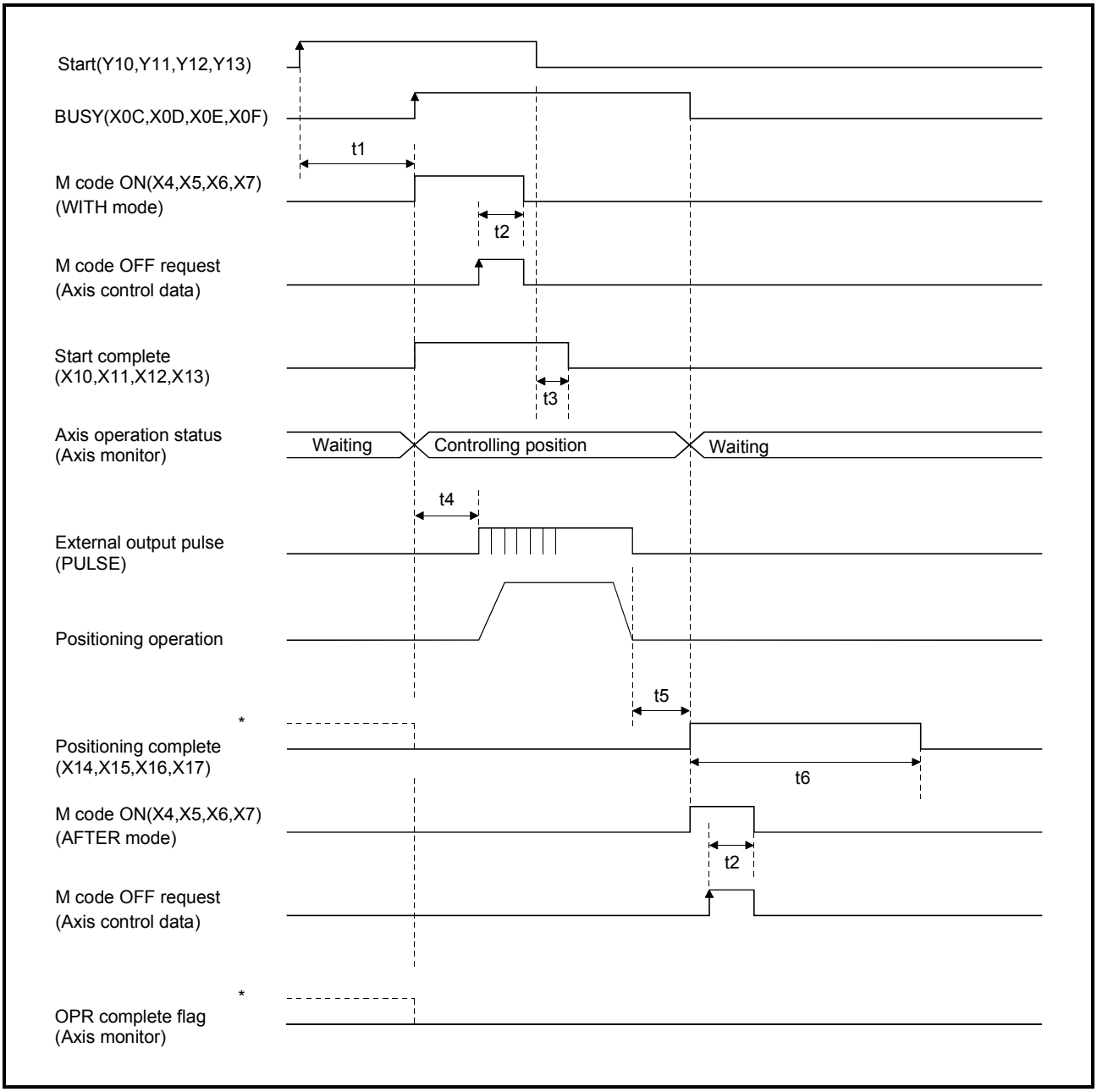
Note: If all signals marked with an asterisk (*) are already ON or OFF, the signals marked with an asterisk (*) will turn ON or OFF when the positioning start signal turns ON.

Normal timing time Unit: ms

t1	t2	t3	t4
1.0 to 1.4	2.7 to 4.4	0 to 1.8	0 to 1.8

• The t1 timing time could be delayed depending on the operating conditions of the other axis.

(2) Input/output signal timing of the position control operation



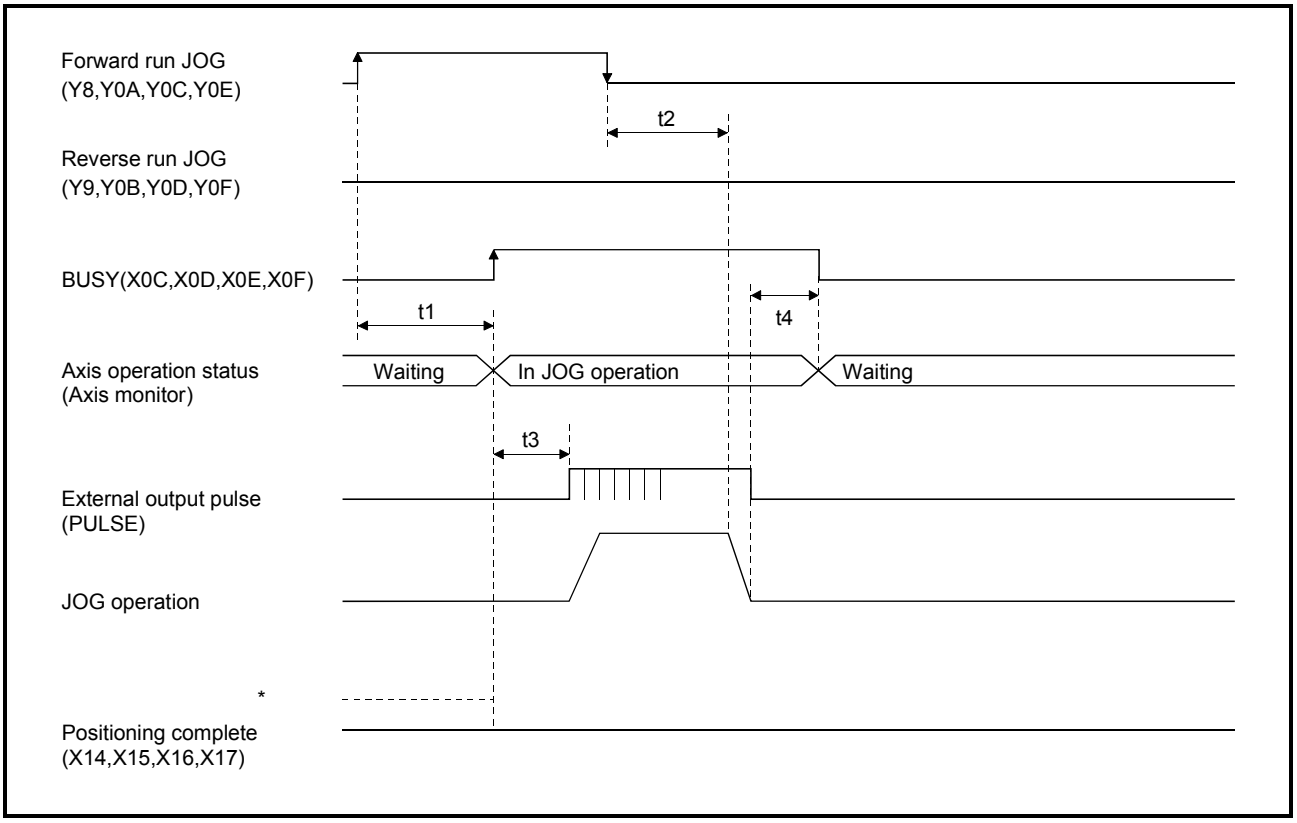
Note: If all signals marked with an asterisk (*) are already ON, the signals marked with an asterisk (*) will turn OFF when the positioning start signal turns ON.

Normal timing time Unit: ms

t1	t2	t3	t4	t5	t6
1.2 to 2.3	0 to 1.8	0 to 1.8	2.7 to 4.4	0 to 1.8	Follows parameters

• The t1 timing time could be delayed depending on the operating conditions of the other axis.

(3) Output signal timing at JOG operation



Note: If all signals marked with an asterisk (*) are already ON, the signals marked with an asterisk (*) will turn OFF when the positioning start signal turns ON.

Normal timing time Unit: ms

t1	t2	t3	t4
1.0 to 3.0	0 to 1.8	2.7 to 4.4	0 to 1.8

• The t1 timing time could be delayed depending on the operating conditions of the other axis.

3.4 Input/Output Interfaces with External Devices

QD75 connector's signal layout for external devices is shown below.

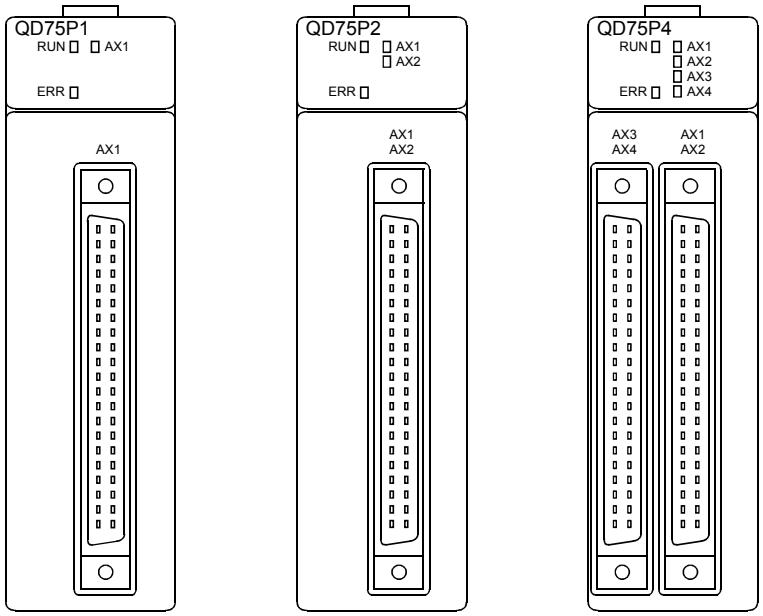
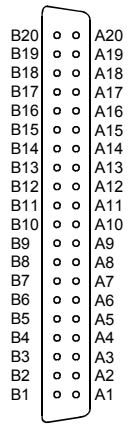


Table 3.3 Signal layout of connector

PIN layout	Axis 4 (AX4)		Axis 3 (AX3)		Axis 2 (AX2)		Axis 1 (AX1)	
	Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name	Pin No.	Signal name
	2B20	Vacant	2A20	Vacant	1B20	PULSER B-	1A20	PULSER B+
	2B19	Vacant	2A19	Vacant	1B19	PULSER A-	1A19	PULSER A+
	2B18*3	PULSE COM PULSE R-	2A18*3	PULSE COM PULSE R-	1B18*3	PULSE COM PULSE R-	1A18*3	PULSE COM PULSE R-
	2B17*3	PULSE R PULSE R+	2A17*3	PULSE R PULSE R+	1B17*3	PULSE R PULSE R+	1A17*3	PULSE R PULSE R+
	2B16*3	PULSE COM PULSE F-	2A16*3	PULSE COM PULSE F-	1B16*3	PULSE COM PULSE F-	1A16*3	PULSE COM PULSE F-
	2B15*3	PULSE F PULSE F+	2A15*3	PULSE F PULSE F+	1B15*3	PULSE F PULSE F+	1A15*3	PULSE F PULSE F+
	2B14	CLRCOM	2A14	CLRCOM	1B14	CLRCOM	1A14	CLRCOM
	2B13	CLEAR	2A13	CLEAR	1B13	CLEAR	1A13	CLEAR
	2B12	RDYCOM	2A12	RDYCOM	1B12	RDYCOM	1A12	RDYCOM
	2B11	READY	2A11	READY	1B11	READY	1A11	READY
	2B10	PGOCOM	2A10	PGOCOM	1B10	PGOCOM	1A10	PGOCOM
	2B9	PGO5	2A9	PGO5	1B9	PGO5	1A9	PGO5
	2B8	PGO24	2A8	PGO24	1B8	PGO24	1A8	PGO24
	2B7	COM	2A7	COM	1B7	COM	1A7	COM
	2B6	COM	2A6	COM	1B6	COM	1A6	COM
	2B5	CHG	2A5	CHG	1B5	CHG	1A5	CHG
	2B4	STOP	2A4	STOP	1B4	STOP	1A4	STOP
	2B3	DOG	2A3	DOG	1B3	DOG	1A3	DOG
	2B2	RLS	2A2	RLS	1B2	RLS	1A2	RLS
	2B1	FLS	2A1	FLS	1B1	FLS	1A1	FLS

Front view of the module

*1: Pin No. "1□□□" indicates the pin No. for the right connector. Pin No. "2□□□" indicates the pin No. for the left connector.

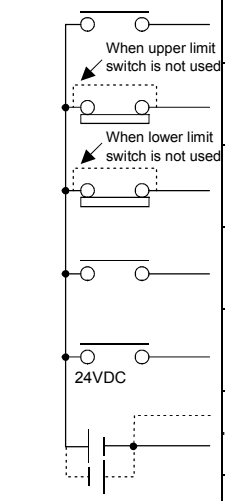
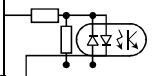
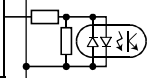
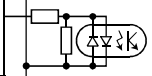
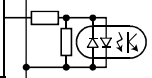
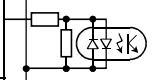
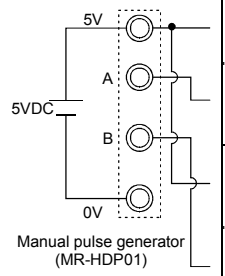
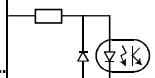
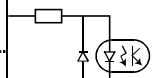
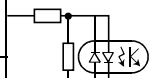
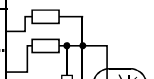
*2: When a 1-axis module is used, pin Nos. 1B1 to 1B18 are "vacant".

*3: The upper line indicates the signal names for the QD75P1/QD75P2/QD75P4, and the lower line indicates the signal names for the QD75D1/QD75D2/QD75D4.

3.4.1 Input/output interface signals

The input and output signals of input/output interfaces for the QD75P1/QD75D1 are shown below.

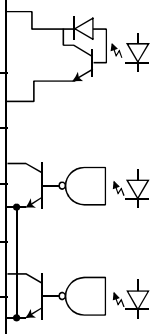
(1) Input (Common for QD75P1 and QD75D1)

External wiring	Pin No.	Internal circuit	Signal name		Need for wiring *1
	1A3		Zeroing dog signal	DOG	△
	1A1		Upper limit signal	FLS	○
	1A2		Lower limit signal	RLS	○
	1A4		Stop signal	STOP	△
	1A5		External command signal	CHG	△
	1A6 1A7		Common	COM	○
	(+) 1A19		Manual pulse generator A phase	PULSER A+	△
	(-) 1B19			PULSER A-	
	(+) 1A20		Manual pulse generator B phase	PULSER B+	
	(-) 1B20			PULSER B-	
To servo amplifier	A11		Drive unit READY	READY	○
	1A12		Drive unit READY common	RDY COM	○
	1A8 1A9		Zero signal	PGO24 PGO5	△
	1A10		Zero signal common	PGO COM	

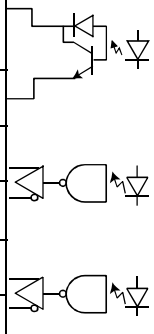
*1: The symbols in the Need for wiring column indicate the following meanings:

- ○: Wiring is necessary for positioning.
- △: Wiring is necessary depending on the situation.

(2) Output (For QD75P1 open collector output)

External wiring	Pin No.	Internal circuit	Signal name		Need for wiring *1
To servo amplifier	1A13		Deviation counter clear	CLEAR	○
	1A14		Common	CLEAR COM	
	1A15		CW A phase PULSE	PULSE F	○
	1A16			PULSE COM	
	1A17		CCW B phase SIGN	PULSE R	
	1A18			PULSE COM	

(3) Output (For QD75D1 differential driver output)

External wiring	Pin No.	Internal circuit	Signal name		Need for wiring *1
To servo amplifier	1A13		Deviation counter clear	CLEAR	○
	1A14		Common	CLEAR COM	
	1A15		CW A phase PULSE	PULSE F+	○
	1A16			PULSE F-	
	1A17		CCW B phase SIGN	PULSE R+	
	1A18			PULSE R-	

*1: The symbols in the Need for wiring column indicate the following meanings:

- ○: Wiring is necessary for positioning.
- △: Wiring is necessary depending on the situation.

3.5 Buffer Memory

The QD75's buffer memory provides addresses ranging from 0 to 30099. By reading or writing data from or to them using a sequence program, highly precise control is realized.

3.5.1 Buffer memory configuration

The following shows the entire configuration of the buffer memory.

Table 3.4 Buffer memory configuration

Address	Area by use			Power on	Writing condition
0 to 15	Basic parameter 1·2	For axis 1	Parameter area	The parameter value in flash ROM is transferred.	Can be written at any time (1) For basic parameter 1, detailed parameter 1 and OPR basic/detailed parameters, data written from PLC CPU becomes valid at the raising edge of the PLC READY signal (OFF→ON). (2) Basic parameter 2 and detailed parameter 2 become valid when written from PLC CPU. During positioning control, however, they are changed with maximum 3 data delayed from the positioning data No. which were executed when they were written.
17 to 62	Detailed parameter 1·2				
70 to 89	OPR parameter				
150 to 165	Basic parameter 1·2	For axis 2			
167 to 212	Detailed parameter 1·2				
220 to 239	OPR parameter				
300 to 315	Basic parameter 1·2	For axis 3			
317 to 362	Detailed parameter 1·2				
370 to 389	OPR parameter				
450 to 465	Basic parameter 1·2	For axis 4			
467 to 512	Detailed parameter 1·2				
520 to 539	OPR parameter				
800 to 847	Axis monitor for axis 1		Monitor data area	Initialization	Read-only
900 to 947	Axis monitor for axis 2				
1000 to 1047	Axis monitor for axis 3				
1100 to 1147	Axis monitor for axis 4				
1200 to 1425	System monitor				
1500 to 1599	Axis Control data for axis 1		Control data area	Initialization	Can be written at any time (Except positioning data during starting up)
1600 to 1699	Axis control data for axis 2				
1700 to 1799	Axis control data for axis 3				
1800 to 1899	Axis control data for axis 4				
1900 to 1901	System control data				
2000 to 7999	Positioning data for axis 1		Positioning data area (No.1 to No.600)	The data in flash ROM is transferred.	
8000 to 13999	Positioning data for axis 2				
14000 to 19999	Positioning data for axis 3				
20000 to 25999	Positioning data for axis 4				
26000 to 26999	Block start data for axis 1 (including condition data)		Block start data area (Block No. 7000 to No.7004)	The data in flash ROM is transferred.	
27000 to 27999	Block start data for axis 2 (including condition data)				
28000 to 28999	Block start data for axis 3 (including condition data)				
29000 to 29999	Block start data for axis 4 (including condition data)				
30000 to 30099	PLC CPU memo area		CPU memo area	Initialization	Reading/writing

* Use of the address Nos. skipped from the above is prohibited.
If used, the system may not operate correctly.

3.5.2 Explanations of frequently-used buffer memory address

The following describes the buffer memory addresses which are used in the program of school text.
For buffer memories which are not shown below, refer to the Help of SW□D5C-DP75P.

Table 3.5 Frequently-used buffer memory

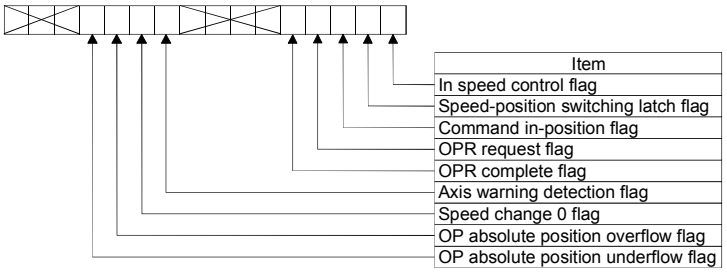
Buffer Memory Address				Item	Remarks/Setting range	Initial value
Axis 1	Axis 2	Axis 3	Axis 4			
27	177	327	477	M code ON signal output timing	0: WITH mode 1: AFTER mode	0
62	212	362	512	External command function selection	0: External positioning start 1: External speed change request 2: Speed-position, position-speed switching request 3: Skip request	0
800 801	900 901	1000 1001	1100 1101	Current feed value	The currently commanded address is stored. The current position address is stored. If "degree" is selected as the unit, the address will have a ring structure for values between 0 and 359.99999 degrees. • Update timing: 1.8ms • The OP address is stored when the OPR is completed. • When the current value is changed with the current value changing function, the changed value is stored.	0
802 803	902 903	1002 1003	1102 1103	Machine feed value	The address of the current position according to the machine coordinates will be stored. Note that the current value changing function will not change the machine feed value. Under the speed control mode, the machine feed value is constantly updated regardless of the parameter setting. The value will not be cleared to "0" at the beginning of fixed-feed control. Even if "degree" is selected as the unit, the address will not have a ring structure for values between 0 and 359.99999 degrees. • Machine coordinates: Characteristic coordinates determined with machine • Update timing: 56.8ms	0
804 805	904 905	1004 1005	1104 1105	Feedrate	The command output speed of the operating workpiece is stored. • During interpolation operation, the speed is stored in the following manner. Reference axis: Composite speed or reference axis speed (Set with "interpolation speed designation method" of detailed parameter 1.) • Update timing: 56.8ms	0
806	906	1006	1106	Axis error No.	When an axis error is detected, the error code corresponding to the error details is stored. • The latest error code is always stored. (When a new axis error occurs, the error code is overwritten.) • When "axis error reset" (axis control data) turns ON, the axis error No. is cleared (set to 0).	0
807	907	1007	1107	Axis warning No.	Whenever an axis warning is reported, a related warning code is stored. • This area always stores the latest warning code. (Whenever an axis warning is reported, a new warning code replaces the stored warning code.) • When "axis error reset" (axis control data) turns ON, the axis error No. is cleared (set to 0).	0
808	908	1008	1108	Valid M code	This area stores an M code that is currently active (the M code set to the positioning data relating to the current operation). • Update timing: turning ON of the M code ON signal When the PLC READY signal (Y0) goes OFF, the value is set to "0".	0
817	917	1017	1817	Status	• The following shows ON/OFF status of various flags.  	0

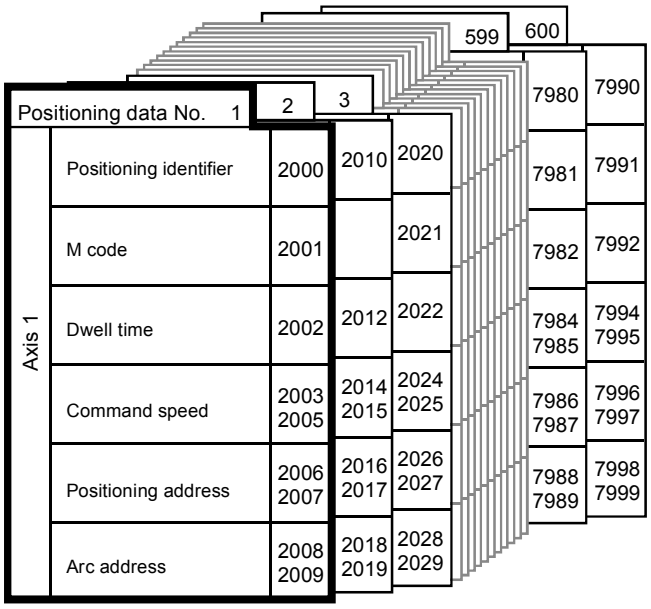
Table 3.5 Frequently-used buffer memory (Continued)

Buffer Memory Address				Item	Remarks/Setting range	Initial value
Axis 1	Axis 2	Axis 3	Axis 4			
1500	1600	1700	1800	Positioning start No.	• Set the positioning start No. for executing the positioning 1 to 600: Positioning data No. designation 7000 to 7004: Block start designation 9001: Machine OPR 9002: Fast-OPR 9003: Current value changing 9004: Simultaneous starting of multiple axes	0
1502	1602	1702	1802	Axis error reset	• Clears the axis error detection, axis error No., axis warning detection and axis warning No. • When the axis operation is in an error occurrence state, the error is cleared and the QD75 is returned to the waiting state. 0: Axis error reset request acceptance is completed (set by QD75) 1: Axis error reset request (Set by PLC program)	0
1503	1603	1703	1803	Restart command	• By setting "1" when axis operation state is stopped, positioning will be carried out again from the stopped position to the end point of the stopped positioning data. 0: Restart command acceptance is completed (set by QD75) 1: Restart command (set by PLC program)	0
1504	1604	1704	1804	M code OFF request	• The M code ON signal turns off. 0: M code OFF request acceptance is completed (set by QD75) 1: M code OFF request (set by PLC program)	0
1505	1605	1705	1805	External command valid	• Validates or invalidates external command signals. 0: Invalidates an external command. 1: Validates an external command.	0
1506 1507	1606 1607	1706 1707	1806 1807	New current value	• When changing the current feed value using the start No. 9003, use this data item to specify a new feed value. -2147483648 to +2147483647 $\times 10^{-1}$ μm -2147483648 to +2147483647 $\times 10^{-5}$ inch 0 to 35999999 $\times 10^{-5}$ degree -2147483648 to +2147483647 pulse 1 to 300%	0
1514 1515	1614 1615	1714 1715	1814 1815	New speed value	• When changing the speed, use this data item to specify a new speed. The operation halts if you specify 0. 0 to 2000000000 $\times 10^{-2}$ mm/min 0 to 2000000000 $\times 10^{-3}$ inch/min 0 to 2000000000 $\times 10^{-3}$ degree/min 0 to 1000000 pulse/s	0
1516	1616	1716	1816	Speed change request	• When changing the speed, use this data item to specify a new speed. 0: Speed change request acceptance is completed. (set by QD75) 1: Speed change request (set by PLC program)	0
1517	1617	1717	1817	Inching movement amount	• Use this data item to set the amount of movement by inching. The machine performs a JOG operation if 0 is set. 0 to 65535 $\times 10^{-1}$ μm 0 to 65535 $\times 10^{-5}$ inch 0 to 65535 $\times 10^{-5}$ degree 0 to 65535 pulse	0
1518 1519	1618 1619	1718 1719	1818 1819	JOG speed	• Use this data item to store the JOG speed during JOG operation. • When changing JOG speed during JOG operation, new JOG speed is stored. 1 to 2000000000 $\times 10^{-2}$ 2mm/min 1 to 2000000000 $\times 10^{-3}$ inch/min 1 to 2000000000 $\times 10^{-3}$ degree/min 1 to 1000000 pulse/s	0
1528	1628	1728	1828	Speed-position switching enable flag	• When the external command function selection is set to speed-position or position-speed switching request, set whether to enable the switching by the external control switching signal (external command signal "CHG"). 0: Disable 1: Enable	0

Table 3.5 Frequently-used buffer memory (Continued)

Buffer Memory Address				Item	Remarks/Setting range	Initial value
Axis 1	Axis 2	Axis 3	Axis 4			
1900				Flash ROM write request	• Write the set details of buffer memory to the flash ROM Writing to the flash ROM is executed when the PLC READY signal [Y0] is OFF. 0: Flash ROM write is completed. (set by QD75) 1: Flash ROM write request (set by PLC program)	0
2004 2005	8004 8005	14004 14005	20004 20005	Command speed	-1: The command speed setting is omitted. (current speed) 1 to 2000000000 $\times 10^{-2}$ mm/min | 1 to 2000000000 $\times 10^{-3}$ inch/min | 1 to 2000000000 $\times 10^{-3}$ degree/min | 1 to 1000000 pulse/s	0
2006 2007	8006 8007	14006 14007	20007 20006	Positioning address/movement amount	• Set the positioning address or movement amount. • The setting range differs according to the control system and units. (Refer to Section 4.3)	0
2008 2009	8008 8009	14008 14009	20008 20009	Arc address	• When the control system is the ABS system circular interpolation, set the sub point or center point address. • When the control system is the INC system circular interpolation, set the distance from the start point to the sub point or center point.	0

<Configuration of positioning data area>



- Up to 600 positioning data items can be set (stored) in the buffer memory address shown on the left for each axis from axis 1 to 4.
- One positioning data item is configured of the items shown in the bold box.

Calculation example of buffer memory

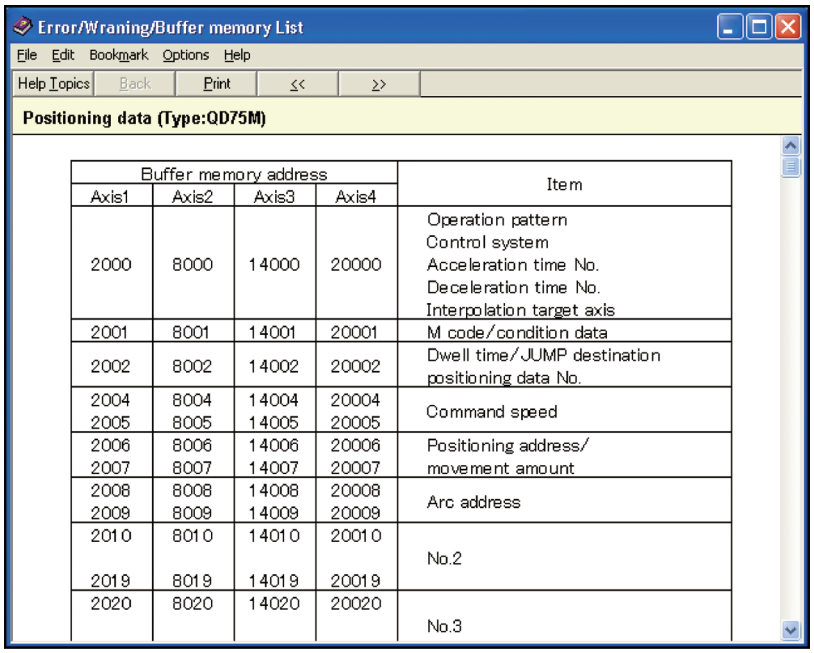
"Positioning address" for the positioning data No.31 of axis 1

2006+(31´10)-10=2306

- Buffer memory of No.31
- In the case of No.31
- Buffer memory of No.1 address

The set details of buffer memory can be checked using the HELP of SW□D5C-QD75P
For the operation of the HELP of SW□D5C-QD75P, refer to Section 5.6.

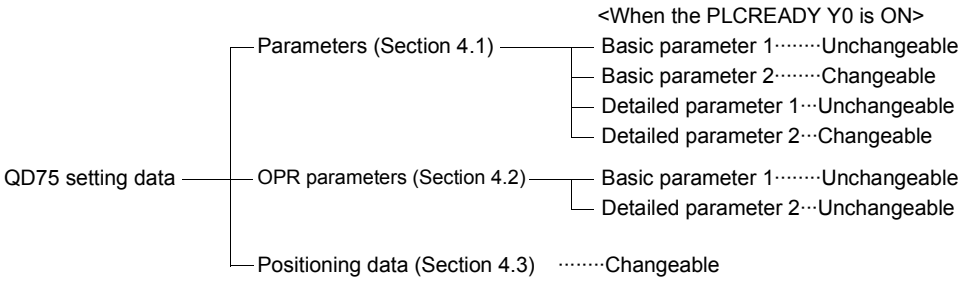
<"Buffer memory List" screen of the HELP of SW□D5C-QD75P>



Buffer memory address				Item
Axis1	Axis2	Axis3	Axis4	
2000	8000	14000	20000	Operation pattern Control system Acceleration time No. Deceleration time No. Interpolation target axis
2001	8001	14001	20001	M code/condition data
2002	8002	14002	20002	Dwell time/JUMP destination positioning data No.
2004 2005	8004 8005	14004 14005	20004 20005	Command speed
2006 2007	8006 8007	14006 14007	20006 20007	Positioning address/ movement amount
2008 2009	8008 8009	14008 14009	20008 20009	Arc address
2010 2019	8010 8019	14010 14019	20010 20019	No.2
2020	8020	14020	20020	No.3

CHAPTER 4 TYPES AND FUNCTIONS OF SETTING DATA

Setting data refers to data required for positioning control by QD75 and there are eight types of setting data as shown below. (Block start data is not explained.)
The "Setting data" can be created for each axis and is stored in the QD75 buffer memory.
Some types of the setting data can be changed only while the PLC READY Y0 is OFF.
Also note that writing the setting data from a peripheral device can only be executed when the PLC CPU is in the STOP state.



* : For the block start data, refer to the QD75 User's Manual.

(1) The parameter and the OPR parameter are determined by the design of the positioning hardware.

(2) The positioning data is determined by how the positioning machine is controlled and operated.

(3) At the time of shipment from the factory, the initial value is set. (The initial value is same from axis 1 to 4.)

(4) When all the memory addresses are cleared, the initial value is stored.

(5) Setting data change can be performed by the peripheral device or by the TOP or DTOP instruction of the sequence program.
(Refer to the above chart for information on whether setting data change is available while the PLC CPU READY Y0 is ON.)

4.1 Parameters

Four parameters are available: Basic parameters 1 and 2, detailed parameters 1 and 2.
This is basic data determined by the mechanical system to allow the QD75 to perform the positioning control.

4.1.1 Basic parameters

Basic parameters are subdivided into basic parameter 1 and 2.

Table 4.1 Basic parameter list

Item \ Used unit			Setting range				Initial value
			mm	inch	degree	pulse	
Basic parameters 1	Unit setting		0: mm	1: inch	2: degree	3: pulse	3
	Movement amount per pulse (A)	No. of pulses per rotation (Ap)	1 to 65535 pulse				20000
		Movement amount per rotation (AL)	0.1 to 6553.5μm	0.00001 to 0.65535 inch	0.00001 to 0.65535 degree	1 to 65535pulse	20000
		Unit magnification (Am)	1-fold 10-fold 100-fold 1000-fold				1
	Pulse output mode		0: PLS/SIGN mode 1: CW/CCW mode 2: A phase/B phase (multiple of 4) 3: A phase/B phase (multiple of 1)				1
	Rotation direction setting		0: Current value increment with forward run pulse output 1: Current value increment with reverse run pulse output				0
	Bias speed at start		0.01 to 20000000.00 mm/min	0.001 to 2000000.000 inch/min	0.001 to 2000000.000 degree/min	1 to 1000000 pulse/s	0
Basic parameters 2	Speed limit value		0.01 to 20000000.00 mm/min	0.001 to 2000000.000 inch/min	0.001 to 2000000.000 degree/min	1 to 1000000 pulse/s	200000
	Acceleration time 0		1 to 8388608ms				1000
	Deceleration time 0		1 to 8388608ms				1000

(1) The initial value is the same for axis 1 to 4.
(2) When the sequence program is used for making the settings, a decimal point cannot be used.
(3) Acceleration time 1 to 3 and deceleration time 1 to 3 are in the detailed parameters.

Unit setting

Set the unit used for defining positioning operations. Choose from the following units depending on the type of the control target: mm, inch, degree, and pulse.

(Example) mm, inch.....X-Y table, Conveyor
(Select mm or inch depending on the machine specifications.)
degree .....Rotating body (360 degrees/rotation)
pulse .....X-Y table, Conveyor

Each axis unit can be set individually.

Movement amount per pulse

These parameters define the amount of movement achieved by each single pulse within a pulse train output by the QD75.

(The following explanations are made using mm as the unit.)

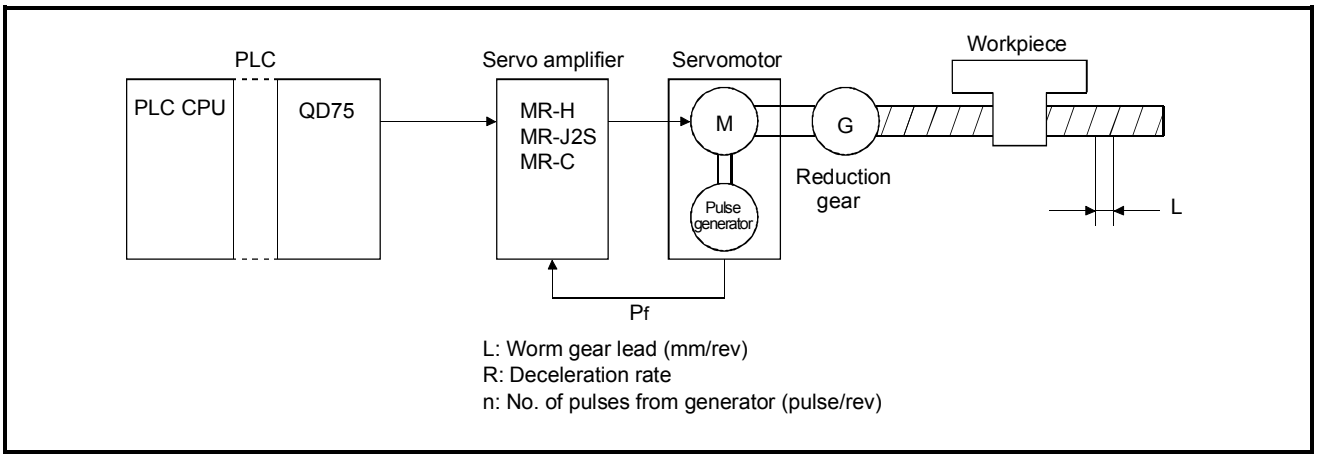


Figure4.1 Movement amount per pulse

(1) No. of pulses per rotation (Ap)

The number of pulses (n) generated from the generator is fed back to the servo amplifier MR-H or MR-J2S.

$Ap=n$

(2) Movement amount per rotation (A_L)

How much the workpiece moves per one motor rotation is determined by the mechanical structure.

$A_L=L\times R$

(3) Unit magnification (Am)

The movement amount per rotation is basically within the set range, however, if this set range can be exceeded with the magnification multiplied.

"Movement amount per rotation" and "Unit magnification" setting

<Condition>

• Lead of ball screw is 10mm (10000μm), gear ratio is $\frac{1}{1}$.

<Setting example>

• As the setting range of "movement amount per rotation" is from 0.1 to 6553.5μm, set as "1000.0".
• Set the "unit magnification" to "10".

<Method of compensating the mechanical system errors>

When the positioning is carried out by the set "movement amount per pulse", an error sometimes occurs between the command movement amount and the actual movement amount.
The QD75 can compensate this error by adjusting the values in No. of pulses per rotation, movement amount per rotation and unit magnification.
The method of compensating the errors using the QD75 is shown below.

(1) Set the command movement amount (mm) and carry out positioning.

(2) After positioning, measure the actual movement amount.

(3) With the obtained command and actual movement amount, how much compensation is needed for [No. of pulses per rotation] and [Movement amount per rotation] can be calculated as follows:

(a) Movement amount per pulse (mm/pulse) to command movement amount (mm)

$$\text{Movement amount per pulse} = \frac{\text{Movement amount per rotation (AL)}}{\text{No. of pulses per rotation (AP)}} \times \text{Unit magnification (Am)}$$

(b) No. of pulses required

$$\text{No. of pulses required} = \frac{\text{Command movement amount}}{\text{Movement amount per rotation}} \text{(pulse)}$$

(c) Apparent movement amount per pulse to actual movement amount (mm)

$$\frac{\text{Movement amount per rotation (AL)} \times \text{Unit magnification (Am)}}{\text{No. of pulses per rotation (AP)}} \times \frac{\text{Actual movement amount}}{\text{Command movement amount}}$$

$$= \frac{\text{Movement amount per rotation for compensation (AL')}}{\text{No. of pulses per rotation for compensation (AP')}} \times \text{Unit magnification (Am)}$$

In the upper formula, reduce the fraction of A_L'/A_P' to its lowest terms and replace with this obtained value.

Calculation example

<Condition>

Movement amount per pulse....5000 (μm/rev)

No. of pulses per rotation .....12000 (pulse/rev)

Unit magnification 1

<Positioning results>

Command movement amount..100000μm

Actual movement amount.....100173μm

<Compensation amount>

$$\frac{AL'}{AP'} = \frac{5000}{12000} \times \frac{100173}{100000} = \frac{25043.25}{60000} \fallingdotseq \frac{2504.3 \times 10}{60000}$$

Set the unit magnification which makes the calculation result 6553.5 or less.

Unit magnification

Reduce until the denominator becomes 65535 or less.

Movement amount per rotation: 60000 (pulse/rev)

Movement amount per pulse: 2504.3 (μm/rev)

Unit magnification: 10

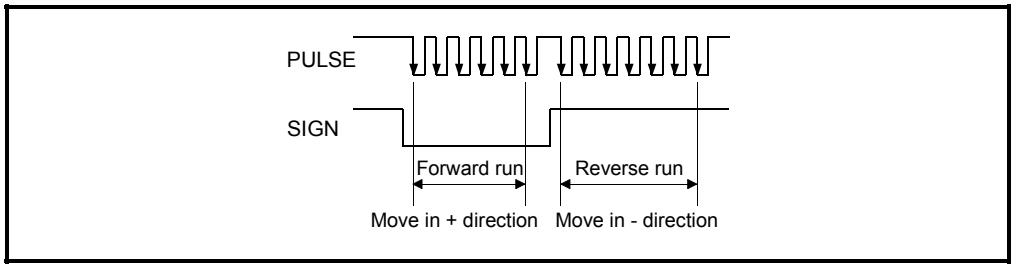
Pulse output mode

Set the pulse output mode to match the servo amplifier being used.
(The QD75 outputs the pulse in negative logic at default.)

(1) PLS/SIGN mode

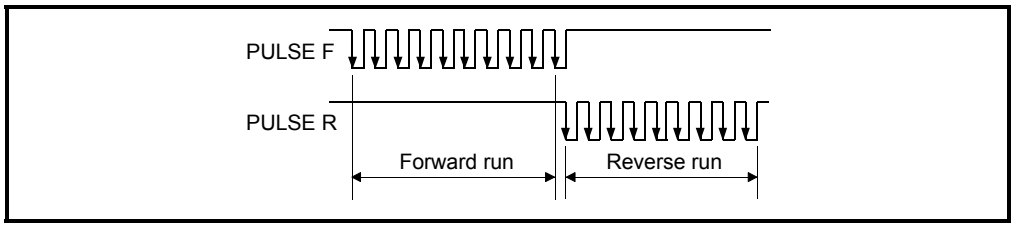
Forward run and reverse run are controlled with the ON/OFF of the direction sign (SIGN).

- The motor will run in the forward direction when the direction sign is LOW.
- The motor will run in the reverse direction when the direction sign is HIGH.



(2) CW/CCW mode

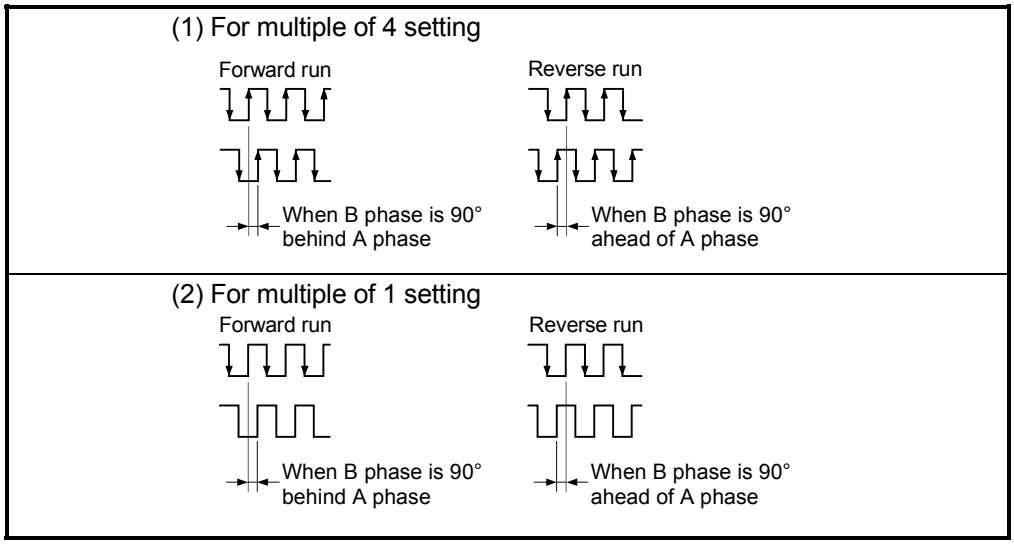
During forward run, the forward run feed pulse (PULSE F) will be output.
During reverse run, the reverse run feed pulse (PULSE R) will be output.



(3) A phase/B phase mode (Common for multiple of 4 and multiple of 1)

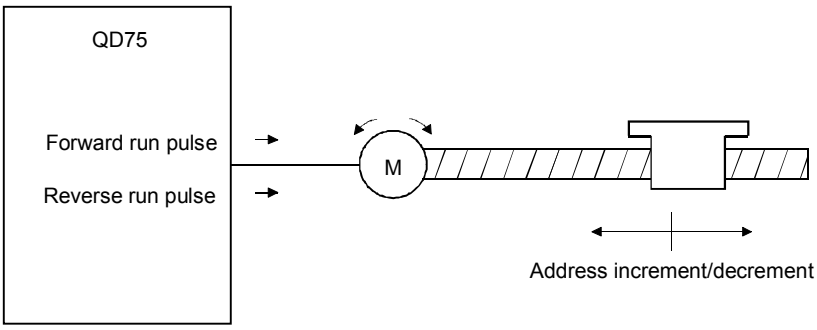
Forward run and reverse run are controlled with the phase difference of the A phase ($A\phi$) and B phase ($B\phi$).

- When the B phase is 90° behind the A phase, the motor will run in the forward direction.
- When the B phase is 90° ahead of the A phase, the motor will run in the reverse direction.



Rotation direction setting

Set the relation between the motor rotation direction and the current value address increment/decrement.



Set value

		Increase/decrease	
		Current value increase	Current value decrease
Output pulse	Forward run pulse	0	1
	Reverse run pulse	1	0

Figure 4.2 Rotation direction setting

IMPORTANT

Rotation direction is determined by whether the address increases (the setting is 0) or decreases (the setting is 1) in the JOG operation in reaction to the forward run command. Refer to the below.

[Setting]

· Rotation direction
- → Forward run pulse (motor forward run CW) 0
- → Reverse run pulse (motor reverse run CCW) 1
- ← Forward run pulse (motor forward run CW) 0
- ← Reverse run pulse (motor reverse run CCW) 1

Address 0 (←Address decrement) (Address increment→) 1000

Bias speed at start

The bias speed at start is a minimum speed required for ensuring the smooth start of the motor, especially when a stepping motor is used.

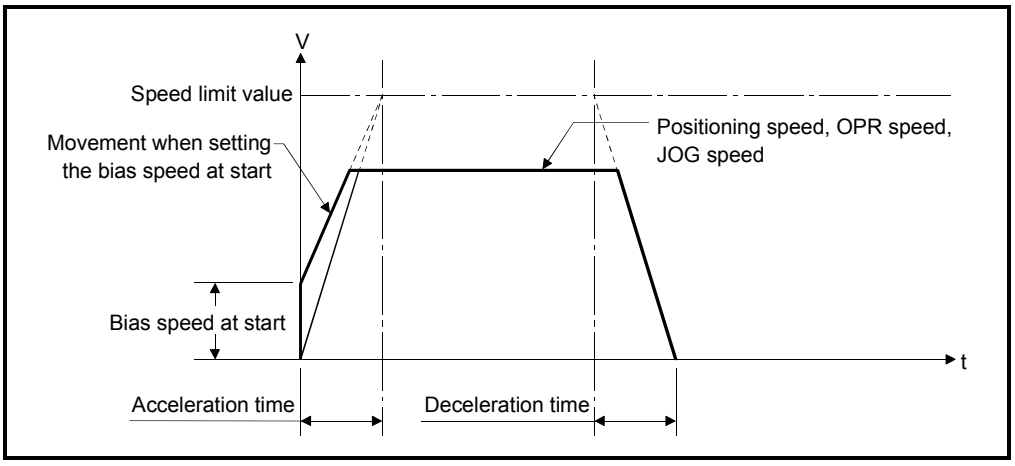


Figure 4.3 Bias speed at start

(1) This setting is valid for the OPR, positioning and JOG operations.
(2) If not using this setting, set it to "0".

Speed limit value

The maximum speed during positioning control has to be limited in consideration of the drive unit and the specifications of the control target.
Take account of the following when determining the speed limit value:

1) Motor speed
2) Workpiece movement speed

Thus, set the maximum speed for positioning.

Acceleration time/Deceleration time

Set how long the machine takes to reach the speed limit value, specified in the basic parameter (2), from its start.

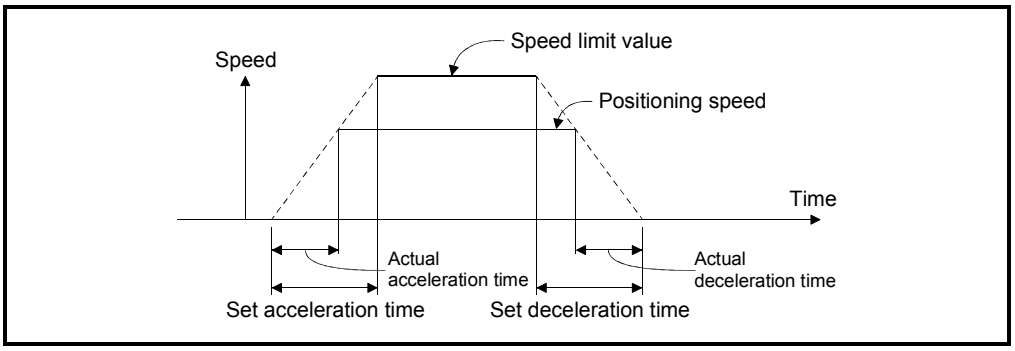


Figure 4.4 Acceleration/deceleration time

(1) If the positioning speed is set to lower than the parameter-defined speed limit value, the actual acceleration/deceleration time will be proportionally short.
Thus, set the maximum positioning speed equal to or only a little lower than the parameter-defined speed limit value.
(2) This setting is valid for the OPR, positioning and JOG operations.
(3) When the positioning involves interpolation, the acceleration/deceleration time defined for the reference axis is valid.

4.1.2 Detailed parameters

The detailed parameters are subdivided into detailed parameter 1 and 2.

Table 4.2 Detailed parameters list

Item \ Used unit			Setting range				Initial value
			mm	inch	degree	pulse	
Detailed parameter 1	Backlash compensation amount		0 to 6553.5μm	0 to 0.65535inch	0 to 0.65535degree	0 to 65535pulse	0
	Software stroke limit upper limit value		-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	0 to 359.99999degree	-2147483648 to 2147483647pulse	2147483647
	Software stroke limit lower limit value		-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	0 to 359.99999degree	-2147483648 to 2147483647pulse	-2147483648
	Software stroke limit selection		0: Apply software stroke limit on current feed value 1: Apply software stroke limit on machine feed value				0
	Software stroke limit valid/invalid setting		0: Software stroke limit valid during JOG operation and manual pulse generator operation 1: Software stroke limit invalid during JOG operation and manual pulse generator operation				0
	Command in-position width		0.1 to 214748364.7μm	0.00001 to 2147.83647inch	0.00001 to 21474.83647degree	1 to 2147483647pulse	100
	Torque limit setting value		1 to 500%				300
	M code ON signal output timing		0: WITH mode 1: AFTER mode				0
	Speed switching mode		0: Standard speed switching mode 1: Front-loading speed switching mode				0
	Interpolation speed designation method		0: Composite speed 1: Reference axis speed				0
	Current feed value during speed control		0: Do not update current feed value during speed control. 1: Update current feed value during speed control. 2: Clear current feed value to zero during speed control.				0
	Input signal logic selection	Lower limit	0: Negative logic 1: Positive logic				0
		Upper limit					
		Drive unit READY					
		Stop signal					
		External command					
		Zero signal					
		Near-point signal					
		Manual pulse generator input					
	Output signal logic selection	Command pulse signal	0: Negative logic 1: Positive logic				0
		Deviation counter clear					
Detailed parameter 2	Manual pulse generator input selection		0: A-phase/B-phase multiplied by 4 1: A-phase/B-phase multiplied by 2 2: A-phase/B-phase multiplied by 1 3: PLS/SIGN				0
	Acceleration time 1 to 3		1 to 8388608ms				1000
	Deceleration time 1 to 3		1 to 8388608ms				1000

Table 4.2 Detailed parameters list (continued)

Item \ Used unit		Setting range				Initial value
		mm	inch	degree	pulse	
Detailed parameter 2	JOG speed limit value	0.01 to 20000000.00 mm/min	0.001 to 2000000.000 inch/min	0.001 to 2000000.000 degree/min	1 to 1000000pulse/s	20000
	JOG operation acceleration time selection	0 to 3				0
	JOG operation deceleration time selection	0 to 3				0
	Acceleration/deceleration processing selection	0: Automatic trapezoid acceleration/deceleration processing 1: S-curve acceleration/deceleration processing				0
	S-curve ratio	1 to 100%				100
	Sudden stop deceleration time	1 to 65535ms/1 to 8388608ms				1000
	Stop group 1 to 3 sudden stop selection	0: Normal deceleration stop 1: Sudden stop				0
	Positioning complete signal output time	0 to 65535ms				300
	Allowable circular interpolation error width	0 to 10000.0μm	0 to 1.00000inch	0 to 1.00000degree	0 to 100000pulse	100
	External command function selection	0: External positioning start 1: External speed change request 2: Speed-position, position-speed switching request 3: Skip request				0

Backlash compensation amount

The error that occurs due to a backlash when moving the machine via gears can be compensated.

When the backlash compensation amount is set, pulses equivalent to the compensation amount will be output each time the direction changes during positioning.

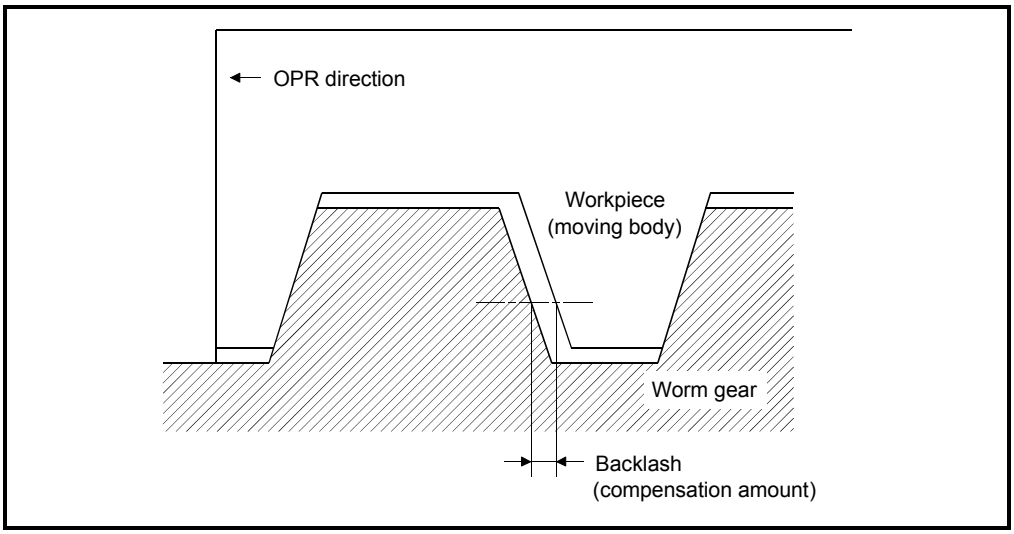


Figure 4.5 Backlash compensation amount

(1) The backlash compensation is valid after the machine OPR. Thus, if the backlash compensation amount is set or changed, always carry out the machine OPR once.

(2) The backlash compensation amount setting ranges from 0 to 65535, however, as shown in the expression below, it should be set to 255 or less.

$$0 \leq \frac{\text{Backlash compensation amount}}{\text{Movement amount per pulse}} \leq 255$$

Software stroke limit upper limit value

Set the upper limit for the machine's movement range during positioning control.

Software stroke limit lower limit value

Set the lower limit for the machine's movement range during positioning control.
(However, the stroke limit value is ignored during the JOG operation.)

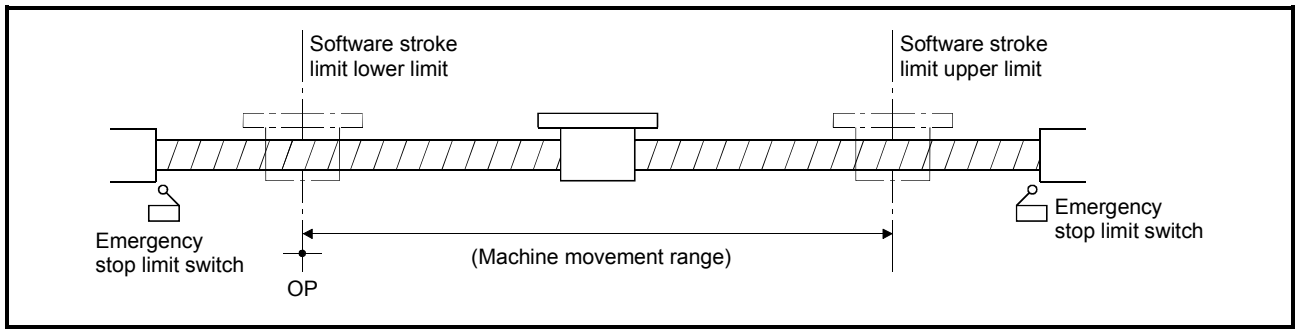
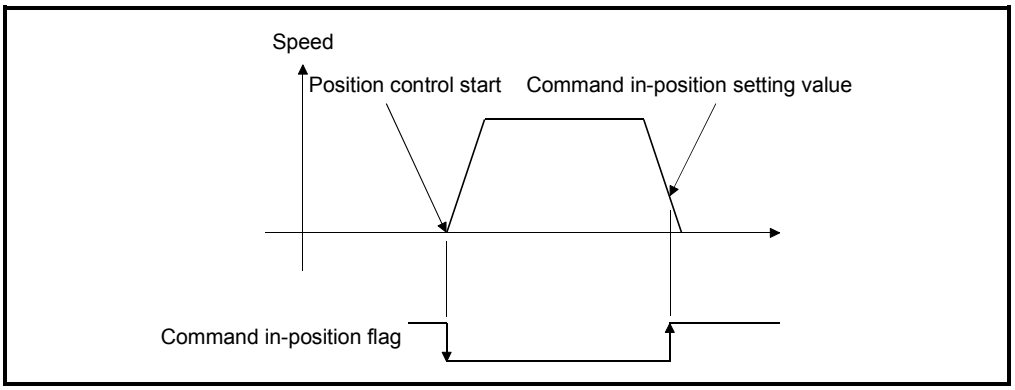


Figure 4.6 Software stroke limit upper limit value/lower limit value

(1) Generally, the OP is set at the lower limit or upper limit of the stroke limit.
(2) By setting the upper limit value or lower limit value of the software stroke limit, overrun can be prevented in the software. However, an emergency stop limit switch must be installed nearby outside the range.

Command in-position width

This is the value of "positioning address" from which "current feed value" was subtracted at the position where the command in-position signal (bit 2 of the buffer memory 817, 917, 1017, and 1117) turns ON.
(It is used as a front-loading signal of the positioning complete signal.)



Torque limit setting value

The torque limit function limits the torque generated by the servomotor within the set range.
If the torque required for control exceeds the torque limit value, the control is performed with the set torque limit value.

Usage

(1) Limitation for pulse train output type
- (a) Wiring for a D/A conversion module and wiring between a D/A conversion module and drive unit must be made.
- (b) A drive unit that can issue the torque limit command with the analog voltage is required.
- (c) The torque limit setting value is set in the buffer memory area "torque limit stored value (826, 926, 1026, and 1126)". Transmit that "torque limit stored value" to the D/A conversion module with the sequence program.

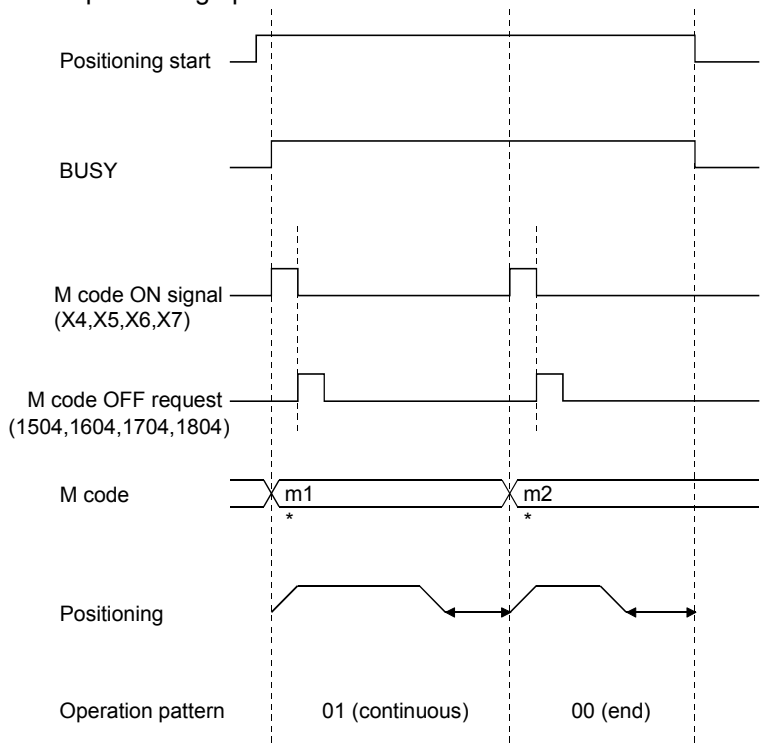
M code ON signal output timing

An M code is a number between 0 and 65535 that can be assigned to each positioning control.

(1) The sequence program can be coded to read an M code from the buffer memory address specified by "Valid M code (808, 908, 1008, and 1108)" whenever the M code ON signal [X4, X5, X6, X7] turns ON so that a command for the sub work (e.g. clamping, drilling, tool change) associated with the M code can be issued.

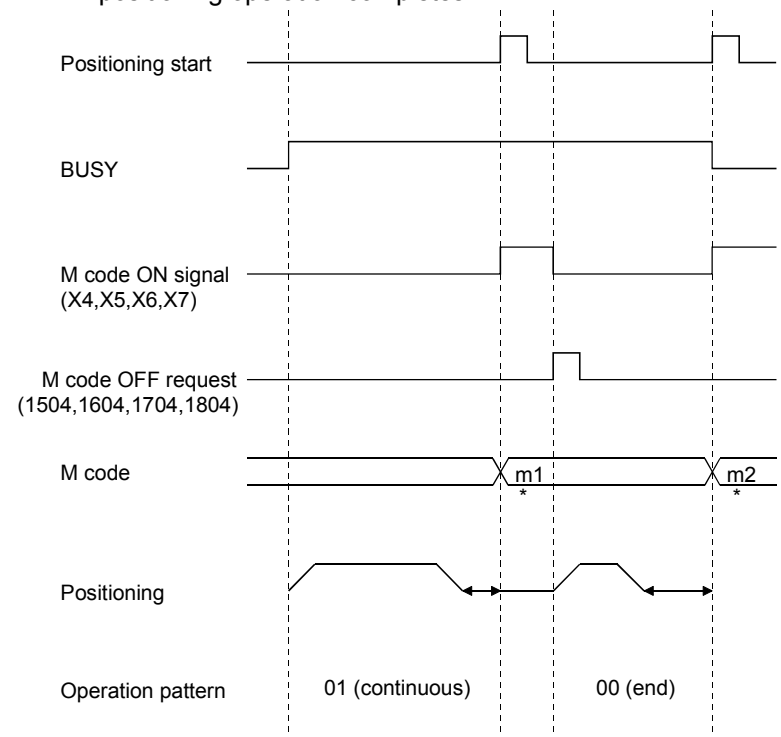
(2) Choose either the WITH mode or the AFTER mode as the M code ON signal output timing.

WITH mode..... An M code is output and the M code ON signal is turned ON when positioning operation starts.



*: m1 and m2 indicate set M codes.

AFTER mode ... An M code is output and the M code ON signal is turned ON when positioning operation completes.



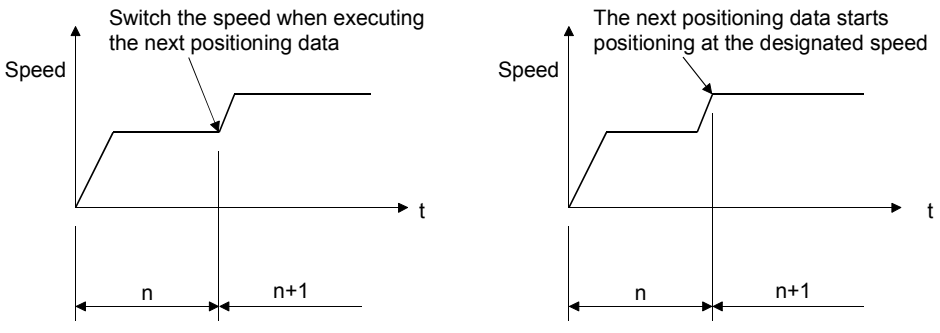
*: m1 and m2 indicate set M codes.

Note: If the AFTER mode is used with speed control, an M code will not be output and the M code ON signal will not be turned ON.

Speed switching mode

(a) Select the speed switching mode from the standard switching mode and front-loading switching mode.
- The standard switching switches the speed when executing the next positioning data.
- The front-loading switching switches at the end of the positioning data currently being executed.

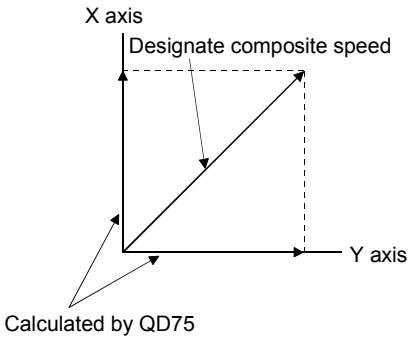
(b) The following shows the speed switching when positioning data No. n is executed.



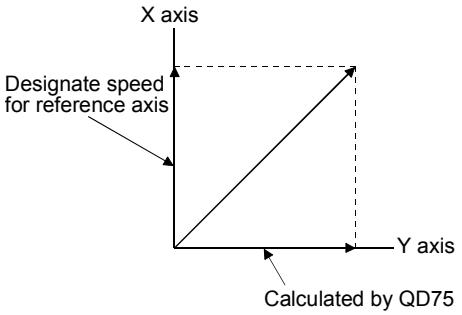
Interpolation speed designation method

When carrying out the linear interpolation/circular interpolation, select which speed to designate, the composite speed or reference axis speed.

- The composite speed designates the movement speed of the control target, and the speed of each axis is calculated by the QD75.
- The reference axis speed designates the axis speed set for the reference axis, and the speed for the other axis carrying out interpolation is calculated by the QD75. (The axis longer than the other must be the reference axis.)



<When composite speed is designated>



<When reference axis speed is designated>

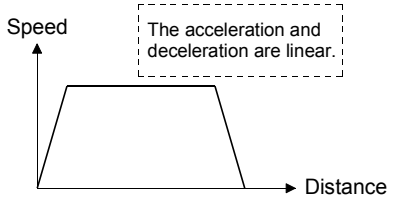
Input/output signal logic selection

Set the I/O signal logic that matches the signal specifications of the connected external device.

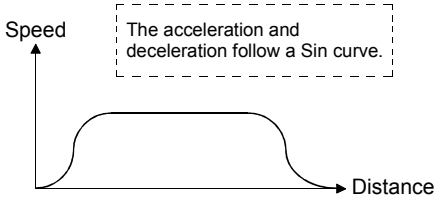
A mismatch in the signal logic will cause errors. Be careful of this when you change from the default value.

Acceleration/deceleration process selection

Select the acceleration/deceleration mode from the automatic trapezoid acceleration/deceleration mode and S-curve acceleration/deceleration mode.



<Automatic trapezoid acceleration/deceleration>

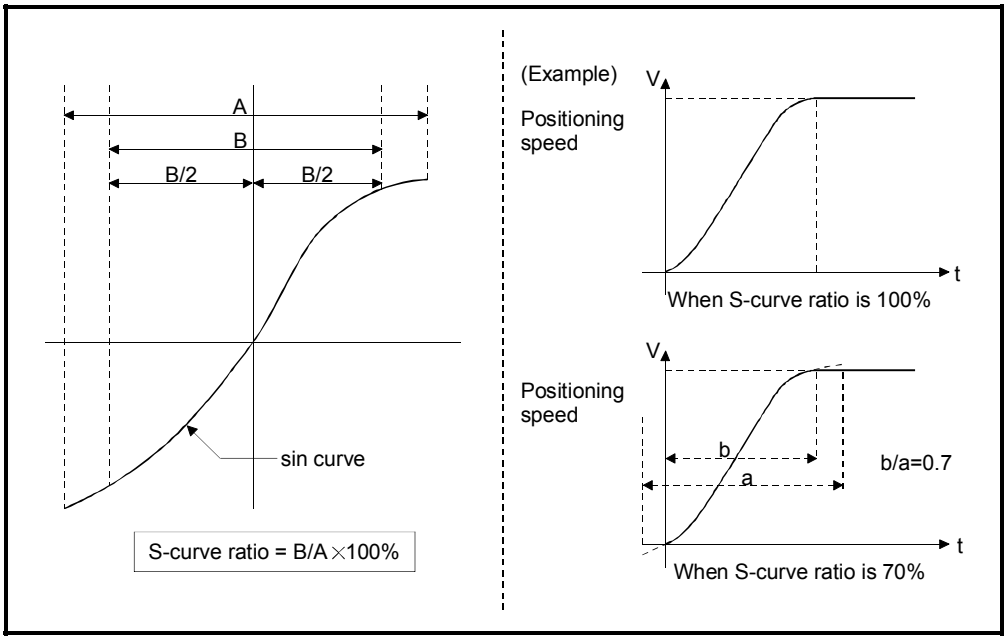


<S-curve acceleration/deceleration>

S-curve ratio

(a) Set the S-curve ratio (1 to 100%) for carrying out the S-curve acceleration/deceleration processing.

(b) The S-curve ratio indicates where to draw the acceleration/deceleration curve using a Sin curve as shown below.



Sudden stop selection (Stop group 1 to 3)

With "sudden stop" selected, the axis will rapidly decelerate to a stop when the stop signal from stop group 1 to 3 corresponding to the stop cause listed below is input.

(1) Stop group 1 is a stop due to a hardware stroke limit.

(2) Stop group 2 is a stop due to I/O reset, the PLC READY signal [Y0] OFF and an error in test mode.

(3) Stop group 3 is a stop due to the external stop signal.
A stop due to the stop signal from the PLC
A stop due to an error occurrence (excluding stop groups 1 and 2)

Positioning complete signal output time

(a) Set the output time of "positioning complete signal (X14, X15, X16, X17)" that is output from the QD75. Positioning completion refers to a state where the specified dwell time has passed after the QD75 had terminated the output.

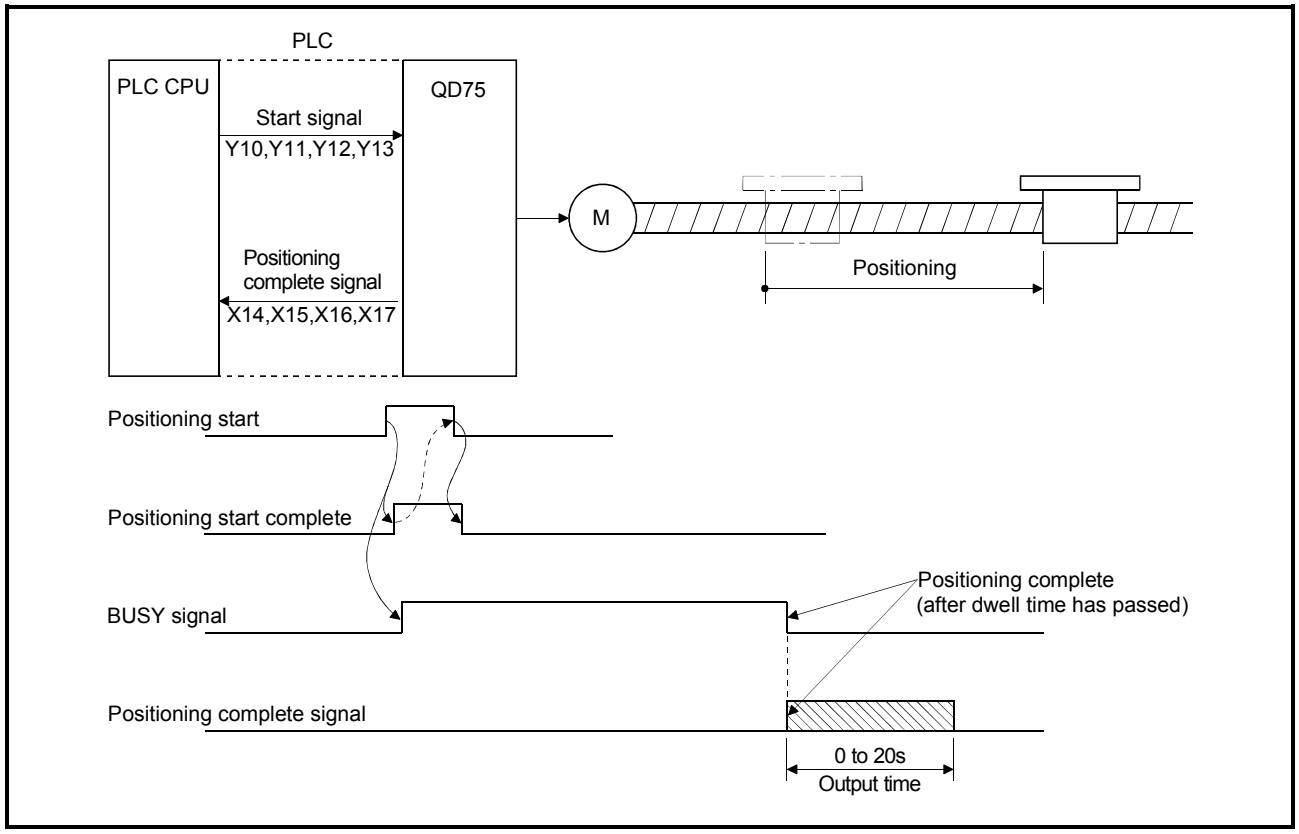
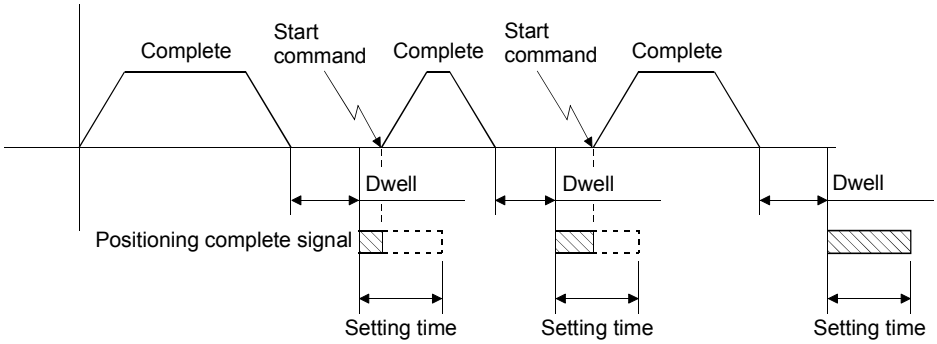


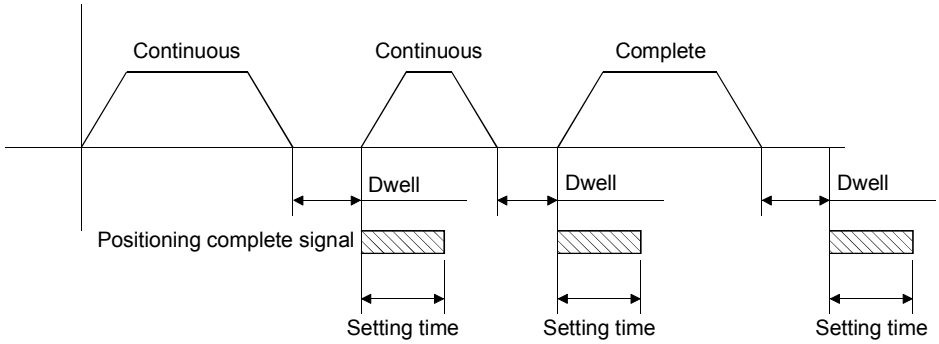
Figure 4.7 Positioning complete signal output time

(b) The operation when the next positioning is started while the positioning complete signal is ON is shown below. (For details of positioning patterns, refer to the section of positioning data.)

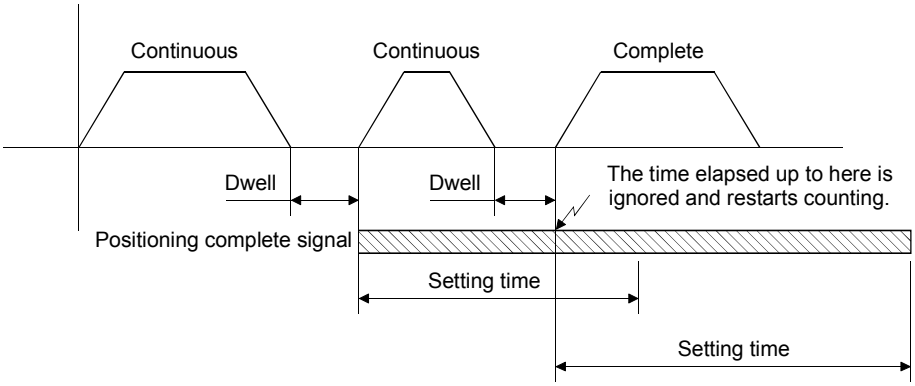
(1) When the positioning pattern is "complete", the positioning complete signal turns OFF after the next data No. starts operation.



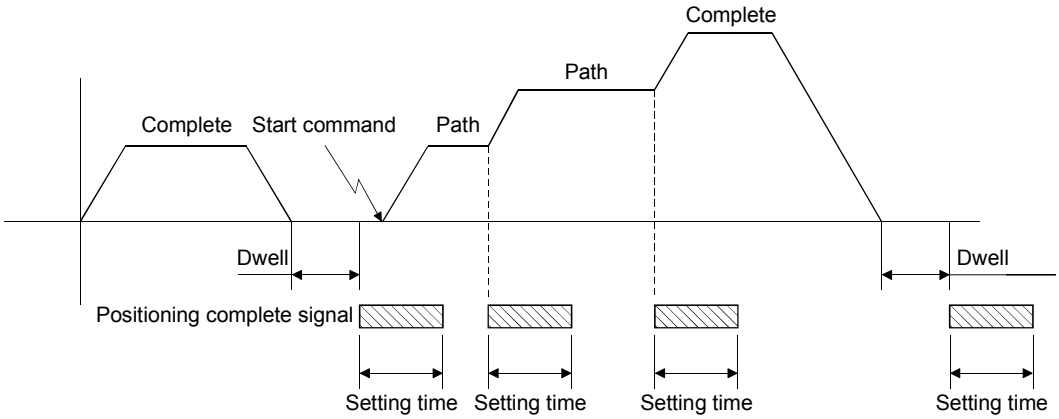
(2) In the condition that the positioning pattern is set to "continuous positioning" and the set time of the positioning complete signal is shorter than the next positioning operation time, the positioning complete signal turns ON when the next data No. starts operation after the previous dwell time has passed.
It turns OFF when the set time has elapsed.



(3) In the condition that the positioning pattern is set to "continuous positioning" and the set time of the positioning complete signal is longer than the next positioning operation time, the positioning complete signal turns ON when the next data No. starts operation after the previous dwell time has passed. However, if the next data No. continuously starts operation before the set time has elapsed, the elapsed time is ignored and the set time starts elapsing from the beginning.
It turns OFF when the set time has elapsed.



(4) When the positioning pattern is set to "continuous path", the positioning complete signal turns ON at speed alteration and moves onto the positioning of the next data No.



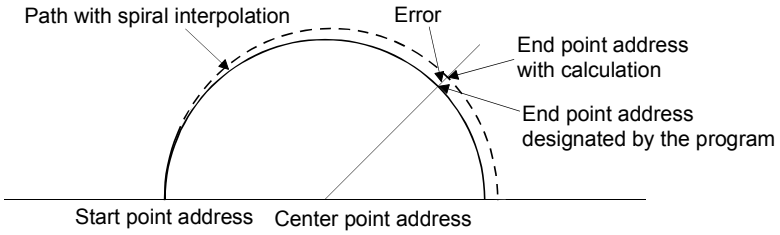
(Note) When the setting time of the positioning complete signal is longer than the next positioning operation time, the operation of the path is as explained in 3).

Allowable circular interpolation error width

(a) With the circular interpolation control using the center point designation, the arc path calculated with the start point address and center point address and the end point address may deviate.

(b) With the allowable circular interpolation error width, the allowable error range of the calculated arc path and end point address can be set. If the error of the calculated arc path and end point address are within the set range, circular interpolation will be carried out to the set end point address while compensating the error with spiral interpolation.

(c) The allowable circular interpolation error width is set in the following axis detailed parameter.
- If axis 1 is the reference axis, set in the axis 1 detailed parameter.
- If axis 2 is the reference axis, set in the axis 2 detailed parameter.
- If axis 3 is the reference axis, set in the axis 3 detailed parameter.
- If axis 4 is the reference axis, set in the axis 4 detailed parameter.



External command function selection

Select a function with which the external command signal should be associated.

(1) When the external positioning start is set
- The external command signal input is used to start positioning operation.

(2) When the external speed change request is set
- The external command signal input is used to change the speed in the current positioning operation.
- Set a new speed value to the "new speed value" of axis control data for external speed change.

(3) Speed-position/position-speed switching request
- The external command signal input is used to switch from the speed control to the position control/from the position control to the speed control during the speed-position switching control mode/position-speed switching control mode.
- To enable the speed-position switching control, set 1 to the speed-position switching enable flag (1528, 1628, 1728, and 1828) of the buffer memory.
- To enable the speed-position switching control, set 1 to the position-speed switching enable flag (1532, 1632, 1732, and 1832) of the buffer memory.

(4) When the skip request is set
- The external command signal input is used to skip the current positioning operation.

POINT
To enable the external command signal, set 1 to the "external command enable" (1505, 1605, 1705, and 1805) of the buffer memory.

4.2 OPR Parameters

The OPR parameters consist of the basic parameters and detailed parameters.

4.2.1 OPR basic parameters

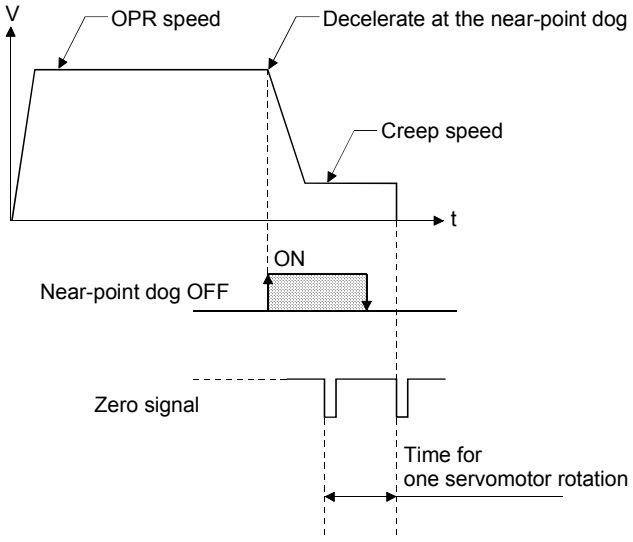
(Unchangeable during PLC CPU READY)

Table 4.3 OPR basic parameters

Item \ Unit	Setting range				Initial value
	mm	inch	degree	pulse	
OPR method	0: Near-point dog method 1: Stopper method 1) (By dwell time elapse) 2: Stopper method 2) (By OP signal when stopper is hit) 3: Stopper method 3) (Without zeroing dog method) 4: Count method 1) (Use zero signal) 5: Count method 2) (Do not use zero signal)				0
OPR direction	0: Positive direction (address increment direction) 1: Negative direction (address decrement direction)				0
OP address	-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	0 to 359.99999degree	-2147483648 to 2147483647pulse	0
OPR speed	0.01 to 20000000.00mm/min	0.001 to 2000000.000 inch/min	0.001 to 2000000.000 degree/min	1 to 1000000pulse/s	1
Creep speed	0.01 to 20000000.00 mm/min	0.001 to 2000000.000 inch/min	0.001 to 2000000.000 degree/min	1 to 1000000pulse/s	1
OPR retry	0: Do not retry OPR by upper/lower limit switch 1: Retry OPR by limit switch				0

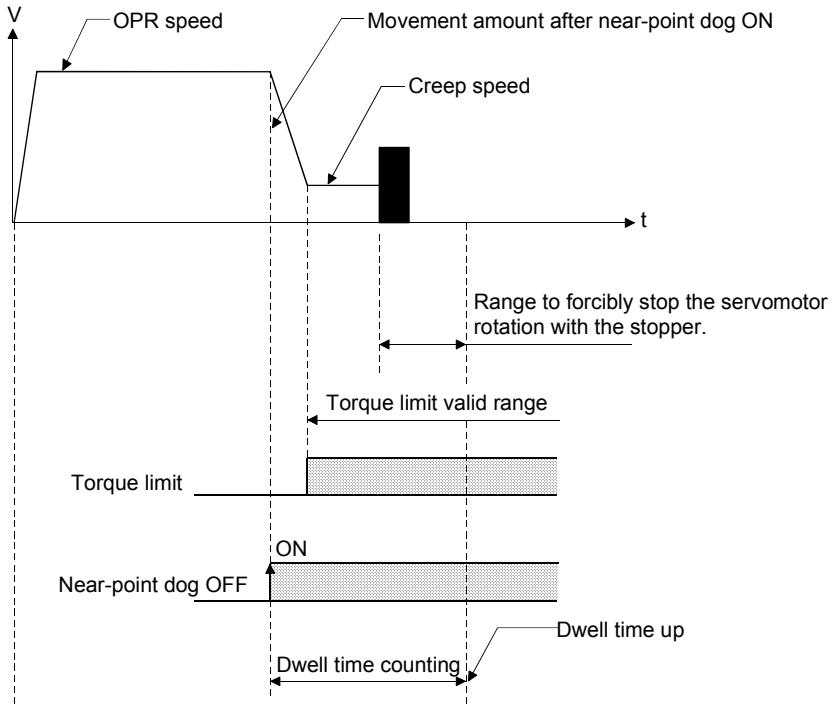
(1) Near-point dog method

This method does not strain a mechanical system and features high precision. However, to use this method, caution must be used on the position and length of a near-point dog.



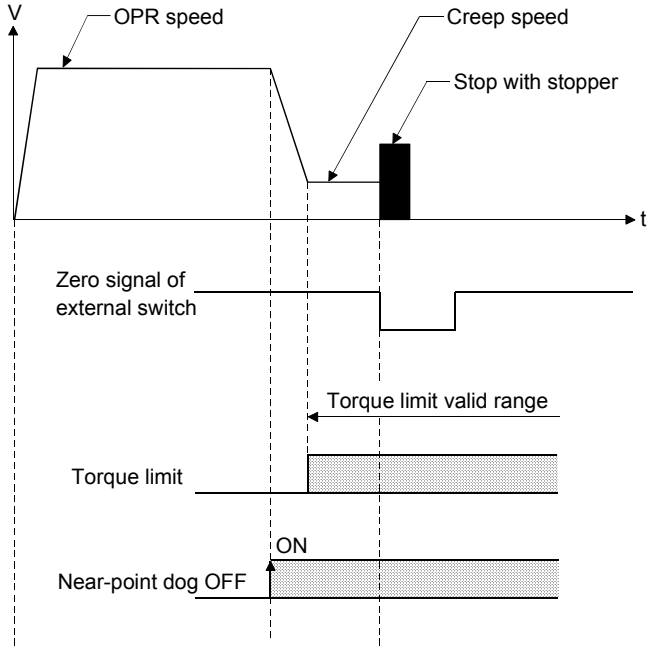
(2) Stopper method (1) (By dwell time elapse)

To use this method, caution must be used on the strain to a mechanical system, torque limit settings and OPR dwell time settings.



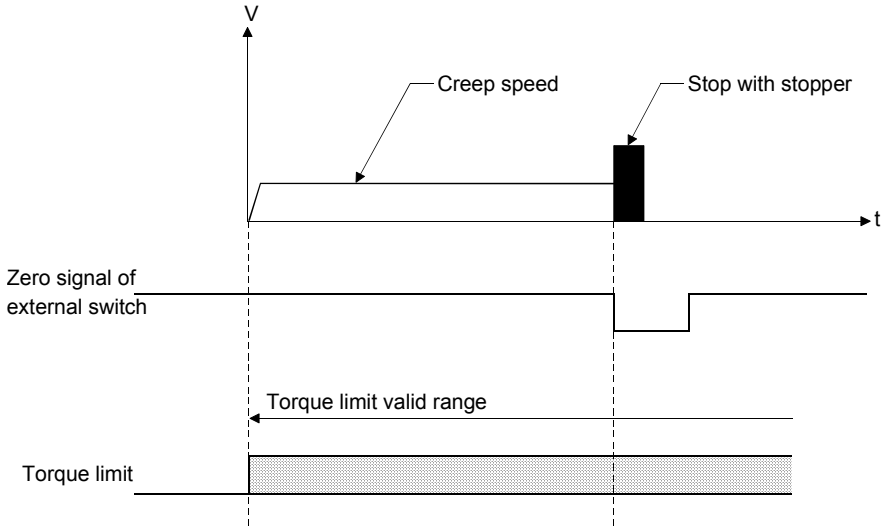
(3) Stopper method (2) (By zero signals when the stopper is hit)

To use this method, caution must be used on the strain to a mechanical system and torque limit settings.



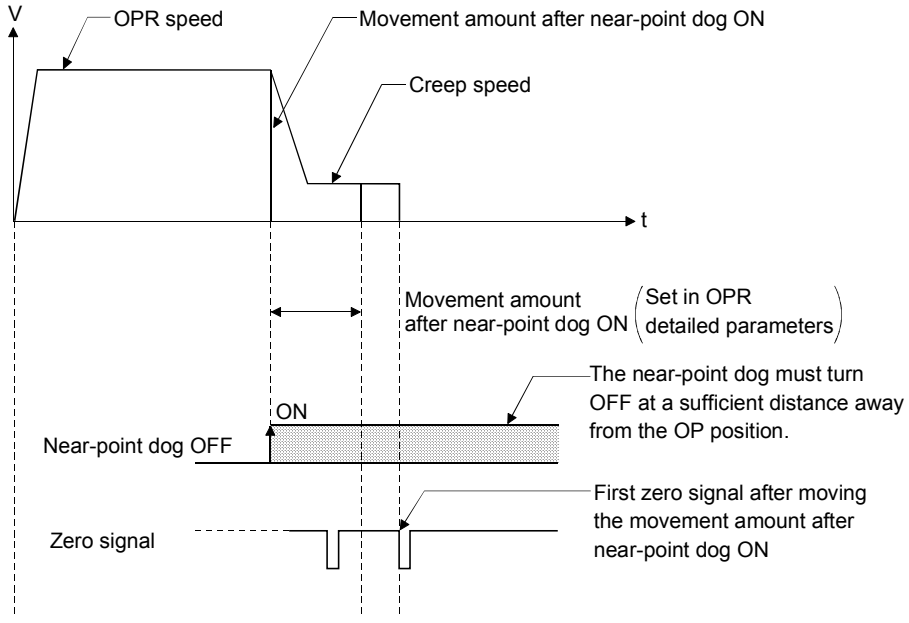
(4) Stopper method (3) (Without zeroing dogs)

To use this method, caution must be used on the strain to a mechanical system and torque limit settings. However, a zeroing dog is not required.



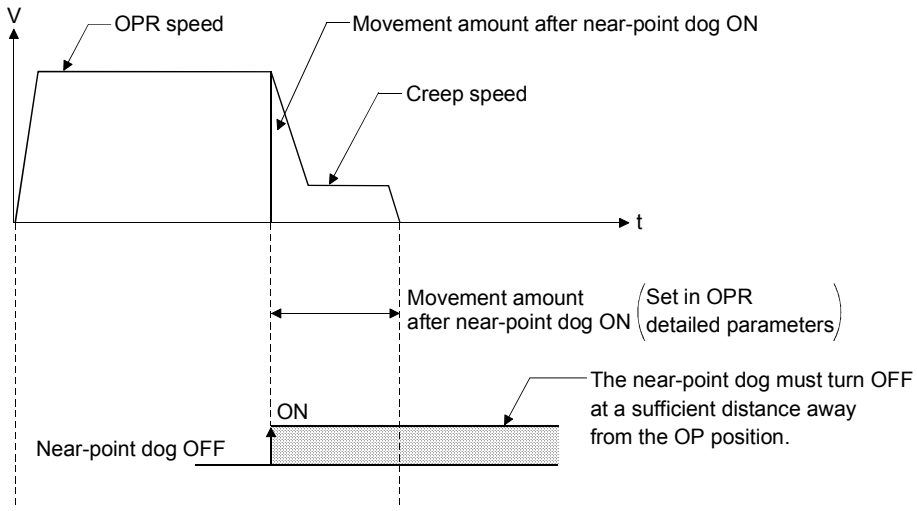
(5) Count method (1) (With zero signals)

This method does not strain a mechanical system and features high precision. To use this method, caution must be used on the position and length of a near-point dog, however, it does not have to be used as much as in the near-point dog method.



(6) Count method (2) (Without zero signals)

This method does not strain a mechanical system or require zero signals, however it also does not provide high stopping accuracy.



OPR direction

Set the direction in which the machine OPR will go at start .

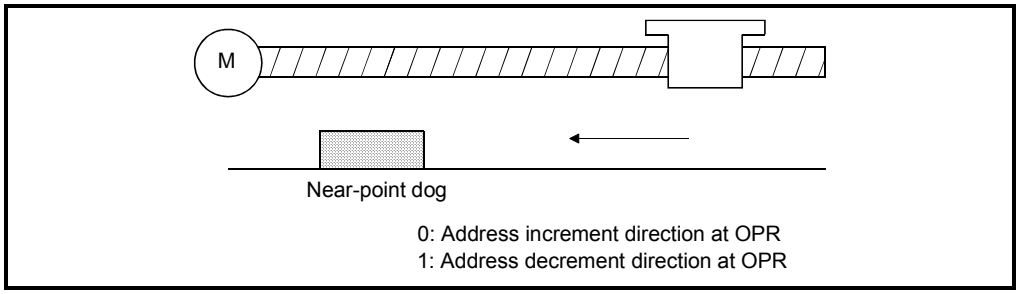


Figure 4.8 OPR direction

IMPORTANT

(1) Setting the OP address to the upper limit side (address increment) or the lower limit side (address decrement) determines the OPR direction.

[Setting]

• OPR direction
- → (Positive direction) 0
- ← (Negative direction) 1

(2) Rotation direction is determined by whether the address increases (the setting is 0) or decreases (the setting is 1) in the JOG operation in reaction to the forward run command. Refer to the below.

[Setting]

• Rotation direction
- →
  - Forward run pulse (motor forward run CW) 0
  - Reverse run pulse (motor reverse run CCW) 1
- ←
  - Forward run pulse (motor forward run CW) 0
  - Reverse run pulse (motor reverse run CCW) 1

Address 0 (← address decrement) (address increment →) 1000

OP address

After the completion of OPR, the current position is set as the specified address. This newly specified address can be the reference value of absolute positioning.
〔This OP address is stored in "current feed value" and "machine feed value" when the OPR is completed.〕

OPR speed

Set the speed of OPR.
Set the OPR speed within the following range.
Speed limit value ≥ OPR speed ≥ Creep speed ≥ Bias speed at start

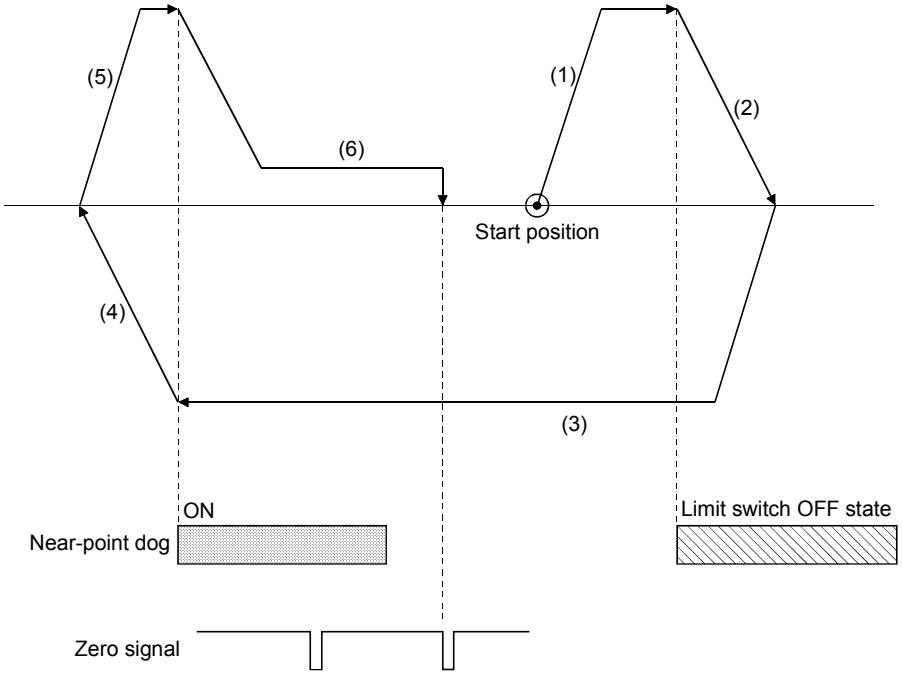
Creep speed

Set the creep speed (the low speed just before a stop, after decelerating from the OPR speed) that comes after near-point dog turns ON.
The creep speed is set within the following range.
OPR speed ≥ Creep speed ≥ Bias speed at start

OPR retry

(a) This function retries the machine OPR with the upper/lower limit switches during the machine OPR.
This allows the machine OPR to be carried out even if the axis is not returned to before the zeroing dog with JOG operation, etc.

(b) When the OPR retry function is validated and the machine OPR is started, the axis will move in the OPR direction. If the upper/lower limit signal turns OFF before the near-point dog signal ON is detected, the axis will decelerate to a stop, and then will move in the direction opposite to the specified OPR direction.
If the falling edge of the near-point dog signal is detected during movement in the opposite direction, the axis will decelerate to a stop, and will carry out the OPR again.



[Operation for OPR retry function]
(1) Movement in the OPR direction starts with the machine OPR start.
(2) The axis decelerates to a stop when the limit switch is detected.
(3) After stopping, the axis moves at the OPR speed in the direction opposite to the specified OPR direction.
(4) The axis decelerates to a stop when the near-point dog turns OFF.
(5) After stopping, carries out OPR in the OPR direction.
(6) The axis moves to the OP at creep speed.

Figure 4.9 Retry OPR with limit switch

4.2.2 OPR detailed parameters

(Unchangeable during PLC CPU READY)

Table 4.4 OPR detailed parameters

Item \ Unit	Setting range				Initial value
	mm	inch	degree	pulse	
OPR dwell time	0 to 65535ms				0
Setting for the movement amount after near-point dog ON	0 to 214748364.7μm	0 to 21474.83647inch	0 to 21474.83647 degree	0 to 2147483647pulse	0
OPR acceleration time selection	Select acceleration time 0 to 3 from basic parameters 2 and detailed parameters 2.				0
OPR deceleration time selection	Select deceleration time 0 to 3 from basic parameters 2 and detailed parameters 2.				0
OP shift amount	-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	-21474.83648 to 21474.83648degree	-2147483648 to 2147483647pulse	0
OPR torque limit value	1 to 300%				300
Deviation counter clear signal output time	1 to 65535ms				11
Speed designation during OP shift	0: OPR speed 1: Creep speed				0
Dwell time during OPR retry	0 to 65535ms				0

OPR dwell time

This is the period of time from when the near-point dog turns ON to when OPR is completed, if the OPR is set by the stopper method (1).
The setting value must be longer than the movement time from when the near-point dog turns ON to when stopped by the stopper.

〔If the OPR method is not stopper method 1, the OPR dwell time value is irrelevant, even if the setting value is within setting range.〕

Setting for the movement amount after near-point dog ON

When using the count method (1) or (2), set the movement amount to the OP after the near-point dog signal turns ON.

〔The movement amount after near-point dog ON should be equal to or greater than distance covered by the deceleration from the OPR speed to the creep speed.〕

OP shift amount from zero

The OP shift function is used to compensate the OP position obtained by the OPR.
With the OP shift function, the OP position can be shifted to a point between zero points or point far from zero point detected.

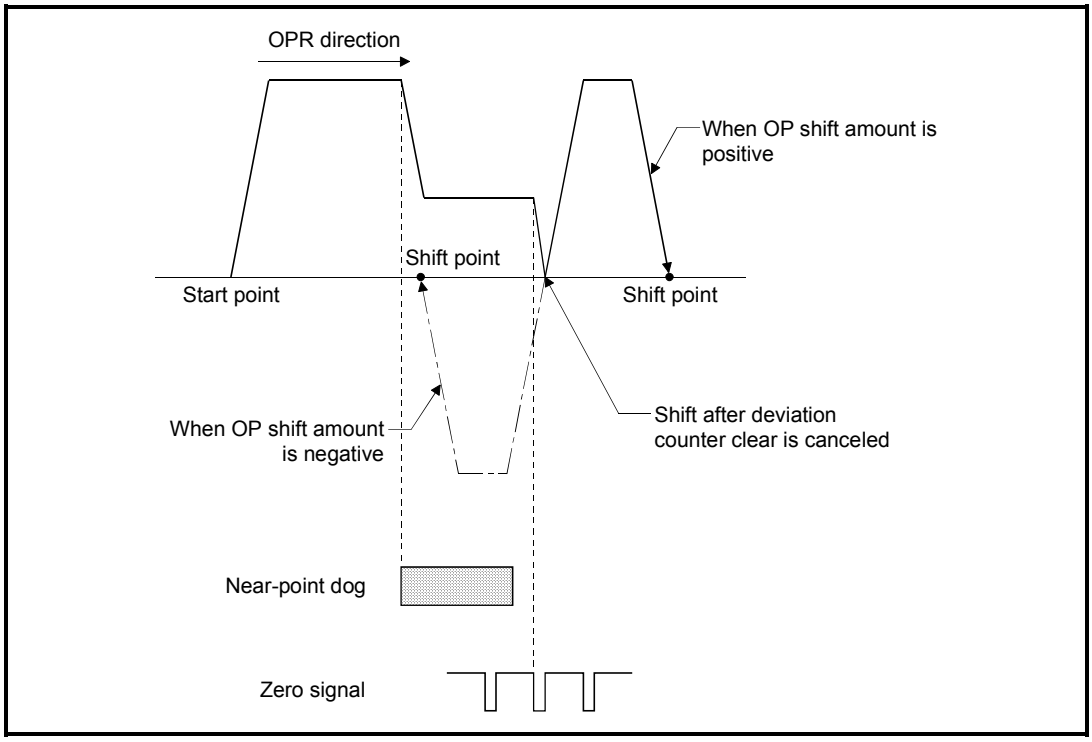


Figure 4.10 OP shift

(Changeable during PLC CPU READY)

(a) The positioning data is used for positioning operation (excluding the OPR, JOG operation and manual pulse generator operation), consisting of types of data shown below.

(b) Choose a reference axis and axis to be interpolated between axes 1 and 4 when interpolation control, such as 2-axis linear interpolation, 2-axis linear fixed-feed, and 2-axis circular interpolation, is performed to 2 axes.
Set all positioning data to a reference axis such as control system and operation patterns.
Set only positioning address/movement amount required for interpolation to the axis to be interpolated.

(c) The width check for each setting value of positioning data is carried out at each positioning.
(An error will occur if the set width is exceeded and positioning will not be executed.))

Table 4.5 Positioning data

Item \ Unit	Setting range				Initial value
	mm	inch	degree	pulse	
Operation pattern	0: Completed	Positioning complete			0: Completed
	1: Continuous	Continuous positioning control			
	2: Path	Continuous path control			
Control system	1: ABS linear 1	1-axis linear control (ABS)			
	2: INC linear 1	1-axis linear control (INC)			
	3: Fixed-feed 1	1-axis fixed-feed control			
	4: VF1	1-axis speed control (forward run)			
	5: VR1	1-axis speed control (reverse run)			
	6: VPF	Speed-position switching control (forward run)			
	7: VPR	Speed-position switching control (reverse run)			
	8: PVF	Position-speed switching control (forward run)			
	9: PVR	Position-speed switching control (reverse run)			
	A: ABS linear 2	2-axis linear interpolation control (ABS)			
	B: INC linear 2	2-axis linear interpolation control (INC)			
	C: Fixed-feed 2	Fixed-feed control by 2-axis linear interpolation			
	D: ABS	Circular interpolation control with sub point specified (ABS)			
	E: INC	Circular interpolation control with sub point specified (INC)			
	F: ABS circular right	Circular interpolation control with center point specified (ABS, CW)			
	G: ABS circular left	Circular interpolation control with center point specified (ABS, CCW)			
	H: INC circular right	Circular interpolation control with center point specified (INC, CW)			
	I: INC circular left	Circular interpolation control with center point specified (INC, CCW)			
	J: VF2	2-axis speed control (forward run)			
	K: VR2	2-axis speed control (reverse run)			
	L: ABS linear 3	3-axis linear interpolation control (ABS)			
	M: INC linear 3	3-axis linear interpolation control (INC)			
	N: Fixed-feed 3	Fixed-feed control by 3-axis linear interpolation			
	O: VF3	3-axis speed control (forward run)			
	P: VR3	3-axis speed control (reverse run)			
	Q: ABS linear 4	4-axis linear interpolation control (ABS)			
	R: INC linear 4	4-axis linear interpolation control (INC)			
	S: Fixed-feed 4	Fixed-feed control by 4-axis linear interpolation			
	T: VF4	4-axis speed control (forward run)			
	U: VR4	4-axis speed control (reverse run)			
	V: NOP	NOP instruction			
	W: Current value changing	Current value changing			
	X: JUMP instruction	JUMP instruction			
	Y: LOOP	Declares the beginning of LOOP to LEND section			
	Z: LEND	Declares the end of LOOP to LEND section			

Table 4.5 Positioning data (Continued)

Item \ Unit		Setting range				Initial value
		mm	inch	degree	pulse	
Axis to be interpolated		0: Axis1 1: Axis 2 2: Axis 3 3: Axis 4				—
Acceleration time No.		Select acceleration time 0 to 3 from the basic parameters 2 and detailed parameters 2.				0
Deceleration time No.		Select deceleration time 0 to 3 from the basic parameters 2 and detailed parameters 2.				0
Positioning address	Absolute	-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	0 to 359.99999degree	-2147483648 to 2147483647pulse	0
Movement amount	Increment	-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	-21474.83648 to 21474.83647degree	-2147483648 to 2147483647pulse	0
	Speed-position, position-speed switching request	0 to 214748364.7μm	0 to 21474.83647inch	0 to 21474.83647degree	0 to 2147483647pulse	0
Arc address (sub point or center point)		-214748364.8 to 214748364.7μm	-21474.83648 to 21474.83647inch	--	-2147483648 to 2147483647pulse	0
Command speed		0.01 to 20000000.00 mm/min	0.001 to 2000000.000 inch/min	0.001 to 2000000.000 degree/min	1 to 1000000pulse/s	0
		-1 (Current speed) Same as the previous speed				
Dwell time		When the control system is other than the JUMP instruction and LOOP instruction: 0 to 65535ms JUMP instruction: Jump destination data No. 1 to 600 LOOP instruction: Repeat cycles 1 to 65535				0
M code		Other than JUMP instruction: 0 to 65535 JUMP instruction: Conditional JUMP condition data No.1 to 10				0

(e) The following shows the positioning data setting screen.

<Setting example>

No.	Operation pattern	Control systems	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
1	0: Completed	1: ABS linear 1	—	0: 100	0: 100	50000.0	0.0	2000.00	0	0	
2	0: Completed	1: ABS linear 1	—	0: 100	0: 100	75000.0	0.0	2000.00	0	0	
3	0: Completed	1: ABS linear 1	—	0: 100	0: 100	100000.0	0.0	2000.00	0	0	
4	0: Completed	1: ABS linear 1	—	0: 100	0: 100	150000.0	0.0	2000.00	0	0	
5	0: Completed	1: ABS linear 1	—	0: 100	0: 100	200000.0	0.0	2000.00	0	0	
6	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	2000.00	0	0	
7											
8											
9											
10											

For positioning data, the items which require settings differ depending on control systems, etc.
Therefore, SW0D5C-QD75P displays setting columns as shown below depending on the need of setting.
Yellow: Setting is not available as it is on the interpolation axis side of interpolation control.
Red: Item to be set has not been set or an error occurred
Grey: Setting is not required (Setting is invalid)

Operation pattern

The operation pattern designates whether positioning of a certain data No. is to be completed with just that data, or whether the positioning is to be carried out with the next data No. in succession.

Operation pattern

- Positioning complete ..... Complete
- Positioning continued
  - Continuous positioning with one start signal ..... Continued
  - Continuous path positioning with speed change..... Path

(1) Positioning complete ... Set to execute positioning to the designated address, and then complete positioning after the dwell time has passed.

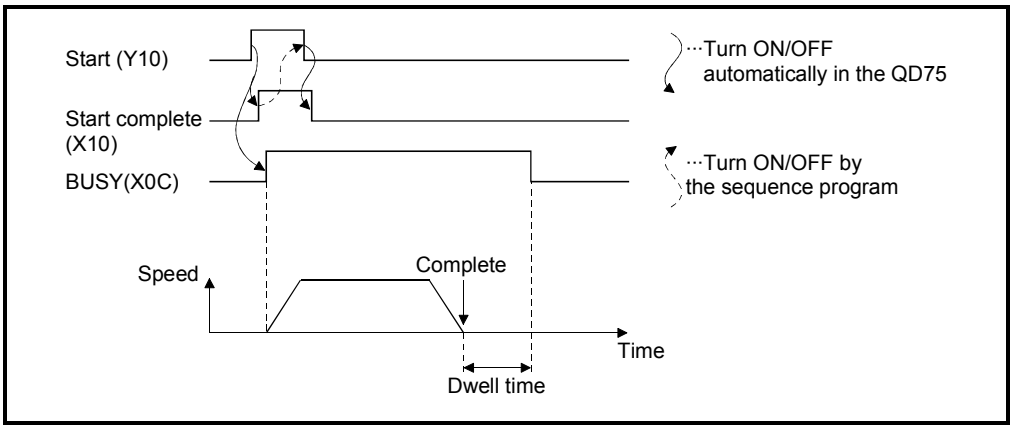


Figure 4.11 Pattern [Complete]

(2) Continuous positioning control .... Positioning is carried out successively in order of data Nos. with one start signal. (the BUSY signal remains ON during positioning continued.)

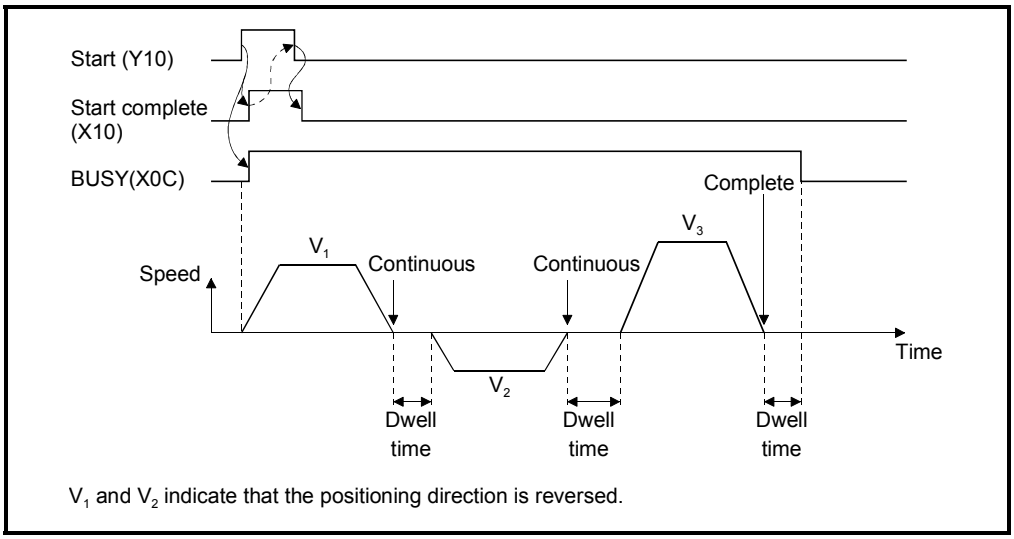


Figure 4.12 Pattern [Continued]

(3) Continuous path positioning
with speed change..... Positioning is carried out successively in order of data Nos. with one start signal. This positioning control enables speed change during positioning.

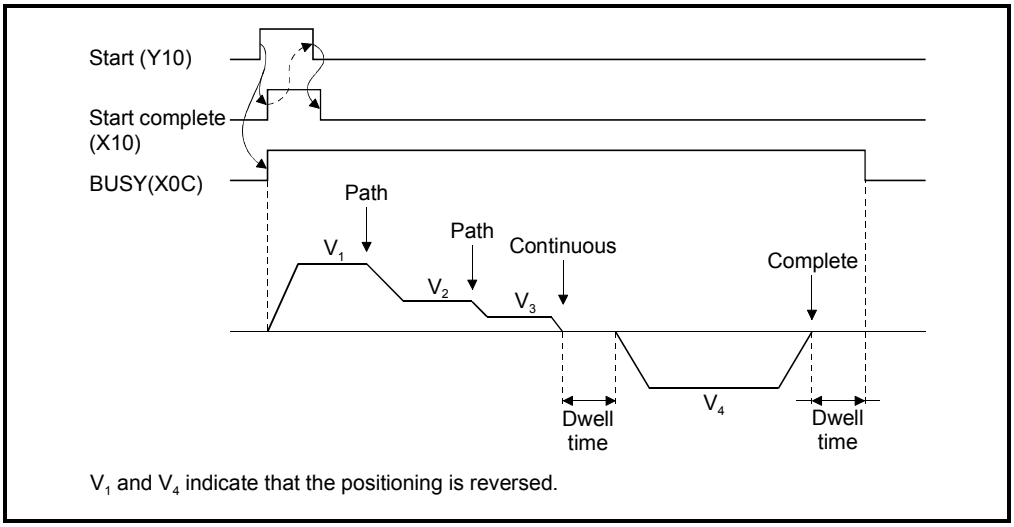


Figure 4.13 Pattern [Path]

Control system

Set the "control system" for carrying out positioning control.
(1) When "JUMP instruction" is set for the control system, the "dwell time" and "M code" setting details will differ.
(2) When "LOOP" is set for the control system, the "M code" setting details will differ.
(3) Refer to Section 4.3.1 to 4.3.11 for details on the control systems.
(4) If "degree" is set for the unit setting, the circular interpolation control cannot be carried out. (An error will occur when executed.)

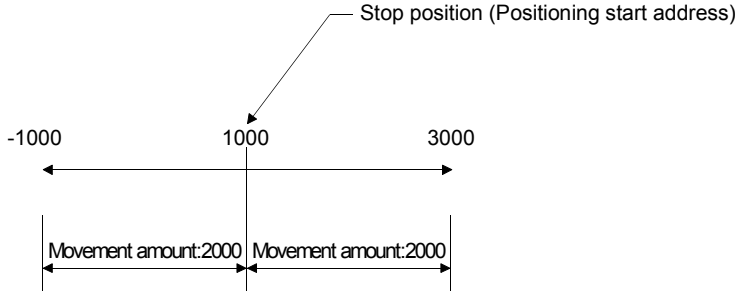
Axis to be interpolated

Set the interpolation axis (target axis) only for operation under the 2-axis interpolation control.
(This item does not need to be set in case where 3 or 4-axis interpolation is selected.)
(1) Do not specify the own axis or a value out of the setting range 1 to 4 for an interpolation target axis. An error will occur when executed.
(2) The following shows the relationship between a reference axis and interpolation axis according to control systems.

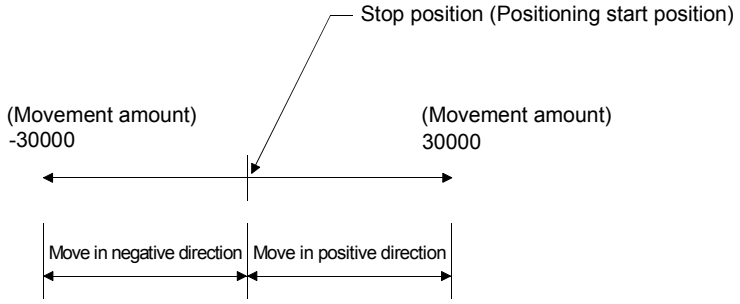
Axis definition / Control systems	Reference axis	Interpolation axis
2-axis linear interpolation control, 2-axis fixed-feed control, 2-axis circular interpolation control, 2-axis speed control	Either of axis 1, axis 2, axis 3 and axis 4	Axis set for "interpolation target axis of reference axis
3-axis linear interpolation control, 3-axis fixed-feed control, 3-axis speed control	Axis 1	Axis 2, Axis 3
	Axis 2	Axis 3, Axis 4
	Axis 3	Axis 4, Axis 1
	Axis 4	Axis 1, Axis 2
4-axis linear interpolation control, 4-axis fixed-feed control, 4-axis speed control	Axis 1	Axis 2, Axis 3, Axis 4
	Axis 2	Axis 3, Axis 4, Axis 1
	Axis 3	Axis 4, Axis 1, Axis 2
	Axis 4	Axis 1, Axis 2, Axis 3

Positioning address

(a) Absolute (ABS) system, current value changing
- The setting value (end point address) for the ABS system and current value changing is set with an absolute address (address from OP).



(b) Incremental (INC) system, fixed-feed 1, fixed-feed 2, fixed-feed 3, fixed-feed 4
- The movement amount (with a sign) for the INC system is set.
- Movement direction is specified with a sign.
  When movement amount is positive: Moves in the positive direction (address increment direction)
  When movement amount is negative: Moves in the negative direction (address decrement direction)



(c) Speed-position switching control
- Set the amount of movement after the switching from speed control to position control.

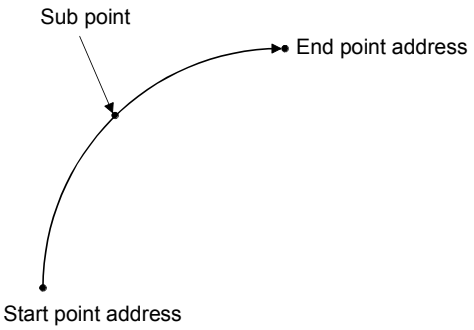
(d) Position-speed switching control
- Set the amount of movement during position control (before the switching to speed control).

Arc address

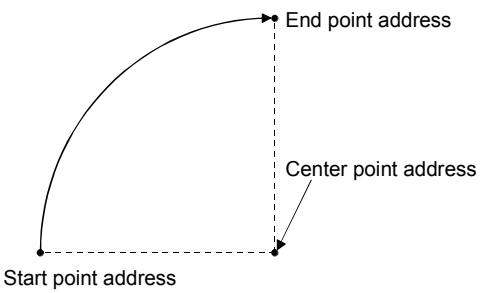
The arc address is data required only when carrying out the circular interpolation control.

(1) When carrying out circular interpolation with a sub point designated, set the sub point (passing point) address.

(2) When carrying out circular interpolation with a center point designated, set the center point address of the arc.



<Circular interpolation with sub point designated>



<Circular interpolation with center point designated>

Command speed

Set the command speed for positioning.

(1) If the set command speed exceeds the speed limit value, positioning will be carried out at the speed limit value.

(2) If "-1" is set for the command speed, the current speed (speed set for previous positioning data No.) will be used for positioning control.

Note that when starting positioning, if the "-1" speed is set for the positioning data that carries out positioning control first, the error "No command speed" will occur, and the positioning will not start.

Dwell time

Dwell time is the time from when the pulse output that is required for positioning is completed to when the completion of the positioning (the BUSY signal OFF).

(1) The positioning will not be accurate if the dwell time is too short.

(2) The dwell time should be set longer than the time from when the output of positioning pulses is completed to when the motor stops..

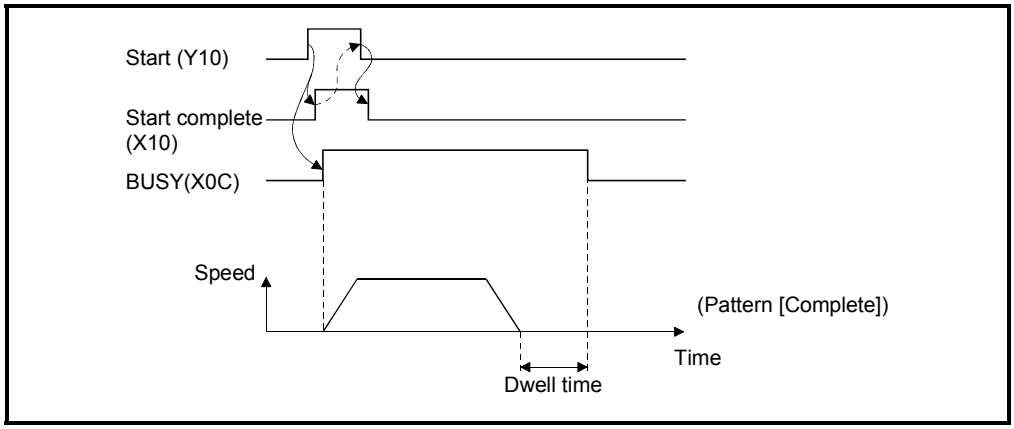


Figure 4.14

(3) If "JUMP instruction" is selected as the control system, set the positioning data No. of the JUMP destination.

M code

An M code is a number used for performing positioning-related operations or displaying positioning-related items during the positioning.

(1) If no M code needs to be output, set "0".

(2) If "JUMP instruction" is selected as the control system, to perform a jump when the conditions are met, set the conditional data No.1 to 10.

(3) If "LOOP" instruction is selected as the control system, set repeat cycles.

4.3.1 Linear control

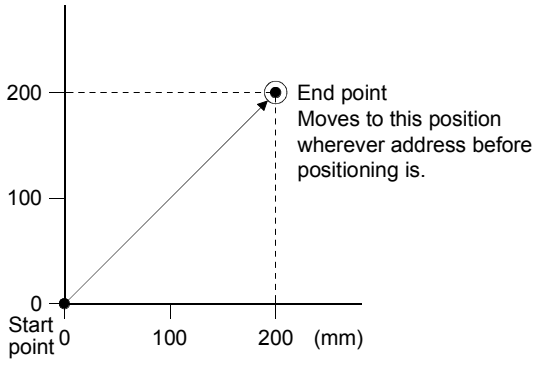
Control by ABS linear 1 to 4 (absolute system)

(1) Positioning control is carried out from the current stop address (address before positioning), that is specified based on the OP, to the designated address.

(2) The movement direction is determined by the current stop address and designated address.

Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	"ABS linear 1" "ABS linear 2" "ABS linear 3" "ABS linear 4"	—
Axis to be interpolated	○*1	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	—	—
Command speed	○	—
Dwell time	△	—
M code	△	—

*1: Required only when ABS linear 2 is selected as the control system



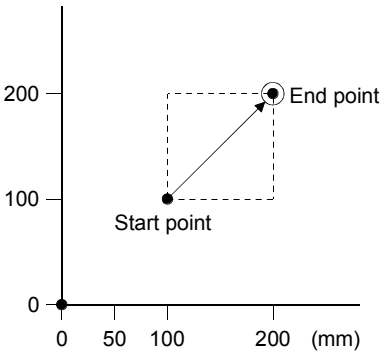
Control by INC linear 1 to 4 (increment system)

(1) Positioning control is carried out for the designated movement amount from the address of the current stop position.

(2) The movement direction is determined by the movement amount sign (+/-).
- When movement direction is positive ... Positioning in the positive direction (address increment direction)
- When movement direction is negative .. Positioning in the negative direction (address decrement direction)

Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	"INC linear 1" "INC linear 2" "INC linear 3" "INC linear 4"	—
Axis to be interpolated	○*1	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	—	—
Command speed	○	—
Dwell time	△	—
M code	△	—

*1: Required when INC linear 2 is selected as the control system



4.3.2 Fixed-feed

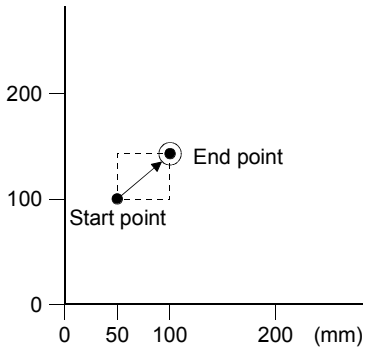
Control by fixed feed 1 to 4 (increment system)

(1) The positioning control is carried out for the designated movement amount treating the current stop position as 0.

(2) The movement direction is determined by the movement amount sign.
- When movement direction is positive ... Positioning in the positive direction (address increment direction)
- When movement direction is negative .. Positioning in the negative direction (address decrement direction)

(3) Fixed-feeds 2 to 4 are controlled by the interpolation control.

Item	Necessity of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	"Fixed-feed 1" "Fixed-feed 2" "Fixed-feed 3" "Fixed-feed 4"	—
Axis to be interpolated	○*1	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	—	—
Command speed	○	—
Dwell time	△	—
M code	△	—



*1: Required when fixed-feed 2 is selected as the control system

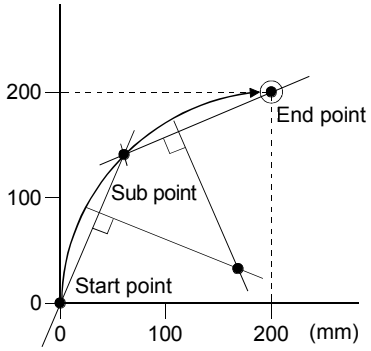
4.3.3 Circular interpolation control with sub point designated

2-axis control with ABS circular interpolation (absolute system)

(1) Circular interpolation is curried out from the current address (address before positioning), which is specified based on the OP, to the end point address through the designated sub point address.

(2) The path that the positioning operation draws results in an arc whose center point is an intersection point of two perpendicular bisectors, one of which is a straight line between the start point address (current stop position) and sub point address, and the other of which is a straight line between the sub point address and end point address.

Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	Selects "ABS circular sub"	—
Axis to be interpolated	○	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	○ (Sets sub point address)	○ (Sets sub point address)
Command speed	○	—
Dwell time	△	—
M code	△	—

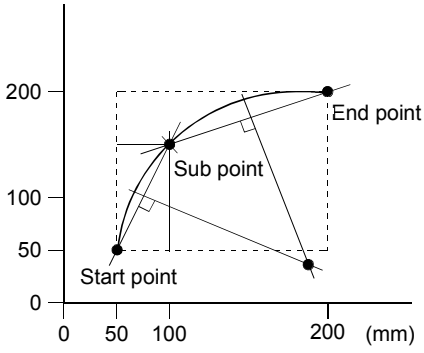


2-axis control with INC circular sub (increment system)

(1) Circular interpolation is carried out from the current stop position address to the end point through the designated sub point.

(2) The path that the positioning operation draws results in an arc whose center point is an intersection point of two perpendicular bisectors, one of which is a straight line between the start point (current stop position) and the sub point, and the other of which is a straight line between the sub point and an end point .

Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	Selects "INC circular sub"	—
Axis to be interpolated	○	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	○ (Sets the movement amount from the start point to the sub point)	○ (Sets the movement amount from the start point to the sub point)
Command speed	○	—
Dwell time	△	—
M code	△	—

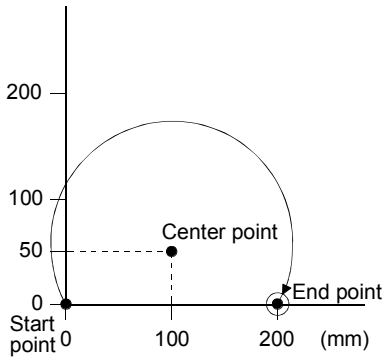


4.3.4 Circular interpolation control with center point designated

2-axis control with ABS circular in right or left direction (absolute system)

(1) Circular interpolation is carried out from the current stop position (address before positioning), which is specified based on the OP and works as a start point in this control, to the end point in an arc movement.

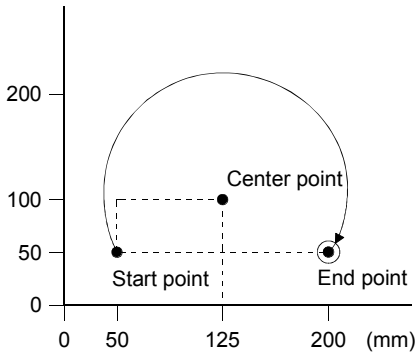
Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	"ABS circular to right" "ABS circular to left"	—
Axis to be interpolated	○	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	○ (Sets the center point address)	○ (Sets the center point address)
Command speed	○	—
Dwell time	△	—
M code	△	—



2-axis control with INC circular in right or left direction (increment system)

(1) Circular interpolation is carried out from the current stop address, which works as a start point (0, 0), to the end point in an arc movement.

Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	○	—
Control system	"INC circular to right" "INC circular to left"	—
Axis to be interpolated	○	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	○	○
Arc address	○ (Sets the center point address)	○ (Sets the center point address)
Command speed	○	—
Dwell time	△	—
M code	△	—



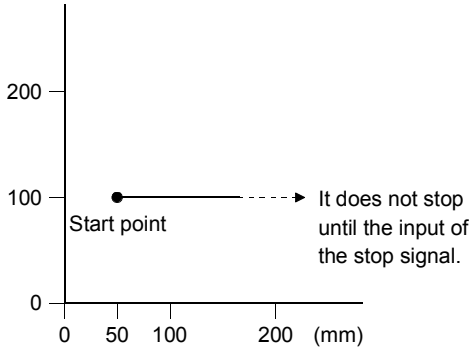
4.3.5 Speed control

Speed control in forward and reverse direction

(1) After startup, the servomotor continues running at a designated speed until the stop command is input.

(2) The current feed value remains 0. (The machine feed value is incremented.)

Item	Need of setting in interpolation control	
	Reference axis	Interpolation axis
Operation pattern	"Complete"	—
Control system	"Forward run speed 1" "Forward run speed 2" "Forward run speed 3" "Forward run speed 4" "Reverse run speed 1" "Reverse run speed 2" "Reverse run speed 3" "Reverse run speed 4"	—
Axis to be interpolated	○*1	—
Acceleration time No.	○	—
Deceleration time No.	○	—
Positioning address	—	—
Arc address	—	—
Command speed	○	○*1
Dwell time	—	—
M code	△*2	—



*1: Required when forward run speed 2 or reverse run speed 2 is selected as the control system.

*2: M codes are valid in "WITH mode" only.

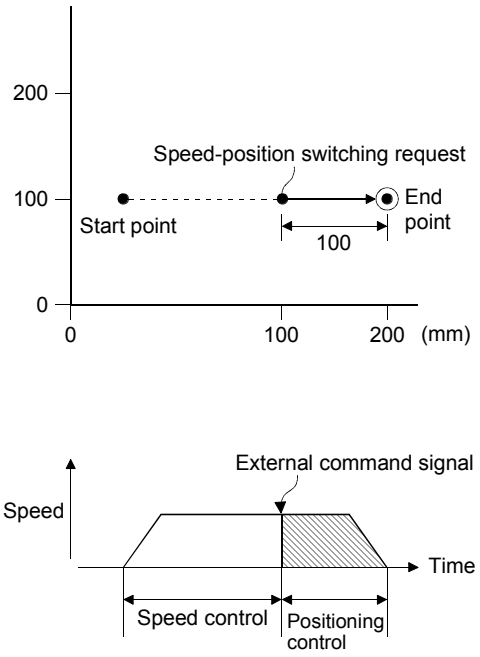
4.3.6 Speed-position switching control

1-axis control with forward run speed/position switching and reverse run speed/position switching (increment system)

(1) The speed control is carried out after the start, and switched to the position control by the external command signal (select the "speed-position/position-speed switching request" for the "external command function selection") when the "speed-position switching enable flag" is ON (Enable), and then the positioning for the designated movement amount is carried out.

(2) The current feed value at the start and during speed control depends on the setting of "current feed value during speed control". (The machine feed value is always incremented.)

Item	Need of setting
Operation pattern	"Complete"
Control system	"Forward run: speed/position" "Reverse run: speed/position"
Axis to be interpolated	—
Acceleration time No.	○
Deceleration time No.	○
Positioning address	○
Arc address	—
Command speed	○
Dwell time	△
M code	△



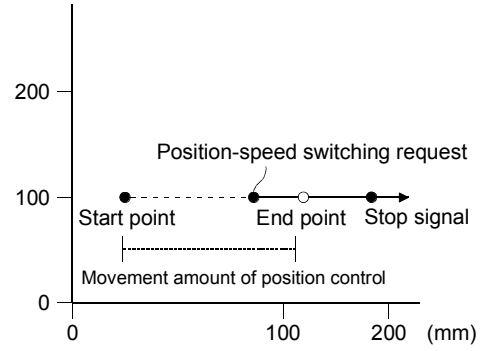
4.3.7 Position-speed switching control

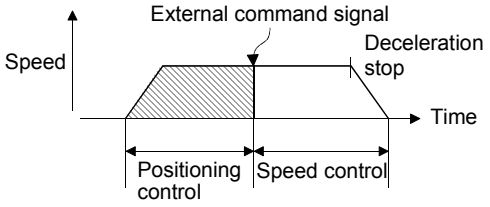
1-axis control with forward run position/speed switching and reverse run position/speed switching (increment system).

(1) The position control is carried out after the start, and switched to the speed control before reaching to the positioning end point by the external command signal (select the "speed-position/position-speed switching request" for the "external command function selection") when the "speed-position switching enable flag" is ON (Enable), and then the speed control is carried out until the input of the stop signal.

(2) The current feed value at the start and during speed control depends on the setting of "current feed value during speed control". (The machine feed value is always incremented.)

Item	Need of setting
Operation pattern	"Complete"
Control system	"Forward run: position/speed" "Reverse run: position/speed"
Axis to be interpolated	—
Acceleration time No.	○
Deceleration time No.	○
Positioning address	○
Arc address	—
Command speed	○
Dwell time	△
M code	△





4.3.8 NOP instruction

Instruction to execute nothing

(1) The NOP instruction is used for the control system that executes nothing.
When the NOP instruction is selected as the control system, all settings (positioning address, command speed, etc.) other than the control system are invalid.

(2) The positioning data No. to which the NOP instruction is set is skipped, without any processing, to the operation for the next positioning data No.
However, when the NOP instruction is set to the positioning data No.600, an error will occur.

REMARK

The NOP instruction is used for reserving the data if there is a possibility of executing speed switching or temporary stop (automatic deceleration) somewhere in the positioning control.
The data can be changed simply by replacing the identifier.

4.3.9 Current value changing

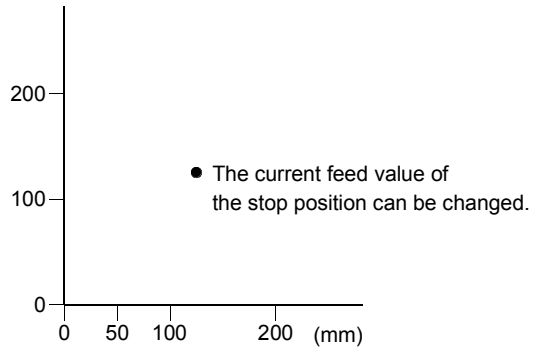
Changing current value of stop position

(1) Change the [Current feed data] to a desired value using the current value changing instruction at a stop or during the continuous positioning control.
(The current value changing cannot be executed during the continuous path control.)

(2) Set a new value in the [Positioning address] column.

(3) When this instruction is executed, the current feed value is changed, and the machine feed value is kept.

Item	Need of setting
Operation pattern	○
Control system	"Current value changing"
Axis to be interpolated	—
Acceleration time No.	—
Deceleration time No.	—
Positioning address	○
Arc address	—
Command speed	—
Dwell time	—
M code	○



REMARK

The current feed value can also be changed by storing a new value to the buffer memory (1506, 1507/1606, 1607/1706, 1707/1806, 1807) using the positioning data No.9003 and the DTO instruction.

4.3.10 JUMP instruction

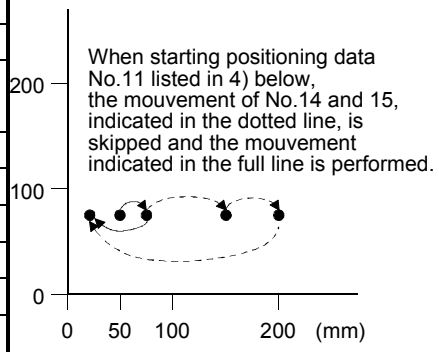
Jumping to data No. by the JUMP instruction during continuous/path operation

(1) The JUMP instruction is used to perform "unconditional JUMP" or "conditional JUMP" to the positioning data No. which is designated during the continuous path control or continuous positioning control.
- Unconditional JUMP : When no execution conditions (M code column) are set for the JUMP instruction, executing this instruction unconditionally makes a jump.
- Conditional JUMP : When execution conditions (M code column) are set to 1 to 10 for the JUMP instruction, executing this instruction makes a jump if the condition is met, and moves to the next positioning data No. if the condition is not met.

(2) The jump destination positioning data No. is set to 1 to 600 in the dwell time column.

(3) The execution condition is set using the block start condition data No. 1 to 10 in the M code column.

Item	Necessity of setting
Operation pattern	—
Control system	"JUMP instruction"
Axis to be interpolated	—
Acceleration time No.	—
Deceleration time No.	—
Positioning address	—
Arc address	—
Command speed	—
Dwell time	○ (Jump destination data No.)
M code	△*1



*1: For a conditional JUMP, set a condition data No.

4) The following shows an example where a jump is made to data No. 16 when the JUMP instruction is input to positioning data No.13 and the condition data 1 is set in the M code column and then the condition is met.

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
11	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	50000.0	0.0	2000.00	0	0	
12	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	75000.0	0.0	2000.00	0	0	
13	1: Continuous	X: JUMP instruction	—	0: 100	0: 100	0.0	0.0	2000.00	16	1	
14	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	150000.0	0.0	2000.00	0	0	
15	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	200000.0	0.0	2000.00	0	0	
16	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	2000.00	0	0	
17											

Note) For the condition data No.1, a condition must be created separately.

JUMP destination data No.

Condition data No.

4.3.11 LOOP to LEND control

Repeat control by repetition (LOOP to LEND)

(1) The LOOP to LEND loop is repeated for the set number of cycles.

(2) The repeat cycles are set to 1 to 65535 in the M code column.

(3) When LOOP is selected as the control system, settings other than the repeat cycles (M code column) are ignored.

(4) When LEND is selected as the control system, the settings of other items are ignored.

(5) When the repeat cycle designated by the LOOP becomes 0, the loop is terminated, and the next positioning data No. processing is started. (The operation pattern will be ignored.)
To stop the operation after the operation has been repeated for the designated number of times, set the dummy positioning data (for example, incremental positioning without movement amount) next to LEND.

Item	Necessity of setting	
	LOOP	LEND
Operation pattern	—	—
Control system	"LOOP"	"LEND"
Axis to be interpolated	—	—
Acceleration time No.	—	—
Deceleration time No.	—	—
Positioning address	—	—
Arc address	—	—
Command speed	—	—
Dwell time	—	—
M code	○ (Setting of repeat cycles)	—

(6) The following shows an example where a jump is made to the positioning data No.25 after LOOP is input to the positioning data No.22 and the repeat cycle 2 is set to the M code column.

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
21	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	50000.0	0.0	2000.00	0	0	
22	0: Completed	Y:LOOP	—	0: 100	0: 100	0.0	0.0	0.00	0	2	
23	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	100000.0	0.0	2000.00	0	0	
24	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	150000.0	0.0	2000.00	0	0	
25	0: Completed	Z:LEND	—	0: 100	0: 100	0.0	0.0	0.00	0	0	
26	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	2000.00	0	0	
27											

Repeat cycles

Positioning data No.21→22→23→24→25→22→23→24→25→26

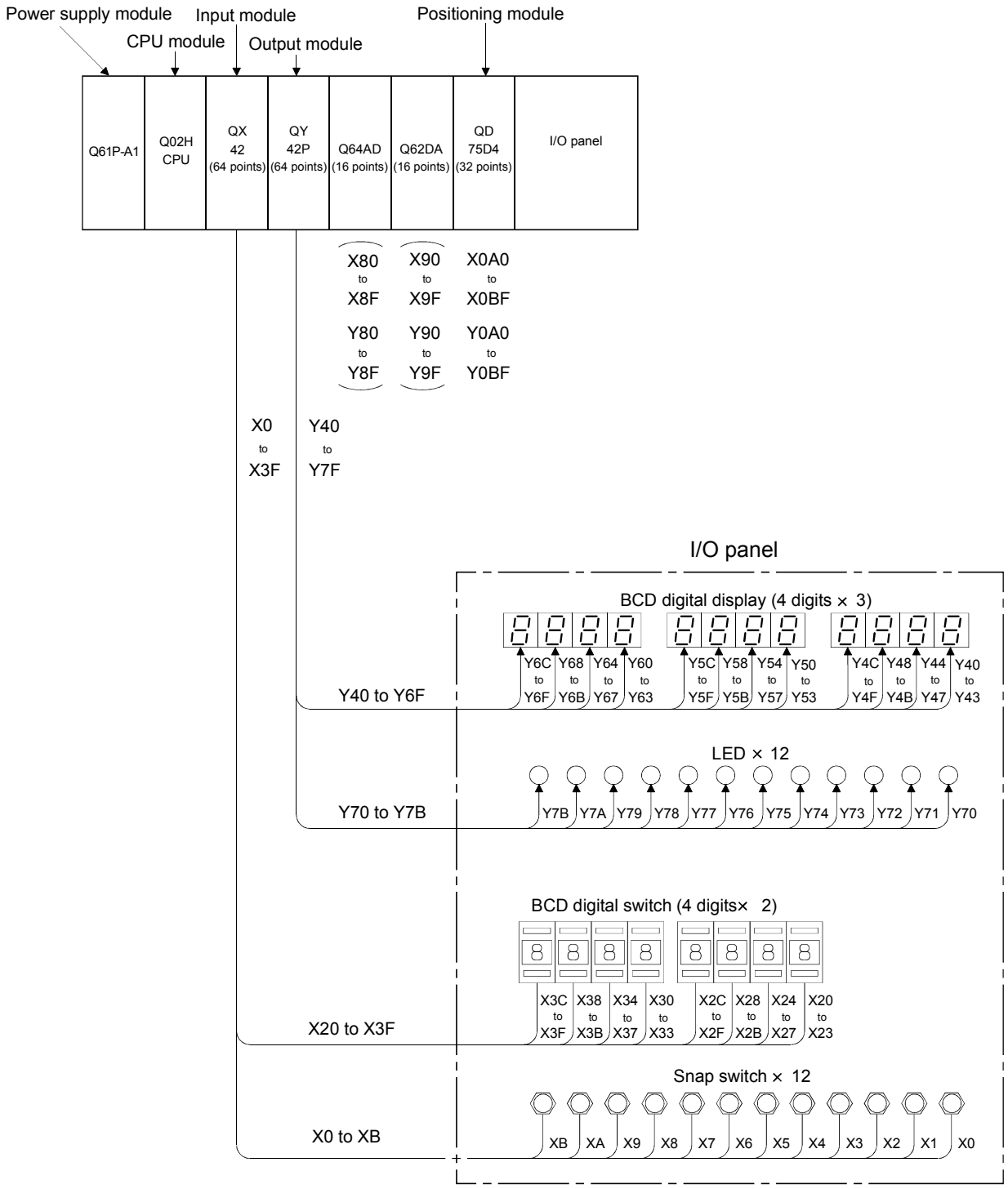
|----------|----------|

Repeat cycles First Second

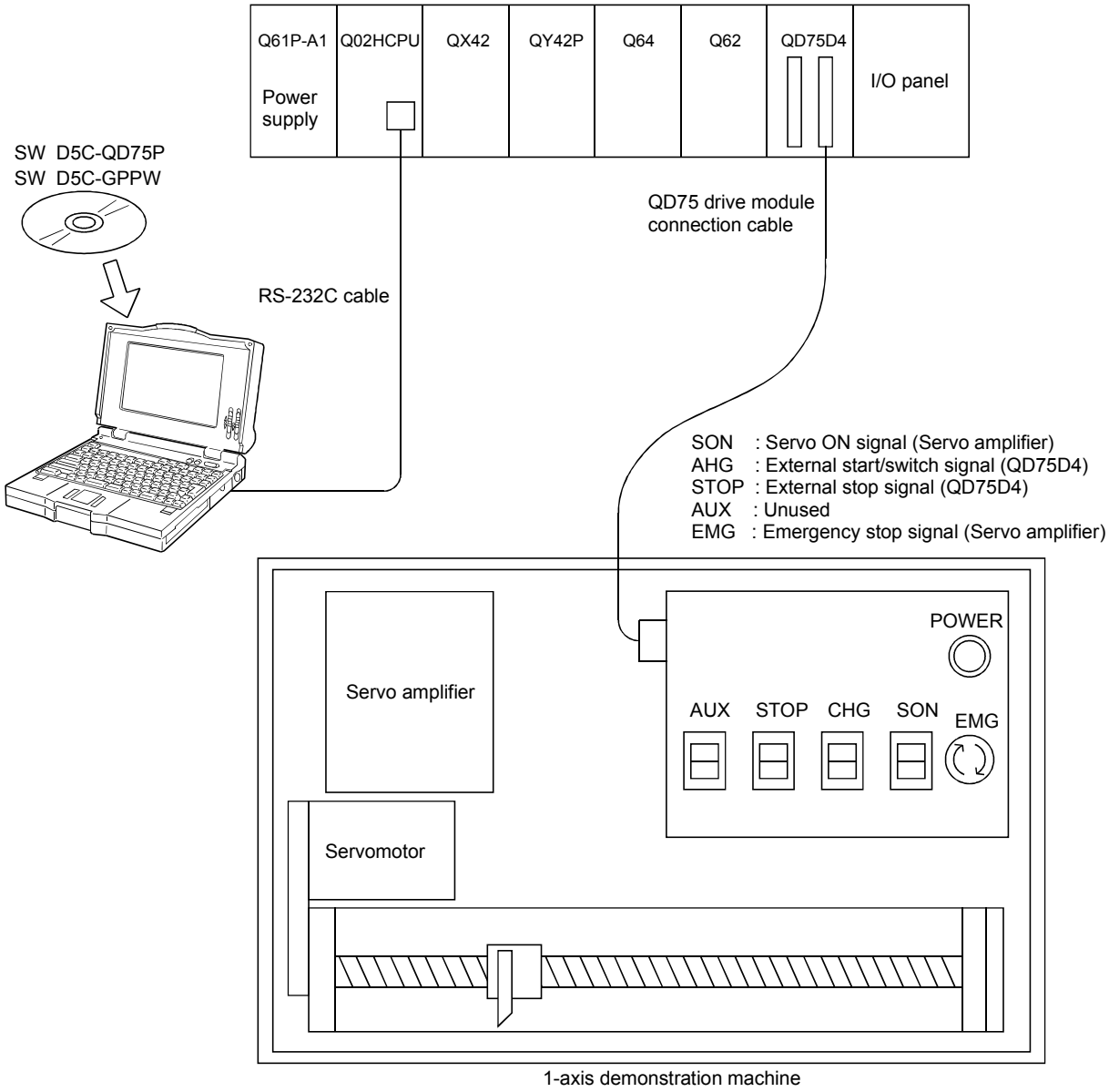
CHAPTER 5 EXERCISE (1) TEST OPERATION USING SW□D5C-QD75P

5.1 System Configuration of Demonstration Machine

(1) I/O number assignment



(2) Wiring and preparation

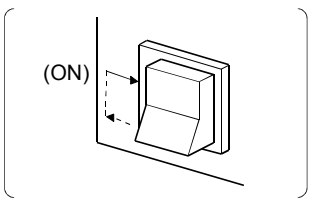


1-axis demonstration machine

IMPORTANT
Be sure to turn the power off before replacing the module or wiring.

(3) Powering-on and the switch

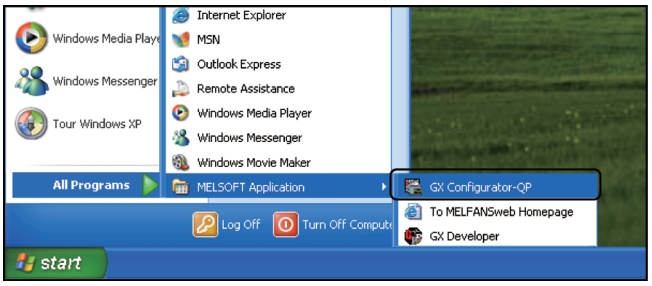
1) After mounting modules as shown above and completing the wiring, turn the Q02HCPU to "STOP", and then turn ON the power switch of the demonstration machine.
2) After powering on, turn the STOP and CHG switches of the 1-axis demonstration machine to OFF and the SON switch to ON.
   Press the upper side of each switch to turn ON and the lower side to turn OFF.



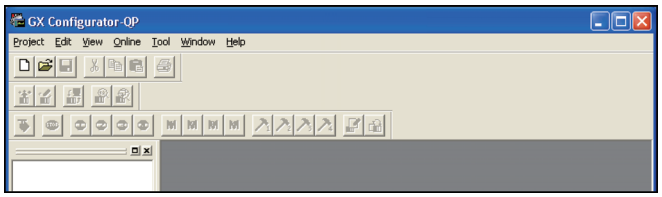
5.2 Starting Up and Exiting SW□D5C-QD75P

5.2.1 Start up operation

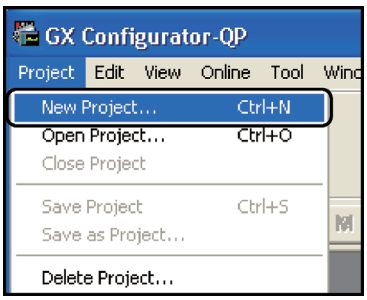
This section provides explanations from how to start up the SW□D5C-QD75P software package for QD75 positioning to how to create a new project.



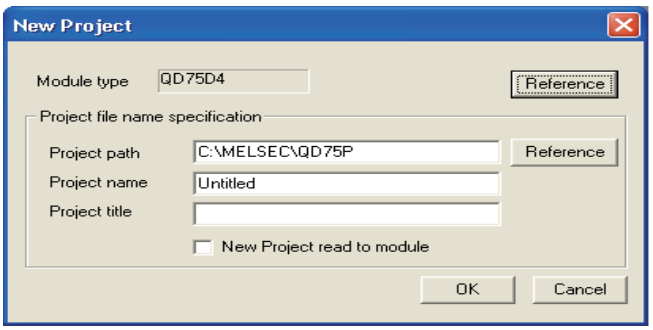
1) Click "Start" of Windows → "All Programs"
→ "MELSOFT Application"
→ "GX Configurator-QP".



2) SW□D5C-QD75P starts up.



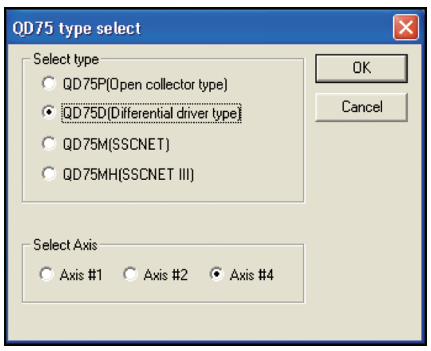
3) Click "Project" → "New project".



4) Confirm that "QD75D4" is set for Module type.

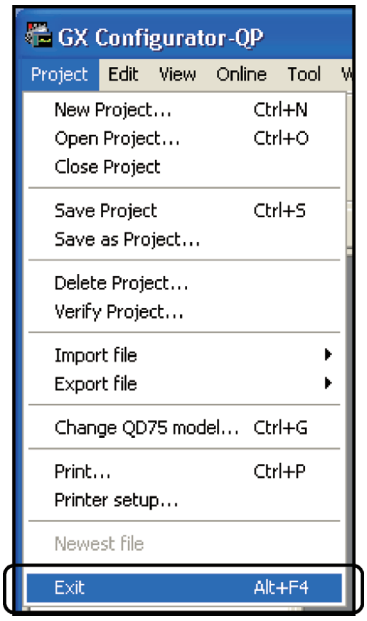
5) Click the OK button to start the project.

*: When the demonstration machine (QD75D4) is not set for Module type, click the "Reference" button at the upper right to set in the QD75 type select dialog box shown below.



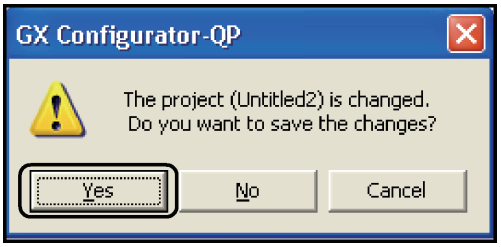
5.2.2 Exit operation

This section explains how to exit SW□D5C-QD75P.

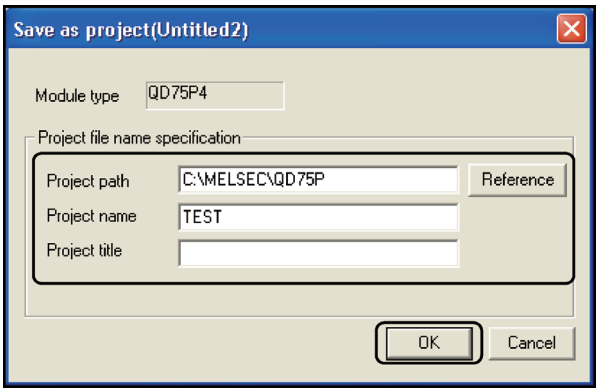


1) Click "Project" → "Exit" menu.

- If no project is opened, the operation is completed here.
- If the settings of the opened project have not been changed, click the "Yes" button on the dialog box asking whether to close the project.
- If the settings of the opened project have been changed, go to step 2).



2) The dialog box appears asking whether to save the project.
Click the [Yes] button to save and terminate the project.



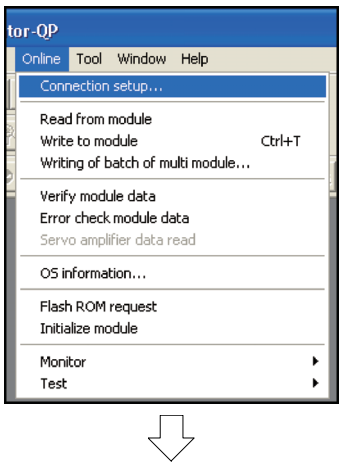
3) When Project name is not set (untitled), the "Save as project(Untitled)" dialog box appears.

4) Enter "Project path" and "Project name". If required, enter "Project title".

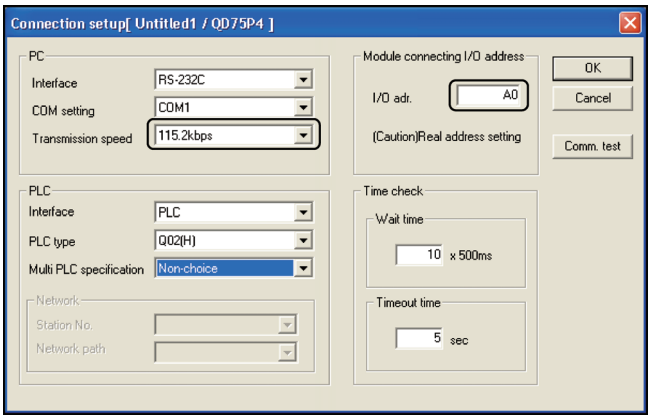
5) Click the [OK] button to save and terminate the project.

5.3 Specifying Connection Target QD75

SW□D5C-QD75P accesses the QD75 via PLC CPUs, serial communication modules, etc.
Make the settings for the interfaces located midway along the communication path and interfaces on the peripheral device side to perform the online operations (data write/read/monitor/test and so on).



1) Click the "Online" → "Connection setup".



2) Change the following items on the Connection setup dialog box.
"Transmission speed" 115.2 kbps
"I/O adr." A0

3) Click the OK button.

IMPORTANT

In SW□D5C-QD75P, connection setup must be performed each time a project is opened in order not to access undesired QD75s.
When a project is opened, display the Connection setup dialog box before online operation and click the OK button. (The latest saved settings are retained.)
The online operation cannot be performed without connection setup.
The connection setup is not required for offline operation (such as editing positioning data on the peripheral device).

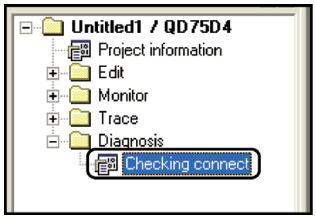
5.4 Initialization and Connection Check Using SW□D5C-QD75P

When the positioning system is changed or a new system is installed, initialize the QD75 and check the I/O signals from the drive module and the external devices.
Also, execute the JOG operation in the test mode to check the rotation direction of the servo motor and the ON/OFF of zeroing and zero point.

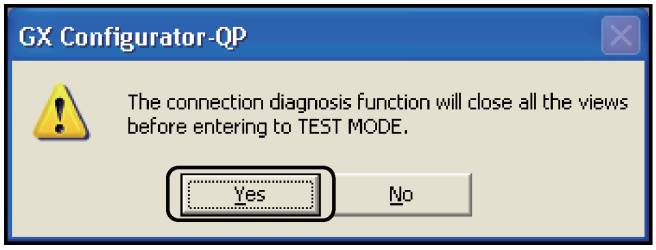
Note) Make the PLC CPU to the "STOP" status.

1) Double-click the project name to be checked from the project tool bar.

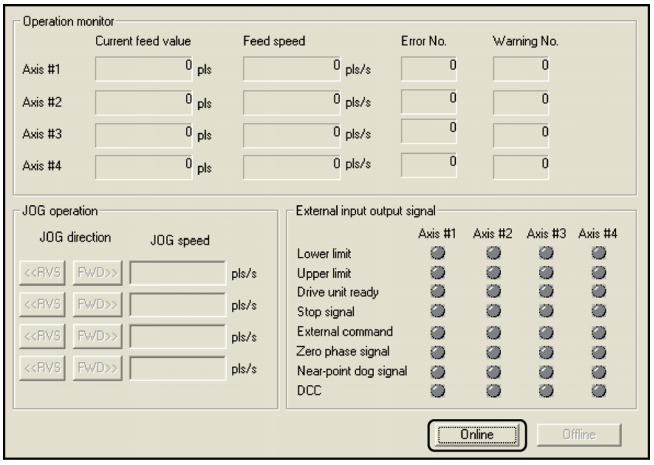
2) Double-click the "Diagnosis" icon.



3) Double-click the "Checking connect" icon.



4) The dialog box appears asking whether to close all the displayed windows. Click the Yes button.



5) Connection check window appears. Click the Online button.

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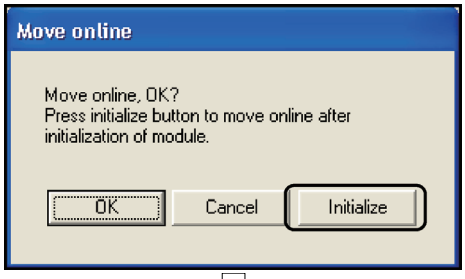
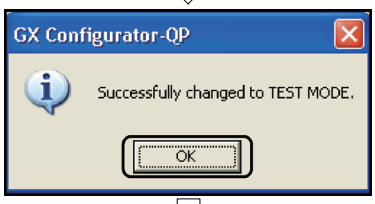
From the previous page

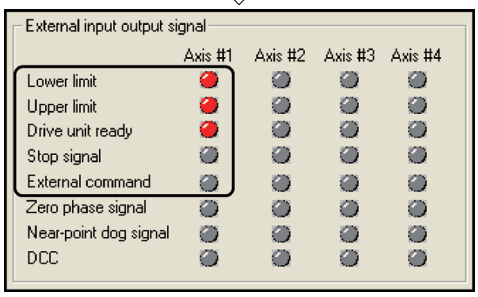


6) The dialog box appears asking whether to move to the online mode (move to the test mode) and to initialize the QD75.
Click the [Initialize] button to initialize the QD75 and then move to the test mode.

(Parameters and positioning data are not initialized in this process. The internal data of the QD75 module is initialized.)

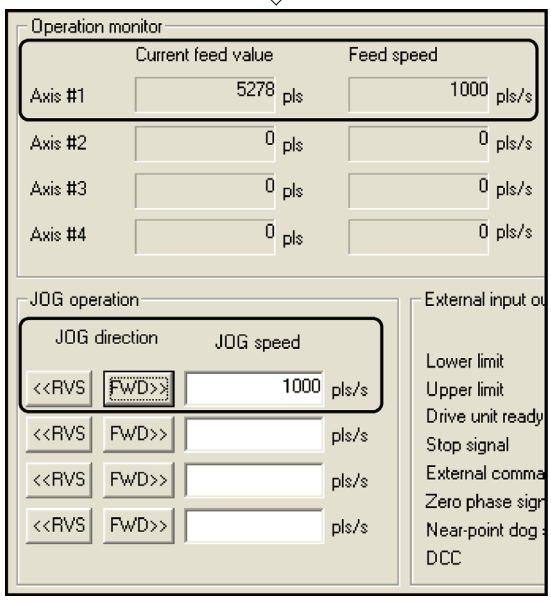


7) The dialog box appears confirming that the QD75 has been successfully changed to TEST MODE.
Click the [OK] button.



8) Check the "External input output signal" status on the connection check window.
- Upper limit, Lower limit, Drive unit ready →● (Red): ON
- Stop signal, External command →○ (Gray) : OFF

9) Check the ON/OFF of "External input output signal" with the STOP and CHG switches of the 1-axis demonstration machine.
STOP = Stop signal,
CHG = External command



10) Enter a speed in the text box of "JOG speed" and press and hold the left button of the mouse for a few seconds with the mouse pointer on [FWD] or [RVS].
The JOG operation is performed for the period of time the left button of the mouse was pressed.

11) Check how "Current feed value" was changed and "Feed speed" at the Operation monitor during the JOG operation.

12) Click the [Offline] button. The dialog box appears asking whether to terminate the test mode.
Click the [Yes] button to terminate the connection check.

REMARK

The operation check of the upper/lower limit switches (FLS/RLS) can be performed in the JOG operation.
Perform one of the three following operations to initialize the parameters and the positioning data.
1) Select and execute "QD75Initialization" with the QD75P in the online mode.
2) Execute the QD75 dedicated instruction "PINIT".
3) Write "1" to the buffer memory "1901".

5.5 Positioning Exercise Using Test Operation Function

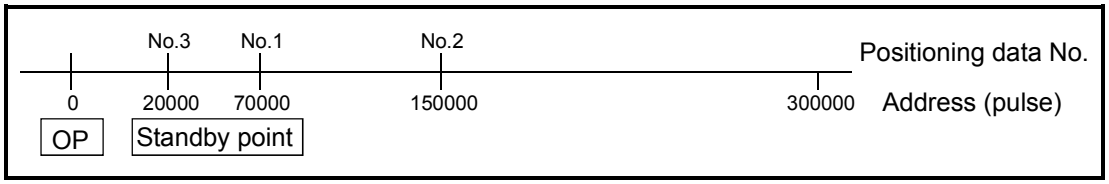
Project name	TEST

Set the parameters, OPR parameters and positioning data using SW□D5C-QD75P and write them to the QD75.
Perform the test operation and monitoring from the peripheral device in the test mode.

Procedure

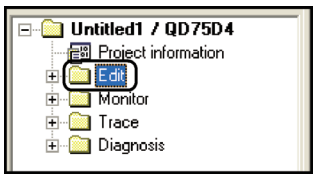
Basic parameter and OPR parameter setting	.....	Section 5.5.1
↓		
Positioning data setting	.....	Section 5.5.2
↓		
Simulation	.....	Section 5.5.3
↓		
Data write to QD75	.....	Section 5.5.4
↓		
Test operation and monitoring	.....	Section 5.5.5

<Example of positioning >
Linear control (Operation pattern: Complete)

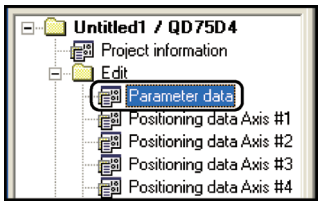


5.5.1 Basic parameter and OPR basic parameter setting

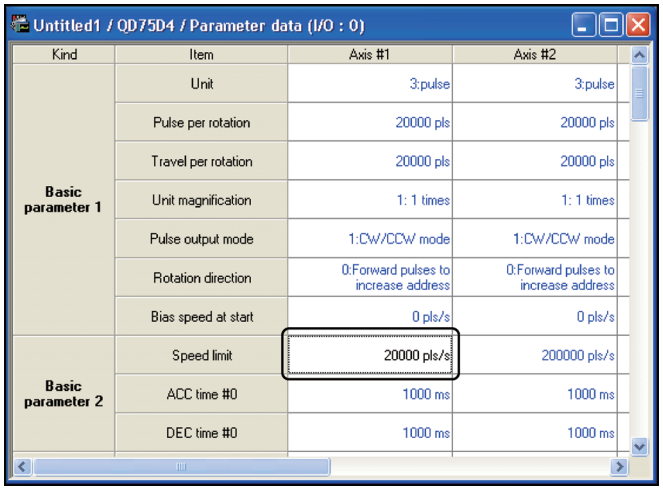
Set the parameters according to the devices to be used and the control details.
In the procedure below, the initial values (default values) are used except some items.



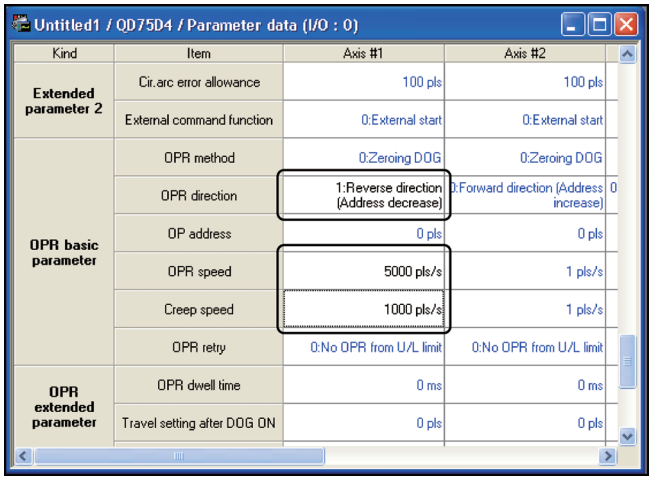
1) Double-click the "Edit" icon.



2) Double-click the "Parameter data" icon.



3) The parameter edit window appears.
Enter "20000" in the Axis #1 column of Basic parameter2 "Speed limit".

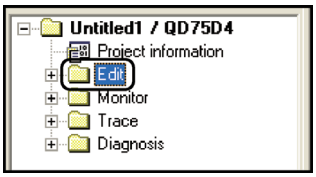


4) Scroll down the parameter edit window and set the Axis #1 OPR basic parameter as follows.

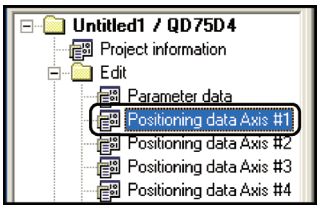
"OPR direction" ..... 1: Reverse direction (Address decreases)
"OPR speed" 5000
"Creep speed" 1000

5.5.2 Positioning data setting

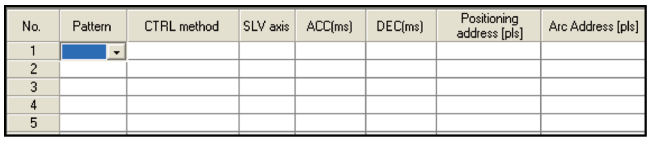
Set the positioning data.



1) Double-click the "Edit" icon.



2) Double-click the "Positioning data Axis #1" icon.



3) The positioning data axis #1 edit window appears.
Double-click Pattern, CTRL method, ACC (ms) and DEC (ms) to select a desired item from their lists.
Enter a setting value directly for other items.

<Setting example of positioning data axis #1>

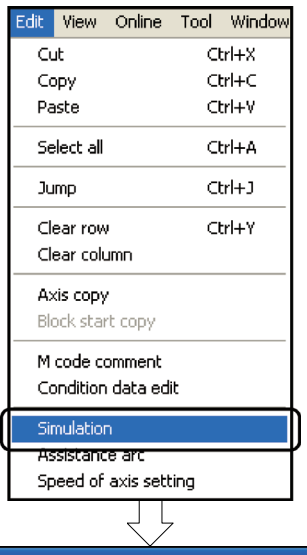
No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [PLS]	Arc address [PLS]	Command speed [PLS/sec]	Dwell time [ms]	M code	Positioning data comment
1	0: Completed	1: ABS linear 1	—	0: 1000	0: 1000	70000	0	8000	0	0	
2	0: Completed	1: ABS linear 1	—	0: 1000	0: 1000	150000	0	8000	0	0	
3	0: Completed	1: ABS linear 1	—	0: 1000	0: 1000	20000	0	10000	0	0	

REMARK

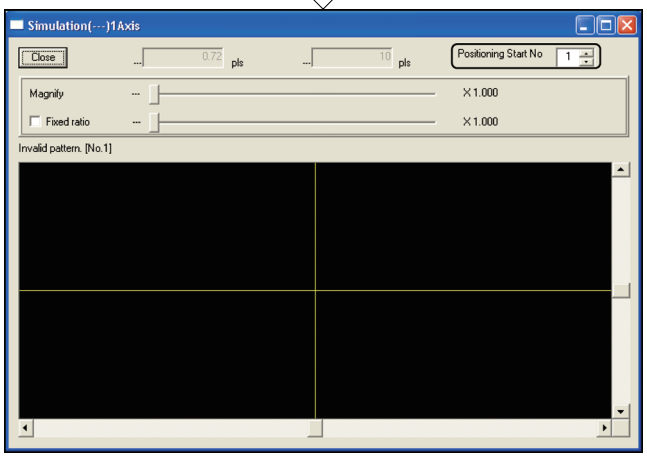
The positioning data can be edited using [Edit] → [Cut] / [Copy] / [Paste] for a dragged area.

5.5.3 Simulation

Check if the set details of the operation pattern, control method, address and command speed are correct using the simulation (virtual positioning) function.



1) Click "Edit" → "Simulation" with the Positioning data Axis #1 displayed.



2) The simulation window appears. Select "1" for "Positioning Start No.".

3) The simulation result of the positioning data No.1 appears.

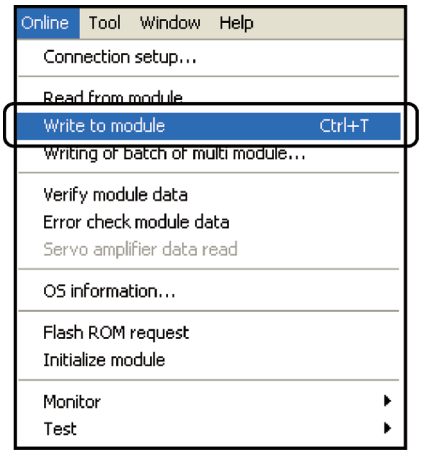
4) To see the simulation of other positioning data, change "Positioning start No." to "2", "3", and so on.

Note) The simulation result is made on the premise that positioning is started from the address 0.

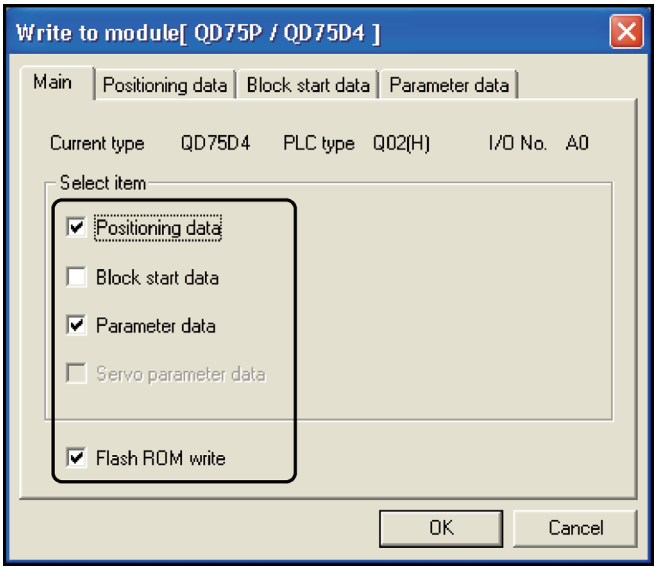
5.5.4 Data write to QD75

Write the set parameters, OPR parameters and positioning data to the QD75.
(For the writing, a data type and range can be designated per axis.)

Note) Set the PLC CPU to the "STOP" status.

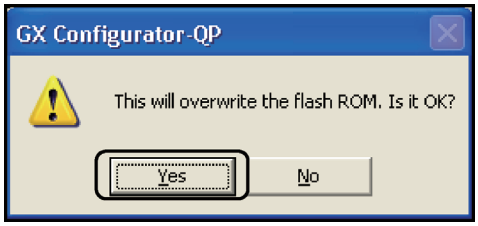


1) Click "Online" → "Write to module".



2) Write to module dialog box appears.
Put a checkmark in the check boxes of "Positioning data", "Parameter data" and "Flash ROM write".

3) Click the OK button to execute writing to the QD75.



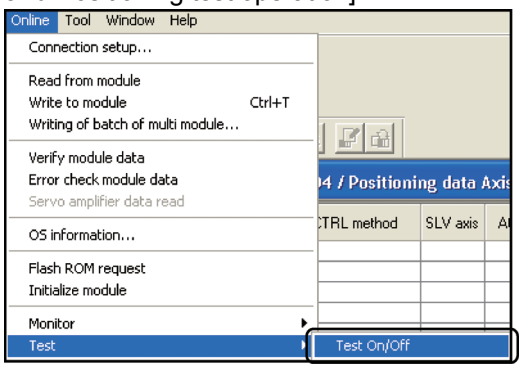
4) The dialog box appears asking whether to overwrite the flash ROM. Click the Yes button.

5) Reset the PLC CPU.

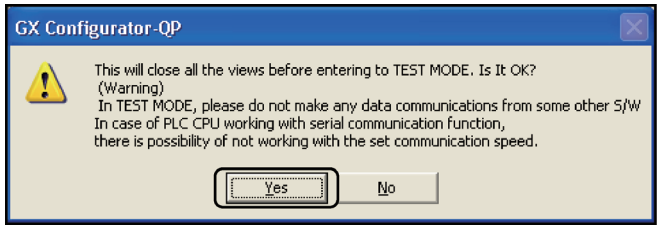
5.5.5 Test operation and monitoring

To check how the QD75 operates, perform the OPR test and the test operation using the stored positioning data.
Also, monitor the axis status during operation and set details. .

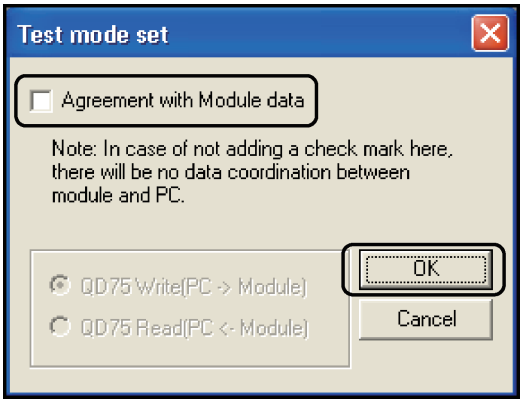
[OPR and Positioning test operation]



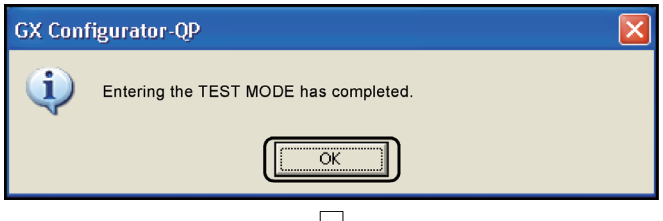
1) Click "Online" → "Test" → "Test On/Off".



2) The dialog box appears asking whether to close all windows currently open. Click the Yes button.



3) Remove the checkmark of "Agreement with Module data" on the Test mode set dialog box, then click the OK button.



4) The dialog box appears confirming that QD75 has been successfully changed to the TEST MODE.
Click the OK button.

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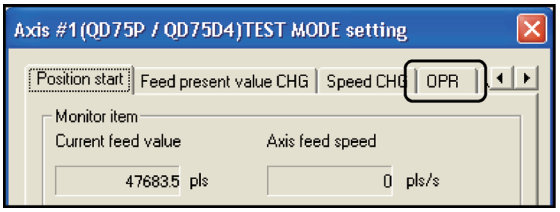
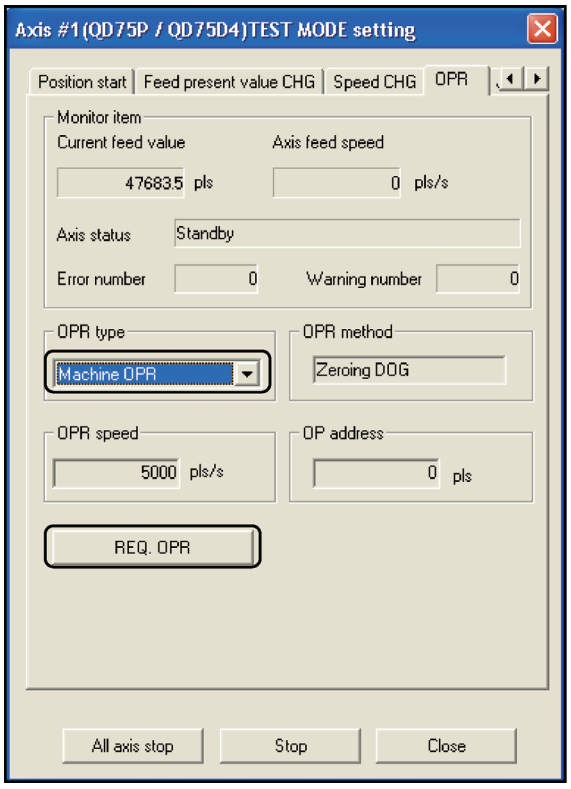
5) Click (Axis #1 operation test) on the toolbar.

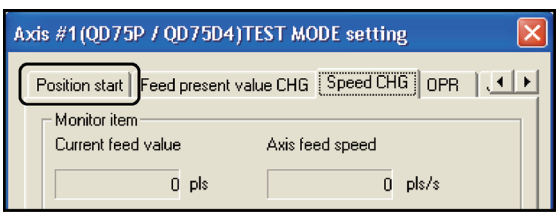


6) The Axis #1 TEST MODE setting dialog box appears. Click the "OPR" tab.



7) Confirm that "Machine OPR" is selected for "OPR type", and then click the REQ OPR button.

8) When "Current feed value" of Monitor item becomes "0", this means the OPR test has completed.



9) From here, perform the test operation on the next positioning data.
Click the "Position start" tab.

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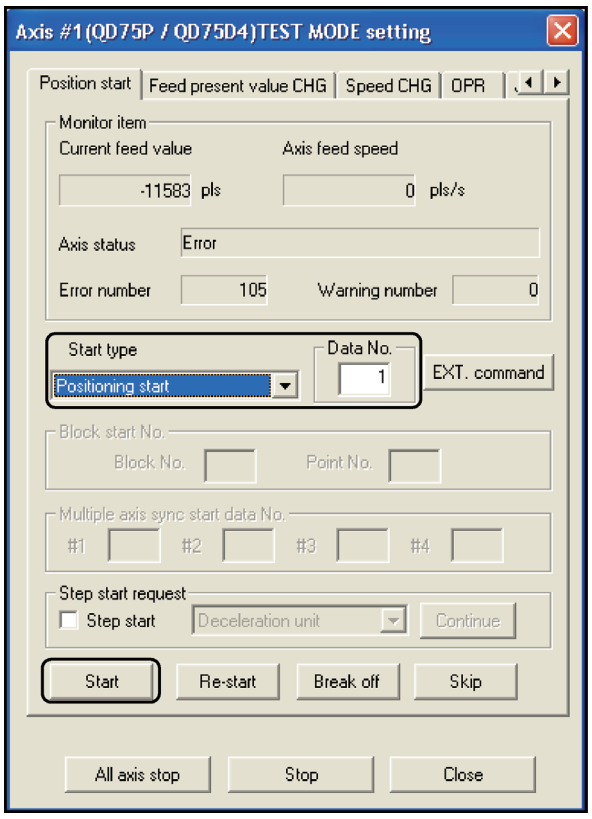
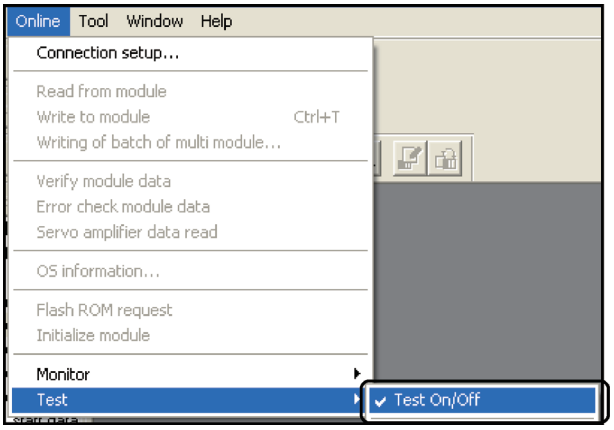
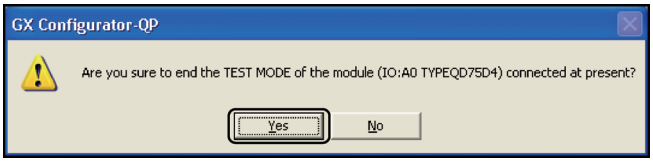


10) Confirm that "Start type" is set to "Positioning start" and "Data No." to "1", and then click the Start button.
When "Current feed value" of Monitor item becomes "70000", this means the 1-axis linear control test has completed.

11) Click the Close button on the Axis #1 TEST MODE setting dialog box to terminate the test mode.

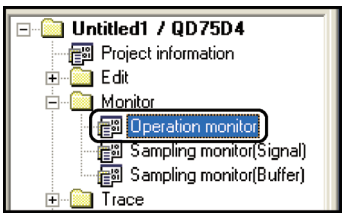


12) Click "Online" → "Test" → "Test On/Off".

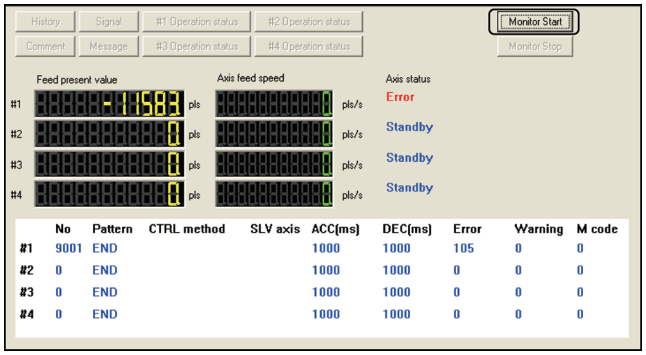


13) The dialog box appears asking whether to terminate the test mode. Click the Yes button.

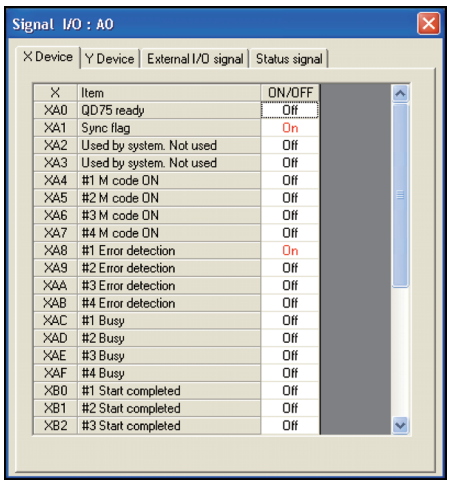
[Monitoring operation]



1) Double-click the "Monitor" → "Operation monitor" icon on the project toolbar.



2) The operation monitor window appears.
To display the feed present value, axis feed speed, axis status and positioning data being executed of each axis, click the Monitor Start button.
To monitor the details of the settings and status of the QD75, click the [History] / [Signal] / [#1 Operation status] to [#4 Operation status] buttons on the operation monitor window.



3) History monitor, Signal monitor or Operation dialog box appears. Click the tab on each dialog box to display items to monitor.
(The left screen is the X Device monitor screen of the Signal monitor dialog box.)

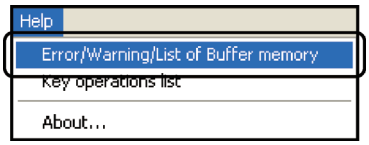
4) Click the Monitor Stop button on the operation monitor window to terminate monitoring.

<Monitor target by dialog box>

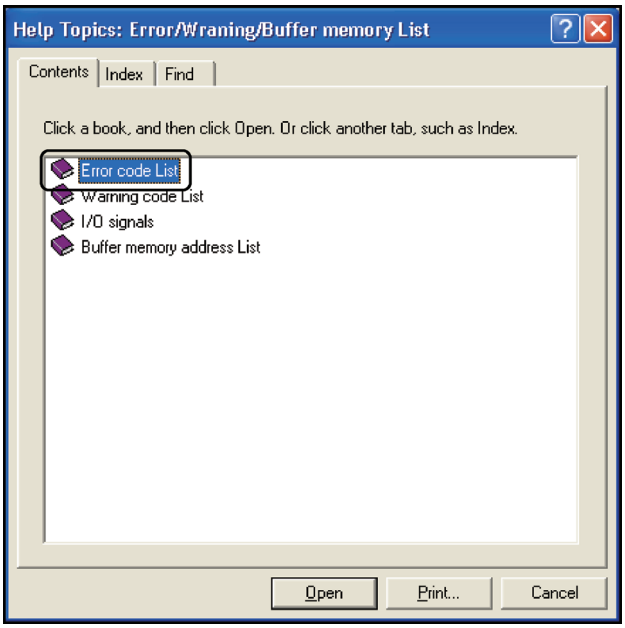
Dialog box name	Monitor target (tab name)	Description
History monitor	Error history	Occurrence time, axis and code of the latest 16 errors.
	Warning history	Occurrence time, axis and code of the latest 16 warnings.
	Start history	Time and normal/error judgment of the latest 16 axis starts.
Signal monitor	X device	ON/OFF status of QD75 input signal.
	Y device	ON/OFF status of QD75 output signal.
	External I/O signal	ON/OFF status of external input/output signal to QD75.
	Status signal	ON/OFF status of QD75 status signal.
Operation monitor	Axis control data	Details of axis while positioning control is being executed.
	Speed-position control	Details while speed or speed-position switching control is being executed.
	Position-speed control	Details while position-speed switching control is being executed.
	OPR control	Settings and signal status relevant to OPR control.
	JOG/manual pulse generator	Settings and status of JOG operation and manual pulse generator.

5.6 Search Method of Error Code and Warning Code Using Help

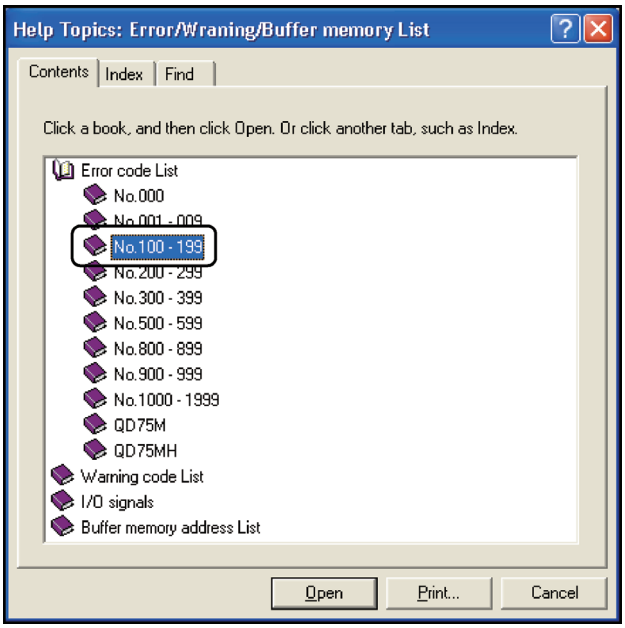
The example of search operation using the SQ□D5C-QD75P is shown below. In this example, the error code 102 is searched.
Details of other error codes and warning codes can be searched using the same method.



1) Click "Help" → "Error/Warning/List of Buffer memory".



2) The Help Topics dialog box appears.
Double-click "Error code List".



3) Double-click "No. 100-199".

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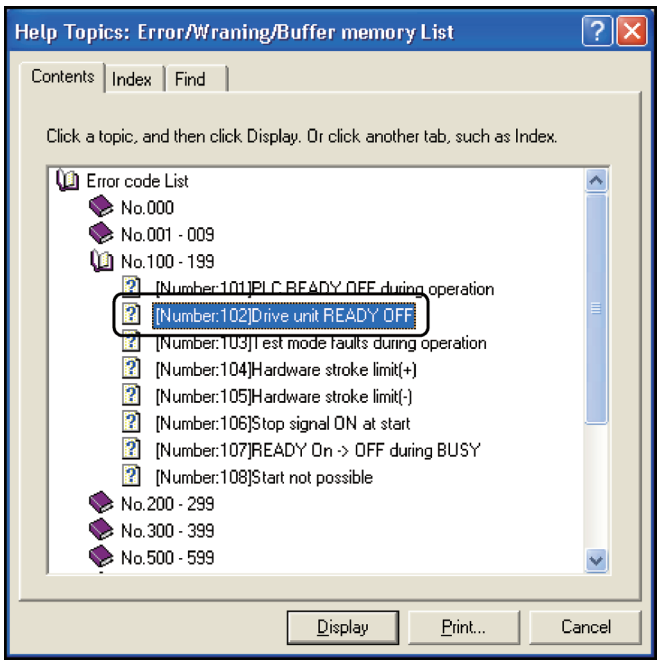
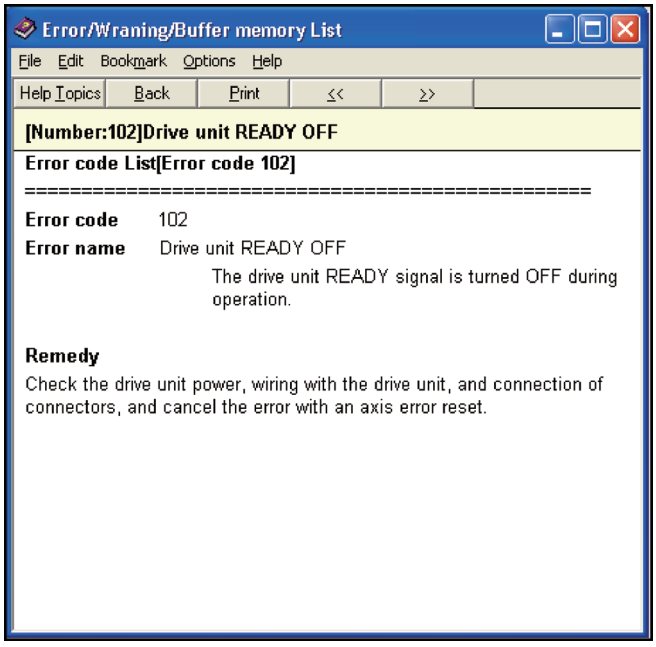


4) Double-click "[Number: 102]Drive unit READY OFF".



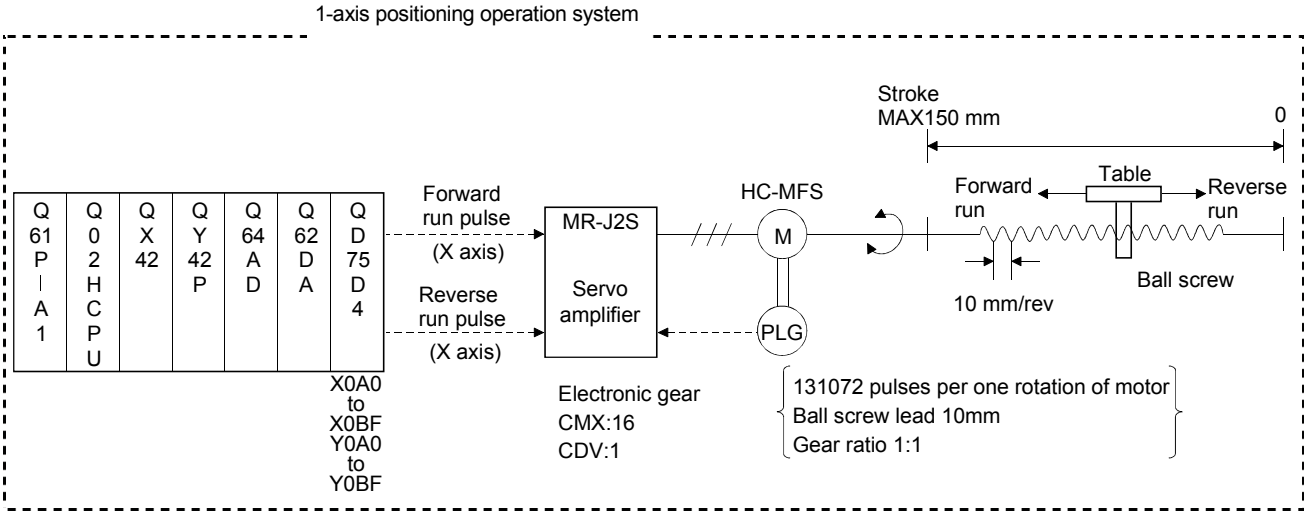
5) The details of "[Error code 102] Drive unit READY OFF" and the remedy are displayed.

REMARK
The lists of [Warning code], [I/O signal] and [Buffer memory address] can be viewed by the same operation.

CHAPTER 6 EXERCISE (2) 1-AXIS POSITIONING OPERATION USING SEQUENCE PROGRAM

The OPR and positioning operation are carried out by the sequence program of the PLC CPU.

6.1 Positioning System Used in Exercise



*: Since the feedback pulse of the servomotor HC-MFS (generates 131072 pulses per rotation) exceeds the Q75 parameter setting range of 65535 pulses, in this example 8192 pulses are set and multiplied by 16 with the electronic gear of the servo amplifier to obtain 131072 pulses.

6.2 Practice Question (1)

Fulfill the basic parameter 1 of positioning system used in the exercise.

Kind	Item	Axis #1
Basic parameter 1	Unit	0:mm
	Pulse per rotation	20000 pls
	Travel per rotation	2000.0 um
	Unit magnification	1: 1 times
	Pulse output mode	1:CW/CCW mode
	Rotation direction	0:Forward pulses to increase address
	Bias speed at start	0.00 mm/min

Feedback pulse

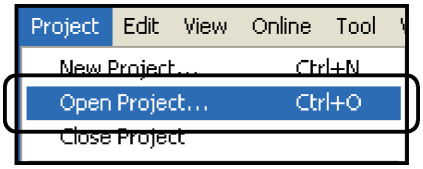
Movement amount per motor rotation

6.3 Opening Text FD Project

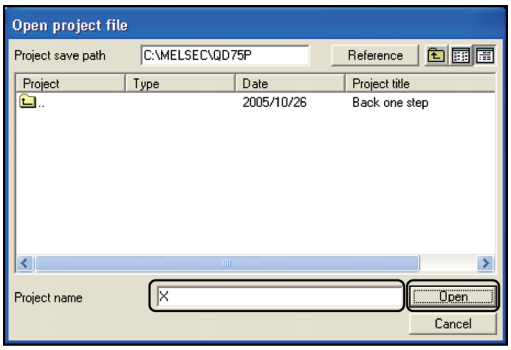
Project name	X

This section explains how to open the project of SW□D5C-QD75P saved in the text FD.

Insert the text FD into FDD.

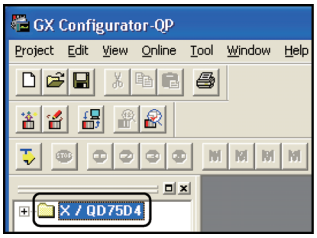


1) Click [Project] → [Open Project].

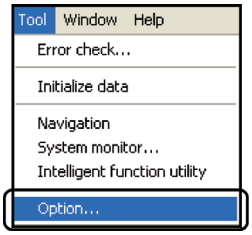


2) The dialog box to open the project appears.
Enter as follows.
- [Project save path]
  "A: \QD75WIN\QD75P"
- [Project name]
  "X"

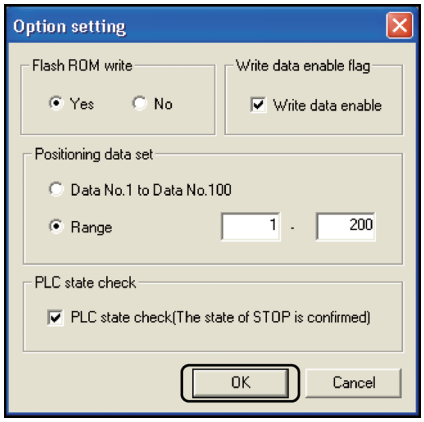
3) Click the Open button.



4) The project name and model name appear on the project toolbar.



5) Click [Tool] → [Option] to display the Option setting dialog box. In the dialog box, positioning data No.101 and later Nos. can be set.



6) Check "Range" of "Positioning data set" and set it in the range of "1 to 200".

7) Click the OK button.

The parameter and positioning data are already selected in the project "X" of text FD.
The items changed from the default settings are shown below.
Double-clicking the Edit → Parameter data icon displays the parameter edit window.
The items that differ from the default settings in the parameters and OPR parameters are shown below.

<Basic parameters 1>

Kind	Item	Axis #1	
Basic parameter 1	Unit	0:mm	← mm unit
	Pulse per rotation	20000 pls	← Feedback pulse
	Travel per rotation	2000.0 um	← Movement amount per motor rotation
	Unit magnification	1: 1 times	
	Pulse output mode	1:CW/CCW mode	
	Rotation direction	0:Forward pulses to increase address	
	Bias speed at start	0.00 mm/min	

<Basic parameters 2>

Kind	Item	Axis #1	
Basic parameter 2	Speed limit	20000.00 mm/min	← 3000r/min, 10mm/rev (output pulse 400kpulse/s)
	ACC time #0	100 ms	← Note) Set the speed limit value under the maximum rotation speed of the motor to be used in order to satisfy the maximum output pulse of QD75 (pulse/s).
	DEC time #0	100 ms	← 0.1s

<Extended parameter 1>

Kind	Item	Axis #1
Extended parameter 1	JOG&MPG stroke limit	0:Valid
	Command in-position	10.0 um
	Torque limit	300 %
	M code ON output	1:AFTER mode
	Speed switching mode	0:Change speed from specified address
	Interpolation speed mode	0:Composed speed
	Address update in V-control	0:No address update in velocity control
	Lower limit	0:Negative
	Upper limit	0:Negative
	Drive unit READY	0:Negative
	Stop signal	0:Negative
	External command	0:Negative
	Zero signal	0:Negative
	Near-point dog signal	0:Negative
	MPG	0:Negative
	Command pls signal	0:Negative
	DCC	0:Negative
	MPG mode	0:A/B mode(4)
	Speed-position function selection	0:Execute V/P switching control(INC)
Extended parameter 2	ACC time #1	1000 ms
	ACC time #2	1000 ms
	ACC time #3	1000 ms
	DEC time #1	1000 ms

M code ON when a positioning operation completes

<Extended parameter 2>

Kind	Item	Axis #1
Extended parameter 2	ACC time #1	1000 ms
	ACC time #2	1000 ms
	ACC time #3	1000 ms
	DEC time #1	1000 ms
	DEC time #2	1000 ms
	DEC time #3	1000 ms
	JOG speed limit	20000.00 mm/min
	JOG ACC time	0;100
	JOG DEC time	0;100
	ACC/DEC set	0:Trapezoid acceleration mode
	S-curve ratio	100 %
	Sudden stop DEC time	1000 ms
	Stop group #1 Sudden stop	0:Normal stop
	Stop group #2 Sudden stop	0:Normal stop
	Stop group #3 Sudden stop	0:Normal stop
	Positioning complete signal	300 ms
	Cir.arc error allowance	10.0 um
	External command function	0:External start

← 3000r/min, 10mm/rev (Output pulse 400kpulse/s)

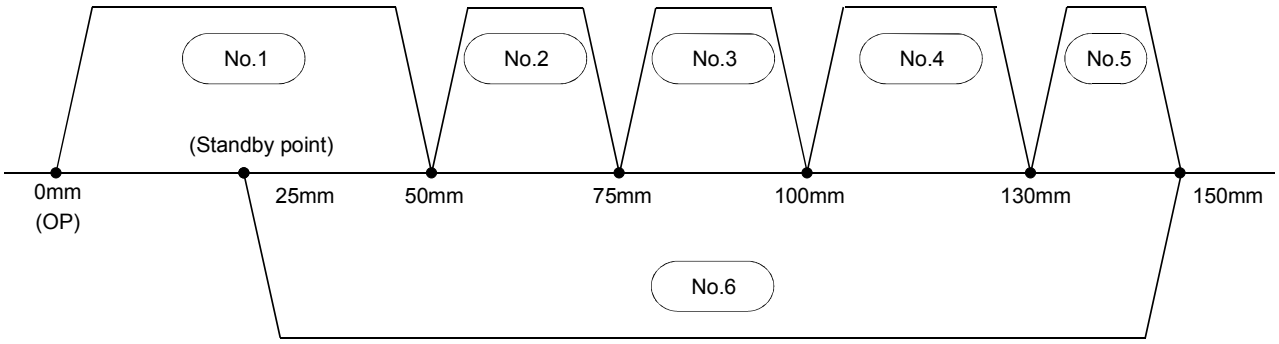
<OPR basic parameter/OPR detailed parameter>

Kind	Item	Axis #1	
OPR basic parameter	OPR method	0:Zeroing DOG	
	OPR direction	1:Reverse direction (Address decrease)	← Address decrement direction
	OP address	0.0 um	
	OPR speed	1000.00 mm/min	← 1000mm/min
	Creep speed	300.00 mm/min	← 300mm/min
	OPR retry	1:Execute OPR from U/L limit	← OPR is available even if it stops between lower limit and DOG
OPR extended parameter	OPR dwell time	0 ms	
	Travel setting after DOG ON	0.0 um	
	OPR ACC time	0;100	
	OPR DEC time	0;100	
	OP shift amount	0.0 um	
	OPR torque limit value	300 %	
	Deviation command signal out time	11 ms	
	OP shift speed specification	0:OPR speed	
	Dwell time during OPR retry	0 ms	

Double-clicking the Edit → Positioning data Axis #1 icon displays the positioning data edit window (1 axis).

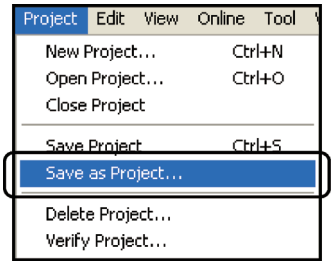
No.	Pattern	CTRL method	SLV axis	ACC(ms)	DEC(ms)	Positioning address [um]	Arc Address [um]	Command speed [mm/min]	Dwell time [ms]	M code
1	0:END	1:ABS line1	-	0;100	0;100	50000.0	0.0	2000.00	0	0
2	0:END	1:ABS line1	-	0;100	0;100	75000.0	0.0	2000.00	0	0
3	0:END	1:ABS line1	-	0;100	0;100	100000.0	0.0	2000.00	0	0
4	0:END	1:ABS line1	-	0;100	0;100	130000.0	0.0	2000.00	0	0
5	0:END	1:ABS line1	-	0;100	0;100	150000.0	0.0	2000.00	0	0
6	0:END	1:ABS line1	-	0;100	0;100	25000.0	0.0	2000.00	0	0
7										

Note) The positioning data comment field is not shown because it does not require settings.

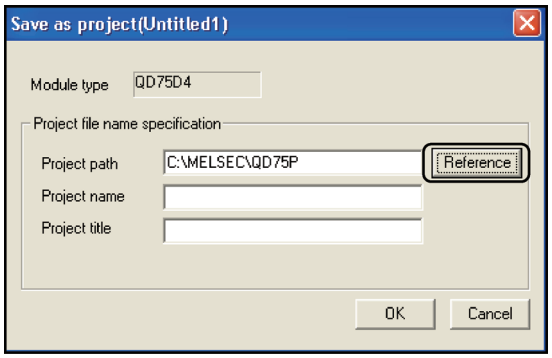


6.4 Saving Project to User FD

This section explains how to write and save the currently opened project data to the user FD.
Insert the formatted user FD into FDD (A drive).

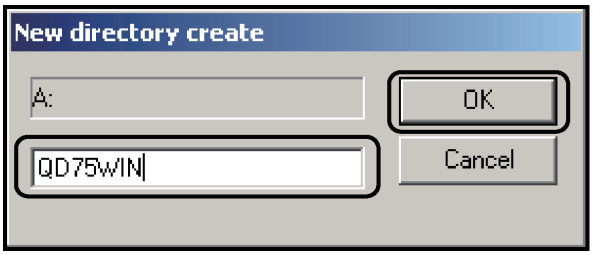


1) Click [Project] → [Save as Project].



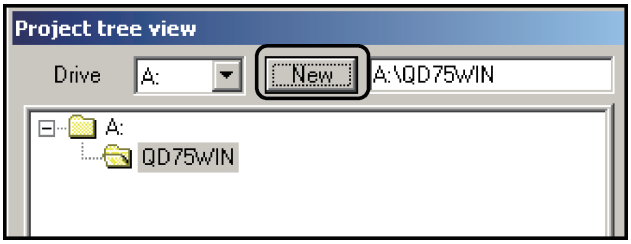
2) Click the [Reference] button in the "Save as project" dialog box to reference the A drive.

3) Select "A:" in the "Project tree view" dialog box and click the [New] button.



4) Enter "QD75WIN" in the "New directory create" dialog box.

5) Click the [OK] button.



6) Select "A:" in the "Project tree view" dialog box and click the [New] button.

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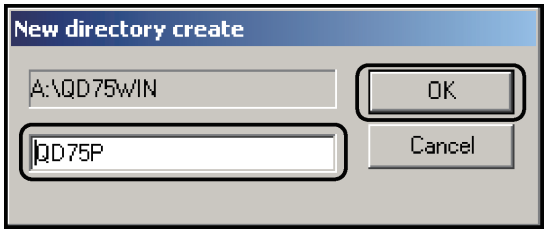
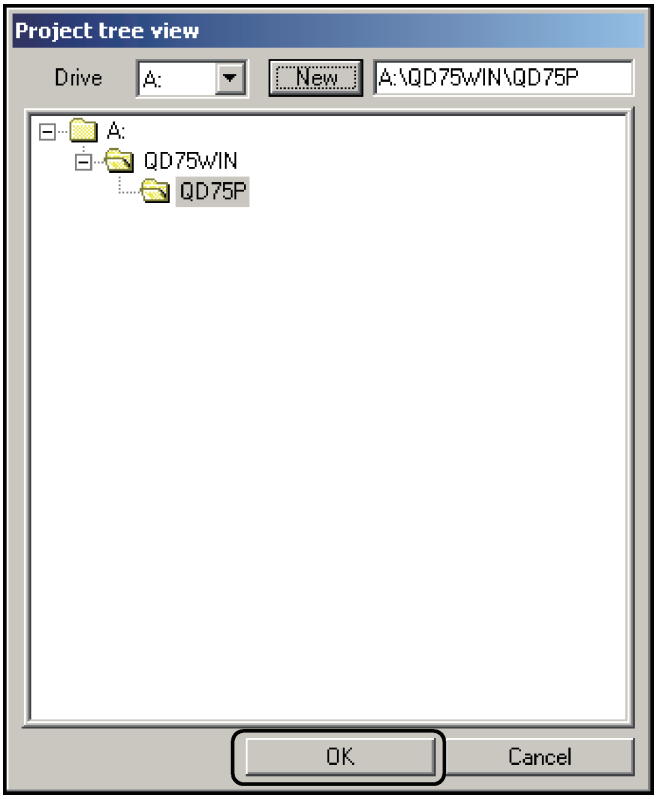


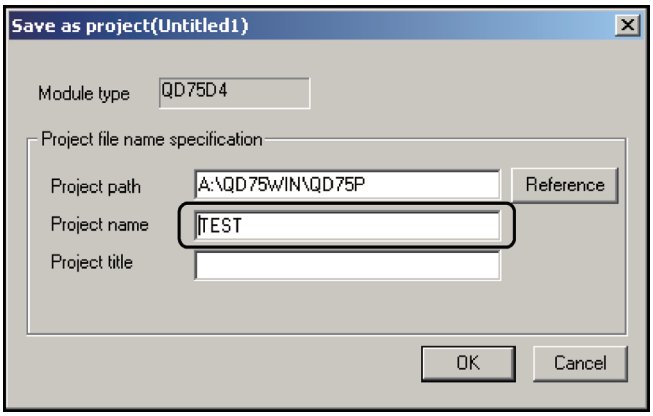
7) Enter "QD75P" in the "New directory create" dialog box.

8) Click the OK button.



9) The newly created directory is displayed in the "Project tree view" dialog box.

10) Click the OK button.

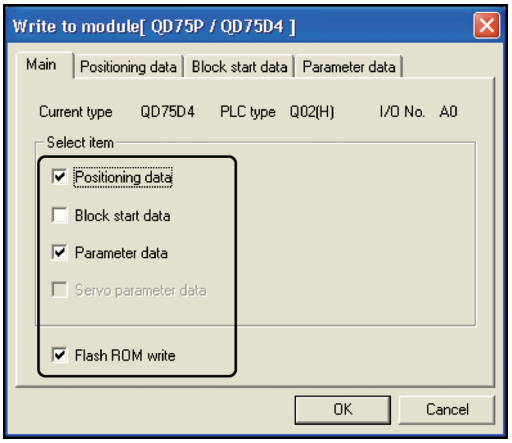


11) Enter "TEST" in the "Project name" area of the "Save as project" dialog box and click the OK button.

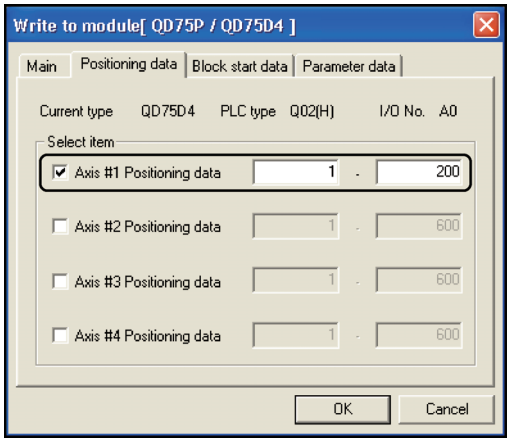
6.5 Writing Data to QD75

This section explains how to write the project data read from the text FD to the QD75.
Refer to Section 5.5.4 for the basic write operation to the QD75.
The example below is to explain the method of writing data only to the required range.

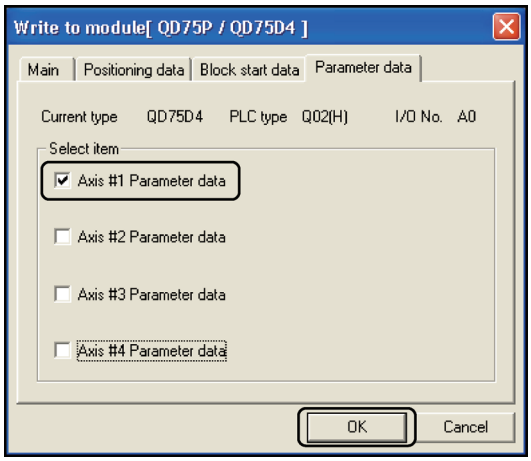
1) Click the [Online] → [Write to module [QD75P/QD75D4]] menu.



2) Check the data type to be written in the "Main" tab.
"Positioning data", "Parameter data" and "Flash ROM write" are selected as target data types in this case.



3) Click the "Positioning data" tab.
Designate the range of the axis and positioning data No. to be written to.
The positioning data No. 1 to 200 of axis 1 is designated as the writing range in this case.



4) Click the "Parameter data" tab.
Designate the axis to be written to.
The axis 1 is selected as the writing target in this case.

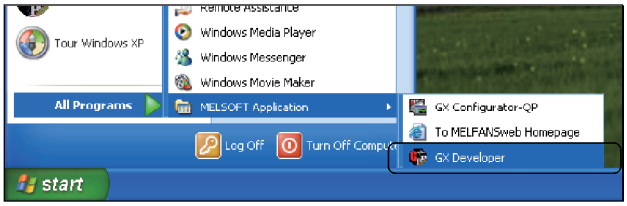
5) Click the [OK] button to write the designated data and execute the Flash ROM write.

6) Overwrite the contents of Flash ROM.
When "Is it all right?" message appears, click the [Yes] button.
Then, click the [OK] button.

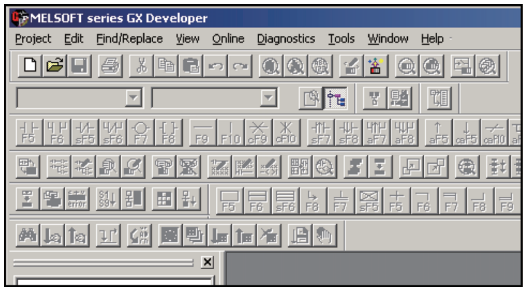
6.6 Starting Up and Exiting GPPW

6.6.1 Startup operation

This section provides explanations from how to start up the SW□D5C-GPPW software package to how to create a new project.

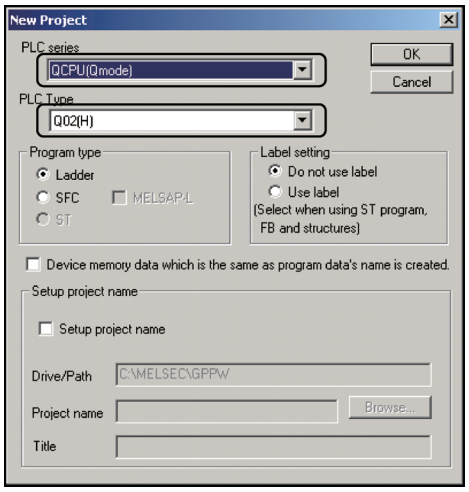


1) Click [Start] of Windows → [All Programs] → [MELSOFT Application] → [GX Developer].



2) GPPW starts up.

3) Click the [Project] → [New project] menu.

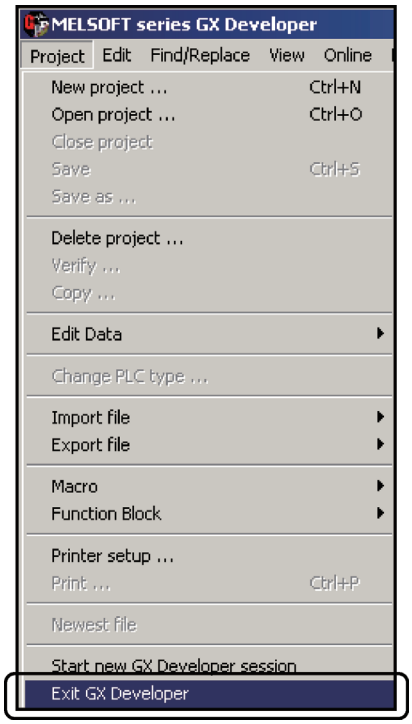


4) The "New Project" dialog box appears. Set as follows:
   • [PLC series] "QCPU (Q mode)"
   • [PLC type] "Q02(H)"

5) Click the OK button to set the project PLC type to Q02(H)CPU.

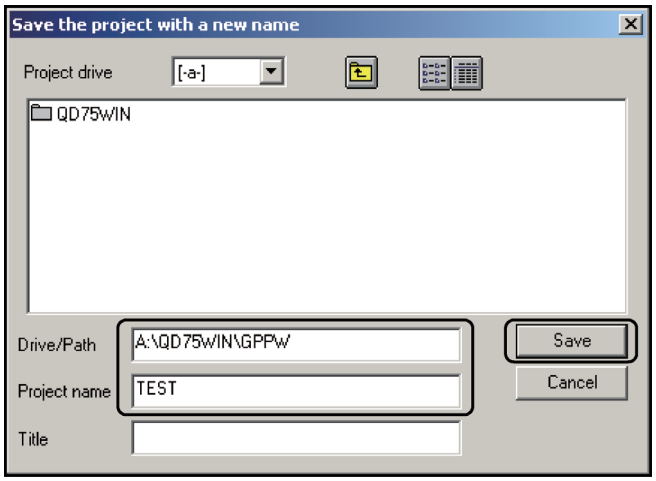
6.6.2 Exit operation

This section explains how to exit GPPW and save the project.



1) Click the [Project] → [Exit GPPW Developer] menu.
   If the project contents have not been changed, the operation is completed here.

2) The dialog box appears asking whether to save the project. Click the Yes button to save the project.



3) If the project is a new project, the "Save the project with a new name" dialog box appears.

4) Enter "Drive/Path" and "Project name".
   If required, enter "Title".

5) Click the Save button.

6) After the "The specified project does not exist. Do you wish to create a new project." message appears, click the Yes button.
   When the project is saved, the operation has completed.

1) Condition for sequence program

For the system using the QD75, always set the following program.

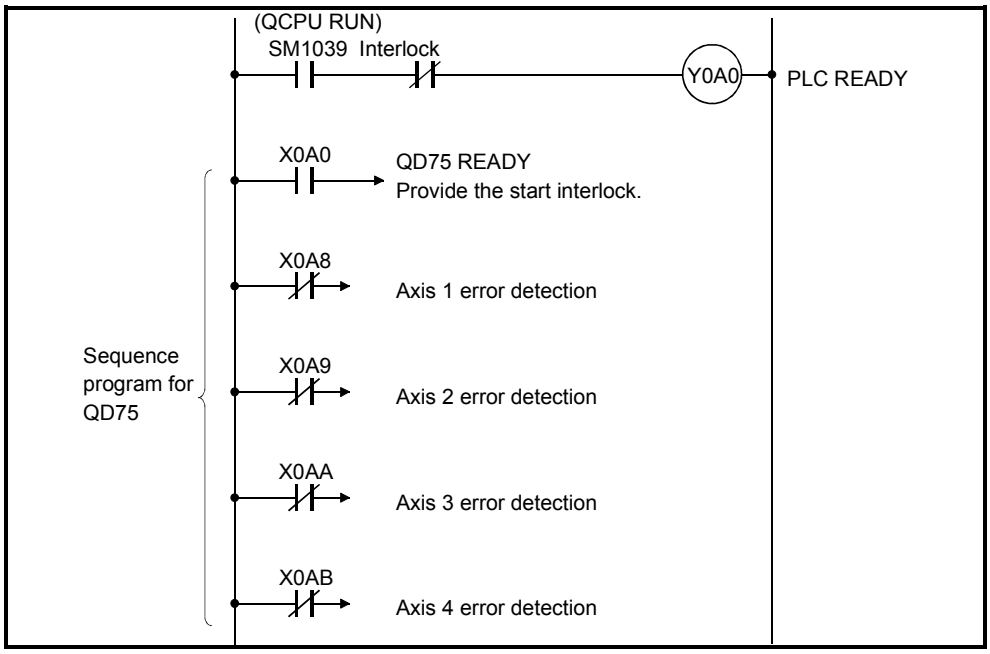


Figure 6.1 Required program

2) Reset of PLC READY

To use the sequence program that detects errors, write the routine that turns OFF the PLC READY (Y0A0) at error detection in the sequence program.

3) OPR

At power-ON or start of operation, carry out OPR to check the original position.
Also, it is recommended to carry out OPR when the OPR request is issued.

4) Limit switch for zeroing dog

For a limit switch, use the one with a highly reliable contact. If the signal of zeroing dog is not input at OPR, the movement continues at the OPR speed.

5) Processing for overrun

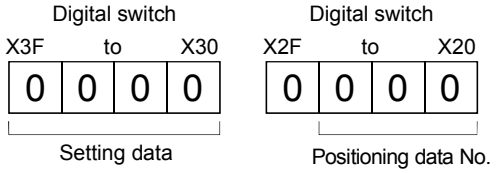
Setting the upper and lower stroke limit of the QD75 prevents overrun. However, this prevention works only when the QD75 is in normal operation. In terms of the safety of the overall system, it is recommended to install the external circuit which turns off the motor power with the limit switch ON.

6) Emergency stop signal

The STOP input signal is a stop signal for normal operation. The emergency stop signal must be separately prepared in the external circuit of the PLC program.

6.8 Device Assignment Used in Exercise

X0..... OPR command
X1..... Stop command
X2..... Standby point start
X3..... Designated positioning data No. start
X4..... Forward run JOG start
X5..... Reverse run JOG start
X6..... Inching operation
X7..... Setting data registration
X8..... Data change target switching
X9..... Restart command
X0A ..... PLC READY OFF command
X0B ..... Error reset



Y70..... OPR request
Y71..... STOP
Y73..... M code detection
Y74..... Forward JOG operating
Y75..... Reverse JOG operating
Y76..... Error display

D10..... For positioning data No.
D11..... (X20 to X2B)
D13,14..... For setting data (X30 to X3F)
D20..... For calculation
For status signal read

M0..... OPR command pulse
M2..... Standby point start pulse
M3..... Designated positioning data No. start
M7..... pulse
M9..... Setting data registration pulse
M10..... Error reset, restart pulse
Interlock
M20..... (Flash ROM write)
Master control
T1..... M code 1 detection
T2..... M code 3 detection
T3..... M code 5 detection

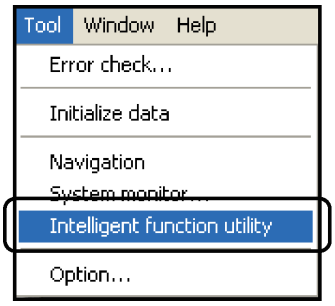
Automatic refresh setting

D100,101 ..... Axis 1 current feed value
D102,103 ..... Axis 1 machine feed value
D104,105 ..... Axis 1 feed speed
D106 ..... Axis 1 error code
D107 ..... Axis 1 warning code
D108 ..... Axis 1 valid M code
D109 ..... Axis 1 operation status

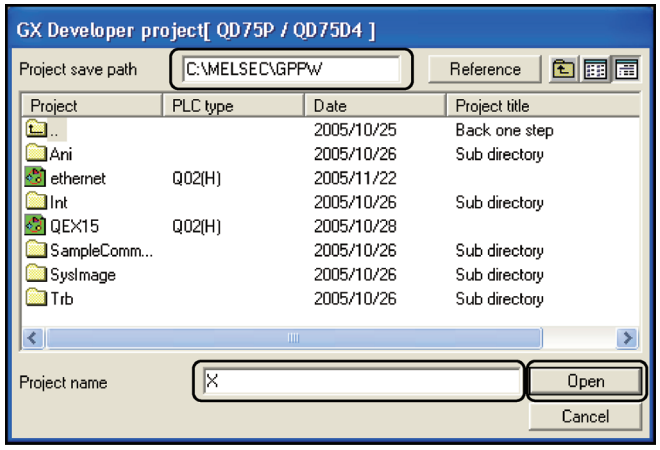
*: The automatic refresh setting of SW□D5C-QD75P automatically updates the buffer memory value of QD75.

M200
to M259..... Used for QD75 dedicated
D200 instruction
to D259.....

The following shows how to add the intelligent function module parameters to a GPPW project, using the auto refresh setting of SW□D5C-QD75P.

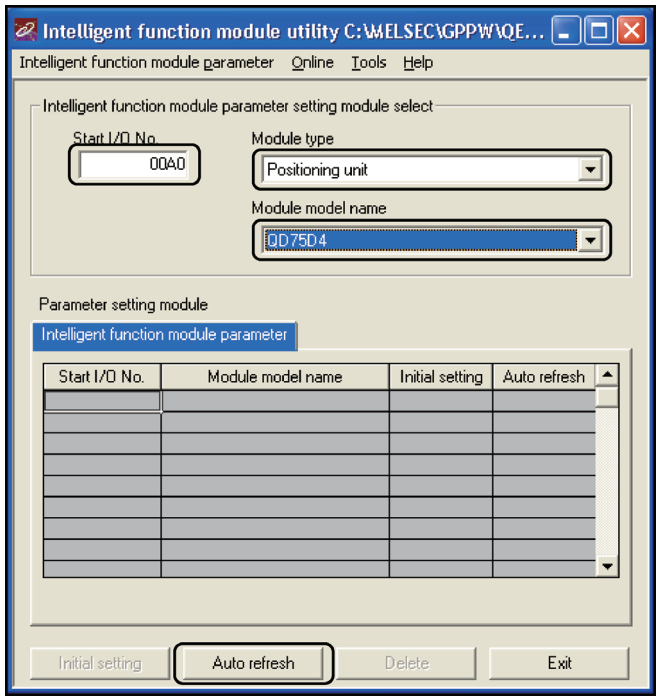


1) Click [Tool] → [Intelligent function utility].



2) The GPPW project name dialog box appears. Enter "C:\MELSEC\GPPW" in [Project save path] and "X" in [Project name] and click the Open button.

Note) When the message "Cannot startup the project. The project has already been in use on GPPW." appears, close the project "X" on the GPPW side.



3) Intelligent function module utility window activates. Make the settings as follows.
Start I/O No.: 00A0
Module type: Positioning unit
Module model name: QD75D4
After the settings are made, click the Auto refresh button.

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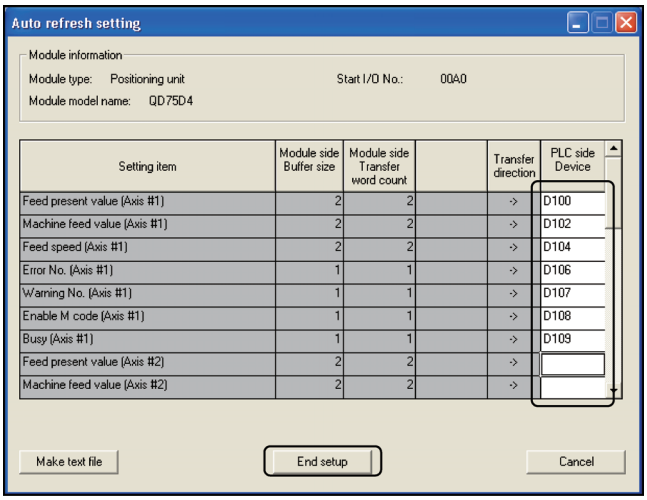
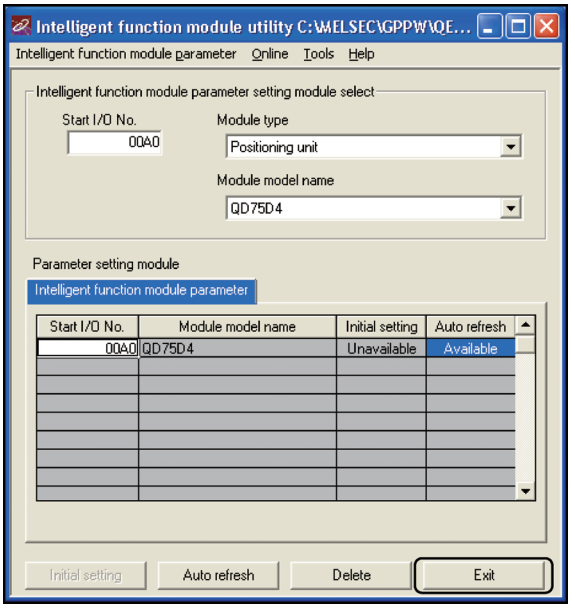
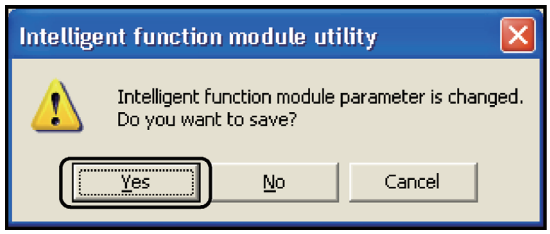


4) The "Auto refresh setting" dialog box appears.
Make the settings as follows:
Feed present value (Axis #1): D100
Machine feed value (Axis #1): D102
Feed speed (Axis #1): D104
Error No. (Axis #1): D106
Warning No. (Axis #1): D107
Enable M code (Axis #1): D108
Busy (Axis #1): D109
After the settings are made, click the End setup button.



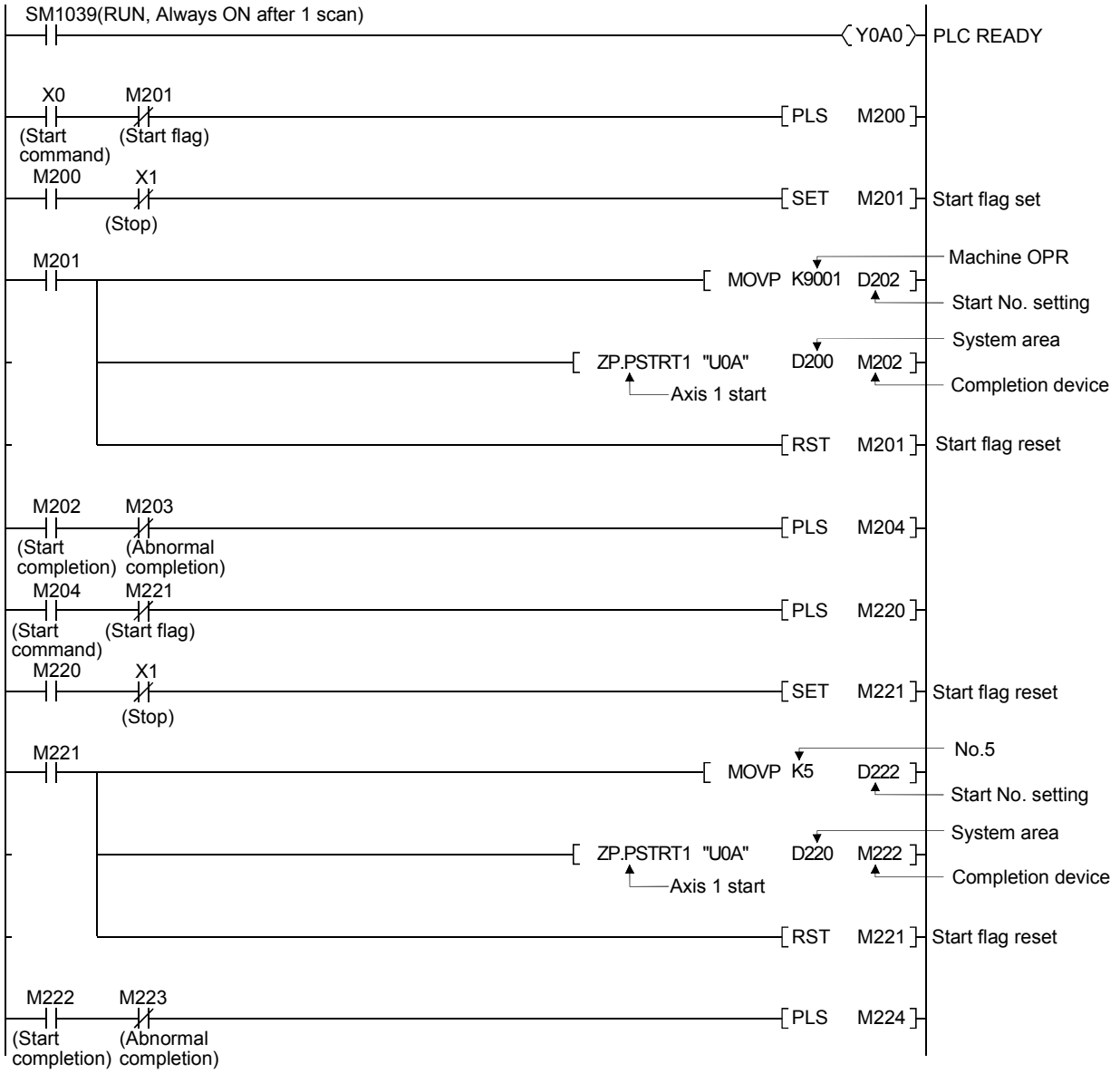
5) Click the Exit button.



6) The dialog box appears asking whether to save the parameter. Click the Yes button.

6.9 Simple Sequence Program

Project name	A



(For the QD75 dedicated instruction "ZP.PSTRT1", refer to Appendix 5.)

Operation of peripheral devices

Create the sequence program above and write to the PLC CPU.

1) Start GPPW on the peripheral device.

2) Create a new circuit.

3) Convert the circuit with (the [Convert] → [Convert] menu).

4) Write the parameter and the sequence program to the PLC CPU with (the [Online] → [Write to PLC] menu).

PLC CPU is STOP

(Click the Param+Prog button on the PLC write dialog box, then click the Execute button.)

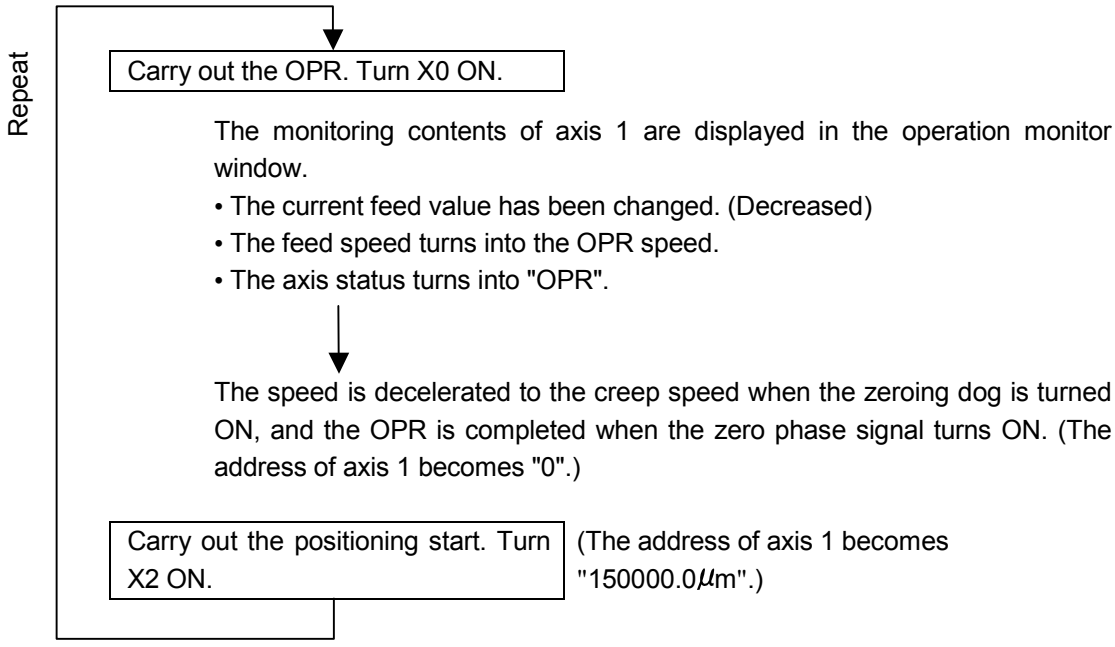
5) Reset the PLC CPU once, and then put into the RUN state.

6) Carry out the circuit monitor of GPPW by the peripheral device.
Click (the [Online] → [Monitor] → [Monitor mode] menu.)

7) Monitors the operation of SW□D5C-QD75P, using the peripheral device.
Click the Monitor → Operation monitor icon.

Start operation

During OPR, check the current feed value and the axis status in the SW□D5C-QD75P operation monitor window.

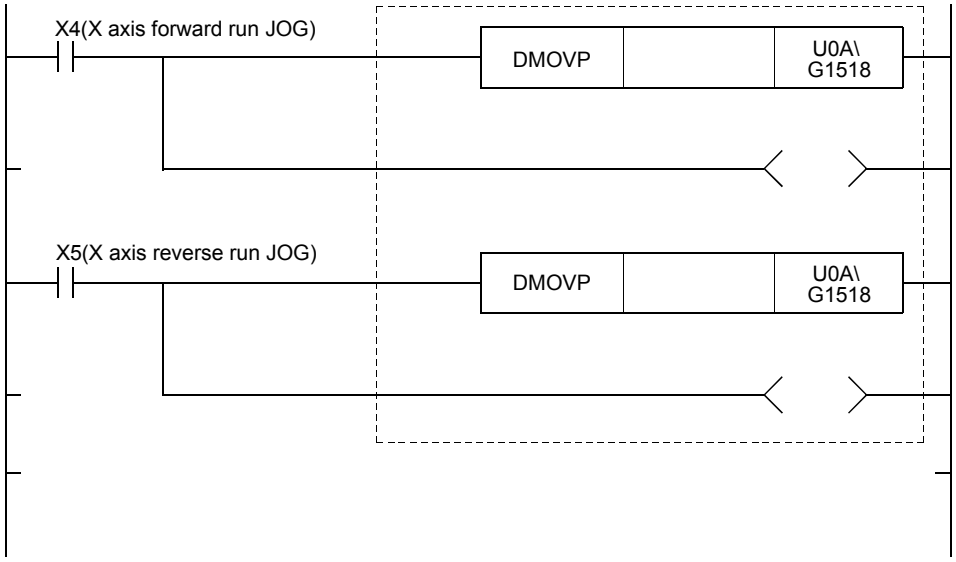


6.10 Practice Question (2) JOG Operation

<Condition> • Turning X4 ON carries out the axis 1 forward run JOG.
• Turning X5 ON carries out the axis 1 reverse run JOG.
• The JOG speed is 1000.00mm/min.

<Hint> • Directly transfer the JOG speed into the buffer memory of the QD75 by the DMOV command from the intelligent function module direct device.
• Turn ON the output Y of the JOG start.

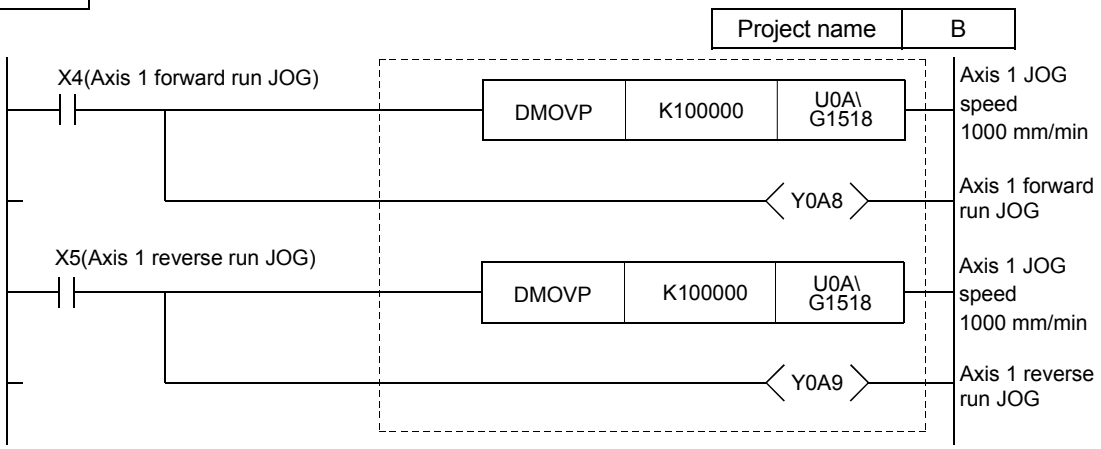
<Answer> • Fill in the .



<Operation>
Add the answer into the sequence program in Section 6.9 and write it to the PLC CPU, and confirm the operation.

MEMO

Practice question (2) Answer



Reference: When designating the JOG speed by the sequence program, designate 100 times as much as the actual value since the unit is [$\times 10^{-2}$mm/min].

6.11 Sample Sequence Program

Practice with the sequence program used as a sample.
For a preparation, read out the sequence program from the text FD and then write it to the PLC CPU.

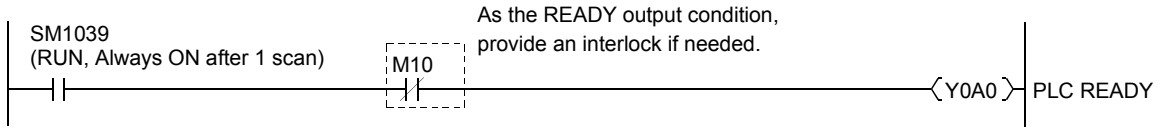
Operation of peripheral devices

1) Start GPPW on the peripheral device.
2) Insert the QD75 text FD into the FDD and click  (the [Project] → [Open project] menu).
   Open the project named "X" from the A drive on the dialog box to open projects.
3) Write the parameter and the main sequence program to the PLC CPU, using  (the [Online] → [Write to PLC]).
   PLC CPU is STOP
   (Click the Param+Prog button on the PLC write dialog box, then click the Execute button.)
4) Save the project to user FD.
   Remove the QD75 text FD from the FDD and insert the formatted user FD.
   Click the [Project] → [Save as Project] menu.
   Set "Drive/Path" and "Project name" and save the project.
5) Reset the PLC CPU once, and then put into the RUN state.
6) Monitor GPPW by the peripheral device.
   Click  (the [Online] → [Monitor] → [Monitor mode] menu).

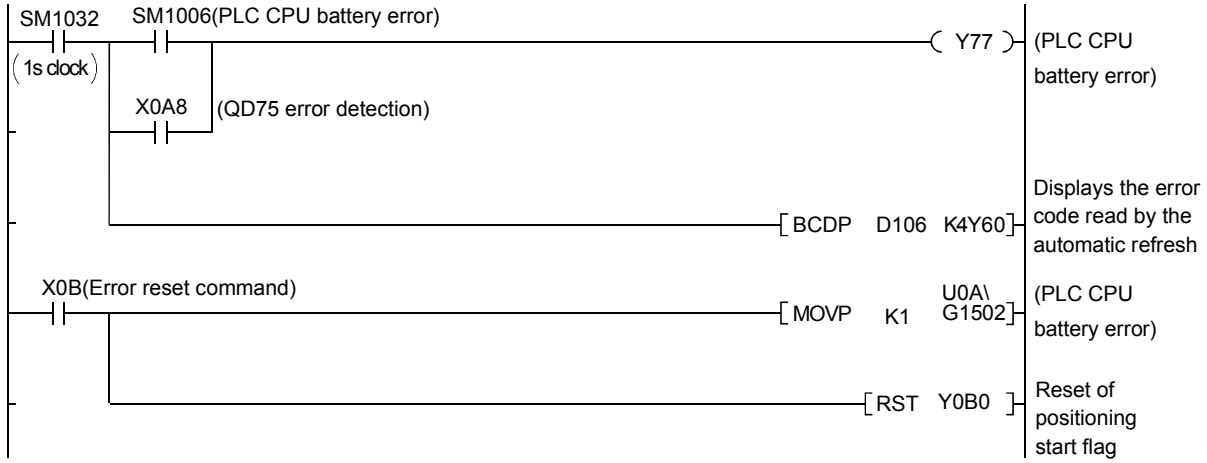
6.11.1 PLC READY

Project name	X

Always set this program.

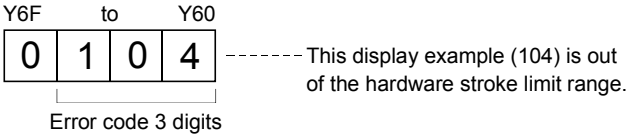


6.11.2 Error code display and error reset



Demonstration machine operation

Displays the X axis error code that is read from the buffer memory "806" by the automatic refresh, in BCD code on the digital display.



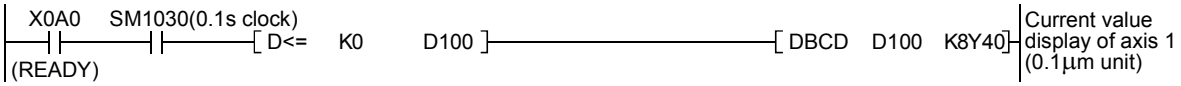
Error codes are roughly divided as follows.

Error Code	Classification of errors
001 to 009	Fatal error
100 to 199	Common error
200 to 299	Error at OPR or absolute position restoration
300 to 399	Error during JOG operation or inching operation
500 to 599	Error during positioning operation
800 to 899	I/F (Interface) error
900 to 999	Error during parameter setting range check

Refer to the manual or the error code list of QD75P Help for details.

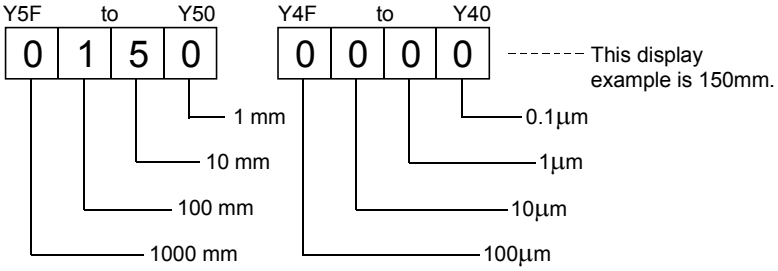
6.11.3 Current value read of axis 1

Display the No. of pulses that is output by the QD75 as a current value.
With SM1030, the display of the current value varies every 0.1s.



Demonstration machine operation

Displays the error code of axis 1 that is read from the buffer memory "800" by the automatic refresh, in BCD code on the digital display.
Unit is 0.1μm.

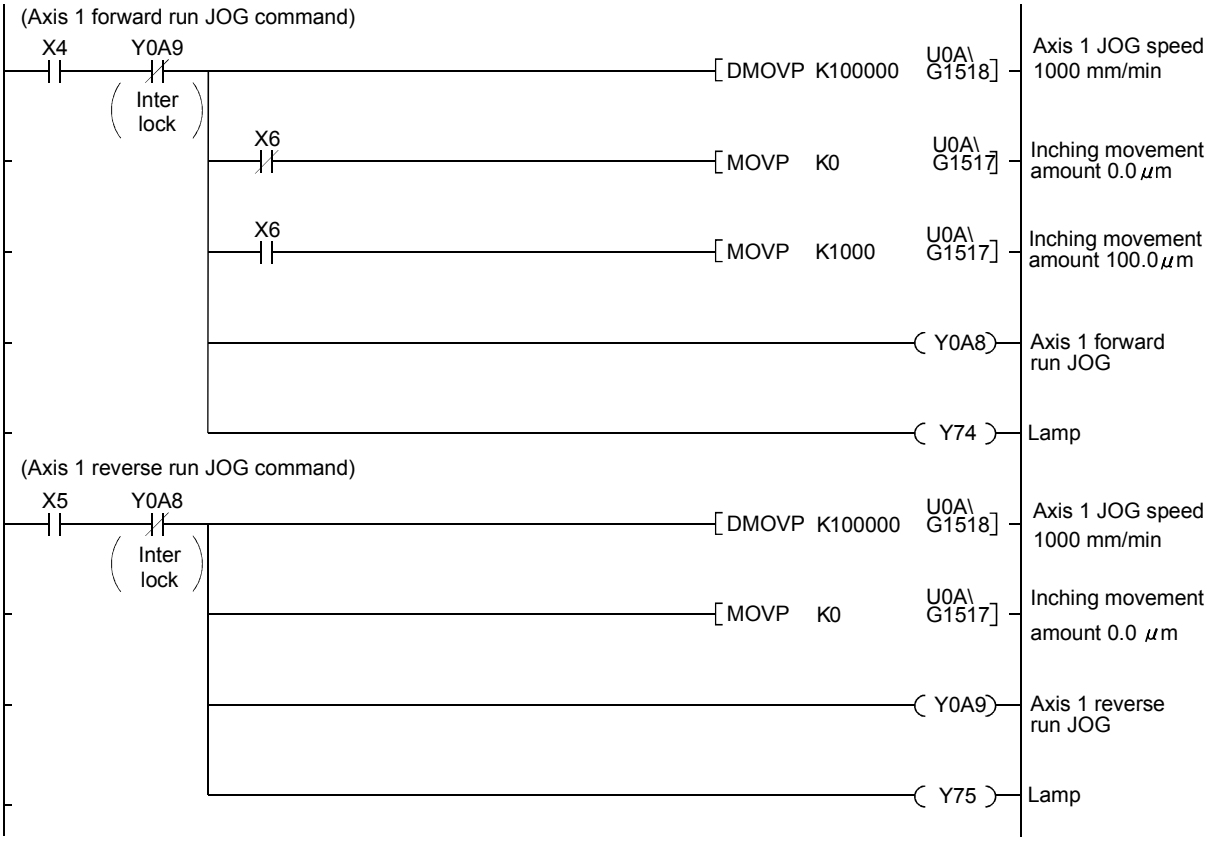


Reference

Control unit	mm	inch	degree	pulse
Minimum current feed value	0.1μm	0.00001inch	0.00001degree	1pulse

6.11.4 JOG operation of axis 1

Write the program that makes the machine perform forward run JOG while X4 is ON and reverse run JOG while X5 is ON.



Demonstration machine operation

1) Turning X4 ON starts the forward run and turning OFF stops it.
2) Turning X5 ON starts the reverse run and turning OFF stops it.
3) Turning X4 ON with X6 ON once makes a 100.0 μm inching movement in the forward direction.

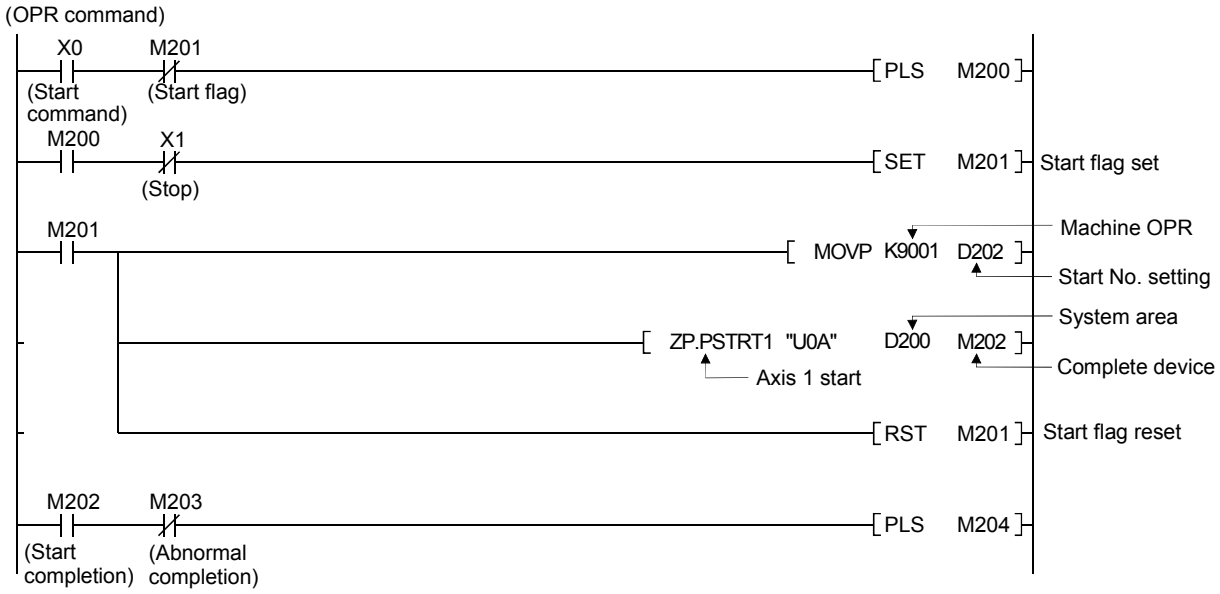
REFERENCE

The inching operation can be carried out by setting the inching movement amount into the JOG operation program.

	Axis 1	Axis 2	Axis 3	Axis 4
Inching movement amount buffer memory	1517	1617	1717	1817

6.11.5 OPR of axis 1

"Retry OPR" is set in "OPR retry" of the OPR basic parameter, therefore when the machine is at a stop inside the DOG, it automatically gets out of the DOG and conducts OPR.

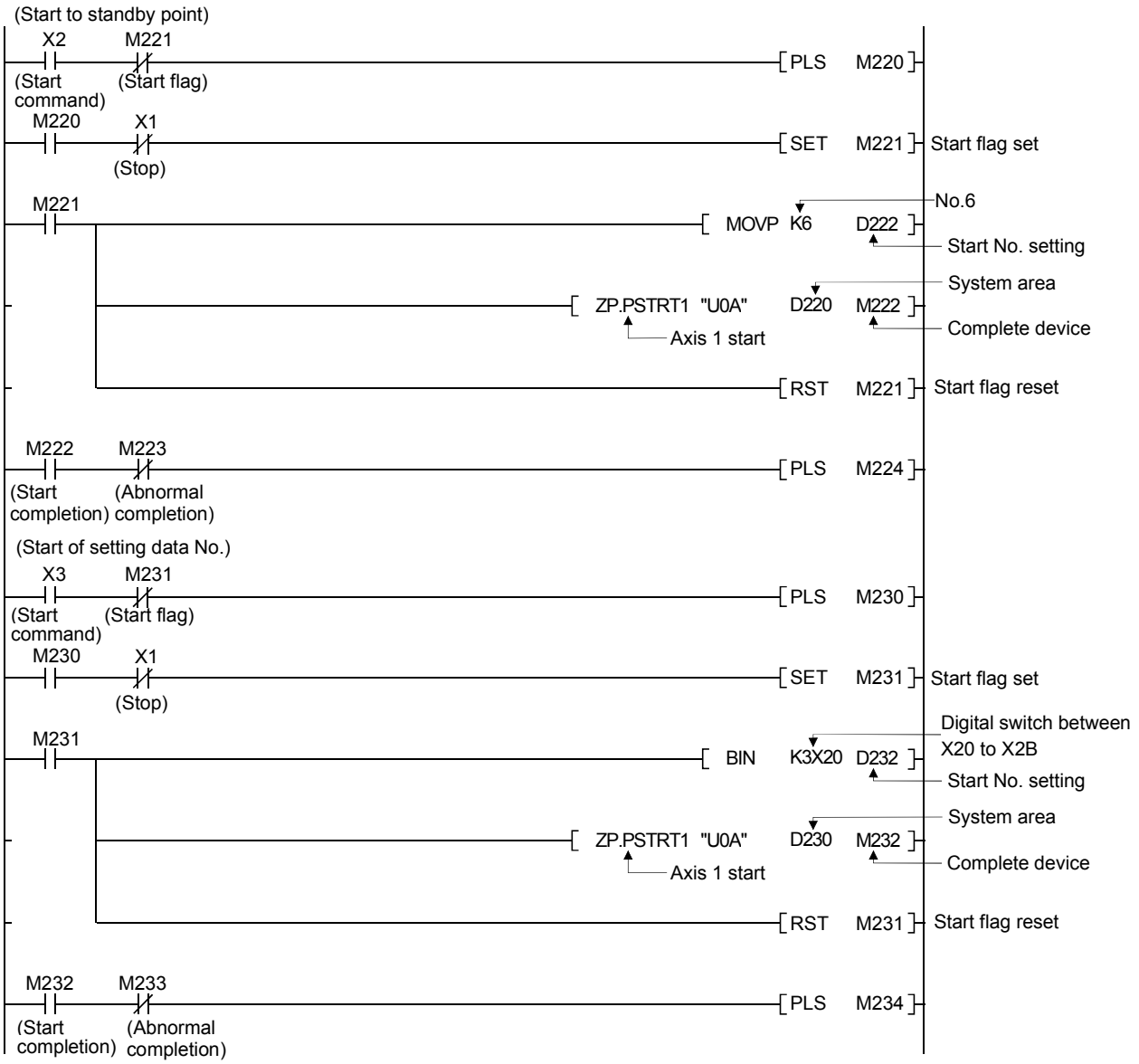


Demonstration machine operation

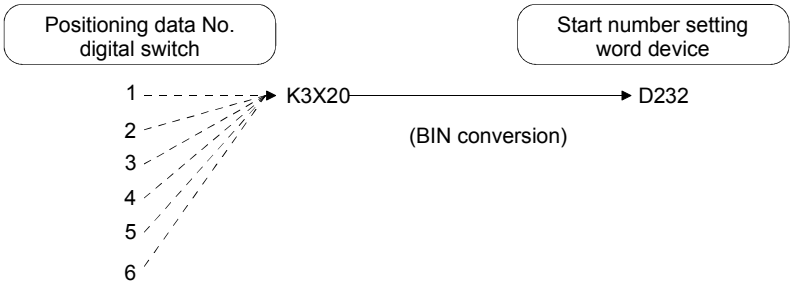
1) Turning X0 ON starts OPR.
(The current value becomes 0.)

6.11.6 Start of positioning data

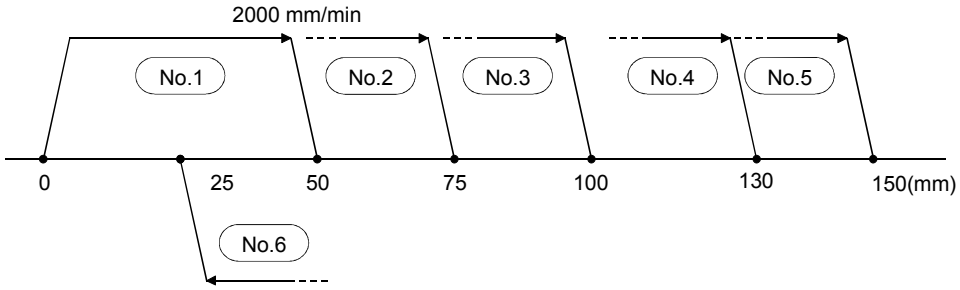
Turning X2 ON directly designates the data No.6 and starts it.
Turning X3 ON indirectly designates the positioning data No. that was set in 3 digits of digital switch X20 to X2B in D232, and starts it.



Indirect designation is transferred to the start No. setting word device of the PSTRT instruction.
Positioning data No. is stored in the word device by BIN instruction.



<Figure for operation explanation>



<Positioning data>

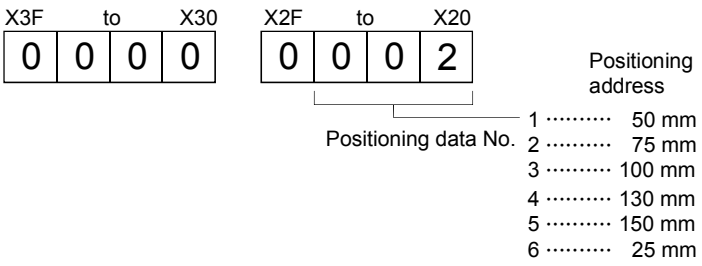
No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
1	0: Completed	1: ABS linear 1	—	0:100	0:100	50000.0	0.0	2000.00	0	0	
2	0: Completed	1: ABS linear 1	—	0:100	0:100	75000.0	0.0	2000.00	0	0	
3	0: Completed	1: ABS linear 1	—	0:100	0:100	100000.0	0.0	2000.00	0	0	
4	0: Completed	1: ABS linear 1	—	0:100	0:100	130000.0	0.0	2000.00	0	0	
5	0: Completed	1: ABS linear 1	—	0:100	0:100	150000.0	0.0	2000.00	0	0	
6	0: Completed	1: ABS linear 1	—	0:100	0:100	25000.0	0.0	2000.00	0	0	
7											
8											
9											
10											

Demonstration machine operation

Repeat

1) Turning X2 ON carries out the positioning to the standby point of the positioning data No.6 (25mm).
(The current value becomes 25000.0μm.)

2) The positioning data No. is designated by the digital switch.

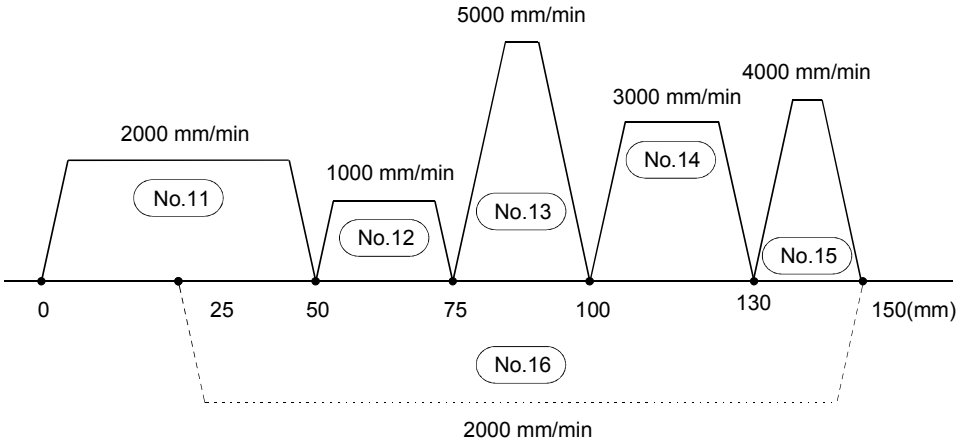


3) Turning X3 ON carries out the designated positioning.
(The current value becomes the address of the designated data No.)

6.11.7 Multiple points continuous positioning

In this positioning system, the desired multiple points are positioned by starting just one positioning data.
Set the positioning data pattern to "1" (continuous positioning control).
(The sequence program needs not be changed.)

<Figure for operation explanation>

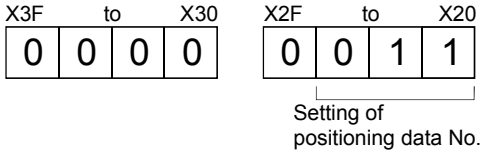


<Positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
11	1: Continuous	1: ABS linear 1	—	0:100	0:100	50000.0	0.0	2000.00	500	0	
12	1: Continuous	1: ABS linear 1	—	0:100	0:100	75000.0	0.0	1000.00	500	0	
13	1: Continuous	1: ABS linear 1	—	0:100	0:100	100000.0	0.0	5000.00	500	0	
14	1: Continuous	1: ABS linear 1	—	0:100	0:100	130000.0	0.0	3000.00	500	0	
15	1: Continuous	1: ABS linear 1	—	0:100	0:100	150000.0	0.0	4000.00	500	0	
16	0: Completed	1: ABS linear 1	—	0:100	0:100	25000.0	0.0	2000.00	500	0	
17											
18											
19											
20											

Demonstration machine operation

1) Start the positioning data No.11.

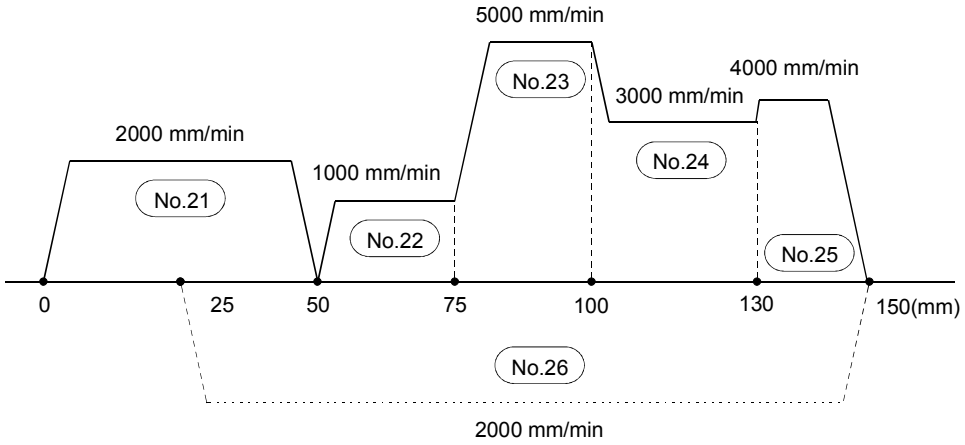


Turn X3 ON.
(Confirm on the operation monitor screen of SW□D5C-QD75P.)

6.11.8 Multiple points continuous positioning by speed switching

In this positioning system, by starting just one positioning data, the machine automatically changes its movement speed at the desired addresses on the movement path, and moves through the multiple points continuously.
Set the positioning data pattern to "2" (continuous path control).
(The sequence program needs not be changed.)

<Figure for operation explanation>

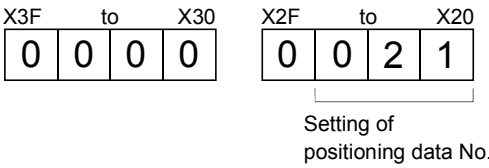


<Positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
21	1: Continuous	1: ABS linear 1	—	0:100	0:100	50000.0	0.0	2000.00	500	0	
22	2: Path	1: ABS linear 1	—	0:100	0:100	75000.0	0.0	1000.00	0	0	
23	2: Path	1: ABS linear 1	—	0:100	0:100	100000.0	0.0	5000.00	0	0	
24	2: Path	1: ABS linear 1	—	0:100	0:100	130000.0	0.0	3000.00	0	0	
25	1: Continuous	1: ABS linear 1	—	0:100	0:100	150000.0	0.0	4000.00	0	0	
26	0: Completed	1: ABS linear 1	—	0:100	0:100	25000.0	0.0	2000.00	0	0	
27											
28											
29											
30											

Demonstration machine operation

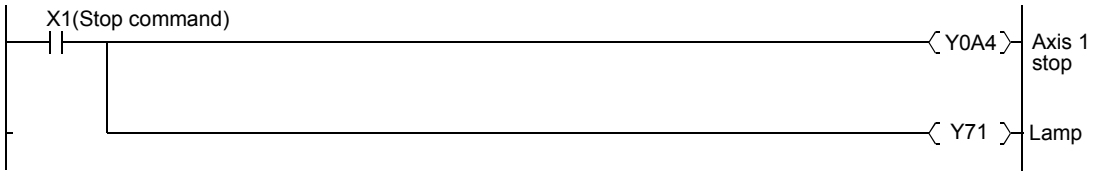
1) Start the positioning data No.21.



Turn X3 ON.
(Confirm on the operation monitor screen of SW□D5C-QD75P.)

6.11.9 Stop in operation

Turn the axis 1 stop (Y0A4) ON to stop during the BUSY.



Demonstration machine operation

1) Turn X1 ON while in operation.

REMARK

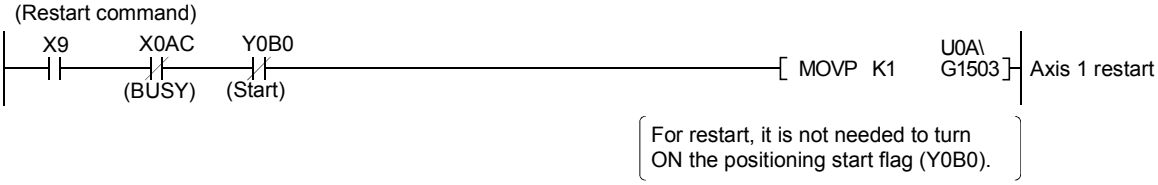
To stop while in operation can also be carried out by wiring the external switch to the external STOP signal, which enables a quick stop regardless of the scan time of the PLC CPU.

6.11.10 Restart after stopping

If the restart needs to be continued when the stop X1 turns ON during the continuous positioning of data No.11 to No.16 or data No.21 to No.26, write "1" to the buffer memory 1503 (start of restart).

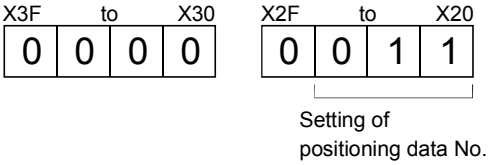
<Figure for operation explanation>
Same as the one in Section 6.11.7.

<Sequence program>



Demonstration machine operation

1) Start the positioning data No.11.



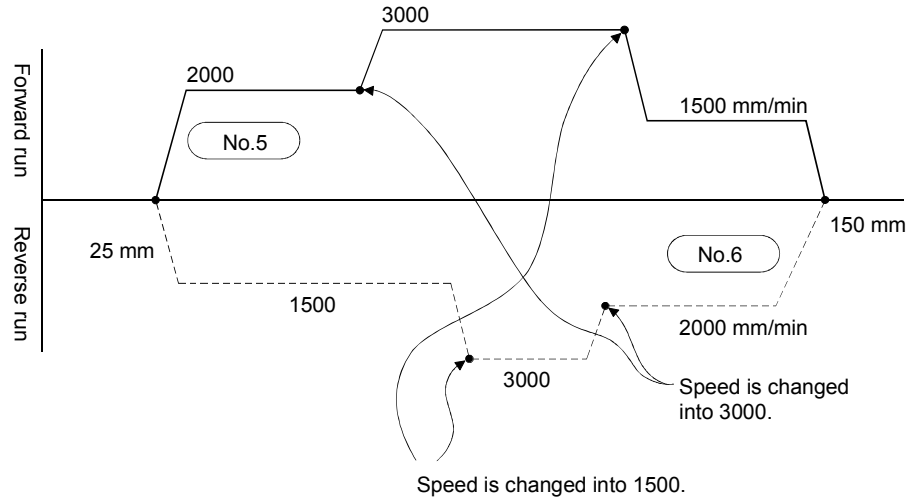
Turn X3 ON.

2) Turn the stop X1 ON during the continuous positioning.

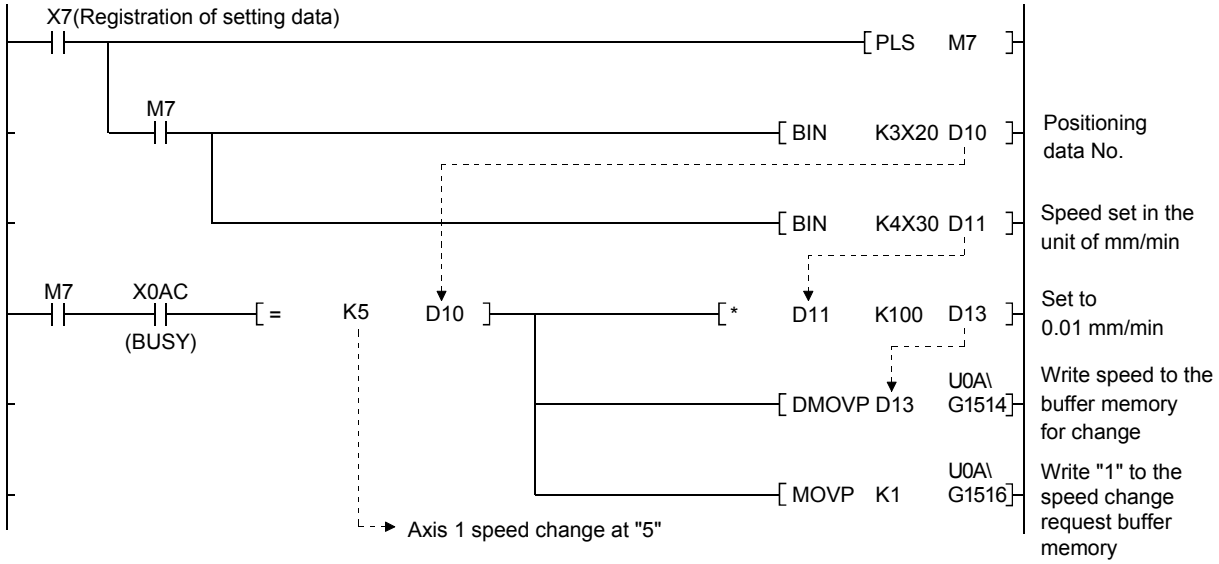
3) Turn X9 ON.

6.11.11 Speed change during positioning

Speed can be changed during the BUSY.
Write the speed in the unit of 0.01mm/min to the axis 1 buffer memory 1514, 1515.
(If the speed is set to 0, stop is enabled.)
Next, write "1" to the speed change request buffer memory 1516 and execute the speed change.
<Figure for operation explanation>



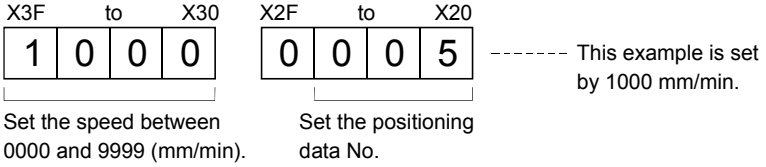
<Sequence program>



Demonstration machine operation

Repeat

1) Set the digital switch.

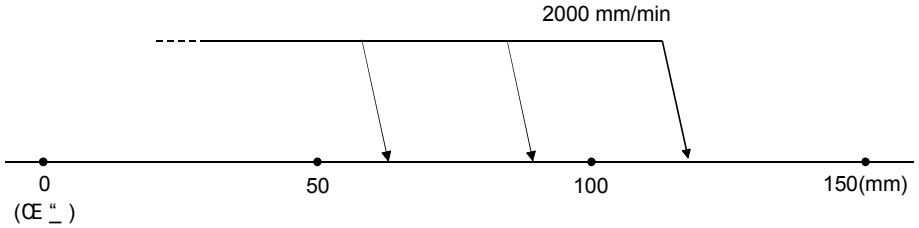


2) The speed changes if X7 is turned ON when the data No.5 is moving to 150mm after X3 is turned ON.
3) The speed changes if X7 is turned ON when the data No.6 is moving to 25mm in after X2 is turned ON.

6.11.12 Address designation by digital switch

Changes the positioning address of positioning data No.31 (buffer memory is 2306, 2307) designating in the unit of 1mm.

<Figure for operation explanation>

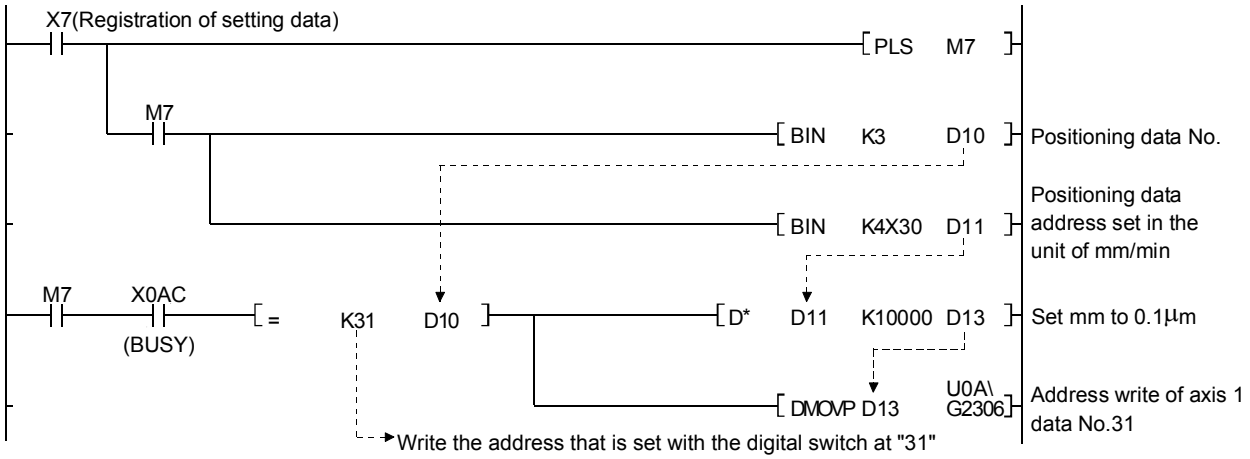


<Positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
31	0: Completed	1: ABS linear 1	—	0:100	0:100	0.0	0.0	2000.00	0	0	
32											
33											

Change this column.
(Refer to Section 3.5.2.)

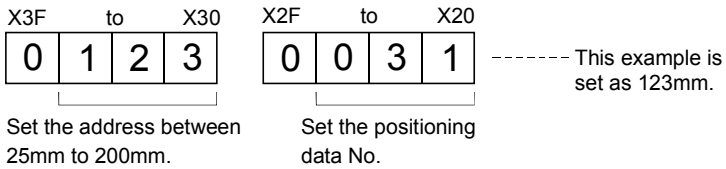
<Sequence program>



Demonstration machine operation

Repeat

1) Set the digital switch.



2) Turning X7 ON sets the value of the 10000-multiplied setting value (unit: 0.1μm) as the address of data No.31.

3) Turning X3 ON carries out the positioning for the designated address.

6.11.13 Teaching playback

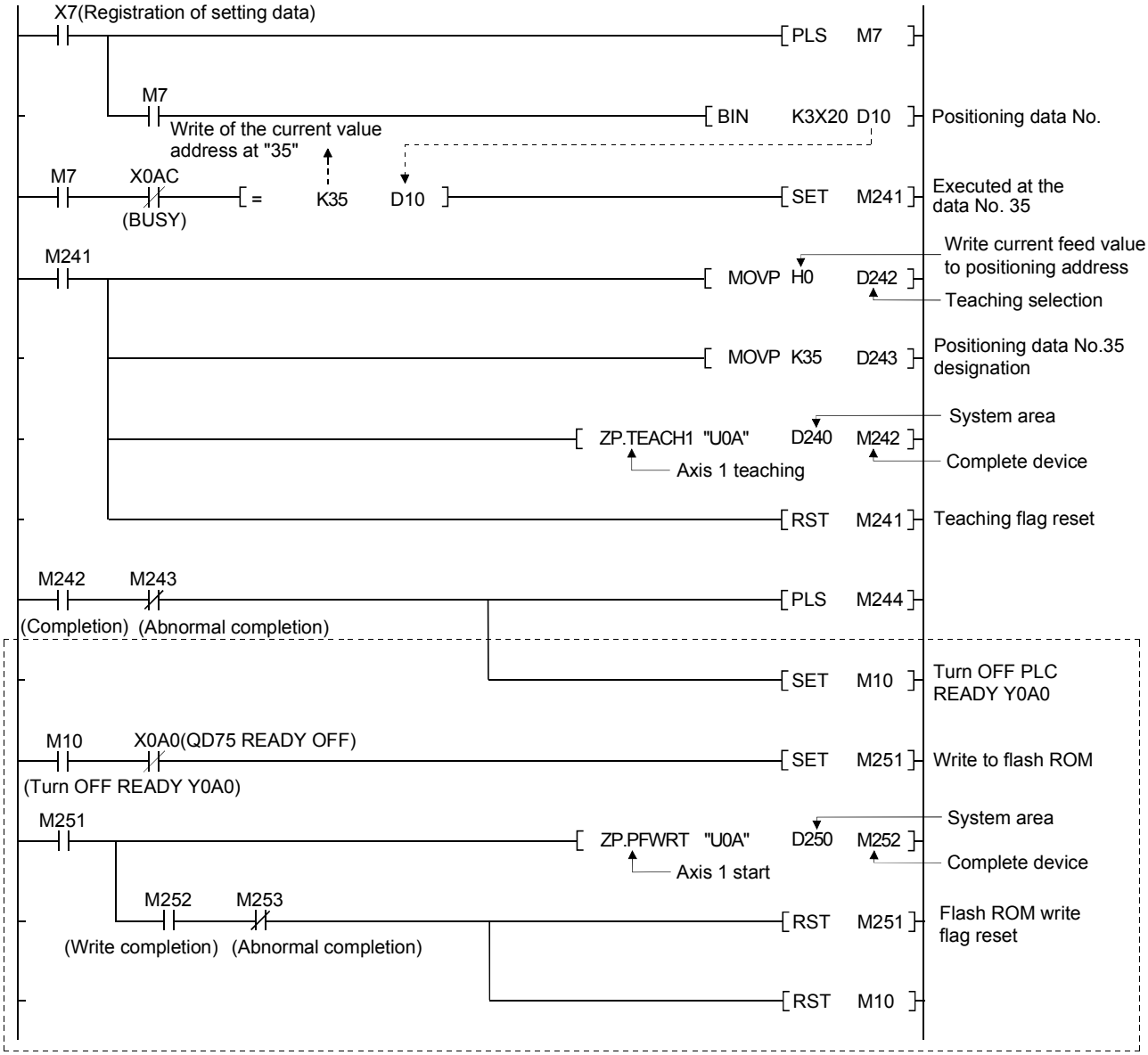
Move to the position to be registered by the JOG operation (or manual pulse generator operation) and carry out the registration operation. Once the position is registered, the positioning to the registered position is performed by the start switch any number of times.

<Positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
35	0: Completed	1: ABS linear 1	—	0:100	0:100	0.0	0.0	2000.00	0	0	
36											
37											

Change this column.

<Sequence program>



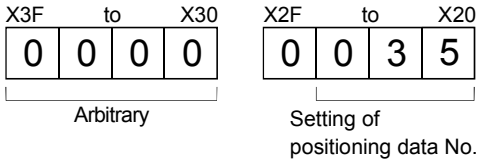
Create the program inside the dotted line when the writing to flash ROM is performed after teaching.

Demonstration machine operation

Repeat

1) Turn X4 ON, operate the forward run JOG, and turn X4 OFF at the desired position.
(Jot down the current value address | | | | | | | | |)

2) Set the digital switch.

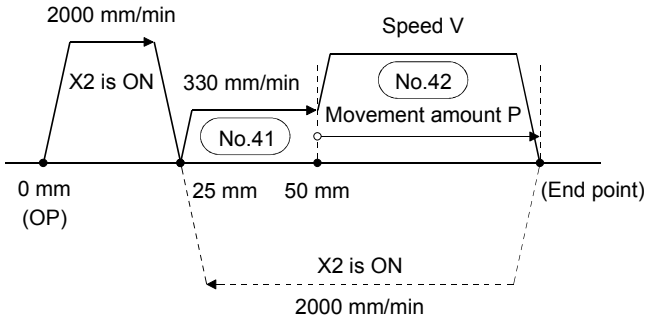


3) Turning X7 ON carries out teaching the current value to the data No.35.
4) Turn X2 ON and move to the standby point.
5) Turning X3 ON executes the data No.35. (Stop at the jotted address)
6) Read the positioning data from the QD75.
7) Confirm that teaching has been performed for the address of the data No.35.

6.11.14 Speed/movement amount designation by digital switch

Combine the absolute and incremental positioning and designate the speed and move amount of the incremental part by the digital switch.

<Figure for operation explanation>



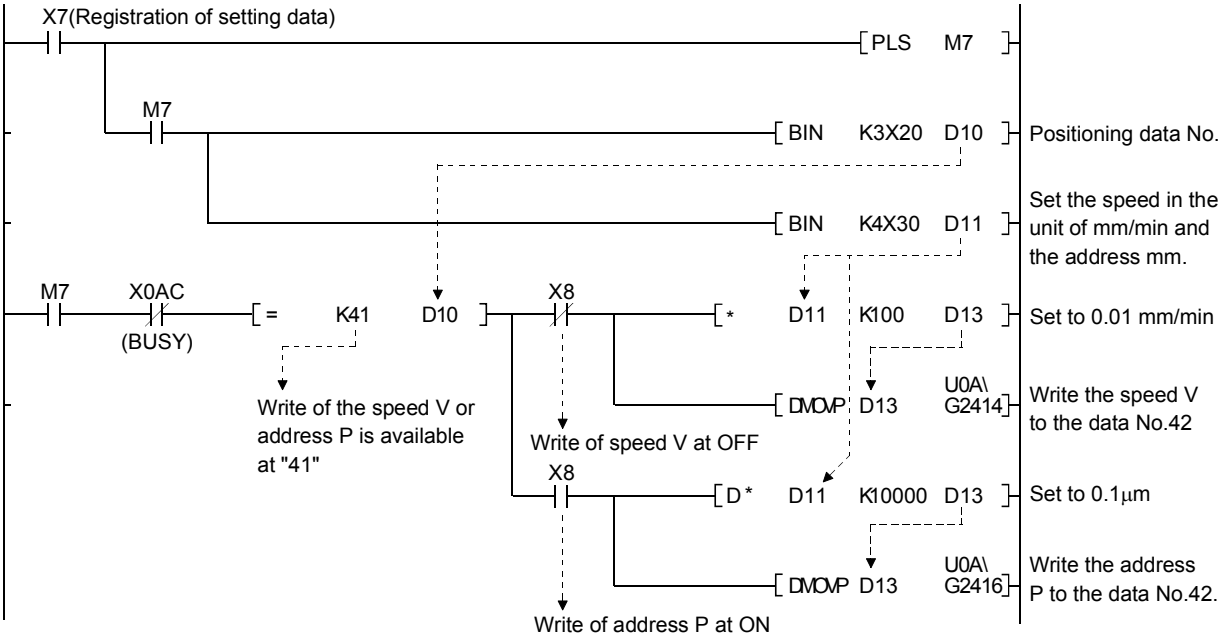
<Positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
41	2: Path	1: ABS linear 1	—	0:100	0:100	50000.0	0.0	2000.00	0	0	
42	0: Completed	2: INC linear 1	—	0:100	0:100	0.0	0.0	1.00	0	0	
43											
44											
45											

Setting of speed

Setting of address

<Sequence program>

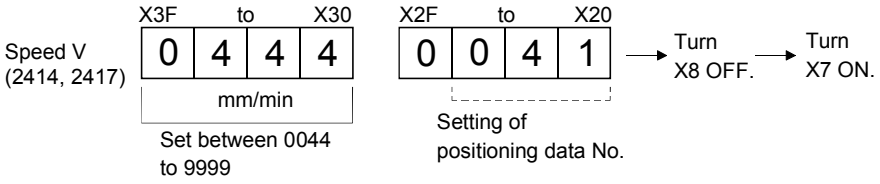


Demonstration machine operation

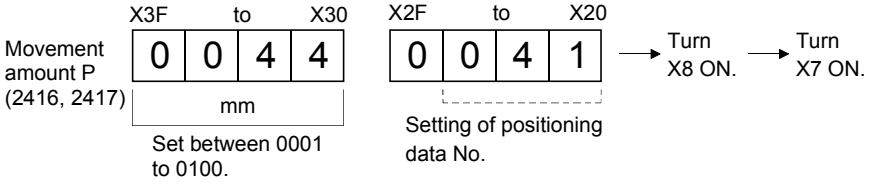
Repeat

1) Turn X2 ON and return to the standby point of 25mm.

2) Set the digital switch and write the speed V to the buffer memory by X7.



3) Set the digital switch and write the address P to the buffer memory by X8 and X7.



For the movement amount, do not set the bigger value than 100mm.

〔The upper limit of the stroke limit might be exceeded.〕

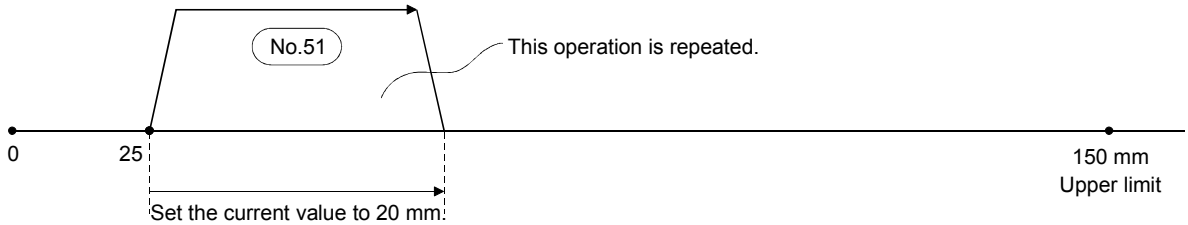
4) Turn X3 ON.

Address 50 mm of the data No.41.	+	Movement amount of the data No.42.	=	End point

6.11.15 Fixed-feed

Feed again after feeding a certain amount by the incremental system to carry out "cut" or "drilling".

<Figure for operation explanation>



<Positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
51	0: Completed	3: Fixed-feed 1	—	0:100	0:100	20000.0	0.0	3000.00	0	0	
52											
53											

<Sequence program>
A program to start the positioning data No.51.
(Same program as the one in Section 6.11.6.)

Demonstration machine operation

Repeat

1) Turn X0 ON to carry out OPR.
2) Set the digital switch.

X3F to X30				X2F to X20			
0	0	0	0	0	0	5	1

Setting of positioning data No.

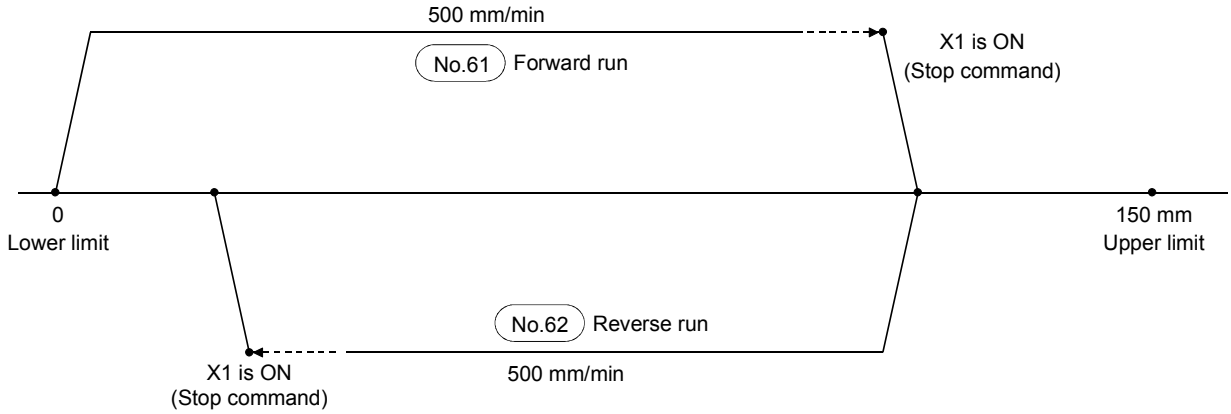
3) Turn X3 ON.
Confirm that the current value becomes 20000.0μm.

Do not turn ON more than 8 times on the 1-axis demonstration machine and more than 10 times on the XYZ table.
It exceeds the upper limit causing an error.

6.11.16 Speed control

Speed control is used to move endlessly in the same direction; for example, a conveyer or a carrying machine.
Normally, in speed control, the current value does not change regardless of the forward run or the reverse run, and it does not stop until the stop instruction comes.
However, if "1" is set to the current feed value update request command in the detailed parameter (1) (buffer memory address 30/180/330/480), the current value increases or decreases.
This demonstration machine with the upper/lower limit switch automatically stops at that position.

<Figure for operation explanation>



<Positioning data>

No.	operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
61	0: Completed	4: Forward run Speed 1	—	0:100	0:100	0.0	0.0	500.00	0	0	
62	0: Completed	5: Forward run Speed 1	—	0:100	0:100	0.0	0.0	500.00	0	0	
63											

<Sequence program>
A program to start the positioning data No.61, No.62.
(Same program as the one in Section 6.11.6.)

Demonstration machine operation

Repeat

1) Turn X0 ON to carry out OPR.

2) Set the digital switch to 61.

Turn X3 ON for the forward run.

The axis-1 current value of the SW□D5C-QD75P operation monitor screen remains "0" and is not incremented.

(Confirm that the speed is displayed.)

Turn X1 ON during the operation to stop the operation.

3) Set the digital switch to 62.

Turn X3 ON for the reverse run.

The axis-1 current value of the SW□D5C-QD75P operation monitor screen remains "0" and is not decremented.

(Confirm that the speed is displayed.)

Turn X1 ON during the operation to stop the operation.

REFERENCE

If an error occurs, move to the center by the JOG operation and turn X0B (Error reset) ON.

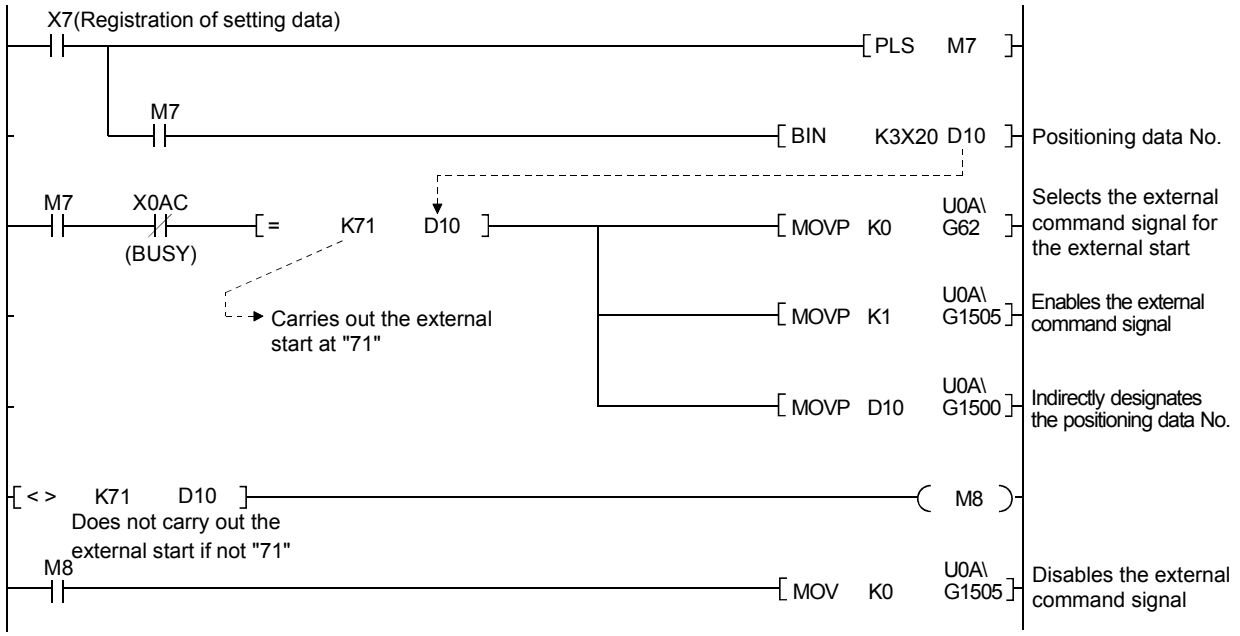
6.11.17 When external command signal is used

After creating the positioning data and writing the start data No. to the buffer memory 1500, "0" needs be written to the external command signal function selection (buffer memory address 62) and "1" to the external command signal valid (buffer memory address 1505) to start the data by the input of the external command signal.

<Positioning data>

No.	Operation pattern	Control systems	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
71	1: Continuous	1: ABS linear 1	—	0:100	0:100	50000.0	0.0	1500.00	1000	0	
72	0: Completed	1: ABS linear 1	—	0:100	0:100	75000.0	0.0	1000.00	0	0	
73											

<Sequence program>



Demonstration machine operation

Repeat

1) Turn X0 ON to carry out OPR.
2) Start the positioning data No.71 by the external command signal (CHG).

3) Turn X7 ON.
4) Turn ON the CHG switch of the 1-axis demonstration machine.
(The operation starts.)

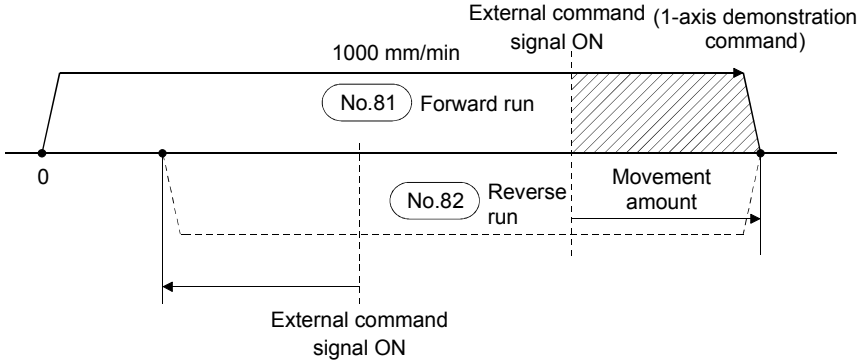
REMARK

The external command signal can be used as the external start request, external speed switching request, speed • position/position • speed control switching request, and skip request by the external command signal function selection of detailed parameter 2.

6.11.18 Speed position switching control by external command signal

Inputting the external switching signal (CHG signal) during speed control carries out the positioning for the set movement amount.

<Figure for operation explanation>

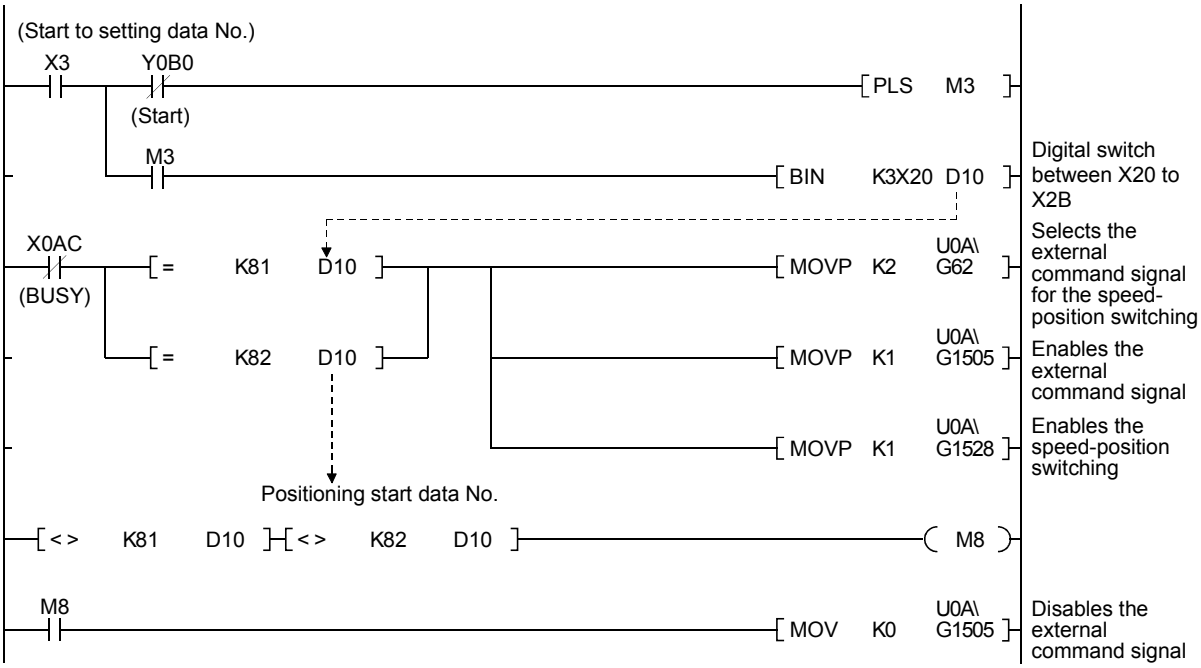


<Positioning data>

No.	Operation pattern	Control systems	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
81	0: Completed	6: VPF	—	0:100	0:100	50000.0	0.0	1000.00	0	0	
82	0: Completed	7: VPR	—	0:100	0:100	50000.0	0.0	1000.00	0	0	
83											

<Sequence program>

1) A program to start the positioning data No.81, No.82.
   (Same program as the one in Section 6.11.6.)
2) The following programs are needed to use the external command signal (CHG) for the speed • position switching.
   - Write "2" to the 'external command signal function selection' of detailed parameter 2 (1-axis buffer memory address 62).
   - Write "1" to the 'external command valid' (1-axis buffer memory address 1505).
   - Write "1" to the 'speed position switching enable flag' (1-axis buffer memory address 1528).



Demonstration machine operation

Repeat

1) Turn X0 ON to carry out OPR.

2) Set the digital switch to the positioning data No.81.

X3F	to	X30	X2F	to	X20
0	0	0	0	0	8	1

Setting of positioning data No.

3) Turn X7 ON and read the data No.81.

4) Turn X3 ON for the forward run.
If the CHG switch of the demonstration machine is turned ON during the operation, it stops after moving 50mm.

Turn X1 ON during the operation to stop the operation.

5) Set the digital switch to 82.

X3F	to	X30	X2F	to	X20
0	0	0	0	0	8	2

Setting of positioning data No.

Turn X7 ON and read the data No.82.
Turn X3 ON for the reverse run.
If the CHG switch of the demonstration machine is turned ON during the operation, it stops after moving 50mm.

6.11.19 Positioning using M code

For an M code, numbers of 0 to 65535 are used for each axis and added to the positioning data.

Using the 'M code ON signal output timing' of detailed parameter (1) (buffer memory 27/177/327/477), select when to detect the signal, at the start of "WITH mode [0]" or at the completion of "AFTER mode (1)".

(For this time, "AFTER mode [1]" is set by the parameter.

If the M code detection signal (X0A4/X0A5/X0A6/X0A7) turns ON in the sequence program, the sequence (work) corresponding to the M code is executed by reading the valid M code (buffer memory 808/908/1008/1108) from the QD75 buffer memory.

Also, comments (32 characters) can be attached to M codes 1 to 50, and the M code comments being detected by peripheral devices (work descriptions) can be monitored.

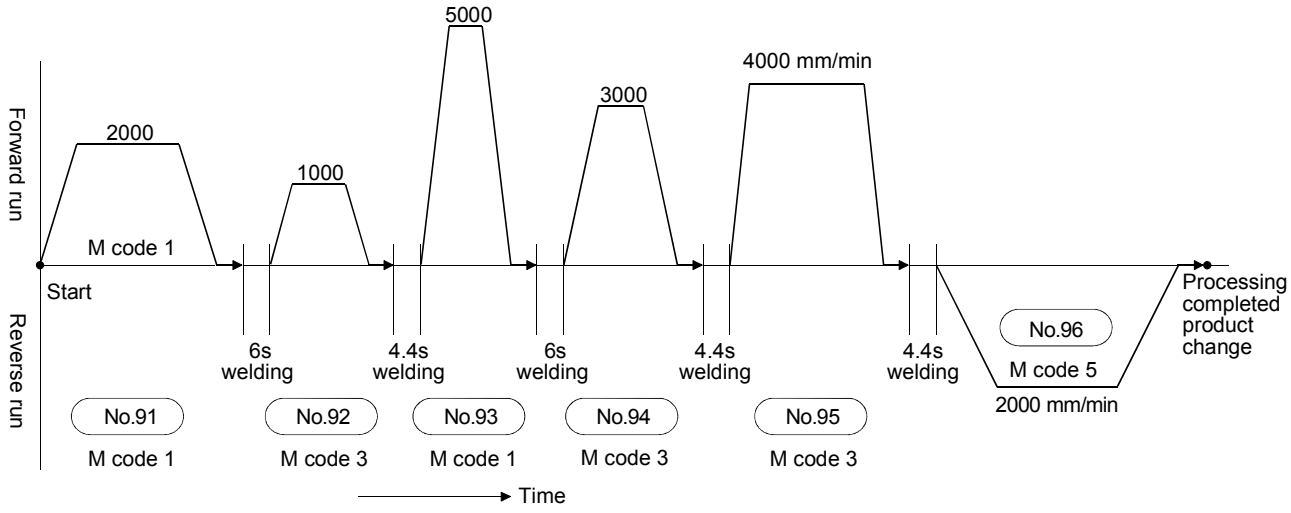
1) An M code is detected when the next data No. is executed, and the work corresponding to the M code is executed.

   No.91,93.....M code "1"..... Comment "6s welding"

   No.91,93.....M code "3"..... Comment "4.4s welding"

   No.91,93.....M code "5"..... Comment "Processing completed product change"

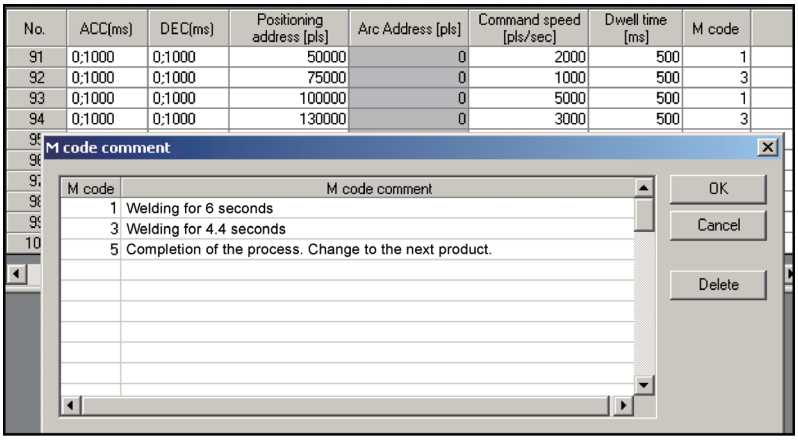
<Figure for operation explanation>



<Positioning data>

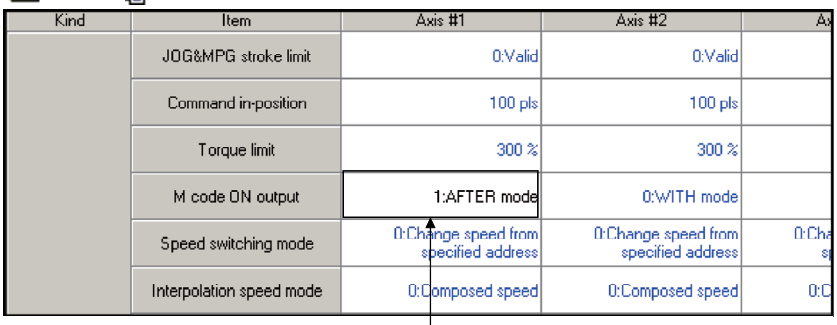
No.	Operation pattern	Control systems	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
91	1: Continuous	1: ABS linear 1	—	0:100	0:100	50000.0	0.0	2000.00	500	1	
92	1: Continuous	1: ABS linear 1	—	0:100	0:100	75000.0	0.0	1000.00	500	3	
93	1: Continuous	1: ABS linear 1	—	0:100	0:100	100000.0	0.0	5000.00	500	1	
94	1: Continuous	1: ABS linear 1	—	0:100	0:100	130000.0	0.0	3000.00	500	3	
95	1: Continuous	1: ABS linear 1	—	0:100	0:100	150000.0	0.0	4000.00	500	3	
96	0: Completed	1: ABS linear 1	—	0:100	0:100	25000.0	0.0	2000.00	500	5	
97											
98											
99											
100											

Edit → Positioning data Axis #1 → [Edit] → [M code comment] menu



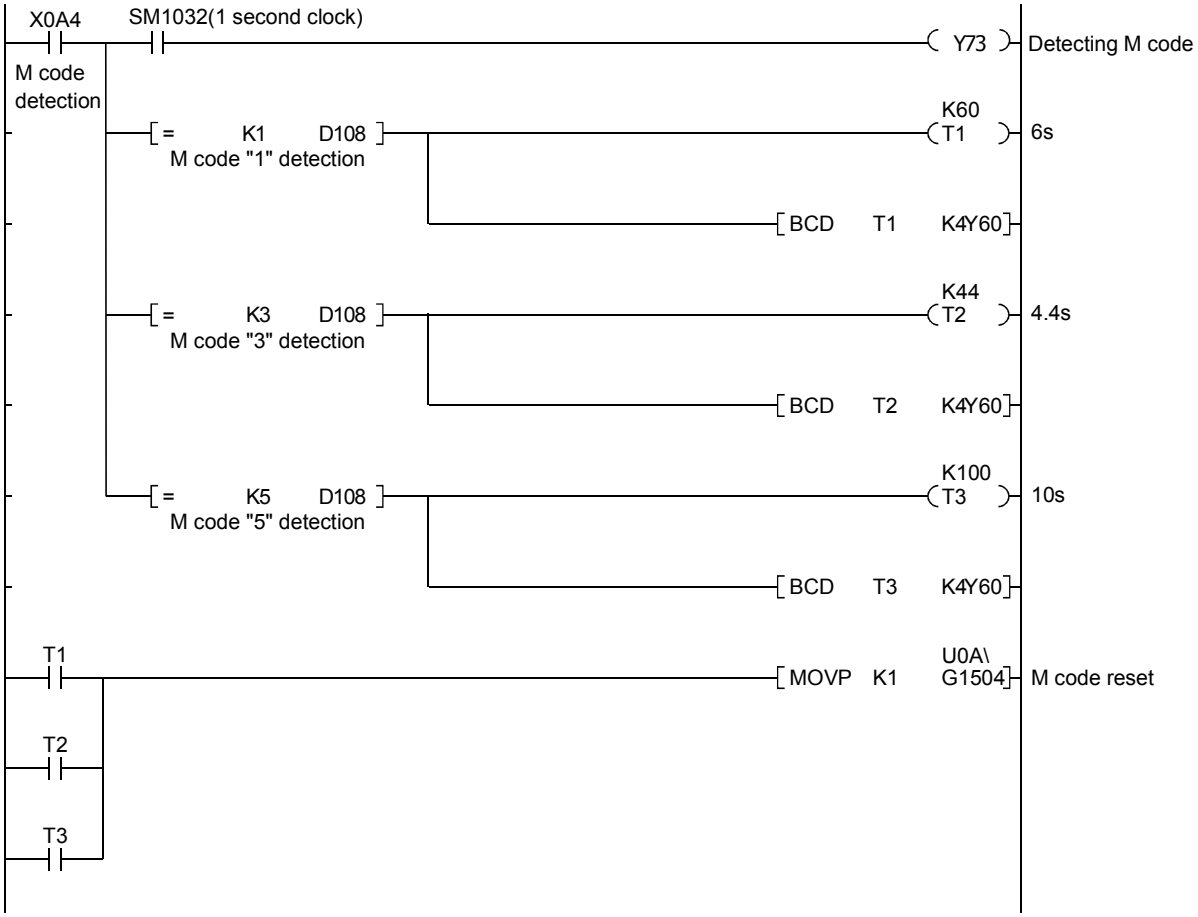
<M code AFTER mode output>

Edit→ Parameter data



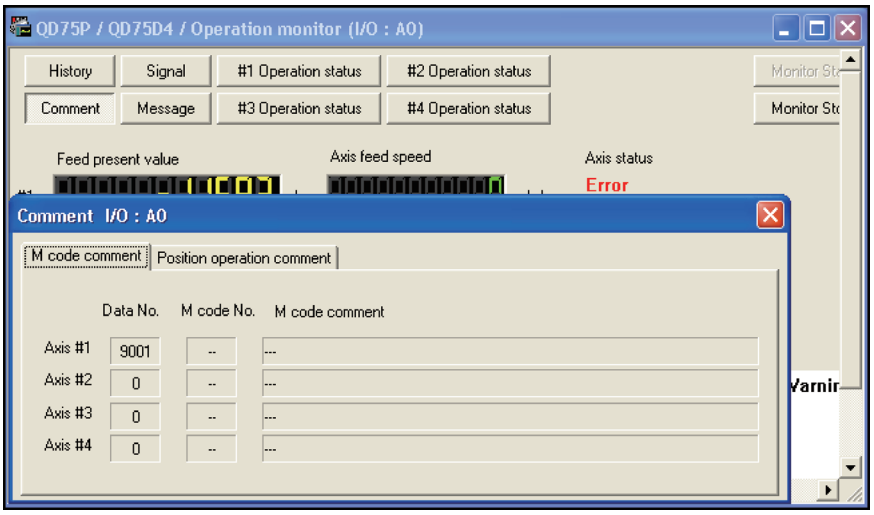
Confirm that AFTER mode is selected.

<Sequence program>



Demonstration machine operation

1) Click Monitor → Operation monitor → Monitor Start button → Comment button.



2) Carry out the circuit monitor of GPPW.
Click (the [Online] → [Monitor] → [Monitor mode] menu.)

3) Turn X0 ON to carry out OPR.

4) Start the positioning data No.91.

Repeat

X3F	to	X30	X2F	to	X20
0	0	0	0	0	9	1

Setting of positioning data No.

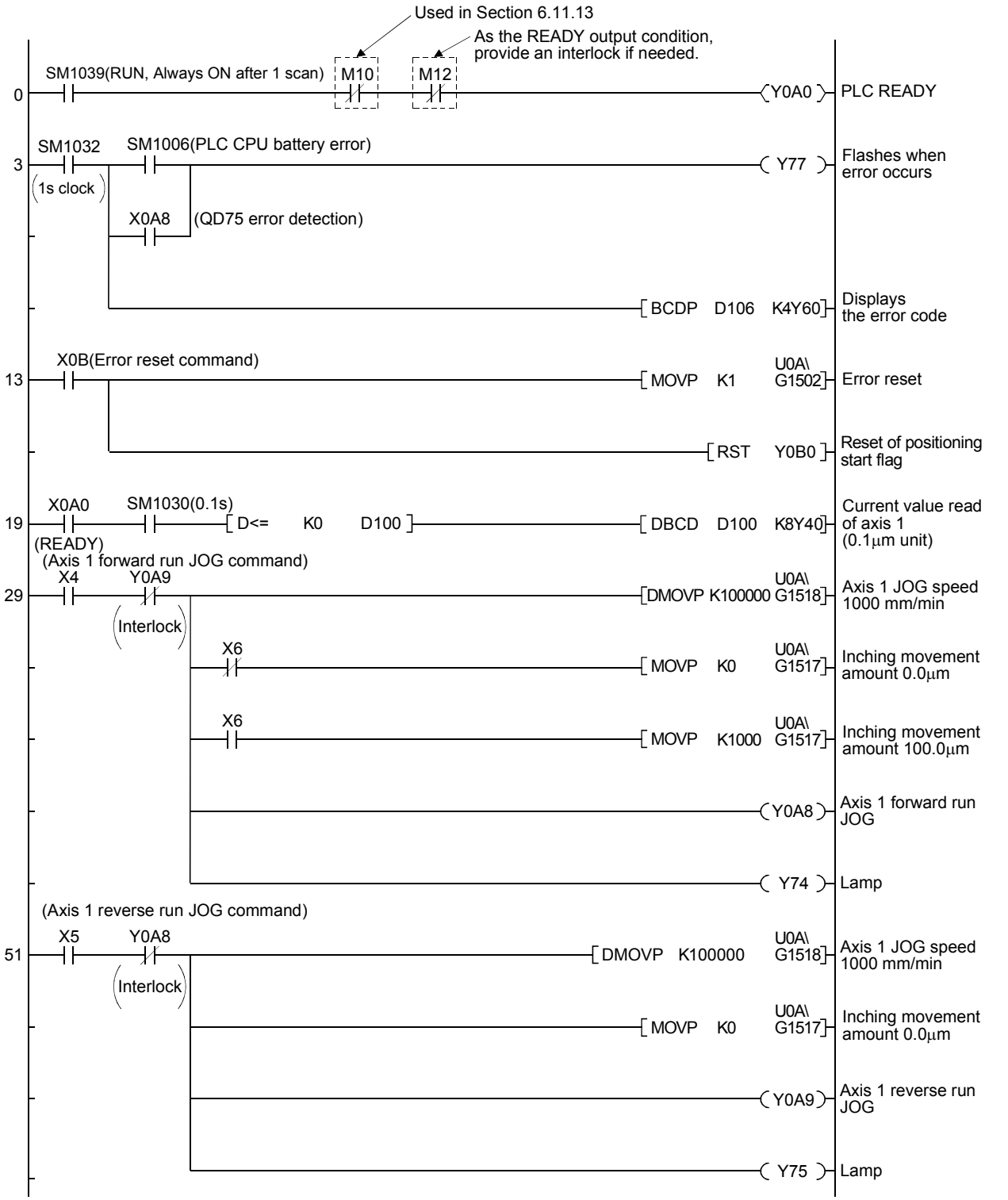
Turn X3 ON.

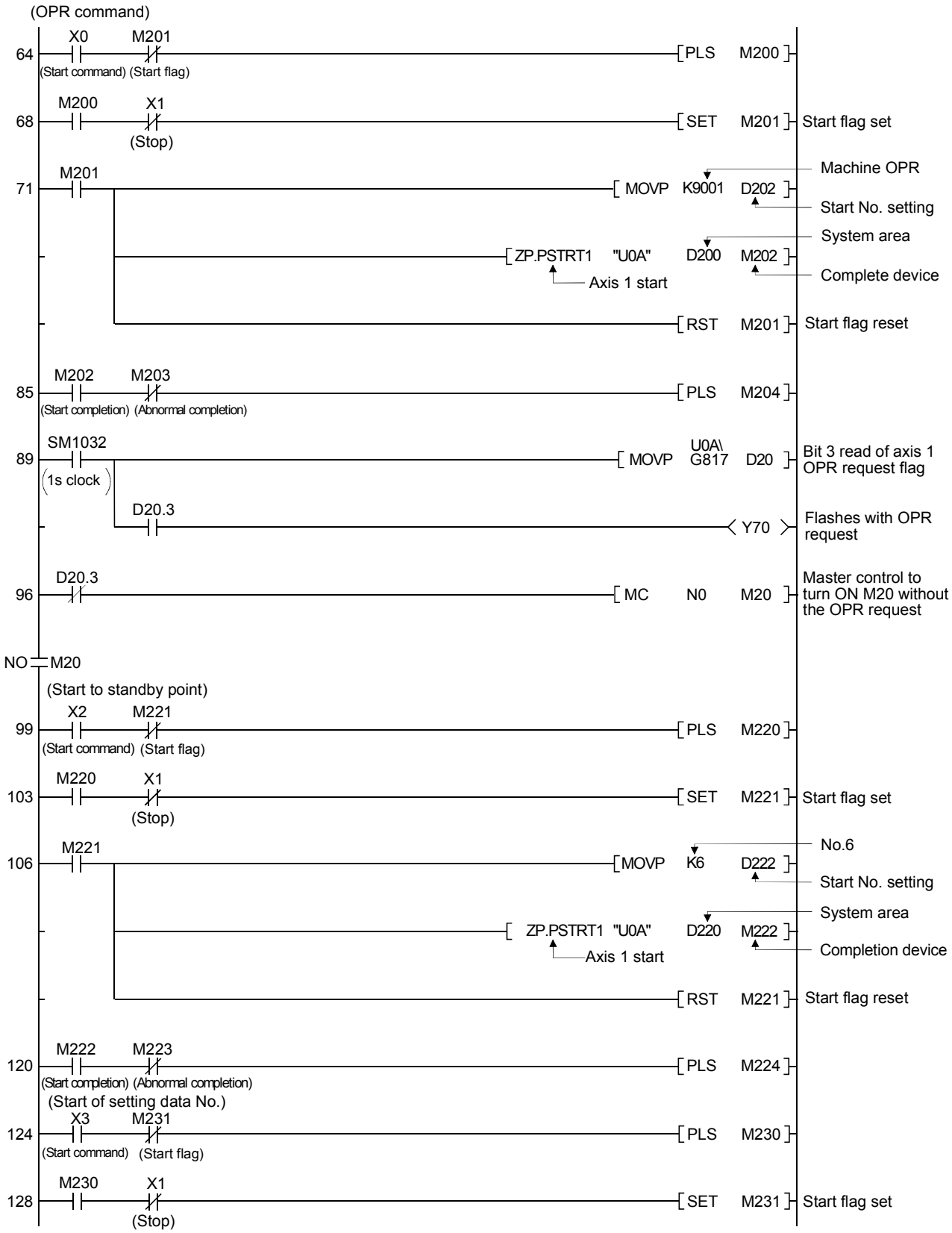
Data from No.91 to 96 are executed consecutively, and weld time is displayed on the digital displays from Y60 to Y6F.

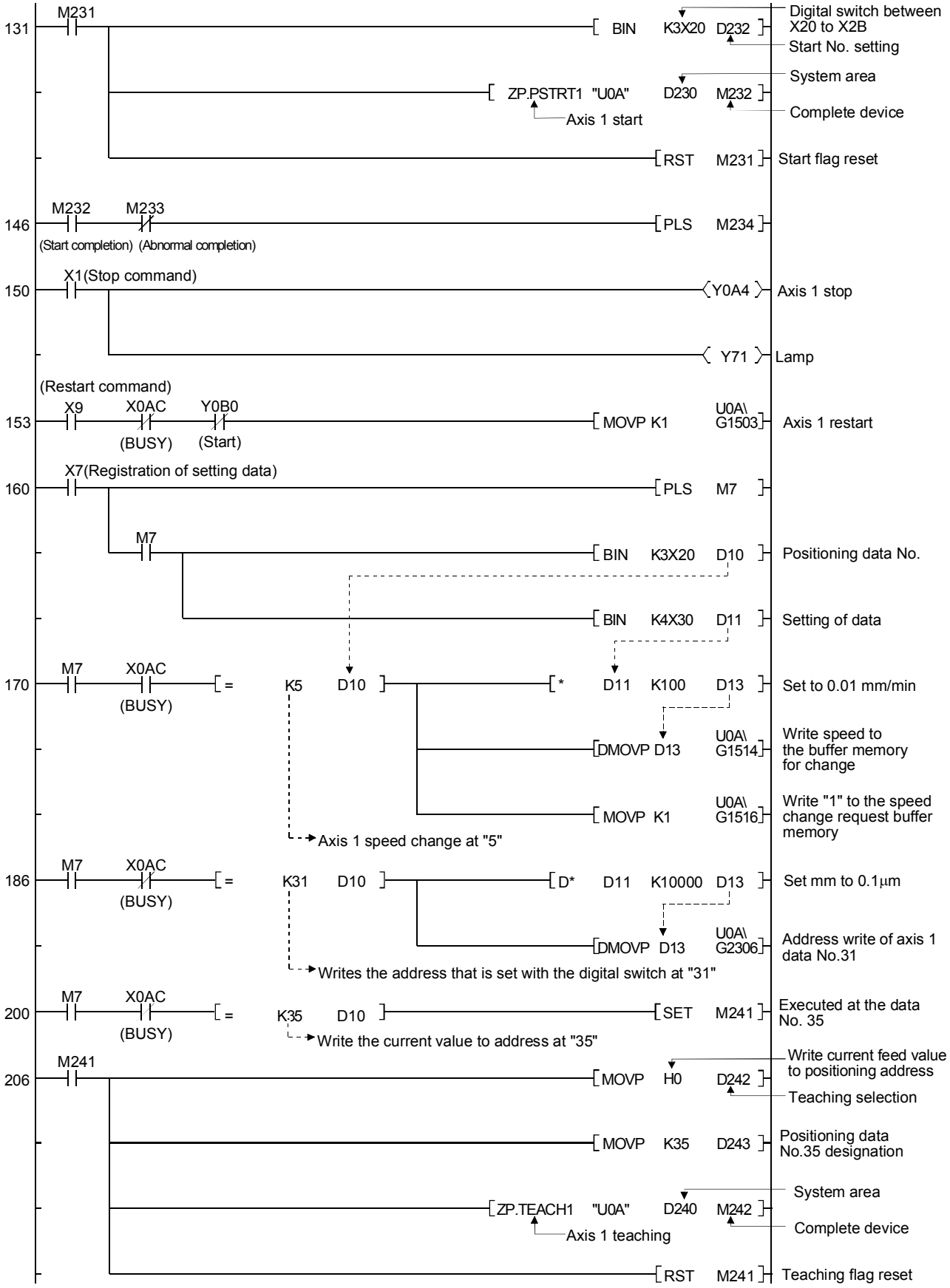
6.11.20 Summary of sequence program

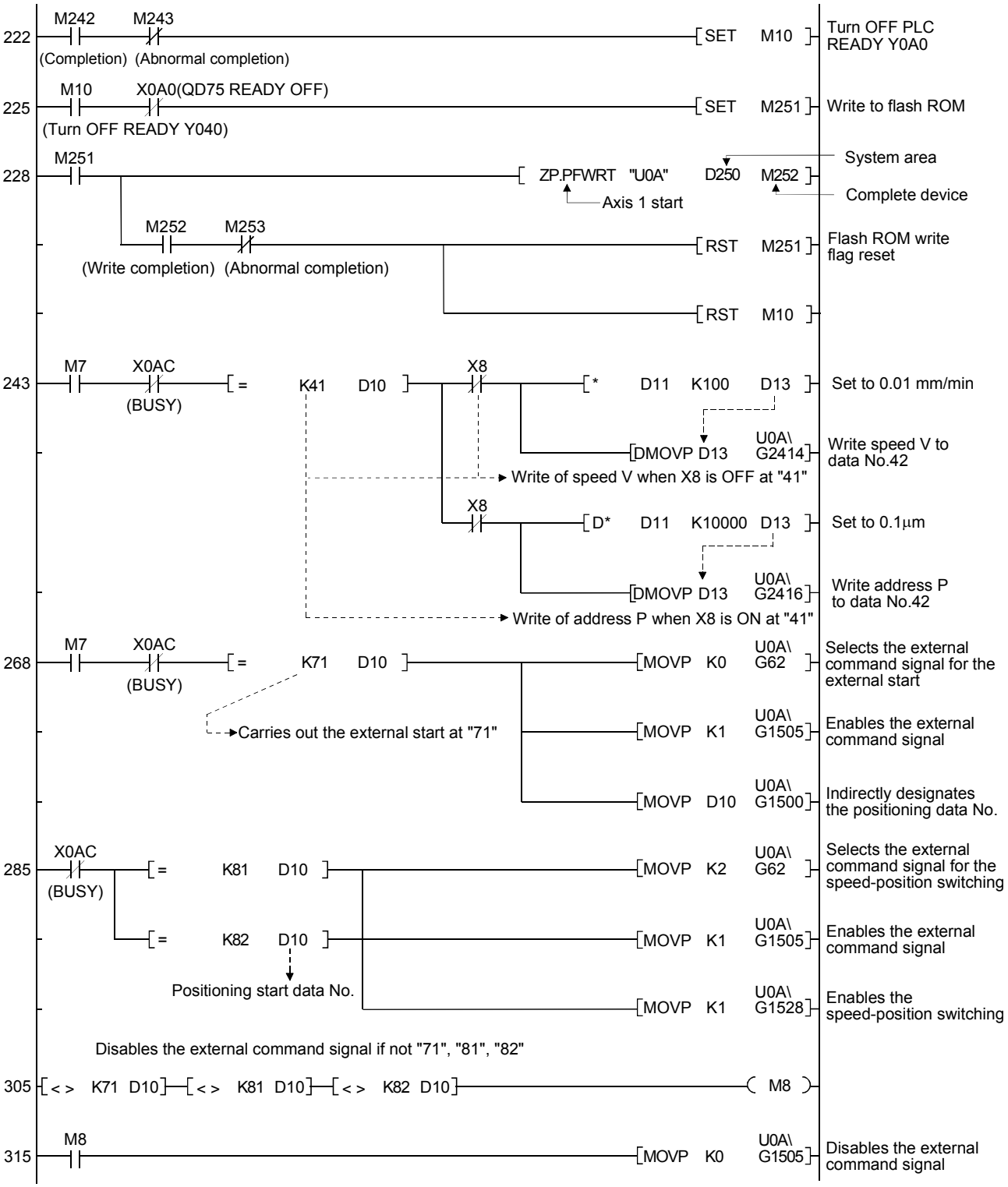
Regular programs explained in Section 6.11 are brought into one here.

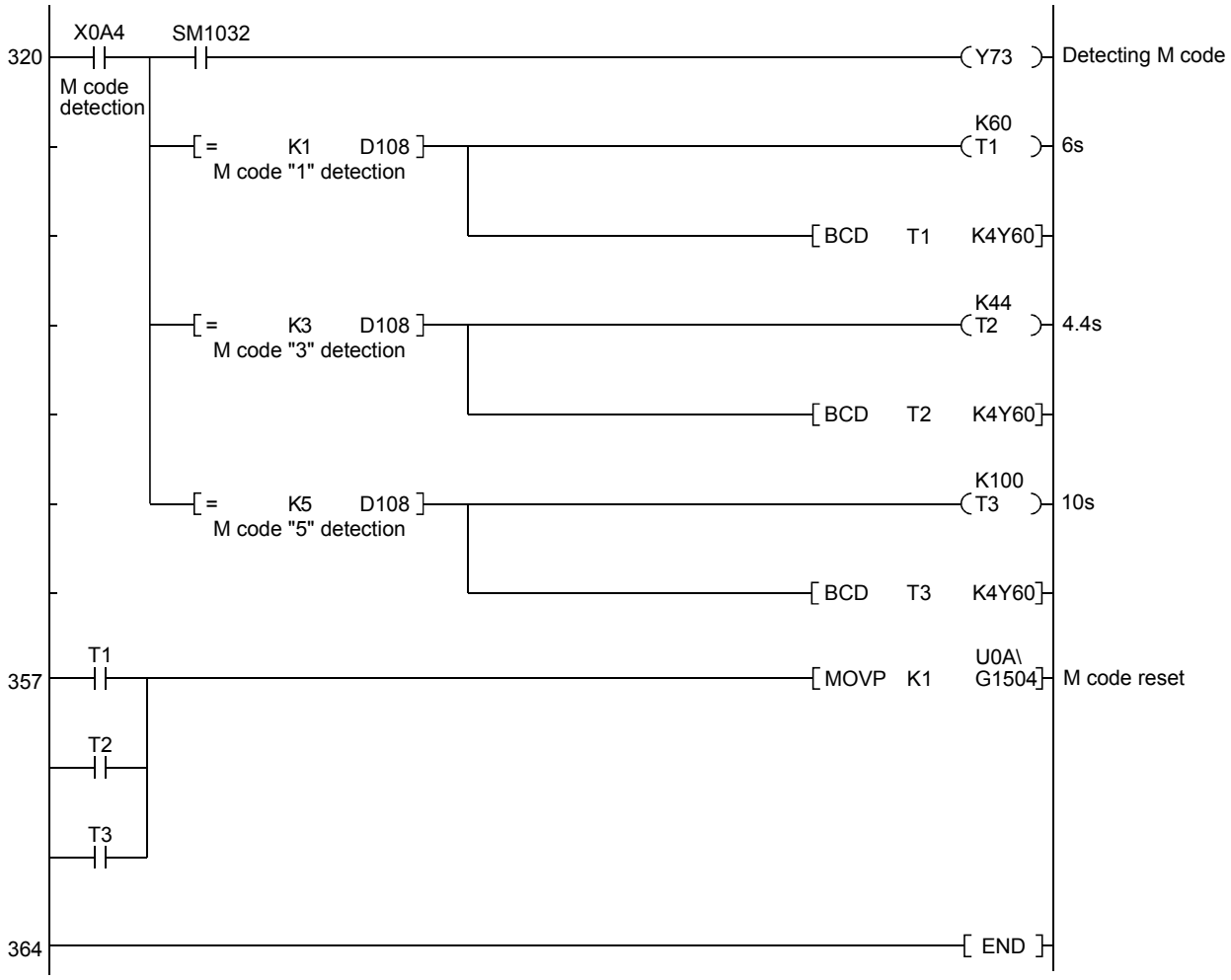
Project name	X




(OPR command)
64
X0
M201
(Start command)
(Start flag)
PLS M200
68
M200
X1
(Stop)
SET M201
Start flag set
71
M201
MOVP K9001 D202
Machine OPR
Start No. setting
ZP.PSTRT1 "U0A" D200 M202
System area
Complete device
Axis 1 start
RST M201
Start flag reset
85
M202
M203
(Start completion)
(Abnormal completion)
PLS M204
89
SM1032
(1s clock)
MOVP U0A\G817 D20
Bit 3 read of axis 1 OPR request flag
D20.3
Y70
Flashes with OPR request
96
D20.3
MC N0 M20
Master control to turn ON M20 without the OPR request
NO
M20
(Start to standby point)
99
X2
M221
(Start command)
(Start flag)
PLS M220
103
M220
X1
(Stop)
SET M221
Start flag set
106
M221
MOVP K6 D222
No.6
Start No. setting
ZP.PSTRT1 "U0A" D220 M222
System area
Completion device
Axis 1 start
RST M221
Start flag reset
120
M222
M223
(Start completion)
(Abnormal completion)
PLS M224
(Start of setting data No.)
124
X3
M231
(Start command)
(Start flag)
PLS M230
128
M230
X1
(Stop)
SET M231
Start flag set


131
M231
BIN K3X20 D232
Digital switch between X20 to X2B
Start No. setting
ZP.PSTRT1 "U0A" D230 M232
System area
Axis 1 start
Complete device
RST M231
Start flag reset
146
M232 M233
PLS M234
(Start completion) (Abnormal completion)
150
X1(Stop command)
Y0A4
Axis 1 stop
Y71
Lamp
(Restart command)
153
X9 X0AC Y0B0
MOVP K1 U0A\ G1503
Axis 1 restart
(BUSY) (Start)
160
X7(Registration of setting data)
PLS M7
M7
BIN K3X20 D10
Positioning data No.
BIN K4X30 D11
Setting of data
170
M7 X0AC
= K5 D10
* D11 K100 D13
Set to 0.01 mm/min
(BUSY)
DMOVP D13 U0A\ G1514
Write speed to the buffer memory for change
MOVP K1 U0A\ G1516
Write "1" to the speed change request buffer memory
Axis 1 speed change at "5"
186
M7 X0AC
= K31 D10
D* D11 K10000 D13
Set mm to 0.1μm
(BUSY)
DMOVP D13 U0A\ G2306
Address write of axis 1 data No.31
Writes the address that is set with the digital switch at "31"
200
M7 X0AC
= K35 D10
SET M241
Executed at the data No. 35
(BUSY)
Write the current value to address at "35"
206
M241
MOVP H0 D242
Write current feed value to positioning address
Teaching selection
MOVP K35 D243
Positioning data No.35 designation
ZP.TEACH1 "U0A" D240 M242
System area
Complete device
Axis 1 teaching
RST M241
Teaching flag reset


222
M242
M243
(Completion)
(Abnormal completion)
SET M10
Turn OFF PLC READY Y0A0
225
M10
X0A0(QD75 READY OFF)
(Turn OFF READY Y040)
SET M251
Write to flash ROM
228
M251
ZP.PFWRT "U0A" D250 M252
System area
Complete device
Axis 1 start
M252
M253
(Write completion)
(Abnormal completion)
RST M251
Flash ROM write flag reset
RST M10
243
M7
X0AC
(BUSY)
= K41 D10
X8
* D11 K100 D13
Set to 0.01 mm/min
DMOVP D13 U0A\G2414
Write speed V to data No.42
Write of speed V when X8 is OFF at "41"
X8
D* D11 K10000 D13
Set to 0.1μm
DMOVP D13 U0A\G2416
Write address P to data No.42
Write of address P when X8 is ON at "41"
268
M7
X0AC
(BUSY)
= K71 D10
MOVP K0 U0A\G62
Selects the external command signal for the external start
Carries out the external start at "71"
MOVP K1 U0A\G1505
Enables the external command signal
MOVP D10 U0A\G1500
Indirectly designates the positioning data No.
285
X0AC
(BUSY)
= K81 D10
MOVP K2 U0A\G62
Selects the external command signal for the speed-position switching
= K82 D10
MOVP K1 U0A\G1505
Enables the external command signal
Positioning start data No.
MOVP K1 U0A\G1528
Enables the speed-position switching
Disables the external command signal if not "71", "81", "82"
305
< > K71 D10
< > K81 D10
< > K82 D10
M8
315
M8
MOVP K0 U0A\G1505
Disables the external command signal

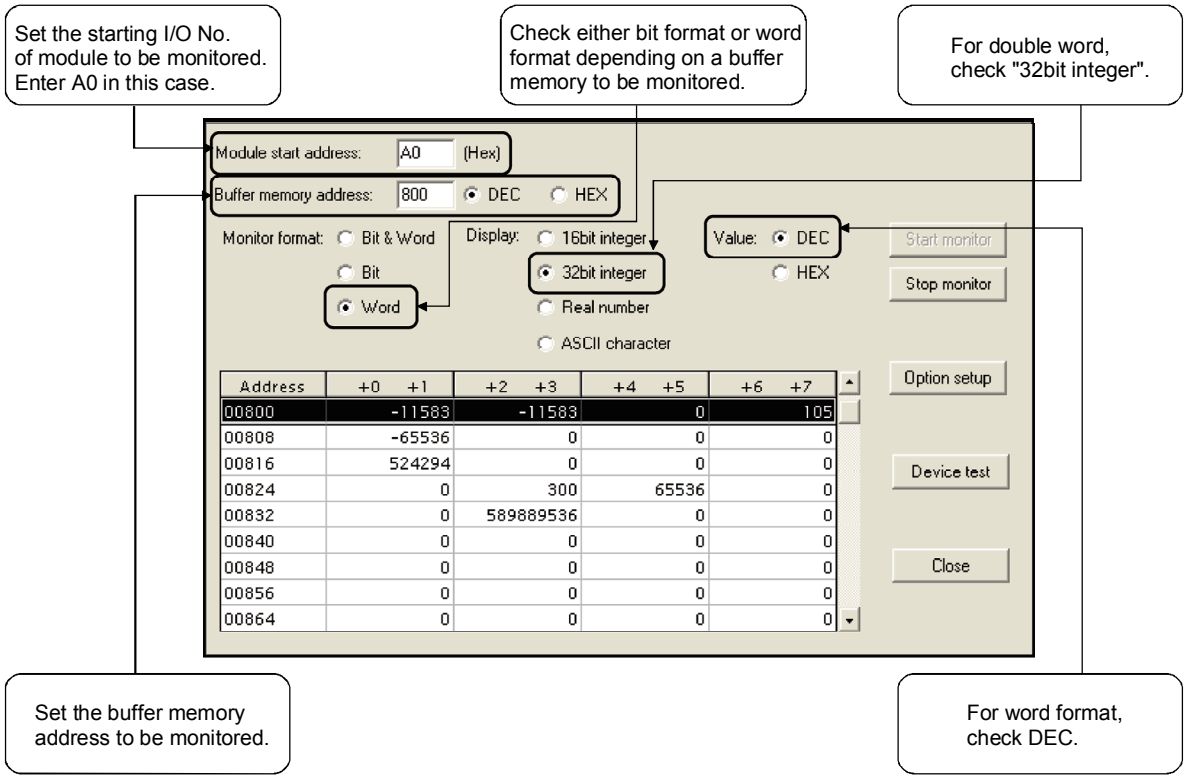

320
X0A4
SM1032
Y73
Detecting M code
M code detection
= K1 D108
M code "1" detection
K60
T1
6s
BCD T1 K4Y60
= K3 D108
M code "3" detection
K44
T2
4.4s
BCD T2 K4Y60
= K5 D108
M code "5" detection
K100
T3
10s
BCD T3 K4Y60
357
T1
T2
T3
MOVP K1 U0A\G1504
M code reset
364
END

6.12 Monitoring Buffer Memory Using GPPW

The QD75 buffer memory can be monitored directly from GPPW.

Demonstration machine operation

1) Click the [Online] → [Monitor] → [Buffer memory batch] menu on GPPW.
2) Set the buffer memory address and display type, etc. in the "Buffer memory batch monitor" dialog box.
3) Clicking the "Monitor Start" button starts monitoring the buffer memory.



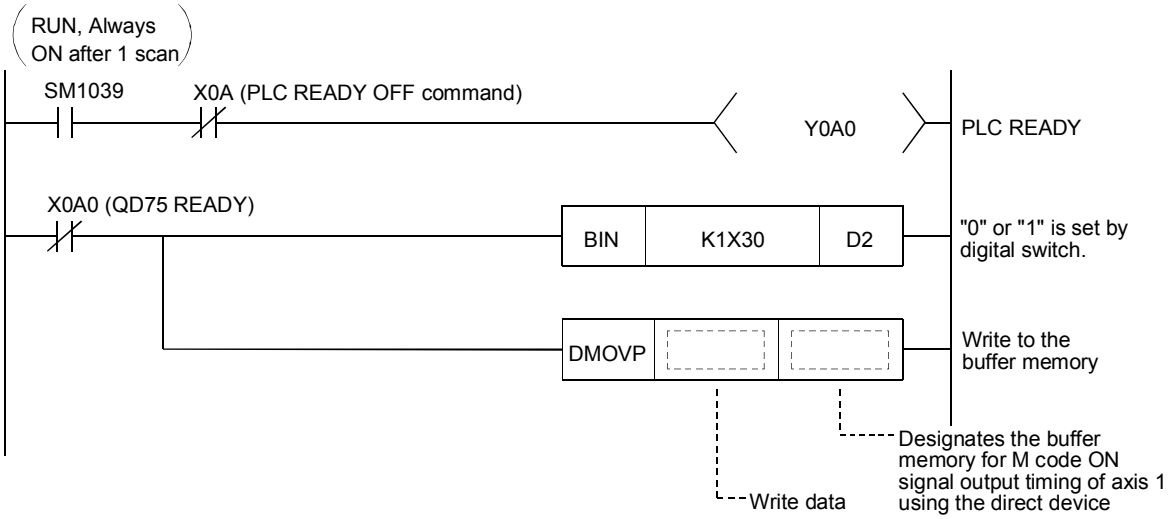
REMARK

Device test can perform data writing to the buffer memory.

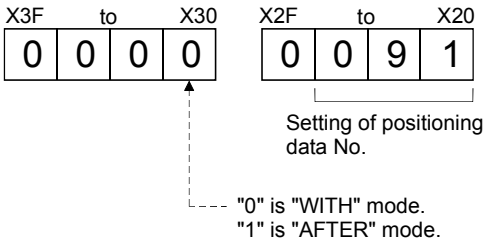
6.13 Practice Question (3) Parameter Change During RUN

There may be the cases where the detailed parameter (1) must be changed while the PLC is running.

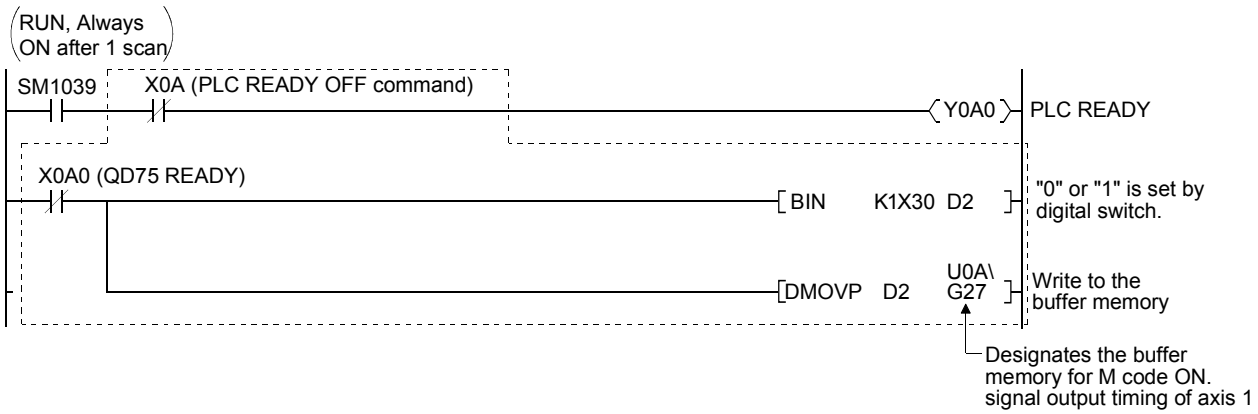
To do this, create the sequence program that executes the following actions: when the PLC READY Y0A0 turns OFF and the QD75 READY X0A0 turns OFF, the MOV instruction is turned ON to rewrite the buffer memory storing the M code ON signal output timing of the detailed parameter (1), using the intelligent function module direct device.



Turn ON the PLC READY (Y0A0) after rewriting and start the positioning data No.91.

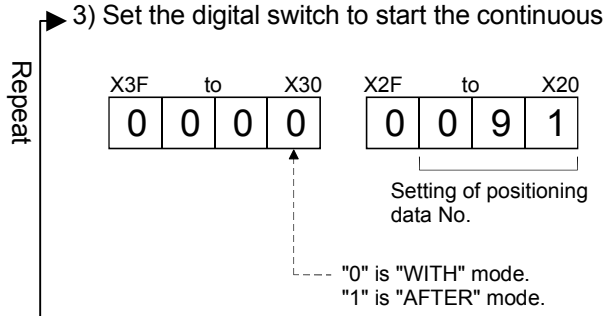


Practice question (3) Answer



Demonstration machine operation

1) Add the sequence program inside the dotted line above and write the program to the PLC CPU.
2) Monitor the QD75 buffer memory "27" by the buffer memory batch monitor of GPPW.
3) Set the digital switch to start the continuous positioning of the data No.91.



4) Turn X0A from OFF to ON to turn OFF the PLC READY, and rewrite the buffer memory.
5) Turn ON the PLC READY Y0A0 by turning X0A from ON to OFF.
6) Turn X0 ON to carry out OPR.
7) Turn X3 ON.

- When the WITH mode is selected, the M code is detected at the same time with start, and the timer starts.
- When the AFTER mode is selected, the M code is detected after the positioning is completed, and the timer starts.

CHAPTER 7 EXERCISE (3) 3-AXIS POSITIONING OPERATION USING SEQUENCE PROGRAM

(1) Interpolation axis

The 2- to 4-axis linear interpolation and 2-axis circular interpolation operation generate the positioning data to the reference axis and set the required items to the interpolation axis.

1) For 2-axis interpolation control, specify the interpolation axis in the "axis to be interpolated" of the positioning data of the reference axis side.

Axis definition / Control system	Reference axis	Interpolation axis
2-axis linear interpolation control, 2-axis fixed-feed control, 2-axis circular interpolation control, 2-axis speed control	Any of axes 1, 2, 3, and 4	Axis set in "axis to be interpolated" of reference axis

2) For 3-axis interpolation control, the interpolation axis is automatically specified for the reference axis.

Axis definition / Control system	Reference axis	Interpolation axis
3-axis linear interpolation control, 3-axis fixed-feed control, 3-axis speed control	Axis 1	Axis 2, Axis 3
	Axis 2	Axis 3, Axis 4
	Axis 3	Axis 4, Axis 1
	Axis 4	Axis 1, Axis 2
4-axis linear interpolation control, 4-axis fixed-feed control, 4-axis speed control	Axis 1	Axis 2, Axis 3, Axis 4
	Axis 2	Axis 3, Axis 4, Axis 1
	Axis 3	Axis 4, Axis 1, Axis 2
	Axis 4	Axis 1, Axis 2, Axis 3

(2) Interpolation speed

The interpolation speed has the composite speed and the reference axis speed, and the initial value is the composite speed. However, the value can be changed to the reference axis speed with the "interpolation speed designation method" of the detailed parameters (1).

1) Composite speed : Interpolated with the speed to the vector generated by the movement of the reference axis and interpolation axis.

2) Reference axis speed : Interpolated with the speed of the reference axis. (Set so the major axis side becomes the reference axis.)

(3) Interpolation control continuous positioning

When carrying out interpolation control in which the "continuous positioning control" and "continuous path control" are designated as the operation pattern, interpolation control must be set for the positioning methods of all positioning data from the started positioning data to the positioning data for which "positioning complete" is set.

(4) Limits to interpolation control

There are limits to the interpolation control that can be executed and speed (Interpolation speed designation method) that can be set, depending on the reference axis and the "Unit setting of the interpolation axis". (For example, circular interpolation control cannot be executed if the reference axis and interpolation axis units differ.)

The following table shows the interpolation control and speed designation limits.

"Control system" interpolation control	Interpolation speed designation method	Unit setting*1	
		Reference axis and interpolation axis units are the same, or a combination of "mm" and "inch" *3	Reference axis and interpolation axis units differ *3
Linear 2 (ABS, INC) Fixed-feed 2	Composite speed	○	×
	Reference axis speed	○	○
Circular sub (ABS, INC) Circular right (ABS, INC) Circular left (ABS, INC)	Composite speed	○*2	×
	Reference axis speed	×	×
Linear 3 (ABS, INC) Fixed-feed 3	Composite speed	○	×
	Reference axis speed	○	○
Linear 4 (ABS, INC) Fixed-feed 4	Composite speed	×	×
	Reference axis speed	○	○

○: Setting possible, ×: Setting not possible

*1 : "mm" and "inch" unit mix possible.

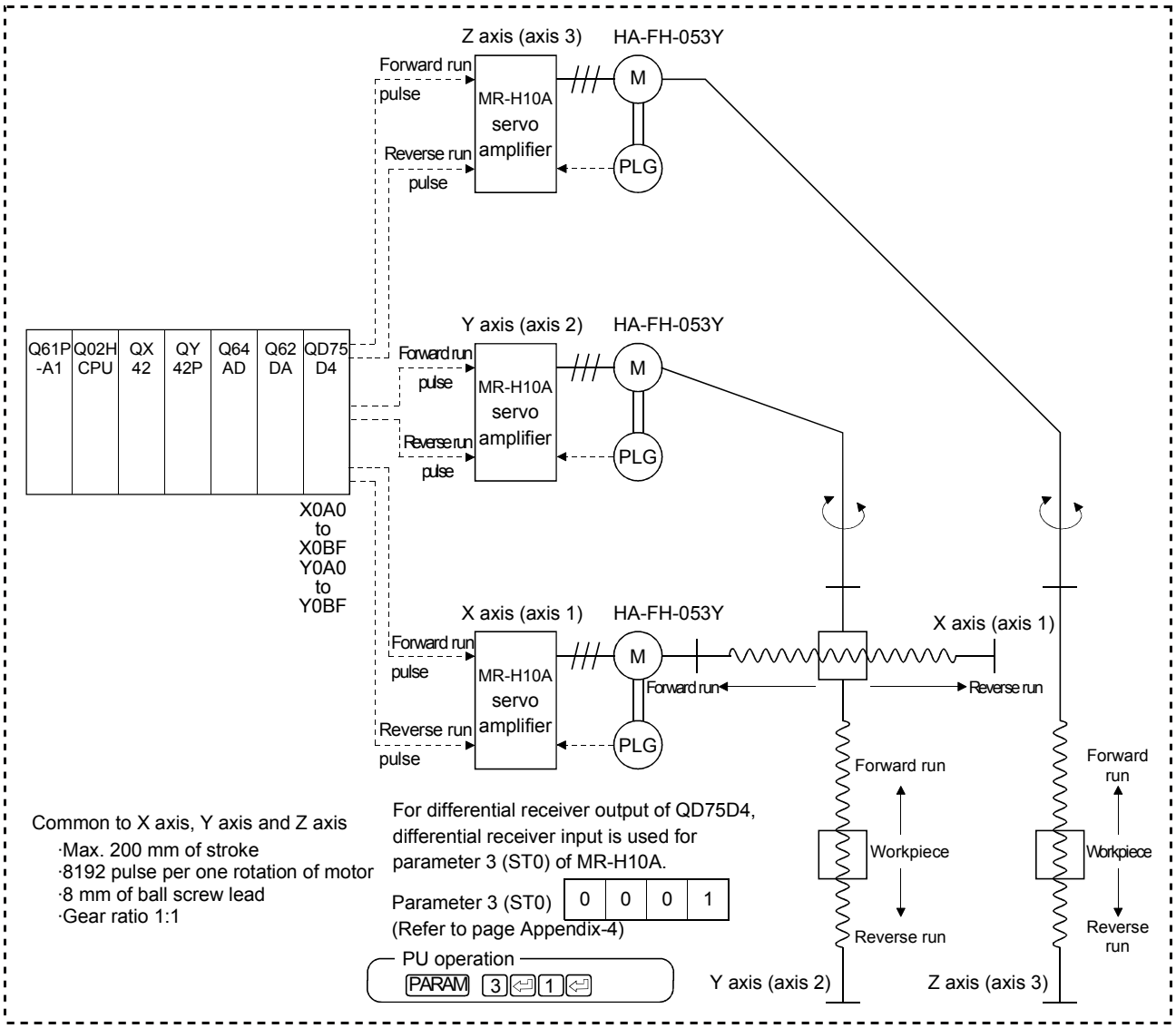
*2 : "degree" setting not possible.

The "Control system error (error code: 524)" will occur and the positioning cannot be executed if circular interpolation control is set when the unit is "degree".

The machine will immediately stop if "degree" is set during positioning control.

*3 : The unit set in the reference axis will be used for the speed unit during control if the units differ or if "mm" and "inch" are combined.

7.1 XYZ Axis Control Positioning Operation System



7.2 Parameter of Axis 1, Axis 2, Axis 3 and OPR Parameter

The "rotation direction setting" is set according to the X, Y, Z table where the axis is forward run increment and the axes 2 and 3 are reverse run increment.
The interpolation speed is the composite speed of the initial value of detailed parameter (1).

Project name	XYZ

Edit → Parameter data

(In the following screen example, the settings of unused 4 axes (initial value for all) are omitted.)

Kind	Item	Axis #1	Axis #2	Axis #3
Basic parameter 1	Unit	0:mm	0:mm	0:mm
	Pulse per rotation	8192 pls	8192 pls	8192 pls
	Travel per rotation	800.0 um	800.0 um	800.0 um
	Unit magnification	10: 10 times	10: 10 times	10: 10 times
	Pulse output mode	1:CW/CCW mode	1:CW/CCW mode	1:CW/CCW mode
	Rotation direction	0:Forward pulses to increase address	1:Reverse pulses to increase address	1:Reverse pulses to increase address
	Bias speed at start	0.00 mm/min	0.00 mm/min	0.00 mm/min

Kind	Item	Axis #1	Axis #2	Axis #3
Basic parameter 2	Speed limit	20000.00 mm/min	20000.00 mm/min	20000.00 mm/min
	ACC time #0	100 ms	100 ms	100 ms
	DEC time #0	100 ms	100 ms	100 ms
	Backlash compensation	0.0 um	0.0 um	0.0 um

Kind	Item	Axis #1	Axis #2	Axis #3
Extended parameter 1	Backlash compensation	0.0 um	0.0 um	0.0 um
	S/W stroke LMT HIGH	214748364.7 um	214748364.7 um	214748364.7 um
	S/W stroke LMT LOW	-214748364.8 um	-214748364.8 um	-214748364.8 um
	S/W stroke LMT select	0:Valid for command address	0:Valid for command address	0:Valid for command address
	JOG&MPG stroke limit	1:Invalid	1:Invalid	1:Invalid
	Command in-position	10.0 um	10.0 um	10.0 um
	Torque limit	300 %	300 %	300 %
	M code ON output	1:AFTER mode	0:WITH mode	0:WITH mode
	Speed switching mode	0:Change speed from specified address	0:Change speed from specified address	0:Change speed from specified address
	Interpolation speed mode	0:Composed speed	0:Composed speed	0:Composed speed
	Address update in V-control	0:No address update in velocity control	0:No address update in velocity control	0:No address update in velocity control
	Lower limit	0:Negative	0:Negative	0:Negative
	Upper limit	0:Negative	0:Negative	0:Negative
	Drive unit READY	0:Negative	0:Negative	0:Negative
	Stop signal	0:Negative	0:Negative	0:Negative
	External command	0:Negative	0:Negative	0:Negative
	Zero signal	0:Negative	0:Negative	0:Negative
	Near-point dog signal	0:Negative	0:Negative	0:Negative
	MPG	0:Negative	0:Negative	0:Negative

Kind	Item	Axis #1	Axis #2	Axis #3
Extended parameter 2	ACC time #1	1000 ms	1000 ms	1000 ms
	ACC time #2	1000 ms	1000 ms	1000 ms
	ACC time #3	1000 ms	1000 ms	1000 ms
	DEC time #1	1000 ms	1000 ms	1000 ms
	DEC time #2	1000 ms	1000 ms	1000 ms
	DEC time #3	1000 ms	1000 ms	1000 ms
	JOG speed limit	20000.00 mm/min	20000.00 mm/min	20000.00 mm/min
	JOG ACC time	0;100	0;100	0;100
	JOG DEC time	0;100	0;100	0;100
	ACC/DEC set	0:Trapezoid acceleration mode	0:Trapezoid acceleration mode	0:Trapezoid acceleration mode
	S-curve ratio	100 %	100 %	100 %
	Sudden stop DEC time	1000 ms	1000 ms	1000 ms
	Stop group #1 Sudden stop	0:Normal stop	0:Normal stop	0:Normal stop
	Stop group #2 Sudden stop	0:Normal stop	0:Normal stop	0:Normal stop
	Stop group #3 Sudden stop	0:Normal stop	0:Normal stop	0:Normal stop
	Positioning complete signal	300 ms	300 ms	300 ms
	Cir.arc error allowance	10.0 um	10.0 um	10.0 um
	External command function	0:External start	0:External start	0:External start

Kind	Item	Axis #1	Axis #2	Axis #3
OPR basic parameter	OPR method	0:Zeroing DOG	0:Zeroing DOG	0:Zeroing DOG
	OPR direction	1:Reverse direction (Address decrease)	1:Reverse direction (Address decrease)	1:Reverse direction (Address decrease)
	OP address	0.0 um	0.0 um	0.0 um
	OPR speed	1000.00 mm/min	1000.00 mm/min	1000.00 mm/min
	Creep speed	300.00 mm/min	300.00 mm/min	300.00 mm/min
	OPR retry	1:Execute OPR from U/L limit	1:Execute OPR from U/L limit	1:Execute OPR from U/L limit

Kind	Item	Axis #1	Axis #2	Axis #3
OPR extended parameter	OPR dwell time	0 ms	0 ms	0 ms
	Travel setting after DOG ON	0.0 um	0.0 um	0.0 um
	OPR ACC time	0;100	0;100	0;100
	OPR DEC time	0;100	0;100	0;100
	OP shift amount	0.0 um	0.0 um	0.0 um
	OPR torque limit value	300 %	300 %	300 %
	Deviation command signal out time	11 ms	11 ms	11 ms
	OP shift speed specification	0:OPR speed	0:OPR speed	0:OPR speed
	Dwell time during OPR retry	0 ms	0 ms	0 ms

The following shows the sequence program for controlling 3 axes, containing the PLC READY, error code reading/resetting, current value reading, JOG operation, OPR and positioning data No. start.

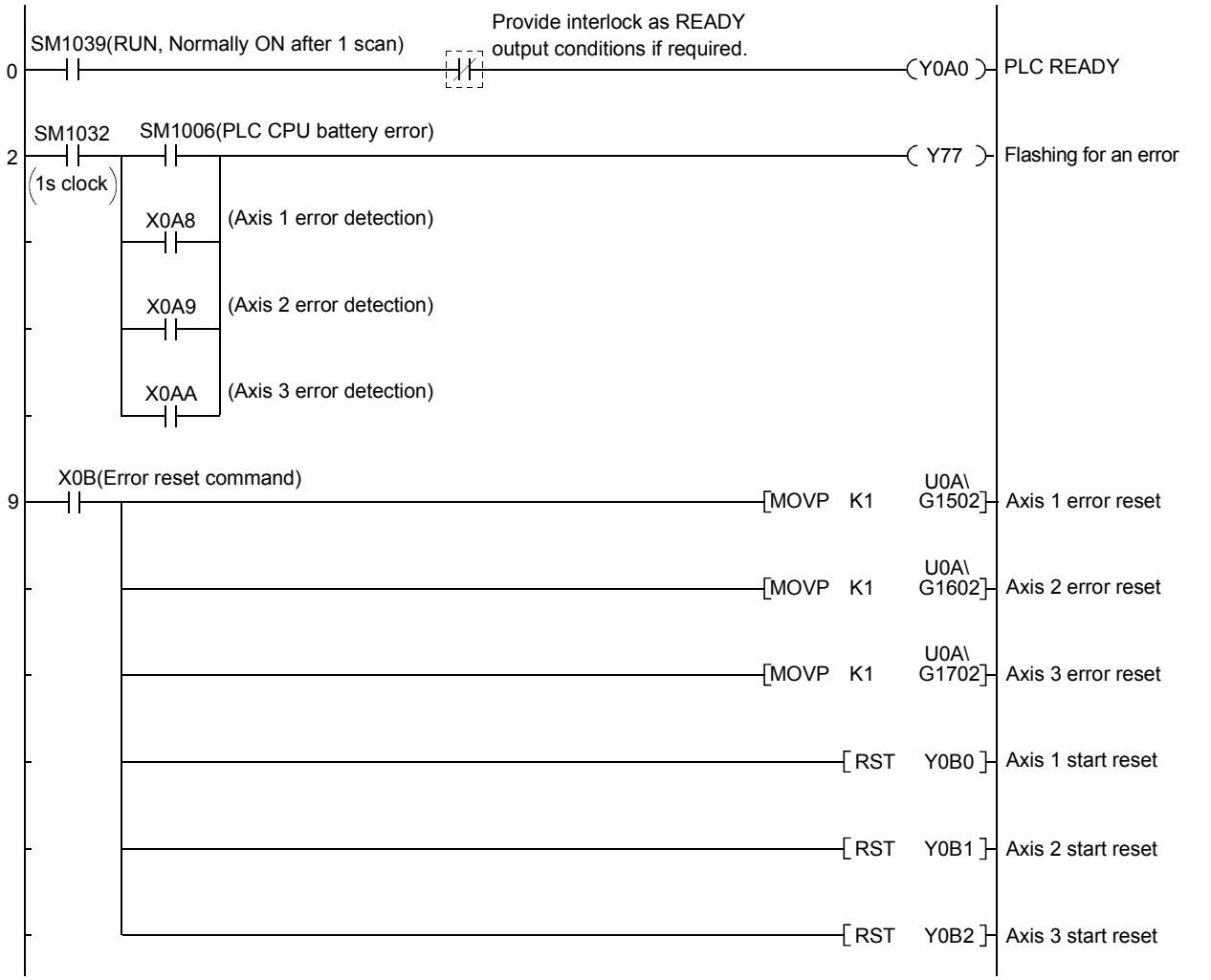
Automatic refresh setting			
Current feed value	Axis 1 D100	Axis 2 D110	Axis 3 D120

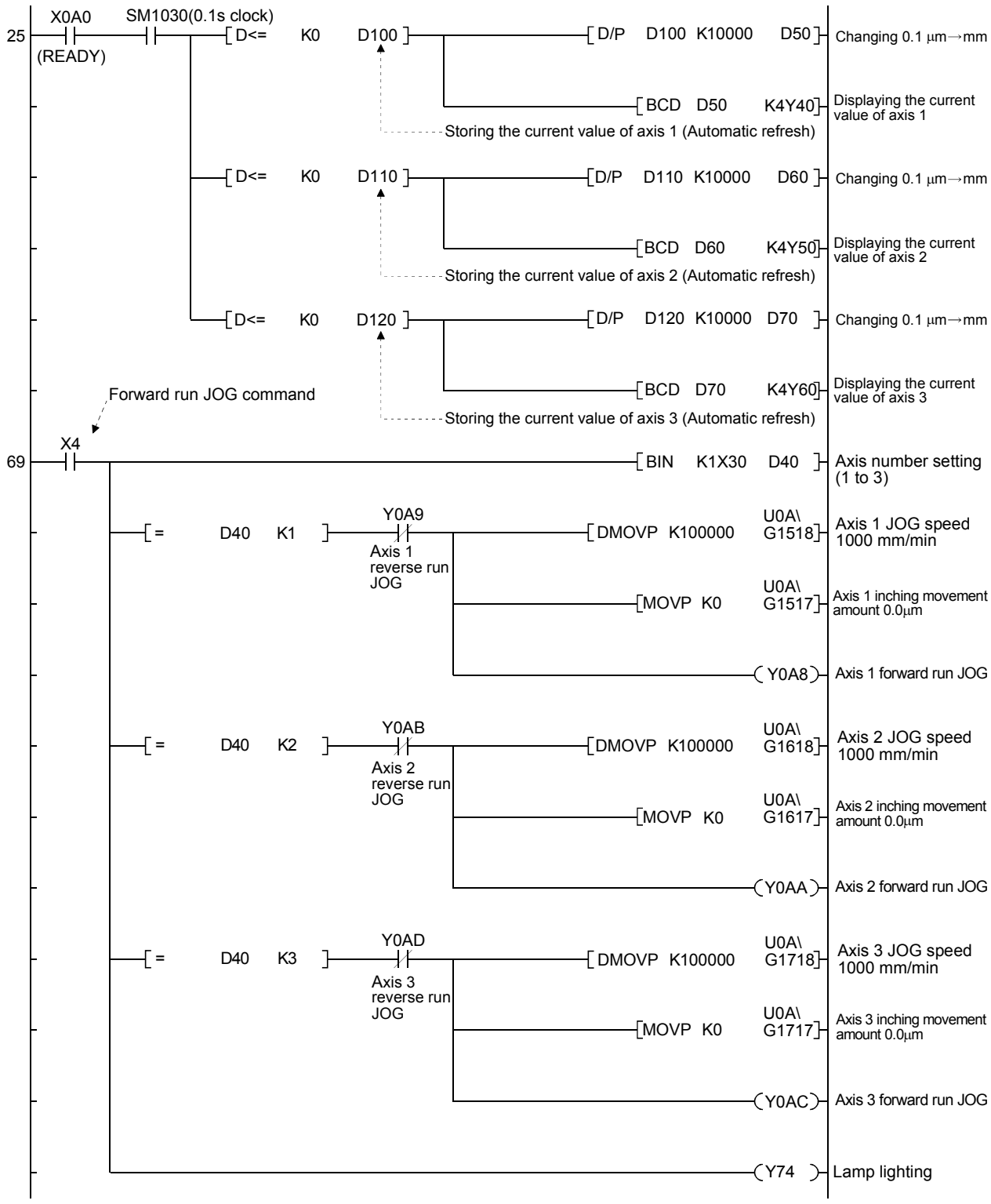
X0: OPR command
X1: Stop command
X2: Moving to standby point
X3: Circular interpolation command
X4: Forward run JOG command
X5: Reverse run JOG command
X6: -
X7: Linear interpolation command
X8: -
X9: Restart command
X0A: -
X0B: Error reset command

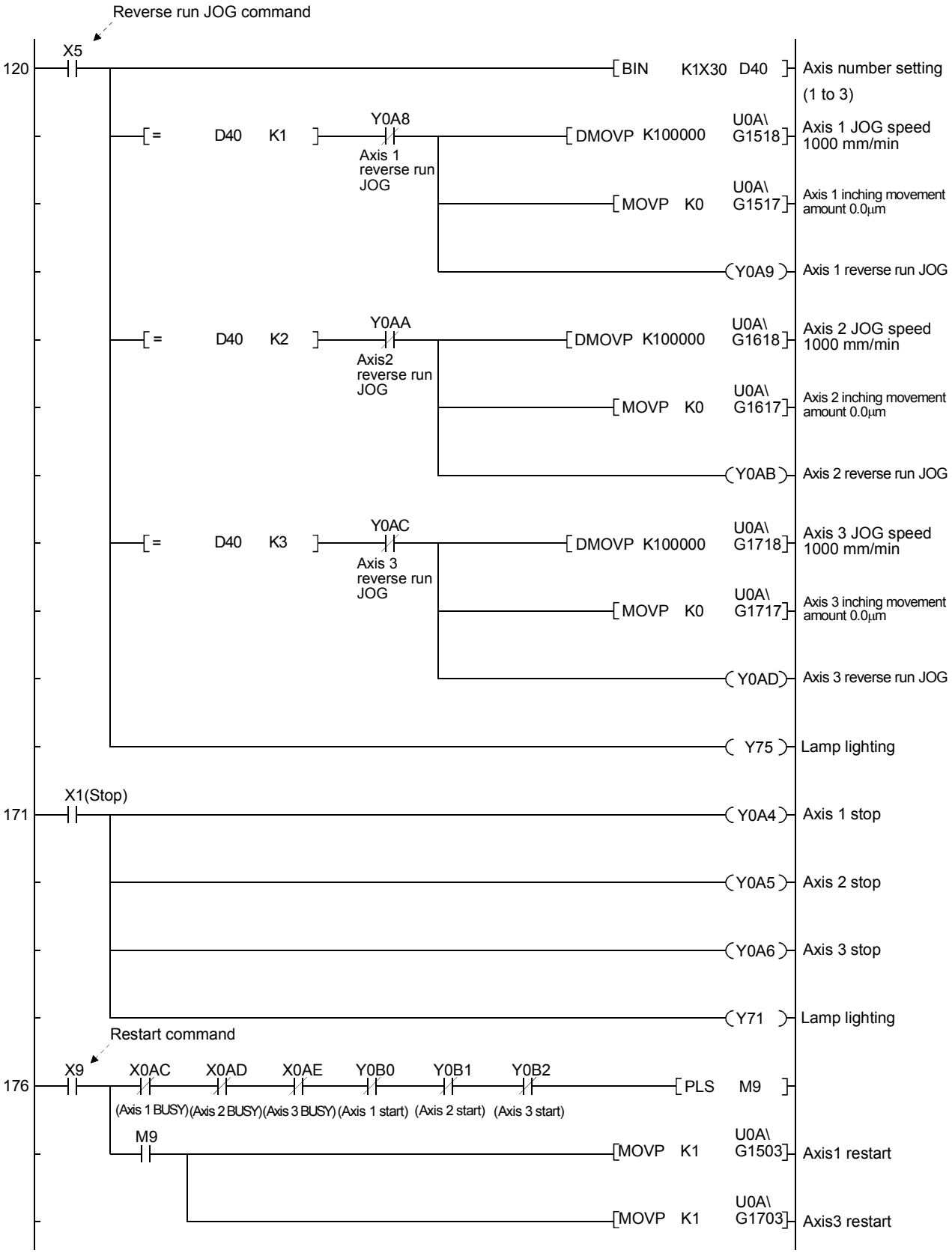
Y70: OPR request
Y71: Commanding stop
Y72:
Y73:
Y74: Forward run JOG operating
Y75: Reverse run JOG operating
Y76:
Y77: Error occurrence

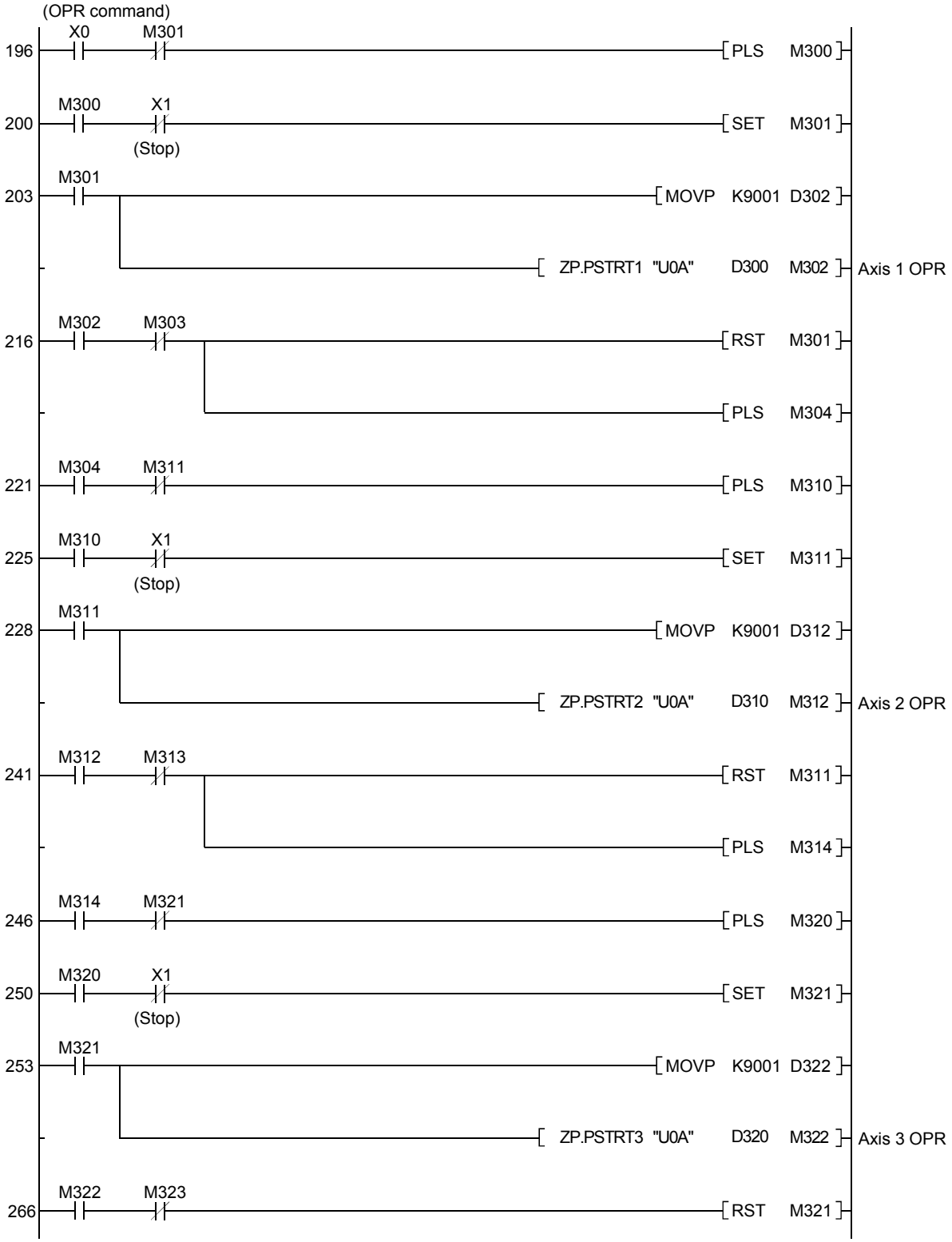
M300 to M389, D300 to D389: Used for QD75 dedicated instruction

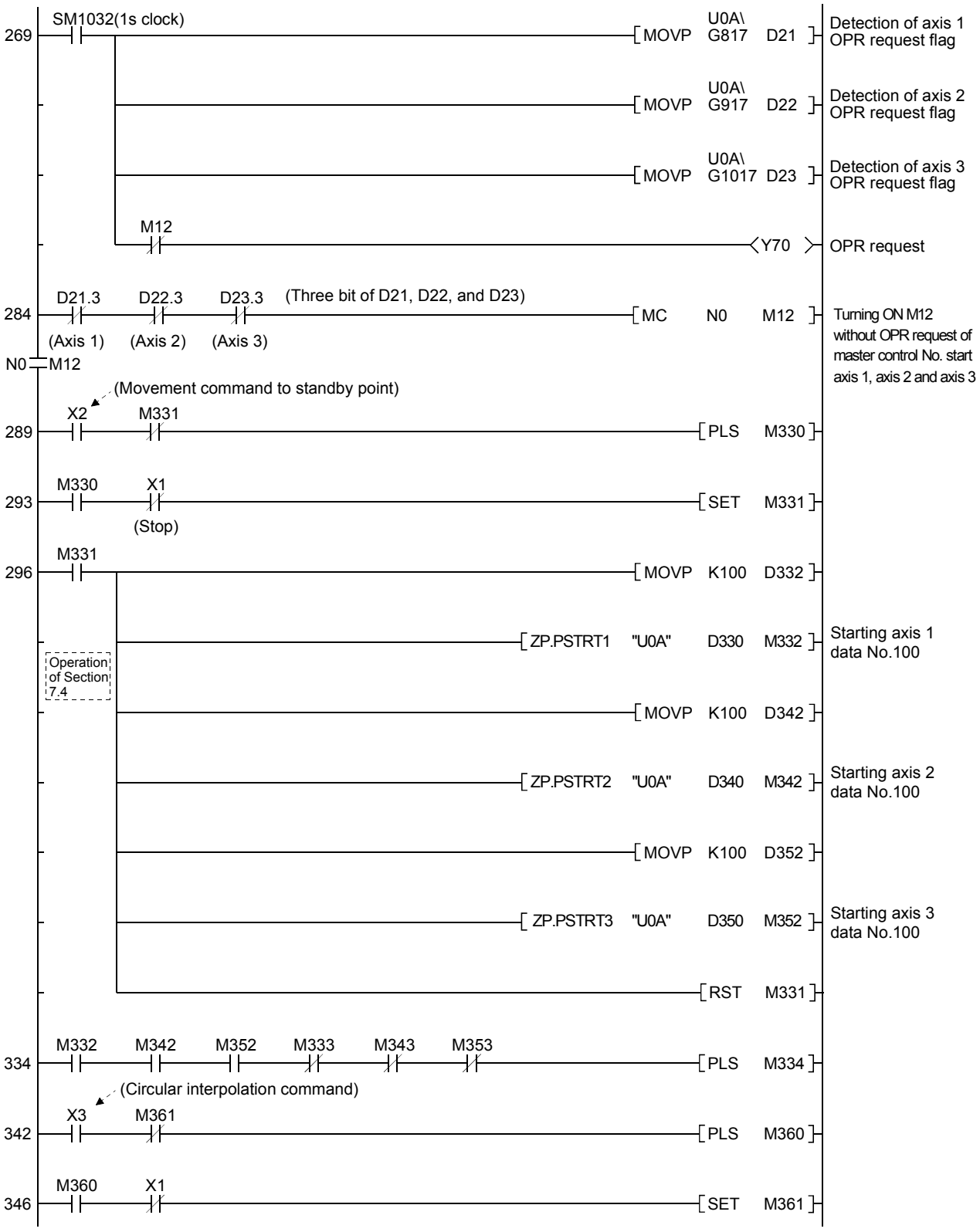
Project name	XYZ

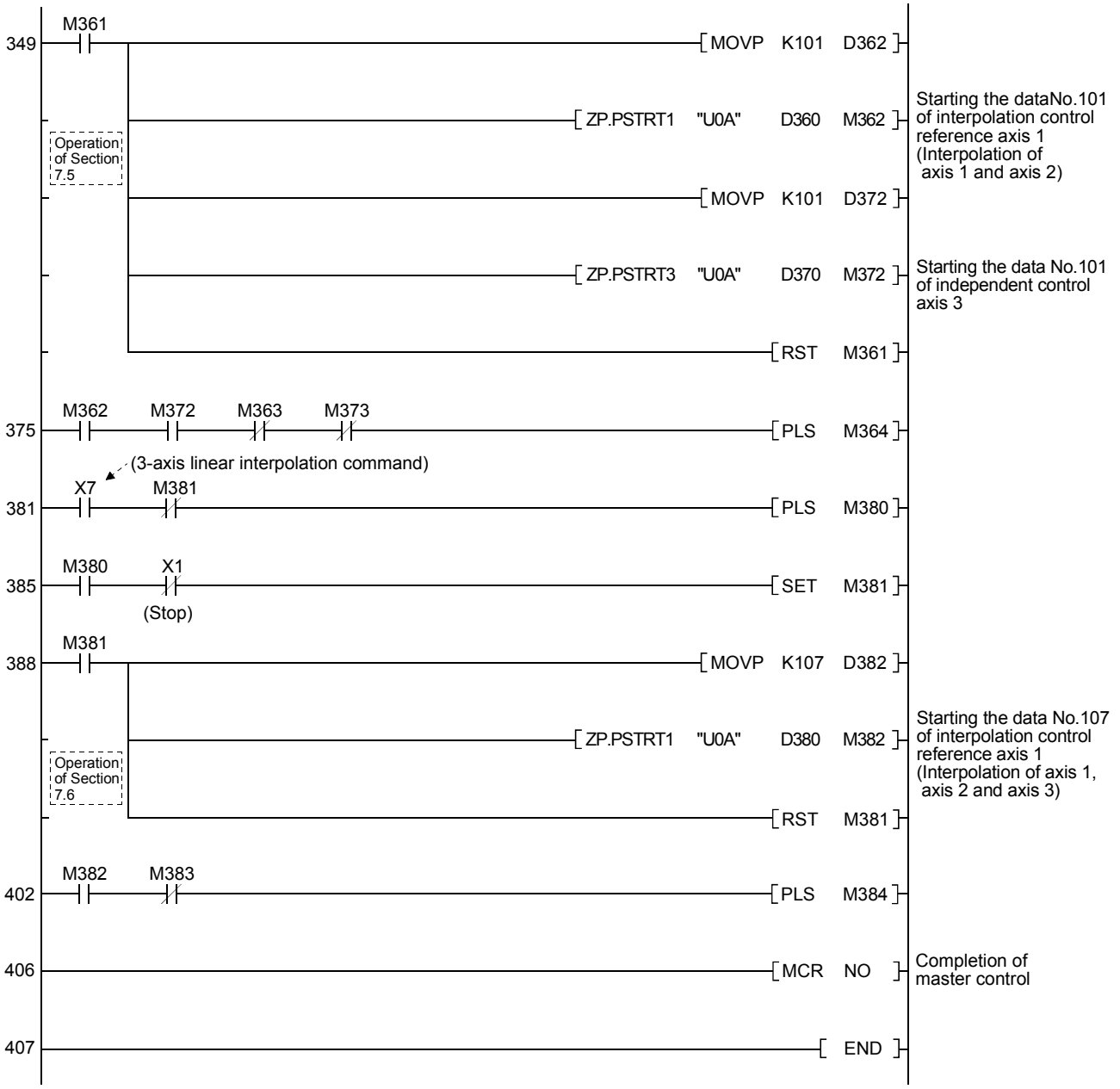



25
X0A0
(READY)
SM1030(0.1s clock)
D<= K0 D100
D/P D100 K10000 D50
Changing 0.1 μm→mm
BCD D50 K4Y40
Displaying the current value of axis 1
Storing the current value of axis 1 (Automatic refresh)
D<= K0 D110
D/P D110 K10000 D60
Changing 0.1 μm→mm
BCD D60 K4Y50
Displaying the current value of axis 2
Storing the current value of axis 2 (Automatic refresh)
D<= K0 D120
D/P D120 K10000 D70
Changing 0.1 μm→mm
BCD D70 K4Y60
Displaying the current value of axis 3
Storing the current value of axis 3 (Automatic refresh)
Forward run JOG command
69
X4
BIN K1X30 D40
Axis number setting (1 to 3)
= D40 K1
Y0A9
Axis 1 reverse run JOG
DMOVP K100000 U0A\ G1518
Axis 1 JOG speed 1000 mm/min
MOVP K0 U0A\ G1517
Axis 1 inching movement amount 0.0μm
Y0A8
Axis 1 forward run JOG
= D40 K2
Y0AB
Axis 2 reverse run JOG
DMOVP K100000 U0A\ G1618
Axis 2 JOG speed 1000 mm/min
MOVP K0 U0A\ G1617
Axis 2 inching movement amount 0.0μm
Y0AA
Axis 2 forward run JOG
= D40 K3
Y0AD
Axis 3 reverse run JOG
DMOVP K100000 U0A\ G1718
Axis 3 JOG speed 1000 mm/min
MOVP K0 U0A\ G1717
Axis 3 inching movement amount 0.0μm
Y0AC
Axis 3 forward run JOG
Y74
Lamp lighting


Reverse run JOG command
X5
120
BIN K1X30 D40
Axis number setting
(1 to 3)
= D40 K1
Y0A8
Axis 1 reverse run JOG
DMOVP K100000 U0A\G1518
Axis 1 JOG speed 1000 mm/min
MOVP K0 U0A\G1517
Axis 1 inching movement amount 0.0μm
Y0A9
Axis 1 reverse run JOG
= D40 K2
Y0AA
Axis2 reverse run JOG
DMOVP K100000 U0A\G1618
Axis 2 JOG speed 1000 mm/min
MOVP K0 U0A\G1617
Axis 2 inching movement amount 0.0μm
Y0AB
Axis 2 reverse run JOG
= D40 K3
Y0AC
Axis 3 reverse run JOG
DMOVP K100000 U0A\G1718
Axis 3 JOG speed 1000 mm/min
MOVP K0 U0A\G1717
Axis 3 inching movement amount 0.0μm
Y0AD
Axis 3 reverse run JOG
Y75
Lamp lighting
X1(Stop)
171
Y0A4
Axis 1 stop
Y0A5
Axis 2 stop
Y0A6
Axis 3 stop
Y71
Lamp lighting
Restart command
X9
176
X0AC (Axis 1 BUSY)
X0AD (Axis 2 BUSY)
X0AE (Axis 3 BUSY)
Y0B0 (Axis 1 start)
Y0B1 (Axis 2 start)
Y0B2 (Axis 3 start)
PLS M9
M9
MOVP K1 U0A\G1503
Axis1 restart
MOVP K1 U0A\G1703
Axis3 restart


(OPR command)
X0
M301
196
PLS M300
M300
X1
200
(Stop)
SET M301
M301
203
MOVP K9001 D302
ZP.PSTRT1 "U0A" D300 M302
Axis 1 OPR
M302
M303
216
RST M301
PLS M304
M304
M311
221
PLS M310
M310
X1
225
(Stop)
SET M311
M311
228
MOVP K9001 D312
ZP.PSTRT2 "U0A" D310 M312
Axis 2 OPR
M312
M313
241
RST M311
PLS M314
M314
M321
246
PLS M320
M320
X1
250
(Stop)
SET M321
M321
253
MOVP K9001 D322
ZP.PSTRT3 "U0A" D320 M322
Axis 3 OPR
M322
M323
266
RST M321

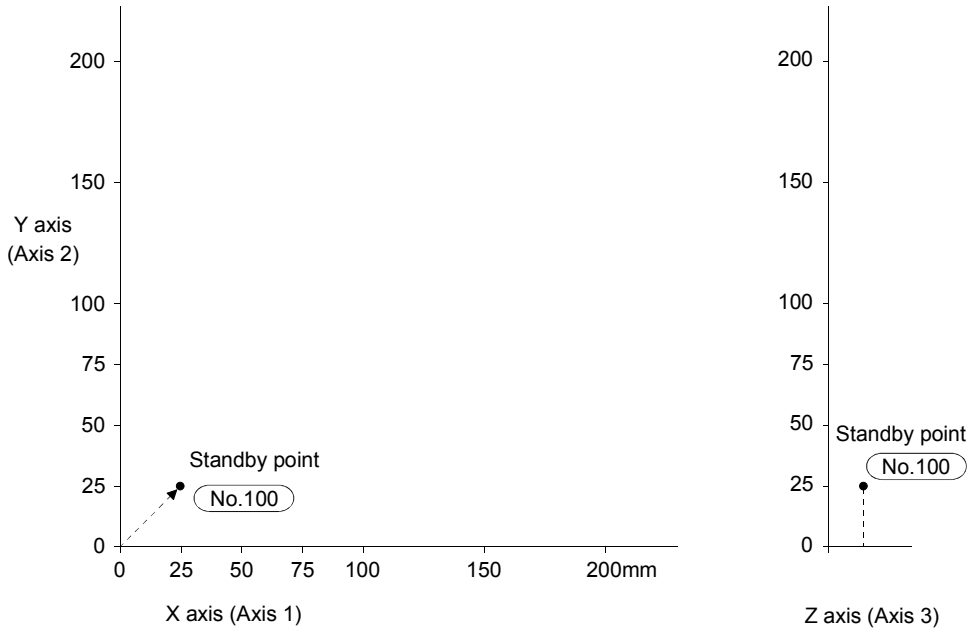

269
SM1032(1s clock)
MOVP U0A\G817 D21
Detection of axis 1 OPR request flag
MOVP U0A\G917 D22
Detection of axis 2 OPR request flag
MOVP U0A\G1017 D23
Detection of axis 3 OPR request flag
M12
Y70
OPR request
284
D21.3
D22.3
D23.3
(Three bit of D21, D22, and D23)
(Axis 1)
(Axis 2)
(Axis 3)
MC N0 M12
Turning ON M12 without OPR request of master control No. start axis 1, axis 2 and axis 3
N0
M12
(Movement command to standby point)
289
X2
M331
PLS M330
293
M330
X1
(Stop)
SET M331
296
M331
MOVP K100 D332
ZP.PSTRT1 "U0A" D330 M332
Starting axis 1 data No.100
Operation of Section 7.4
MOVP K100 D342
ZP.PSTRT2 "U0A" D340 M342
Starting axis 2 data No.100
MOVP K100 D352
ZP.PSTRT3 "U0A" D350 M352
Starting axis 3 data No.100
RST M331
334
M332
M342
M352
M333
M343
M353
PLS M334
(Circular interpolation command)
342
X3
M361
PLS M360
346
M360
X1
SET M361


349
M361
MOVP K101 D362
ZP.PSTRT1 "U0A" D360 M362
Starting the dataNo.101 of interpolation control reference axis 1 (Interpolation of axis 1 and axis 2)
Operation of Section 7.5
MOVP K101 D372
ZP.PSTRT3 "U0A" D370 M372
Starting the data No.101 of independent control axis 3
RST M361
375
M362 M372 M363 M373
PLS M364
(3-axis linear interpolation command)
381
X7 M381
PLS M380
385
M380 X1
SET M381
(Stop)
388
M381
MOVP K107 D382
ZP.PSTRT1 "U0A" D380 M382
Starting the data No.107 of interpolation control reference axis 1 (Interpolation of axis 1, axis 2 and axis 3)
Operation of Section 7.6
RST M381
402
M382 M383
PLS M384
406
MCR NO
Completion of master control
407
END

7.4 Independent Positioning to Standby Point by Each Axis

The axis 1, axis 2 and axis 3 are independently operated with the control system of ABS linear 1.

<Figure for operation explanation>



Edit → Positioning data Axis #1 (Independent axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
100	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	2000.00	0	0	

Edit → Positioning data Axis #2 (Independent axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
100	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	2000.00	0	0	

Edit → Positioning data Axis #3 (Independent axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
100	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	2000.00	0	0	

Demonstration machine operation

1) The QD75 setting data (parameter and positioning data) is

Project name	XYZ

Read from the text FD and write to the QD75D4.

2) The sequence program is

Project name	XYZ

Read from the text FD and write to the Q02HCPU.

3) When turning ON X0, OPR is started in the order of axis 1, axis 2 and axis 3.

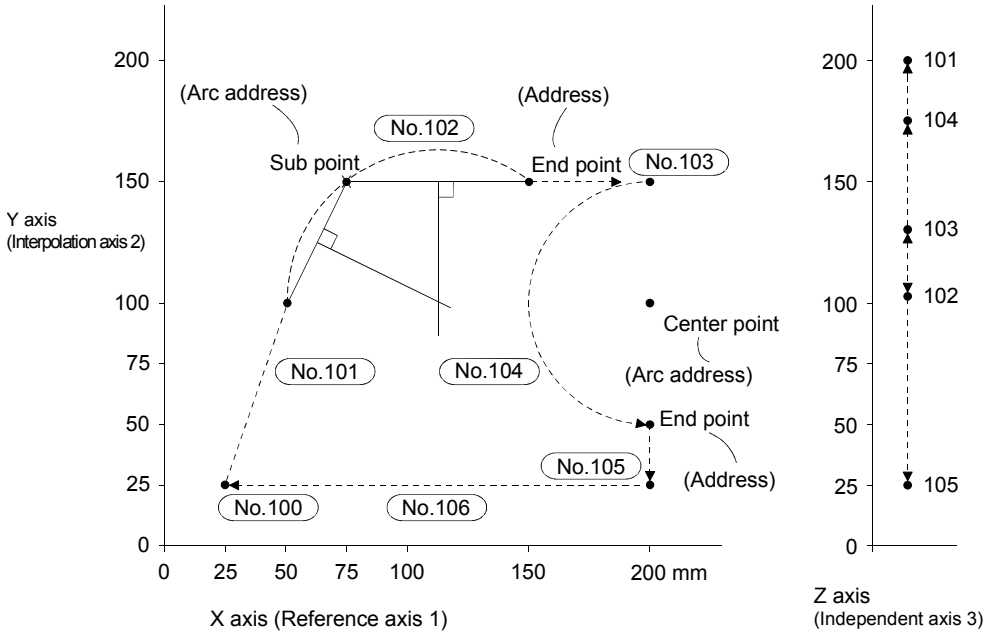
4) When turning ON X2, the axis 1, axis 2 and axis 3 carry out positioning together to the standby point of positioning data No.100 (25mm).
(The current value is 25000.0mm.)

Y6F to Y60				Y5F to Y50				Y4F to Y40			
0	0	2	5	0	0	2	5	0	0	2	5
(Current value (mm) of axis 3)				(Current value (mm) of axis 2)				(Current value (mm) of axis 1)			

7.5 Interpolation Operations (Axis 1/Axis 2) and Simultaneous Operation (Axis 3)

When carrying out 2-axis linear interpolation or 2-axis circular interpolation by axis 1 and axis 2, the axis 3 is independently operated.

<Figure for operation explanation>



REMARK

Axis	QD75P3 connector	XYZ table connector	Basic parameters (1) rotation direction
Axis 1	AX1	X	0: Forward run increment
Axis 2	AX2	Y	1: Reverse run increment
Axis 3	AX3	Z	1: Reverse run increment

The positioning data ranges from No.1 to 600. As default, however, only No.1 to 100 are displayed on the screen.
To display No.101 or higher numbers, specify a range with the following procedure.
[Tools] → [Options] → [Positioning data set] → set a specified range.

Edit → Positioning data Axis #1(Reference axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
101	1: Continuous	A: ABS linear 2	2-axis	0: 100	0: 100	50000.0	0.0	5000.00	700	0	
102	1: Continuous	D: ABS circular sub	2-axis	0: 100	0: 100	150000.0	0.0	3000.00	700	0	
103	1: Continuous	A: ABS linear 2	2-axis	0: 100	0: 100	200000.0	75000.0	9000.00	700	0	
104	2: Path	G: ABS circular left	2-axis	0: 100	0: 100	200000.0	0.0	4000.00	0	0	
105	2: Path	A: ABS linear 2	2-axis	0: 100	0: 100	200000.0	200000.0	2000.00	0	0	
106	0: Completed	A: ABS linear 2	2-axis	0: 100	0: 100	25000.0	0.0	10000.00	0	0	

Edit → Positioning data Axis #2(Interpolation axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
101						100000.0	0.0	0.00			
102						150000.0	0.0	0.00			
103						150000.0	150000.0	0.00			
104						50000.0	0.0	0.00			
105						25000.0	100000.0	0.00			
106						25000.0	0.0	0.00			

Edit → Positioning data Axis #3(Independent axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
101	1: Continuous	1: ABS linear 1	—	0: 100	0: 100	200000.0	0.0	5000.00	700	0	
102	1: Continuous	2: INC linear 1	—	0: 100	0: 100	-100000.0	0.0	7000.00	700	0	
103	1: Continuous	2: INC linear 1	—	0: 100	0: 100	30000.0	0.0	1500.00	700	0	
104	1: Continuous	2: INC linear 1	—	0: 100	0: 100	50000.0	0.0	2000.00	700	0	
105	0: Completed	1: ABS linear 1	—	0: 100	0: 100	25000.0	0.0	4000.00	700	0	
106											

Demonstration machine operation

1) When turning ON X3, the interpolation operation is carried out by axis 1 and axis 2, and the independent operation is carried out by axis 3.

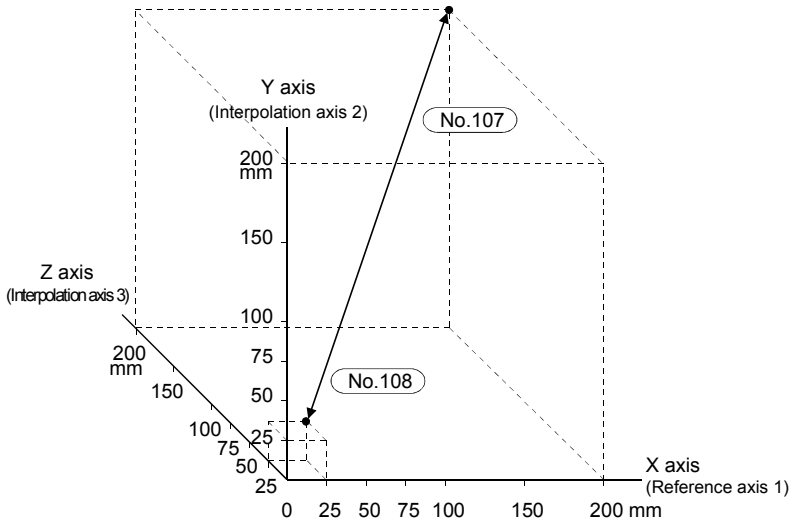
2) When turning ON X1 during the continuous operation, the operation is stopped. When turning ON X9, the continuous operation is carried out.

7.6 3-Axis Interpolation Operation

The 3-axis linear interpolation control by axis 1, axis 2 and axis 3 is operated.

<Figure for operation explanation>

The following shows the operation image. The actual demonstration machine is the same as that of Section 7.4.



Edit → Positioning data Axis #1 (Reference axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
107	1: Continuous	L: ABS linear 3	—	0: 100	0: 100	200000.0	0.0	3000.00	700	0	
108	0: Completed	L: ABS linear 3	—	0: 100	0: 100	25000.0	0.0	2000.00	700	0	
109											

Edit → Positioning data Axis #2 (Interpolation axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
107						200000.0	0.0	0.00			
108						25000.0	0.0	0.00			
109											

Edit → Positioning data Axis #3 (Interpolation axis)

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address [μm]	Arc address [μm]	Command speed [mm/min]	Dwell time [ms]	M code	Positioning data comment
107						200000.0	0.0	0.00			
108						25000.0	0.0	0.00			
109											

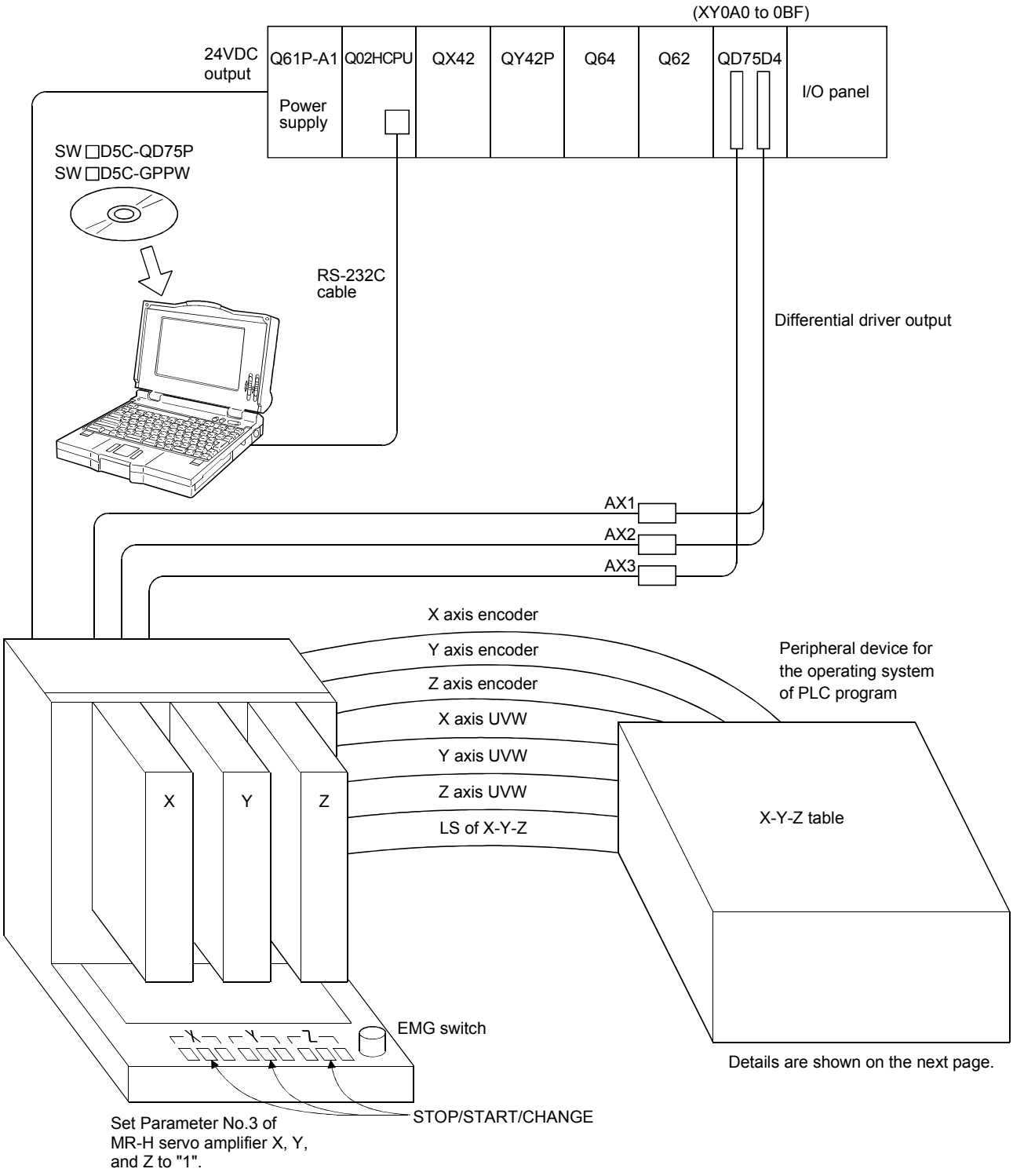
Demonstration machine operation

1) When turning ON X7, the linear interpolation operation is carried out by axis 1, axis 2 and axis 3.

APPENDICES

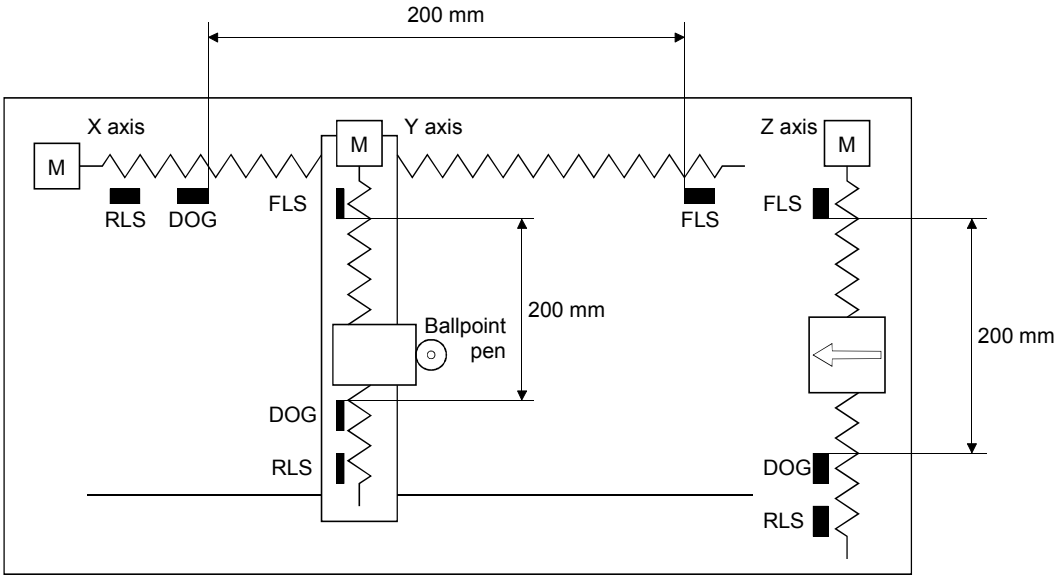
Appendix 1 X-Y-Z Control Demonstration Machine

Mount the QD75 on the slot of the demonstration machine and connect the MR-H10A amplifier and X-Y-Z table as shown below.



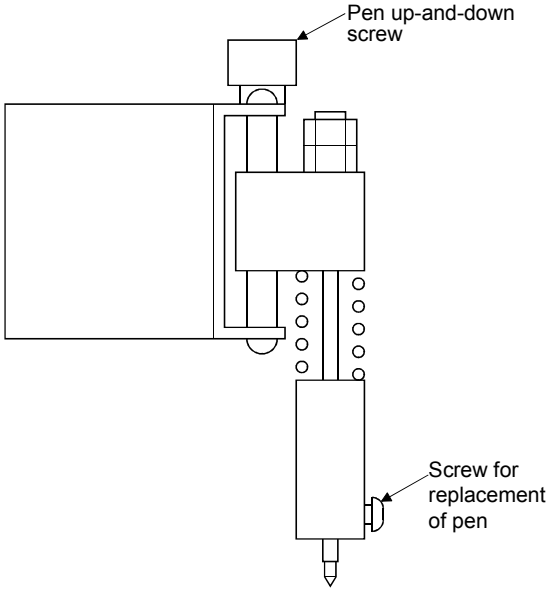
The XYZ table allows you to draw a plain view with a ballpoint pen using three servomotors (HA-FH-053Y) and a ball screw (Lead 8mm).

(1) Plain view of XYZ table



Ball screw lead: 8mm/rotation
Timing belt: 1/1 coupling
Weight: Approx. 23 kg
Accessory: EA-850C type manufactured by SHARP CORPORATION
Ballpoint pen (5 sets)

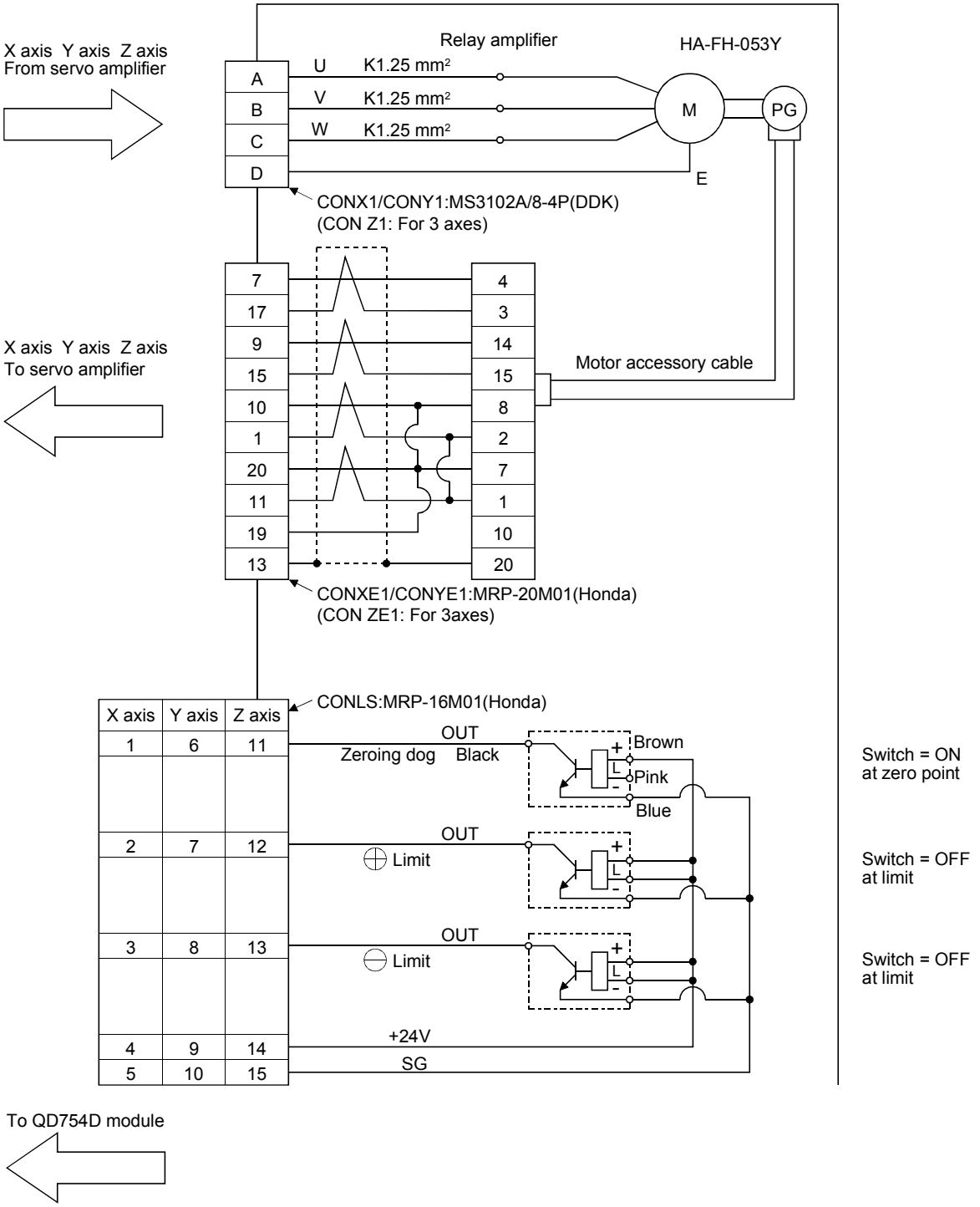
Replacement of ballpoint pen



• Before using the demonstration machine, be sure to move the ballpoint pen up and down.
If the ballpoint pen is constantly attached to a paper, its ink will leak and be wasted quickly.
Move the ball point pen down after checking the machine operation.

• When replacing the ballpoint pen, loosen the replacement screw on the edge of the head.
Be sure not to tighten up the screw too much after the replacement.

(2) Internal connection diagram of XYZ table



(3) Basic parameter of the MR-H10A servo amplifier (For details, refer to the instruction manual.)
(For the demonstration machine, set the parameter No.3 (ST0) to "1".)

Pr No. abbr.	Name	Setting value Setting range	Initial value Unit	Function description
0 MSR*	Motor series	3 0 to 3	3 —	0: HA-SH standard 2: HA-UH flat 1: HA-LH low-inertia 3:HA-FH
1 MIY*	Motor type	053 023 to 2202	053 —	Upper 2 digits : Motor rated output (Unit: 100W) Last 1 digit : Rated rotation speed (Unit: 1000rev/min.) 053 → 3000 rev/min, 50 W
2 STY*	Servo type	0000 Without regenerative brake option 0000 to 0D05h	0000 —	0 ① 0 ② 1) 0 to e according to the type of regenerative brake option 2) Servo loop 0: Position 1: Position-speed 2: Speed 3: Speed-torque 4: Torque 5: Torque-position
3 STO*	Function selection 1	0001 0000 to 2111h	0000 —	① ② ③ ④ 1) Absolute position detection 0: Invalid 1: Valid 2) External dynamic brake 0: Without 1: With 3) Pin 23 function of connector CN1 0: Zero speed detection ZSP 1: Electromagnetic brake interlock 4) Pulse train input system 0: Open collector 1: Differential receiver
4 CMX	Command pulse multiplying factor (numerator)	1 1 to 50000	1 —	Command pulse input f1 → CMX/CDV → Position command pulse f2 $f2=f1\times\frac{CMX}{CDV}$ $\frac{1}{50}\leq\frac{CMX}{CDV}\leq 50$ (Refer to the next page)
5 CDV	Command pulse multiplying factor (denominator)	1 1 to 50000	1 —	
6 INP	In-position range	100 0 to 50000	100 PLS	Sets a droop pulse value to output the positioning complete signal.
7 PG1	Position control gain 1	70 4 to 1000	70 rad/sec	Position loop gain. Sets this gain to improve trace ability within the range where overshooting does not have a too high value.
8 PST	Smoothing	3 0 to 50000	3 msec	Sets time constant when setting the primary delay filter to the position command.
9 10 11 12 13 14 15		Not used for positioning		SC1 Internal speed command 1 speed (Speed torque) SC2 Internal speed command 2 speeds (Speed torque) SC3 Internal speed command 3 speeds (Speed torque) STA Acceleration time constant (Speed) STB Deceleration time constant (Speed) STC S-curve acceleration/deceleration time constant TQC Torque command time constant (Torque)
16 TLT	Torque limit time constant	0 0 to 50000	0 msec	Sets time constant when setting the primary delay filter to the torque limit command
17 MOD	Monitor output mode selection	0001 (Speed, droop pulse) 0000 to 0909h	0001 —	0 0 Monitor 2 output Monitor 1 output Output details are shown right. 0: Motor speed (±8V/max.speed) 1: Torque (±8V/max.torque) 2: Motor speed (±8V/max. speed) 3: Torque (±8V/max.torque) 4: Current command output 5: Command pulse frequency (±8V/400KPPS) 6: Droop pulse 1/1 (±11.6V/2048PLS) 7: Droop pulse 1/4 (±11.6V/512PLS) 8: Droop pulse 1/16 (±11.6V/128PLS) 9: Droop pulse 1/32 (±11.6V/64PLS)

Pr No. abbr.	Name	Setting value	Initial value	Function description
		Setting range	Unit	
18 DMD*	Display mode selection Main body display is valid when the rotary switch CS1 is 0	0000	0000	① ② ③ ④ 1) Display-switching of the MR-PRU at power-on 0: The following table 1: Depends on 4) 2) Status display of the MR-PRU at power-on Set 0 to F like 4) 3) Main body display automatic switching (CS1=0) 0: The following table 1: Depends on 4) <Table> Position control mode : Cumulative feedback pulses Speed control mode : Motor speed Torque control mode : Peak load ratio Main body display (CS1=0) 0 : Cumulative feedback pulses 1 : Motor speed 2 : Command speed 3 : Droop pulses 4 : Cumulative command pulses 5 : Command pulse frequency 6 : Speed command voltage 7 : Reverse run torque limit command voltage 8 : Forward run torque limit command voltage 9 : Regenerative load ratio A : Effective load ratio B : Peak load ratio C : Within one-revolution position D : ABS counter E : Machine speed F : Bus voltage
		0000 to 1F1Fh	—	
19 DMD*	Display mode selection	000E*1	0000	Reference parameter / Write parameter 0000: Basic / Basic 000A: PARA-No.19 / PARA-No.19 000C: Basic + Expansion / Basic 000E: Basic + Expansion / Basic + Expansion
		0000 to FFFFh	—	

*: Valid when switching power OFF to ON after the parameter settings

*1: When setting the expansion parameters on the next page, set to "0000E"

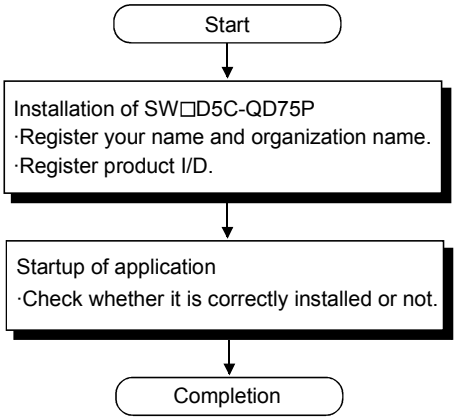
(4) Expansion parameter of the MR-H10A servo amplifier (For details, refer to the instruction manual.)
(The expansion parameters of the demonstration machine are the initial values.)

<table>
<tr><th>Pr No.
abbr.</th><th>Name</th><th>Setting value
Setting range</th><th>Initial value
Unit</th><th>Function description</th></tr>
<tr><td>20
OP1*</td><td>Function selection 2</td><td>0001
0000 to 1C12h</td><td>0001
—</td><td>First digit: Auto tuning selection 0.1.2
Second digit : Restart after instantaneous power failure Valid/Invalid
Third digit : Auto tuning response 0 to C
Fourth digit : Speed control servo lock Invalid/Valid</td></tr>
<tr><td>21
OP2*</td><td>Function selection 3</td><td>0000
0000 to 2124h</td><td>0000
—</td><td>First digit: Low acoustic noise selection 0.3
Second digit: Command pulse input form
(0: CW/CCW 1: Signed 2: A phase/B phase)
Third digit: Command pulse input logic
(0: Positive logic 2: Negative logic Fourth digit: 0)</td></tr>
<tr><td>22
OP3*</td><td>Function selection 4</td><td>0000
000 to 0010</td><td>0000
—</td><td>Specifies sudden stop (0) or slow stop (1) (by PARA No.8) when the limit switch (stroke end) operates in second digit.</td></tr>
<tr><td>23
FFC</td><td>Feed forward gain</td><td>0
0 to 100</td><td>0
%</td><td>Droop pulse is 0 at constant speed operation when set to 100%.
Used when the auto tuning is invalid.</td></tr>
<tr><td>24
CM1</td><td>Command pulse multiplying factor numerator 2</td><td>1
1 to 50000</td><td>1
—</td><td rowspan="3">Sets to $\frac{1}{50}$ or more, 50 or less when electronic gear switching function is valid in PARA No.41.
<table><tr><th>DI1</th><th>DI2</th><th>Electronic gear numerator</th></tr><tr><td>ON</td><td>OFF</td><td>CM1</td></tr><tr><td>OFF</td><td>ON</td><td>CM2</td></tr><tr><td>ON</td><td>ON</td><td>CM3</td></tr><tr><td>OFF</td><td>OFF</td><td>PARA-No.4</td></tr></table></td></tr>
<tr><td>25
CM2</td><td>Command pulse multiplying factor numerator 3</td><td>1
1 to 50000</td><td>1
—</td></tr>
<tr><td>26
CM3</td><td>Command pulse multiplying factor numerator 4</td><td>1
1 to 50000</td><td>1
—</td></tr>
<tr><td>27
ERZ</td><td>Excessive error alarm level</td><td>80
1 to 1000</td><td>80
KPLS</td><td>For alarm output of excessive droop pulse</td></tr>
<tr><td>28
29
30
31
32
33</td><td></td><td>Not used for positioning</td><td></td><td>STD Second acceleration time constant
STE Second deceleration time constant
SC4 Internal command speed 4
SC5 Internal command speed 5
SC6 Internal command speed 6
SC7 Internal command speed 7</td></tr>
<tr><td>34
ZSP</td><td>Zero speed</td><td>50
0000 to 10000</td><td>50
rpm</td><td>Operating range of zero speed output</td></tr>
<tr><td>35
36
37
38</td><td></td><td>Not used for positioning
Spare</td><td></td><td>VCM Rotation speed at 10V command
VCA* VC speed command average
TLC Torque control command full-scale value</td></tr>
<tr><td>39
ENR*</td><td>Encoder output of servo amplifier</td><td>1
1 to 32768</td><td>1
—</td><td>The following selection can be made with second digit of PARA No.43.
1) Output division ratio setting
$\text{Servo amplifier output} = \frac{\text{Cumulative feedback pulse per motor rotation}}{4\times \text{ENR setting value}}$ (P/R)
2) Output pulse setting
Servo amplifier output = ENR setting value/4 (P/R)</td></tr>
<tr><td>40
TLL</td><td>Torque limit value (Internal)</td><td>100
0 to 100</td><td>100
%</td><td>Max. torque is 100%. When external torque limit is valid, limits nearer one. Monitor output 8V at this setting level.</td></tr>
<tr><td>41
IP1*</td><td>Input signal selection 1</td><td>0000
0000 to 1111h</td><td>0000
—</td><td><table><tr><td>①</td><td>②</td><td>③</td><td>④</td></tr></table>
1) Second acceleration/deceleration selection
(Select with CR=ON)
0: Invalid
1: Valid (PARA No. 28, 29)
2) Clear signal (CR)
0: Leading
1: Shortened
3) Internal speed 7 (D10 D11 D12)
0: Invalid
1: PARA No. 30 to 33 Valid
4) Electronic gear 4-stage switching
0: Invalid
1: PARA No.24, 25 Valid</td></tr>
</table>

Pr No. abbr.	Name	Setting value / Setting range	Initial value / Unit	Function description
42 IP2*	Input signal selection 2	0000 / 0000 to 1111h	0000 / —	① ② ③ ④ 1) LSN input selection 2) LSP input selection 3) SON input selection 4) External torque limit signal 0: OFF—Internal limit ON—External limit 1: OFF—Max. torque ON—Internal limit
43 OP4*	Function selection 5	0000 / 0000 to 0012h	0000 / —	First digit: 0: m/min 1: m/sec 2: deg/min Multiplying factor is according to PARA No.45 Second digit: Encoder output selection of the servo amplifier (PARA No. 39) 0: Division ratio setting 1: Output pulse setting
44 OPC*	Output signal selection	0000 / 0000 to 0011h	0000 / —	First digit: Alarm code output Valid/Invalid Second digit: Pre-alarm output Valid/Invalid
45 MVC*	Machine speed conversion constant	10000 / 0 to 50000	10000 / —	Sets the conversion constant of rotation speed/machine speed.
46 MOA*	Data selection before alarm	0001 / 0000 to 0499h	0001 / —	0 ① ② ③ 1) Sampling time (msec) 0: 1.77 3: 14.2 2: 7.11 2) Data selection 1 3) Data selection 2 Every selection is according to on items 0 to 9 of PARA Nol.17.
47 VCO		Not used for positioning		VC offset
48 TPO	TLAP offset	0 / -9.999 to 9.999	0 / mV	Offset for the limit analog command of a reverse run side torque
49 TNO	TLNP offset	0 / -9.999 to 9.999	0 / mV	Offset for the limit analog command of a forward run side torque
50 MO1	MO1 offset	0 / -9.999 to 9.999	0 / mV	Offset for monitor output 1
51 MO2	MO2 offset	0 / -9.999 to 9.999	0 / mV	Offset for monitor output 2
53 MBR	Electromagnetic brake sequence output	100 / 0 to 1000	100 / msec	Sets the time delay from the electromagnetic brake operation to the base circuit shut-off.
52 54 55 56 57				Spare
58 DG2	Load inertia ratio	1.0 / 0.0 to 100.0	1.0 / 0.1	Automatically set if the auto tuning is set for the load inertia moment ratio to the servomotor
59 NCH	Machine resonance suppression filter	0 / 0 to 7	0 / —	0: Without filter Sets 1 to 7 according to the resonance frequencies 1125 to 281
60 PG2	Position control gain 2	25 / 1 to 500	25 / rad/sec	Used when increasing the response for load disturbance Setting larger values generates vibration noise.
61 62 63 64		Not used for positioning		VG1 Speed control gain 1 VG2 Speed control gain 2 VIC Speed integral compensation VDC Speed differential compensation

Appendix 2 Installing SW□D5C-QD75P

This section explains how to install and uninstall the SQ□D5C-QD75P.



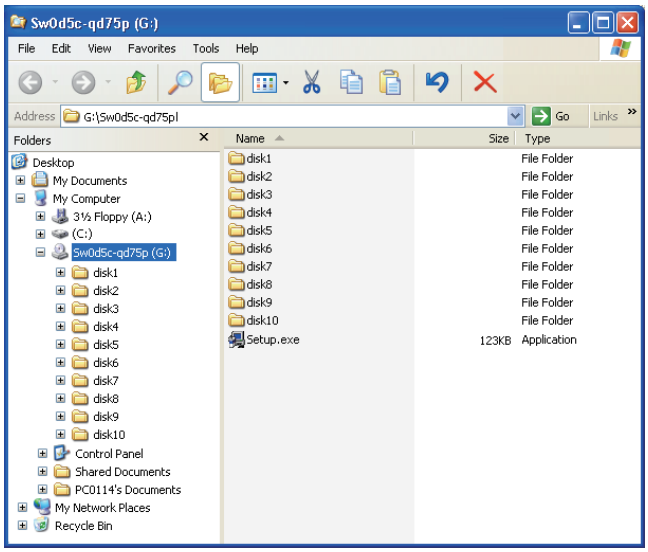
(1) Refer to the details on QD75P install operation

Refer to Section 5.2 Startup of QD75P

(1) Installing SW□D5C-QD75P

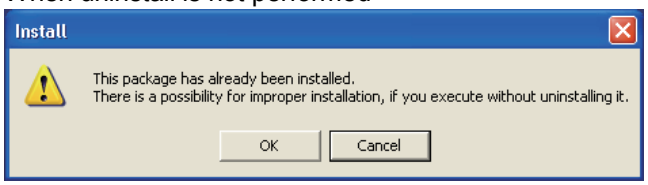
This section explains how to install SW□D5C-QD75P.

POINT
• Before installation, close all other applications running on Windows. • When using Windows NT Workstation 4.0, log on as a user with administrative privileges (for computer management).

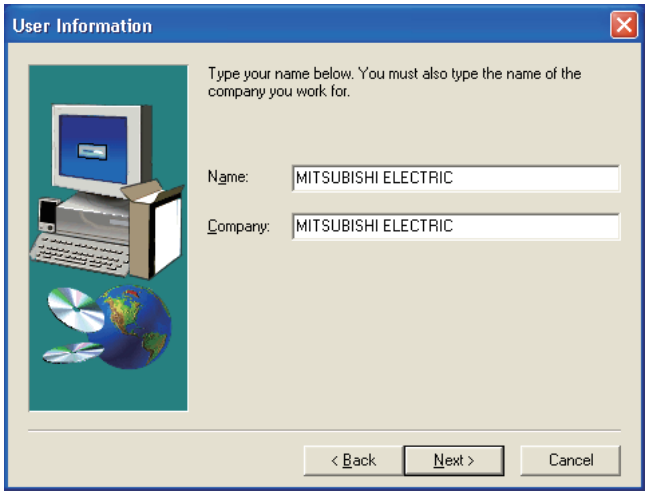


1) Start the explorer and click the drive where a disk is inserted.
Double-click "Setup.exe".
To display the explorer, select "Start" → "Program" → "Explorer".

When uninstall is not performed



When the message on the left appears, click the "Cancel" button to uninstall the software, and then install it again.

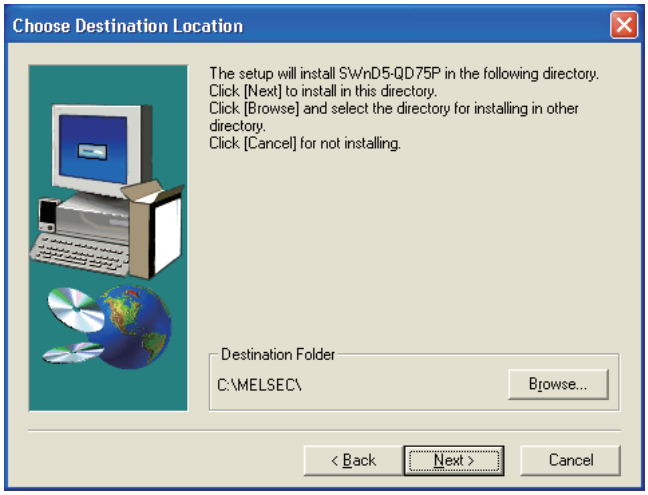


2) Input your name and any organization name, and click the "Next" button.
The confirmation dialog box is displayed. Perform the operation according to the message.

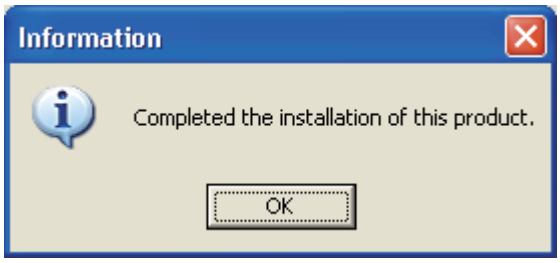
(To the next page)

(From the previous page)

3) Enter the product ID of the software and click the "Next" button.
The product ID is indicated on the "software registration certificate".



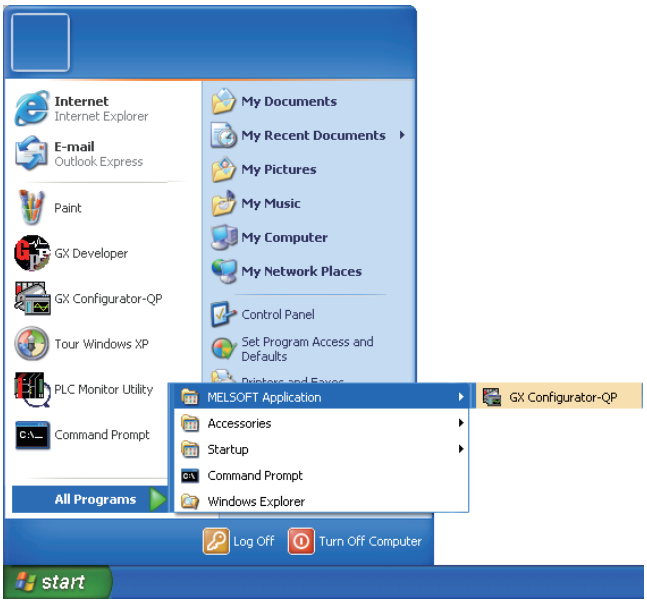
4) Specify the installation destination folder.
Specify the installation destination folder and click the "Next" button.
Default is "C:\MELSEC".
When changing the installation destination, click the "Browse…" button and specify a new destination drive and folder.



5) The installation is completed.

POINT
• When the installation is failed in the middle of process, uninstall the software, and then reinstall it again.

The following icon appears after the installation of SW□D5C-QD75P.



Appendix 3 QD75 Maintenance Instructions

The following describes the replacement procedures of the QD75 module.
The explanations are on the premise that SW□D5C-QD75P is installed in a peripheral device (personal computer).

1) Read the positioning data, parameters and block start data from the QD75 buffer memory to a peripheral device (personal computer).

2) Turn the PLC power off and remove the connector connected to the QD75 module.

3) Remove the QD75 from the base unit.

4) Mount a new QD75 module on the base unit.

5) Set the connector to be connected to the QD75 module.

6) Turn the power on, and check the QD75 status and the connecting status with external devices using the QD75P connection confirmation function of a peripheral device (personal computer).

7) Write each data from a peripheral device (personal computer) to the QD75D module.

8) Activate the PLC CPU and confirm that it operates properly.

Appendix 4 Intelligent Function Module Direct Device

In this document, writing and reading of data are performed using the intelligent function module direct device in order to simplify the sequence program and reduce steps

(1) Intelligence function module direct device

This device directly accesses the buffer memory of the intelligent function module/special function module from the QCPU.

Designation method : U□\G□

- □ → Buffer memory address (0 to 16383 with a decimal)
- □ → High-order two digits when expressing the I/O number of intelligent function module/special function module in 3 digits

In case of X/Y0A0····X/Y0A0 → Designation: 0A

(2) Program examples

The following shows the two program examples, one of which uses the intelligent function module device and the other of which uses the TO instructions, when writing "9001" to the buffer memory (address: 1500) for one axis positioning start No. of the QD75D4 positioning module (X/X0A0).

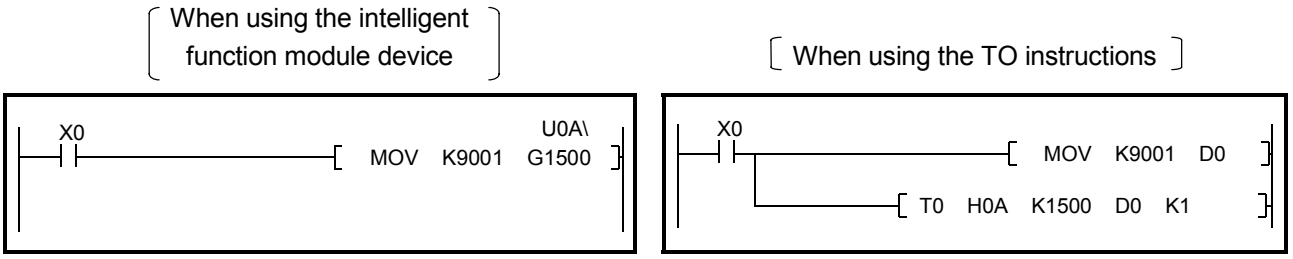


Figure App.4.1 Examples of data write to the buffer memory

(3) Processing speed

The following describes the processing speed by the intelligence function module direct device.

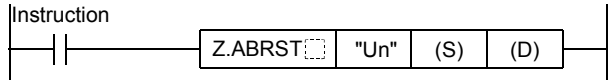
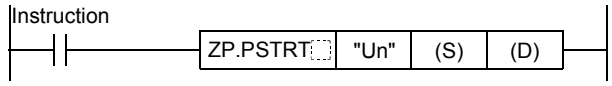
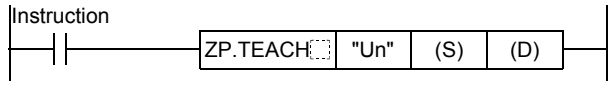
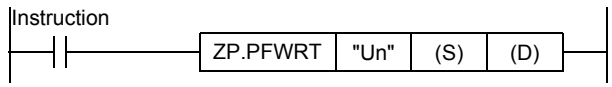
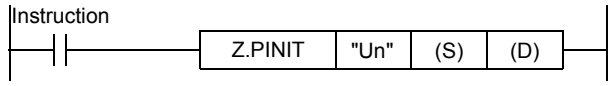
(a) When reading and writing, the processing speed is equivalent to the "processing speed of the FROM/TO instructions. (For example, in the case of "DMOV U0A\G800 D0".)

(b) When performing read operation and other operations together by one instruction, the processing speed is the total speed of the "processing speed by FROM/TO instructions" and the "instruction processing speed". (For example, in the case of "D/U0A\G800 K10000 D10".)

Appendix 5 QD75 Dedicated Instructions

The following describes the QD75 dedicated instruction types, the form of each instruction and how to use them.

(1) List of QD75 dedicated instructions

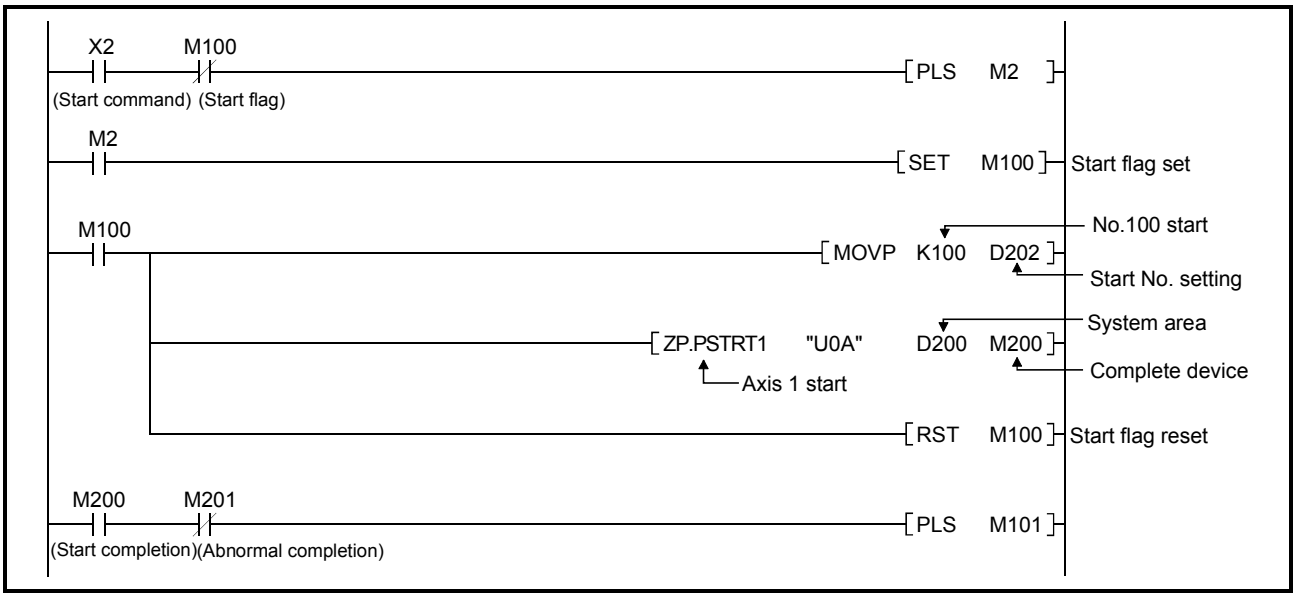
Application		Instruction symbol		Outline of functions
Absolute position restoration	Axis 1	ABRST1		Restores the absolute position of the designated axis of the QD75. (Refer to Section 14.3 of the manual.)
	Axis 2	ABRST2		
	Axis 3	ABRST3		
	Axis 4	ABRST4		
Positioning start	Axis 1	PSTRT1		Starts the positioning control of the designated axis of the QD75. (Refer to Appendix 5.1 of the text.)
	Axis 2	PSTRT2		
	Axis 3	PSTRT3		
	Axis 4	PSTRT4		
Teaching	Axis 1	TEACH1		Carries out teaching of the designated axis of the QD75. (Refer to Appendix 5.2 of the text.)
	Axis 2	TEACH2		
	Axis 3	TEACH3		
	Axis 4	TEACH4		
Writing to flash ROM		PFWRT		Writes the buffer memory parameters, positioning data and block start data to the flash ROM. (Refer to Appendix 5.3 of the text.)
Parameter initialization		PINIT		Initializes the parameters of the buffer memory and flash ROM to the factory-set data (initial values). (Refer to Section 14.7 of the manual.)

Setting data	Setting details	Data type
"Un"	A QD75 head I/O number (00 to FE: Highest two digits in the case of an I/O number expressed in three digits)	BIN 16 bits
(S)	A head number of a word device in which control data is stored	Word
(D)	A head number of a bit device that turns ON for one scan time at completion of the instruction. If the instruction is completed abnormally, ((D) + 1) will also be turned ON for one scan time.	Bit

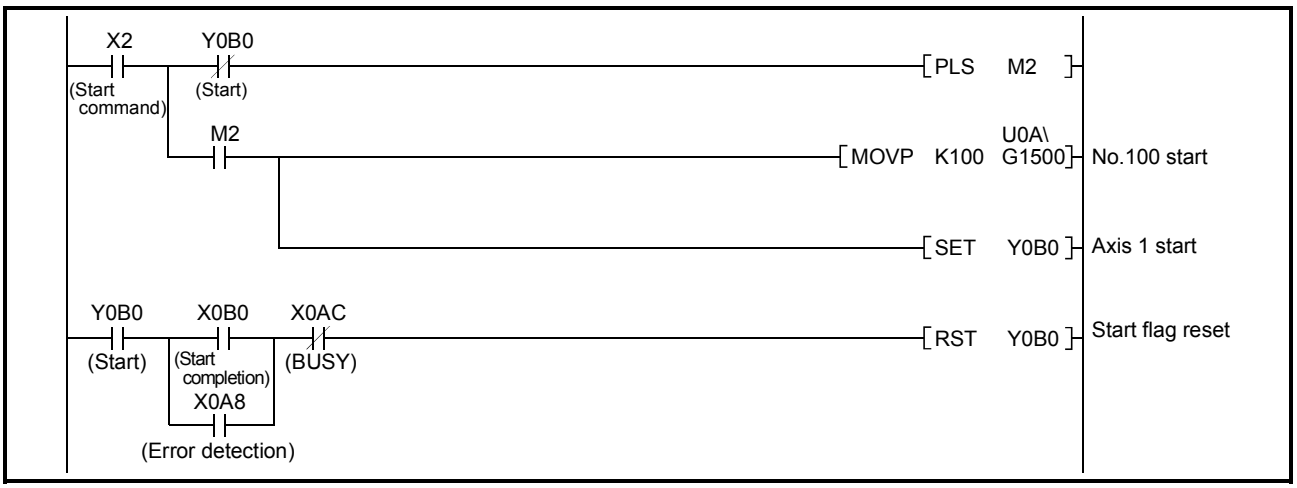
(2) Sequence program of dedicated instructions

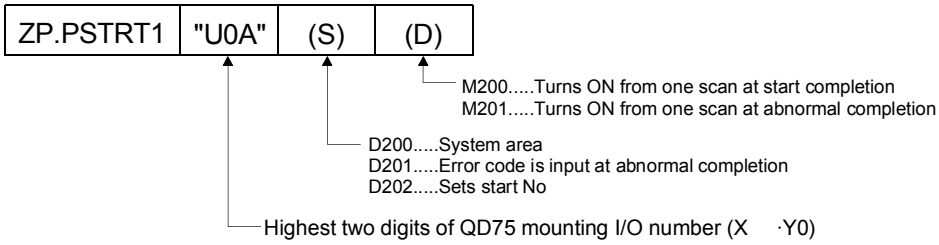
The following shows two examples of the sequence program that starts the axis 1 positioning data No. 100 when X2 is turned on. One of the examples uses the dedicated instruction PSTRT and the other uses the direct device.

[When dedicated instruction PSTRT1 is used]



[When dedicated instruction is not used]

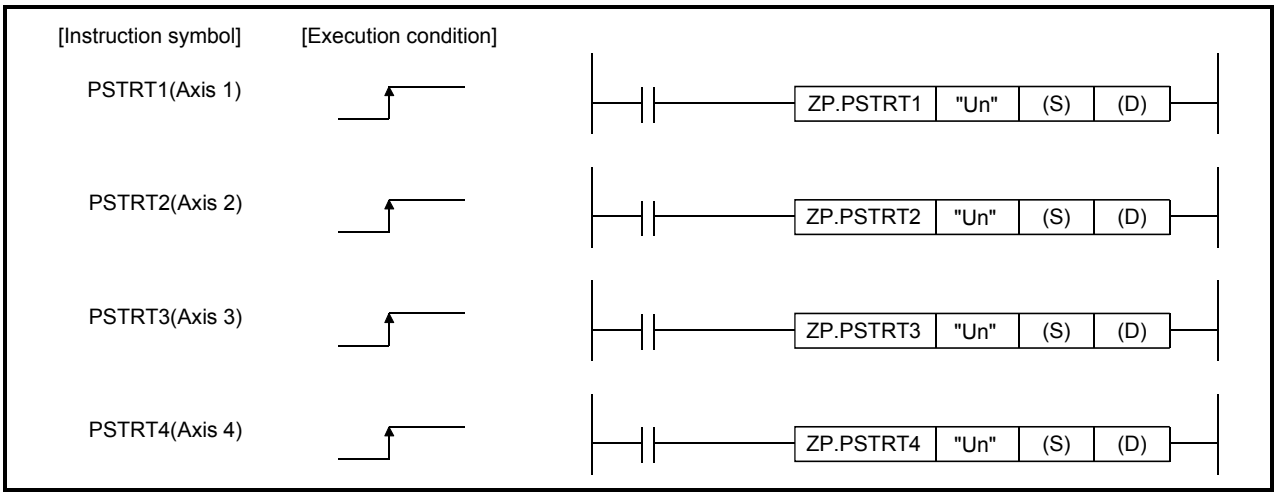




Appendix 5.1 PSTRT1, PSTRT2, PSTRT3, PSTRT4

These dedicated instructions are used to start the positioning of the designated axis.

Setting data	Usable device								
	Internal device		File register	MELSECNET/10 direct J□\□		Special module U□\G□	Index register Zn	constant	Others
	Bit	Word		Bit	Word			K,H,$	
(S)	—	○		—				—	—
(D)	○	○	—	—				—	—



When PSTRT1, PSTRT2, PSTRT3 and PSTRT4 are the same, they are designated as "PSTRT□".

Setting data

Setting data	Setting details	Setting side (*1)	Data type
"Un"	A QD75 head I/O number (00 to FE: Highest two digits in the case of an I/O number expressed in three digits)	User	BIN 16 bits
(S)	A head number of a word device in which control data is stored	—	Word
(D)	A head number of a bit device that turns ON for one scan time at completion of the instruction. If the instruction is completed abnormally, ((D) + 1) will also be turned ON.	System	Bit

Control data

Device	Item	Setting data	Setting range	Setting side (*1)
(S)+0	System area	—	—	—
(S)+1	Complete status	The state at the time of completion is stored. • 0 : Normal completion • Other than 0 : Abnormal completion (error code)	—	System
(S)+2	Start No.	The following data Nos. to be started by the PSTRT☐ instruction are designated. • Positioning data No. : 1 to 600 • Block start : 7000 to 7004 • Machine OPR : 9001 • Fast OPR : 9002 • Current value changing : 9003 • Multiple axes simultaneous start : 9004	1 to 600 7000 to 7004 9000 to 9004	User

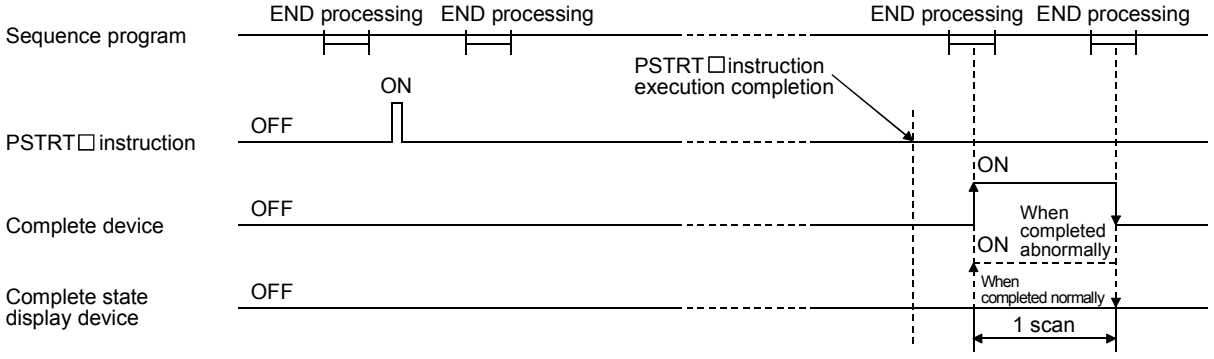
*1: The data on the setting side is as follows.
• User : Data before the execution of dedicated instructions is stored by users.
• System : Data after the execution of dedicated instruction is stored by PLC CPU.

Functions

(1) The positioning start of the axes to be processed (See below) is carried out.
• PSTRT1: Axis 1
• PSTRT2: Axis 2
• PSTRT3: Axis 3
• PSTRT4: Axis 4

(2) The block start, OPR start, current value changing, and multiple axes simultaneous start can be carried out by setting "start number" to 7000 to 7004/9001 to 9004 in ((S)+2).

(3) The PSTRT☐ instruction completion can be confirmed using the complete devices ((D)+0) and ((D)+1).
(a) Complete device ((D)+0)
This device is turned ON by the END processing of the scan in which PSTRT☐ instruction was completed, and turned OFF by the next END processing.
(b) Complete state display device ((D)+1)
This device is turned ON or OFF according to how the PSTRT☐ instruction is completed.
• When completed normally : Kept unchanged at OFF.
• When completed abnormally : This device is turned ON by the END processing of the scan in which the PSTRT instruction was completed, and turned OFF by the next END processing. (Same ON/OFF operation as the complete device).



Errors

(1) When the PSTRT☐ instruction is completed abnormally, the error complete signal ((D)+1) is turned ON, and the error code is stored in the complete status ((S)+1).

Precautions

(1) When positioning is started by the PSTRT☐ instruction, the positioning start signals (Y10 to Y13) will not turn ON.
To confirm that positioning control is being executed, use the PSTRT☐ start command or the positioning start complete signals (X10 to X13).

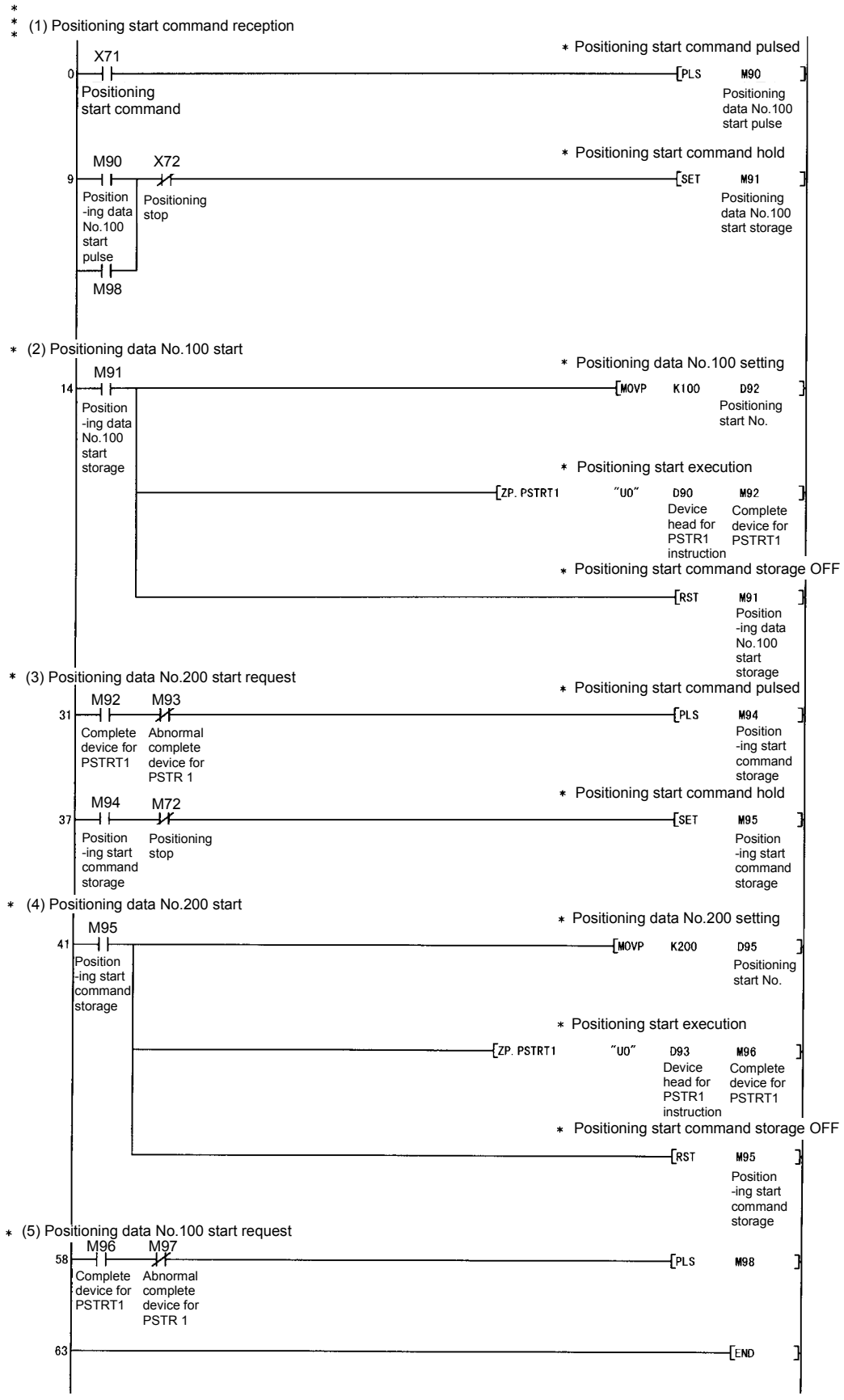
(2) The following dedicated instructions cannot be executed simultaneously for the same axis.
(They can be executed simultaneously for different axes.)
• Positioning start instructions (PSTRT1 to PSTRT4)
• Absolute position restoration instructions (ABRST1 to ABRST4)
• Teaching instructions (TEACH1 to TEACH4)

(3) The PSTRT☐ instruction can be executed when the QD75 READY signal (X0) is turned ON.
When the QD75 READY signal is turned OFF, the PSTRT☐ instruction will not be executed even if the PSTRT☐ instruction execution request is given. (Not processed.)
Before executing the PSTRT☐ instruction, turn ON the PLC READY signal (Y0), and turn ON the QD75 READY signal (X0).

Program examples

The following program executes the positioning of positioning data No.100 and No.200 repeatedly when X71 turns ON.
The positioning is completed when X72 turns ON.
Use D90 to D92 as the control data devices, and M92 and M93 as the complete devices of the positioning data No. 100.

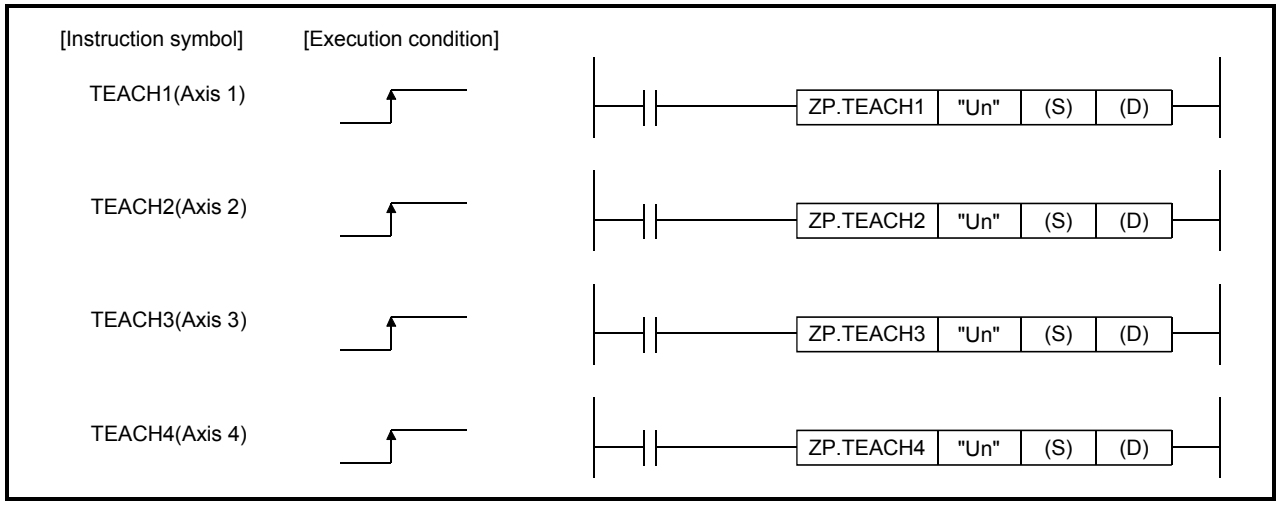
Use D93 to D95 as the control data devices, and M95 and M96 as the complete devices of the positioning data No. 200.


(1) Positioning start command reception
* Positioning start command pulsed
X71
0
Positioning start command
PLS M90
Positioning data No.100 start pulse
* Positioning start command hold
M90 X72
9
Position -ing data No.100 start pulse
Positioning stop
SET M91
Positioning data No.100 start storage
M98
(2) Positioning data No.100 start
* Positioning data No.100 setting
M91
14
Position -ing data No.100 start storage
MOVP K100 D92
Positioning start No.
* Positioning start execution
ZP. PSTRT1 "U0" D90 M92
Device head for PSTR1 instruction
Complete device for PSTRT1
* Positioning start command storage OFF
RST M91
Position -ing data No.100 start storage
(3) Positioning data No.200 start request
* Positioning start command pulsed
M92 M93
31
Complete device for PSTRT1
Abnormal complete device for PSTR 1
PLS M94
Position -ing start command storage
* Positioning start command hold
M94 M72
37
Position -ing start command storage
Positioning stop
SET M95
Position -ing start command storage
(4) Positioning data No.200 start
* Positioning data No.200 setting
M95
41
Position -ing start command storage
MOVP K200 D95
Positioning start No.
* Positioning start execution
ZP. PSTRT1 "U0" D93 M96
Device head for PSTR1 instruction
Complete device for PSTRT1
* Positioning start command storage OFF
RST M95
Position -ing start command storage
(5) Positioning data No.100 start request
M96 M97
58
Complete device for PSTRT1
Abnormal complete device for PSTR 1
PLS M98
63
END

Appendix 5.2 TEACH1, TEACH2, TEACH3, TEACH4

These dedicated instructions are used to teach the designated axis.

Setting data	Usable device							
	Internal device		File register	MELSECNET/10 direct J□\□		Special module U□\G□	Index register Zn	Constant	Others
	Bit	Word		Bit	Word			K,H,$	
(S)	—	○		—				—	—
(D)	○	○	—	—				—	—



When PSTRT1, PSTRT2, PSTRT3, and PSTRT4 are the same, they are shown as "PSTRT□".

Setting data

Setting data	Setting details	Setting side (*1)	Data type
"Un"	A QD75 head I/O number (00 to FE: Highest two digits in the case of an I/O number expressed in three digits)	User	BIN 16 bits
(S)	A head number of a device in which control data is stored	-	Word
(D)	A head number of a bit device that turns ON for one scan time at completion of the instruction. If the instruction is completed abnormally, ((D) + 1) will also be turned ON.	System	Bit

Control data

Device	Item	Setting data	Setting range	Setting side (*1)
(S)+0	System area	—	—	—
(S)+1	Complete status	The state at the time of completion is stored. 0 : Normal completion Other than 0 : Abnormal completion (error code)	—	System
(S)+2	Teaching data selection	The address to write the current feed value to (positioning address/arc address) is set. 0: Writes the current feed value to the positioning address. 1: Writes the current feed value to the arc address.	0,1	User
(S)+3	Positioning data No.	The positioning data No. to carry out teaching is set.	1 to 600	User

*1 The data on the setting side is as follows.
- User : Data before the execution of dedicated instructions is stored by users.
- System : Data after the execution of dedicated instruction is stored by PLC CPU.

Functions

(1) The "current feed value" of the axes to be processed (See below) is set in the positioning address or arc address.
The positioning data other than the positioning addresses and arc addresses are set using a peripheral device or sequence program.
- TEACH1: Axis 1
- TEACH2: Axis 2
- TEACH3: Axis 3
- TEACH4: Axis 4

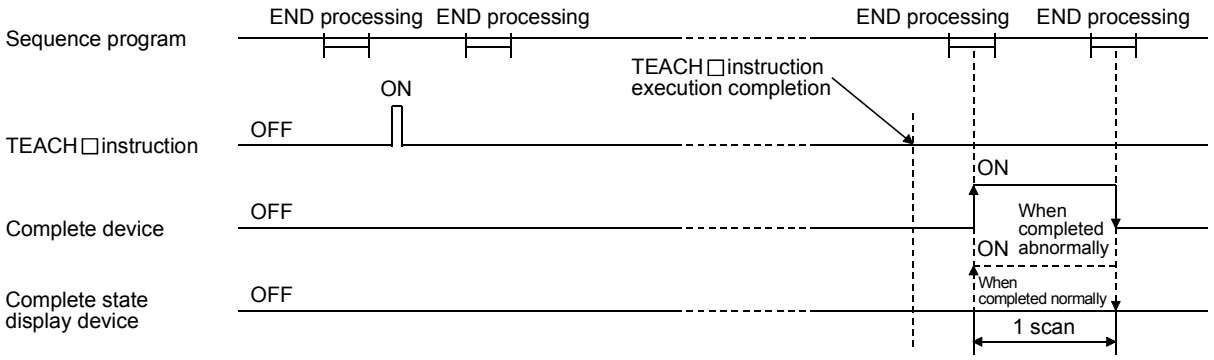
(2) Teaching can be carried out for the positioning data No. 1 to 600.

(3) The movement of the machine to the address (position) set in the positioning address/arc address of the positioning data is carried out in the JOG operation, inching operation, or manual pulse generator operation.

(4) The TEACH□ instruction completion can be confirmed using the complete devices ((D)+0) and ((D)+1).

(a) Complete device ((D)+0)
This device is turned ON by the END processing of the scan in which TEACH□ instruction is completed, and turned OFF by the next END processing.

(b) Complete state display device ((D)+1)
This device is turned ON and OFF according to how the TEACH□ instruction is completed.
- When completed normally : Kept unchanged at OFF.
- When completed abnormally : This device is turned ON by the END processing of the scan in which TEACH□ instruction was completed, and turned OFF by the next END processing. (Same ON/OFF operation as complete device).



Errors

(1) When the TEACH□ instruction is completed abnormally, the error complete signal ((D)+1) is turned ON, and the error code is stored in the complete status (S)+1.

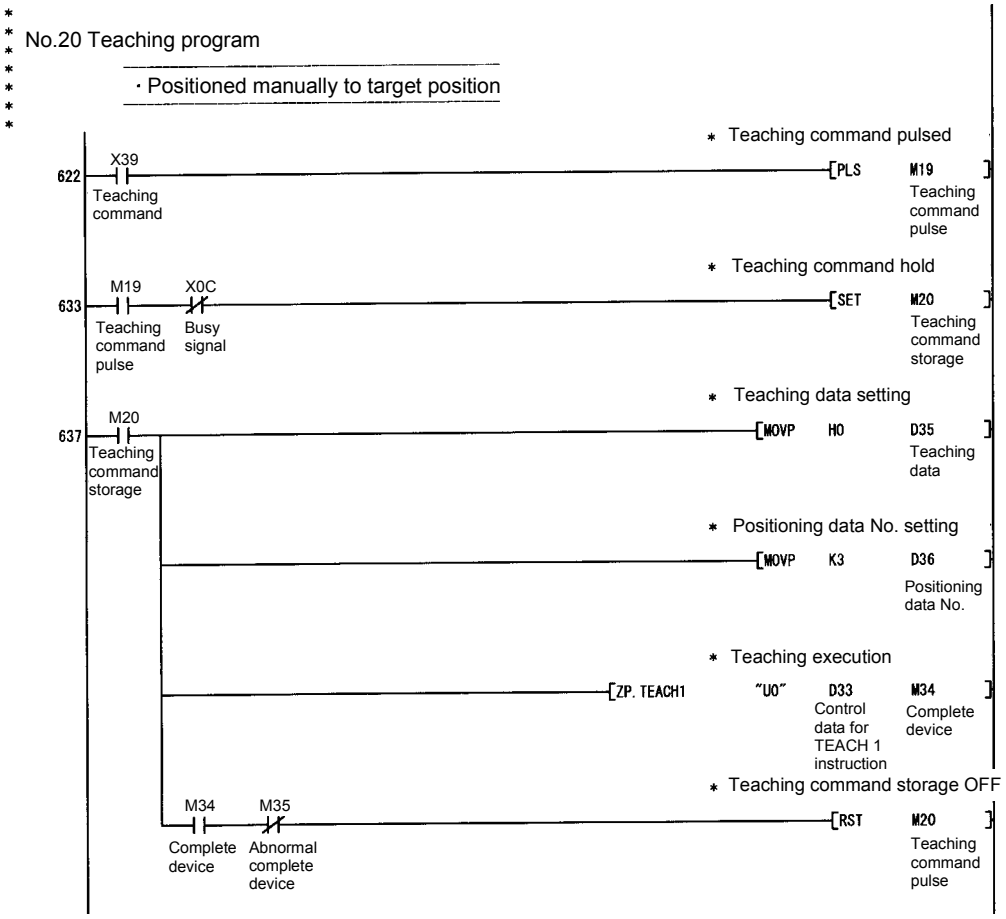
Precautions

(1) The following dedicated instructions cannot be executed simultaneously for the same axis.
(They can be executed simultaneously for different axes.)
• Positioning start instructions (PSTRT1 to PSTRT4)
• Absolute position restoration instructions (ABRST1 to ABRST4)
• Teaching instructions (TEACH1 to TEACH4)

(2) The TEACH□ instruction can be executed when the BUSY signal (XC, XD, XE, XF) is turned OFF.
When the BUSY signal is turned ON, the TEACH□ instruction will not be executed. (Not processed.)
Before executing the PFWRT instruction, make sure that the BUSY signal for the axis to be processed is turned OFF.

Program example

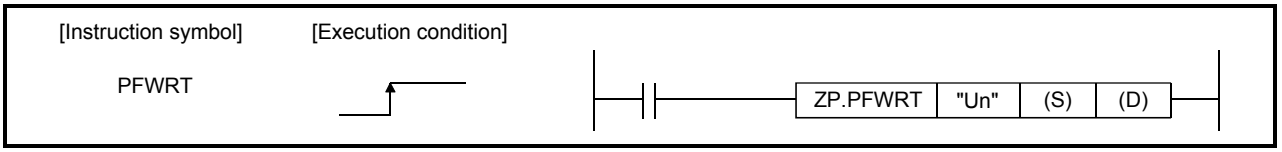
(1) Write a sequence program where the teaching is executed to the positioning data No. 3 of the axis 1 when X39 is turned ON.



Appendix 5.3 PFWRT

These dedicated instructions are used to write the QD75 parameters, positioning data and block start data to the flash ROM.

Setting data	Usable device								
	Internal device		File register	MELSECNET/10 direct J□\□		Special module U□\G□	Index register Zn	Constant	Others
	Bit	Word		Bit	Word			K,H,$	
(S)	—	○		—				—	—
(D)	○	○	—	—				—	—



Setting data

Setting data	Setting details	Setting side (*1)	Data type
"Un"	A QD75 head I/O number (00 to FE: Highest two digits in the case of I/O number expressed in three digits)	User	BIN 16 bits
(S)	A head number of a word device in which control data is stored	—	Word
(D)	A head number of a bit device that turns ON for one scan time at completion of the instruction. If the instruction is completed abnormally, ((D) + 1) will also be turned ON.	System	Bit

Control data

Device	Item	Setting data	Setting range	Setting side (*1)
(S)+0	System area	—	—	—
(S)+1	Complete status	The state at the time of completion is stored. 0 : Normal completion Other than 0 : Abnormal completion (error code)	—	System

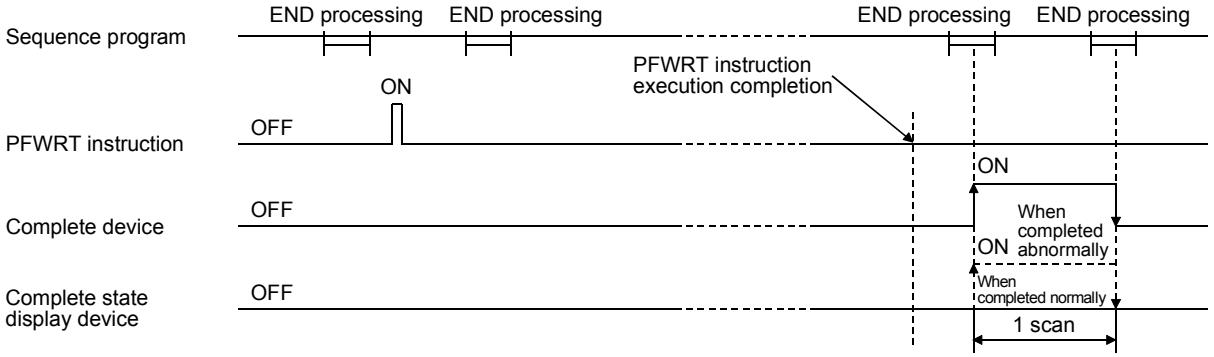
*1: The data on the setting side is as follows.
- User : Data before the execution of dedicated instructions is stored by users.
- System : Data after the execution of dedicated instruction is stored by PLC CPU.

Functions

(1) The PFWRT instruction completion can be confirmed using the complete devices ((D)+0) and ((D)+1).

(a) Complete device ((D)+0)
This device is turned ON by the END processing of the scan in which the PFWRT instruction is completed, and turned OFF by the next END processing.

(b) Complete state display device ((D)+1)
This device is turned ON and OFF according to how the PFWRT instruction is completed.
- When completed normally : Kept unchanged at OFF.
- When completed abnormally : This device is turned ON by the END processing of the scan in which the PFWRT instruction is completed, and turned OFF by the next END processing. (Same ON/OFF operation as complete device).



Errors

(1) When a dedicated instruction is completed abnormally, the error complete signal ((D)+1) is turned ON, and the error code is stored in the complete status ((S)+1).

Precautions

(1) Do not turn OFF the power or reset the PLC CPU while parameters, positioning data and block start data are written to the flash ROM using the PFWRT instruction.
Doing so causes a parameter error or abnormal positioning operation because the parameters, positioning data and block start data are not written normally to the flash ROM.
If this error occurs, restart the operation by the method shown below.
- For the QD75 S/W package, write the parameters, positioning data and block start data again to the flash ROM.
- For a sequence program, write the parameters, positioning data and block start data to the QD75 after initializing the parameters (by executing the PINIT instruction, etc.).
Then execute the PFWRT instruction again.

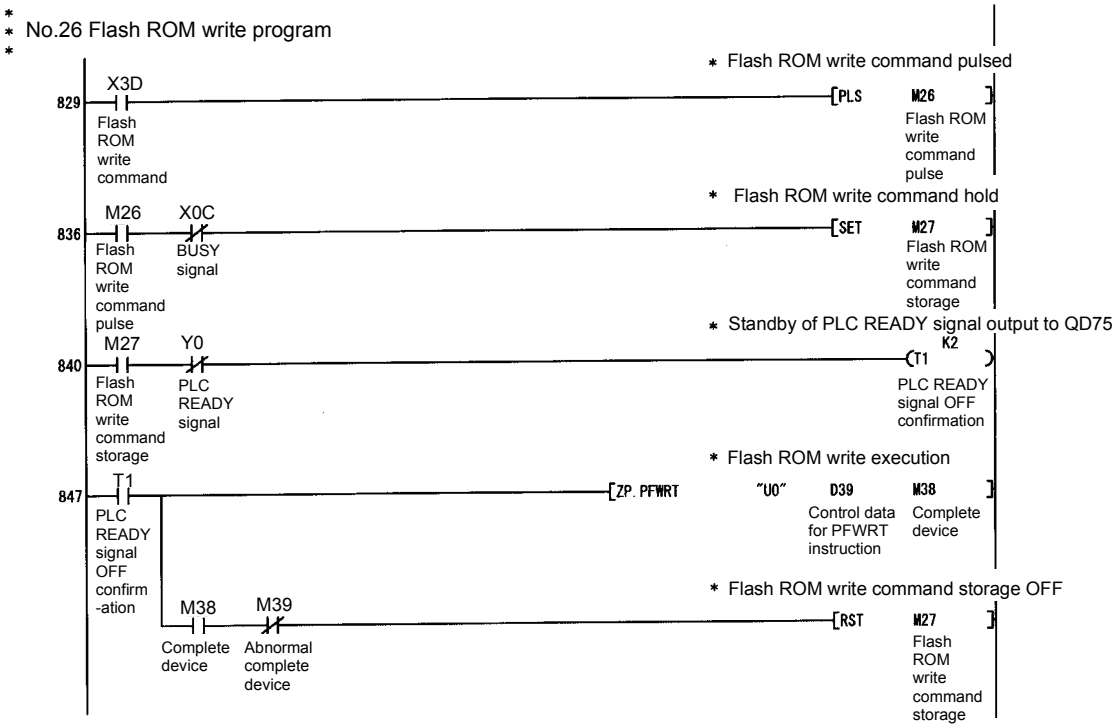
(2) Number of writings to the flash ROM is up to 100,000 times.
If writing to the flash ROM more than 100,000 times, the writing to the flash ROM will become impossible.

(3) After the power ON and PLC CPU reset operation, writing to the flash ROM using a sequence program is limited up to 25 times. (Not limited up to 25 times when writing to the flash ROM is carried out by a peripheral device.)
If writing to the flash ROM is requested more than 25 times after the power ON/PLC CPU reset operation, the flash ROM write number error (error code: 805) will occur, and the writing will be disabled.
If the flash ROM write error occurs even if writing to the flash ROM is requested only one time, check and correct the writing program.
Then reset the error, or turn ON the power and reset the PLC CPU again.

(4) The PFWRT instruction can be executed when the QD75 READY signal (X0) is turned OFF.
When the QD75 READY signal is turned ON, the PFWRT instruction cannot be executed.
Before executing the PFWRT instruction, turn OFF the PLC READY signal (Y0) and then turn OFF the QD75 READY signal.

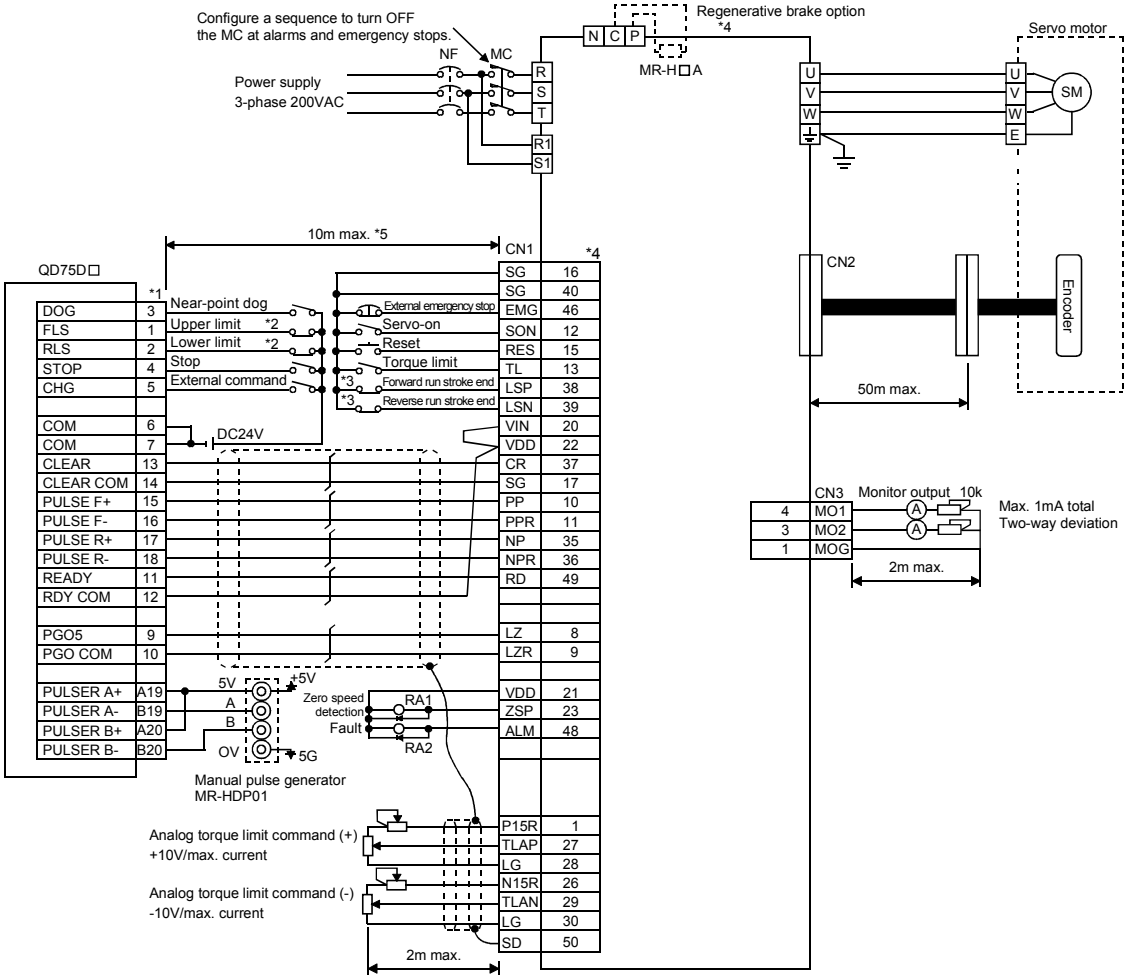
Program example

(1) The following is a program used to write the parameters, positioning data and block start data stored in the buffer memory to the flash ROM when X3D is turned ON.



Appendix 6 Connection Examples with Servomotors

Appendix 6.1 Connection Example of QD75D□ and MR-H□A (Differential Driver)*6



REMARK

(1) *1: The logic for each I/O terminal can be changed with the input signal logic selection and the output signal logic selection in the detailed parameters 1. (Negative logic is used for all terminals in the example above.)

(2) *2: The QD75D□ upper limit (FLS) and lower limit (RLS) are used in the OPR retry function. Set these signals inside the servo amplifier limit switches.

(3) *3: These are limit switches for the servo amplifier (for stop).

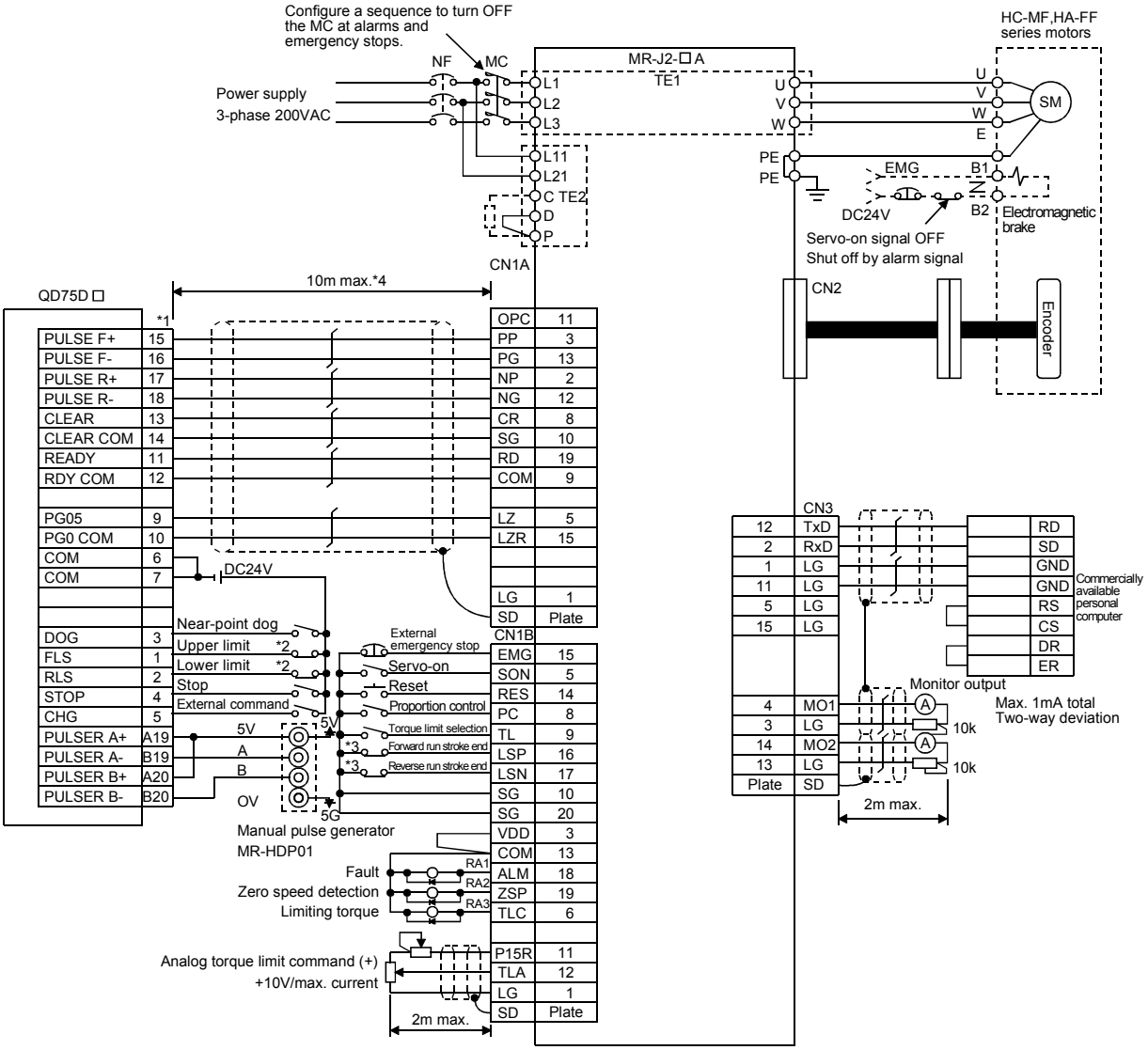
(4) *4: Refer to the specifications and handling instruction manual of the servo amplifier MR-H for details on connection.

(5) *5: This indicates the distance between the QD75D□ and servo amplifier.

(6) *6: Use the same logic (positive logic/negative logic) for the QD75D□ and servo amplifier. The QD75D□ is initially set to negative logic.

(7) "FA-CBLQ75M2H(-P) cable" can be used for the connection between the QD75D□ and MR-H□]A.
(Refer to Section 2.2 Component list.)

Appendix 6.2 Connection Example of QD75D□ and MR-J2/J2S□A (Differential Driver) *5



REMARK

(1) *1: The logic for each I/O terminal can be changed with the input signal logic selection and the output signal logic selection in the detailed parameters 1. (Negative logic is used for all terminals in the example above.)

(2) *2: The QD75D□ upper limit (FLS) and lower limit (RLS) are used in the OPR retry function. Set these signals inside the servo amplifier limit switches.

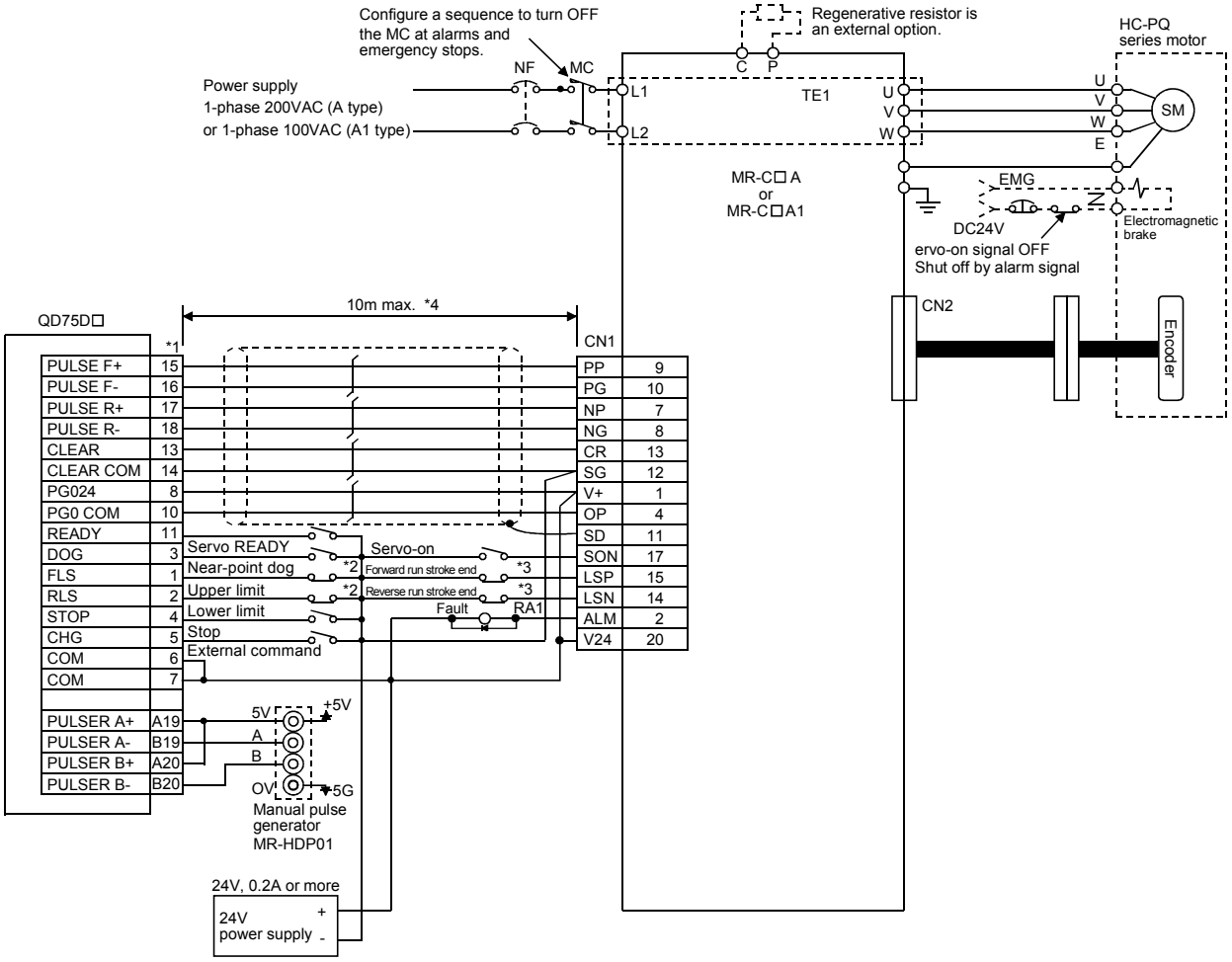
(3) *3: These are limit switches for the servo amplifier (for stop).

(4) *4: This indicates the distance between the QD75D□ and servo amplifier.

(5) *5: Use the same logic (positive logic/negative logic) for the QD75D□ and servo amplifier. The QD75D□ is initially set to negative logic.

(6) "FA-CBLQ75M2J2(-P) cable" can be used for the connection between the QD75D□ and MR-J2/J2S-□A.
(Refer to Section 2.2 Component list.)

Appendix 6.3 Connection Example of QD75D□ and MR-C□A (Differential Driver) *5



REMARK

(1) *1: The logic for each I/O terminal can be changed with the input signal logic selection and the output signal logic selection in the detailed parameters 1. (Negative logic is used for all terminals in the example above.)

(2) *2: The QD75D□ upper limit (FLS) and lower limit (RLS) are used in the OPR retry function. Set these signals inside the servo amplifier limit switches.

(3) *3: These are limit switches for the servo amplifier (for stop).

(4) *4: This indicates the distance between the QD75D□ and servo amplifier.

(5) *5: Use the same logic (positive logic/negative logic) for the QD75D□ and servo amplifier. The QD75D□ is initially set to negative logic.

(6) "FA-CBLQ75M2C2(-P) cable" can be used for the connection between the QD75D□ and MR-C□A.
(Refer to Section 2.2 Component list.)

Appendix 7 Comparisons with Conventional Positioning Modules

Appendix 7.1 Comparisons with A1SD71S2 Model

The following shows comparisons with the conventional positioning module A1SD71S2 with the main focus on the QD75 specifications.

Item \ Model		QD75P1 QD75D1	QD75P2 QD75D2	QD75P4 QD75D4	A1SD71S2
No. of control axes		1-axis	2-axis	4-axis	2-axis
No. of positioning data items		600/axis			400/axis
Interpolation functions	2-axis linear interpolation	×	○	○	○
	3-axis linear interpolation	×	×	○	×
	4-axis linear interpolation	×	×	○	×
	2-axis circular interpolation	×	○	○	×
Positioning systems	Position control	○			○
	Speed control	○			○
	Speed-position switching control	○			○
	Position-speed switching control	○			×
OPR function		○ (6 types)			○ (3 types)
JOG operation		○			○
Inching operation		○			×
Manual pulse generator function		○			×
Acceleration /deceleration processing	Automatic trapezoidal acceleration /deceleration	○			○
	S-curve acceleration /deceleration	○			×
Acceleration/deceleration time		Acceleration time and deceleration time setting possible (4 patterns each)			Acceleration/deceleration time same
Compensation		Electronic gears, backlash compensation			Backlash compensation
Error display		Error LED			Error LED
History data storage (Start, error, warning)		Provided (3 types, 16 items/axis)			None
Data storage destination		Flash ROM (battery-less backup)			Buffer memory (battery backup)
No. of I/O points		32			48
No. of module occupied slots		1			2
Peripheral devices (data setting, etc.)	AD71TU	×			○
	AD75TU	×			×
	A6GPP,A6PHP	×			○
	A7PHP,A7HGP	×			○
	PC9800 series	○			×
	DOS/V personal computer	○			○

○: Possible, ×: Not possible

The following shows the comparisons between the QD75 and the conventional positioning module A1SD75.

(1) Comparisons of performance specifications

Item \ Model			QD75P1 QD75D1	QD75P2 QD75D2	QD75P4 QD75D4	A1SD75 P1-S3	A1SD75 P2-S3	A1SD75 P3-S3
No. of control axes			1-axis	2-axis	4-axis	1-axis	2-axis	3-axis
No. of positioning data items			600/axis			600/axis*1		
Position control interpolation functions	2-axis linear interpolation		×	○	○	×	○	○
	3-axis linear interpolation		×	×	○	×	×	×
	4-axis linear interpolation		×	×	○	×	×	×
	2-axis circular interpolation		×	○	○	×	○	○
Positioning systems	Position control		○			○		
	Speed control	1-axis	○	○	○	○	○	○
		2-axis linear interpolation	×	○	○	×	×	×
		3-axis linear interpolation	×	×	○	×	×	×
		4-axis linear interpolation	×	×	○	×	×	×
	Speed-position switching control		○			○		
	Position-speed switching control		○			×		
Positioning range*2			<Absolute system> -214748364.8 to 214748364.7(μm) -21474.83648 to 21474.83647(inch) 0 to 359.99999 (degree) -2147483648 to 2147483647 (pulse) <Incremental system > -214748364.8 to 214748364.7 (μm) -21474.83648 to 21474.83647 (inch) -21474.83648 to 21474.83647 (degree) -2147483648 to 2147483647 (pulse) <Speed-position or position-speed switching controls> 0 to 214748364.7 (μm) 0 to 21474.83647 (inch) 0 to 21474.83647 (degree) 0 to 2147483647 (pulse)			<Absolute system> -214748364.8 to 214748364.7 (μm) /-13421772.8 to 13421772.7 (μm) -21474.83648 to 21474.83647 (inch) /-1342.17728 to 1342.17727 (inch) 0 to 359.99999 (degree) /0 to 359.99999 (degree) -2147483648 to 2147483647 (pulse) /-134217728 to 134217727 (pulse) <Incremental system> -214748364.8 to 214748364.7 (μm) /-13421772.8 to 13421772.7 (μm) -21474.83648 to 21474.83647 (inch) /-1342.17728 to 1342.17727 (inch) -21474.83648 to 21474.83647 (degree) /-1342.17728 to 1342.17727 (degree) -2147483648 to 2147483647 (pulse)) /-134217728 to 134217727 (pulse) <Speed-position switching control> 0 to 214748364.7 (μm) /0 to 13421772.7 (μm) 0 to 21474.83647 (inch) /0 to 1342.17727 (inch) 0 to 21474.83647 (degree) /0 to 1342.17727 (degree) 0 to 2147483647 (pulse) /0 to 134217727 (pulse)		
Speed command range *2			0.01 to 20000000.00 (mm/min) 0.001 to 2000000.000 (inch/min) 0.001 to 2000000.000 (degree/min) 1 to 1000000 (pulse/s)			0.01 to 6000000.00 (mm/min) /0.01 to 375000.00 (mm/min) 0.001 to 600000.000 (inch/min) /0.001 to 37500.000 (inch/min) 0.001 to 600000.000 (degree/min) /0.001 to 37500.000 (degree/min) 1 to 1000000 (pulse/s) /1 to 62500 (pulse/s)		
OPR function			○ (6 types)*3			○ (6 types)		

Item \ Model		QD75P1 QD75D1	QD75P2 QD75D2	QD75P4 QD75D4	A1SD75P1-S3	A1SD75P2-S3	A1SD75P3-S3
JOG operation		○			○		
Inching operation		○			×		
Manual pulse generator function		1 generator/module			1 generator/axis		
Acceleration/deceleration processing	Automatic trapezoidal acceleration/deceleration	○			○		
	S-curve acceleration/deceleration	○			○		
Acceleration/deceleration time	No. of patterns	Acceleration time and deceleration time setting possible (4 patterns each)			Acceleration time and deceleration time setting possible (4 patterns each)		
	Setting range	1 to 8388608ms			1 to 65535ms/1 to 8388608ms selectable		
Compensation		Electronic gears, backlash compensation, near pass*4			Electronic gears, backlash compensation, near pass*4		
Error display		Error LED			17-segment LED		
History data storage (Start, error, warning)		Provided (3 types, 16 items/axis)			Provided (4 types, 16 items/axis)		
Data storage destination		Flash ROM (battery-less backup)			Flash ROM (battery-less backup)		
Connection connector		A6CON1 (Soldering type, sold separately)			10136-3000VE (Soldering type, supplied)		
		A6CON2 (Crimp type, sold separately)			10136-6000EL (Crimp type, sold separately)		
Applicable wire size		A6CON1: 0.3mm^2			10136-3000VE: AWG#24 to #30 (Approx. 0.05 to 0.2 SQ)		
		A6CON2: AWG#24 to 28			10136-6000EL: AWG#28 (Approx. 0.08 SQ)		
Command pulse output system		QD75P□: Open collector QD75D□: Differential driver			Both differential driver and open collector available		
Max. output pulse		When connected with open collector: 200kpps When connected with differential driver: 1Mpps			When connected with open collector : 200kbps When connected with differential driver : 400 kbps		
Max. connection distance between servos		When connected with open collector: 2m (6.56ft) When connected with differential driver: 10m (32.79ft)			When connected with open collector : 2m (6.56ft) When connected with differential drive : 10m (32.79ft)		
Internal current consumption (A) [5VDC]		QD75P1: 0.4A	QD75P2: 0.46A	QD75P4: 0.58A	0.7A or less		
		QD75D1: 0.52A	QD75D2: 0.56A	QD75D4: 0.82A			
No. of I/O points		32			32		
No. of module occupied slots		1			1		
Outline dimensions (mm (inch))		98(3.86)(H)×27.4(1.08)(W)×90(3.55)(D)			130(5.12)(H)×34.5(1.36)(W)×93.6(3.69)(D)		
Weight (kg (lb))		0.15(0.33)	0.15(0.33)	0.16(0.35)	0.35(0.77)		
I/O signal for external devices	STRT signal	× (integrated into "CHG")			○ (External start signal)		
	CHG signal	External command signal (External start or speed-position switching selectable with parameters)			Speed-position switching signal		
	In-position (INP)	×			○ (for monitor)		
	Signal logic switching	○			Command pulse output signal only		
Peripheral devices*5 (data setting, etc.)	Connection with peripheral devices	Connection via PLC CPU			Direct connection		
	AD71TU	×			×		
	AD75TU	×			○		
	A6GPP,A6PHP	×			○		
	A7PHP,A7HGP	×			○		
	PC9800 series	○			○		
	DOS/V personal computer	○			○		

○: Possible, ×: Not possible

*1: Up to 100 data items/axis of positioning data (No. 1 to 100) can be set using the buffer memory. The positioning data in the buffer memory is not backed up.

*2: Indicates the standard mode/stepping motor mode.

*3: The deviation counter clear signal output time can be set with parameters.

*4: The near pass function is valid only during the continuous path control. (A1SD75: Selected with parameters, QD75: Standard function)

*5: Teaching unit which can be used for the QD75 has not been manufactured.

(2) Function comparisons

Functions added from those of A1SD75

Added functions		Remarks
I/O signal logic switching function		Refer to Section 13.4 of QD75 User's Manual
Inching operation		Refer to Section 11.3 of QD75 User's Manual
Target position change function		Refer to Section 12.7.5 of QD75 User's Manual
Multiple axes simultaneous start control		Refer to Section 10.5 of QD75 User's Manual
Control systems	3-axis linear interpolation control 4-axis linear interpolation control 3-axis fixed-feed control 4-axis fixed-feed control 2-axis speed control 3-axis speed control 4-axis speed control Position-speed switching control NOP instruction LOOP instruction, LEND instruction	Refer to Chapter 9 of QD75 User's Manual
Dedicated instructions	Absolute position restoration Positioning start Teaching Flash ROM writing Parameter initialization	Refer to Chapter 14 of QD75 User's Manual
Automatic refresh of intelligent function modules		Refer to the software package Operating Manual for QD75
Output hold/clear parameter setting during PLC CPU error stop		Refer to User's Manual of PLC CPU to be used
Flash ROM write limit		Refer to Section 13.3 of QD75 User's Manual

Functions deleted from those of A1SD75

Deleted functions	Remarks
Stepping motor mode	—
OPR operation error (Error code: 208)	—
Fast machine OPR	—
Special start (stop)	—
Indirect designation	In the QD75, the start block area on the buffer memory is expanded to five blocks (0 to 4). Each start block can be directly designated with positioning start No. (7000 to 7004).
Block transfer	With the A1SD75, this interface is used to set positioning data Nos. 101 to 600 that do not exist on the buffer memory. Since all positioning data can be set in the buffer memory with the QD75, this function was deleted.
Positioning data I/F	
Start history storage during error	The contents are the same as those of the start history. Therefore, the QD75 stores only the start history.
System monitor data (module type, OS information)	These data were deleted because they can be displayed in the system monitor "Module's detailed information" of GPPW. (Refer to GPP Function software package Operating Manual.)

Functions changed from those of A1SD75

<table>
<tr><th>Changed functions</th><th>Descriptions</th></tr>
<tr><td>Software stroke limit function</td><td>1. The limit check of arc address is carried out only when a sub point is designated. It is not carried out when a center point is designated.
2. The software stroke limit check during speed control is carried out in the following cases:
• When the software stroke limit is applied to the current feed value using software stroke selection and the current feed value is updated with the current feed value during speed control.
• When the software stroke limit is applied to the machine feed value.
3. If an attempt is made to change the current value but the designated address is out of the software stroke limit range, the attempt is considered as an error and the current value is not changed.
4. The conventional models feature three types of software stroke limit error codes for upper limit and lower limit respectively. With the QD75, errors for the software stroke upper limit are integrated into error code 507, and errors for the lower limit are integrated into error code 508. Error codes 509 to 512 were deleted.</td></tr>
<tr><td>Current value changing
M code function</td><td>1. An error occurs when the designated new current value is out of the software stroke limit range.
2. An M code setting value is valid during the positioning data current value changing instruction.</td></tr>
<tr><td>Acceleration/deceleration control</td><td>1. An error occurs when the command frequency value calculated from the speed limit value exceeds the maximum command frequency of the positioning module being used.
2. Only two-word type (1 to 8388608ms) can be used as the setting value for the acceleration/deceleration time.
(The switch between 1-word type and 2-word type was deleted.)</td></tr>
<tr><td>Stop process and restart after stop
Positioning operation stop</td><td>1. "Peripheral side (emergency) stop" was deleted from the stop causes of Stop group 2 sudden stop selection. "Test mode fault" in the stop causes of Stop group 3 sudden stop selection was changed to be in the stop causes of Stop group 2 sudden stop selection.
2. "Stop (QD75 peripheral)" was added to the stop causes of Stop group 3 sudden stop selection.
3. Error code 100 (Peripheral device stop during operation) was deleted.
4. I/O reset was added to the stop causes of Stop group 2 sudden stop selection.</td></tr>
<tr><td>READY signal (X0)</td><td><table><tr><td></td><td>A1SD75</td><td>QD75</td></tr><tr><td>OFF</td><td>Normal(READY)</td><td>Not READY/WDT error</td></tr><tr><td>ON</td><td>Not READY/WDT error</td><td>Normal(READY)</td></tr></table></td></tr>
<tr><td>Manual pulse generator operation</td><td>1. The No. of connectable manual pulse generators was changed from 1 generator/1 axis to 1 generator/1 module.
2. The speed during manual pulse generator operation is limited with "Speed limit value".</td></tr>
<tr><td>Axis operation status</td><td>"Step stopped" was changed to "Stopped" and "Step error occurring" was changed to "Error occurring".
"In position control for position-speed switching control", "In speed control for position-speed switching control", and "In absolute position restoration" were added.</td></tr>
<tr><td>Continuous path control</td><td>A1SD75 : If the reference axis operates in the reverse direction, the control is internally changed into the continuous positioning control (restart after deceleration stop).
QD75 : Even if the reference axis operates in the reverse direction with interpolation, the control remains as the continuous path control.
(In single-axis operation, the operation is the same as that of the A1SD75.)</td></tr>
</table>

<table>
<tr><th>Changed functions</th><th colspan="3">Descriptions</th></tr>
<tr><td>Near pass</td><td colspan="3">For the continuous path control, only the near pass function is available.</td></tr>
<tr><td>2-axis interpolation
• 2-axis linear interpolation
• 2-axis fixed-feed
• Circular interpolation
• 2-axis speed control</td><td colspan="3">The interpolation target axis can be randomly set with a positioning identifier.</td></tr>
<tr><td>Step function</td><td colspan="3">1. "Step stopped" was changed to "Stopped" and "Step error occurring" was changed to "Error occurring" in the axis operation status parameters.
2. The restart command for the step start information (02H) was deleted.
3. The step operation is restarted with the restart command.</td></tr>
<tr><td>Command in-position function</td><td colspan="3">The command in-position width is expanded.
• A1SD75:1 to 32767000
• QD75: 1 to 2147483647</td></tr>
<tr><td>Control unit "degree" handling</td><td colspan="3">The operating direction can be designated even for the ABS control in the unit of "degree".</td></tr>
<tr><td>Positioning start No.</td><td colspan="3">No. 9004 (Multiple axes simultaneous start control) was added.
Nos. 7004 to 7010 (block start designation) and 8000 to 8049 (indirect designation) were deleted.</td></tr>
<tr><td>Block start data</td><td colspan="3">With the QD75, the number of blocks were changed to 5 (7000 to 7004).
(With the A1SD75, this data is called "positioning start information".)</td></tr>
<tr><td>Special start data "Simultaneous start"</td><td colspan="3">The simultaneous start is possible up to 4 axes.</td></tr>
<tr><td>Start history</td><td colspan="3">The configuration of "start information" and "start No." was changed so that the start No. can be directly checked.</td></tr>
<tr><td>Synchronization flag (X1)</td><td colspan="3">When the PLC CPU starting method is set to asynchronous, an interlock is established with the synchronization flag (X1) signal.</td></tr>
<tr><td>Basic parameter 1 "Pulse output mode"</td><td colspan="3">After the PLC is turned ON or the PLC CPU module is reset, the valid value is only the first value when the PLC READY signal (Y0) turns from OFF to ON.</td></tr>
<tr><td rowspan="3">Detailed parameters "Software stroke limit valid/invalid setting"</td><td></td><td>A1SD75</td><td>QD75</td></tr>
<tr><td>0
(Factory setting)</td><td>Software stroke limits invalid for manual operation</td><td>Software stroke limits valid for manual operation</td></tr>
<tr><td>1</td><td>Software stroke limits valid for manual operation</td><td>Software stroke limits invalid for manual operation</td></tr>
</table>

(3) Input/output signal comparisons

Input signal comparisons

Name	A1SD75		QD75	
	Logic (initial status)	Logic switch with parameters	Logic (initial status)	Logic switch with parameters
Drive unit READY	Negative logic	Not possible	Negative logic	Possible
In-position signal	Negative logic	Not possible	—	—
Zero signal	Negative logic	Not possible	Negative logic	Possible
Manual pulse generator A phase Manual pulse generator B phase *1	Negative logic (multiple of 4)	Not possible	Negative logic (multiple of 4)	Possible
Near-point signal	Negative logic	Not possible	Negative logic	Possible
Stop signal	Negative logic	Not possible	Negative logic	Possible
Upper limit	Negative logic	Not possible	Negative logic	Possible
Lower limit	Negative logic	Not possible	Negative logic	Possible
External start *2	Negative logic	Not possible	Negative logic	Possible
Speed-position switching signal *2	Negative logic	Not possible		

Output signal comparisons

Name	A1SD75		QD75	
	Logic (initial status)	Logic switch with parameters	Logic (initial status)	Logic switch with parameters
Command pulse *3	Positive logic CW/CCW mode	Possible	Negative logic CW/CCW mode	Possible
Deviation counter clear	Negative logic	Not possible	Negative logic	Possible

*1: Comparisons about manual pulse generator A phase/B phase

	A1SD75	QD75
No. of connectable manual pulse generators	1 generator/axis	1 generator/module
Mode selection (with parameter)	Not possible	Possible Multiple of 1 mode, multiple of 4 mode, PLS/SIGN mode

*2: With the QD75, the "external start signal" and "speed-position switching signal" are combined into the "external command signal".

*3: Comparisons about command pulse

	A1SD75	QD75
Mode selection (with parameter)	Possible PLS/SIGN mode, A phase/B phase (multiple of 4) mode, A phase/B phase (multiple of 1) mode, CW/CCW mode	
Max. command frequency	Open collector : 200kbps Differential driver: 400kbps	Open collector : 200kpps Differential driver: 1Mpps

Appendix 8 Glossary of MELSEC Positioning Related Terms

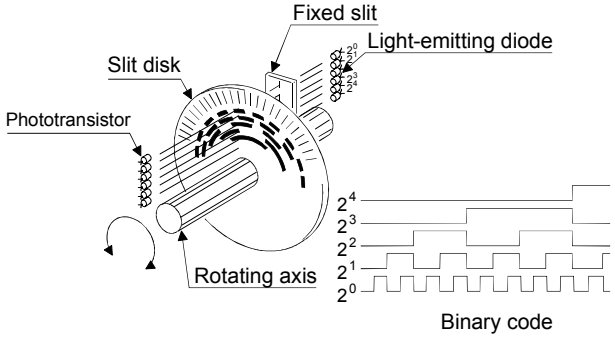
A

ABSOLUTE ENCODER

A detector that enables the angle data within 1 motor rotation to be output to an external destination. Absolute encoders are generally able to output 360° in 8 to 12 bits.

Incremental encoders have a disadvantage in that the axis position is lost when a power failure occurs. On the other hand, with absolute encoders, the axis position is not lost even when a power failure occurs.

Various codes such as a binary code and BCD code can be output. Absolute encoders are more expensive, more accurate, and larger than incremental encoders. Refer to "ENCODER".



ABSOLUTE POSITION DETECTION SYSTEM

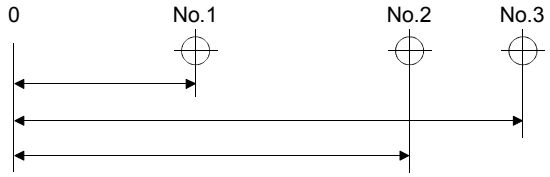
In the absolute position detection system, once OPR is carried out at the system startup, the system stores the machine position in the memory and retains the current position even when the power is turned OFF. Mechanical deviation will be compensated, so that OPR is not required after the power is turned ON next time. This system must have a motor with an absolute position detector and a servo amplifier and positioning module compatible with the absolute position detection system.

ABSOLUTE SYSTEM

One of systems for expressing a positioning address.

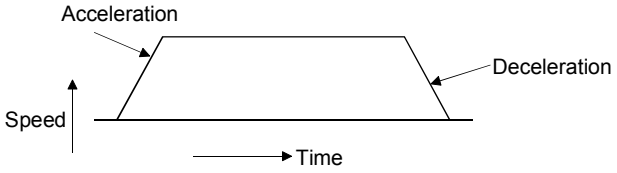
Absolute address system.

This system uses 0 as a reference, and expresses the address as the distance from 0. The direction is automatically determined, even when it is not designated. The other address system is the increment system.



AUTOMATIC TRAPEZOIDAL ACCELERATION/DECELERATION

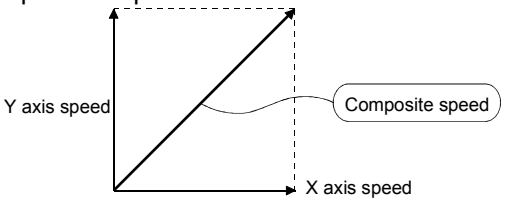
An operation in which a graph of the time and speed takes a trapezoidal shape.



C

COMPOSITE SPEED

Movement speed of the control target during interpolation operations.



CREEP SPEED

Very slow speed at which a machine moves.

It is difficult for the machine to stop suddenly when running at high speed, so the movement must first be changed to the creep speed before stopping.

CURRENT FEED VALUE

The OP address at completion of machine OPR is stored.

The position currently being executed is stored.

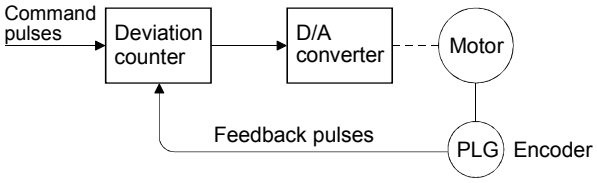
This value changes when the current value is changed.

D

DEVIATION COUNTER

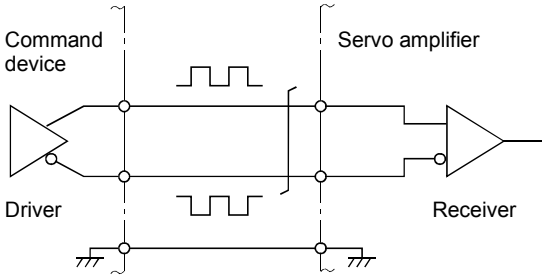
Deviation counters have the following two functions.

1) To count the command pulses issued from the QD75, and transmit the count value to the D/A converter.
2) To subtract the feedback pulses from the command pulses, and run the motor by the deviation value (droop pulse) of the command pulses and feedback pulses until the command pulses reaches 0.



DIFFERENTIAL OUTPUT TYPE

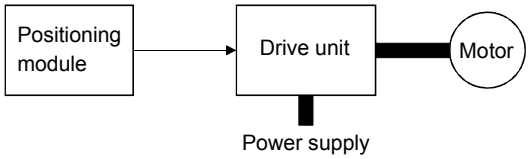
When one signal is output with this method, a companion signal having the reverse polarity is simultaneously output. This method enables high-frequency transfer, and is resistant to noise, etc., so it is also used in high-speed signal transfer such as inputting and outputting of pulse trains. In general, the transmission side is called the driver, the reception side is called the receiver, and a dedicated IC is used.



DRIVE UNIT

Commands output from the positioning module are low-voltage, low-current commands with insufficient energy to run the motor.

The drive unit increases the width of these commands so the motor can be run. It is an accessory on servomotors and stepping motors. Also called a servo amplifier.



DRIVE UNIT READY

This signal is output when the drive unit for the motor is in a READY state.

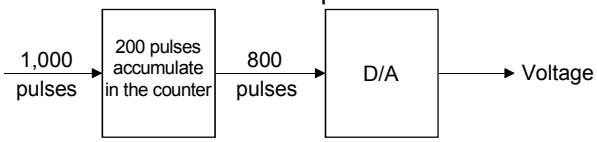
This signal remains OFF when the drive unit power is OFF, or during faults, etc.

DROOP PULSE

Because of inertia (GD^2) on machines, if a speed command is simply issued without any time-consideration, a positioning module will fail to follow the command in time.

To solve this, servomotors employ a method in which the speed command pulses are first accumulated in a deviation counter before sent. This way, the pulses are successfully delayed. These accumulated pulses are called the droop pulse.

The deviation counter emits all pulses and returns to 0 when the machine stops.



DYNAMIC BRAKE

When protection circuits operate due to power failures, emergency stops (EMG signal), etc., this brake is used to short-circuit between servomotor terminals via a resistor, make the motor consume rotation energy, and stop the motor suddenly without allowing coasting of the motor.

Braking torque is provided by electromagnetic brakes only when running motors with which a large brake torque can be obtained. Because electromagnetic brakes have no holding power, they are used in combination with mechanical brakes to prevent dropping of the vertical axis.

E

ELECTRONIC GEAR

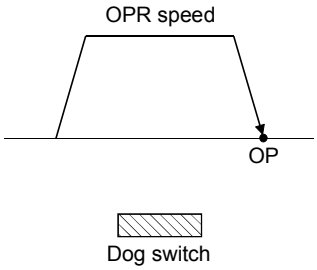
This function electrically increases/decreases the command pulses from the pulse command module by 1/50 to 50-fold. Thus, the positioning speed and movement amount can be controlled by the electronic gear ratio magnification.

F

FAST OPR

The axis returns to the machine OP at the OPR speed without detecting the zeroing dog.

(This is not validated unless machine OPR has been carried out first.)



FEEDBACK PULSE

A method of returning a pulse train to confirm whether the machine faithfully operated according to the commands issued in automatic control. If the machine did not faithfully operate according to the commands, a correction command is issued. For example, if a command is issued for 10,000 pulses, and a feedback pulse of 10,000 pulses is returned, then the balance becomes 0 and it can be judged that the command was faithfully followed.

FLASH ROM

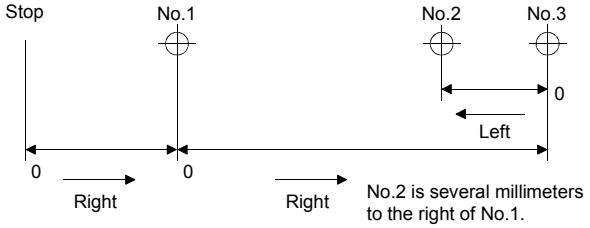
This battery-less memory can be used to store parameters and positioning data for backup.

Because it is battery-less, battery maintenance is not required

I

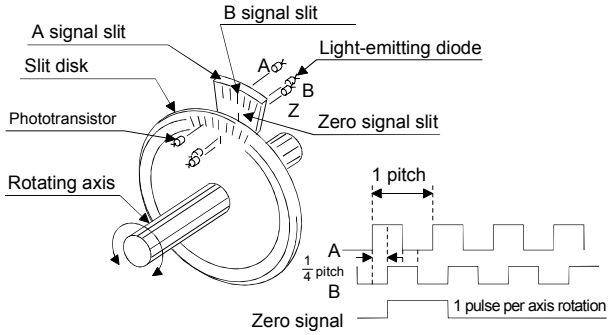
INCREMENTAL SYSTEM

The current value is 0 in this system. Target positions are represented by the designated direction and distance of travel from the current value. Also called the relative address system. This system is used in fixed-feed, etc.



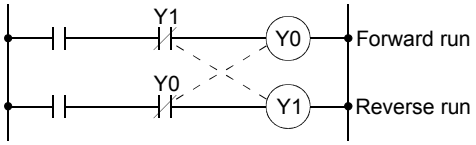
INCREMENTAL ENCODER

A device that simply outputs ON/OFF pulses by the rotation of the axis. 1-phase types output only A pulses, and do not indicate the axis rotation direction. 2-phase types output both A and B pulse trains, and can judge the rotation direction. The direction is judged to be forward if the B pulse train turns ON when A is ON, and judged to be reverse if A turns ON when B is ON. There is also another type of incremental encoders with a zero signal. The most commonly used incremental encoders output between 100 and 10,000 pulses per axis rotation.



INTERLOCK

In this condition, the machine is blocked from moving to the next operation until the operation in progress is complete. This function is used to prevent devices from being damaged and overrunning.



M

MACHINE FEED VALUE

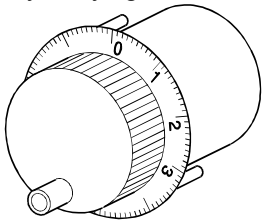
The OP address at completion of machine OPR is stored.

The current position in machine coordinates determined by a machine having an OP address as a reference is stored.

Even if the current value is changed, this value will not change.

MANUAL PULSE GENERATOR

The handle of this device is manually rotated to generate pulses. This device is used when manually carrying out accurate positioning.



Made by Mitsubishi Electric Corp.
(model: MR-HDP01)

MASTER AXIS

When carrying out interpolation operations, this is the side on which the positioning data is executed in priority. For example, when positioning with the X axis and Y axis, the side with the largest movement distance will become the master axis, and the speed will follow that axis. The slave axis speed will be ignored.

O

OVERRIDE FUNCTION

With this function, the speed during positioning operations (current speed) can be varied between 1 and 300%.

The speed can also be changed by the same variable rate for continuous positioning carried out at different designated speeds.

P

PLC READY

This signal is output when the PLC CPU is in a READY state.

Positioning can be started only in this state.

POSITION CONTROL

Control that is performed mainly over position and dimension, such as in fixed-feed, positioning, numerical control, etc. This is always controlled with feed pulses.

POSITIONING

Accurately moving the machine from a point to a determined point. The distance, direction, speed, etc., for that movement are designated by users. Positioning is used in operations such as cutting sheets, drilling holes in plates, mounting parts on a PCB, and welding. Positioning is also used with robots.

POSITIONING DATA

Data for users to carry out positioning. The No. of points to which positioning is carried out (the No. of addresses) is designated by users. In the QD75, these are 600 points. Writing (changing) data by the program during positioning is also possible.

POSITIONING PARAMETER

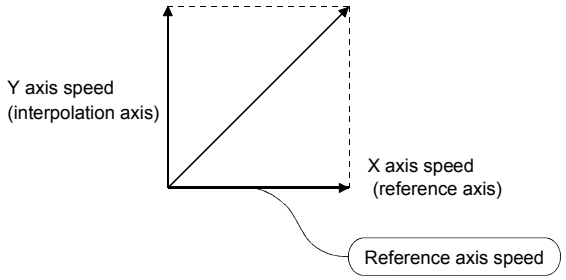
Basic data for carrying out positioning control. Types of data include control unit, movement amount per rotation, speed limit value, upper and lower stroke limit values, acceleration/deceleration time, positioning system, etc.

Parameters have an initial value, which can be changed to match the control conditions.

R

REFERENCE AXIS SPEED

The speed of the reference axis during interpolation operations.

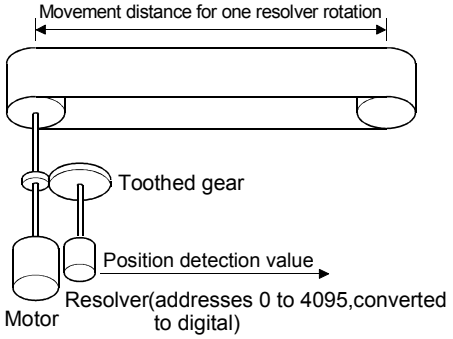


REGENERATIVE BRAKE OPTION

This function is an option. It is used when carrying out highly repetitive acceleration/deceleration.

RESOLVER

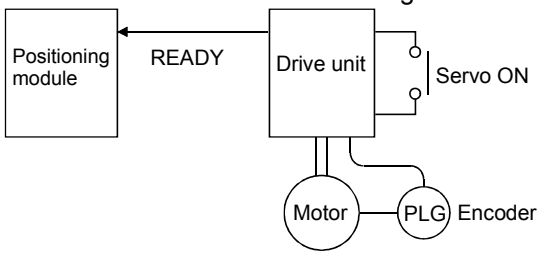
This device detects the angle by resolving the two voltages of an analog input. Also called a 2-phase synchro. For a 1-phase voltage input, the axis rotation angle is converted into a perpendicular 2-phase voltage (analog voltage) and output.



S

SERVO ON

A servo unit will not operate if the drive unit is in an abnormal state and this servo ON signal is OFF.



SKIP FUNCTION

When the SKIP signal is input, the positioning being executed is interrupted, the motor is decelerated to stop, and the next positioning is automatically carried out.

SPEED CONTROL

Normally, speed control is for controlling the speed of a servomotor. For example, it controls grindstone rotation, welding speed, feedrate, etc. Unlike position control, in speed control the current position (address) is not controlled.

SPEED INTEGRAL COMPENSATION

One of the servo parameters of the positioning data, and is used to raise the frequency response during speed control to improve transient characteristics.

When adjusting the speed loop gain, raising this value is effective if the overshooting during acceleration/deceleration remains large.

This compensation is set in the units of ms.

SPEED LIMIT VALUE

The max. speed for positioning. Even if other data is mistakenly set to a higher speed than this, the positioning will be carried out at this speed limit value when it is set in the parameters. The acceleration time is the time to accelerate from a stopped state to the speed limit value, and the deceleration time is the time to decelerate from the speed limit value to a stopped state.

SPEED LOOP GAIN

One of the servo parameters of the positioning data. It represents the speed of the control response during speed control. When the load inertia moment ratio increases, the control system speed response decreases and the operation may become unstable. If this happens, the operation can be improved by raising this setting value.

The overshoot will become larger if the speed loop gain is raised too far, and motor vibration noise will occur during operation and when stopped.

STEP FUNCTION

When the operation is designed so that several positioning data Nos. are consecutively started, this function can be used to carry out test operation for 1 data item at a time.

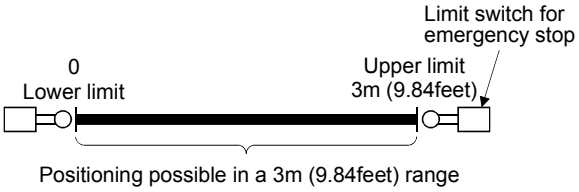
STROKE LIMIT

The range in which a positioning operation is possible, or the range in which the machine can be moved without damage occurring.

(Movement outside this range is possible in JOG.)

For operations using a worm gear, the stroke limit is determined by the length of the screw. For operations using a fixed-feed, it is determined by the max. dimension to be cut.

The upper and lower limits are set in the parameters, however a separate limit switch should be established and an emergency stop circuit outside the PLC should be installed.



T

TEACHING

When the positioning address is uncertain, or gauging is required, users may need to search for the positions by themselves. This function is used in such case to teach the obtained position to the machine.

For example, complex addresses, such as addresses of a drawing, can be taught by tracing a model, and the positioning operation can be reproduced.

TORQUE CONTROL

With this function, a limit is established for the resistance torque applied to a motor used for positioning. The power is turned OFF if torque exceeding that value is applied to a motor.

When an excessive torque is applied to a motor, it causes the current to suddenly increase. Due to this, a motor may be burned or damaged by stresses, causing the life of the motor to be shortened.

With this function, the sudden increase in the torque, which occurs at OPR, can be used as a command to stop the motor.

TRACKING FUNCTION

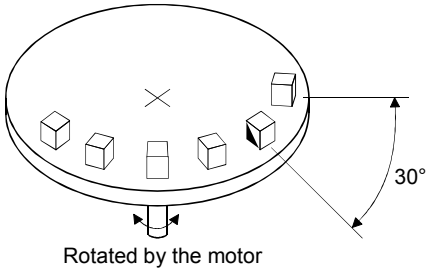
With this function, positioning is carried out to a moving target at relative speed by inputting the movement amount from an external encoder and adding it to the servo command value.

TURNTABLE

A table that rotates with power.

One rotation is 360° and this is divided into angles suitable for the work.

The positioning control unit is "degree".



U

UNIT SETTING

Refers to setting a unit of the target address of positioning, or of the movement amount.

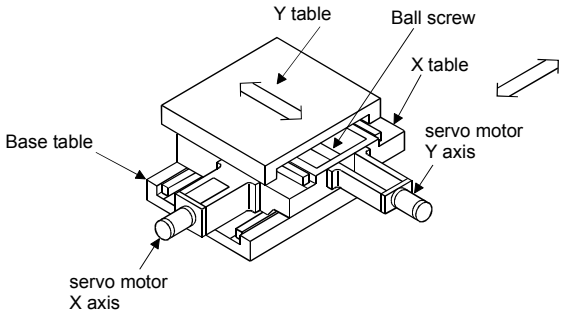
By using the units of mm, inch, degree and pulse appropriately, the initial value in the fixed parameters becomes a pulse unit.

X

XY TABLE

A device that moves a table in the X (latitudinal) and Y (longitudinal) directions so that positioning can be carried out easily.

There are also commercially available XY tables.

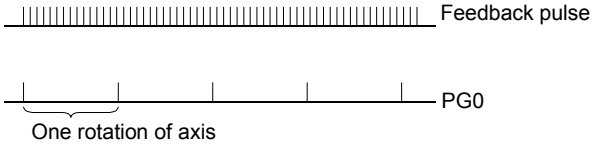


Z

ZERO PHASE SIGNAL

The pulse which is generated one (or two) per rotation of a pulse generator.

It is used for OPR of positioning. Also called "Z signal" or "PGO".



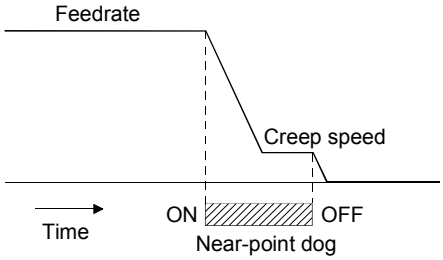
OP SHIFT FUNCTION

The OP position can be shifted in the positive or negative direction by executing OPR and determining the shift amount to the OPR complete position.

An OP can be set to a position other than the zero point position or outside of the dog switch.

NEAR-POINT DOG

A switch placed before the OP. When this switch turns ON, the feedrate is changed to the creep speed. Because of that, the time that this switch is ON must be longer than the time that the feedrate is decelerated to the creep speed.



Mitsubishi Programmable Logic Controller Training Manual
QD75 Positioning course(Q-series)

MODEL	SCHOOL-Q-QD75-E
MODEL CODE	13JW54
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