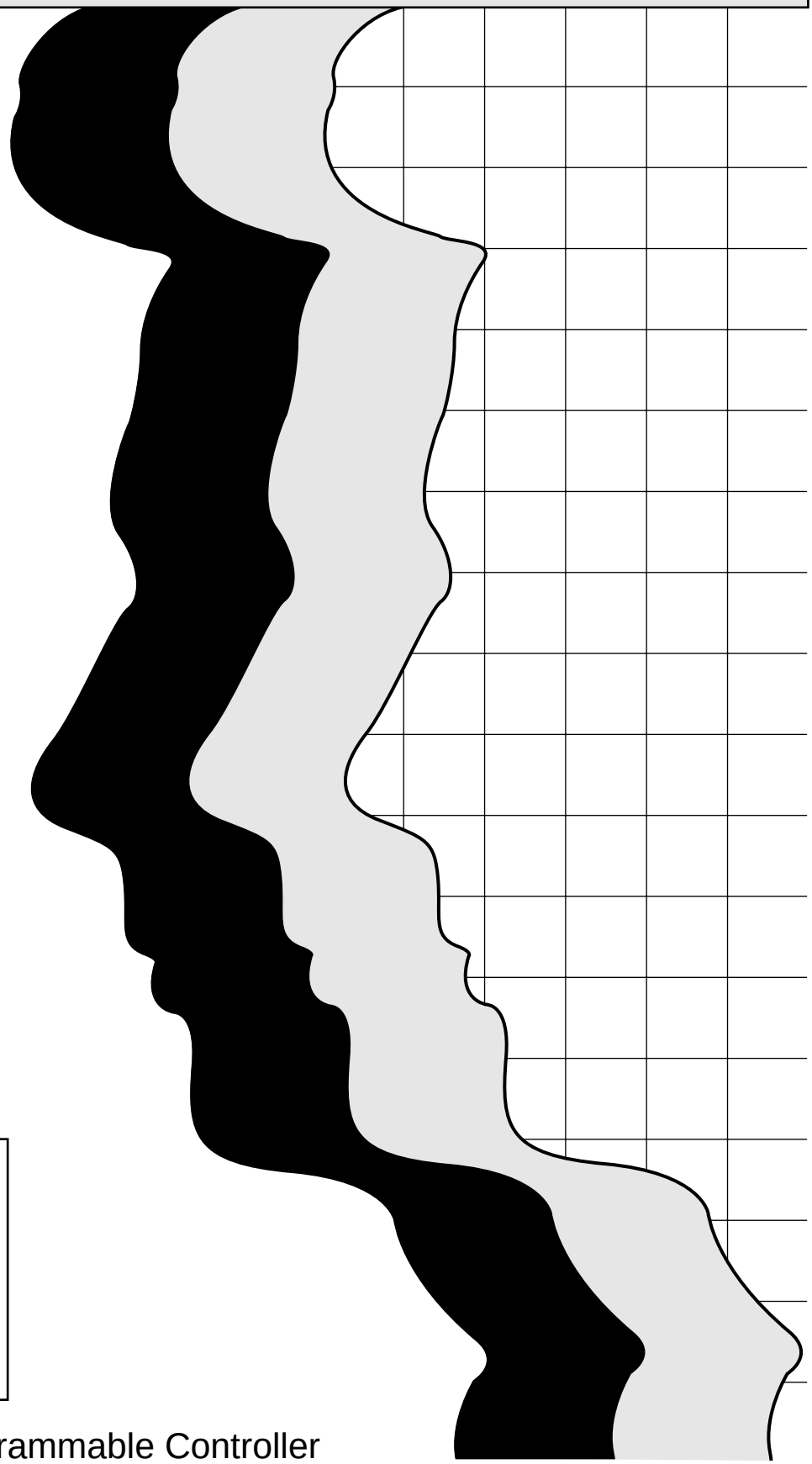
MITSUBISHI

Positioning Module
type A1SD75P1/P2/P3, AD75P1/P2/P3

User's Manual



A
MELSEC

Mitsubishi Programmable Controller

REVISIONS

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

Print Date	*Manual Number	Revision
Nov., 1995	IB (NA) 66589-A	First edition
May, 1996	IB (NA) 66589-B	Overall, revision, additions/modifications made. Addition 3.4.7, 3.6.6, APPENDIX 4 to APPENDIX 6 Correction CONTENTS, 1.3, 2.1, 2.5, 3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.3.5, 3.3.8, 3.3.9, 3.3.10, 3.3.11, 3.3.12, 3.3.15, 3.3.18, 3.3.19, 3.3.21, 3.3.23, 3.3.24, 3.4.5, 3.5.2, 3.6.1, 3.6.2, 3.6.4, 5.1, Program example of Chapter 6 to Chapter 11, 13.1

SAFETY CAUTIONS

(You must read these cautions before using the product)

In connection with the use of this product, in addition to carefully reading both this manual and the related manuals indicated in this manual, it is also essential to pay due attention to safety and handle the product correctly.
The safety cautions given here apply to this product in isolation. For information on the safety of the PC system as a whole, refer to the CPU module User's Manual.
These **SAFETY CAUTIONS** are classified into two grades: "DANGER" and "CAUTION".

DANGER	Safety caution given when incorrect handling could result in hazardous situations involving the possibility of death or serious injury.
CAUTION	Safety caution given when incorrect handling could result in hazardous situations involving the possibility of moderate or light injury or damage to property.

Note that, depending on the circumstances, failing to follow a **CAUTION** may also have very serious consequences.
Both of these classes of safety caution are very important and must be observed.
Store this manual carefully in a place where it is accessible for reference whenever necessary, and forward a copy of the manual to the end user.

[Cautions on Design]

DANGER

- To ensure that the system as a whole will continue to operate safety even if there is a fault in the external power supply or in the PC itself, provide a safety circuit external to the PC. Otherwise, accidents may be caused by erroneous outputs and malfunctions.

  (1) Construct interlock circuitry to prevent damage to the machine, such as an emergency stop circuit, positioning upper/lower limit interlock, etc., external to the PC.

  (2) Home position return operations are controlled by two data: the home position return direction and the home position return speed, and deceleration starts when the near-point dog comes ON. Consequently, if an incorrect home position return direction is set, motion may continue without deceleration. To prevent damage to the machine if this happens, construct a circuit such as an interlock circuit external to the PC.

  (3) When the module detects as error, a normal deceleration to stop or emergency stop is executed in accordance with the setting for stop group n in the parameters. Match the parameter settings to the system specifications.
  Also, set home position return data and positioning data with values no greter than the values specified in the porameters.

CAUTION

- Do not bundle the control wire and communication cable with the main circuit or power line or keep them close to one another.
  Keep the control wire and the communicaiton cable at least 100 mm away from the main circuit or power line: otherwise, noise or malfunctions will occur.

[Cautions on Installation]

DANGER

- Use the PC in the environment specified in the General Specifications section in this manual. Using it in an environment which does not meet the general specifications could cause electric shock, fire or malfunctions, and damage or deterioration of the module.
- Install the module by engaging the module mounting projections on the lower part of the module in the mounting holes of the base unit. Incorrect installation could result in malfuncitons, failure of detachment.
- Engage the drive unit connector and peripheral device connector securely with the connectors on the module: you will hear a click on engagement. Failure to engage the connectors properly could result in a faulty connection, leading to erroneous inputs and outputs.
- If no drive unit is connected, be sure to fit the cover on the connector. Failure to fit the cover could result in malfunctions.

[Cautions on Wiring]

CAUTION

- Carry out wiring to the module correctly, checking the terminal arrangement.
- Take all possible measures to prevent chips or wire scraps from entering the module. Entry of foreign material will cause fire, failure of malfunctions.

[Cautions on Start-Up and Maintenance]

DANGER

- Switch the power off before cleaning the module. If the power is left on, the module will break down or malfunction.

CAUTION

- Do not disassemble or tamper with the module. This will cause failure, malfunctions, injuries or fire.
- Switch the power OFF before installing or removing the module. If the power is left on, the module will break down or malfunction.
- For test operation, set lower speed restriction values in the parameters and make sure that motion can be stopped immediately in the event of any hazard before starting the operation.

[Cautions on Method of Use]

CAUTION

- When specifying the speed for the reference axis in an interpolation operation, note that the speed for the corresponding axis (second axis) may be greater than the set speed (i.e. greater than the speed restriction).

[Cautions on Disposal]

CAUTION

- Dispose of this product as industrial waste.

INTRODUCTION

Thank you for choosing the Mitsubishi MELSEC-A Series of General Purpose Programmable Controllers. Please read this manual carefully so that the equipment is used to its optimum. A copy of this manual should be forwarded to the end User.

CONTENTS

About Manuals

The manuals related to this positioning module are listed below.
Please order those you require.

Related Manuals

Manual Title	Manual No. (Type Code)
AD75P1/P2/P3 Type Positioning Module User's Manual (Hardware) Describes the performance specifications, I/O interface, nomenclature and start-up procedure of the AD75P1/P2/P3 type positioning modules. (Packed with the module)	IB-66585
A1SD75P1/P2/P3 Type Positioning Module User's Manual (Hardware) Describes the performance specifications, I/O interface, nomenclature and start-up procedure of the A1SD75P1/P2/P3 type positioning modules. (Packed with the module)	IB-66584
SW0IVD-AD75P Type Positioning Module Software Package Operating Manual Describes how to use the above software package to create and transmit data (parameters, positioning data, etc.) to a positioning module, and perform positioning monitoring and testing. (Packed with each software package)	IB-66596

Manual Organization

This manual contains the general description, specifications, and details on functions and their use, connection to external devices, and the programming method, for the positioning modules indicated in Chapter 1.

(1) Chapter 1
Gives a general description of each positioning function, and the features of the positioning module.

(2) Chapter 2
Describes the system configuration and devices required for positioning, and gives the precautions on system configuration.

(3) Chapter 3
Describes the specifications and functions of the positioning module, and I/O signals from/to the PC CPU and buffer memory.

(4) Chapter 4
Describes the start-up procedure, handling and operation of the positioning module, and wiring with external devices.

(5) Chapters 5 to 11
These sections describe the software settings and programming required to use each function, including home position return and positioning.

(6) Chapter 12
Describes the program to set clock data, parameters, home position return data, positioning data and start information, from a sequence program.

(7) Chapter 13
Describes error and warning codes displayed when errors occur, and troubleshooting.

(8) APPENDICES
Describe the processing time of the positioning module, examples of connections to external devices, etc.

POINT

This manual describes the functions and method of use of the AD75P3 and A1SD75P3, both of which control three axes.
When using a positioning module controlling two axes or one axis, ignore the descriptions relating to these modules.
(Example) When using an AD75P1 or A1SD75P1, ignore the information relating to the following:
- Interpolation operation, simultaneous start
- I/O signals and buffer memory for controlling second and third axes
- Positioning parameters and data for controlling second and third axes

1. GENERAL DESCRIPTION

This manual describes the specifications, start-up procedure, positioning functions and their use, and programming method of the positioning modules indicated below (hereafter called the AD75).

Number of Controllable Axes	Module Type	
	For Building Block Type	For Compact Building Block Type
1 axis	AD75P1	A1SD75P1
2 axes	AD75P2	A1SD75P2
3 axes	AD75P3	A1SD75P3

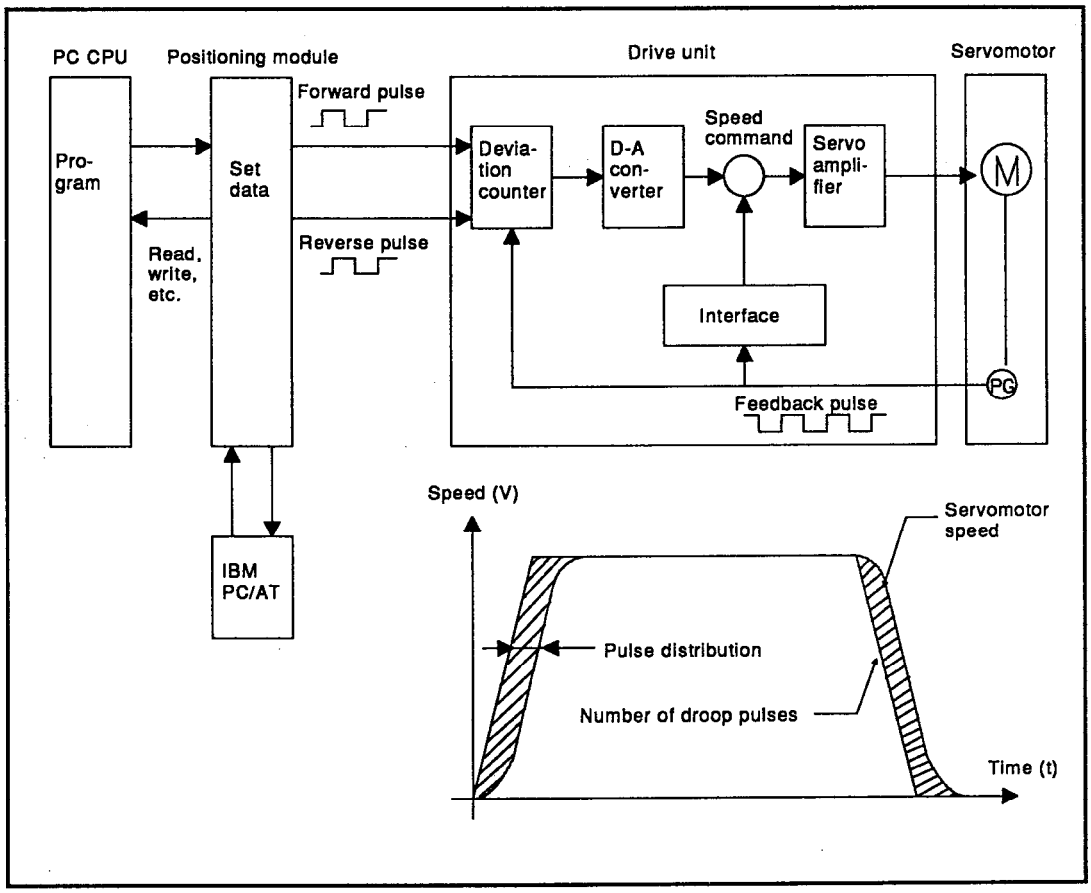


Fig. 1.1 Positioning Control Block Diagram

1.1 Features

The AD75 has the following features:

(1) Wide variety of positioning modules for 1-axis to 3-axis control

(a) A wide variety of positioning modules (six types) are available for 1-axis to 3-axis control.
The most suitable positioning module for the PC CPU type and the number of axes to be controlled can be selected.

(b) Two or more AD75s can be mounted at the same base unit slot, and the number of PC CPU I/O points occupied by each module is 32.
Any number of modules can be mounted provided the number of occupied I/O points they require exceeds the number of points available at the PC CPU.

(2) Diverse positioning control functions

(a) The AD75 incorporates diverse functions that enable the positioning system to control positioning to any specified position and execute fixed-pitch feed control, constant speed control, etc.
Section 1.2 outlines each of the positioning control functions.

1) Up to 600 data items, including positioning addresses, control method and operation pattern, can be set per axis.
This positioning data is used to position each axis in "independent operation" and "multi-axis (simultaneous) operation".

2) Linear control can be performed during positioning of each axis (simultaneous linear control of three axes is possible), and positioning can be executed on the basis of a single positioning data setting or by consecutively processing two or more data settings.

3) In multi-axis positioning, linear interpolation control and circular interpolation control can be performed with two axes. Positioning on each axis can be executed on the basis of a single positioning data setting or by consecutively processing two or more data settings.

(b) Position control, speed control or speed/position switching control can be specified as the control method for positioning data.

(c) The operation pattern set by the user as positioning data allows continuous positioning on each axis or on two or more axes on the basis of multiple positioning data settings.
These multiple positioning data settings are contained in a "block", and continuous positioning extending over more than one block is possible.

(d) Improved home position return control

1) Six home position return methods - near-zero point dog (one type), stopper (three types) and count (two types) - are available.

2) A home position return retry function is provided for positioning from any position to the machine home position.

(e) Either automatic trapezoidal acceleration/deceleration or S-pattern acceleration/deceleration can be selected as the acceleration/deceleration method.

(3) Faster start processing

Faster processing at the start of positioning has reduced the start processing time to 20 ms.
There is no delay between the axes when a simultaneous start is executed (independent operation, interpolation operation).

(4) Faster pulse output and longer distance between the module and the drive unit

(a) The AD75 is equipped with a differential driver pulse output interface and an open collector pulse output interface.
Connect the drive unit to the correct interface for the type of drive unit.

(b) Connecting the AD75 to a differential driver increases the pulse output speed and the possible communication distance.

- When connecting the AD75 to a differential driver
  : 400 kpps, max. 30 m
- When connecting the AD75 to an open collector
  : 200 kpps, max. 3 m

(5) Easy maintenance

The following points facilitate the maintenance of the AD75:

(a) Positioning data, parameters and other data are stored in the internal flash ROM of the AD75.
The data can therefore be retained without a battery.

(b) A 17-segment display shows errors, mechanical system input status and zero point input status.

(c) Errors are categorized to improve primary diagnosis performance.

(d) Since up to 16 of latest errors or warnings can be stored for each axis, it is easy to identify any error or warning which has occurred.

1.2 General Description of Positioning Control Functions

This section describes the AD75's positioning control functions.

1.2.1 Positioning control

Positioning on the basis of the positioning data is described below.

(1) Linear positioning control

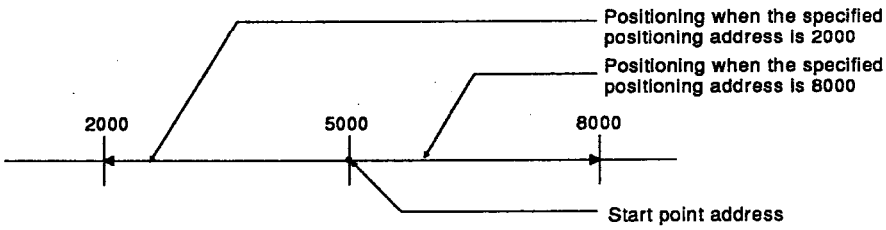
(a) 1-axis linear positioning control

This function controls positioning of a selected axis from the start point address (present stop position) to the specified position.

Control by absolute data method

1) This method controls positioning from the start point address to the specified positioning address.
2) The travel direction depends on the start point and specified positioning addresses.

[Example]
The figure below shows positioning control when the start point address is 5000 and the specified positioning addresses are 2000 and 8000.

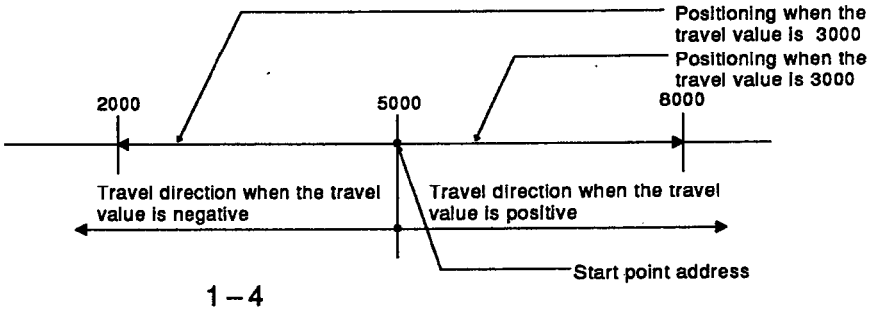


Control by incremental method

1) This method controls positioning for the specified travel value from the start point address.
2) The travel direction depends on the travel value sign.

- + travel direction ..... Positioning in forward direction (direction in which addresses increase)
- – travel direction ..... Positioning in reverse direction (direction in which addresses decrease)

[Example]
The figure below shows positioning control when the start point address is 5000 and the specified travel values are 3000 and -3000.



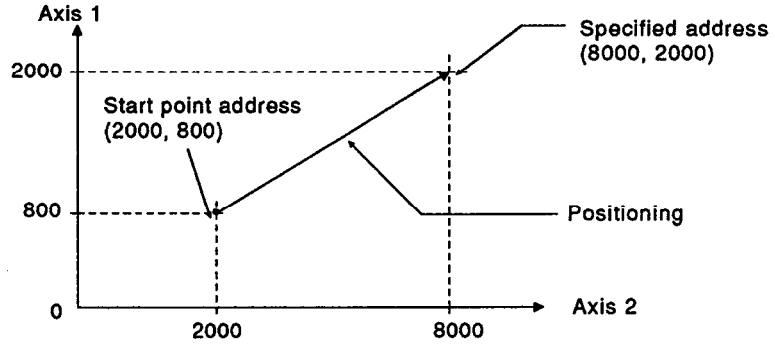
(b) 2-axis linear interpolation control *

This function performs linear interpolation control from the start point address (present stop position) using two specified axes.

Control by absolute data method

1) This method uses two axes to perform linear interpolation from the start point address to the specified positioning address.
2) The travel direction depends on the start point and specified positioning addresses of each axis.

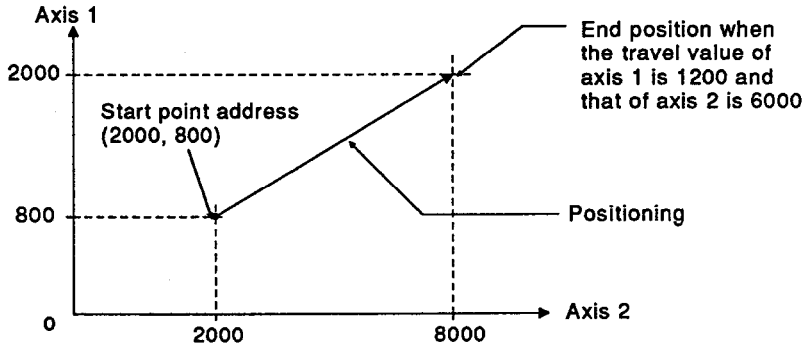
[Example]
The figure below shows positioning control when the start point address and specified positioning address of axis 1 are 800 and 2000 and those of axis 2 are 2000 and 8000.



Control by incremental method

1) This method controls positioning from the start point address to the position determined by the travel direction and distance specified for each axis.
2) The travel direction of each axis depends on the travel value sign.
   - + travel value ..... Positioning in forward direction (direction in which addresses increase)
   - - travel value ..... Positioning in reverse direction (direction in which addresses decrease)

[Example]
The figure below shows positioning control when the start point address and specified travel value of axis 1 are 800 and 2000 and those of axis 2 are 2000 and 8000.



REMARK

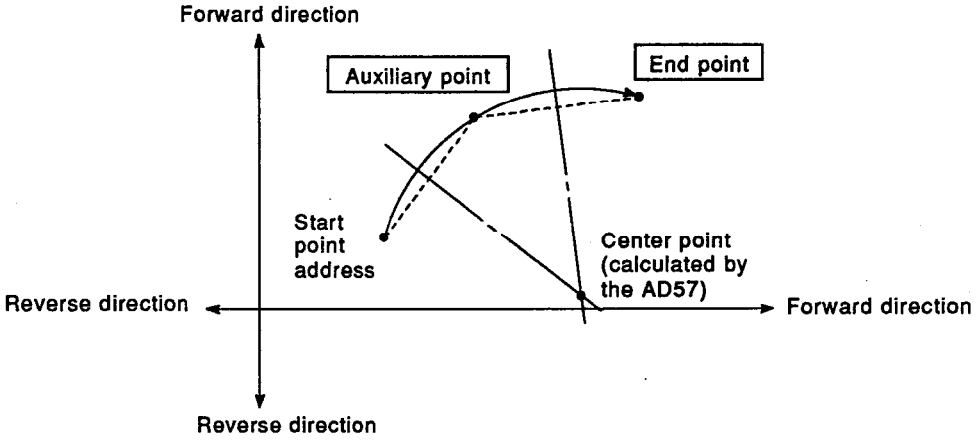
The interpolation speed for linear interpolation can be designated as either the "resultant speed" or "reference axis speed" in the extended parameter settings.
(For details on the extended parameters, See Section 3.4.2.)

(2) Circular interpolation positioning control *

Circular interpolation positioning control is classified into circular interpolation by designating an auxiliary point, and circular interpolation by designating a center point.

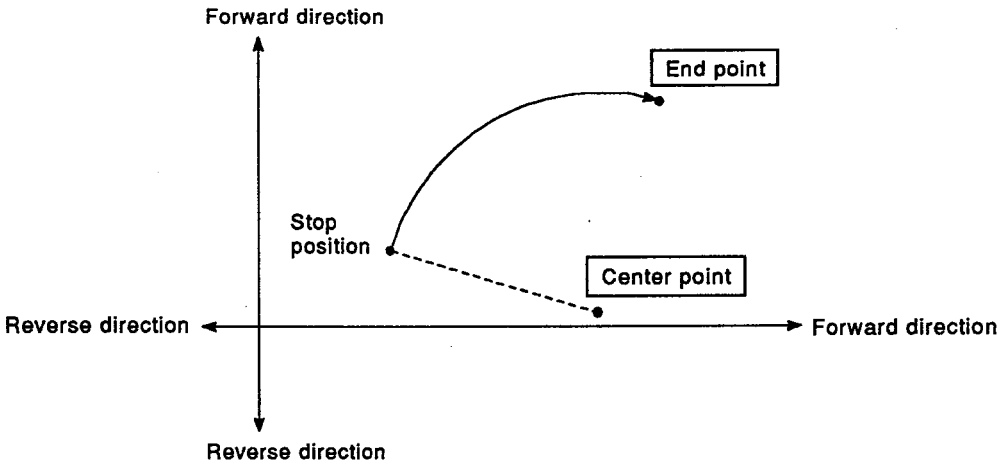
(a) Circular interpolation control by specifying an auxiliary point

This circular interpolation control is performed by designating an end point and an auxiliary point (pass point) for circular interpolation. The absolute data method or incremental method can be used.



(b) Circular interpolation control by designating a center point

This circular interpolation control is performed by designating the end point and center point of a circle for circular interpolation. The absolute dada method or incremental method can be used. The clockwise or counter-clockwise direction can be selected.



REMARK

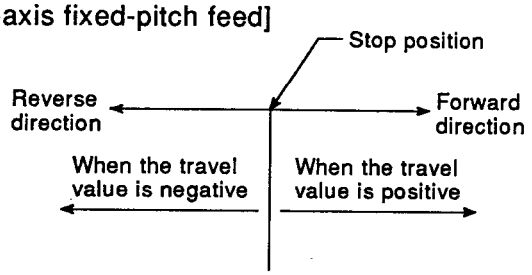
The interpolation speed for arc interpolation can be designated as either the "resultant speed" or "reference axis speed" in the extended parameter settings.
(For details on the extended parameters, See Section 3.4.2.)

(3) Fixed-pitch feed control

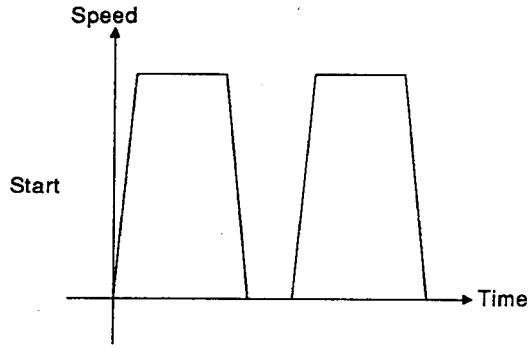
This function controls positioning for a specified travel value.
One-axis fixed-pitch feed control and fixed-pitch feed control by 2-axis linear interpolation are available.

Positioning direction

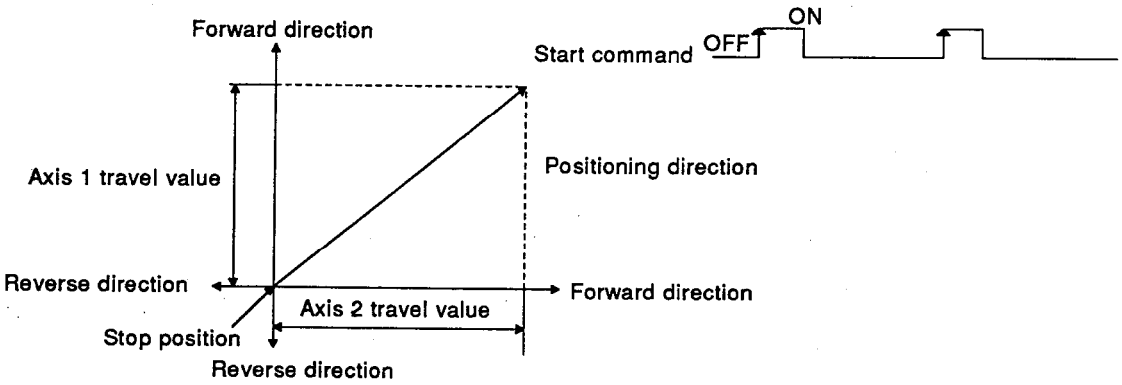
[1-axis fixed-pitch feed]



Operation timing

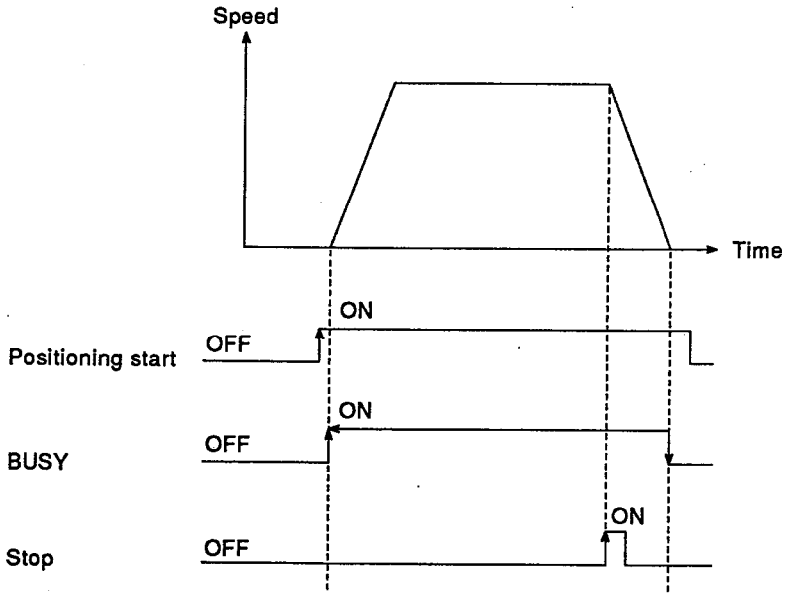


[2-axis fixed-pitch feed]



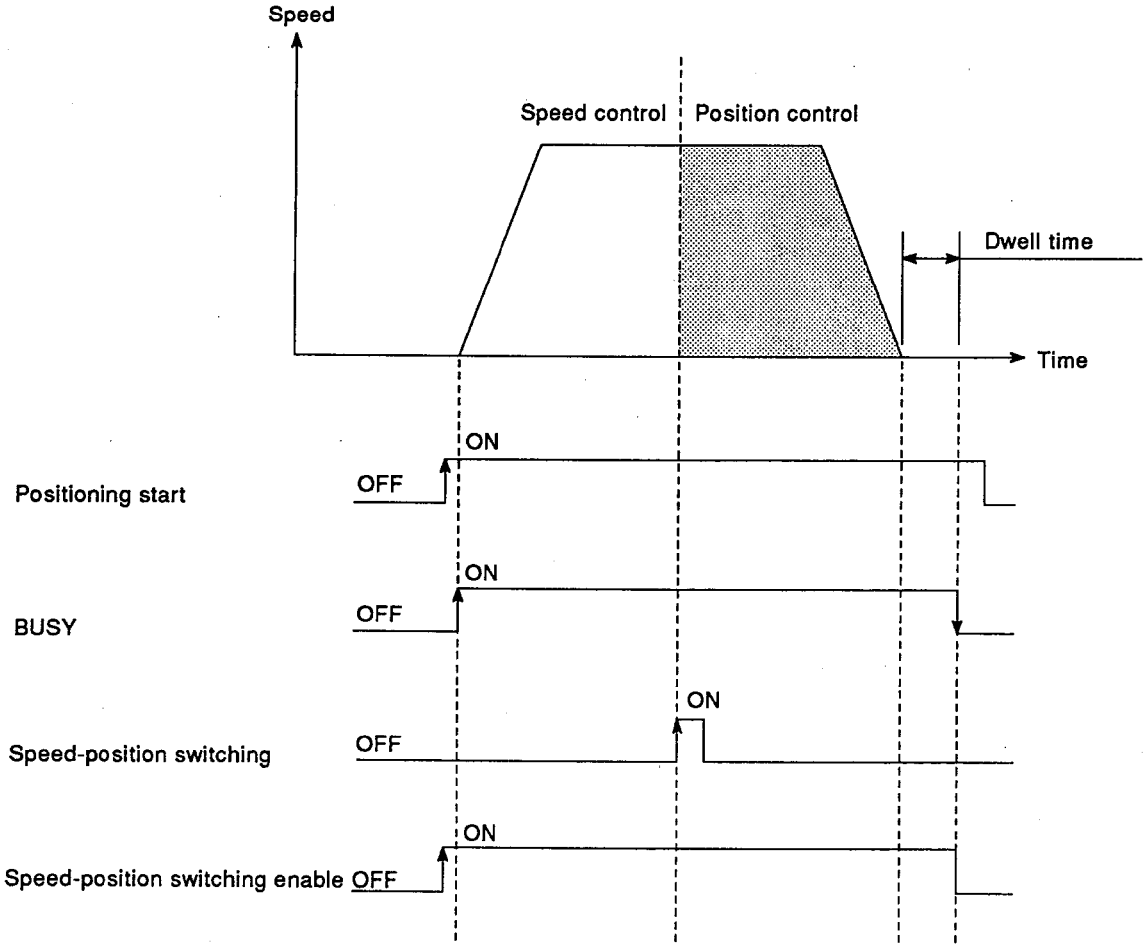
(4) Speed control

Positioning control is performed at the command speed until a stop command is issued after execution of an instruction



(5) Speed-position switching control

When a speed-position switching signal is input during speed control positioning, the control mode switches to position control to perform positioning for a specified travel value.



1.2.2 Individual positioning/continuous positioning control

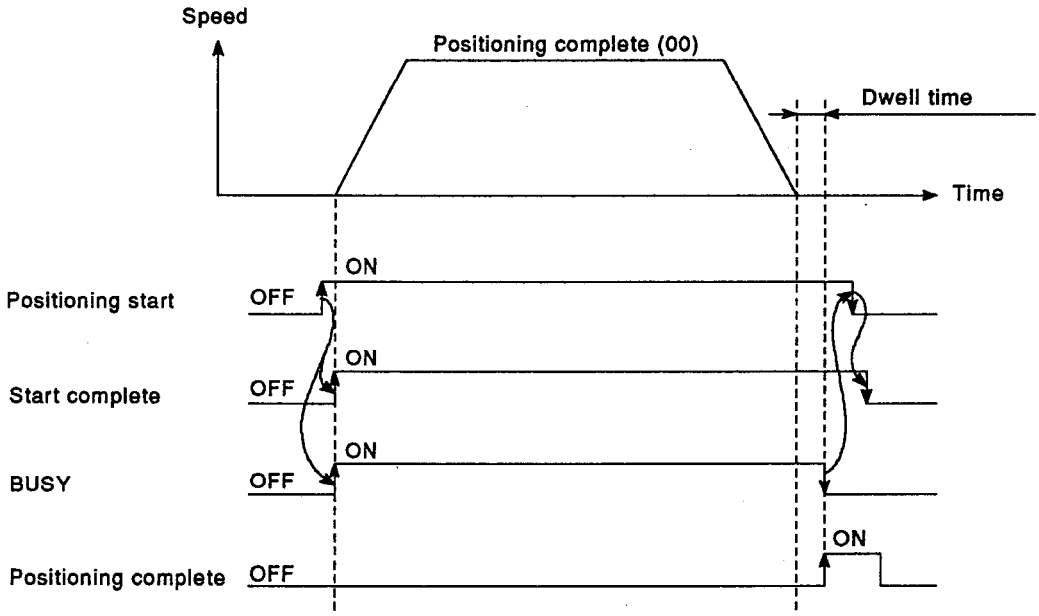
The AD75 performs positioning control according to a set of positioning data set by the user, including control method (position control, speed control or speed-position switching control), positioning addresses and operation pattern.

Up to 600 positioning data can be stored per axis in positioning data Nos. 1 to 600 of the AD75.

Whether positioning according to single positioning data setting or continuous positioning using multiple positioning data settings is performed depends on the operation pattern set by the user as positioning data.

(1) Individual positioning control
(operation pattern = 00: positioning complete)

On completion of positioning in accordance with the specified positioning data, the system stops positioning.
Individual positioning control is also used as the operation pattern for the final positioning data in continuous positioning and continuous locus positioning on completion of positioning in accordance with this operation pattern.

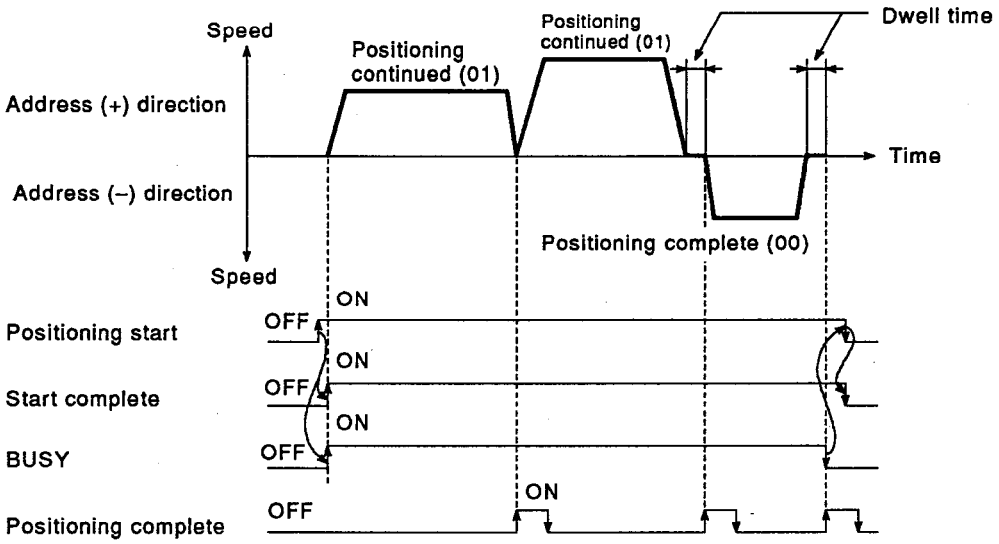


REMARK

Up to 100 positioning data (positioning data No.1 to 100) per axis can be set in the AD57 buffer memory with the sequence program.

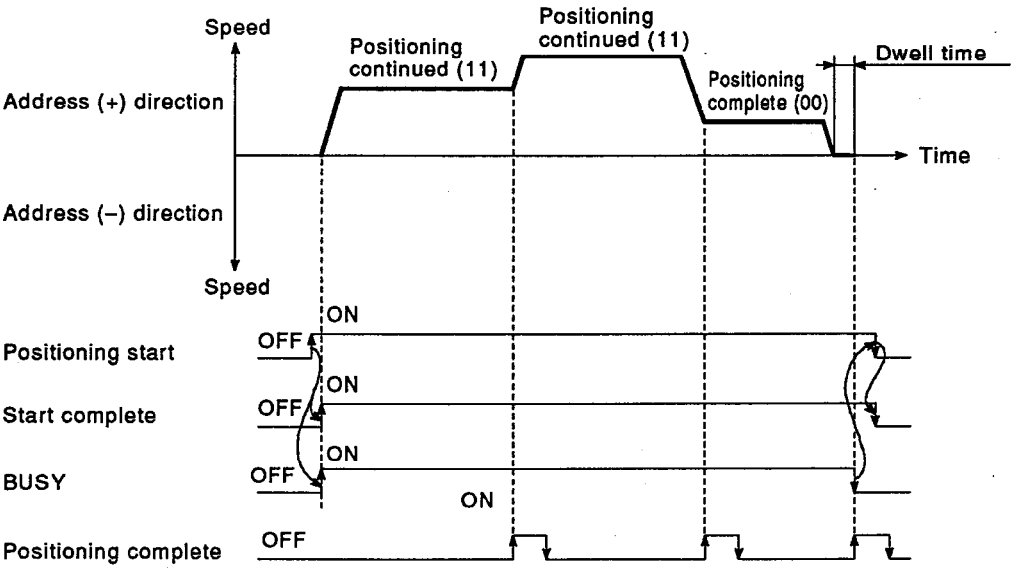
(2) Continuous positioning control
(operation pattern = 01: positioning continued)

The system temporarily stops positioning on completion of positioning using specified positioning data, then restarts positioning based on the data of the next positioning data number.
This mode is selected to perform continuous positioning with direction changes, based on multiple positioning data settings with consecutive numbers.



(3) Continuous locus positioning control
(operation pattern = 11: positioning continued)

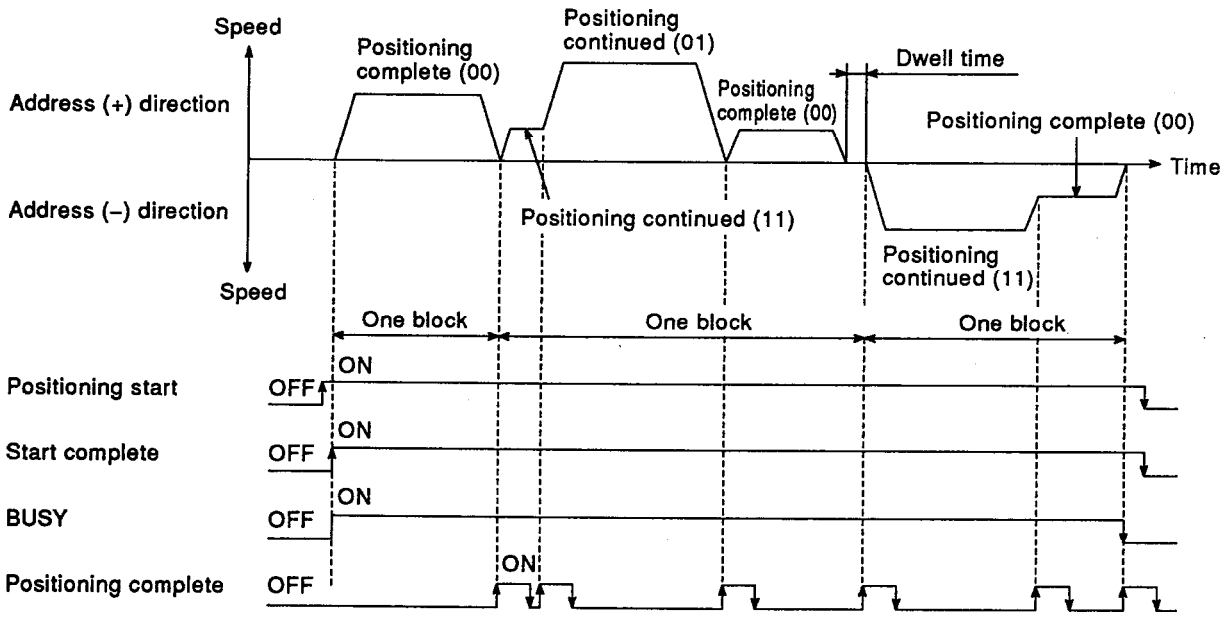
After executing positioning using specified positioning data, the system continues positioning at the speed specified for the next positioning data number.
This mode is selected to perform continuous positioning at a specified speed, based on multiple positioning data settings with consecutive numbers.



1.2.3 Block positioning control

The block positioning control function allows consecutive execution of a number of specified blocks.
A "block" is a single positioning control sequence up to "positioning complete" (operation pattern = 00) in the individual positioning or continuous positioning control mode.
Up to 50 blocks can be specified per axis.

This function allows complicated positioning control to be performed with only one start command from the ACPU or an external device.
To execute block positioning control, the positioning start number and its information must be written to the buffer memory.



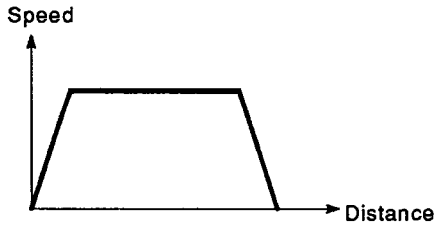
1.2.4 Acceleration/deceleration processing

During positioning, manual pulse generator operation, home position return or JOG operation, acceleration/deceleration processing takes place according to the user-specified method and acceleration and deceleration times.

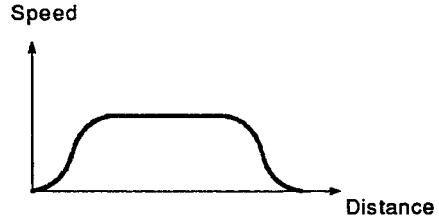
(1) Acceleration/Deceleration method

There are two acceleration/deceleration methods, "automatic trapezoidal acceleration/deceleration" and "S-pattern acceleration/deceleration": the method used is selected in the detailed parameter settings. The specified acceleration/deceleration processing method applies to acceleration/deceleration in all of the following operations: positioning, home position return, JOG operation start and end, speed change, etc.

(a) Automatic trapezoidal acceleration/deceleration method
This method performs linear acceleration and deceleration based on the user-set acceleration and deceleration times and the speed control limit.



(b) S-pattern acceleration/deceleration method
This method reduces the load on the motor when it starts and stops. Gradual acceleration/deceleration is performed based on the user-set acceleration and deceleration times, speed control limit and S-curve ratio (1 to 100%).



(2) Acceleration time, deceleration time, rapid stop/deceleration time

(a) Up to four acceleration times (1 to 65535 ms) and deceleration times (1 to 65535 ms) for positioning control can be specified when setting basic parameters and extended parameters.

- Acceleration time ..... Time required to accelerate from 0 to the speed control limit.
- Deceleration time ..... Time required to decelerate from the speed control limit to 0.

(b) Specify the rapid stop deceleration time (1 to 65535 ms) when setting the extended parameters.

1.2.5 Restart

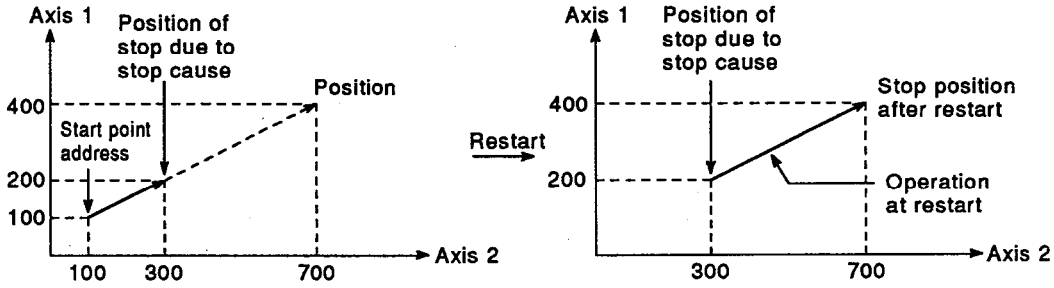
The restart command enables the machine to restart and move to the end point of the positioning data if the machine comes to a stop during positioning control due to a stop cause.

(1) When there is a restart command in the buffer memory

(a) When the axis is at a stop, positioning restarts from the present axis position and continues to the end point of the positioning data regardless of whether the absolute data method or incremental method is selected.

(b) When the axis in a state other than stopped or on standby, a restart disabled warning (error code: 104) is triggered and the restart command is ignored.

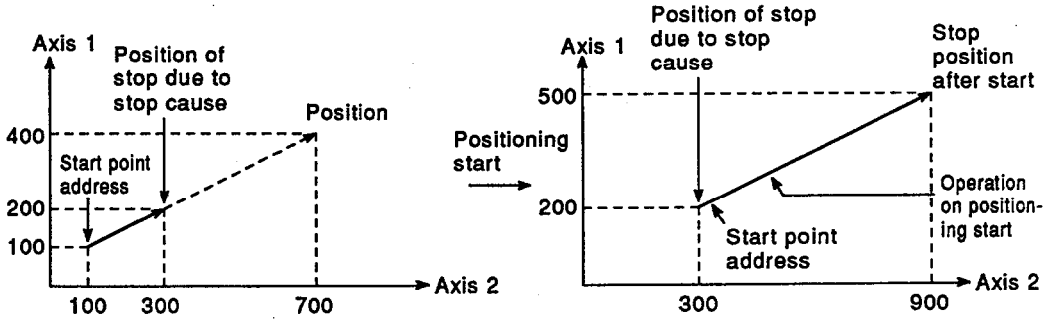
[Incremental method]
Operation when the axis 1 travel vale is 300 and the axis 2 travel value is 600.



(2) When a positioning start signal (Y10 to Y12) or external start signal is turned ON

When the axis is on standby or at a stop, positioning restarts from the beginning of the positioning start data regardless of whether the absolute data method or incremental method is selected (same as regular positioning).

[Incremental method]
Operation when the axis 1 travel value is 300 and the axis 2 travel value is 600.



1.2.6 Home position return

The home position return function is used to confirm that the machine is at the home position when the power is switched on, etc.

There are six home position return methods.

(1) Near-zero point dog method (one type)

This method stops axis motion in response to a zero-point signal after the near-zero point dog has gone OFF.

(2) Stopper method (three types)

(a) Stopper (1) (on lapse of dwell time)

In this method home position return is completed on elapse of the dwell time after axis motion has been decelerated by turning ON the near-zero point dog, then stopped by the stopper.

(b) Stopper (2) (by zero-point signal issued when the machine contacts the stopper)

In this method home position return is completed on receipt of the zero-point signal after axis motion has been decelerated by turning ON the near-zero point dog, then stopped by the stopper.

(c) Stopper (3) (method without a near-zero point dog)

In this method home position return is completed on receipt of the zero-point signal after travel at the creep speed and stopping of axis motion by the stopper.

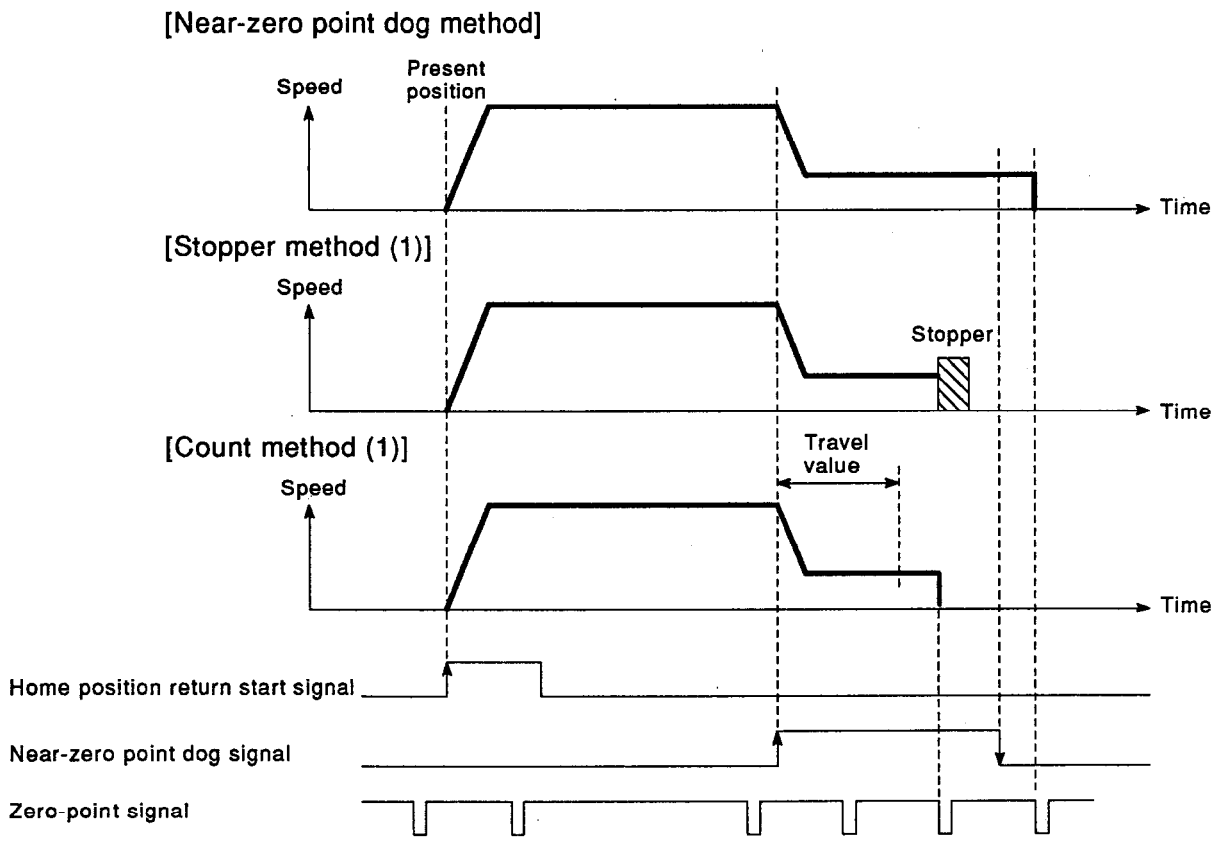
(3) Count method (two types)

(a) Count method (1) (using a zero-point signal)

In this method, axis motion is stopped by a zero-point signal which is issued after travelling for the specified travel value after the near-zero point dog has come ON.

(b) Count method (2) (not using a zero-point signal)

In this method, axis motion is stopped as soon as the machine has traveled for the specified travel value after the near-zero point dog has come ON.



REMARKS

1) Home position return can be performed by the home position return retry function using upper and lower limit switches.

2) After the home position has been established by using the home position return function, it is possible to travel until the machine feed value is equal to the home position address. (This process is the same as positioning to the home position.)

1.3 Comparison with Conventional Positioning Modules

Table 1.1 shows a comparison of specifications between the AD75 and the conventional positioning modules AD71(S1), AD71S2 and A1SD71S2.

Table 1.1 Comparison between AD75 and Conventional Positioning Modules

Specification \ Type	A1SD75P1 AD75P1	A1SD75P2 AD75P2	A1SD75P3 AD75P3	AD71(S1)	A1SD71S2 AD71S2
Number of controlled axes	1 axis	2 axes	3 axes	2 axes	
Number of sets of positioning data	600/axis *1			400/axis	
Interpolation function	——			——	
2-axis linear interpolation	O			O	
2-axis circular interpolation	O			X	
Positioning method	——			——	——
Position control	O			O	O
Speed control	O			X	O
Speed-position switching control	O			X	O
Home position return function	O (6 ways)			O	
JOG operation function	O			O	
Manual pulse generator operation	O			O	X
Acceleration/Deceleration processing	——			——	
Automatic trapezoidal acceleration/deceleration	O			O	
Automatic S-pattern acceleration/deceleration	O			X	
Acceleration/Deceleration time	Acceleration and deceleration times can be set (four patterns each).			The acceleration and deceleration times are the same.	
Compensation	Electronic gear, backlash compensation			Backlash compensation	
Error display	17-segment display			Error LED	
Past data storage (starts, errors, warnings)	Possible (4 types * 16/axis)			Impossible	
Data storage memory	Flash ROM (backup without battery)			Buffer memory (battery backup)	
Number of I/O points	32			32	32 (48) *2
Number of points occupied by module	1			1	1 (2) *3
Peripheral device (data setting, etc.)	——			——	
AD71TU	X			O	
A6GPP, A6PHP	X			O	
IBM PC/AT	X			X	

O: Enable X: Disable

REMARKS

1) *1: The positioning data that can be set using the AD75 buffer memory is positioning data 1 to 100 (i.e. 100 data items) for each axis.
Note that the positioning data in the buffer memory is not backed up.
2) *2: The number of I/O points for an A1SD71S2 is 48.
3) *3: An A1SD71S2 occupies two slots.

1.4 Generic Names, Abbreviations and Terms Used in This Manual

Generic Name/Abbreviation/Term	Description
• Peripheral device	Generic name for IBM PC/ATs which can run the AD75Ps indicated below (differentiated from the "peripheral device for GPP" described below).
• Drive unit (servo amplifier)	Common name of a pulse input processing drive unit (servo amplifier).
• Manual pulse generator	Common name of a manual pulse generator (prepared by the user).
• Data link system	Common name of the MELSECNET (II) or MELSECNET/B data link system.
• Network system	Common name of the MELSECNET/10 network system.
• ACPU	Generic name of an A series PC CPU in which an AD75 can be loaded.
• AD75	Generic name for the AD75P1, AD75P2, AD75P3, A1SD75P1, A1SD75P2 and A1SD75P3 positioning modules. The individual model name is used when referring to a specific module type.
• AD75P	Generic name for SW[ ]IVD-AD75P software packages (the number corresponding to the software package function is indicated in the square brackets [ ]).
• H/W	Abbreviation for hardware.
• I/F	Abbreviation for interface.
• GPP function peripheral device	Generic name of an A6GPP, IBM PC/AT, etc. in which a GPP function software package has been installed (differentiated from "peripheral device" above).
• S/W	Abbreviation for software package.
• 17-segment LED	A 17-segment display on the upper part of the front of the AD75.

1.5 Packed Components

The following table shows the components packed with the AD75.

When unpacking, confirm that all of the following are contained in the package.

Component	Quantity					
AD75P1 type positioning module	1					
AD75P2 type positioning module		1				
AD75P3 type positioning module			1			
A1SD75P1 type positioning module				1		
A1SD75P2 type positioning module					1	
A1SD75P3 type positioning module						1
External wiring connector (made by Sumitomo 3M)	—	—	—	—	—	—
Connector (10136-300VE)	1	2	3	1	2	3
Connector cover (10336-56F0-008)	1	2	3	1	2	3

MEMO

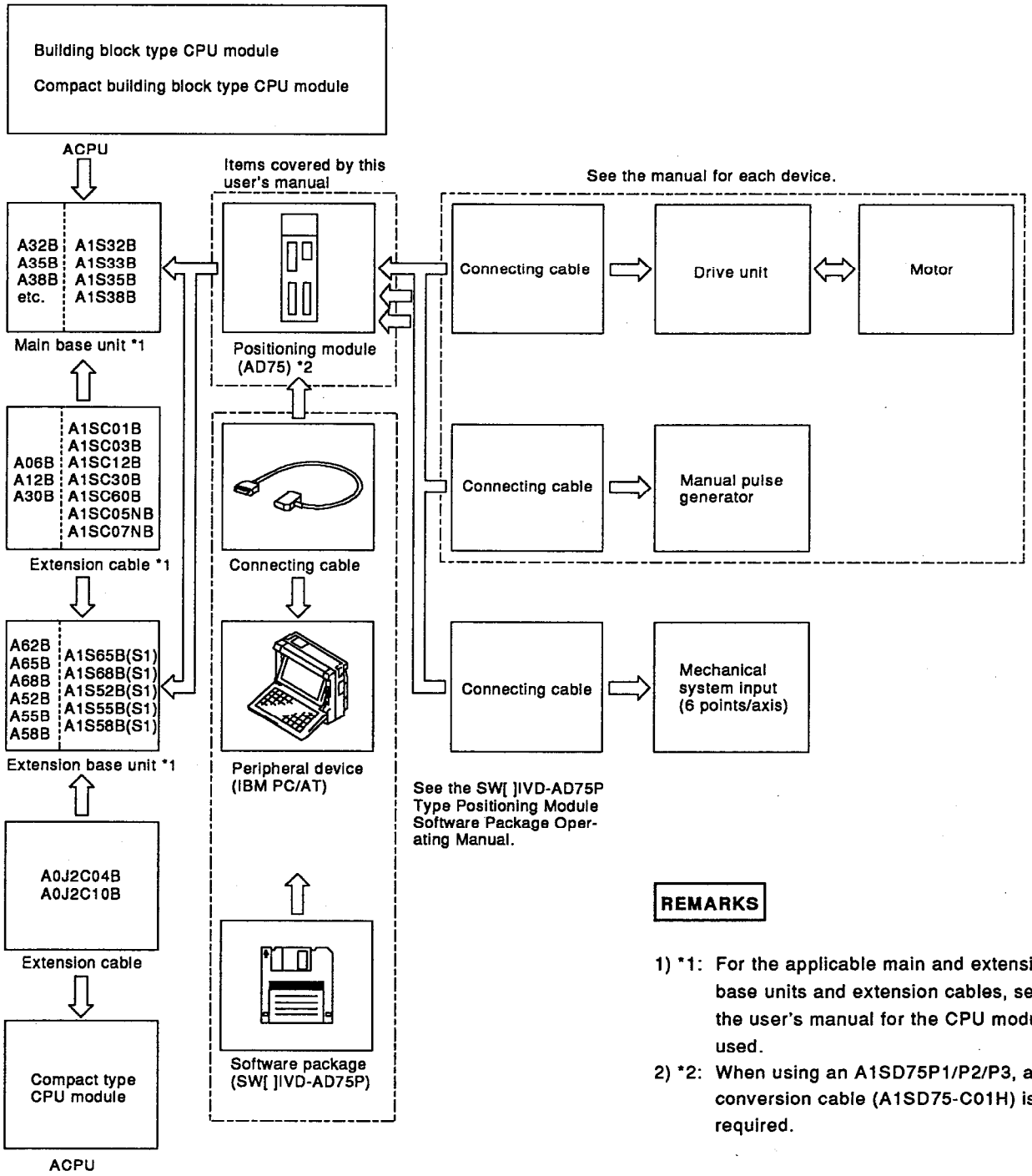
2. SYSTEM CONFIGURATION

This chapter describes the system configuration and system components required for positioning by the AD75.

For details of system configuration using an AD75, see the SW[ ]IVD-AD75P Positioning Module Software Package Operating Manual.

2.1 Overall Configuration

The following figure shows the overall configuration, including an AD75, a PC CPU module and peripheral devices.



REMARKS

1) *1: For the applicable main and extension base units and extension cables, see the user's manual for the CPU module used.
2) *2: When using an A1SD75P1/P2/P3, a conversion cable (A1SD75-C01H) is required.

2.2 Applicable Systems

This section describes PC systems compatible with the AD75, and precautions on system configuration.

(1) PC CPUs

(a) AD75P1(P2/P3)

The AD75P1(P2/P3) type positioning module can be used with the following PC CPUs (including those with a link function):

- A0J2CPU
- A0J2HCPU
- A1CPU
- A2(S1)CPU
- A3CPU
- A1NCPU
- A2N(S1)CPU
- A3NCPU
- A3MCPU
- A3HCPU
- A2A(S1)CPU
- A3ACPU
- A2U(S1)CPU
- A3UCPU
- A4UCPU
- A73(S3)CPU
- A81CPU
- A52GCPU
- A1SCPU(S1)
- A1SJCPU
- A2SCPU(S1)
- A2AS(S1/S30)CPU
- Q2A(S1)CPU
- Q3ACPU
- Q4ACPU

* The A73(S3)CPU and A373CPU can be mounted on an extension base unit.

(b) A1SD75P1(P2/P3)

The A1SD75P1(P2/P3) type positioning module can be used with the following PC CPUs (including those with a link function):

- A1SCPU(S1)
- A1SJCPU
- A2SCPU(S1)
- A2AS(S1/S30)CPU
- A52GCPU

(2) Remote I/O station (MELSECNET/10, MELSECNET (II), MELSECNET/B)

The AD75P1(P2/P3) and A1SD75P1(P2/P3) type positioning modules can be used at remote I/O stations of data link systems or network systems, except for the A0J2P25/R25 (remote I/O station).

POINT

One AD75 requires one slot of the base unit, and occupies 32 I/O points of the PC CPU.
Any number of AD75s can be loaded unless the number of occupied I/O points exceeds that of the PC CPU.

2.3 Precautions on System Configuration

The AD75 can be loaded in any slot of a main or extension base unit, but note the following points:

(1) When mounting the AD75 to an extension base unit without a power supply, give careful consideration to the power supply capacity and voltage drop.

(2) The AD75P1(P2/P3) cannot be loaded in the final slot of the seventh extension stage of the A3CPU.

(3) The AD75P1(P2/P3) cannot be mounted on the main base unit of an A73(S3)CPU. Note also that simultaneous starting or interpolation operation with axes controlled by the A73(S3)CPU is not possible.

(4) The A1SD75P1/P2/P3 cannot be mounted next to the extension power supply module of an extension base unit.

(5) The AD75 cannot be mounted at an A0J2P25/R25 (remote I/O station).

(6) For details on mounting the AD75 on a PC CPU or base unit, see the user's manual for the PC CPU used.

2.4 Precautions on Using a Stepping Motor

The following functions of the AD75 are not available when a stepping motor is used:

- S-pattern deceleration processing
- Circular interpolation control

2.5 List of System Components

Table 2.1 shows the components that can be used in a positioning system using an AD75.

Table 2.1 System Components

Component Name	Type	Remarks	
Positioning module	AD75P1 AD75P2 AD75P3 A1SD75P1 A1SD75P2 A1SD75P3	A[ ]D75P[ ] Number of controllable axes	
Software package for AD75	SW[ ]IVD-AD75P	Software package for IBM PC/AT	
Peripheral device for AD75P	IBM PC/AT	(Prepared by user) For details, see the AD75P Operating Manual.	
Conversion cable	A1SD75-C01H	Length 10 cm	Cable to connect an RS-422 cable and A1SD75P [ ].
Connecting cable (converter)	—	The RS-232C cable and RS-232C/RS-422 converter connected between the AD75 and the IBM PC/AT (prepared by the user). For details, see the AD75P Operating Manual.	
Drive unit	—	(Prepared by user)	
Manual pulse generator	—	(Prepared by user) Recommendation: MR-HDP01	
Connecting cable	—	The cable to connect the AD75 and the drive unit or manual pulse generator. (Prepared by the user) For details, see the manual for the device to be connected.	
Connecting cable	—	The connecting cable for mechanical system input signals to the AD75. (Prepared by the user) For details, see the manual for the device to be connected.	
User's floppy disk	SW0S-USER	2HD type	For storing user programs and set data (3.5-inch fomatted)

3. SPECIFICATIONS

This chapter describes the AD75's specifications, functions, set data, buffer memory, I/O signals and I/O interface with an external device.

3.1 General Specifications

The following table shows the general specifications of the AD75.

Table 3.1 General Specifications

Item	Specification				
Operating ambient temperature	0 to 55 °C				
Storage ambient temperature	-20 to 75 °C				
Operating ambient humidity	10 to 90 % RH, no dewing				
Storage ambient humidity	10 to 90 % RH, no dewing				
Vibration resistance	Conforms to JIS B 3501 and IEC 1131-2. *1	In case of intermittent vibration			
		Frequency	Acceleration	Amplitude	Sweep count
		10 to 57Hz	——	0.075 mm (0.003 inch)	10 times in each of X, Y and Z directions (for 80 minutes)
		57 to 150Hz	9.8 m/s^2 (1G)	——	
		In case of continuous vibration			
		Frequency	Acceleration	Amplitude	
		10 to 57Hz	——	0.035 mm (0.0014 inch)	
		57 to 150Hz	4.9 m/s^2 (0.5G)	——	
Shock resistance	Conforms to JIS B 3501 and IEC 1131-2. (147 m/s^2 (15 G), 3 times in each of 3 directions)				
Operating atmosphere	The operating atmosphere shall not contain corrosive gas.				
Operating altitude	2000 m or lower				
Installation site	Inside control panel				
Overvoltage category *2	11 or lower				
Contamination level *3	2 or lower				

*1 JIS: Japanese Industrial Standard

*2 The value indicates the power distribution unit between the public distribution network and the in-plant machinery to which the device is assumed to be connected.
Category II applies to devices powered by fixed equipment.
The surge voltage withstand capability of devices whose rated voltage is 300 V or lower is 2500 V.

*3 This is an index which gives a measure of the incidence of conductive materials in the environment in which the device is used.
A contamination level of "2" indicates an environment in which there is only contamination by non-conducting materials, but, due to occasional condensation, conductivity may occur.

3.2 Performance Specifications

The following table shows the performance specifications of the AD75.

3.2.1 Performance specifications

Table 3.2 Performance Specifications

Item \ Model		A1SD75P1 AD75P1	A1SD75P2 AD75P2	A1SD75P3 AD75P3
Number of controllable axes		Axis 1	Axis 2	Axis 3
Interpolation function		Not available	2-axis linear interpolation 2-axis circular interpolation	2-axis linear interpolation 2-axis circular interpolation
Control method		PTP (Point To Point) control, locus control (both linear and circular modes can be set), speed control, speed/position switching control		
Control unit		mm, inch, degree, pulse		
Positioning data		Peripheral device : 600 data (positioning data No.: 1 to 600)/axis PC program : 100 data (positioning data No.: 1 to 100)/axis only		
Peripheral device		IBM PC/AT: SW0IVD-AD75P		
Backup		Parameters and positioning data are stored in a flash ROM (without a battery).		
Positioning	Positioning method	PTP control : Incremental method/Absolute data method Speed/position switching control : Incremental method Locus control : Incremental method/Absolute data method		
	Positioning range	In absolute data method • -214748364.8 to 214748364.7 (μm) • -21474.83648 to 21474.83647 (inch) • 0 to 359.99999 (degree) • -2147483648 to 2147483647 (pulse) Incremental method • -214748364.8 to 214748364.7 (μm) • -21474.83648 to 21474.83647 (inch) • -21474.83648 to 21474.83647 (degree) • -2147483648 to 2147483647 (pulse) Speed-position switching control • 0 to 214748364.7 (μm) • 0 to 21474.83647 (inch) • 0 to 21474.83647 (degree) • 0 to 2147483647 (pulse)		
	Speed command	0.01 to 6000000.00 (mm/min) 0.001 to 600000.000 (inch/min) 0.001 to 600000.000 (degree/min) 1 to 400000 (pulse/s)		
	Output variation	1 pulse/3.5 ms		
	Acceleration/Deceleration processing	Automatic trapezoidal acceleration/deceleration, automatic S-pattern acceleration/deceleration		
	Acceleration/Deceleration time	1 to 65535 (ms) Four patterns each can be set for acceleration time and deceleration time.		
	Rapid stop deceleration time	1 to 65535 (ms)		
Compensation		With electronic gear and backlash compensation		
Home position return method		Near-zero point dog method, count method, stopper method		
JOG operation function		Equipped		
Manual pulse generator operation function		Available		
M code output function		Equipped (Either WITH or AFTER mode can be selected.)		
Error display		Indicated by the 17-segment display.		
I/O display		Indicated by the 17-segment display and LED indicators.		
Internal current consumption (5 VDC)		A1SD75P[ ] : 0.7 A or lower AD75P[ ] : 0.7 A or lower		
Number of occupied I/O points		32 points (In I/O allocation: Special function module 32 points)		
Size mm [inch]		A1SD75P[ ] : 130 [5] (H) *34.5 [1.3] (W) *93.6 [3.7] (D) AD75P[ ] : 250 [9.7] (H) *37.5 [1.5] (W) *106 [4.1] (D)		
Weight kg [lb]		A1SD5P[ ] : 0.35 [0.77] AD75P[ ] : 0.45 [0.99]		

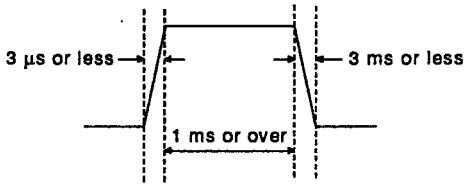
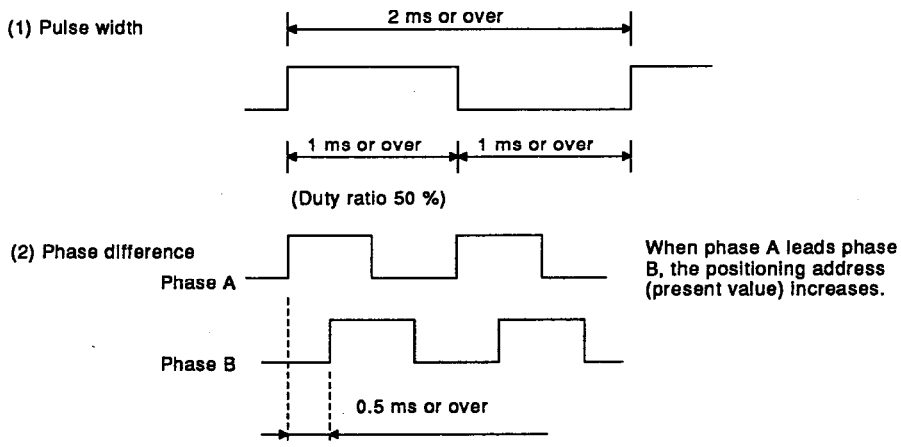
3.2.2 Specifications of I/O interface with external device

This section describes the I/O interface of the AD75 with an external device.

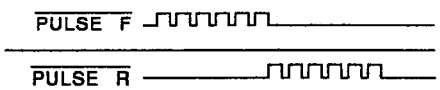
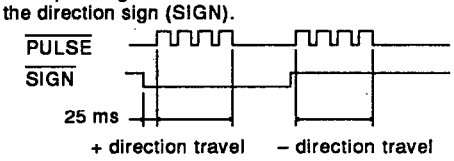
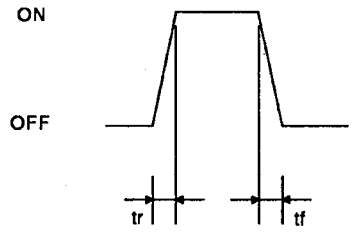
(1) Electrical specifications of the AD75

The following table shows the electrical specifications of I/O signals from/to an external device.

(a) Input specifications

Signal Name	Rated Input Voltage/ Current	Operating Voltage Range	ON Voltage/ Current	OFF Voltage/ Current	Input Resistance	Response Time
Drive unit ready (READY) in-position signal	24 VDC/5 mA	19.2 to 26.4 VDC	17.5 VDC or over/3.5 mA or over	7 VDC or lower/1.7 mA or lower	Approx. 4.7 kΩ	4 ms or less
Zero point signal (PGO)	5 VDC/5 mA	4.5 to 6.1 VDC	2.5 VDC or over/2 mA or over	0.5 VDC or lower/0.5 mA or lower	Approx. 0.5 kΩ	1 ms or less
	24 VDC/5 mA	19.2 to 26.4 VDC	17.5 VDC or over/2 mA or over	7 VDC or lower/0.5 mA or lower	Approx. 8.5 kΩ	1 ms or less
						
Manual pulse generator phase A (PULSER A) Manual pulse generator phase B (PULSER B)	5 VDC/5 mA	4.5 to 6.1 VDC	2.5 VDC or over/3.5 mA or over	1 VDC or lower/1 mA or lower	Approx. 1.5 kΩ	1 ms or less
						
Near-zero point signal (DOG) Stop signal (STOP) Upper limit (FLS) Lower limit (RLS) External start Speed-position switching signal	24 VDC/5 mA	19.2 to 26.4 VDC	17.5 VDC or over/3.5 mA or over	7 VDC or lower/1.7 mA or lower	Approx. 4.7 kΩ	4 ms or less

(b) Output specifications

Signal Name	Rated Load Voltage	Operating Load Voltage Range	Maximum Load Current/Rush Current	Maximum Voltage Drop at ON	Leak Current at OFF	Response Time
Pulse output (CW/PULSE/PHASE A) Pulse sign (CCW/SIGN/PHASE B)	Am26LS31 or equivalent differential driver/open collector					
	CW/CCW type	PULSE/SIGN type	PHASE A/ PHASE B type	Select the CW/CCW, PULSE/SIGN or PHASE A/ PHASE B type when setting driver unit parameters. • CW/CCW type  • PULSE/SIGN type Forward/Reverse feed pulse The operating direction can be identified from the direction sign (SIGN).  • PHASE A/PHASE B type When phase A leads phase B, the positioning address increases. When phase B leads phase A, the positioning address decreases.		
	Forward feed pulse $\overline{\text{PULSE F}}$	Feed pulse $\overline{\text{PULSE}}$	Phase A $\overline{\text{A}\phi}$			
	Reverse feed pulse $\overline{\text{PULSE R}}$	Direction sign $\overline{\text{SIGN}}$	Phase B $\overline{\text{B}\phi}$			
	*The rise time/fall time and duty ratio for the open collector system are shown in the table below. 					
	5 to 24 VDC	4.75 to 30 V	50 mA/point /200 mA and 10 ms or less	0.5 VDC (TYP)	0.1 mA or lower	——
Deviation counter clear ($\overline{\text{CLEAR}}$)	5 to 24 VDC	4.25 to 30 V	0.1 A/point /0.4 A and 10 ms or less	1 VDC (TYP) 2.5 VDC (MAX)	0.1 mA or lower	2 ms or lower (resistance load)

Pulse rise time/fall time of the AD75 (Unit: tr, tf: μs Duty: %)
....At room temperature

1) When the load voltage is 26.4 V

Cable Length (m)		1			3		
Load Current (mA)	Pulse Speed (kpuls/s)	tf (Rise)	tr (Fall)	Duty	tf (Rise)	tr (Fall)	Duty
2	200	0.04	1.70	30	0.06	2.04	27
	100	0.08	3.00	33	0.07	3.49	29
	10	0.07	3.20	48	0.08	6.80	46
5	200	0.06	1.10	39	0.07	1.83	33
	100	0.07	1.24	43	0.08	2.50	36
	10	0.07	1.20	49	0.08	2.70	49
20	200	0.07	0.42	46	0.08	0.72	43
	100	0.07	0.40	48	0.11	0.74	47
	10	0.07	0.40	50	0.08	0.79	50
50	200	0.08	0.28	48	0.09	0.37	47
	100	0.08	0.27	48	0.13	0.37	48
	10	0.09	0.27	50	0.09	0.37	50

2) When the load voltage is 4.75 V

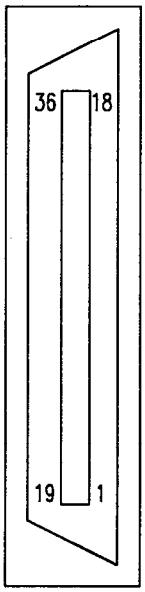
Cable Length (m)		1			3		
Load Current (mA)	Pulse Speed (kpuls/s)	tf (Rise)	tr (Fall)	Duty	tf (Rise)	tr (Fall)	Duty
2	200	0.04	0.63	43	0.04	1.08	38
	100	0.06	0.64	47	0.04	1.28	42
	10	0.04	0.64	49	0.06	1.30	49
5	200	0.04	1.26	48	0.04	0.92	46
	100	0.05	1.26	48	0.06	0.44	47
	10	0.05	1.30	50	0.06	0.44	50
20	200	0.06	0.22	47	0.06	0.22	49
	100	0.08	0.24	50	0.06	0.24	50
	10	0.06	0.24	50	0.06	0.24	50
50	200	0.08	0.20	47	0.10	0.18	50
	100	0.08	0.22	49	0.12	0.20	51
	10	0.08	0.22	50	0.12	0.20	50

(2) Specifications of I/O interface with external device

This section describes the specifications of the AD75's I/O interface with an external device.

(a) Connector signal pin layout

The following table shows the signal pin layout of the AD75's connector for external device (for one axis).
(The signal pin layout of the connector for connection to external devices is the same for axes 1 to 3.)

Pin Layout	Pin No.	Signal Name		Signal Direction AD75 - External Device	Connecting Device
	36	Common	COM	<---->	Drive unit
	35	Common	COM	<---->	Drive unit
	34	Unused			
	33	Unused			
	32	Unused			
	31	Unused			
	30	Unused			
	29	Unused			
	28	Manual pulse generator	Phase B–	<-----	Manual pulse generator
	27	Manual pulse generator	Phase A–	<-----	Manual pulse generator
	26	Common	COM	<---->	Drive unit
	25	Zero point signal common	COM	<-----	Drive unit
	24	Zero point signal	+5 V	<-----	Drive unit
	23	Deviation counter clear common	COM	<---->	Drive unit
	22	Pulse sign (differential-)	CCW/SIGN/Bϕ	----->	Drive unit
	21	Pulse output (differential-)	CW/PULSE/Aϕ	----->	Drive unit
	20	Pulse sign common (open collector)	CCW/SIGN/Bϕ	<---->	Drive unit
	19	Pulse output common (open collector)	CW/PULSE/Aϕ	<---->	Drive unit
	18	Unused			
	17	Unused			
	16	External start (*1)	START	<-----	(External device)
	15	Speed-position switching signal		<-----	(External device)
	14	Stop signal	STOP	<-----	(External device)
	13	Lower limit	RLS	<-----	Limit switch
	12	Upper limit	FLG	<-----	Limit switch
	11	Near-zero point signal	DOG	<-----	Near-zero point dog
	10	Manual pulse generator	Phase B+	<-----	Manual pulse generator
	9	Manual pulse generator	Phase A+	<-----	Manual pulse generator
	8	In-position	INPOS	<-----	Drive unit
	7	Drive unit ready	READY	<-----	Drive unit
	6	Zero point signal	+24 V	<-----	Drive unit
	5	Deviation counter clear	CLEAR	----->	Drive unit
	4	Pulse sign (differential+)	CCW/SIGN/Bϕ	----->	Drive unit
	3	Pulse output (differential+)	CW/PULSE/Aϕ	----->	Drive unit
	2	Pulse sign (open collector)	CCW/SIGN/Bϕ	----->	Drive unit
	1	Pulse output (open collector)	CW/PULSE/Aϕ	----->	Drive unit

REMARK

*1: The signal application depends on the selection of the external start function of extended parameters #2.

(b) Description of connector signals

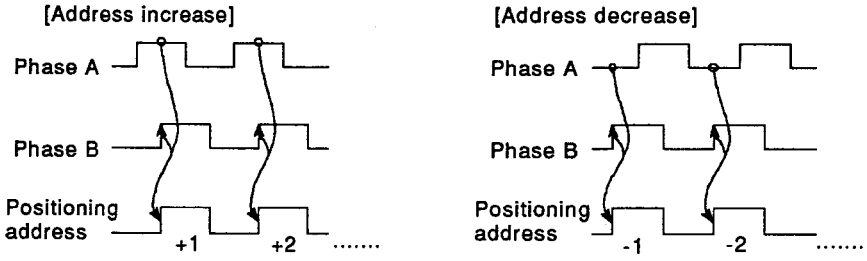
Details of the signals exchanged through the AD75's connector for external device (for one axis) are given below.

1) Common ... (Pin Nos. 36 and 35)

- Common for near-zero point signal, lower and upper limits, stop signal, control switching signal and external start.

2) Manual pulse generator (phase B–), manual pulse generator (phase A–) ... (Pin Nos. 28 and 27)
Manual pulse generator (phase B+), manual pulse generator (phase A+) ... (Pin Nos. 10 and 9)

- Phase A and phase B signals of the manual pulse generator or rotary encoder are inputted.
- When phase A leads phase B, the positioning address increases.
- When phase B leads phase A, the positioning address decreases.



3) Common ... (Pin No. 26)

- Common for drive unit ready and in-position.

4) Common ... (Pin No. 25)

- Common for deviation counter clear.

5) Zero point signal common ... (Pin No. 25)

- Common for zero point signals (+5 V and +24 V)

6) Zero point signal (+5 V), zero point signal (+24 V) ... (Pin Nos. 24 and 6)

- The home position signal is input in home position return. The zero point grid signal from a general pulse encoder is used.
- These signals are also used when the stopper stop method is selected for home position return and a home position return completed signal is input from the external device.
- The home position is detected at the trailing edge of the pulse.

7) Pulse sign, pulse output (differential–) ... (Pin Nos. 22 and 21)
Pulse sign, pulse output (differential+) ... (Pin Nos. 4 and 3)

- A positioning pulse and a pulse sign are output to the drive unit for the differential driver.

8) Pulse sign common, pulse output common (open collector) ... (Pin Nos. 20 and 19)
Pulse sign, pulse output (open collector) ... (Pin Nos. 2 and 1)

- A positioning pulse and a pulse sign are output to the drive unit for the open collector.

9) External start ... (Pin No. 16)

- This signal is used as an external input signal for positioning start, speed change request or skip request.
- The function which will perform an external start depends on the external start function selection of detailed parameter 2.

10) Speed-position switching signal ... (Pin No. 15)

- A control switching signal is input in speed/position switching control.

11) Stop signal ... (Pin No. 14)

- This signal is input to discontinue positioning.
- As soon as this signal is turned ON, the AD75 discontinues the ongoing positioning, and turns OFF the start signal. Thereafter, axis motion will not start even if this signal is turned OFF.

12) Lower limit ... (Pin No. 13)

- The limit switch mounted at the lower stroke end issues this signal.
- Turning OFF this signal discontinues positioning.
- This signal indicates the lower limit for detecting a near-zero point signal when home position return is performed.

13) Upper limit ... (Pin No. 12)

- The limit switch mounted at the upper stroke end issues this signal.
- Turning OFF this signal discontinues positioning.
- This signal indicates the upper limit for detecting a near-zero point signal when home position return is performed.

14) Near-zero point signal ... (Pin No. 11)

- This signal is used to detect the near-zero point dog in home position return.
- The near-zero point dog status switching from OFF to ON is detected at the leading edge of the pulse.
- The near-zero point dog status switching from ON to OFF is detected at the trailing edge of the pulse.

15) In-position ... (Pin No. 8)

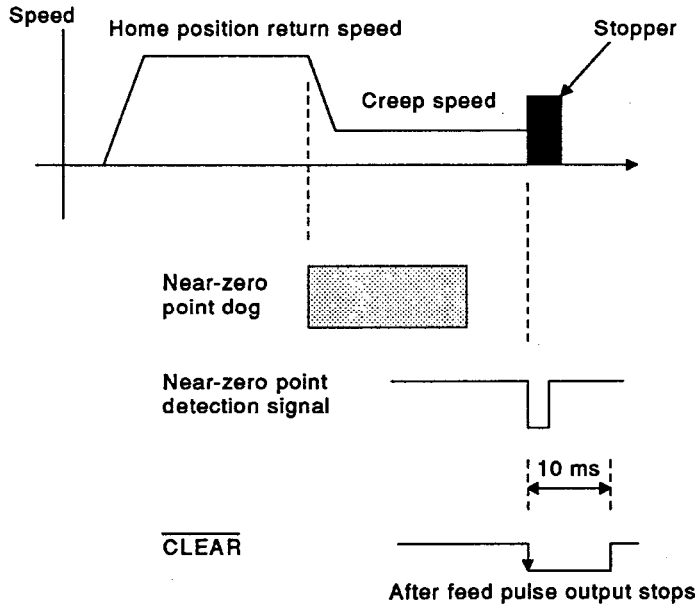
- The drive unit inputs an in-position signal.

16) Drive unit ready ... (Pin No. 7)

- This signal is turned ON when the drive unit is operating normally and is ready to receive feed pulses.
- The AD75 checks the drive unit ready signal, and issues a home position return request if the drive unit is not ready for operation.
- This signal is turned OFF when the drive unit is malfunctioning because of a drive unit control power supply failure.
- If this signal is turned OFF during positioning, axis motion stops. It will not restart even if the signal is turned back ON.
- Turning OFF this signal turns OFF the home position return signal.

17) Deviation counter clear ... (Pin No. 5)

- When performing home position return by stopper stop method (1) or (2), this signal is turned ON after the pulse output has stopped.
  (Example)
  In the case of home position return by stopper stop method (2)



- A deviation counter clear signal is issued for about 10 ms.
- Use a drive unit capable of resetting the number of droop pulses of the internal deviation counter when the AD75 turns ON this signal.

(c) Internal Circuit

The following table shows the schematic circuit diagrams of the internal circuits of the AD75's interface for external devices.

Internal Circuit	Pin No.	Signal Name	Remarks
	1	Pulse output (open collector)	CW/PULSE/Aϕ
	19	Pulse output common (open collector)	
	2	Pulse sign (open collector)	CW/SIGN/Bϕ
	20	Pulse sign common (open collector)	
	3	Pulse output (differential+)	CW/PULSE/Aϕ
	21	Pulse output (differential–)	
	4	Pulse sign (differential+)	CCW/SIGN/Bϕ
	22	Pulse sign (differential–)	
	5	Deviation counter clear	—
	23	Common	
	6	Zero point signal (+24 V)	
	24	Zero point signal (+5 V)	
	25	Zero point signal common	
	7	Drive unit ready	
	8	In-position	
	26	Common	
	9	Manual pulse generator (phase A+)	
	27	Manual pulse generator (phase A–)	
	10	Manual pulse generator (phase B+)	
	28	Manual pulse generator (phase B–)	
	11	Near-zero point signal	
	12	Upper limit	
	13	Lower limit	
	14	Stop signal	
	15	Speed-position switching signal	
	16	External start	
	35	Common	
	36	Common	

(3) Connector specifications

The following tables show the specifications of the AD75's connector for external devices.

(a) AD75 connector

AD Connector (Receptacle)	Lock Type
10236–52A2JL	One-touch lock type

(b) Communicating device connector*

Plug	Applicable Wire Size	Connection Method	Cover	Manufac-turer
10136–6000EL	AWG#28 (approx. 0.08 sq.)	Pressure displacement	10336-56F0-008 (right angle plastic cover)	3M
10136–3000VE	AWG#24 to #30 (approx. 0.05 to 0.2 sq.)	Soldering		

REMARK

* The 10136-3000VE (plug) and the 10336-56F0-008 (right angle plastic cover) are packed with the AD75.

3.3 Functions

Table 3.3 shows the functions of the A1SD75P1/P2/P3 and AD75P1/P2/P3.

Table 3.3 Functions of A1SD75P1/P2/P3 and AD75P1/P2/P3

Function Name			Description	Positioning Module		
				AD75P1 A1SD75P1	AD75P2 A1SD75P2	AD75P3 A1SD75P3
Positioning function	Position control	Individual positioning	• This function performs positioning with one start signal according to a single designated positioning data.	o	o	o
		Continuous positioning	• This function performs and completes positioning according to a designated positioning data, then restarts positioning in response to the positioning data of the following data number. • Positioning continues with one start signal until the positioning data containing positioning end as the operation pattern is detected.			
		Continuous locus positioning	After performing and completing positioning according to the designated data, this function continues positioning using the positioning data of the following data number. Positioning is repeated with one start signal until the positioning data containing positioning end as the operation pattern is detected.			
	Speed control		This function starts positioning with one start signal according to single designated positioning data, and completes it on input of a stop signal.			
	Speed/position switching control		This function starts positioning with one start signal according to single designated positioning data, and completes positioning of the designated addresses on input of a speed-position switching stop signal.			
	Block positioning		This function performs positioning on the basis of one "block" of positioning data, which ends with the operation pattern of positioning complete, after which the subsequent positioning takes place. • This positioning is performed with two or more designated blocks. Positioning continues between blocks only when user-designated conditions are fulfilled. • Positioning is repeated in accordance with only one of the plural blocks until user-designated conditions are met. • Positioning in accordance with plural selected blocks is repeated the number of times the user specifies.			
	Interpolation positioning (2-axis linear/circular)		This function performs linear or circular interpolation positioning using one or two of three axes.	x	o	o
Manual pulse generator operation function			This function performs positioning in response to the number of input pulses from the manual pulse generator.	o	o	o
JOG operation function			This function performs positioning while the JOG operation command from the ACPU or peripheral device remains ON.			
Home position return function			The axis returns to the home position on receipt of a home position return command from the ACPU or peripheral device, and this function corrects the present address (feed present value, machine feed value) to the home position address. Home position return is executed by one of the six methods - one near-zero point dog method, two count methods and three stopper stop methods. When the home position return retry function is set, the axis travel direction changes in accordance with the limit switches and near-zero point dog during return to the home position.			

Symbols in table o: Function equipped x: Function not equipped

Table 3.3 Functions of A1SD75P1/P2/P3 and AD75P1/P2/P3 (Continued)

Function Name		Description	Positioning Module		
			AD75P1 A1SD75P1	AD75P2 A1SD75P2	AD75P3 A1SD75P3
Compensation function	Electronic gear	Based on the travel value per pulse, the AD75 outputs the number of pulses corresponding to the designated unit magnification (1/10/100/1000 times) to control the travel value and speed.	o	o	o
	Backlash compensation	During positioning, JOG operation, manual pulse generator operation or home position return, additional feed pulses are output each time the travel direction changes to compensate for the set machine backlash.			
Error compensation function		If there is a difference (mechanical system error) between the designated and actual travel values, additional pulses are output to compensate for the difference.			
M code output function		When positioning using the current positioning data starts (WITH mode) or ends (AFTER mode), this function stores the set M code to the buffer memory, and turns ON the M code ON signal to the ACPU. M code output takes place during individual or continuous positioning.			
Acceleration/deceleration control function		This function performs acceleration and deceleration by the designated acceleration/deceleration method, automatic trapezoidal or automatic S-pattern, in positioning (including speed change during positioning), JOG operation or at the start and end of home position return.			
Software stroke limit function		This function does not execute a positioning command which exceeds the upper or lower limit of the set machine travel range. The user must select a feed present value or machine feed value as the limit.			
Torque control function		This function controls the torque generated by the servomotor so that it will not exceed the set torque limit value. When the torque limit value is changed in the middle of positioning, the new value becomes valid.			
Present value change function		When the present value is changed, this function changes the feed present value to the designated value. The AD75 controls the position (address) with the feed present value and the machine feed value during positioning; when a present value change is executed, the feed present value and machine feed value become different values. • Present feed value..... Becomes the address to which the change was made by the present value change. • Machine feed value..... Address with respect to the machine home position and based on the home position address: not changed by a presant value change.			
Teaching function		This function writes the positioning address where positioning was completed manually by JOG operation or manual pulse generator operation to the buffer memory as the positioning data of the ACPU-designated data number.			
Override function		This function adjusts the speed during positioning between 1 % and 300 %.			
Shorter path selection function		When "degrees" is selected as the unit, this function performs positioning in the closer direction to the designated address.			

Symbols in table o: Function equipped x: Function not equipped

3.3.1 Control method

(1) Description of the control method

(a) The control method means the mode (type) of positioning control.

(b) There are 17 control methods as shown below:

1) 1-axis linear control (See Section 3.3.1 (2).)
   - Absolute data method
   - Incremental method

2) 2-axis linear interpolation (See Section 3.3.1 (3).)
   - Absolute data method
   - Incremental method

3) Fixed-pitch feed (See Section 3.3.1 (4).)
   - 1-axis fixed-pitch feed
   - 2-axis fixed-pitch feed

4) Circular interpolation: Cannot be used with a stepping motor (See Section 3.3.1 (5) and (6).)
   - Circular interpolation by designating an auxiliary point (absolute)
   - Circular interpolation by designating an auxiliary point (incremental)
   - Circular interpolation by designating a center point (absolute, clockwise)
   - Circular interpolation by designating a center point (absolute, counterclockwise)
   - Circular interpolation by designating a center point (incremental, clockwise)
   - Circular interpolation by designating a center point (incremental, counterclockwise)

5) Speed control (See Section 3.3.4.)
   - Forward
   - Reverse

6) Speed/position switching control (See Section 3.3.5.)
   - Forward
   - Reverse

7) Present value change (See Section 3.3.18.)

(c) Specify a control method of the positioning data.

Positioning data can be set using the peripheral device or sequence program.
For details of positioning data, see Section 3.4.5.

- Peripheral device: Set positioning data when editing positioning data in the edit mode.
  For operation of the peripheral device, see the SW0IVD-AD75P Operating Manual.
- Sequence program: Write TO/DTO instructions to the designated buffer memory area.
  For details of the buffer memory, see Section 3.6.5.

REMARK

*: Positioning data setting using a peripheral device, and writing of positioning data to the buffer memory using the sequence program use different data numbers.

(1) Peripheral device: Positioning data Nos. 1 to 600 (600 data)

(2) Sequence program: Positioning data Nos. 1 to 100 (100 data)

(2) 1-axis linear positioning control

This function controls positioning of the designated axis from the start point address (present stop position) to the designated position (travel value).

Control by absolute data method (ABS linear 1)

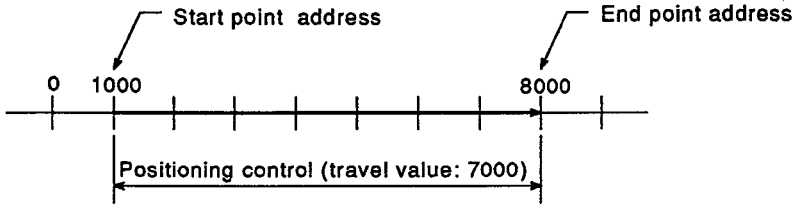
(a) This method controls positioning from the start point address to the end point address (address designated in the positioning data). Positioning control is performed based on the address (home position address) designated for home position return.

(b) The travel direction depends on the start and end addresses.

- Start point address < End point address: Positioning in forward direction
- Start point address > End point address: Positioning in reverse direction

Example

When the start point address is 1000 and the end point address is 8000, the axis travels 7000 (8000 to 1000) in the forward direction.



(c) Designating positioning data *1

The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2
Operation pattern	o
Control method	Select "ABS linear 1".
Acceleration time	o
Deceleration time	o
Positioning address/Travel value	o
Circular interpolation address	—
Commanded speed	o
Dwell time	Δ
M code	Δ

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

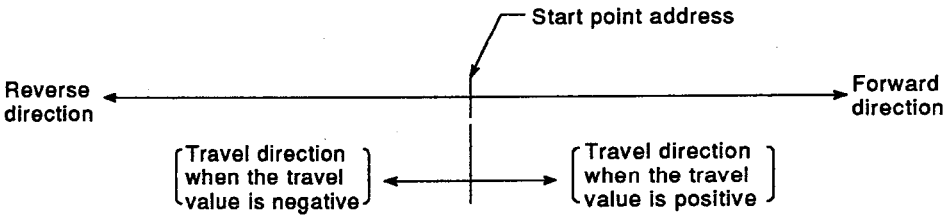
Control by incremental method (INC linear 1)

(a) This method controls positioning for the designated travel value from the start point address.

(b) The travel direction depends on the travel value sign.

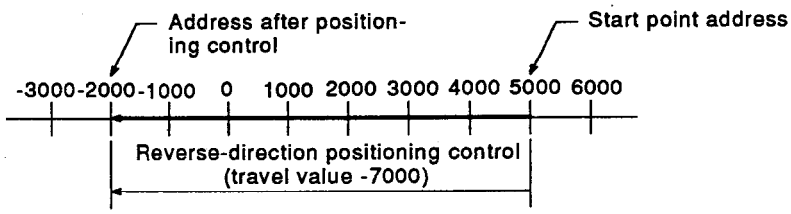
1) + direction..... Positioning in forward direction (address incremental direction)

2) - direction..... Positioning in reverse direction (address decremental direction)



Example

When the start point address is 5000 and the travel value is -7000, the axis travels to the position of -2000.



(c) Designating positioning data *1

The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2
Operation pattern	o
Control method	Select "INC linear 1".
Acceleration time	o
Deceleration time	o
Positioning address/Travel value	o
Circular interpolation address	—
Commanded speed	o
Dwell time	Δ
M code	Δ

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

(3) 2-axis linear interpolation control

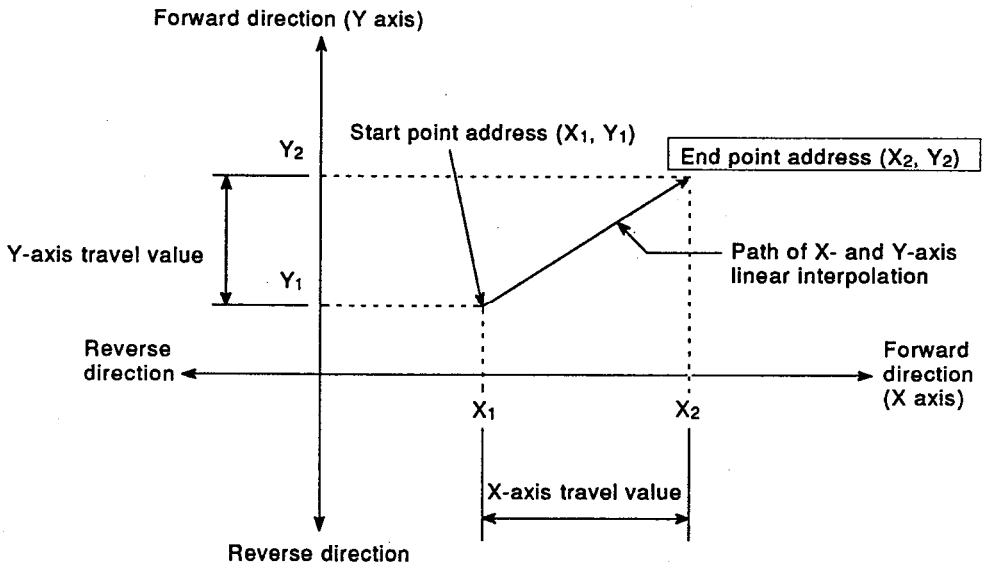
This function performs linear interpolation control from the start point address (present stop position) using two designated axes.

Control by absolute data method (ABS linear 2)

(a) This method performs 2-axis linear interpolation from the start point address to the end point address (address designated in the positioning data).
Positioning control is performed based on the address designated for home position return.

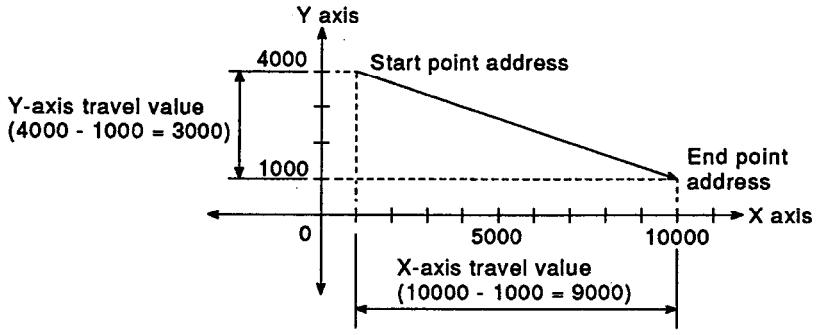
(b) The travel value depends on the start point and designated addresses of each axis.

- Stop point address < End point address:
  Positioning in forward direction
- Stop point address > End point address:
  Positioning in reverse direction



Example

When the start point address is (1000, 4000) and the end point address is (10000, 1000), positioning is performed as shown below:



(c) Travel values of up to 2^{30} are possible for each axis in linear interpolation control.
If the calculated travel value exceeds the range indicated above, an "out of linear travel value range error message (error code 504)" will occur at the start of positioning, and positioning will not begin.

(d) Designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method	Select "ABS linear 2".	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	—	—
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

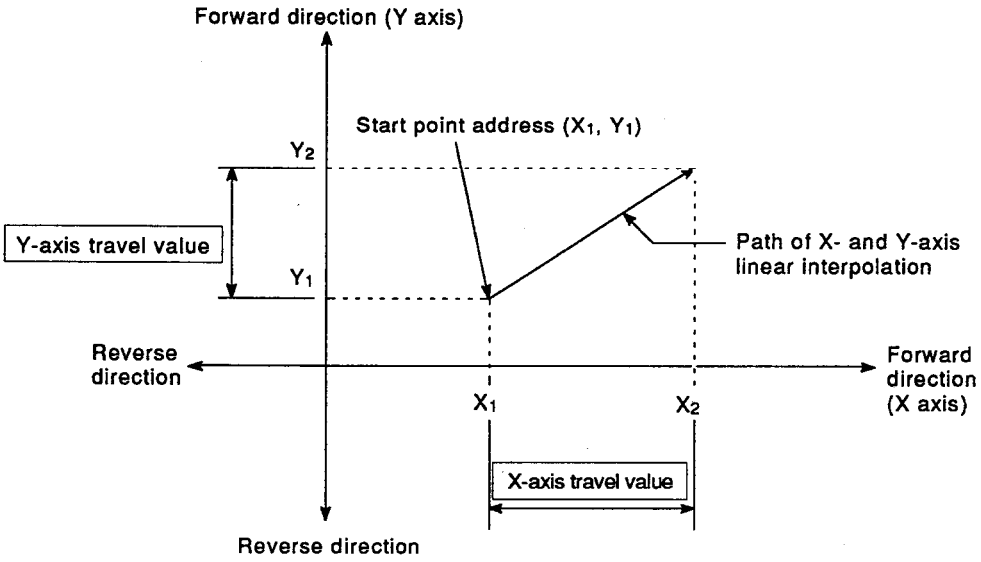
Control by incremental method (INC linear 2)

(a) This method controls positioning from the start point address to the resultant position obtained from the travel direction and distance designated for each axis.

(b) The travel direction of each axis depends on the travel value sign.

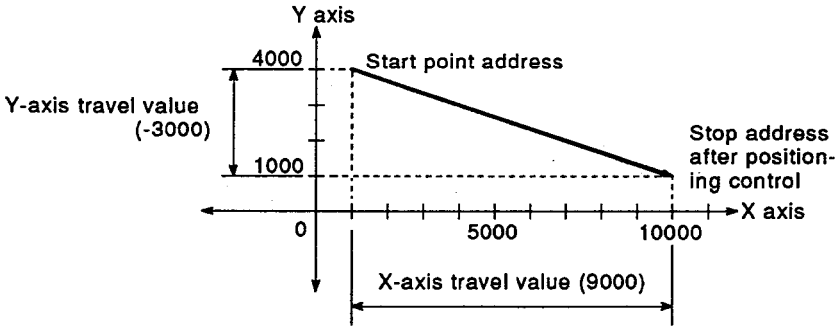
1) + travel value ... Positioning in forward direction (address incremental direction)

2) - travel value ... Positioning in reverse direction (address decremental direction)



Example

When the X-axis travel value is 9000 and the Y-axis travel value is -3000, positioning is performed as shown below:



(c) Travel values of up to 2^{30} are possible for each axis in linear interpolation control.
If the calculated travel value exceeds the range indicated above, an "out of linear travel value range error message (error code 504)" will occur at the start of positioning, and positioning will not begin.

(d) Designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method	Select "INC linear 2".	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	—	—
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

(4) Fixed-pitch feed control

This function controls positioning of a designated axis for a designated travel value from the stop position.
One-axis fixed-pitch feed and 2-axis fixed-pitch feed are available.

POINTS

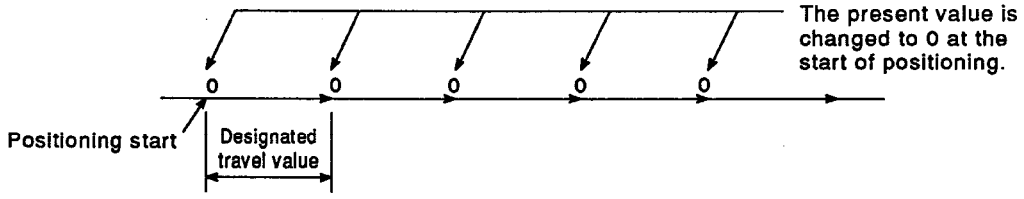
(a) Since fixed-pitch feed matches the number of pulse outputs with the travel value designated in the positioning data, fractions lower than the last digit of the control accuracy are truncated.
(This truncation does not affect the accuracy of regular control.)
When the fraction is truncated, the machine feed value may be compensated.

(b) When continuous locus control is selected as the operation pattern of the positioning data, fixed-pitch feed control cannot be designated.
If continuous locus control and fixed-pitch feed are designated simultaneously, an axis error will occur, and the axis travel will not start.

(c) Fixed-pitch feed control cannot be designated for the next positioning data after a positioning data for which continuous locus control is set as the operation pattern either.
If fixed-pitch feed is designated, an axis error will occur and automatic deceleration will begin.

Control by 1-axis fixed-pitch feed (fixed-pitch feed 1)

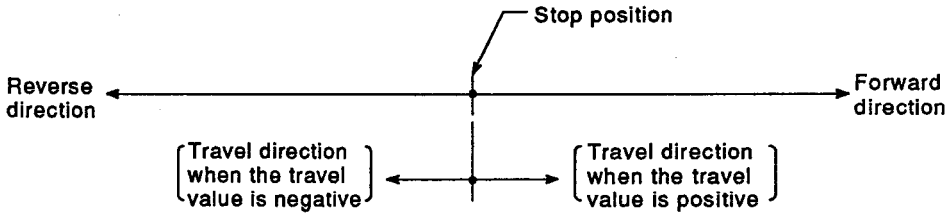
(a) One-axis fixed-pitch feed changes the stop address of the axis designated at the start of positioning to 0, then controls positioning for the designated travel value in the designated direction.



(b) The travel direction depends on the travel value sign.

1) + travel value ... Positioning in forward direction (address incremental direction)

2) - travel value ... Positioning in reverse direction (address decremental direction)



(c) Designating positioning data *1

The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2
Operation pattern	o
Control method	Select "fixed-pitch feed 1".
Acceleration time	o
Deceleration time	o
Positioning address/Travel value	o
Circular interpolation address	—
Commanded speed	o
Dwell time	Δ
M code	Δ

REMARKS

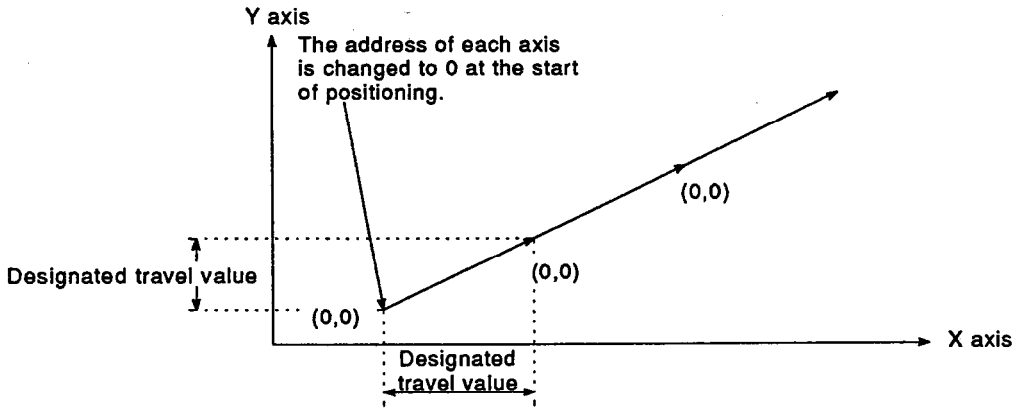
1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

Control by 2-axis fixed-pitch feed (fixed-pitch feed 2)

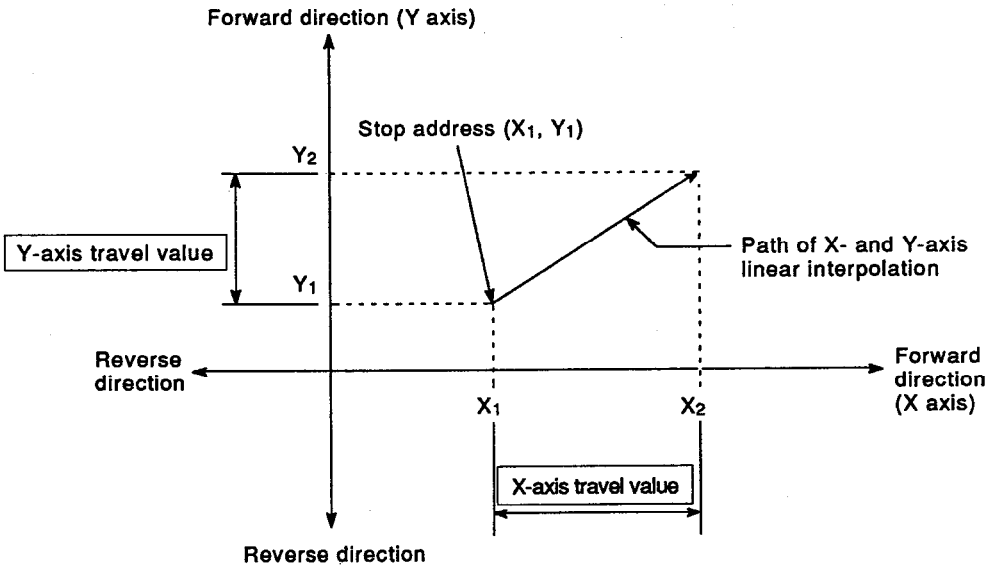
(a) Two-axis fixed-pitch feed changes the stop address of the two axes designated at the start of positioning to 0, then controls positioning to the resultant position of the travel direction and distance designated for each address.



(b) The travel direction of each axis depends on the travel value sign.

1) + travel value ... Positioning in forward direction (address incremental direction)

2) - travel value ... Positioning in reverse direction (address decremental direction)



(c) Travel values of up to 2^{30} are possible for each axis in linear interpolation control.
If the calculated travel value exceeds the range indicated above, an "out of linear travel value range error message (error code 504)" will occur at the start of positioning, and positioning will not begin.

(d) Designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program.

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method	Select "fixed-pitch feed 2".	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	—	—
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

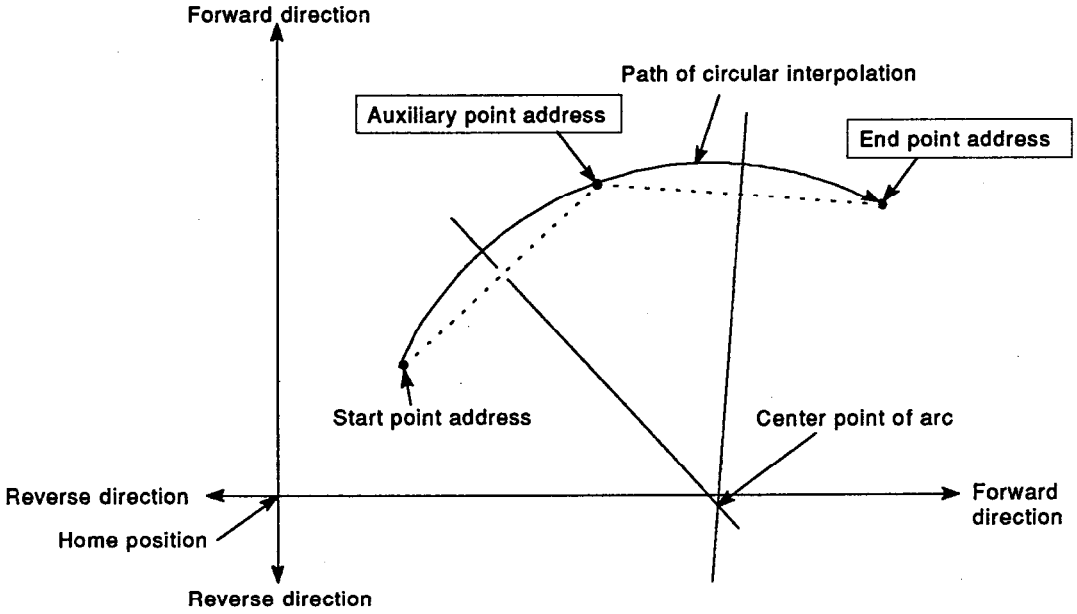
(5) Circular interpolation control by designating an auxiliary point (cannot be used with stepping motors)

This function performs circular interpolation control after designation of an end point and an auxiliary point (passing point).

Control by absolute data method

(a) This method performs circular interpolation from the start point address to the end point address via the designated auxiliary point address.

(b) The center point of the arc is located at the point of intersection of the vertical bisector from the line connecting the start point address and the auxiliary point address and the vertical bisector from the line between the auxiliary point address and the end point address.



(c) Circular interpolation control by designating an auxiliary point can be used even when the operation pattern is continuous locus control.

(d) Circular interpolation control by designating an auxiliary point cannot be used when "degrees" is selected as the unit.

(e) The maximum radius for which circular interpolation control is possible is 2^{29}.
If the calculated radius exceeds the above range, a "radius setting error (error code: 544)" will occur at the start of positioning, and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(f) If the calculated center point address is outside the range -2^{31} to $(2^{31} - 1)$, an "auxiliary point setting error (error code: 525)" will occur, and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(g) In the following cases an error will occur and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

1) Start point address = end point address
... End point setting error (error code: 526)
2) Start point address = auxiliary point address
... Auxiliary point setting error (error code: 525)
3) End point address = auxiliary point address
... Auxiliary point setting error (error code: 525)
4) Start point address, auxiliary point address, and end point address lie on a straight line.
... Auxiliary point setting error (error code: 525)

(h) Designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program.

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method	Select "ABS circular interpolation".	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	o (Set the auxiliary point address.)	o (Set the auxiliary point address.)
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

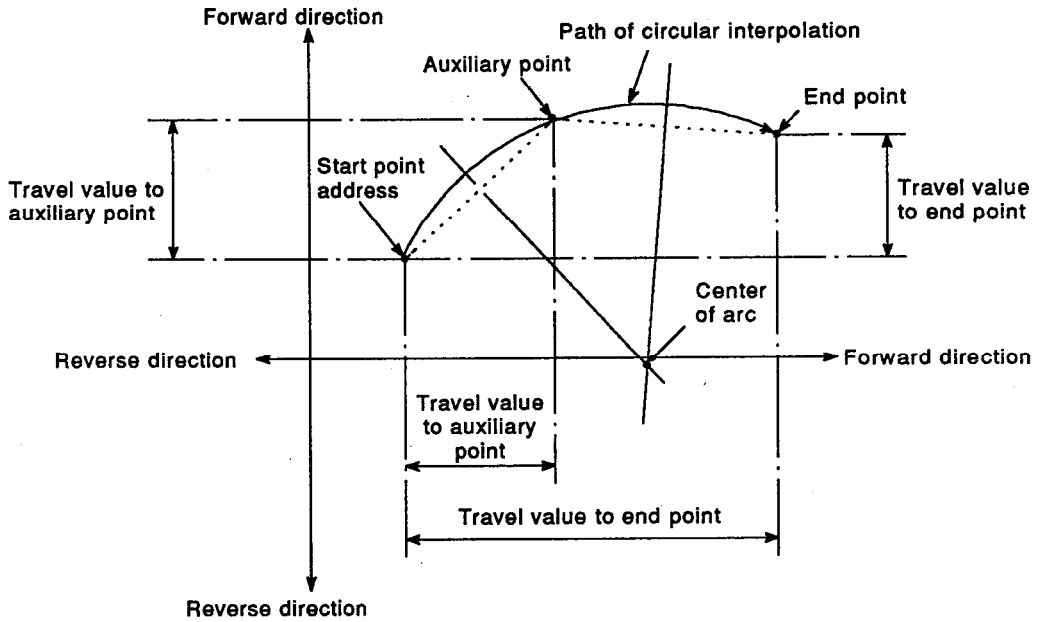
2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

Control by incremental method

(a) This method performs circular interpolation from the start point address to the end point address via the designated auxiliary point address.

(b) The center point of the arc is located at the point of intersection of the vertical bisector of the auxiliary point address calculated from the travel value from the start point address to the auxiliary point, and the vertical bisector of the end point address calculated from the travel value from the auxiliary point address to the end point.



(c) Circular interpolation control by designating an auxiliary point is available even when the operation pattern is continuous locus control.

(d) Circular interpolation control by designating an auxiliary point cannot be used when "degrees" is selected as the unit.

(e) The maximum radius for which circular interpolation control is possible is 2^{29}.
If the calculated radius exceeds the above range, a "radius setting error (error code: 544)" will occur at the start of positioning, and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(f) If the calculated center point address is outside the range -2^{31} to $(2^{31} - 1)$, an "auxiliary point setting error (error code: 525)" will occur, and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(g) In the following cases an error will occur and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

1) Start point address = end point address
... End point setting error (error code: 526)
2) Start point address = auxiliary point address
... Auxiliary point setting error (error code: 525)
3) End point address = auxiliary point address
... Auxiliary point setting error (error code: 525)
4) Start point address, auxiliary point address, and end point address lie on a straight line.
... Auxiliary point setting error (error code: 525)

(h) Designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program.

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method	Select "INC circular interpolation".	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	o (Set the travel value to the auxiliary point.)	o (Set the travel value to the auxiliary point.)
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

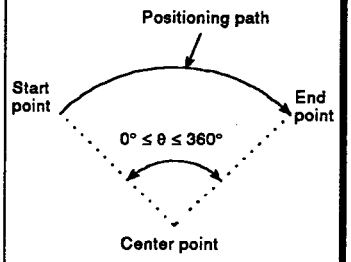
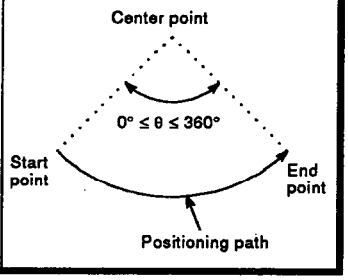
2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

(6) Circular interpolation control by designating a center point (cannot be used with stepping motors)

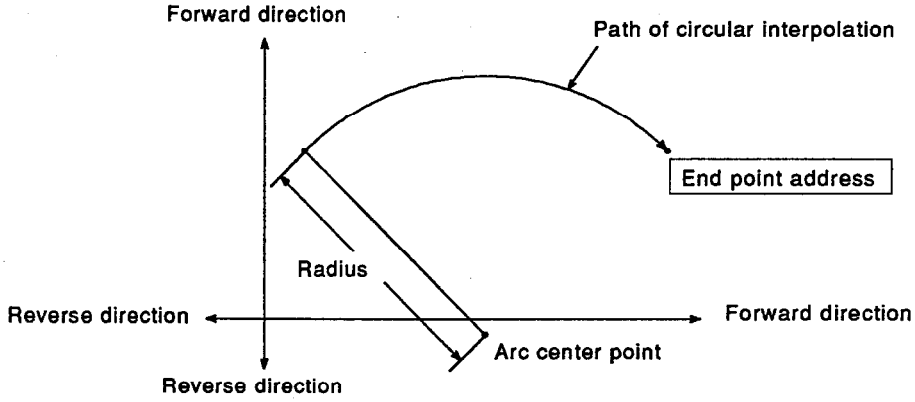
This function performs circular interpolation control after designation of the end point of circular interpolation and the center point of an arc.

The following table shows servomotor directions of rotation, controllable arc center angles and positioning paths.

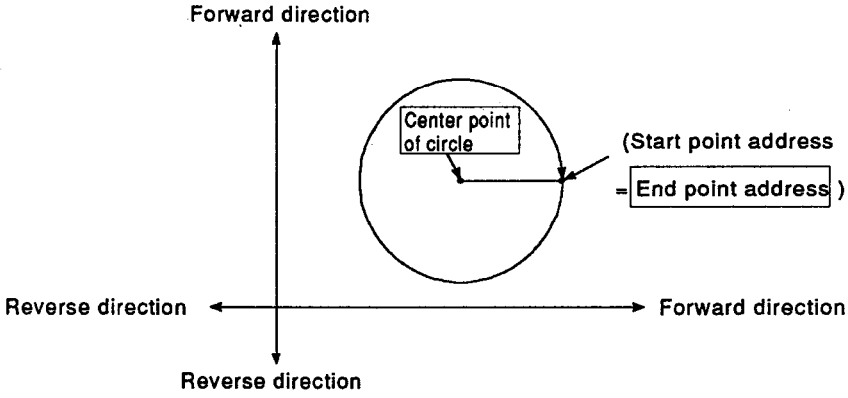
Command	Direction of Rotation	Controllable Arc Center Angle	Positioning Path
ABS circular clockwise	Clockwise	0° ≤ θ ≤ 360°	
INC circular clockwise			
ABS circular counterclockwise	Counterclockwise		
INC circular counterclockwise			

Control by absolute data method

(a) This method performs circular interpolation from the start point address to the end point address along the arc of the circle whose radius is equivalent to the length from the start point address to the designated center point address.



(b) When the end point address and the start point address are the same, positioning can be performed on a circle which takes the length of the line joining the start point address to the center point of the circle as the radius.



(c) In circular interpolation control by designating a center point, the locus of the arc calculated from the start point address and the center point address may not coincide with the set end point address.

- When the error between the calculated locus of the arc and the end point address is within the allowable error range for circular interpolation set in extended parameters #2, circular interpolation is performed based on the set end point address while the error is compensated for by spiral interpolation.*
- When the error between the calculated locus of the arc and the end point address is outside the allowable error range for circular interpolation, an "out of allowable circular interpolation error range error (error code: 506)" will occur, and positioning will not begin.
  If positioning control is in progress, an immediate stop will occur on detection of the error.

REMARK

*: For spiral interpolation, see Section 3.4.2 (22).

(d) Circular interpolation control by designating a center point is available even when the operation pattern is continuous locus control.

(e) Circular interpolation control by designating a center point cannot be used when degree is selected as the unit.

(f) The maximum radius for which circular interpolation control is possible is 2^{29}.
If the calculated radius exceeds the above range, a "radius setting error (error code: 544)" will occur at the start of positioning, and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(g) In the cases shown below, a "center point setting error (error code: 527)" occurs and positioning does not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

1) Start point address = center point address

2) End point address = center point address

(h) Designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program.

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method *3	Select "ABS circular clockwise" or "ABS circular counterclockwise".	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	o (Set the center point address.)	o (Set the center point address.)
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

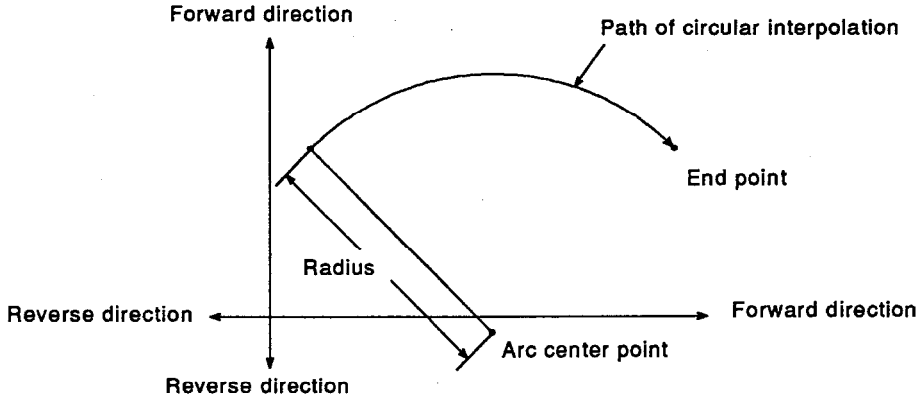
REMARKS

1) *1: For details of positioning data, see Section 3.4.5.
2) *2: Whether or not setting is necessary is indicated by one of the following symbols:
- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

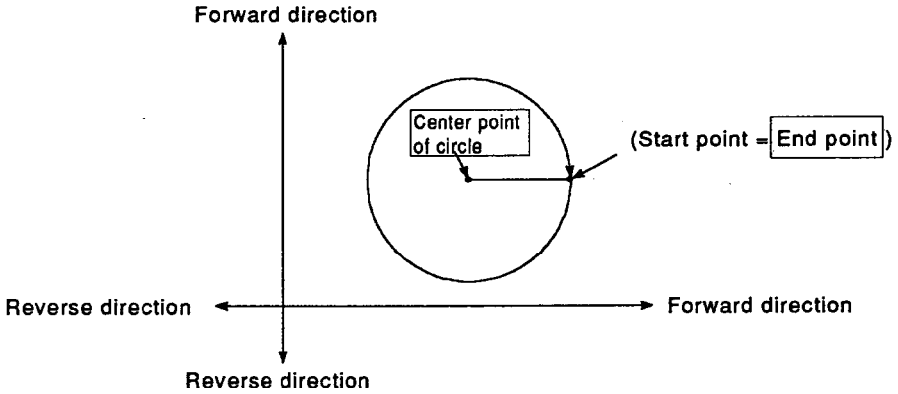
3) *3: With regard to the control method, select either "ABS circular clockwise" or "ABS circular counterclockwise" according to the direction of rotation of the servomotor.

Control by incremental method

(a) This method performs circular interpolation from the start point address to the end point along the arc of the circle whose radius is equivalent to the length from the start point address to the designated center point address.



(b) By setting the travel value to 0, positioning can be performed on a circle which takes the length of the line joining the start point address to the center point of the circle as the radius.



(c) In circular interpolation control by designating a center point, the locus of the arc calculated from the start point address and the center point address may not coincide with the set end point address.

- When the error between the calculated locus of the arc and the end point address is within the allowable error range for circular interpolation set in extended parameters #2, circular interpolation is performed based on the set end point address while the error is compensated for by spiral interpolation.*
- When the error between the calculated locus of the arc and the end point address is outside the allowable error range for circular interpolation, an "out of allowable circular interpolation error range error (error code: 506)" will occur, and positioning will not begin.
  If positioning control is in progress, an immediate stop will occur on detection of the error.

REMARK

*: For details on spiral interpolation, see Section 3.4.2 (22).

(d) Circular interpolation control by designating a center point is possible even when the operation pattern is continuous locus control.

(e) Circular interpolation control by designating a center point cannot be used when "degrees" is selected as the unit.

(f) The maximum radius for which circular interpolation control is possible is 2^{29}.
If the calculated radius exceeds the above range, a "radius setting error (error code: 544)" will occur at the start of positioning, and positioning will not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(g) If the calculated end point address or center point address is outside the range -2^{31} to $(2^{31}-1)$, the following errors occur and positioning does not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

1) For end point address: End point setting error (error code: 526)

2) For center point address:
Center point setting error (error code: 527)

(h) In the cases shown below, a "center point setting error (error code: 527)" occurs and positioning does not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

1) Start point address = center point address

2) End point address = center point address

(i) designating positioning data *1

1) Set the positioning data control method for the reference axis.

2) The following positioning data can be set with the peripheral device or sequence program.

Data	Necessity of Setting *2	
	Reference Axis	Auxiliary Axis
Operation pattern	o	—
Control method *3	Select "INC circular clockwise" or "INC circular counterclockwise"	—
Acceleration time	o	—
Deceleration time	o	—
Positioning address/Travel value	o	o
Circular interpolation address	o (Set the center point address.)	o (Set the center point address.)
Commanded speed	o	—
Dwell time	Δ	—
M code	Δ	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

3) *3: With regard to the control method, select either "INC circular clockwise" or "INC circular counterclockwise" according to the direction of rotation of the servomotor.

3.3.2 Positioning method

There are four positioning methods as shown below:

Positioning method
- Individual positioning
- Continuous locus
- Continuous positioning
- Block positioning

- Individual positioning
  The individual positioning method performs one-time positioning according to the positioning data.

- Continuous locus positioning
  The continuous locus method performs continuous locus operation in response to one start signal according to the operation pattern set in the positioning data.

- Continuous positioning
  The continuous positioning method performs continuous positioning until a set end pattern in response to one start signal according to the operation pattern set in the positioning data.
  Continuous locus positioning and continuous positioning can be used in combination.

- Block positioning
  The block positioning method can perform the most complicated operation in response to a single start signal, and execute the operation indicated in the positioning information.

(1) Positioning start

This section describes processing started by inputting a positioning start signal.

(a) Start with a positioning start signal

1) As soon as the positioning signal is turned ON, the start completed signal and the BUSY signal are also turned ON to start positioning.
The ON status of the BUSY signal indicates that the axis is in operation.

2) The start completed signal is turned OFF whenever the positioning start signal goes OFF.
When the positioning start signal is ON even after positioning has been completed, the start complete signal remains ON.

3) If the positioning start signal is turned ON again while the BUSY signal is ON, an "in-operation start warning (warning code: 100)" will be issued.

4) The processing after the axis has completed operation depends on whether subsequent positioning must be performed.

i) When subsequent positioning need not be performed

- If a dwell time is set, positioning is delayed until the set time has elapsed.
- When positioning is completed, the BUSY signal goes OFF and the positioning complete signal comes ON. However, the positioning completed signal will not be turned ON during speed control, or when the positioning completed signal ON time is "0".
- The lapse of the positioning completed signal ON time turns OFF the positioning completed signal.

ii) When subsequent positioning must be performed

- When the dwell time is set, the axis waits until the set time elapses.
- The subsequent positioning will begin on elapse of the set dwell time.

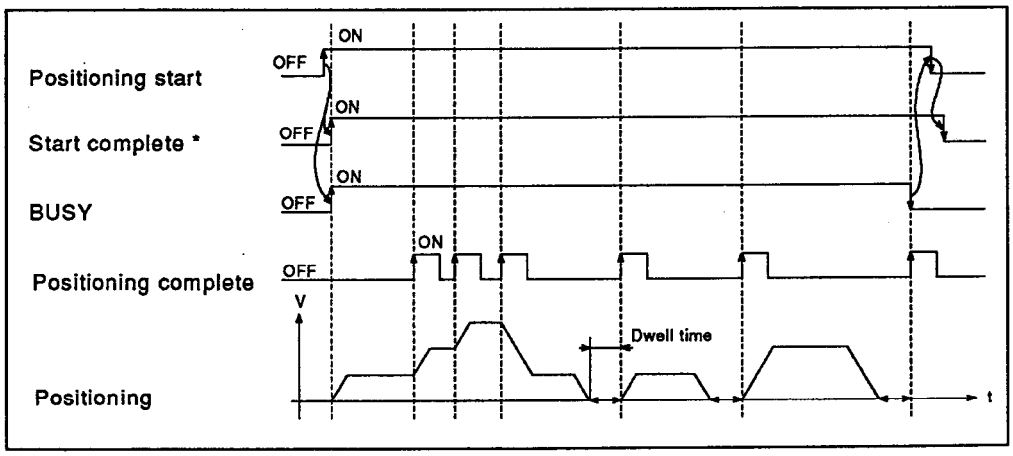


Fig. 3.1 ON/OFF Timing of Signals at Positioning Start

REMARK

* : Does not come ON in the case of a start caused by an external start signal.

(b) External positioning start

1) Positioning can be started by turning ON an external start signal. [The same processing as positioning start with a positioning start signal can be performed. See (1)(a).]

2) To perform positioning with an external start signal, "external positioning start (0)" must be set in the "external start function selection" buffer memory area.

3) To start positioning by external start, "external start enabled (1)" must be set in the "external start valid setting" buffer memory area.
Positioning does not begin if the setting in the external start valid setting buffer memory area is "external start disabled (initial value: 0)".

4) The start complete signal does not come ON in the case of a start caused by an external start signal.

POINT

An external positioning start will be executed in response to an input from an external source provided the start data number has been written by the sequence program in advance.
Because the external input starts positioning by selecting external positioning start, lead time fluctuation due to the sequence scan time can be eliminated by using this method.

REMARK

The buffer memory addresses for the external start function selection area and the external start enable setting area are shown below:

Axis No.	Buffer Memory	
	External Start Function Selection	External Start Valid Setting
Axis 1	62	1171
Axis 2	212	1221
Axis 3	362	1271

(c) Block positioning

1) When the positioning start signal is turned ON, block positioning starts with the positioning data number of the first point set in the positioning start data.

2) When the operation pattern of the positioning data is positioning continued, the next positioning data will be executed after positioning according to the first point of positioning data.
The "next positioning data" means the positioning data number subsequent to the positioning data number on the basis of which positioning was performed last time. For example, when the previously executed data number is 10, positioning will be executed in accordance with positioning data No. 11.

3) When the operation pattern of the positioning data is "positioning end", positioning stops after the first positioning data has been executed.
Positioning will be terminated when the "positioning end/continued" setting for the first point is "positioning end". (The BUSY signal will be turned OFF.)
When "positioning continued" is selected as the operation pattern for the first point, the point will be updated, and the second point positioning data will be executed.

4) Point updating continues until the positioning data proceeds to the end command.
However, note that updating can be continued for a maximum of 50 points.
If this limit of 50 points is exceeded, positioning is discontinued and the warning "no operation end setting (warning code: 505)" is issued.

[Positioning start data setting]

Point	Positioning start data	
1	Con-tinued	20
2	End	30
49		
50		

50 points

Positioning data No.	Operation pattern
20	11
21	11
22	11
23	01
24	00
30	00

Operation pattern
00: Positioning end
01: Continuous positioning control
11: Continuous locus control
10: Error

[Processing sequence]

In the case of the above setting, the positioning data is processed in the following sequence:

- 20 → 21 → 22 → 23 → 24 → 30 → (Positioning end)

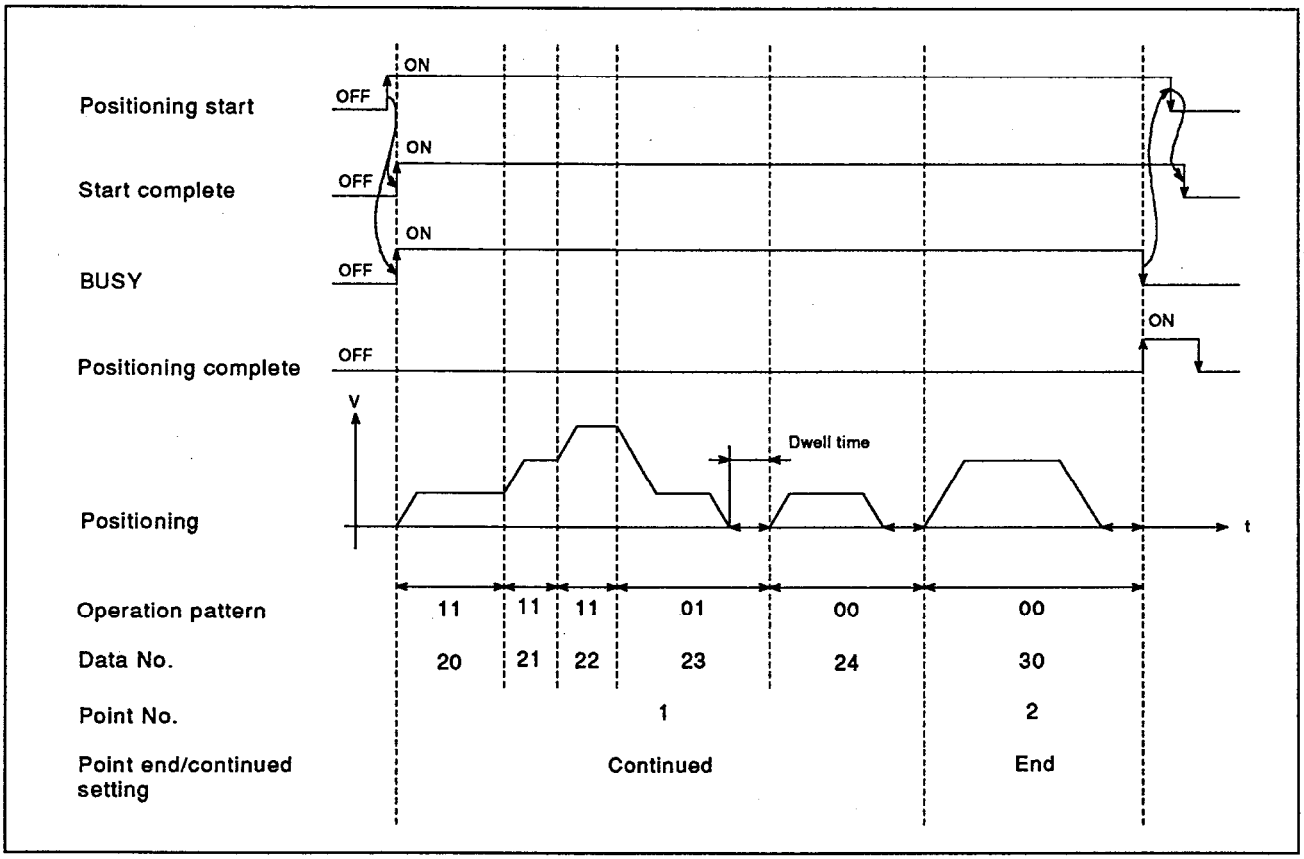


Fig. 3.2 Block Positioning Processing

3.3.3 Positioning stop

This section describes the causes for which axes may be stopped during positioning.

(1) Stop processing and order of priority

(a) Stop processing

There are three types of stop during positioning: deceleration stop, rapid stop, and immediate stop.

1) Deceleration stop *1

This is a stop made in accordance with deceleration times 1 to 4 in the basic parameters and extended parameters.
Which of deceleration times 1 to 4 is used is determined by the positioning data settings.

2) Rapid stop *1

This is a stop in accordance with the "rapid stop deceleration time" set in the extended parameters.

3) Immediate stop

This is a stop without deceleration processing.
The AD75 stops pulse output immediately but coasts by the amount of droop pulses in the drive unit's deviation counter.

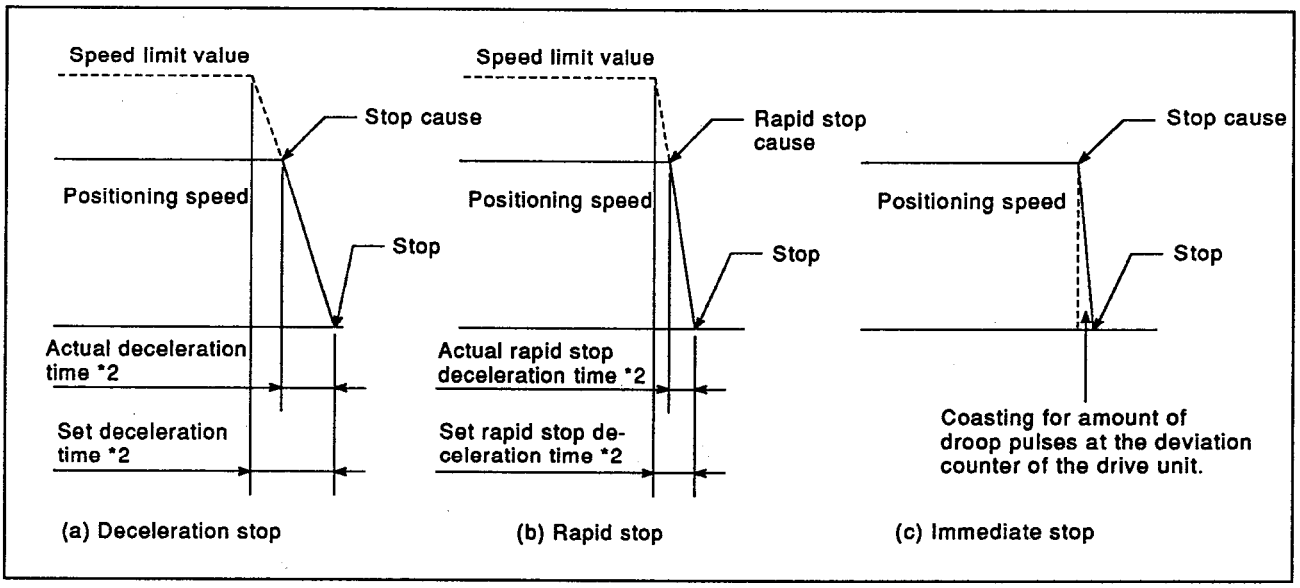


Fig. 3.3 Outline of Stop Processing

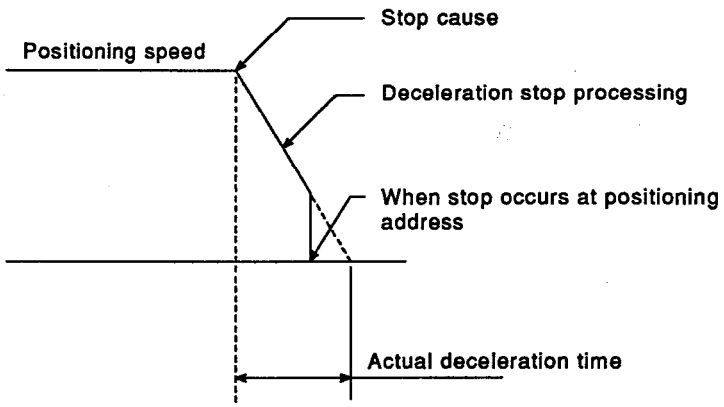
REMARKS

1) *1: Deceleration stop and rapid deceleration stop are selected in the "stop group 1 to 3 rapid stop selections" of the extended parameters. (The default is "normal deceleration stop".)

2) *2: For details on the actual deceleration time, set deceleration time, actual rapid stop deceleration time, and set rapid stop deceleration time, See Section 3.3.15.

POINT

An immediate stop occurs on reaching the set positioning address during a deceleration stop in position control.



(b) Order of priority for stop processing

The order of priority for AD75 stop processing is as follows.

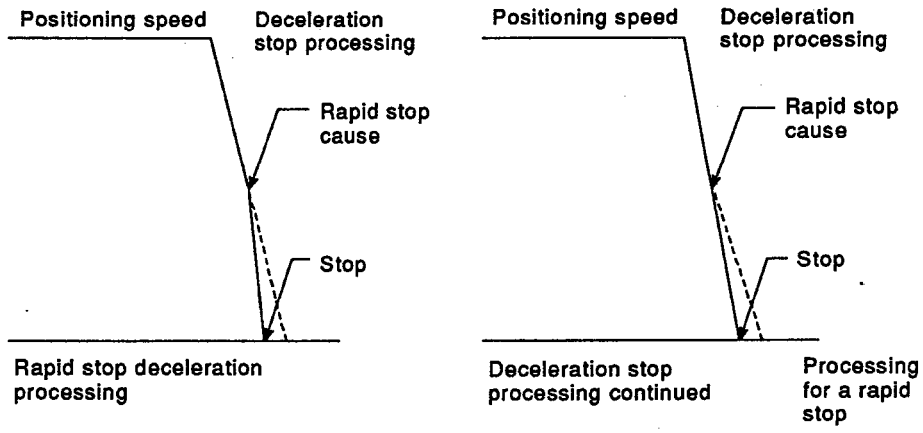
(deceleration stop) < (rapid stop) < (immediate stop)

1) Even if the deceleration stop command comes ON or a deceleration stop cause occurs during deceleration (including automatic deceleration), the current deceleration will remain in effect until the stop.

2) If a stop signal for which rapid stop is designated comes ON - or a stop cause occurs - during deceleration, rapid stop processing commences from that point.
However, if the rapid stop deceleration time is longer than the remaining deceleration time, the current deceleration stop processing will continue even if a rapid stop cause occurs during deceleration stop processing.

Example

The processing when a rapid stop cause occurs during deceleration processing is indicated below.



(a) When deceleration stop time > rapid stop deceleration time

(b) When deceleration stop time < rapid stop deceleration time

(2) Stop commands, stop causes

(a) The types of stop command and stop cause are shown in Table 3.4: they are classified into "individual axis stop" and "all-axis simultaneous stop".

1) In the case of a stop command or stop cause for an individual axis, only the axis for which the stop command came ON or the stop caused occurred stops.
However, if during interpolation control, one of the axes is stopped by a stop command or the occurrence of a stop cause, both axes involved in the interpolation control are stopped.

2) In the case of an all-axis simultaneous stop command or stop cause, all axes are stopped when the stop command comes ON or the stop cause occurs.

(b) The stop commands and stop causes that can be selected for deceleration stops and rapid stops are classified into stop groups 1 to 3.
"Deceleration stop" or "rapid stop" can be set for each stop group by using the extended parameters.

1) Stop group 1: Critical stop cause

2) Stop group 2: Emergencies

3) Stop group 3: Intentional stop and relatively minor errors

Table 3.4 Stop Processing According to Stop Cause and Operating Status

Stop Cause		Positio-ning *4	Home Position Return *5	JOG Operation	Manual Pulse Generator Operation	Stop Axis	Axis Operating Status After Stop	M code ON Signal Status
—	Drive unit ready OFF *1 (Servo ready OFF)	Immediate stop			Immediate stop	Individual axes	Error	No change
	When an error occurs in continuous locus positioning *2							
Stop group 1	External upper limit switch ON	Deceleration stop/rapid stop			Immediate stop	Individual axes	Error	No change
	External lower limit switch ON							
Stop group 2	Outside software stroke limit	Deceleration stop/rapid stop			Immediate stop	Individual axes	Error	No change
	[Stop] key input from peripheral device					All axes		
	Sequence ready OFF							Turned OFF
Stop group 3	External stop signal ON *6	Deceleration stop/rapid stop			Immediate stop	Individual axes	Stopped/ Standby	No change
	Axis stop signal (Yn) ON *6							
	Axis error occurrence (other than stop groups 1, 2)						Error	
	Test mode error							

REMARKS

1) *1: This is stop processing by drive unit hardware processing.

2) *2: Whether or not the software stroke limit is effective for JOG operation and manual pulse generator operation can be selected using validating/invalidating the software stroke limit during JOG operation/manual pulse generator operation in the axis control data.

3) *3: Normal operation proceeds up to the positioning data immediately preceding the positioning data at which any of the following errors occurred, then an immediate stop is executed.
Out of linear travel value range(error code: 504)
Excessive arc error(error code: 506)
Travel outside stroke limit +(error code: 511)
Travel outside stroke limit -(error code: 512)
Auxiliary point setting error(error code: 525)
End point setting error(error code: 526)
Center point setting error(error code: 527)
Out of radius range(error code: 544)

4) *4: "Positioning" here means position control, speed control, or speed/position switching control, in accordance with positioning data.

5) *5: Indicates travel at the home position return speed or creep speed during a home position return.

POINT

*6: Positioning will not start even if the external stop signal or axis stop signal (Yn) goes OFF while the start signal is ON.
(The start signal is effective at its leading edge (OFF → ON)).

(3) Stop signal input during deceleration

(a) If a stop signal is input during deceleration (including automatic deceleration), the deceleration continues unaltered before axis motion stops.

(b) When a stop signal is input during deceleration in a home position return, the deceleration continues unaltered before axis motion stops. However, axis motion stops immediately during axis motion at the creep speed.

(c) Rapid stop processing is performed as soon as a stop cause requiring a rapid stop occurs during deceleration, provided that the rapid stop time is shorter than the stop time.

(4) Stop processing during interpolation

(a) During interpolation, both operating axes are stopped by stop signals issued to both axes.

(b) On restarting interrupted positioning (starting when axis motion is stopped), positioning begins from where the axes stopped.
On restarting after positioning operation has been stopped while the system was waiting for conditions to be fulfilled, the waiting for condition fulfillment status is re-established.

(5) M code

When the PC READY signal is turned OFF, a "0" M code is issued.

3.3.4 Operation pattern

Operation patterns represent control patterns for various factors, such as how the positioning data corresponding to two or more data numbers will be executed, or the nature of the acceleration/deceleration between positioning data.

There are three operation patterns - positioning end, continuous positioning control and continuous locus control.

Of these three operation patterns, continuous locus control executes almost the same function as constant speed control.

The categories of operation pattern are shown below:

- Operation pattern
  - Positioning end (00)
  - Positioning continued
    - Continuous positioning control (01)
    - Continuous locus control (11)

(1) Positioning end

Set this operation pattern to execute positioning to the designated address and complete the positioning of the current point. If a dwell time has been designated, positioning is completed after elapse of the designated time.

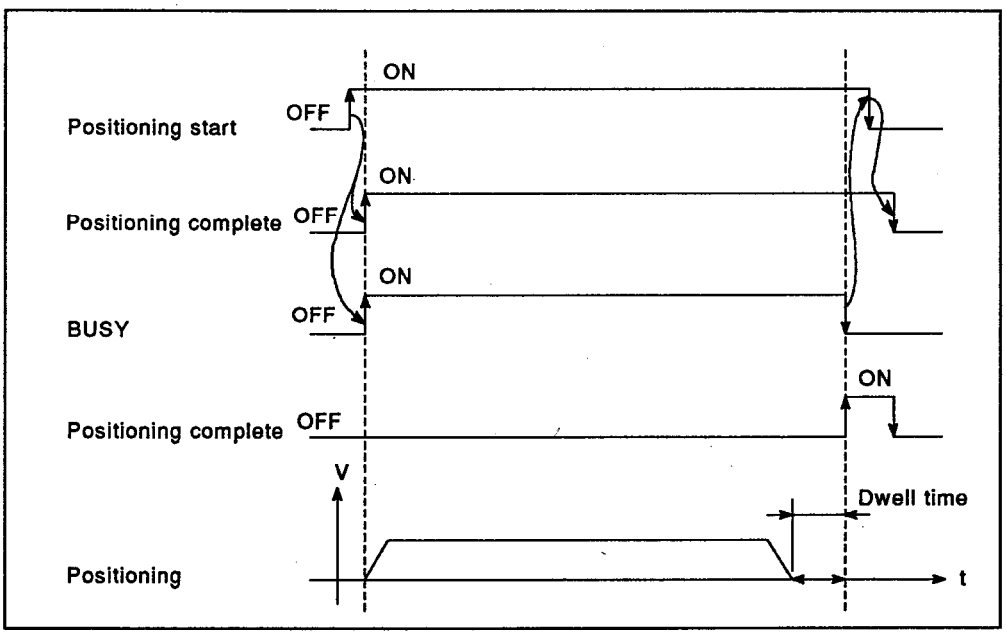


Fig. 3.4 Operation for "Positioning End"

(2) Continuous positioning control

(a) Each time positioning is completed in accordance with a single positioning data, the axis is automatically decelerated to 0, then it is accelerated again to perform positioning based on the next positioning data.

(b) Set operation pattern "00" at the end of positioning by continuous positioning control (01) to terminate positioning.
When "positioning continued" is set as the operation pattern, positioning continues until operation pattern 00 is detected.
If operation pattern 00 is not identified, positioning may proceed to positioning data No. 600.

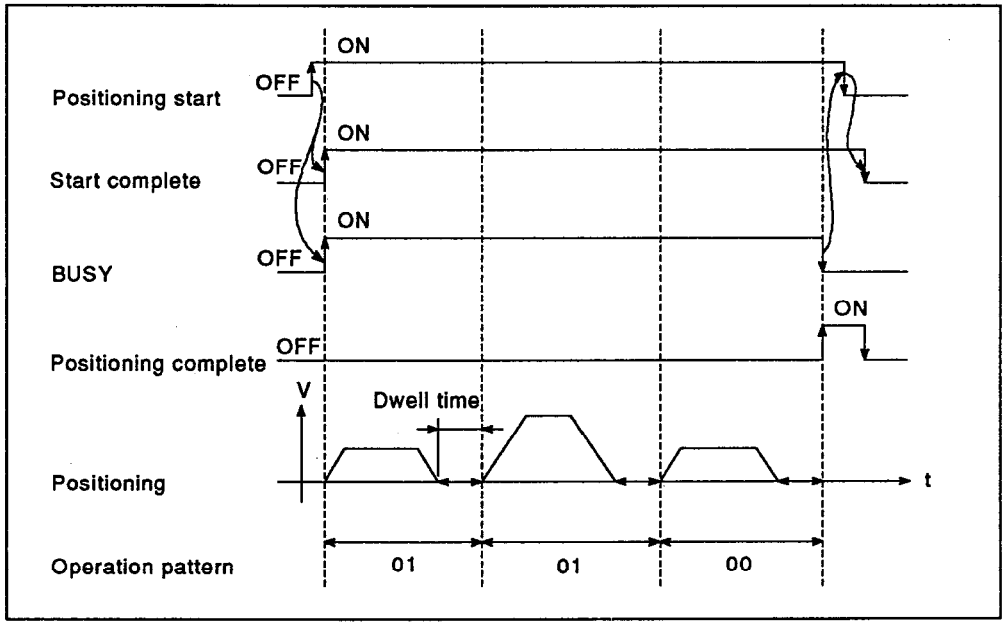


Fig. 3.5 Operation for Continuous Positioning Control

(3) Continuous locus control

(a) The speed of positioning according to the ongoing positioning data is changed to the speed of the positioning data for the next positioning.
The speed will not be changed if the current speed and the speed of the next positioning are the same.

(b) When the set commanded speed is -1, the speed of the previous positioning is valid.

(c) If a dwell time is set, it is ignored.

(d) Set operation pattern "00" at the end of positioning by continuous locus control (11) to terminate positioning.
When positioning continued is set as the operation pattern, positioning continues until operation pattern 00 is detected.
If operation pattern 00 is not identified, positioning may proceed to positioning data No. 600.

(e) As the speed switching pattern, the "advance speed change pattern" which changes the speed at the end of the ongoing positioning, or the "standard speed change pattern" which changes the speed at the start of the next positioning, can be selected.

Continuous locus control ─┬─ Standard speed change mode
└─ Advance speed change mode

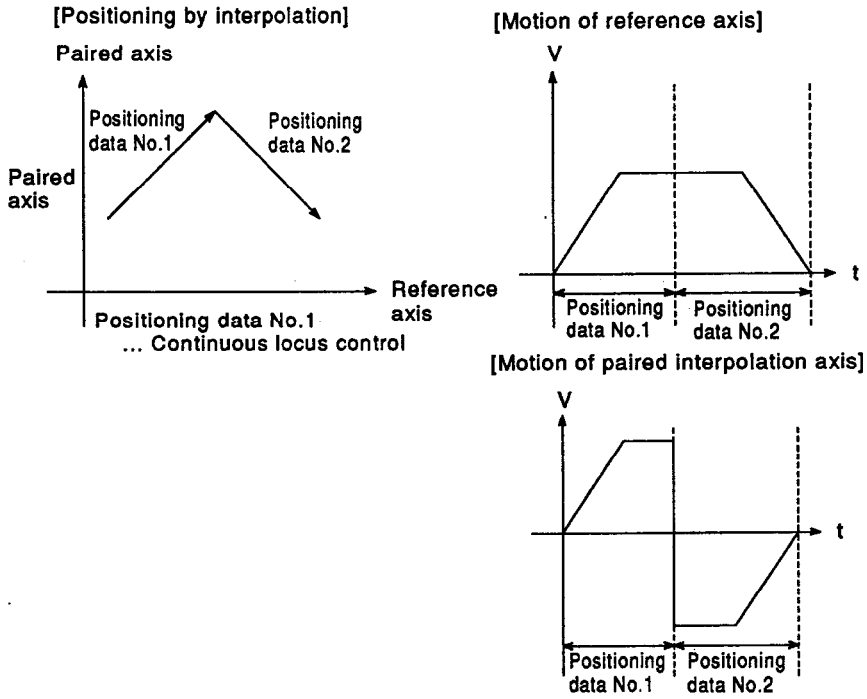
Automatic deceleration conditions

As a rule, automatic deceleration is not executed in continuous locus control. However, under any of the conditions mentioned below, axis motion is decelerated to zero by automatic deceleration:

- When the operation pattern of the current positioning data is "11", and there are different travel values in the current data and the next data. (See POINTS.)
- During step operation (See Section 3.3.21)
- When there is an error in the positioning data to be executed next

POINTS

(1) In interpolation control, only the travel direction of the reference axis is checked. Therefore, automatic deceleration is not performed as long as the travel direction on the reference axis remains unchanged.This may result in sudden direction reversal on the other interpolation axis.
To avoid a sudden direction reversal on the other interpolation axis, program the pass point in continuous positioning control (01) rather than continuous locus control (11).



(2) Automatic deceleration is not performed when circular interpolation control is set for either the current positioning data number or the next data number.

Speed processing

- The commanded speed is set in the setting positioning data, but it may be omitted.
  In such a case, the speed used in the previous positioning remains effective.

- To omit the commanded speed, set "-1" as the commanded speed. The peripheral device displays "-1".

- The AD75 retains the commanded speed set in the positioning data number, and the latest speed set in response to a speed change request as the current speed. When -1 (current speed) is set as the commanded speed, control is performed at the current speed.

- The feed speed may fail to reach the speed change value because of the relationship between the travel value and the change speed. However, the current speed is updated even in such a case.

- If "-1" is set for the commanded speed of the first positioning data on starting, a "No commanded speed error (error code: 503)" occurs and positioning does not begin.

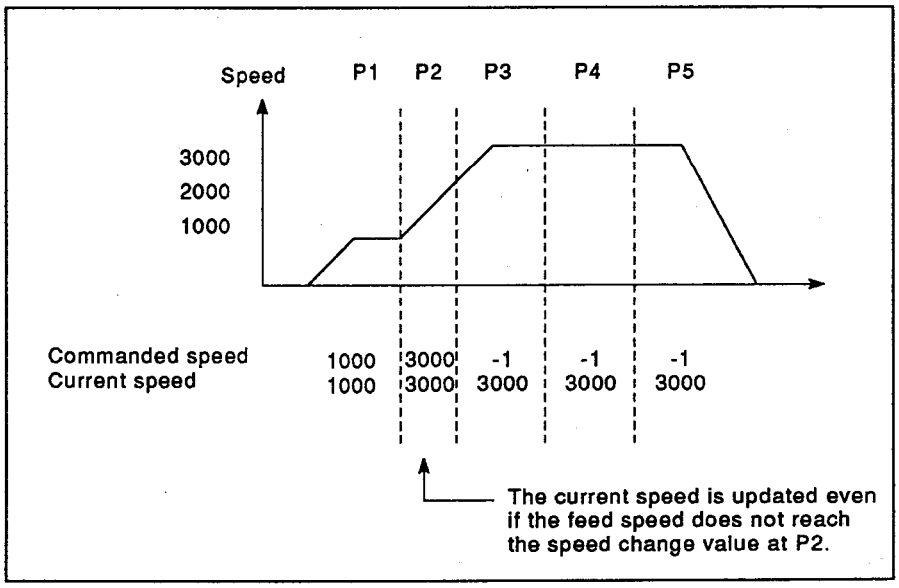


Fig. 3.6 Relationship Between Commanded Speed and Current Speed

Standard speed change mode

- When the commanded speed of the ongoing positioning data number and that of the next data number are different, the currently valid speed is accelerated or decelerated to the designated value of the next data number after the axis has reached the positioning end point.

- For acceleration or deceleration, the parameters of the positioning data number executing acceleration or deceleration are used. A speed change does not take place when the commanded speed is the same.

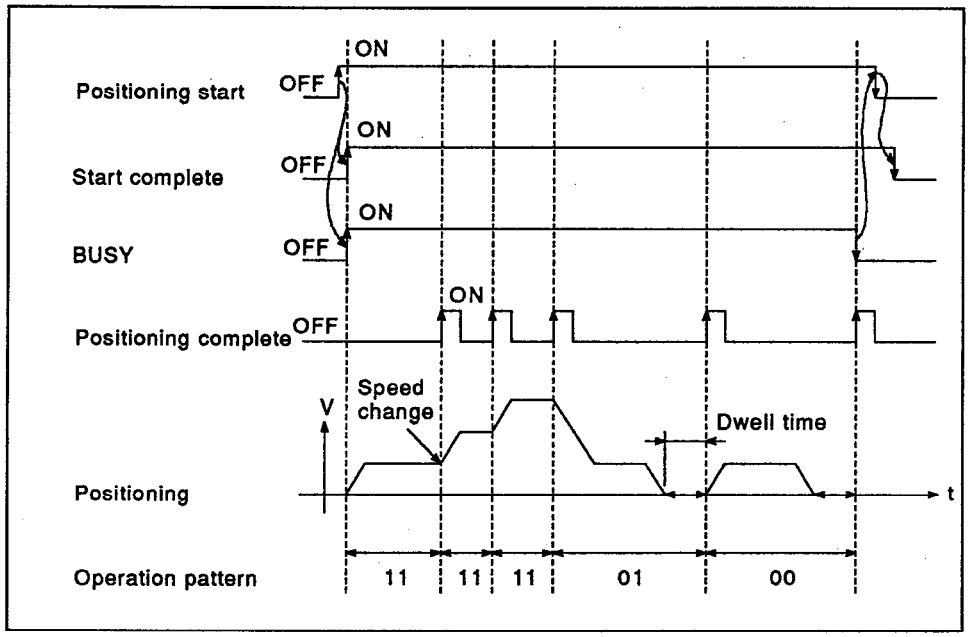
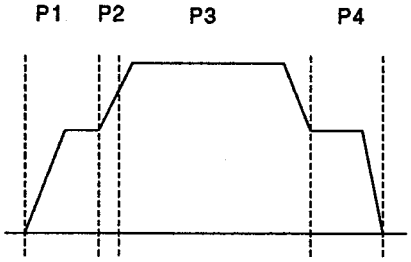


Fig. 3.7 Operation in Standard Speed Change Mode

- Speed change conditions
  When the travel value is too short for the target speed and consequently the actual speed does not reach the target speed in acceleration and deceleration, the actual speed is accelerated or decelerated to as close a speed as possible to the target.
  If the axis overruns the travel value when automatic deceleration is required (for example, when the operation pattern is 00 or 01), the axis will stop at the positioning address immediately, and "insufficient travel value warning (warning code: 513)" will be issued.

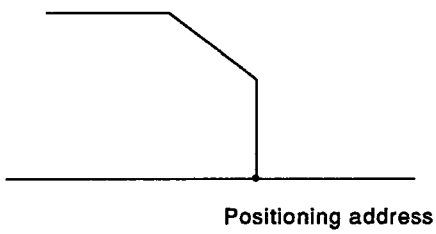
[When the speed cannot be changed at P2]

Speed relationship: P1 = P4, P2 = P3, P1 < P2



[When the travel value is short in automatic deceleration]

Since the travel value required for automatic deceleration cannot be assured, the axis stops immediately at any speed higher than 0.



Advance speed change mode

- When the commanded speed of the ongoing positioning data number and that of the next data number are different, the currently valid speed is changed to the designated value of the next data number at the end of the current positioning.

- For acceleration or deceleration, the parameters of the positioning data number executing the acceleration or deceleration are used. A speed change does not take place when the commanded speed is the same.

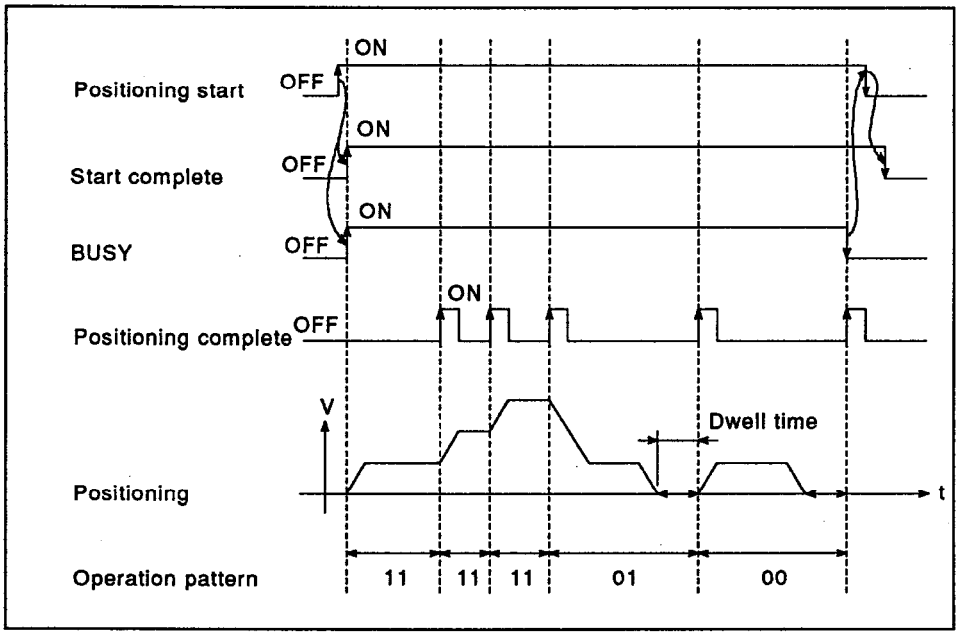
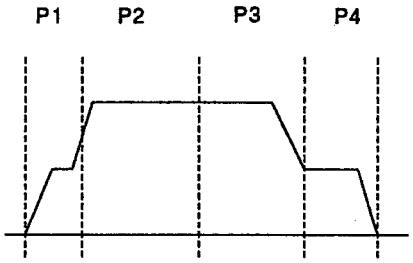


Fig. 3.8 Operation in Advance Speed Change Mode

- Speed change conditions
  When the travel value is too short for the target speed and consequently the actual speed does not reach the target speed in acceleration and deceleration, the actual speed is accelerated or decelerated to as close a speed as possible to the target.
  If the axis overruns the travel value when automatic deceleration is required (for example, when the operation pattern is 00 or 01), the axis will stop at the positioning address immediately, and "insufficient travel value warning (warning code: 513)" will be issued.

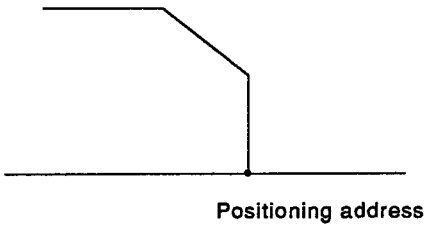
[When the speed cannot be changed to P2 at P1]

Speed relationship: P1 = P4, P2 = P3, P1 < P2



[When the travel value is short in automatic deceleration]

Since the travel value required for automatic deceleration cannot be assured, the axis stops immediately at any speed higher than 0.



3.3.5 Interpolation

(1) Interpolation uses two axes.

(2) Write the control method to: the positioning data for axis 1 for interpolation by axis 1 and axis 2; the positioning data for axis 2 for interpolation by axis 2 and axis 3; or the positioning data for axis 3 for interpolation by axis 3 and axis 1.

(3) The positioning identifier, M code, dwell time, commanded speed and other parameters for axis 1 are used for interpolation by axis 1 and axis 2, those for axis 2 for interpolation by axis 2 and axis 3, or those for axis 3 for interpolation by axis 3 and axis 1.
However, the positioning address and arc data used must be those set for the same positioning data number of each axis.

(4) When interpolation is executed using continuous positioning control or continuous locus control, include everything from the first positioning data No. started to the operation pattern 00 positioning data No. in the interpolation.
If the positioning data set for each point of the positioning start data in a block start is interpolation data, make all these points subject to interpolation.
Failure to do this may cause the AD75 to malfunction.

(5) There are two interpolation speed specification methods (interpolation modes), resultant speed (default) and reference axis speed.
The reference axis speed mode is, however, applicable only to linear interpolation control, and it may not be possible to designate either mode if there is an axis unit G (group) mismatch.
During interpolation, the paired axis (second axis) remains in the interpolation state, and returns to standby on completion of interpolation.
If an error occurs during interpolation, both axes decelerate to a stop and go into an error status.

(a) Axis unit G (groups) are classified as follows.

Unit G (Group)	Unit
Group 1	mm, inch
Group 2	degree
Group 3	PULS (PLS)

(b) Whether or not interpolation is possible is determined as follows.

Interpolation	Speed Designation	Unit G Matched	Unit G Mismatched
Linear interpolation	Resultant speed	Applicable	Inapplicable
	Reference axis speed	Applicable	Applicable
Circular interpolation	Resultant speed	Applicable	Inapplicable
	Reference axis speed	Inapplicable	Inapplicable

1) The units "mm" and "inch" can be used together and they belong to the same group.

2) Circular interpolation cannot be performed when "degrees" is selected as the unit.
Selecting circular interpolation as the control method with degree units causes a "Control method setting error (error code: 524)" and positioning does not begin.
If positioning control is in progress, an immediate stop will occur on detection of the error.

(c) Speed unit when different units are used

Linear or circular interpolation in the resultant speed mode is possible whether unit group is matched or mm and inch units are both used.
Linear interpolation can be executed in the reference axis mode even when the unit G is mismatched.
The following table shows the applicable speed units in such cases.

Speed Designation	Interpolation Axes	Applicable Speed	Speed Unit
Resultant speed (linear interpolation, circular interpolation) (mm and inch are used together.)	Axis 1 and axis 2	Speed of axis 1	Unit of axis 1. The unit is always the same.
	Axis 2 and axis 3	Speed of axis 2	Unit of axis 2. The unit is always the same.
	Axis 3 and axis 1	Speed of axis 3	Unit of axis 3. The unit is always the same.
Reference axis speed (linear interpolation) (Various units are used together.)	Axis 1 and axis 2	Speed of axis 1	Unit of axis 1. The unit is always the same.
	Axis 2 and axis 3	Speed of axis 2	Unit of axis 2. The unit is always the same.
	Axis 3 and axis 1	Speed of axis 3	Unit of axis 3. The unit is always the same.

REMARK

For details on the resultant speed and reference axis speed, see Section3.4.2 (9).

3.3.6 Speed control (VF, VR)

(1) Description of speed control

(a) The designated axis of the positioning start data is controlled at the commanded speed until a stop command is input.

(b) The VF or VR speed control mode can be selected according to the direction of rotation.

- VF..... Start in forward direction
- VR..... Start in reverse direction

(2) Operation timing

Fig. 3.9 shows the speed control operation timing.

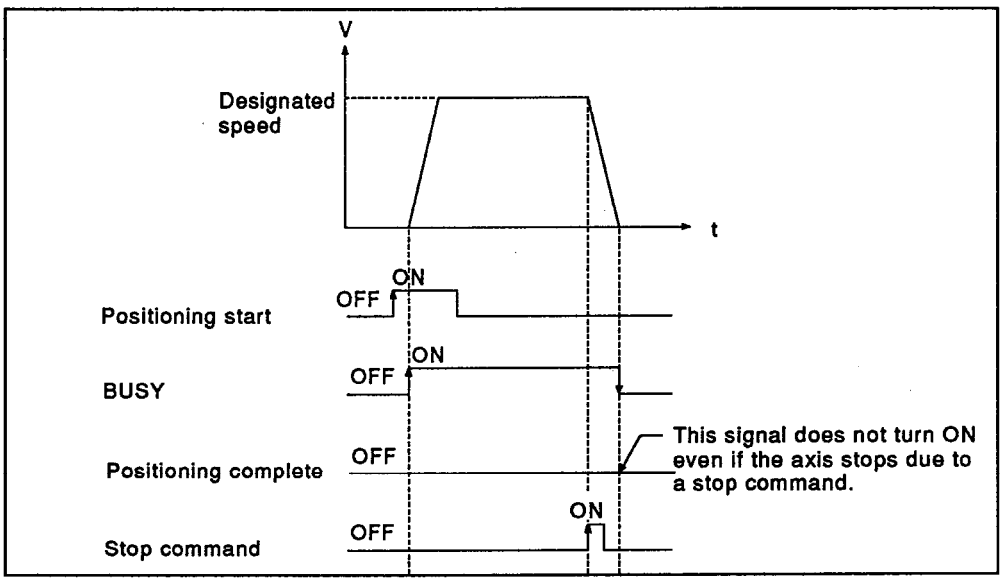


Fig. 3.9 Speed Control Operation Timing

(3) Feed present value updating

As shown below, the processing of the feed present value differs depending on the setting of "feed present value update request designation during speed control" of extended parameters #1. (See Section 3.4.2 (10).)

(a) When 0 (feed present value update disabled) is set:
The feed present value remains unchanged before and after execution of speed control.

(b) When 1 (feed present value update enabled) is set:
The feed present value is updated during speed control.

POINT

When positioning is commenced with the feed present value update request designation setting "1", do not change it until positioning control is completed.
If the setting is changed to "0" in the middle of positioning control, the feed present value cannot be maintained.

(4) Confirmation during speed control

The speed control in progress flag is changed to 1 during speed control. *

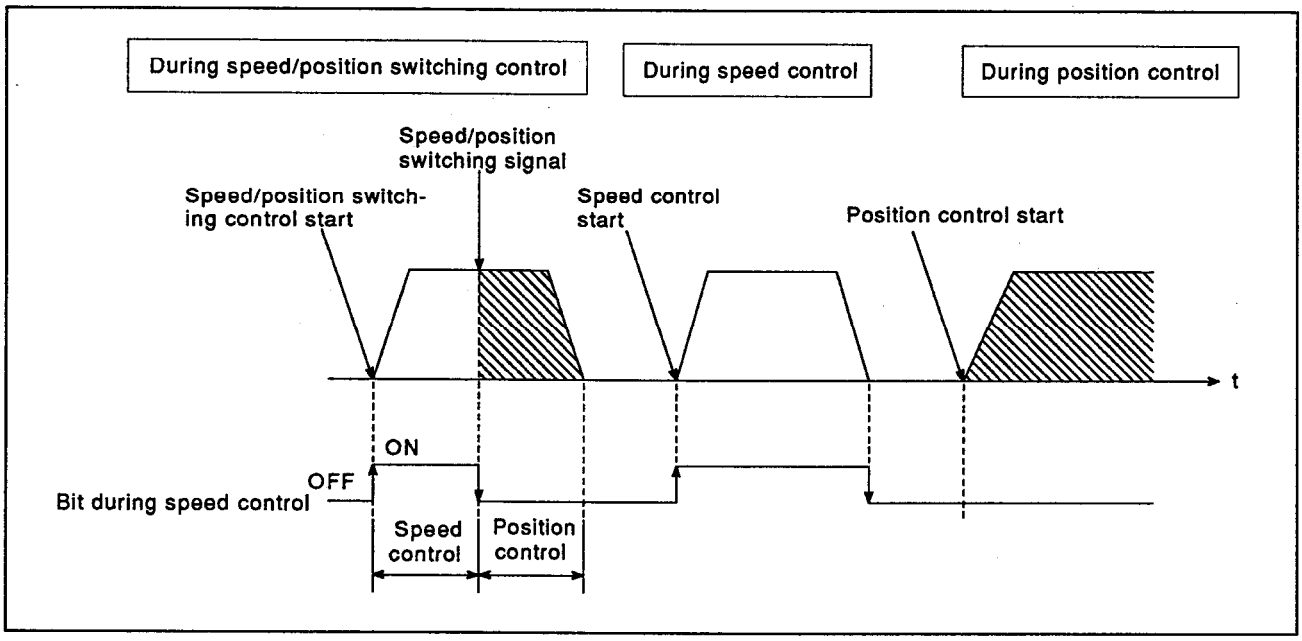


Fig. 3.10 Speed Control In Progress Flag Timing Chart

(5) Constraints

(a) Speed control cannot be used for continuous locus control.

If speed control is designated when the operation pattern of the positioning data is continuous locus control, "continuous locus control not possible error (error code: 516)" will result, and positioning will not begin.

(b) The dwell time setting is ignored.

(c) The M code can be used only in the "WITH mode".
When the AFTER mode is selected, no M codes will be output, and the M code ON signal will not be turned ON.

REMARK

*: The speed control in progress flag is set at bit 0 of the "status" area in the axis monitor area of the buffer memory. For details, See Section 3.6.3 (2).

(6) Designating positioning data *1

The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2
Operation pattern	o
Control method *3	Select "forward speed control" or "reverse speed control".
Acceleration time	o
Deceleration time	o
Positioning address/Travel value	—
Circular interpolation address	—
Commanded speed	o
Dwell time	Δ
M code	Δ

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

3) *3: Make the selection of "forward speed control" or "reverse speed control" for the control method based on the direction of rotation of the motor.

3.3.7 Speed/position switching control (VPF, VPR)

(1) Description of speed/position switching control

(a) Speed control is executed for the designated axis of the positioning start data until receipt of the speed/position switching signal, whereupon the control mode switches from speed control to position control and positioning is performed for the designated travel value.

(b) The VPF or VPR speed/position switching control mode can be selected according to the direction of rotation.

- VPF..... Start in forward direction (address incremental direction)
- VPR ..... Start in reverse direction (address decremental direction)

(2) Switching from speed control to position control

(a) A speed/position switching signal switches the control mode from speed control to position control.

(b) The speed/position switching signal is valid only when the speed/position switching enabled flag in the axis control data is ON. (See Section 3.6.4 (2).)
If the speed/position switching enable flag is turned ON after the speed/position switching signal, the control mode cannot switch from speed control to position control, which means that speed control remains in effect.

(3) Operation timing

Fig. 3.11 shows the operation timing of speed/position switching control.

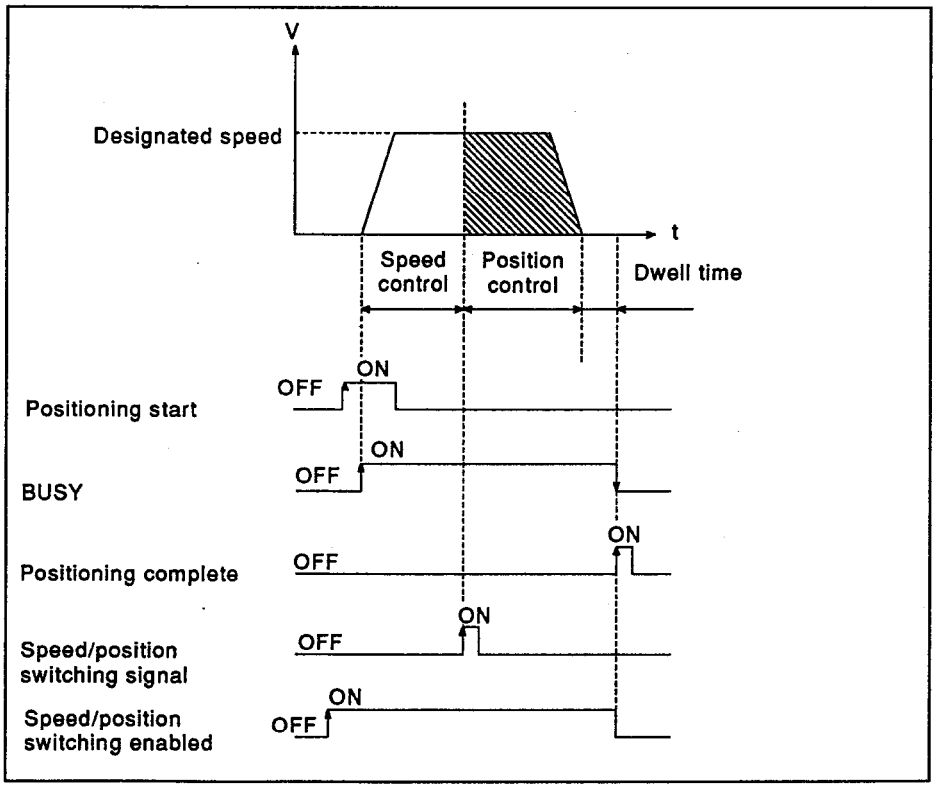


Fig. 3.11 Speed/Position Switching Control Operation Timing

(4) Feed present value updating

As described below, the processing of the feed present value is different depending on the setting of "feed present value update request designation during speed control" of extended parameters #1. (See Section 3.4.2 (10).)

(a) When 0 (feed present value update disabled) is set:

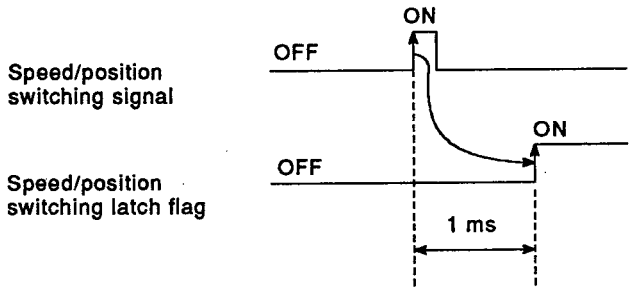
- The feed present value remains is the same during speed control as before speed control started.
- Feed present value updating begins on switching of the control mode to position control.

(b) When 1 (feed present value update enabled) is set:

- The feed present value is updated during speed control.

(5) Switching time from speed control to position control

The time from speed/position control switching signal ON to speed/position switching latch flag ON is 1 ms.



POINT

When positioning is commenced with a feed present value update request designation setting of "1", do not change it until positioning control is completed.
If the setting is changed to "0" in the middle of positioning control, the feed present value cannot be maintained.

(6) Travel value change

(a) Travel values can be changed by position control in the speed control mode of speed/position switching control.
Any requests for travel value changes will be ignored in the position control mode of speed/position switching control.

(b) Travel values changed during speed control are stored to the speed/position switching control travel value change register using the sequence program. (See Section 3.6.4 (2).)
The data stored in the speed/position switching control travel value change register will become the travel value when the speed/position switching signal is turned ON.

(c) The travel value from the point when a switch to position control is made due to input of a speed/position switching signal from an external source is stored in the "travel value after speed/position switching signal ON" area in the axis monitor area. (See Section 3.6.3 (2))

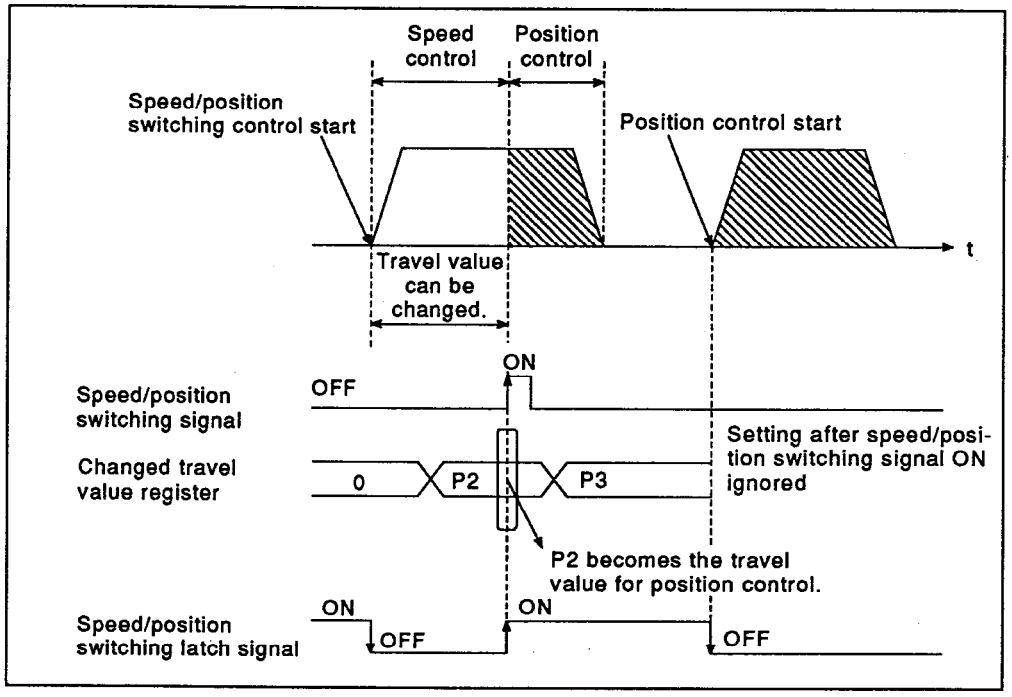


Fig. 3.12 Travel Value Change Timing in Position Control

POINTS

(1) Requests for travel value changes can be identified simply by writing changed travel values to the changed travel value register using the sequence program.

(2) The travel value after the change can become valid at any time up to input of the speed/position switching signal during speed/position switching control.

(3) The "speed/position switching latch flag" in the axis monitor area can be used as a travel value change enable/disable interlock in position control. (See Section 3.6.3 (2))

(7) Constraints

(a) To use a pulse train output motor, turn ON the speed/position switching signal within the stable speed range (stable speed state). A warning will be issued if the signal is turned ON during acceleration because of a large fluctuation in the number of droop pulses.

(b) Speed/position switching control cannot be used for continuous locus control.
If speed/position switching control is designated when the operation pattern of the positioning data is continuous locus control, an axis error will result, and positioning will not begin.

(c) Only position control is performed when both speed/position switching enabled and speed/position switching signals are turned ON at the start of positioning.

(d) If the travel value in position control is shorter than the deceleration distance at the control speed, deceleration begins on input of a speed/position switching signal.

(e) A software stroke limit range check is executed only when the "feed present value update request" is ON during speed control.

(8) Designating positioning data *1

The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2
Operation pattern	o
Control method *3	Select "forward speed/position control" or "reverse speed/position control".
Acceleration time	o
Deceleration time	o
Positioning address/Travel value	—
Circular interpolation address	—
Commanded speed	o
Dwell time	Δ
M code	Δ

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

3) *3: Make the selection of "forward speed/position control" or "reverse speed/position control" for the control method based on the direction of rotation of the motor.

3.3.8 Home position return function

(1) Description of home position return

(a) Home position return means moving the axes to the machine home position, for example when the power is switched on.

(b) The AD75 provides the following six types of home position return:

- Near-zero point dog method
- Stopper stop (1) (on elapse of dwell time)
- Stopper stop (2) (by zero point signal issued when the axis contacts the stopper)
- Stopper stop (3) (method without a near-zero point dog)
- Count method (1) (using a zero point signal)
- Count method (2) (using no zero point signal)

Specify the home position return method with the home position return parameter.

(2) Precautions

(a) The home position return parameter must be set for each axis to perform home position return.

(b) The home position return function is not available when the operation pattern is continuous locus control or continuous positioning control.

(c) Acceleration/Deceleration time selection for home position return
For home position return, set an acceleration time and a deceleration in the parameters for home position return of positioning data No. 9001 and high-speed home position return of positioning data No. 9002, respectively.

REMARK

The home position return parameters comprise the "basic parameters for home position return" and the "extended parameters for home position return".

- Basic parameters for home position return: Section 3.4.3
- Extended parameters for home position return: Section 3.4.4

(3) Home position return methods

Near-zero point dog home position return

(a) Description of near-zero point home position return

Near-zero point dog home position return stops axis motion with in response to a zero point signal after the near-zero point dog has been turned OFF.
A pulse generator (PG) capable of generating a zero point signal is required.

(b) Operations in near-zero point dog home position return

When near-zero point dog home position return is started, the following operations are performed:

1) Axis travel occurs in the designated home position return direction at the designated home position return speed.

2) The speed decreases to the creep speed when the near-zero point dog comes ON.

3) The axis stops in response to the zero point signal after the near-zero point dog has been turned OFF.
A "deviation counter clear output" is issued to the drive unit.

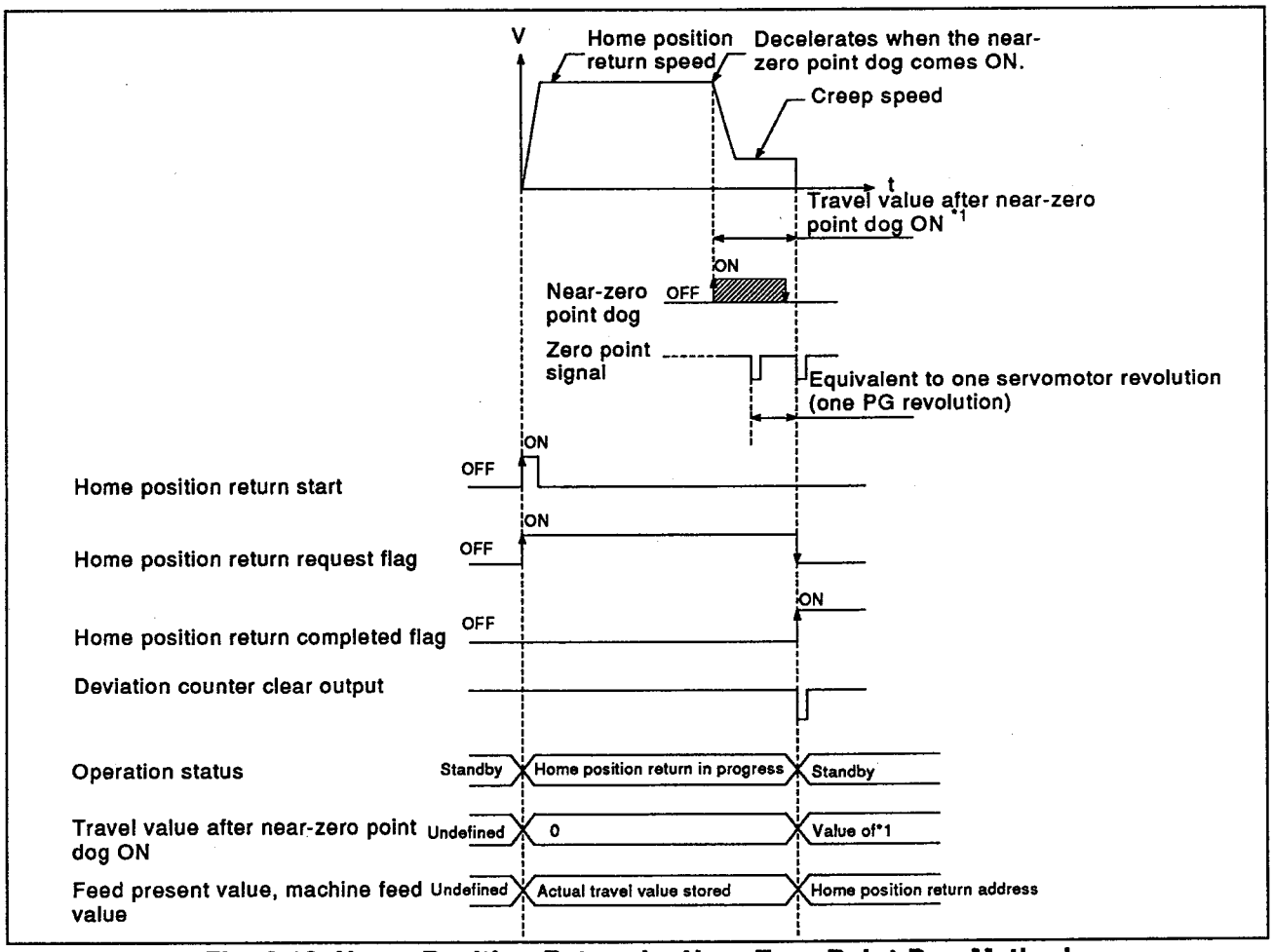
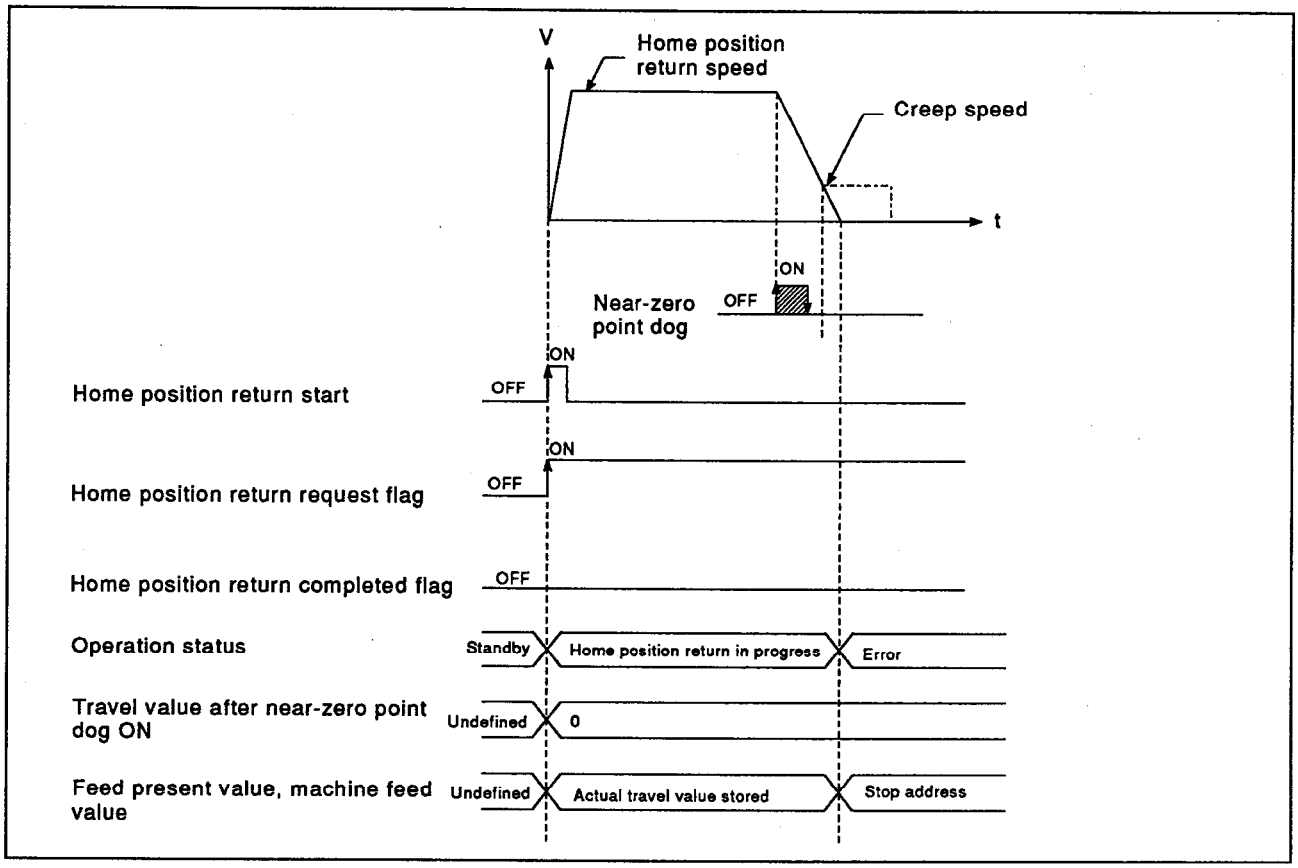


Fig. 3.13 Home Position Return by Near-Zero Point Dog Method

(c) Constraints

1) Keep the near-zero point dog ON until deceleration from the home position return speed to the creep speed begins.
If the dog is turned OFF during deceleration from the home position return speed, axis motion will decelerate to a stop.

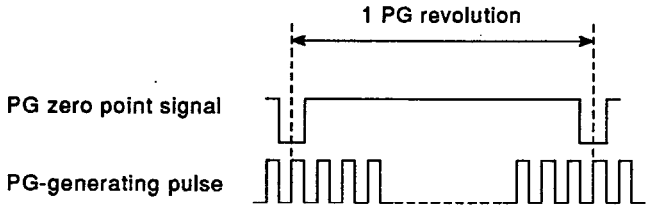


2) An error will occur if an attempt is made to perform another home position return after completion of one home position return operation with the home position return retry function disabled.
In such a case, return the axis by JOG operation to a position before where the near-zero point dog turns ON, then perform home position return.

3) Home position return when the near-zero point dog comes ON begins at the creep speed.

REMARK

The zero point signal issued from the PG is generated as a single pulse per PG revolution.



Count method (1) (using a zero point signal)

(a) Description of count method (1) home position return

1) Count method (1) home position return stops axis motion in response to a zero point signal as soon as the designated distance after the near-zero point dog was turned ON (travel value after near-zero point dog ON) has been traveled.

2) Set the travel value after near-zero point dog ON in the home position return parameters.

3) A pulse generator (PG) capable of generating a zero point signal is required.

(b) Operations in count method (1) home position return
When count method (1) home position return is started, the following operations are performed:

1) Axis travel occurs in the designated home position return direction at the designated home position return speed.

2) The speed decelerates to the creep speed with the near-zero point dog ON.

3) The axis stops with a zero point signal after the near-zero point dog has been turned ON.
A "deviation counter clear output" is issued to the drive unit.

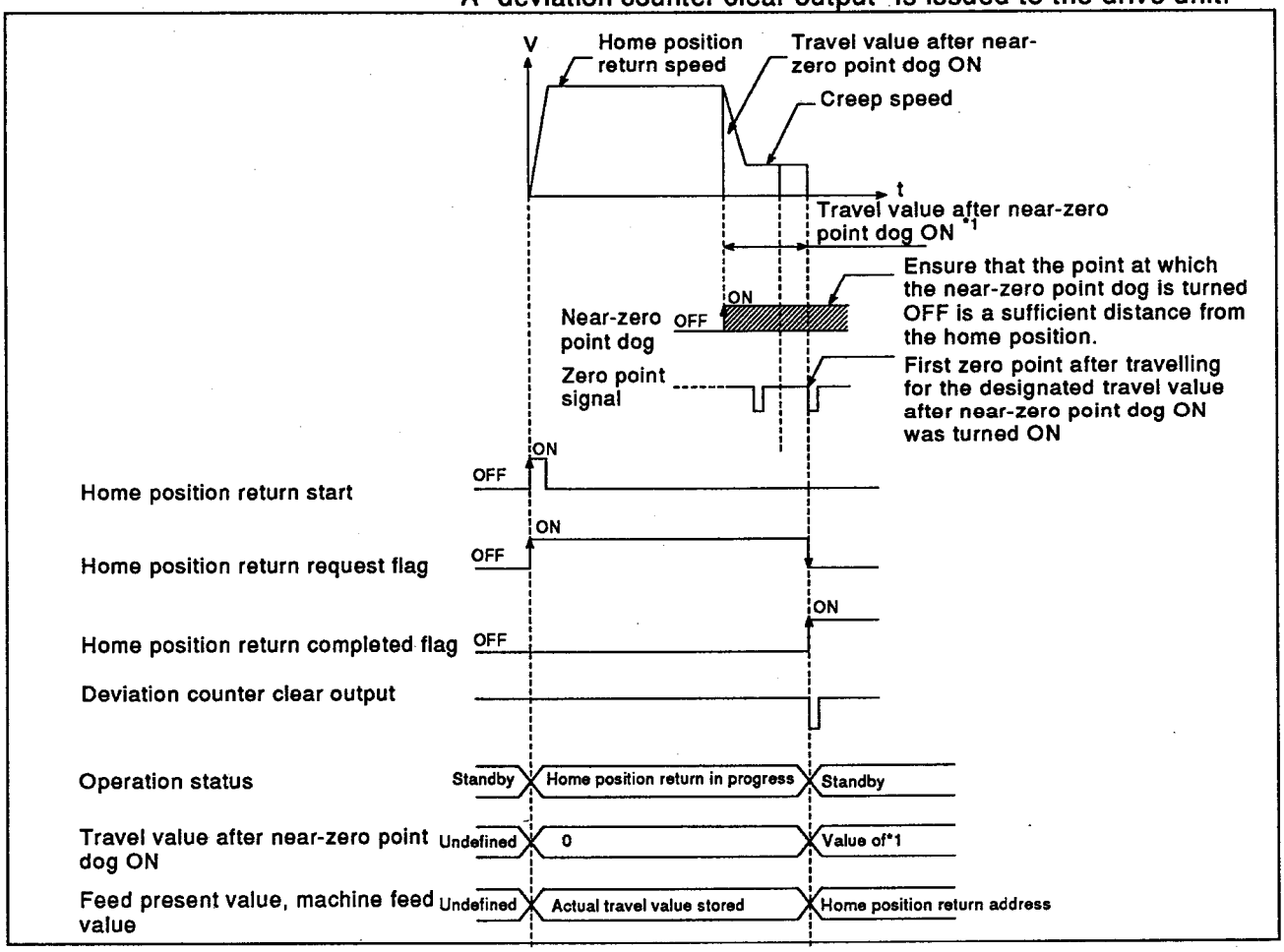
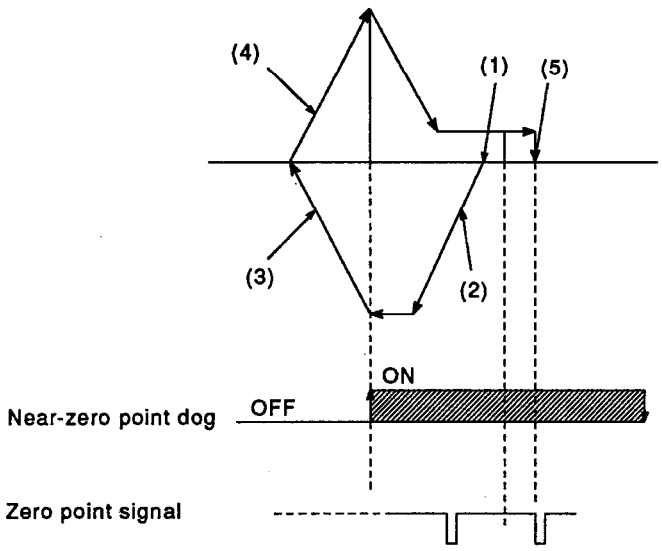


Fig. 3.14 Home Position Return by Count Method (1)

(c) Operations on home position return when the near-zero point dog comes ON and continuous starting of home position return

In count method (1) home position return, home position return can be performed when the near-zero point dog comes ON, and continuous starting of home position return is possible.
When home position return when the near-zero point dog comes ON or continuous starting of home position return is executed, the axis returns to a position where the near-zero point dog is OFF before home position return is started.



[Operations at the start of home position return when the near-zero point dog comes ON]

(1) Home position return begins.

(2) Axis travel occurs in the reverse direction to the home position return direction.

(3) Deceleration begins as soon as the near-zero point dog is detected in the OFF status.

(4) After the axis has stopped, it returns to the home position.

(5) Home position return is completed on detection of the first zero point subsequent to travelling for the travel value after near-zero point dog ON was turned ON.

Fig. 3.15 Count Method (1) Home Position Return at Near-zero Dog ON

(d) Constraint

1) If the set travel value after near-zero point dog ON is shorter than the distance required for deceleration from the home position speed, an error will result, and home position return will not be performed.
Refer to the setting example for the travel value after near-zero point dog ON in the home position parameters, and set a travel value longer than the distance for deceleration from the home position return speed.

Count method (2) (no zero point signal used)

(a) Description of count method (2) home position return

1) Count method (2) home position return uses the designated distance after the near-zero point dog has been turned ON (travel value after near-zero point dog ON) to define the home position.

2) Set the travel value after near-zero point dog ON in the home position return parameters.
Compared with the other home position return methods, this method causes an error of about 1 ms.

(b) Operations in count method (2) home position return
When count method (2) home position return is started, the following operations are performed:

1) Axis travel occurs in the designated home position return direction at the designated home position return speed.

2) The speed decreases to the creep speed when the near-zero point dog comes ON.

3) Axis motion stops after travelling for the designated travel value after the near-zero point dog has been turned ON.

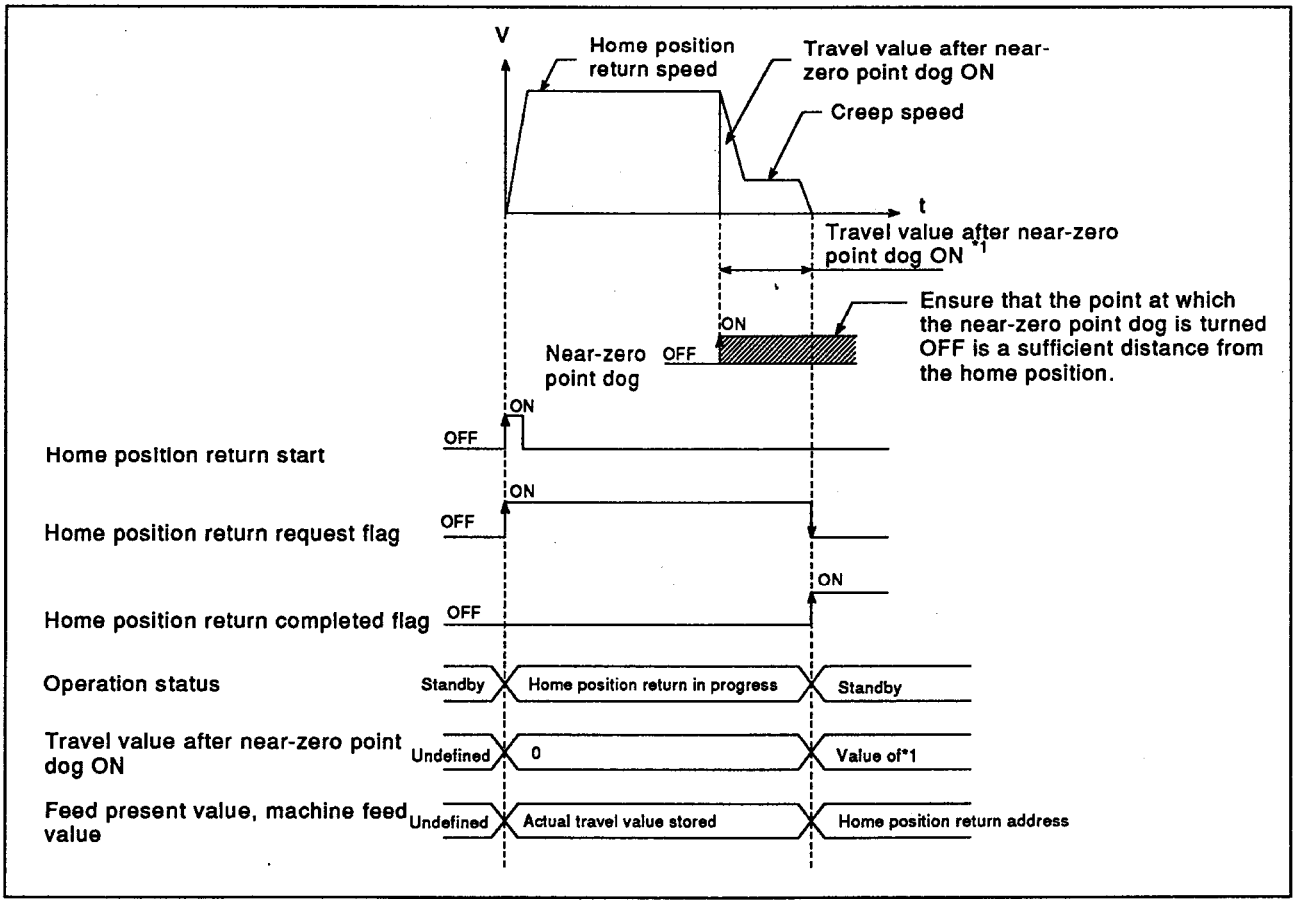
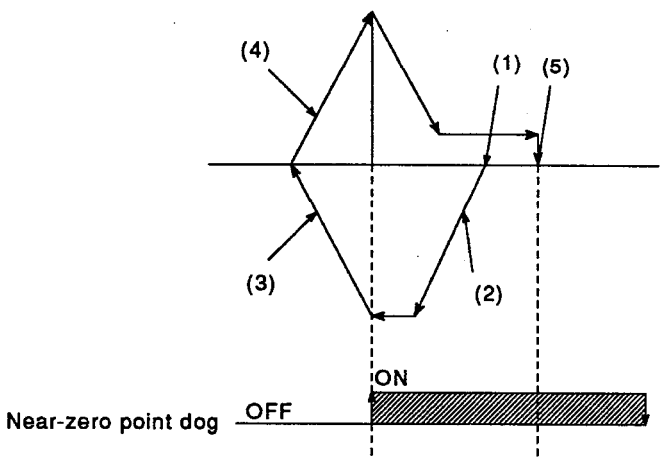


Fig. 3.16 Home Position Return by Count Method (2)

(c) Operations on home position return when the near-zero point dog comes ON and continuous starting of home position return
In count method (2) home position return, home position return can be performed when the near-zero point dog comes ON, and continuous starting of home position return is possible.
When home position return when the near-zero point dog comes ON or continuous starting of home position return is executed, the axis returns to a position where the near-zero point dog is OFF before home position return is started.



[Operations at the start of home position return when the near-zero point dog comes ON]

(1) Home position return begins.

(2) Axis travel occurs in the reverse direction to the home position return direction.

(3) Deceleration begins as soon as the near-zero point dog is detected in the OFF status.

(4) After the axis has stopped, it returns to the home position.

(5) Home position return is completed on completion of travelling for the travel value after near-zero point dog ON was turned ON.

Fig. 3.17 Count Method (2) Home Position Return at Near-zero Dog ON

(d) Constraint

1) If the set travel value after near-zero point dog ON is shorter than the distance required for deceleration from the home position speed, an error will result, and home position return will not be performed.
Refer to the setting example for travel value after near-zero point dog ON in the home position parameters, and set a travel value longer than the distance for deceleration from the home position return speed.

POINT

Compared with count method (1) home position return, count method (2) home position return is inferior in the accuracy of the stop position in home position return. However, this method is helpful when the AD75 cannot receive a zero point signal.

Stopper stop (1) (on elapse of dwell time)

(a) Description of stopper stop (1) home position return

1) Home position return is completed on elapse of the dwell time after the near-zero point dog has been turned ON.
In stopper stop (1), home position return is not completed until the dwell time elapses even if the near-zero point dog is turned OFF in the middle of home position return.

2) After the home position return speed has decreased to the creep speed, it is necessary to limit the servomotor torque, otherwise the servomotor will malfunction when contact is made with the stopper.

(b) Operations in stopper stop (1) home position return

When stopper stop (1) home position return is started, the following operations are performed:

1) Axis travel occurs in the designated home position return direction at the designated home position return speed.

2) The speed decreases to the creep speed when the near-zero point dog comes ON.

3) During travel at the creep speed the stopper is contacted and axis motion stops.

4) On elapse of the dwell time measured from the point when the near-zero point dog comes ON, home position return is completed.

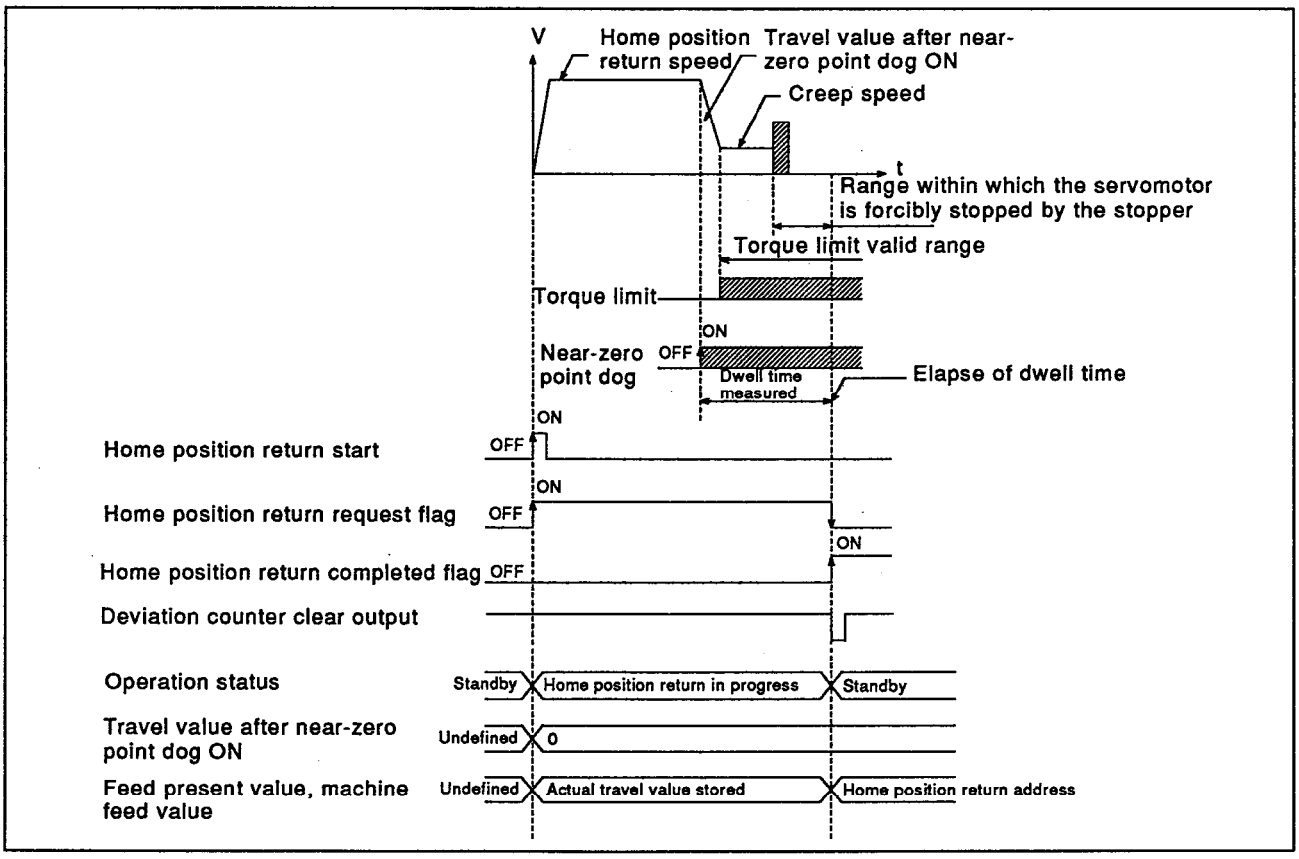
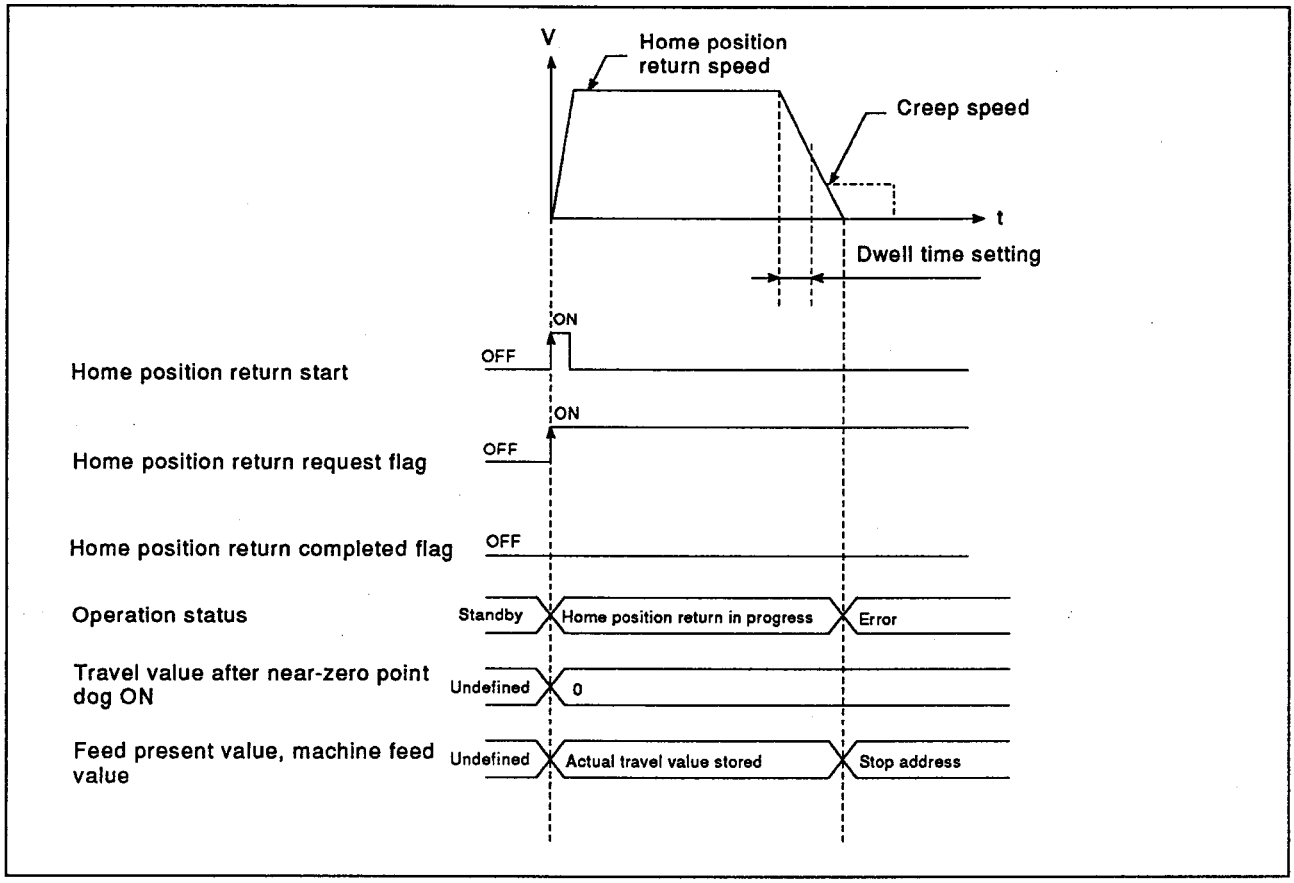


Fig. 3.18 Home Position Return by Stopper Stop (1)

(c) Constraints

1) Set a longer dwell time than the time required for axis motion to reach the stopper after the near-zero point dog has been turned ON.

- If the dwell time elapses during deceleration from the home position return speed, axis motion decelerates to a stop.



2) If the dwell time elapses before axis motion reaches the stopper, motion stops at that point and this position is set as the home position.

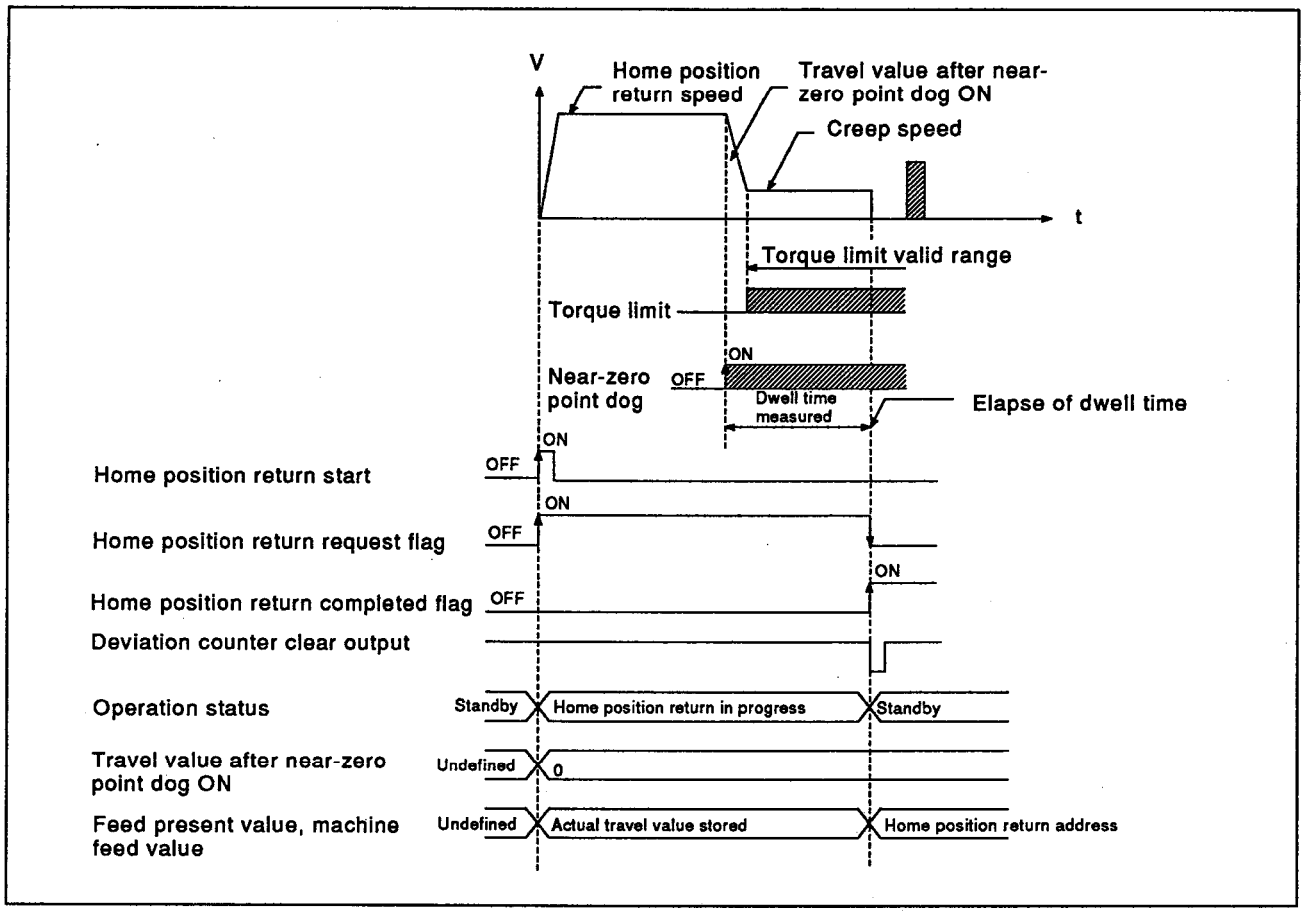


Fig. 3.19 When Dwell Time Elapses Before Axis Reaches Stopper

3) Home position return when the near-zero point dog comes ON begins at the creep speed.

Stopper stop (2) (by zero point signal issued on contacting the stopper)

(a) Description of stopper stop (2) home position return

1) This method completes home position return in response to a zero point signal input from an external switch to the zero point signal terminal on contacting the stopper.
The zero point signal is input whether the near-zero point dog is turned ON or OFF.

2) After the home position return speed has reached the creep speed, it is necessary to limit the servomotor torque, otherwise the servomotor will malfunction when contact is made with the stopper.

(b) Operations in stopper stop (2) home position return

When stopper stop (2) home position return is started, the following operations are performed:

1) Axis travel occurs in the specified home position return direction at the specified home position return speed.

2) The speed decreases to the creep speed when the near-zero point dog comes ON.

3) During travel at the creep speed the stopper is contacted and axis motion stops.

4) On input of a zero point signal, home position return is completed.

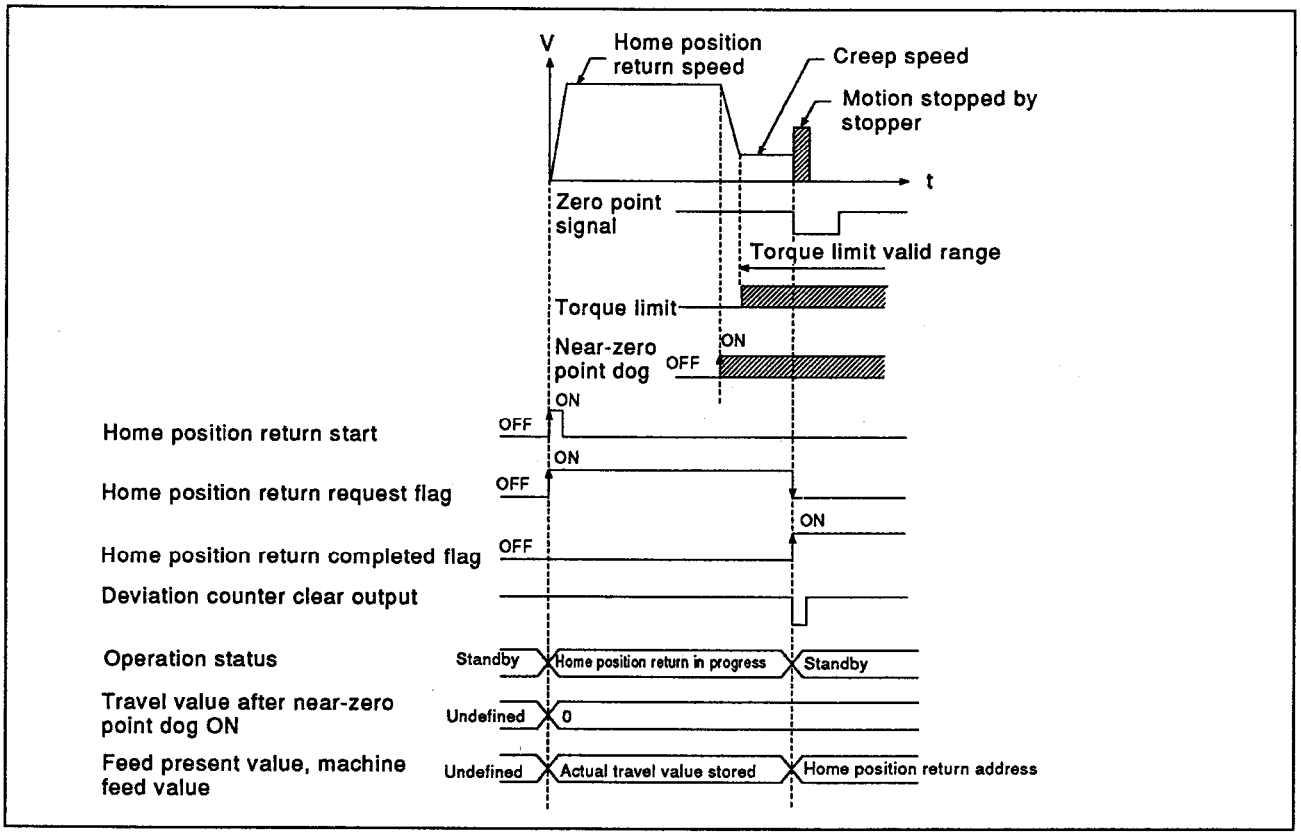


Fig. 3.20 Home Position Return by Stopper Stop (2)

(c) Constraints

1) Input an external zero point signal after contact is made with the stopper.
A zero point signal input before deceleration to the creep speed causes axis motion to decelerate to a stop.

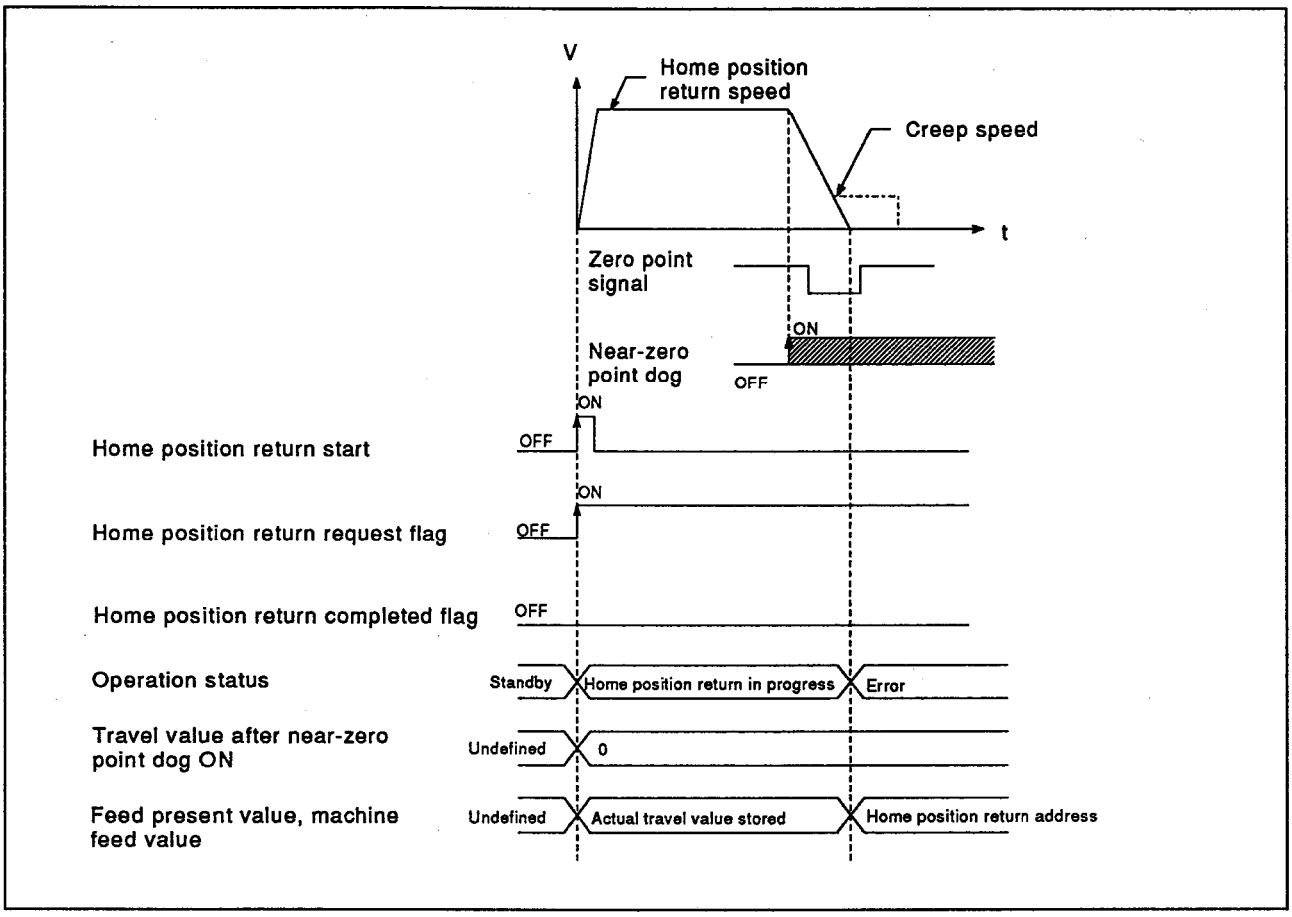


Fig. 3.21 Operation When Zero Point Signal Input Before Creep Speed Reached

2) If a zero point signal is input before axis motion reaches the stopper, motion stops at that point and this position is set as the home position.

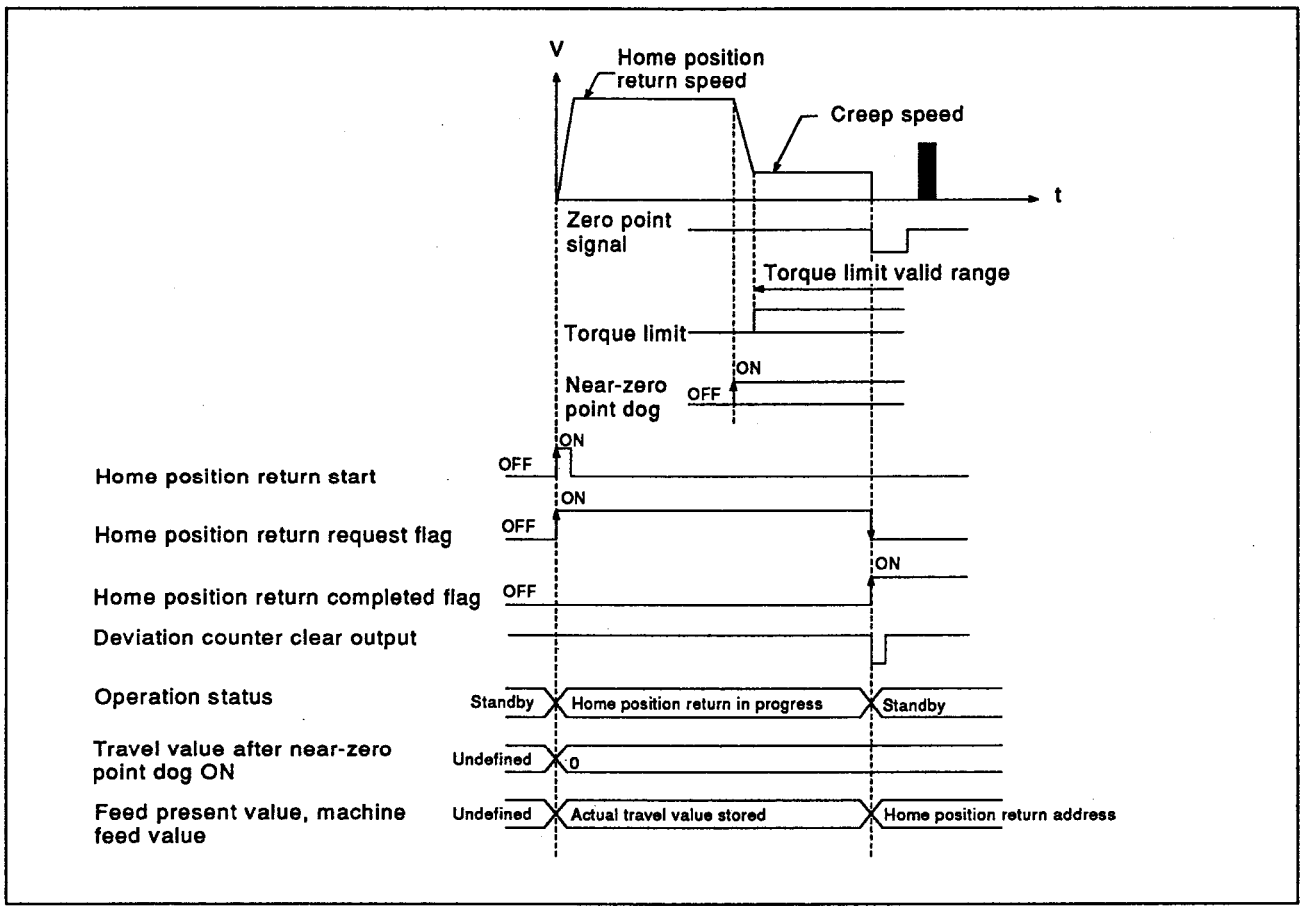


Fig. 3.22 Operation when Dwell Time Elapses before Stopping by the Stopper

3) Home position return at near-zero dog ON begins at the creep speed.

Stopper stop (3) (method without a near-zero point dog)

(a) Description of stopper stop (3) home position return

1) This method starts home position return at the creep speed, and completes it with a zero point signal input from an external switch to the zero point signal terminal when the axis contacts the stopper.

2) It is necessary to limit the servomotor torque.

Otherwise, the servomotor will malfunction when contact is made with the stopper.

(b) Operations in stopper stop (3) home position return

When stopper stop (3) home position return is started, the following operations are performed:

1) Axis travel occurs in the specified home position return direction at the specified home position return speed.

2) During travel at the creep speed the stopper is contacted and axis motion stops.

3) On input of a zero point signal, home position return is completed.

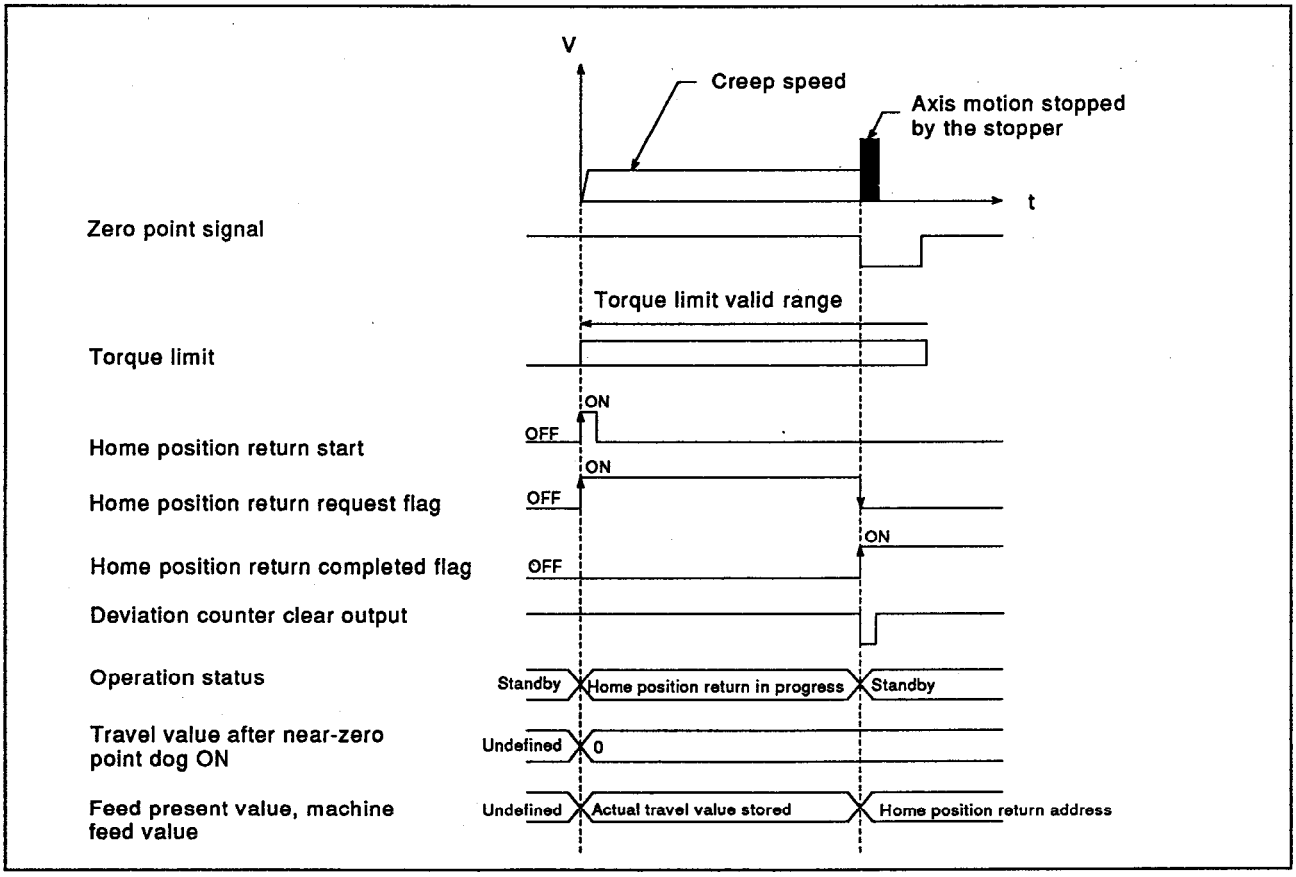


Fig. 3.23 Home Position Return by Stopper Stop (3)

(c) Constraints

1) If a zero point signal is input before axis motion reaches the stopper, motion stops at that point and this position is set as the home position.

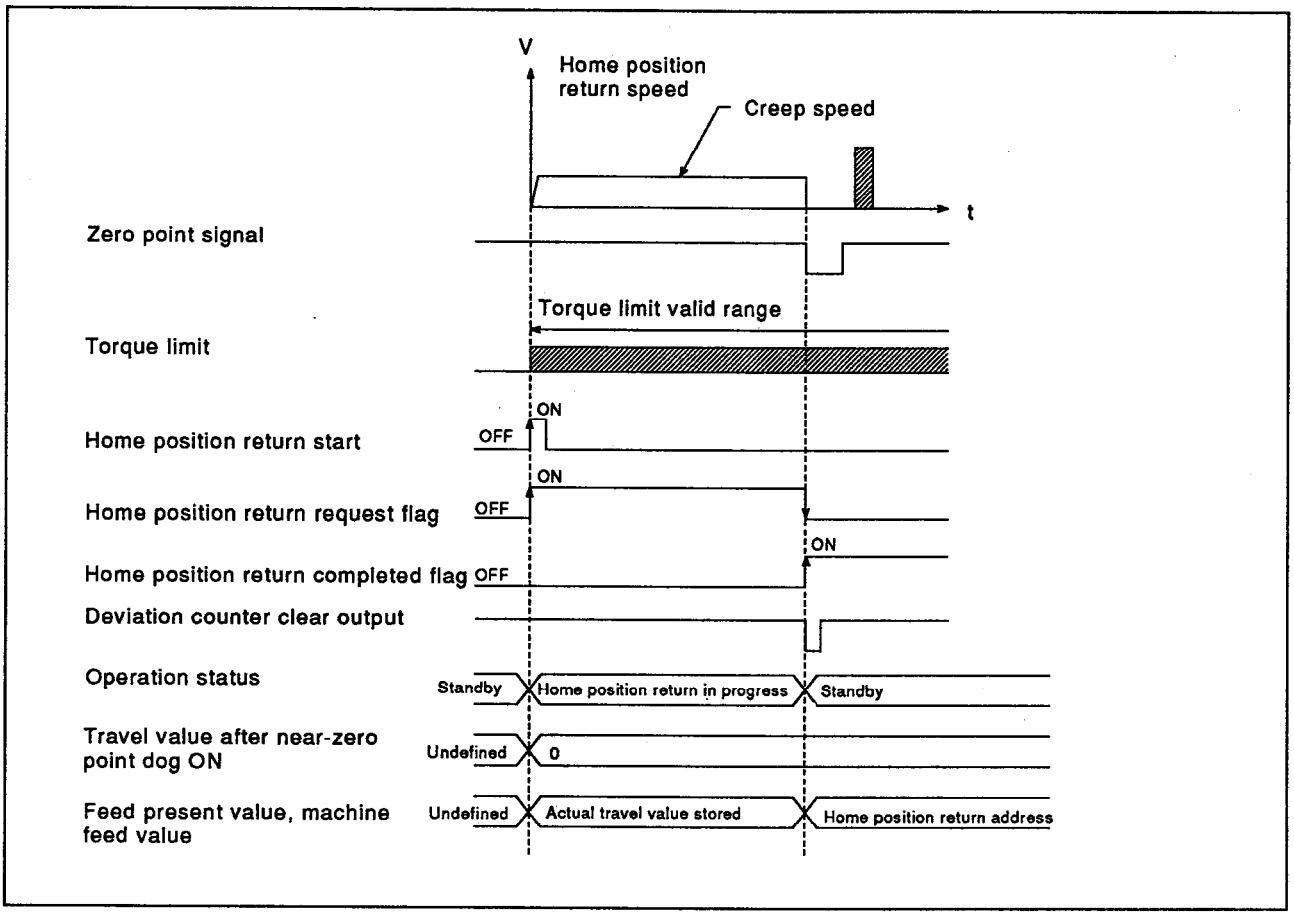


Fig. 3.24 When a Zero Point Signal is Input Before Reaching Stopper

2) If there is an external zero point signal input at the start of home position return, an error will result, and home position return will not be performed.

3) Stopper stop (3) home position return cannot execute the home position return retry function.

4) When the limit switch is turned OFF, axis motion decelerates to a stop.

POINT

Although stopper stop (3) home position return takes time to complete home position return because it is performed at the creep speed from the beginning, it is helpful when a near-zero point dog cannot be installed.

(4) Home position return start methods

There are three home position return start methods, as shown below:

- Machine home position return start
- High-speed home position return start
- High-speed machine home position return start

POINTS

(1) The "home position return request flag" is turned ON at the start of machine home position return.
As soon as machine home position return is completed properly, the "home position return request flag" is turned OFF, and the "home position return completed flag" is turned ON.
Depending on the home position return method, the actual travel value may be stored to the "travel value after near-zero point dog ON" area.

(2) After machine home position return has been completed normally, the set home position address is stored to the feed present value/machine value area.

(3) During machine home position return, the "axis operation status" in the axis monitor area remains "home position return in progress".

Machine home position return start

(a) Description of machine home position return

1) Machine home position return start establishes the machine home position by the home position return methods described in Section 3.3.8 (3).

2) Designate positioning start data No. 9001 to start machine home position return.

High-speed home position return start

(a) Description of high-speed home position return start

1) After the machine home position has been established by a machine home position return, high-speed home position return start can be used to travel to the home position at a high speed at the start of positioning without using a home position detection signal.
The travel value is calculated from the home position return address stored in the AD75's internal buffer memory when machine home position return is completed, and the present machine value at high-speed home position return start, and the axis travels to the home position according to this value.

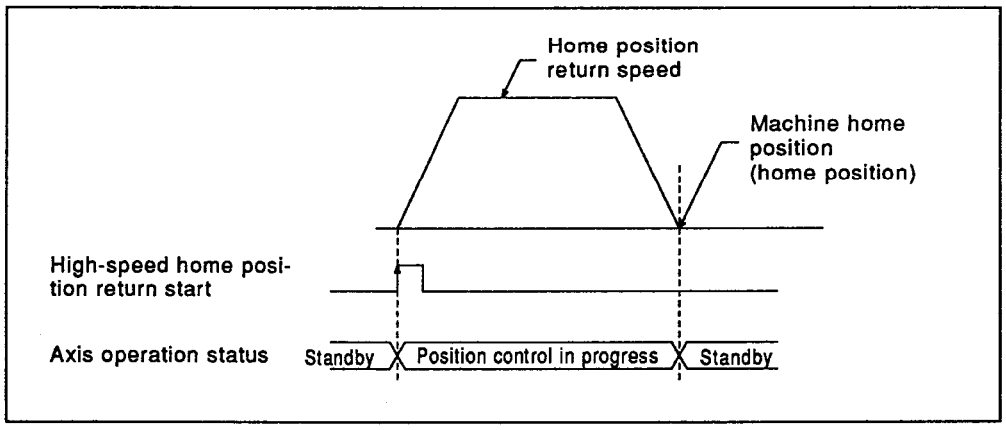
2) Designate positioning start data No. 9002 to start high-speed home position return.

(b) Operations in high-speed home position return

When high-speed home position return is started, the following operations are performed:

1) Axis travel occurs in the machine home position direction at the specified home position return speed. (The travel direction depends on the present machine value when the high-speed home position return start was performed.)

2) Axis motion decelerates to a stop at the home position.



(c) Constraints

1) High-speed home position return cannot be performed until the machine home position has been established by executing a machine home position return.
High-speed home position return cannot be executed while the "home position return request flag" is ON.

2) High-speed home position return is performed at the home position return speed set in the parameters.

3) The set home position address is not stored to the feed present value/machine feed value area when high-speed home position return is completed.

4) During home position return, the axis operation status of the axis is "position control in progress".

5) The following data values do not change in high-speed home position return:

- Home position return request flag
- Home position return completed flag
- Travel value after near-zero point dog ON

6) If the present machine value exceeds the lower or upper limit even once during positioning over an indefinite distance in speed control, an error will occur when high-speed home position return is performed.
High-speed home position return cannot take place until the machine home position has been established by executing a machine home position return.

REMARK

The present machine value is always updated, regardless of the operation pattern. It remains unchanged when the present value is changed.

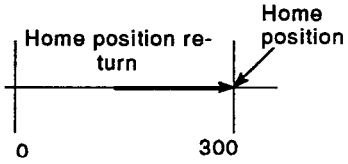
High-speed machine home position return

(a) By executing the positioning program for absolute home position using the "absolute original point" value in the buffer memory axis monitor area, positioning to the absolute original point can be performed.

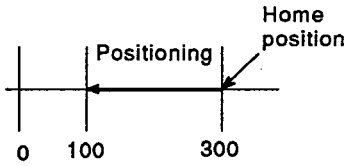
(b) The "absolute original point" matches the home position address parameter when home position return is completed.

(c) The "absolute original point" value changes when the present value changes.

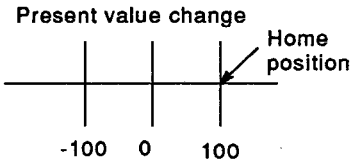
1) When home position return is completed, home position address 300 is stored to the "absolute original point" area.



2) The axis is positioned to address 100.



3) If the present value is changed to -100 at this position, the "absolute original point" is changed to 100.



4) By executing the program for positioning to absolute original point (ABS linear 1) using the "absolute original point" value at this position, positioning to the home position is performed.

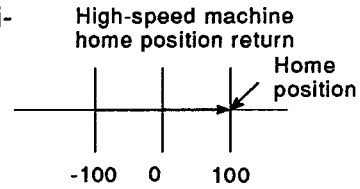


Fig. 3.25 Absolute Original Point Value and Positioning to Home Position

POINT

The absolute original point is not changed after any of the following control operations is performed:

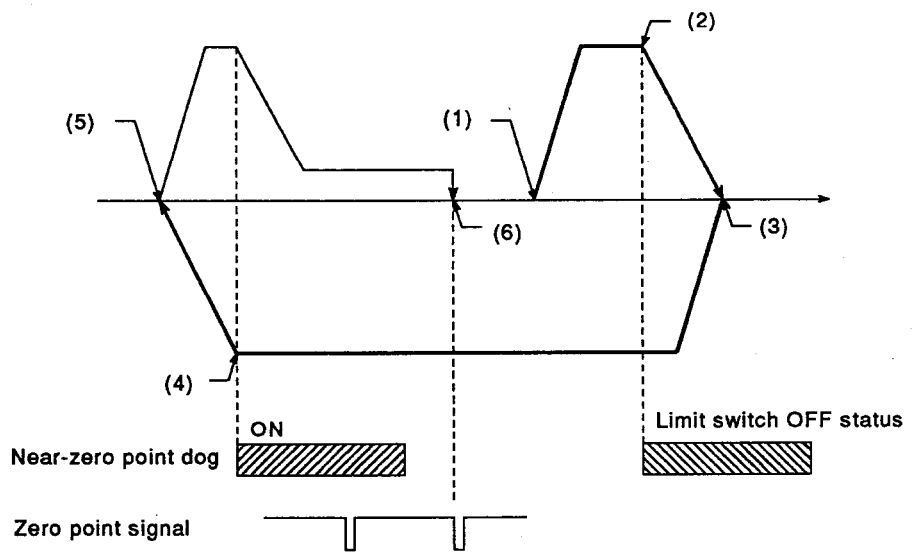
- Present feed value 0 clear at the start of fixed-pitch feed
- Present feed value update request command OFF during speed control

Consequently, positioning to the home position cannot be executed by absolute positioning using the absolute original point after the above operations.

(5) Home position return retry function

(a) This function retries home position return using the upper and lower limit switches.
It can perform home position return without moving the axis back past the near-zero point dog by using JOG operation or other operation modes.

(b) When a home position return start is executed with the home position return retry function enabled, axis travel occurs in the home position return direction. However, if the upper or lower limit switch is turned OFF before the near-zero point dog status is detected, the axis decelerates to a stop, then travels in the reverse direction to the home position return direction.
When the near-zero point dog is detected in the OFF status, the axis decelerates to a stop, and home position return is reattempted.



[Operation of home position return retry function]

(1) Axis motion starts in the home position return direction on receipt of a home position return start signal.

(2) Axis motion decelerates to a stop as soon as the limit switch is turned OFF.

(3) After axis motion has stopped in response to the detection of the limit switch OFF status, it starts in the reverse direction to the home position return direction at the home position return speed.

(4) Axis motion decelerates to a stop when the near-zero point dog goes OFF.

(5) After it has stopped after near-zero point dog OFF, the axis returns to the home position.

Fig. 3.26 Home Position Return Retry Using Upper/Lower Limit Switches

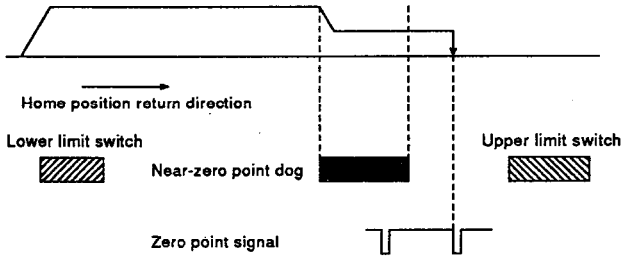
POINT

Set upper and lower limit switches whenever the home position return retry function is disabled.

(c) Even if the upper and lower limit switches are turned OFF, home position return can be performed when the home position return retry function is enabled.

- When the direction of travel into the travel range and the home position return direction are the same, normal home position return takes place.
- When the direction of travel into the travel range is different from the home position return direction, axis motion decelerates to a stop when the near-zero point dog goes OFF, then returns to the home position.

1) Operation when the direction of travel into the travel range and the home position return direction are the same



2) Operation when the direction of travel into the travel range is different from the home position return direction

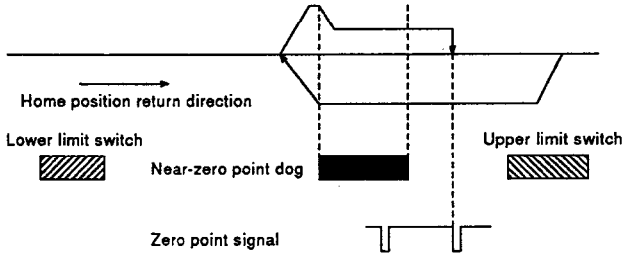


Fig. 3.27 Home Position Return Retry Operation with Upper/Lower Limit Switches OFF

(d) Relationship between home position return method and home position return retry function

Home Position Return Method	Home Position Return Retry Function Disabled	Home Position Return Retry Function Enabled
Near-zero point dog method	x	o
Count method (1)	x	o
Count method (2)	x	o
Stopper stop (1)	x	Δ*
Stopper stop (2)	x	
Stopper stop (3)	x	x

*: In some cases, home position return retry may not be possible due to a mechanical stopper.

(e) Conditions for executing the home position return retry function

- Limit switches must be installed at the upper and lower stroke ends of the machine.
  The motor will keep running until either limit switch is actuated.

- Do not make it impossible to continue operation (for example by turning OFF the power to the drive unit) by using the upper and lower limit switches.

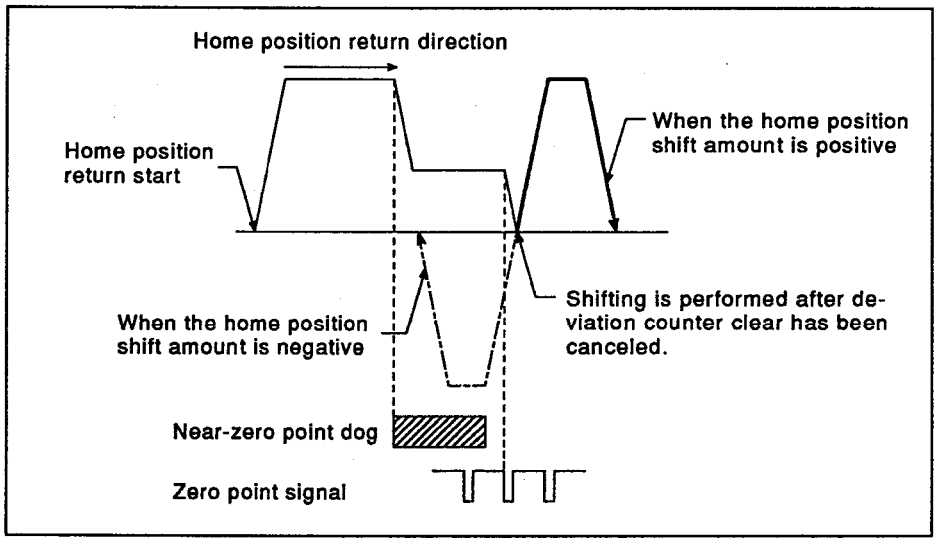
(6) Home position shift function

(a) Description of home position shift function

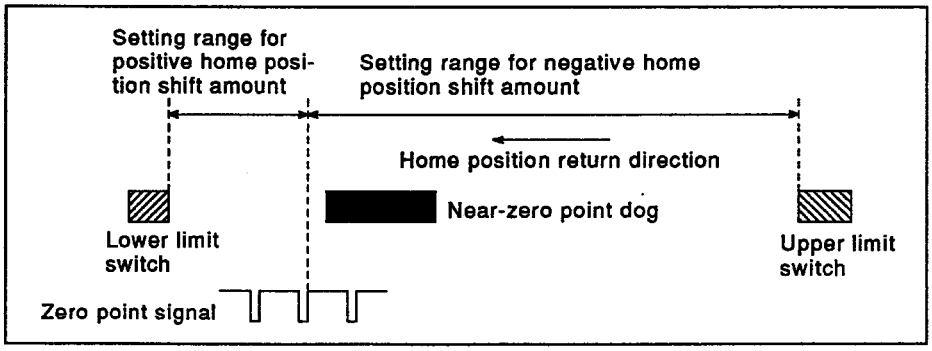
This function discontinues home position return to correct the home position.
It can shift the home position to a position between zero points or to a position away from the zero point.

- When the home position shift amount is positive:
  The home position is shifted in the specified home position return direction.

- When the home position shift amount is negative:
  The home position is shifted in the reverse direction of the specified home position return direction.



(b) Set the home position shift amount within the range from the position at which the zero point signal is detected to the upper and lower limit switches.



(c) Set the following data after shifting with the home position shift function:

- Home position return request flag
- Home position return completed flag
- Axis operation status
- Travel value after near-zero point dog ON
- Feed present value
- Machine feed value

(d) The set home position shift amount is not added to the travel value after near-zero point dog ON.

(e) The home position shift function perform shifting at the home position return speed, irrespective of the home position return method.

(7) Home position return request flag OFF request

(a) Description of home position return request flag OFF request

This function forcibly turns OFF the ON home position return request flag in a system which does not require home position return.

(8) Combinations of home position return and other functions

(a) Home position return start after home position return stop

Home position return interrupted by an external stop signal or axis stop can be restarted by inputting a positioning start signal.
However, when the home position return retry function is disabled an error may occur, depending on the stop position.
Before restarting positioning suspended in the middle of home position return, enable the home position return retry function, or move the axis from the stop position by JOG operation or manual pulse generator operation.

(b) Speed change during home position return

Speed changes are not possible after entering the creep speed.

3.3.9 Manual pulse generator operation

(1) Description of manual pulse generator operation

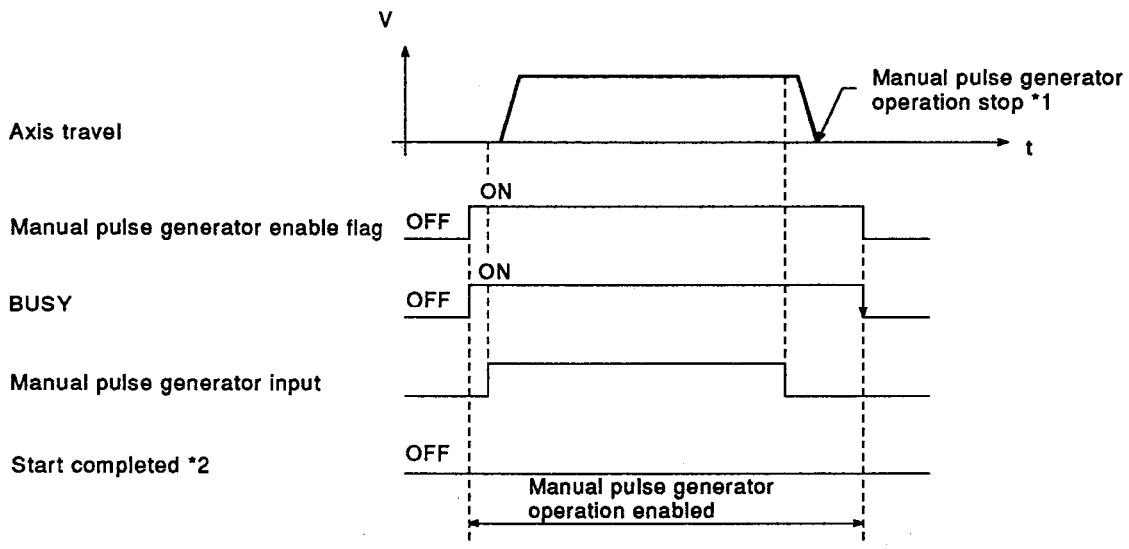
(a) Manual pulse generator operation means positioning control using input pulses from a manual pulse generator. *1
This function is used to perform accurate positioning manually.

(b) Up to three manual pulse generators can be connected to one AD75. One manual pulse generator can control one to three axes simultaneously.

(2) Execution of manual pulse generator operation

(a) Setting the manual pulse generator enable flag to "1 (enabled)" turns ON the BUSY signal, enabling manual pulse generator operation. *2
Positioning control can be performed with input pulses from the manual pulse generator.

(b) Setting the manual pulse generator enable flag to "0 (disabled)" turns OFF the BUSY signal, disabling manual pulse generator operation.



[Notes]

1) *1: One control cycle time (100 ms) after the manual pulse generator has stopped input, the AD75 outputs the last pulse.

2) *2: In manual pulse generator operation, the start completed signal remains OFF.

REMARKS

1) Select and set the manual pulse generator to be used at the following buffer memory addresses:

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address	29	179	329

2) Set the manual pulse generator enable flag at the following buffer memory addresses:

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address	1167	1217	1267

(3) Description of control

(a) The travel value and output speed in positioning control by manual pulse generator operation are shown below.

- The travel value according to input pulses from the manual pulse generator is calculated from the following expression:

$$\left[\begin{array}{c}\text{Travel}\\ \text{value}\end{array}\right] = \left[\begin{array}{c}\text{Number of}\\ \text{input pulses}\end{array}\right] \times \left[\begin{array}{c}\text{Set manual pulse}\\ \text{generator 1 pulse}\\ \text{input magnification}\end{array}\right] \times \left[\begin{array}{c}\text{Travel value}\\ \text{per pulse}\end{array}\right]$$

- In manual pulse generator operation, positioning is performed at a speed corresponding to the number of input pulses per unit time.

$$\left[\begin{array}{c}\text{Output}\\ \text{speed}\end{array}\right] = \left[\begin{array}{c}\text{Number of input}\\ \text{pulses per con-}\\ \text{trol cycle time}\end{array}\right] \times \left[\begin{array}{c}\text{Set manual pulse}\\ \text{generator 1 pulse}\\ \text{input magnification}\end{array}\right] \times \left[\begin{array}{c}\text{Travel}\\ \text{value}\\ \text{per pulse}\end{array}\right]$$

(4) Precautions

(a) After manual pulse generator operation, set the manual pulse generator enable flag to "0 (disabled)".
If this flag is left at the "1" (enabled) setting, unintended positioning could be started by inadvertent operation at the manual pulse generator.

(b) If the manual pulse generator enable flag is turned on when the BUSY signal is ON in positioning control, home position return or JOG operation, a "in-operation start warning" will be issued.

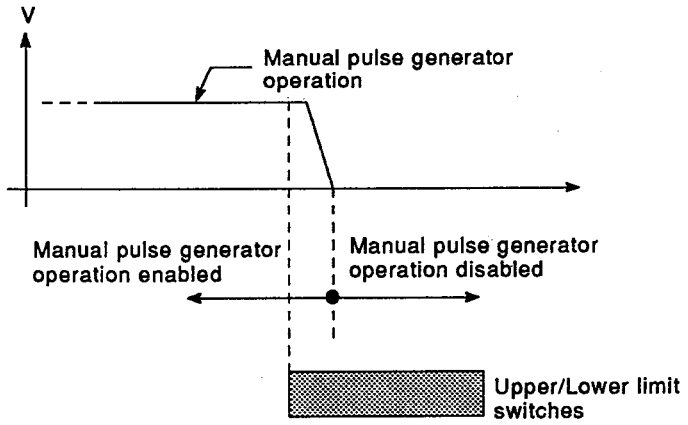
(c) During manual pulse generator operation, the torque limit value is controlled to the value set in the parameters or by a torque value change.

(d) For the manual pulse generator 1 pulse input magnification, set the value for the relevant axis.
If the magnification is outside the setting range, operation is performed using the following values.

- If the manual pulse generator 1 pulse input magnification is set higher than "100", the value used is "100".
- If the manual pulse generator 1 pulse input magnification is set lower than "1", the value used is "1".

(e) If a stop cause occurs during manual pulse generator operation, the axis will stop, and go into the "stopped" or "error" status. The BUSY signal will be turned OFF at the same time.
After eliminating the stop cause, set the manual pulse generator enable flag from "0" to "1". Manual pulse generator operation will be enabled.

(f) Axis motion decelerates to a stop when the upper or lower limit switch is turned OFF.
Input pulses to the upper or lower limit switch in the OFF status are ignored after the axis has stopped.
However, manual pulse generator operation can be continued with input pulses to the limit switch in the ON status.



3.3.10 JOG operation

(1) Description of JOG operation

(a) JOG operation refers to positioning control in response to a JOG start signal.
While the JOG start signal remains ON, JOG operation is performed at the JOG speed set in the control data. Axis motion decelerates to a stop as soon as the JOG start signal is turned OFF.

(b) JOG operation can be executed in the test mode when a peripheral device is used.

(2) Acceleration/Deceleration processing and JOG speed

(a) Acceleration/Deceleration processing is controlled by the acceleration time and deceleration time set in the JOG operation acceleration/deceleration selection of the extended parameters, as well as the JOG speed limit parameter.

(b) If the JOG speed is outside the setting range at the start of JOG operation, an axis error will occur, and JOG operation will not begin.

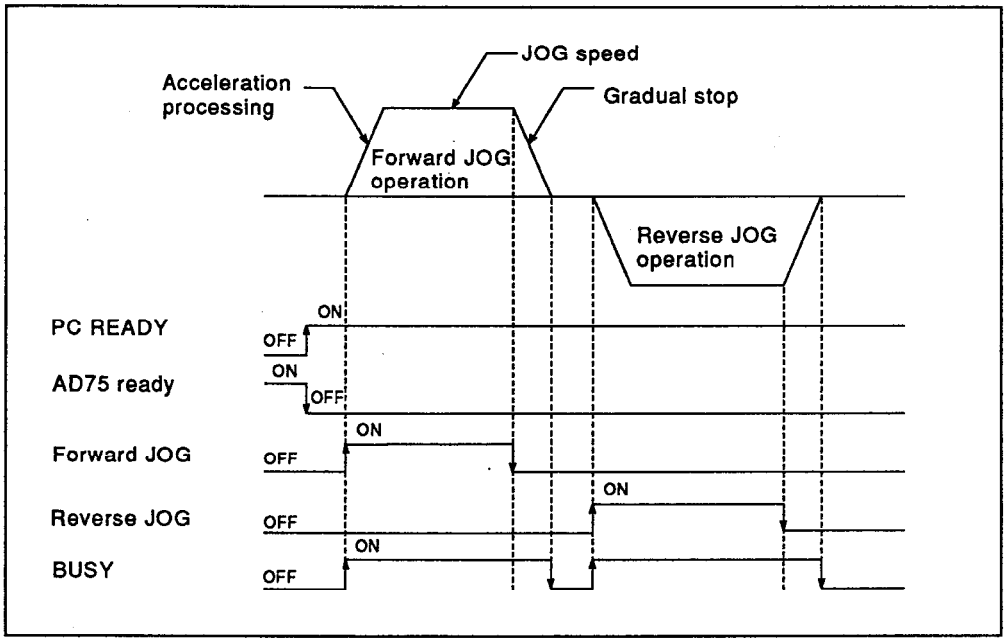
(c) If the JOG speed exceeds the JOG speed limit, an axis warning will be issued, and JOG operation will be performed according to the JOG speed limit.
In such a case, the speed limit flag will be turned ON.

(3) Operations in JOG operation

When JOG operation is started, the following operations are performed:

(a) As soon as the forward/reverse JOG start signal is turned ON, axis motion starts in the specified direction at the specified JOG speed.

(b) Axis motion decelerates to a stop when the JOG start signal goes OFF.



REMARKS

1) A specific JOG start signal is assigned to each axis.

Axis No.	Axis 1	Axis 2	Axis 3
Forward JOG start	Y16	Y18	Y1A
Reverse JOG start	Y17	Y19	Y1B

2) The JOG speed during JOG operation can be checked in the buffer memory.

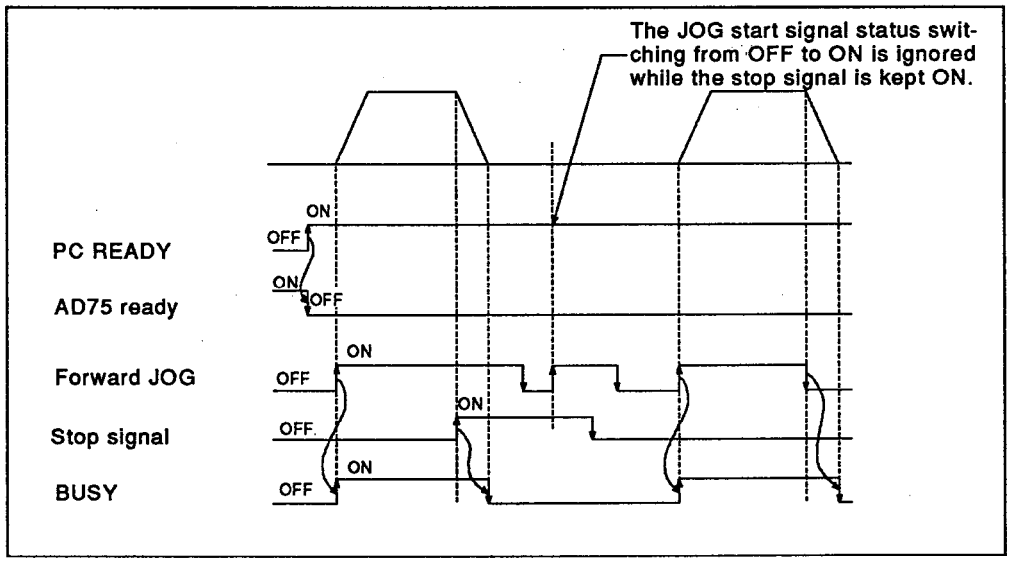
Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address	1161,1160	1211,1210	1261,1260

(4) Operations when the stop signal is ON (input)

(a) When the stop signal is turned ON during JOG start, axis motion decelerates to a stop.

(b) While the stop signal remains ON, the JOG start signal is ignored.

(c) JOG operation can be restarted by turning OFF the stop signal and turning ON the JOG start signal.



POINTS

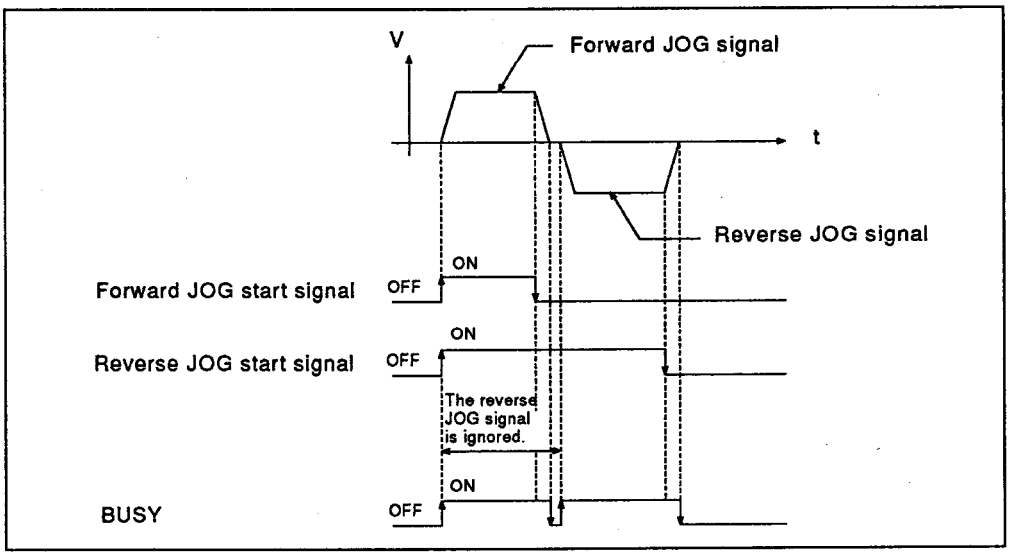
(1) When setting the JOG speed using the sequence program, write the value of the actual JOG speed multiplied by 100 or 1000 to the JOG speed area of the buffer memory.
For example, to set a JOG speed of 10000.00 mm/min., store "1000000" as the speed change value.

(2) The JOG speed is set in the units specified in basic parameters #1.

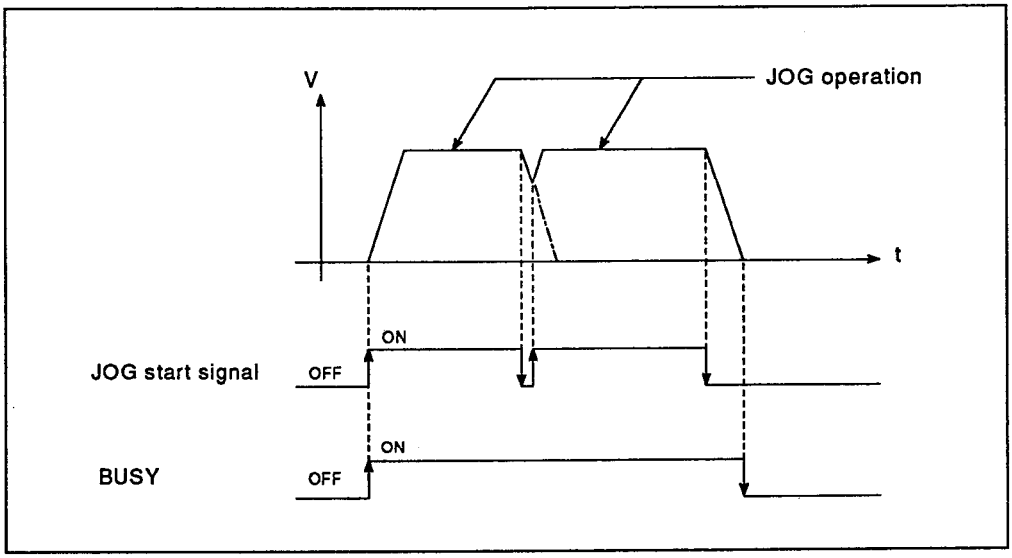
(3) Write the JOG operation speed in units of two words.

(5) Limitations on JOG operation

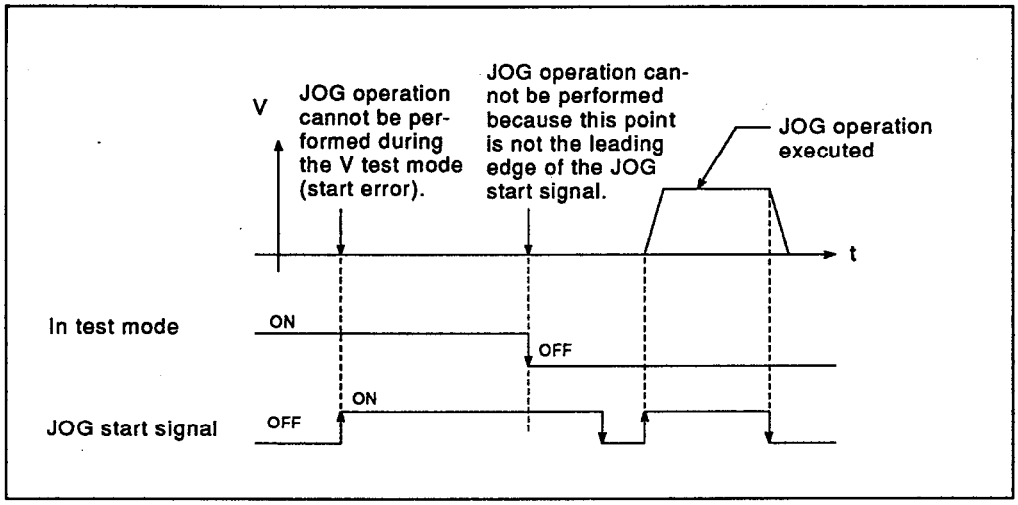
(a) When both forward and reverse JOG signals are turned ON simultaneously for one axis, forward JOG operation will be performed.
If the reverse JOG signal is ON when the forward JOG is turned OFF, JOG operation will stop and then reverse JOG operation will begin. (The reverse JOG signal becomes valid when the BUSY signal is turned OFF.)



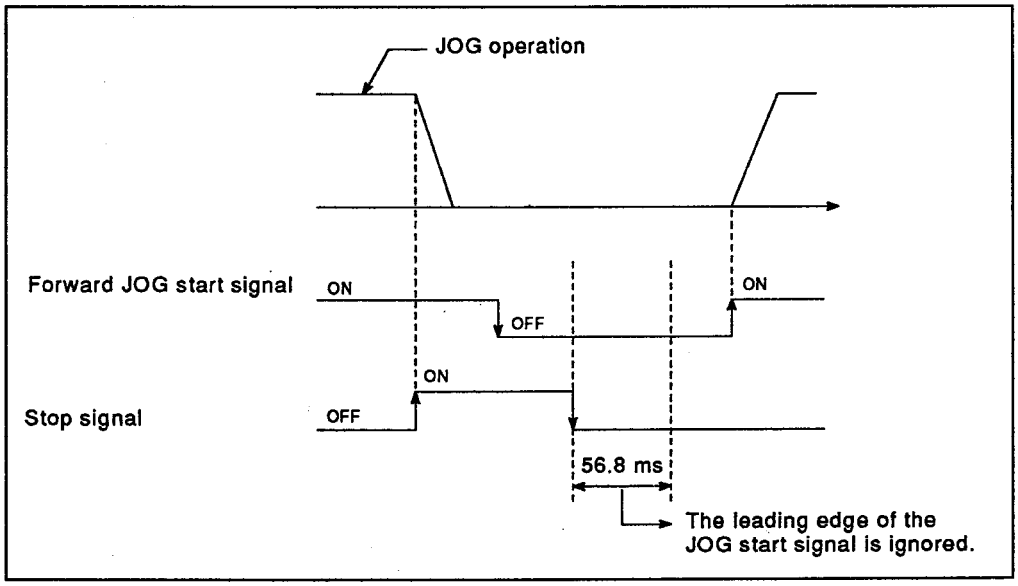
(b) If the JOG start signal is turned back ON during deceleration initiated by turning it OFF, JOG operation will restart from where the signal is turned ON.



(c) In the test mode at a peripheral device, JOG operation cannot be performed with a JOG start signal.
JOG operation will begin at the leading edge (OFF → ON) of the JOG start signal after the test mode of the peripheral device has been cancelled.



(d) The JOG signal status switching from OFF to ON, which takes place within 56.8 ms after the stop signal has been turned OFF, is ignored.



(6) JOG speed change

(a) The jog speed can be changed within the "JOG speed limit" setting range of basic parameters #2 during JOG operation.

(b) To change the JOG speed, turn ON the positioning speed change request of the axis control data, or an external speed change request.
The "speed change processing in progress flag" in the axis monitor area remains ON during speed change processing.

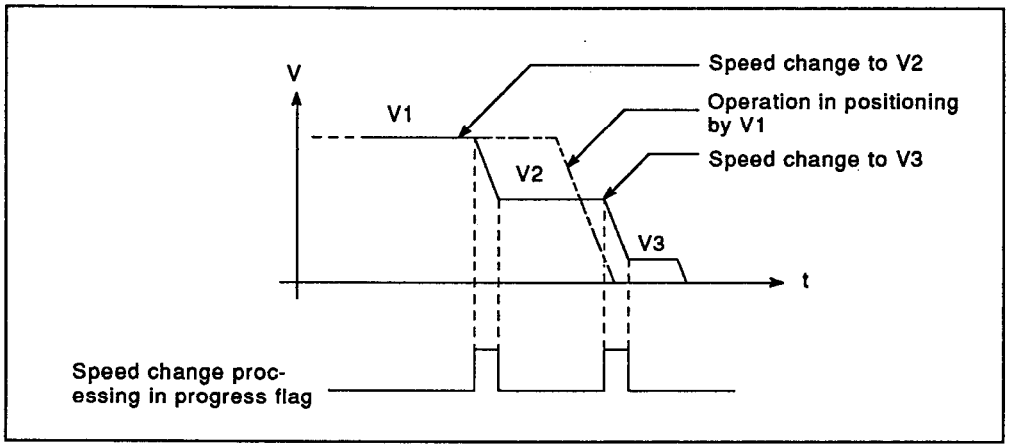


Fig. 3.28 Speed Change Processing Flag Operation Timing

(c) Even if the speed change processing flag is turned ON, the JOG speed can be changed.

(d) Deceleration processing can be continued even if the JOG speed is changed during deceleration with the JOG start signal OFF. However, a warning will be issued.

(e) A speed change value beyond the JOG speed limit results in an axis warning, and JOG operation is executed at the limit JOG speed.
The speed limit flag is kept ON during this JOG operation.

REMARKS

1) The JOG speed can be changed at the following buffer memory address:

Axis No.		Axis 1	Axis 2	Axis 3
Buffer memory address	Changed speed value	1157, 1156	1207, 1206	1257, 1256
	Speed change request	1158	1208	1258

2) The speed change flags are set at the following buffer memory addresses:

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address	831	931	1031

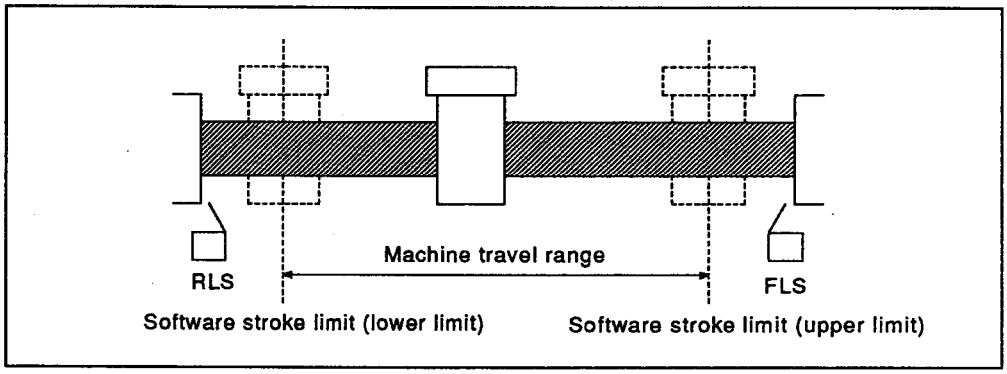
3.3.11 Software stroke limit function

(1) Description of software stroke limit function

(a) The software stroke limit function prevents positioning requested by a command which is outside the upper/lower stroke limit setting range.

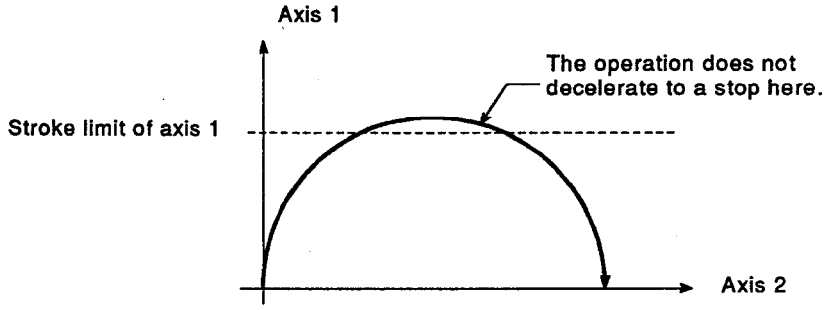
(b) Select a feed present value or machine feed value as the limit in the parameters.

(c) The software stroke limit range is checked at the start of and during operation.



POINT

In circular interpolation control, a software stroke limit check is performed at the start point, end point and arc addresses.
Thus, the path of the axis may overrun the software stroke limit in the middle of control.
However, the operation does not decelerate to a stop in such a case.
Install an external limit switch if there is a possibility of overrun.

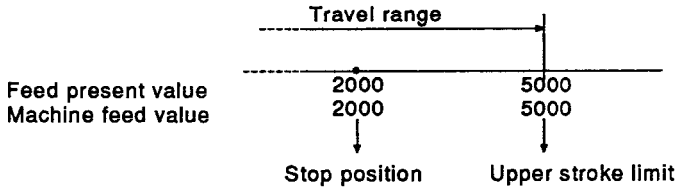


(2) Description of the control

(a) Difference in travel range between the feed present value and the machine feed value
The stroke limit set for the machine feed value is an absolute value with respect to the home return position.*
The stroke limit set for the feed present value is relative to the feed present value.*

[Conditions]

If the current stop position is 2000 and the upper stroke limit is set to 5000;

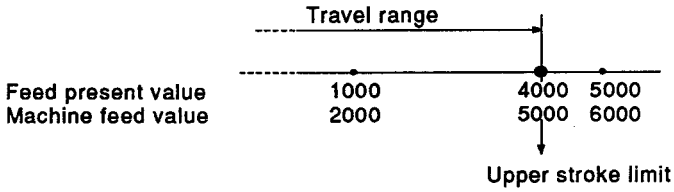


[Present value change]

If the present value is changed from 2000 to 1000, the feed present value is changed to 1000 while the machine feed value remains unchanged.

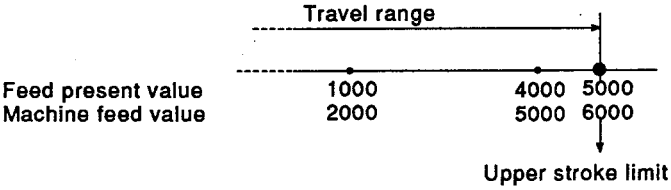
1) If the above upper stroke limit is set for the machine feed value:

Machine feed value 5000 will be the upper stroke limit, which equals the feed present value 4000.



2) If the above upper stroke limit is set to the feed present value:

Feed present value 5000 will be the upper stroke limit, which equals machine feed value 6000.



REMARK

Upon completion of home position return, the feed present value and the machine feed value are set to the home position address of the home position return parameter.

- If positioning control is performed upon completion of the home position return, both the feed present value and the machine feed value will be changed.
- If present value change is performed, only the feed present value will be changed.
- The machine feed value always represents the value with respect to the home position.

(b) Software stroke limit range check performed at the start of operation

1) The following software stroke limit range check is performed on each axis at operation start to determine;
   - Whether or not the operation start point is outside the software stroke limit range.
   - Whether or not the operation would overrun the software stroke limit range.
2) Any axis that has failed to pass either of the above check points, thus causing an axis error, will not be operated.
3) During interpolation control in positioning operation, even if only one axis is out of the software stroke limit range or would overrun the range, an axis error will occur. Consequently, neither axis will be operated.
4) Even if only one axis is out of the software stroke limit range or would overrun the range, thus preventing both axes from being operated at the same time at the start of simultaneous axis positioning, an axis error will occur. Consequently, neither axis will be operated.

Table 3.5 List of Software Stroke Limit Range Checks Performed at Operation Start

		Condition			Remarks
Positioning control	Position control	None			(1) If the feed present value or the machine feed value is outside the software stroke limit range at the start of position control, an error will occur. Consequently, no position control will be performed. (2) If the positioning address is outside the software stroke limit range, no position control will be performed. (3) During circular interpolation control, the software stroke limit range check will also be performed on arc addresses.
	Speed control	When a limit is set to the feed present value	Present value change not performed		(1) Software stroke limit range check not performed.
			Present value change performed		(1) If the feed present value is outside the software stroke limit range at the start of speed control, an error will occur. Consequently, no speed control will be performed.
		When a limit is set to the machine feed value			(1) If the machine feed value is outside the software stroke limit range at the start of speed control, an error will occur. Consequently, no speed control will be performed.
	Speed/ position switching control	When a limit is set for the feed present value	Present value change not performed		(1) Software stroke limit range check not performed.
			Present value change performed		(1) If the feed present value is outside the software stroke limit range at the start of speed/position switching control, an error will occur. Consequently, no speed/position switching control will be performed.
		When a limit is set to the machine feed value			(1) If the machine feed value is outside the software stroke limit range at the start of speed/position switching control, an error will occur. Consequently, no speed control will be performed.
	Home position return	None			(1) Software stroke limit range check not performed.
Manual operation	JOG operation	Software stroke limit of JOG operation/manual pulse generator operation		Invalid	(1) Software stroke limit range check not performed.
				Valid	(1) If the feed present value is outside the software stroke limit range at the start of JOG operation, JOG operation will be started if its direction is toward the software stroke limit range.
	Manual pulse generator operation	Software stroke limit of JOG operation/manual pulse generator operation		Invalid	(1) Software stroke limit range check not performed.
				Valid	(1) If the feed present value is outside the software stroke limit range at the start of manual pulse generator operation, manual pulse generator operation will be started only if its direction is toward the software stroke limit range.

*1: The parameter for "feed present value update request command during speed control" determines whether or not to update the feed present value during speed control.

(c) Software stroke limit range check during operation

1) A software stroke limit range check is performed for position control only.

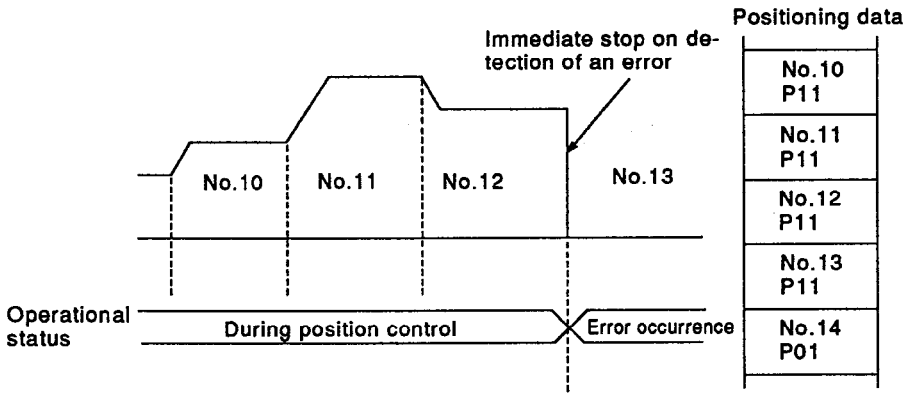
2) If the positioning address of the positioning data is outside the range, an error will occur.

3) During interpolation control, even if one axis is out of the software stroke limit range, an axis error will occur.

4) If the operation pattern is P11 and the next positioning data is position control data, the software stroke limit range check is also run on the next data.
If the next positioning data is found to be outside the software stroke limit range by the check, the current positioning data will be subjected to the same positioning control as P01.
When the next data comes up for processing, an error occurs.

Example

- If the positioning address of positioning data No.13 is outside the software stroke limit range, the axis will decelerate and stop upon execution of positioning data No.12.



(d) Invalidating the software stroke limit range check

To invalidate software stroke limit range check, make the "lower software stroke limit value" equal to the "upper software stroke limit value".
This will allow control regardless of the software stroke limit setting.

(e) Choosing to validate or invalidate the software stroke limit during JOG operation/manual pulse generator operation

The software stroke limit during JOG operation/manual pulse generator operation can be validated or invalidated by setting the parameter for "invalidating the software limit during JOG operation/manual pulse generator operation".

(f) Present value change and software stroke limit range check

Even if an address is put outside the software stroke limit range by a present value change, no error will occur during the change. However, an error will occur at the start of operation due to "attempting to start operation outside the software stroke limit range".

REMARK

To set a stroke limit, or to validate or invalidate a stroke limit with a sequence program, enter data in the following buffer memory areas.

Axis No.	Axis 1	Axis 2	Axis 3
Upper stroke limit	16, 17	166, 167	316, 317
Lower stroke limit	18, 19	168, 169	318, 319
Software limit selection	20	170	320
Invalidating the software limit during JOG operation and manual pulse generator operation	21	171	321

3.3.12 Electronic gear

(1) Electronic gear

(a) Allows the machine travel value per command pulse to be changed as required by setting a travel value per pulse.

(b) Set the travel value per pulse by specifying the "Number of pulses per revolution", "Travel value per revolution", and "Unit magnification" of basic parameters #1.

(c) Setting the travel value per pulse makes it unnecessary to select a servomotor or a detector (encoder) that conforms to the mechanical system, allowing flexible positioning.

(d) The electronic gear function is effective for positioning control, JOG operation, manual pulse generator operation, and home position return.

(2) Electronic gear processing

(a) The electronic gear function accumulates in the AD75 the values less than the travel value per pulse that could not be output as pulses during machine travel. When the cumulative value reaches the travel value per pulse, it is output as a pulse.

(b) Upon completion of fixed-pitch feed, a cumulative value less than the travel value per pulse is cleared to zero.
Accordingly, even when fixed-pitch feed is executed consecutively, the same machine travel value is obtained each time.

(3) Relationship between the commanded speed and the actual speed

The relationship between the commanded speed (the commanded speed set by the positioning data) and the actual speed varies as follows, depending on the electronic gear setting:

(a) When electronic gear setting = 1: commanded speed = actual speed.

(b) When electronic gear setting < 1: commanded speed < actual speed.

(c) When electronic gear setting > 1: commanded speed > actual speed.

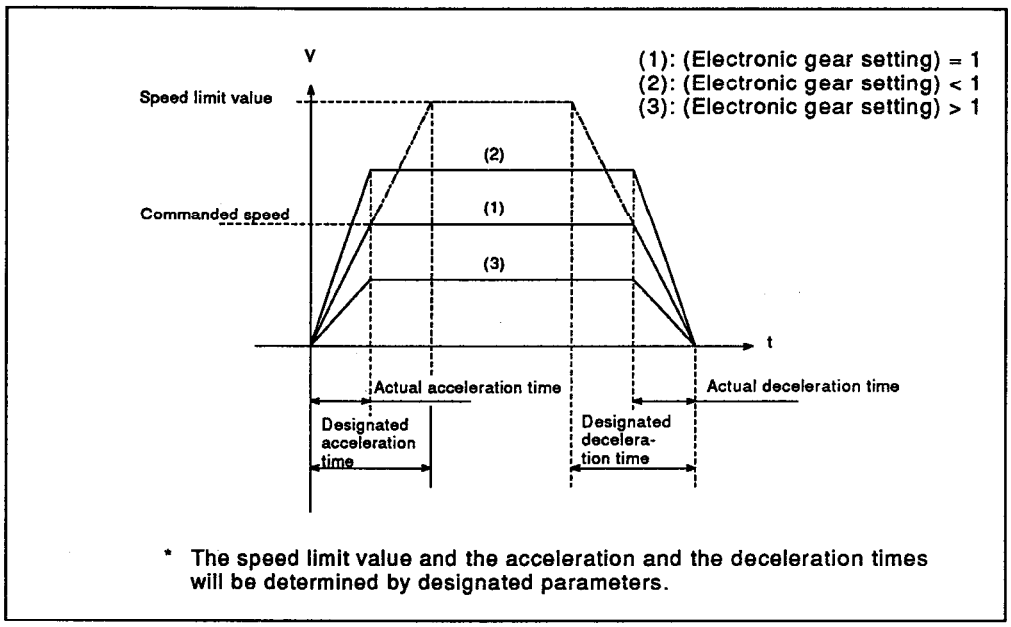


Fig. 3.29 Relationship between commanded speed and actual speed

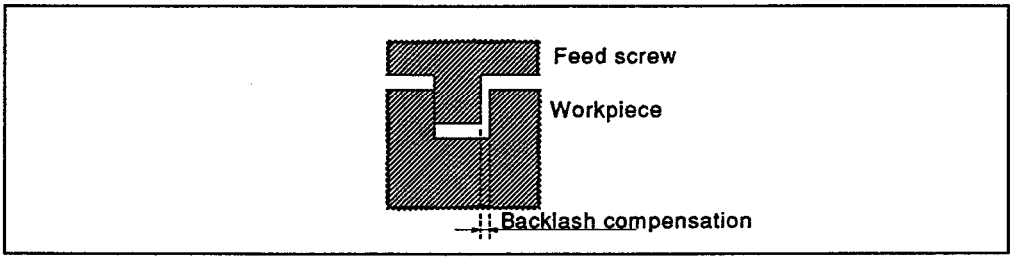
(4) Caution

(a) Note that if the electronic gear setting is low, the actual speed could exceed the speed limit value, causing the servo motor to operate at too high a speed.

3.3.13 Backlash compensation

(1) Backlash compensation

(a) Allows compensation for mechanical backlash to achieve accurate positioning.



(b) When a backlash compensation amount is set, every time the travel direction changes during positioning control, JOG operation, manual pulse generator operation, and home position return, extra feed pulses corresponding to the set backlash compensation amount are generated.

(c) Backlash compensation is performed based on the result of dividing the set backlash compensation amount by the travel value per pulse. The backlash compensation amount can be set in the range from 0 to 65535. Make sure that the backlash compensation amount will be no more than 255 when divided by the travel amount per pulse.
A setting error will occur if 255 is exceeded.
Round off decimals in this calculation.

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

(Round off decimals)

(2) Caution

(a) The feed pulses for a backlash compensation amount are not added to the feed present value/machine present value.

(b) Be sure to perform home position return before backlash compensation. Otherwise, accurate backlash compensation for the mechanical system is not possible.

(c) The backlash compensation amount can be changed when the PC READY status is OFF.
After the backlash compensation amount is changed, perform home position return.
(When the PC READY status is turned ON, the "home position return request" of the axis monitor will be ON if the backlash compensation amount has been changed.)

(d) When the travel direction changes, feed pulses representing both the travel value and the backlash compensation amount are generated.

REMARK

To change the backlash compensation amount, enter data in the following buffer memory addresses.

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address	15	165	315

3.3.14 M code function

(1) M codes

(a) M codes are code numbers (0 to 32767) assigned by the user for each type of positioning control.

(b) M codes can be read by a sequence program to control auxiliary functions (such as clamp, drill rotation, stop, and tool change commands).

(2) Description of M code control

(a) When M = 0, no M code is generated, with the previously issued M code remains valid.
Also, in this case, no M code ON signal is generated.

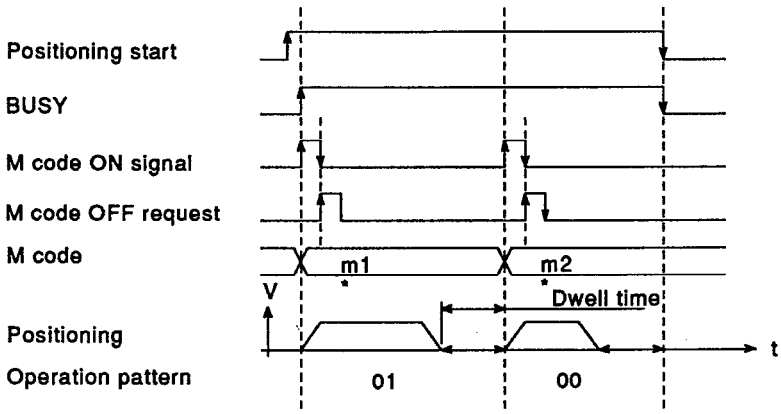
(b) The M code ON signal for the reference axis is generated during interpolation operation as follows.

Interpolation Axis	Reference Axis	M code ON Signal
During interpolation with axis 1 and axis 2	Axis 1	XD
During interpolation between with 2 and axis 3	Axis 2	XE
During interpolation with axis 3 and axis 1	Axis 3	XF

(3) Output timing of "M code" ON signal

(a) The M code ON signal can be output in two timing modes:
WITH and AFTER

- In the WITH mode, the M code is generated at approximately the same time as the positioning operation starts, thus turning ON the M code ON signal.



*: m1 and m2 represent the designated M codes.

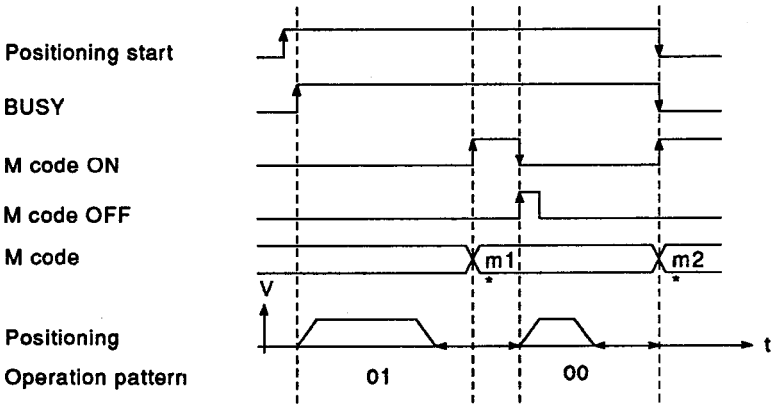
Fig. 3.30 M Code ON/OFF Timig (WITH mode)

REMARK

To set the M code ON signal output timing and request an M code OFF signal, enter data at the following buffer memory address.

Axis No.	Output Timing of M code ON Signal	M code OFF Signal Request
Axis 1	25	1153
Axis 2	175	1203
Axis 3	325	1253

- In the AFTER mode, the M code is output upon completion of the positioning operation, thus turning ON the M code ON signal.



*: m1 and m2 represent the designated M codes.

Fig. 3.31 M Code ON/OFF Timing (AFTER mode)

(b) In speed control in the AFTER mode, no M code is output at the completion of the positioning operation during speed control, and the M code ON signal does not come ON.

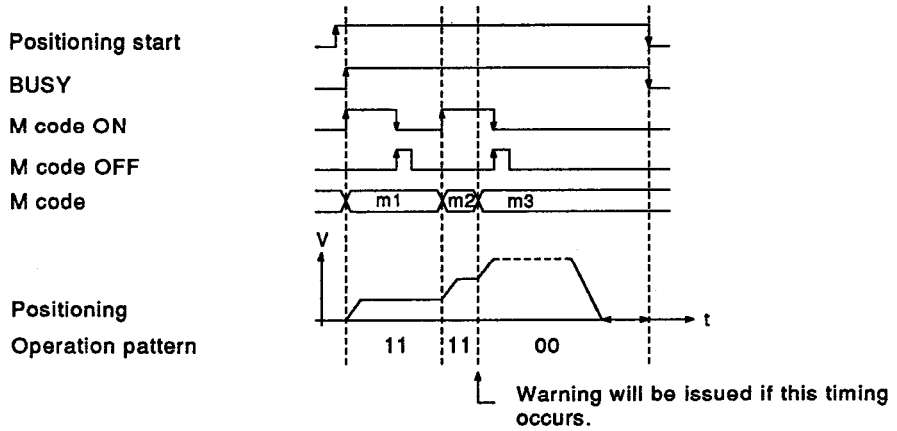
(c) If the M code ON signal has been turned ON, it must be turned OFF by turning the M code OFF request signal ON with the sequence program.
If the M code ON signal is not turned OFF, one of the following will happen, depending on the operation pattern.

1) If the operation pattern is either positioning complete (00) or continuous positioning control (01):

- The next positioning will not be carried out.
- The system will stand by until the M code ON signal is turned OFF.

2) If the operation pattern is continuous locus control (11):

- The next positioning will be performed, but a warning will be issued.
- If the M code ON signal is ON at the start of positioning control, an error will occur, and the positioning operation will not start.
- If the PC READY signal is turned OFF, the M code ON signal is turned OFF, and "0" will be output as the M code.
- In continuous locus control (11), a warning may be issued if the positioning operation time is too short.
- If there is not enough time to turn OFF the M code ON signal, set 0 for the M code number instead.



*: m1 to m3 represent the designated M codes.

Fig. 3.32 When a Warning Occurs in the WITH Mode

3.3.15 Acceleration/deceleration processing

(1) What is acceleration/deceleration processing?

(a) It is the acceleration processing and deceleration processing at the start of positioning operation, JOG operation, home position return operation, and speed changes.

(2) Relationship between the speed control limit, JOG speed control limit, acceleration time, deceleration time, and rapid stop deceleration time

(a) The speed control limit, JOG speed control limit, acceleration time, deceleration time, and rapid stop deceleration time are defined as follows:

1) The speed control limit is the maximum speed during positioning operation, manual pulse generator operation, and home position return operation.

2) The JOG speed control limit is the maximum speed during JOG operation.
Set the JOG speed control limit to, or lower than, the speed control limit.

3) The acceleration time is the time it takes to reach the designated speed control limit from speed 0.

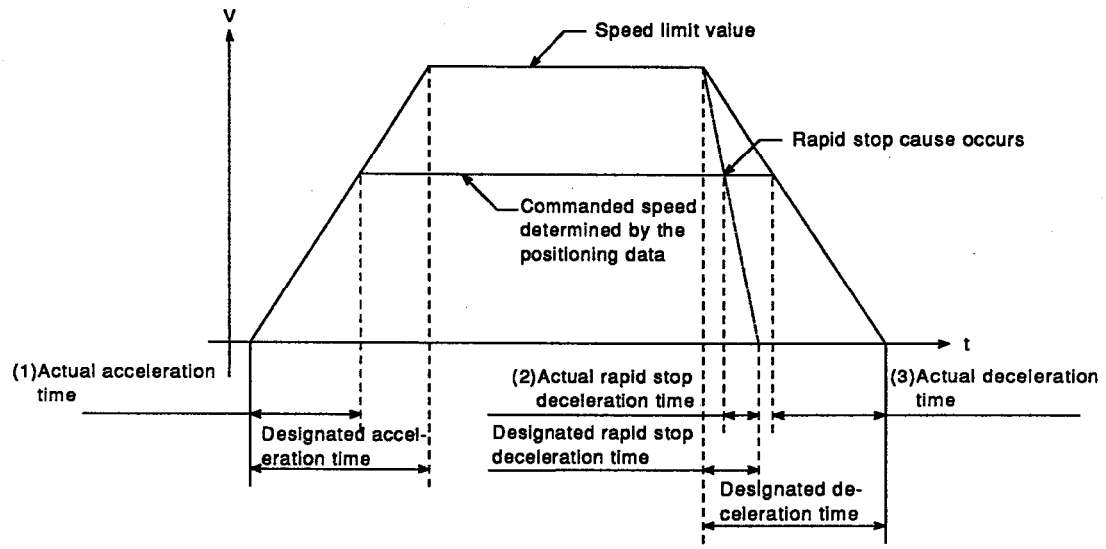
4) The deceleration time and rapid stop deceleration time are times taken to reach speed 0 from the designated speed control limit.

(b) If the commanded speed is designated lower than the parameter speed control limit, the acceleration/deceleration time will be relatively shorter.
Accordingly, set the maximum commanded speed to the same value as, or a similar value to, the parameter speed control limit.

(c) Set the speed control limit, acceleration time, deceleration time, and rapid stop deceleration time by specifying their respective parameters.

(d) During interpolation control with two axes, set the parameters for one of the axes as follows:

- Interpolation control with axis 1 and 2: parameter for axis 1
- Interpolation control with axis 2 and 3: parameter for axis 2
- Interpolation control with axis 3 and 4: parameter for axis 3



(1)Actual acceleration time : Actual acceleration time: The time taken to reach the commanded speed in the positioning data
(2)Actual rapid stop deceleration time : Actual rapid stop deceleration time: The time to reach a complete sudden stop from the commanded speed in the positioning data
(3)Actual deceleration time : Actual deceleration time: The time taken to reach a complete stop from the commanded speed in the positioning data.

Fig. 3.33 Relationships Among Speed Control Limit, Acceleration Time, Deceleration Time, and Rapid Stop Deceleration Time

(e) Setting ranges for acceleration/deceleration time

The setting range for both acceleration and deceleration time is 1 to 65535 ms.

(f) Selection of an acceleration/deceleration time pattern

1) Four patterns each for acceleration time and deceleration time are available for positioning operation.

2) Specify which acceleration and deceleration pattern is to be used for home position return and JOG operation by parameter setting.

POINT

There are four patterns each of acceleration time and deceleration time to choose from.
If more than four patterns are required, rewrite acceleration times 0 to 3 and deceleration times 0 to 3 using the programmable controller before turning ON positioning start signal (Y10 to 12).

(3) Acceleration/deceleration processing

(a) There are two acceleration/deceleration methods: "trapezoidal acceleration/deceleration" and "S-pattern acceleration/deceleration".

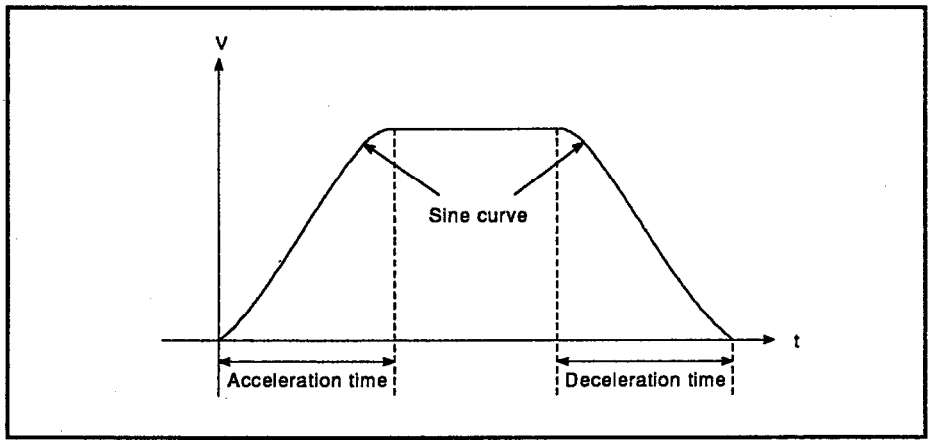


Fig. 3.34 S Pattern Acceleration/Deceleration Processing

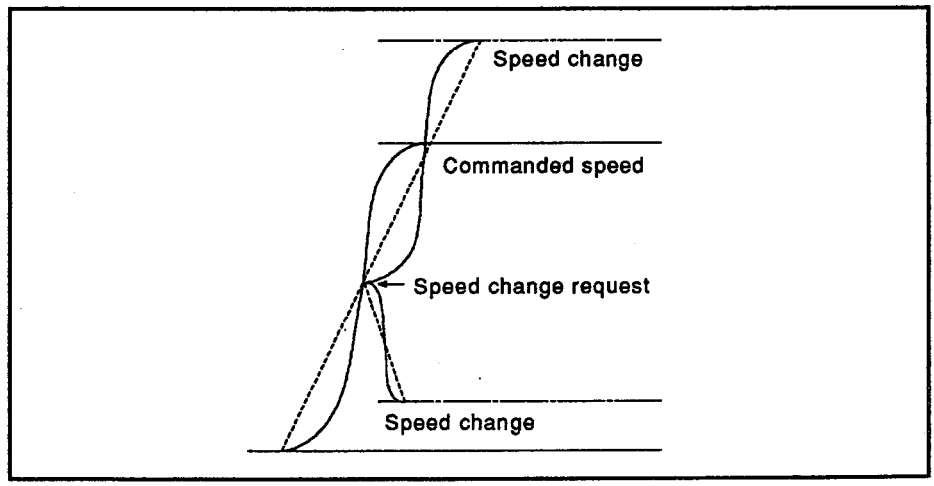
POINTS

(1) S pattern acceleration/deceleration processing cannot be used with stepping motors.

(2) To use S pattern acceleration/deceleration processing, set "S pattern acceleration/deceleration processing" for the acceleration/deceleration processing selection, and set an S curve ratio, in extended parameters #2.

(b) When S curve acceleration/deceleration processing is selected, an S curve ratio must be set. (For details on the S curve ratio, see Section 3.4.2 (18).)
S pattern acceleration/deceleration processing is performed for all acceleration and deceleration at the start and end of positioning, JOG, and home position return operations, and at speed changes.

(c) When a speed change is executed during S pattern acceleration/deceleration, S curve acceleration/deceleration is executed from when the speed change request is received.



3.3.16 Torque limit function

(1) Torque limit function

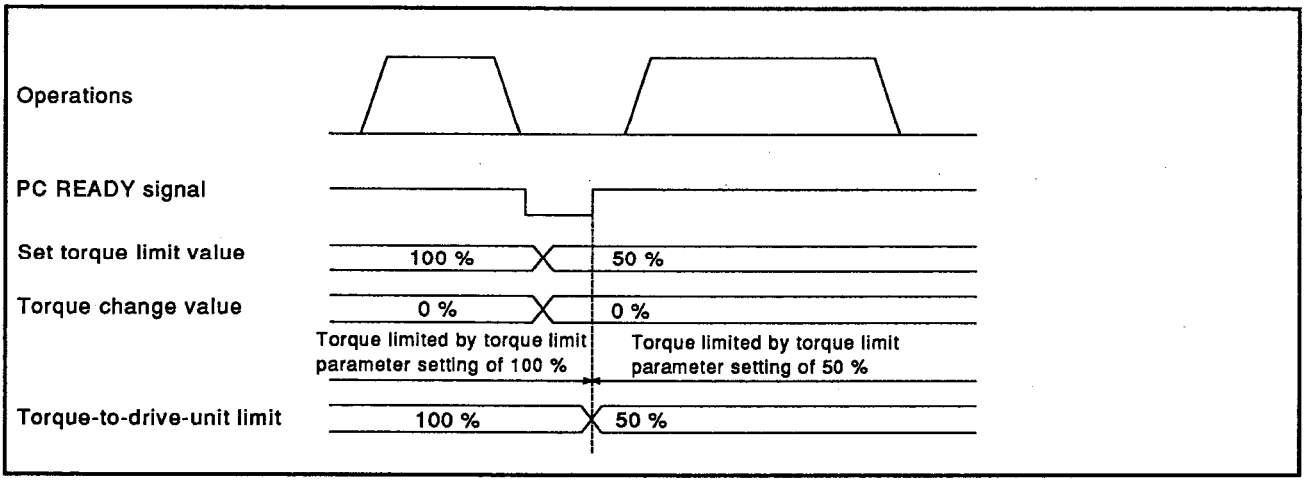
(a) Limits the torque generated by the servomotor within a setting range.

(b) It also maintains the torque within the setting range if the torque required for control exceeds the torque limit value.

(2) Description of the operation under torque limit control

(a) The torque limit value set in the parameters is used as the torque limit setting.
To perform torque limit control based on the set torque limit parameter value, set the torque change value of the axis control data to "0".
If the torque change value is set to any value other than "0", torque limit control will be performed based on the torque change value.
See Section 3.3.17 "Torque change function" for further details.

(b) The torque limit parameter value can be changed when the PC READY signal is OFF.
The torque limit parameter value after such a change will be effective after the PC READY signal is turned ON.



(c) The following table describes the operation status and the applicable torque limit value.

Operation Status	Applicable Torque Limit Value(s)
Positioning operation	The torque limit setting in the parameters or the torque change value is used.
Home position return	The torque limit setting in the parameters or the torque change value is used. However, the torque limit value of the home position return parameter is used after the creep speed is reached.
JOG operation	The torque limit setting in the parameters or the torque change value is used.
Manual pulse generator operation	The torque limit setting in the parameters or the torque change value is used.

POINTS

(1) Requirements for using a pulse-train output type

(a) Wiring is required between the D/A conversion module and the drive unit.

(b) A drive unit capable of issuing torque limit commands based on analog voltage is required.

(c) The set torque limit setting is set in the "torque limit storage area" of the axis monitor. Transmit the "torque limit storage value" to the D/A conversion module using a sequence program.

REMARKS

1) To set the torque limit value using a sequence program, enter data in the following buffer memory addresses.

Axis No.	Axis 1	Axis 2	Axis 3
Torque limit value	24	174	324

2) The following are the buffer memory area addresses of the axis monitor for storing the torque limit value.

Axis No.	Axis 1	Axis 2	Axis 3
For storing the torque limit value	826	926	1026

3.3.17 Torque change function

(1) What is the torque change function?

(a) It is a function for changing the torque limit value during positioning control, JOG operation, and manual pulse generator operation. To change the torque limit value, set the "torque change value" of the axis control data to the required value. The torque generated by the servomotor will be limited to the changed value.

(b) To perform this change, data has to be written to the buffer memory area using a sequence program.

(2) Description of the torque change function

(a) Details of the torque change function

1) The "torque change value" of the axis control data can be changed at any time.
The torque change value takes effect the moment it is written.

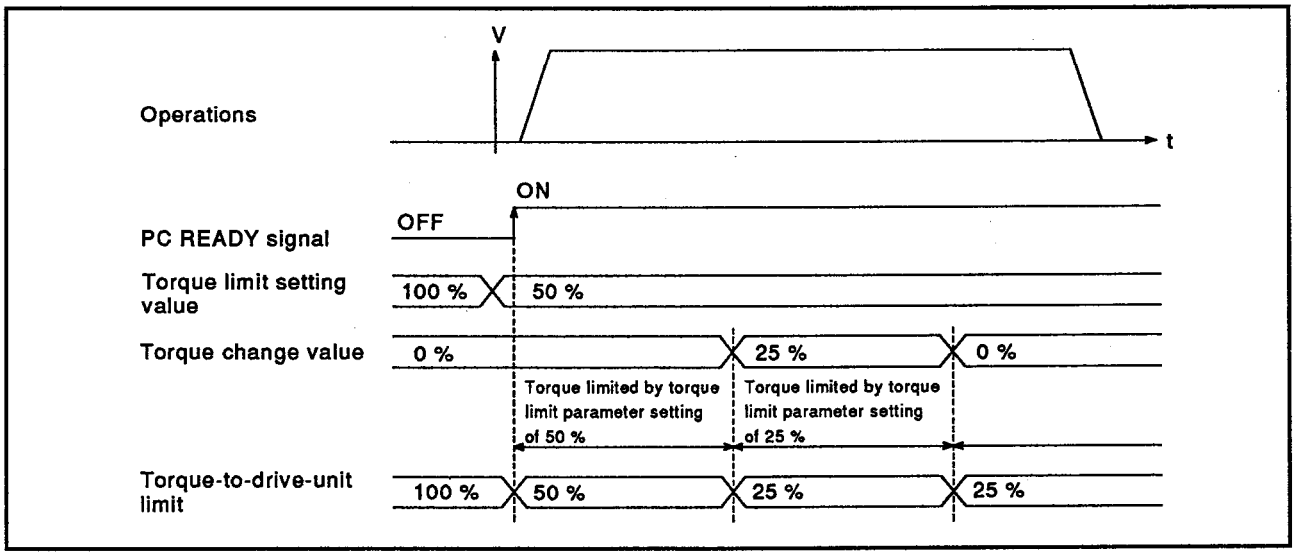
2) The setting range is from 0 (zero) to the torque limit setting in the parameters.

- To perform torque limit control based on the torque limit setting in the parameters, set the torque change value of the axis control data to "0".

- If the torque change value is set to any value other than "0", torque limit control will be performed based on the torque change value.

3) At the start of positioning control, JOG operation, and manual pulse generator operation, torque limit control will be performed based on the torque limit setting in the parameters.

(b) If the torque change value is out of the setting range, an axis warning will occur.



REMARK

Set the torque change value in the following buffer memory areas.

Axis No.	Axis 1	Axis 2	Axis 3
Torque change	1176	1226	1276

3.3.18 Present value change

(1) What is present value change?

(a) This function changes the feed present value of an axis that has not been moved to a designated address.
Present value change does not change the machine feed value.

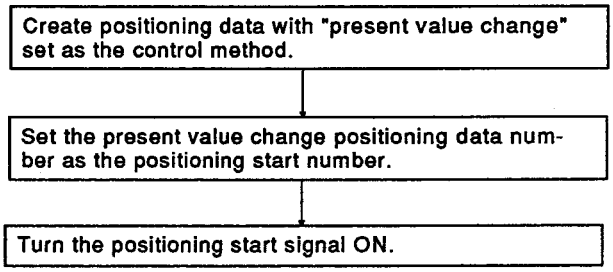
(b) There are two present value change methods: the method using the positioning data, and the method using the present value change buffer memory.

1) For present value change using the positioning data, use the "present value change" setting for the control method in the positioning data.

2) For present value change using the present value change buffer memory, set the address after the change in the buffer memory allocated for present value change use.
Use the positioning start number "9003".

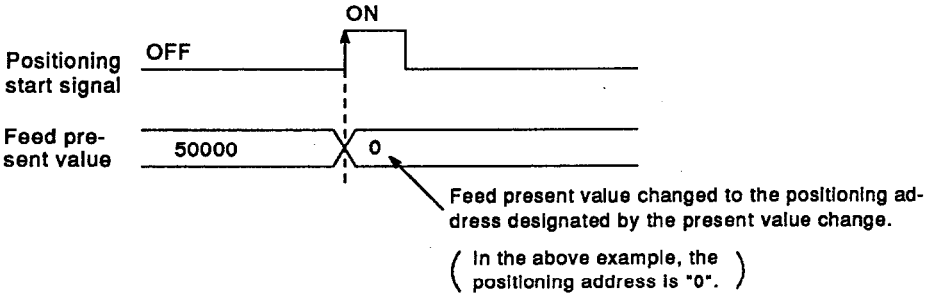
(2) Present value change using positioning data

(a) A present value change using the positioning data is performed according to the procedure below.



(b) Timing of change

When the positioning start signal is turned ON, the feed present value is changed to the newly designated value .



REMARK

The following are the buffer memory addresses for positioning start.

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address for positioning start	1150	1200	1250

(c) Error detection

1) An axis error will occur if a value designated in degree units is outside the setting range.

2) An error will not occur even if the set value is outside the stroke limit range.
At the start of positioning control, however, an error will occur due to an operation start from outside the software stroke limit range.

3) An error will occur if the positioning data following the positioning data for continuous locus control is present value change data.
An error will also occur if the operation pattern of the positioning data designating present value change is continuous locus control.

(d) Designating positioning data *1

The following positioning data can be set with the peripheral device or sequence program:

Data	Necessity of Setting *2
Operation pattern	Select "positioning end".
Control method	Select "present value change".
Acceleration time	—
Deceleration time	—
Positioning address/Travel value	o *3
Circular interpolation address	—
Commanded speed	—
Dwell time	—
M code	—

REMARKS

1) *1: For details of positioning data, see Section 3.4.5.

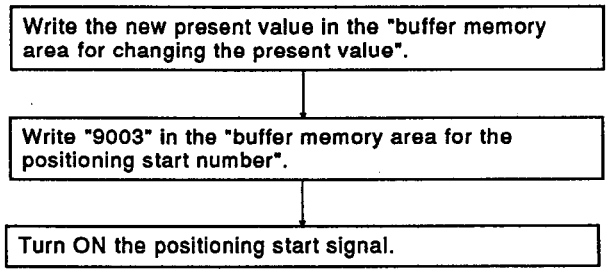
2) *2: Whether or not setting is necessary is indicated by one of the following symbols:

- o : Must be set.
- Δ : May be set as required.
- — : Need not be set.

3) *3: Set the address after the change.

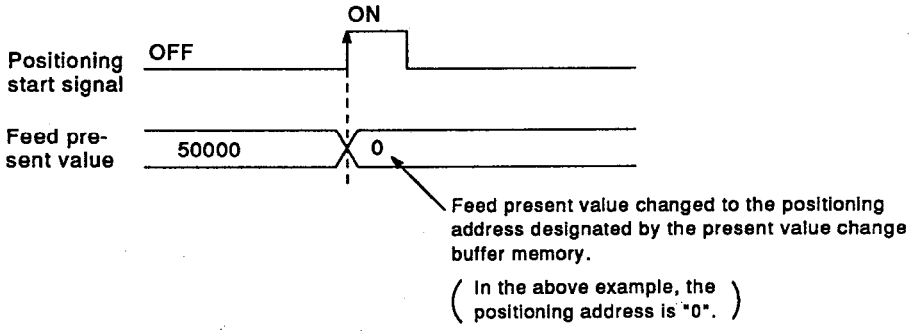
(3) Present value change using the present value change buffer memory

(a) A present value change using the present value change buffer memory is performed according to the procedure below.



(b) Timing of change

When the positioning start signal is turned ON, the feed present value is changed to the newly designated value .



(c) Error detection

1) An axis error will occur if a value designated in degree units is outside the setting range.

2) An error will not occur even if the set value is outside the stroke limit range.
At the start of positioning control, however, an error will occur due to an operation start from outside the software stroke limit range.

REMARK

The following are the buffer memory addresses forpresent value change and positioning start.

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory address for present value change	1154, 1155	1204, 1205	1254, 1255
Buffer memory address for positioning start	1150	1200	1250

3.3.19 Speed change

(1) What is speed change?

(a) This function changes the present speed to a designated speed during the following positioning.

- Position control
- Speed control
- Speed/position switching control
- JOG operation

(b) A new speed can be written by using a sequence program or the test mode of a peripheral device.

(c) A speed change can be executed at any required position either by turning ON a speed change request in the axis control data, or by turning ON an external speed change request* (external signal).

POINTS

(1) To change the present speed with a sequence program, first multiply the new value by 100 or 1000 and then enter the product of the multiplication as the speed change value.

Example

If the current speed is to be changed to 10000.00 mm/min, enter 1000000 for the changed speed value.

(2) When making consecutive speed changes, set at least 100 ms intervals between successive speed changes.

REMARK

* : To use an external speed change request, "1: external speed change request" must be set for "external positioning start selection" in extended parameters #2. Also, "external start valid" of the buffer memory axis control data must be set to "valid" (1).

Axis No.	Axis 1	Axis 2	Axis 3
Buffer memory for external start valid setting	1171	1221	1271

(2) Description of the operation

(a) A warning will occur in the following cases.

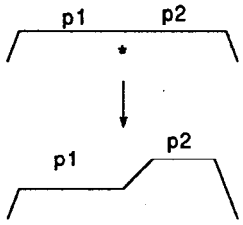
- During deceleration due to a stop command
- During automatic deceleration under positioning control

(b) To change to a new value, set the positioning operation speed change value of the axis control data to the new value.
If the positioning operation speed change value exceeds the speed limit value, a warning will occur and the change value will be set at the limit value.

(c) When the remaining distance is insufficient to complete the change during position control, or during position control in speed/position switching control, the feed speed is controlled to approach the speed change value as closely as possible.

<When the remaining distance is insufficient>

If a speed is designated for P1 while the current speed is designated for P2:



If speed change occurs at "*" where the remaining distance is insufficient to complete the speed change, it is completed in P2, and the current speed is set to the changed speed.

* If a commanded speed is designated for P2, operation is performed at the commanded speed, and the current speed is set to the commanded speed.

However, since the current speed is changed, if the current speed is used as the next positioning speed during continuous positioning, the new change speed value is achieved during the next positioning. On the other hand, if a speed is designated in the next positioning data, the operation is performed at the designated speed.

(d) During interpolation control, speed change is performed based on the speed change value and the speed change request stored in the buffer memory area for the reference axis.

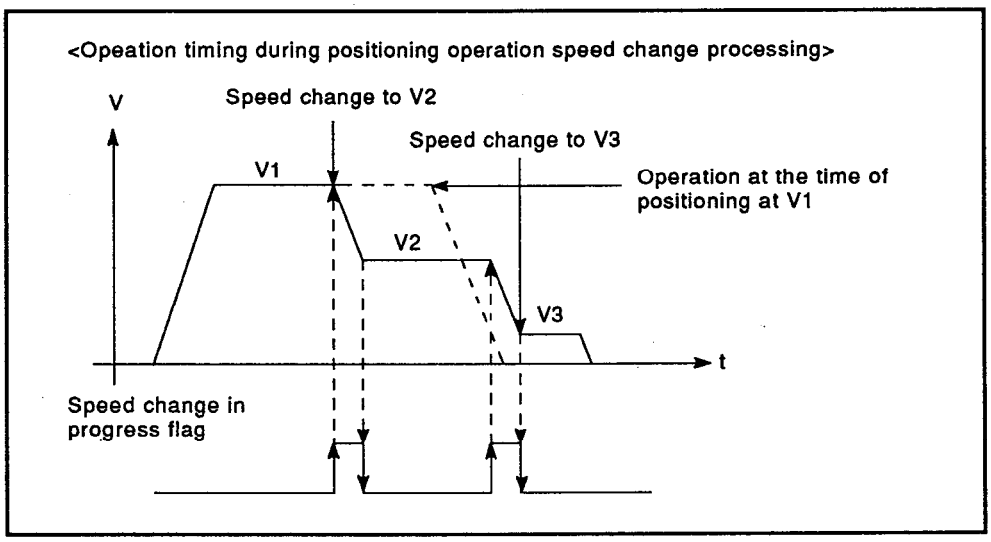
Interpolation Axis	Reference Axis	Buffer Memory	
		Speed Change Value	Speed Change Request
During interpolation with axis 1 and axis 2	Axis 1	1156,1157	1158
During interpolation with axis 2 and axis 3	Axis 2	1206,1207	1208
During interpolation with axis 3 and axis 1	Axis 3	1256,1257	1258

(e) If the control units of the reference axis and other axis differ from each other, the unit of the reference axis will be the unit for the speed change. (See (d) above.)

(f) During speed control, "1" is stored in the applicable buffer memory for the speed change in progress flag (flag ON). Upon completion of the speed change, "0" replaces "1" (flag OFF). (See the table below.)

Axes No.	Speed Change Flag
Axis 1	831
Axis 2	931
Axis 3	1031

(g) Even when the operation pattern is set to continuous locus control (11), an immediate speed change can be executed upon receiving a speed change request.
However, if the distance required to change to the designated speed cannot be secured, no speed change is executed.



(3) Speed change request with speed change value of "0"

(a) If a speed change request is made with a speed change value of "0" during positioning control, the axis will decelerate to a stop and the speed change 0 flag of the buffer memory axis monitor will be turned ON.

(b) During interpolation control, "1" is stored in the buffer memory area for the speed change 0 flag for the applicable reference axis.

Interpolation Axes	Reference Axis	Speed Change 0 Flag
During interpolation with axis 1 and axis 2	Axis 1	817
During interpolation with axis 2 and axis 3	Axis 2	917
During interpolation with axis 3 and axis 1	Axis 3	1017

(c) If the speed change value is set to any value other than "0", the speed change "0" flag will be turned OFF, continuing the operation.

(d) When the speed becomes "0" after making a speed change to "0", the BUSY signal will remain ON.
In this case, the axis is stopped but maintains its operation status.

(e) Upon receiving a stop signal, the BUSY signal will be turned OFF, with the operation status of the axis changed to "stopped".

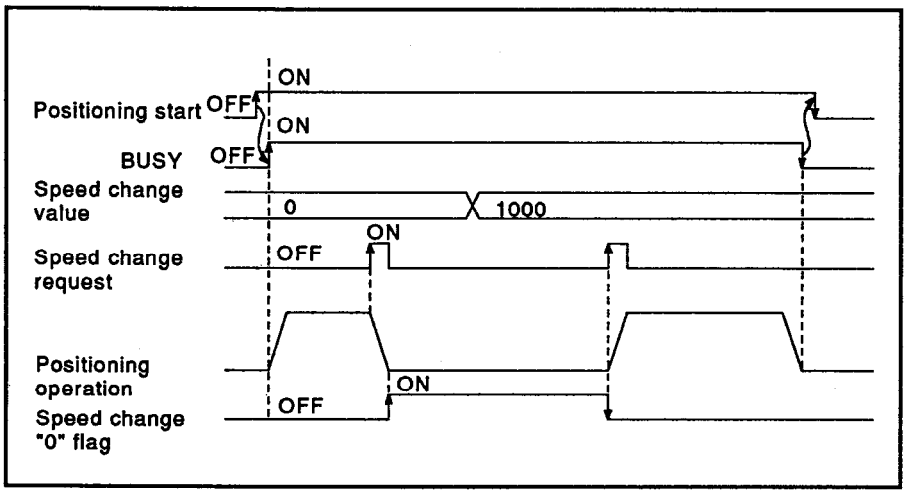


Fig. 3.35 Speed Change "0" Timing

3.3.20 Skip function

(1) What is the skip function?

Upon receipt of a skip signal, this function decelerates axis motion to a stop without processing the remaining travel value, and executes the next positioning.

(2) Skip signal

(a) The skip signal is turned ON when the skip command of the axis control data or the external start signal comes ON.

(b) When the skip signal is turned ON, the axis automatically decelerates and performs the next positioning.
If the skip signal is turned ON in a final positioning operation, operation is terminated.

(c) When the positioning being executed is skipped, the positioning completed signal for positioning in data No. units or automatic acceleration and deceleration units is not turnd ON.

(d) When skip is executed during a dwell time, the dwell time is terminated and the next positioning is started.

(e) The following describes the operation after the skip signal is turned ON during interpolation.

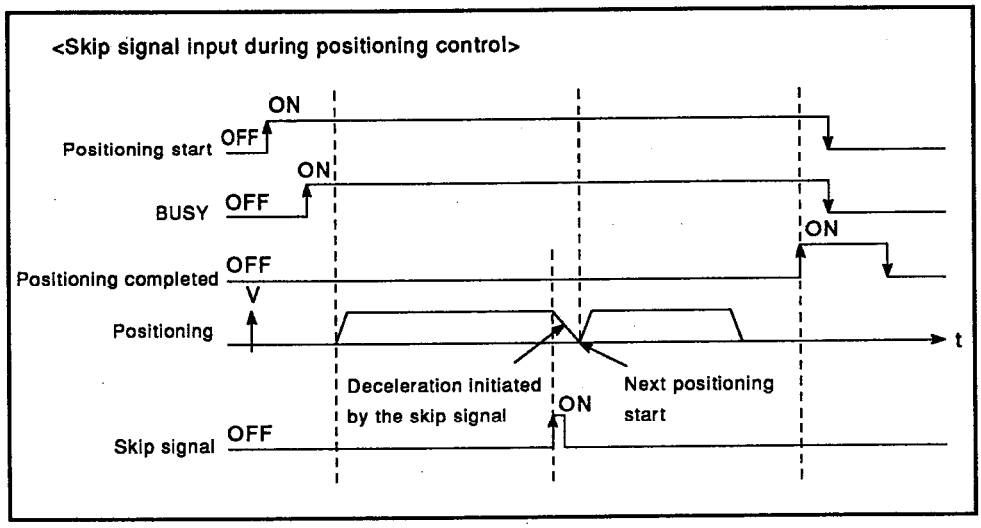
1) During interpolation with axis 1 and axis 2
(reference axis: axis 1)
When the skip signal of axis 1 is turned ON, both axes decelerate to a stop and axis 1 performs the next positioning.

2) During interpolation with axis 2 and axis 3
(reference axis: axis 2)
When the skip signal of axis 2 is turned ON, both axes decelerate to a stop and axis 2 performs the next positioning.

3) During interpolation with axis 3 and axis 1
(reference axis: axis 3)
When the skip signal of axis 3 is turned ON, both axes decelerate to a stop and axis 3 performs the next positioning.

(f) If the M code output is in the AFTER mode, no M code is output and the M code ON signal does not come ON.

(g) A skip signal received during home position return is ignored.



REMARKS

1) *: Since the external start signal is used for the following purposes, the skip function must be set in advance if it used to be used for the skip function.

- External positioning start
- External speed change request
- Skip request input signal

External start enable setting is also necessary to use the external start signal.

2) Enter data in the following buffer memory addresses to turn ON the skip command, select the external start input function, and perform the external start enable setting.

Axis No.	Skip Command	External Start Input Selection	External Start Enable Setting
Axis 1	1175	62	1171
Axis 2	1225	212	1221
Axis 3	1275	362	1271

3.3.21 Step function

(1) What is the step function?

The step function enables the user to confirm each positioning step.

(2) Executing the step function

(a) After turning the step enabled flag ON in advance, turn the positioning start signal ON.

(b) When one positioning step is completed normally, the axis operation status will become step standby.

(c) If operation is stopped by the stop signal during step operation, the axis operation status will become step-stopped.

(d) If an error occurs which causes deceleration to a stop during step operation, a step error condition will occur.

(e) The next positioning step is performed if the step start data is set to 01H when the axis operation status is step standby.

(f) The stopped processing of positioning data restarts if the step start data is set to 01H or 02H when the axis operation status is step-stopped.
Positioning will not be performed even if the step start data is set to 02H when the axis operation status is other than step-stopped.

(g) If the axis operation status is inappropriate when setting the step start data, a warning will occur, as shown in the following table.
(A warning is output only when the step enable flag is turned ON.)

Axis Operation Status	Start Data	
	Set to 01	Set to 02
Standby	—	—
Stopped	—	—
Interpolation	X	X
JOG operation	X	X
Manual pulse generator operation	X	X
Analyzing	X	X
Special start standby	X	X
Home position return	X	X
Positioning control	X	X
Speed control	X	X
Speed/position switching: speed control	X	X
Speed/position switching: position control	X	X
Step standby	O	—
Step-stopped	O	O
Step error	—	—
Error	—	—

(X: Warning for starting during operation
O: Normal operation
—: Warning for invalid step start data)

(h) When the axis operation status is step standby, step-stopped, or step error with the step effective signal ON, the first-point positioning step will be performed upon turning ON the positioning start signal again.

(3) Step function modes

(a) Two step function are available: "the deceleration unit step mode"; and "the data No. unit step mode".

1) Deceleration unit step mode

Normal operation is performed until positioning data that calls for automatic deceleration is encountered. Upon such an encounter, axis motion is automatically decelerated and positioning stopped after the positioning data is executed.

2) Data No. unit step mode

After executing the positioning data, automatic deceleration to a stop is performed regardless of whether automatic deceleration is necessary or not.
Automatic deceleration is executed forcibly even if the operation pattern is continuous locus control (11).
(The operation is the same as continuous positioning control (01).)
Therefore, when performing continuous operation in which the positioning data has the operation patterns 00 and 01 only, positioning in the deceleration unit step mode operates in the same manner as in the data No. unit step mode.

(b) During interpolation with axis 1 and axis 2, positioning is performed in the step mode of axis 1; during interpolation with axis 1 and axis 2, the step mode of axis 2; and during interpolation with axis 3 and 1, the step mode of axis 3.

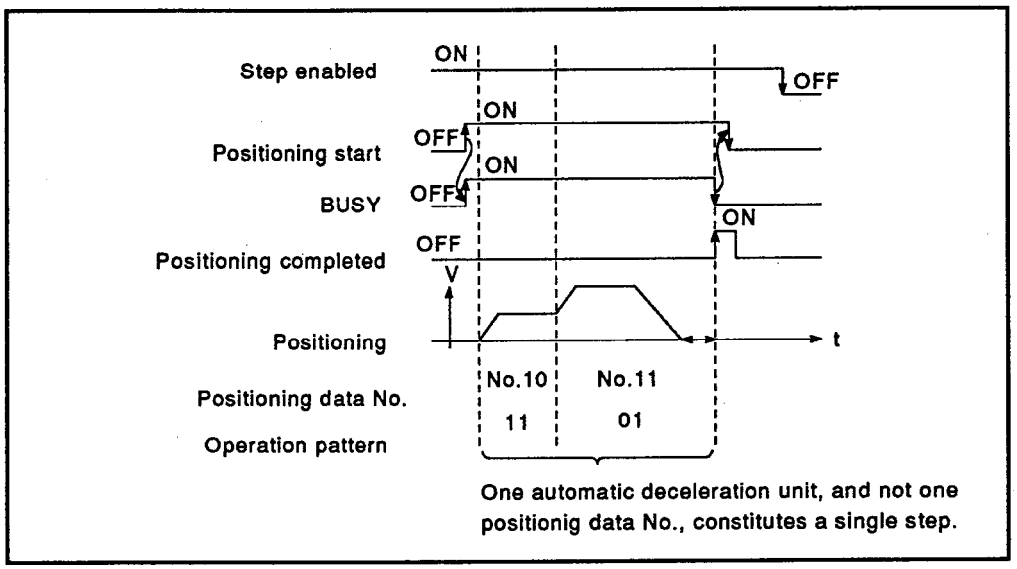


Fig. 3.36 Operation for Deceleration-Unit Step Execution

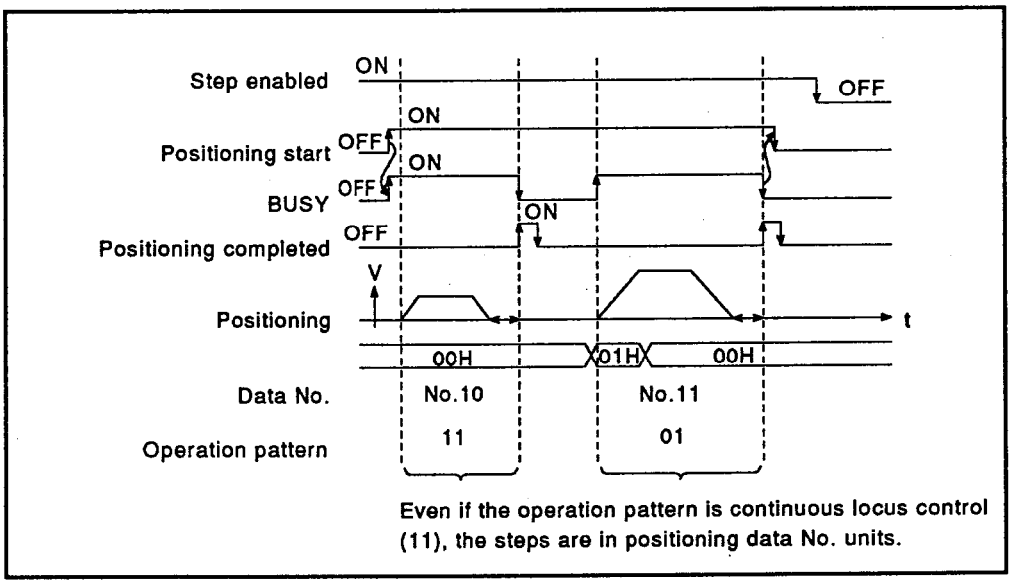


Fig. 3.37 Operation for Positioning Data No.-Unit Step Execution

(4) Step function in continuous locus control (11)
If positioning is performed in the data No. unit step mode when the operation pattern is continuous locus control (11), the AD75 performs operation according to pattern 11 to check the positioning operation for abnormality.
However, since the axis is actually operated in the data No. unit step mode, the operation is carried out in accordance with operation pattern 01.
The axis operation status becomes "step error" at this time.
If "01" is set in the step start data, step operation will resume at the data following the positioning data which has caused the error.

3.3.22 Command in-position

(1) What is command in-position?

(a) For each occurrence of automatic deceleration during positioning control, this function turns ON the command in-position flag when the remaining positioning distance is within the "command in-position range".
The command in-position flag is set when the command in-position range check determines the remaining positioning distance is within the "command in-position range".

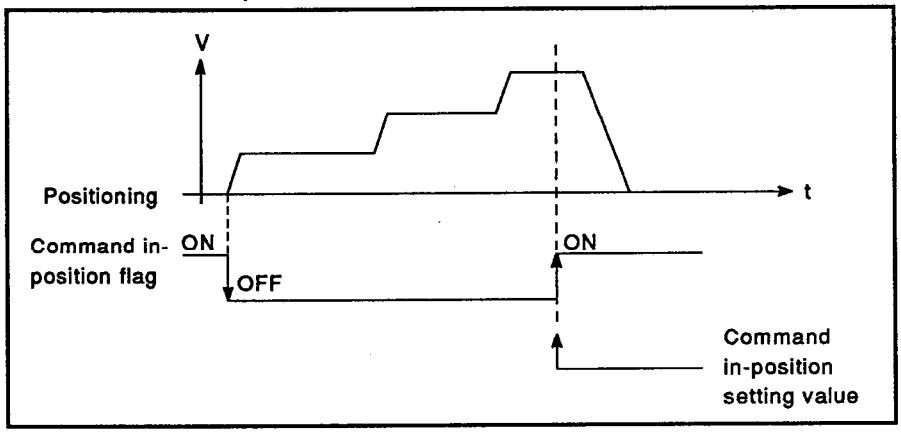


Fig. 3.38 ON/OFF Timing of the Command In-Position Flag

(2) Description of the operation

(a) The command in-position range check is run all the time during positioning control and deceleration to a stop by the step function, except in the following conditions:

- During deceleration to a stop due to a stop command/rapid stop command
- During speed control or during speed control in speed/position switching control

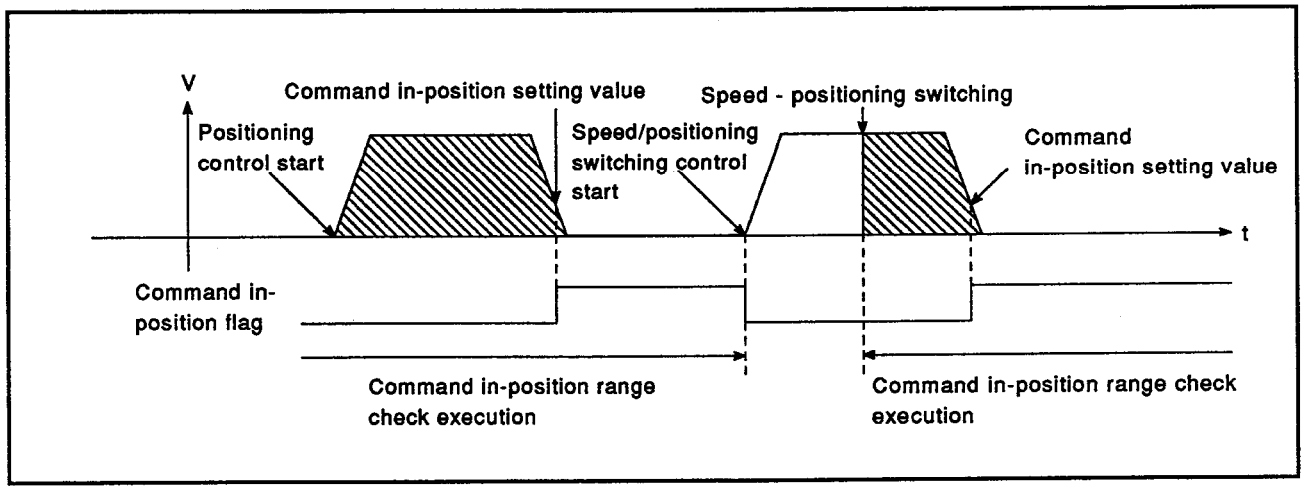


Fig. 3.39 Command In-Position Range Check

(b) The command in-position flag is turned OFF in the following situations:

- At the start of positioning
- During home position return
- During speed control
- During JOG control
- During manual pulse generator operation

(c) During interpolation control, the command in-position function is executed based on the data stored in the buffer memory areas for the command in-position range and the command in-position flag for the reference axis.

Interpolation Axes	Reference Axis	Buffer Memory	
		Command In-position Range	Command In-position Flag
During interpolation with axis 1 and axis 2	Axis 1	22,23	817
During interpolation with axis 2 and axis 3	Axis 2	172,173	917
During interpolation with axis 3 and axis 1	Axis 3	322,323	1017

3.3.23 Teaching function

(1) What is the teaching function?

(a) This function changes a positioning address reached by manual operation (JOG operation or manual pulse generator operation) to the positioning address of a designated positioning data No.

(b) In the case of circular interpolation with a designated auxiliary point, The teaching function can change the circular interpolation auxiliary point address and the positioning address.
In the case of circular interpolation with a designated center point the teaching function can change the positioning address.

(2) Positioning address

The written positioning address or auxiliary point address for circular interpolation is an absolute address with respect to the home position.

(3) Axes subject to teaching

Teaching can be performed for each axis individually or for designated interpolation axes.

- Individual axis teaching: designate one target axis at a time.
- Interpolation axes teaching:designate a pair of target axes at a time.

(4) Constraints

(a) The teaching function is performed for stopped axes with a sequence program.
Even if an error or warning occurs during manual operation, this function is effective unless the axis is in the BUSY status.

POINTS

(1) Positioning identifiers, M codes, dwell time, and commanded speed can also be changed during teaching operation.

(2) The teaching function uses the control data addresses of the buffer memory.
Set the following data in the control data addresses.

Setting Data	Buffer Memory Address(es)
Target axis	1103
Positioning data No.	1104
Write pattern	1105
Write request	1106
Write positioning data	1108 to 1137
Flash ROM write request	1138

For details of the control data addresses, see Section 3.6.4.

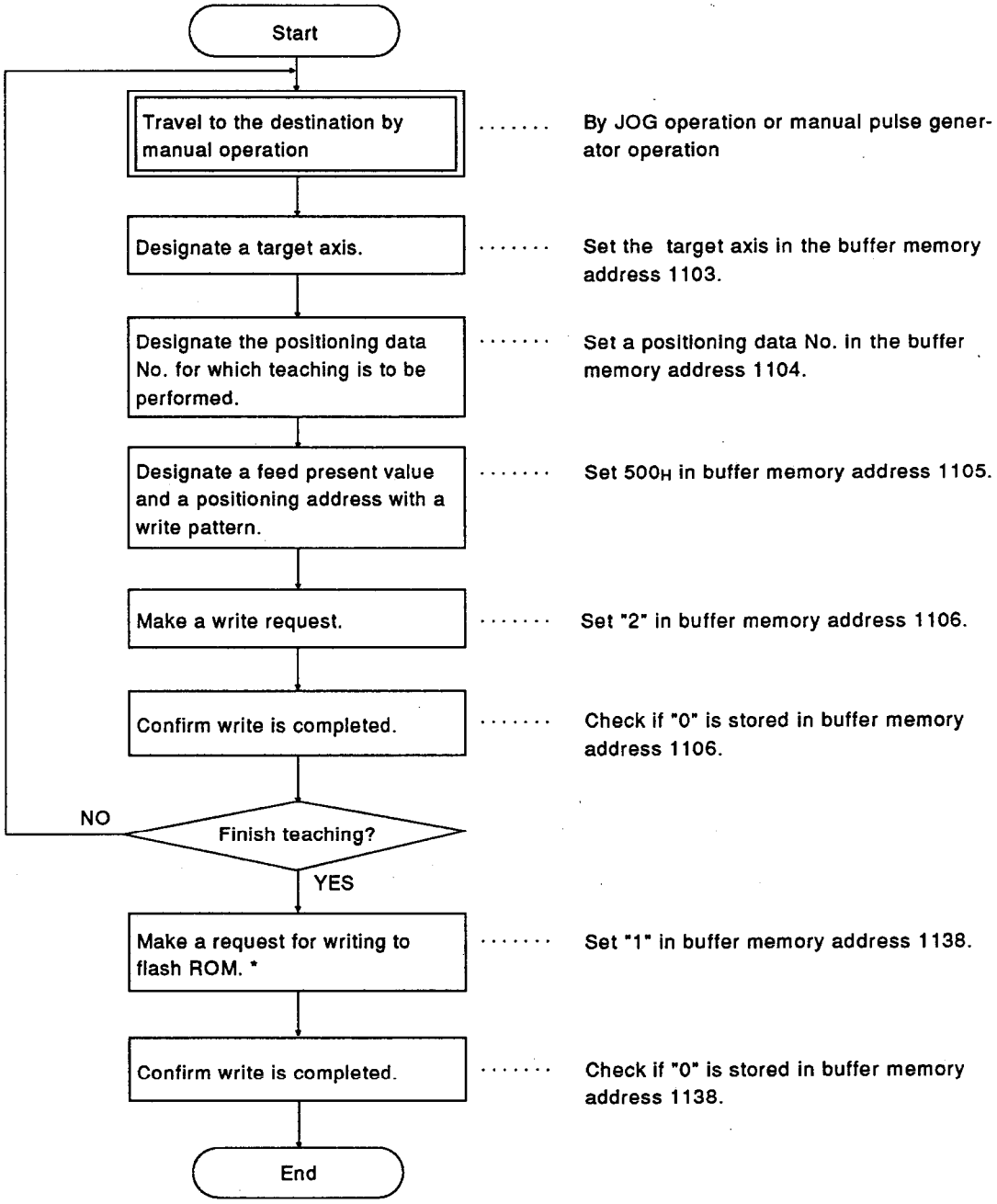
REMARK

*: "Positioning identifier" is a generic term that covers the positioning pattern, acceleration time No., deceleration time No., and control method.

(5) Teaching procedure

The following flowcharts describes the teaching procedure with a sequence program.

(a) When controlling each axis independently, and when performing interpolation (except for circular interpolation with a designated auxiliary point), the teaching function can be used to change the positioning address in the individual axis control or interpolation control (except circular interpolation with a designated auxiliary point).



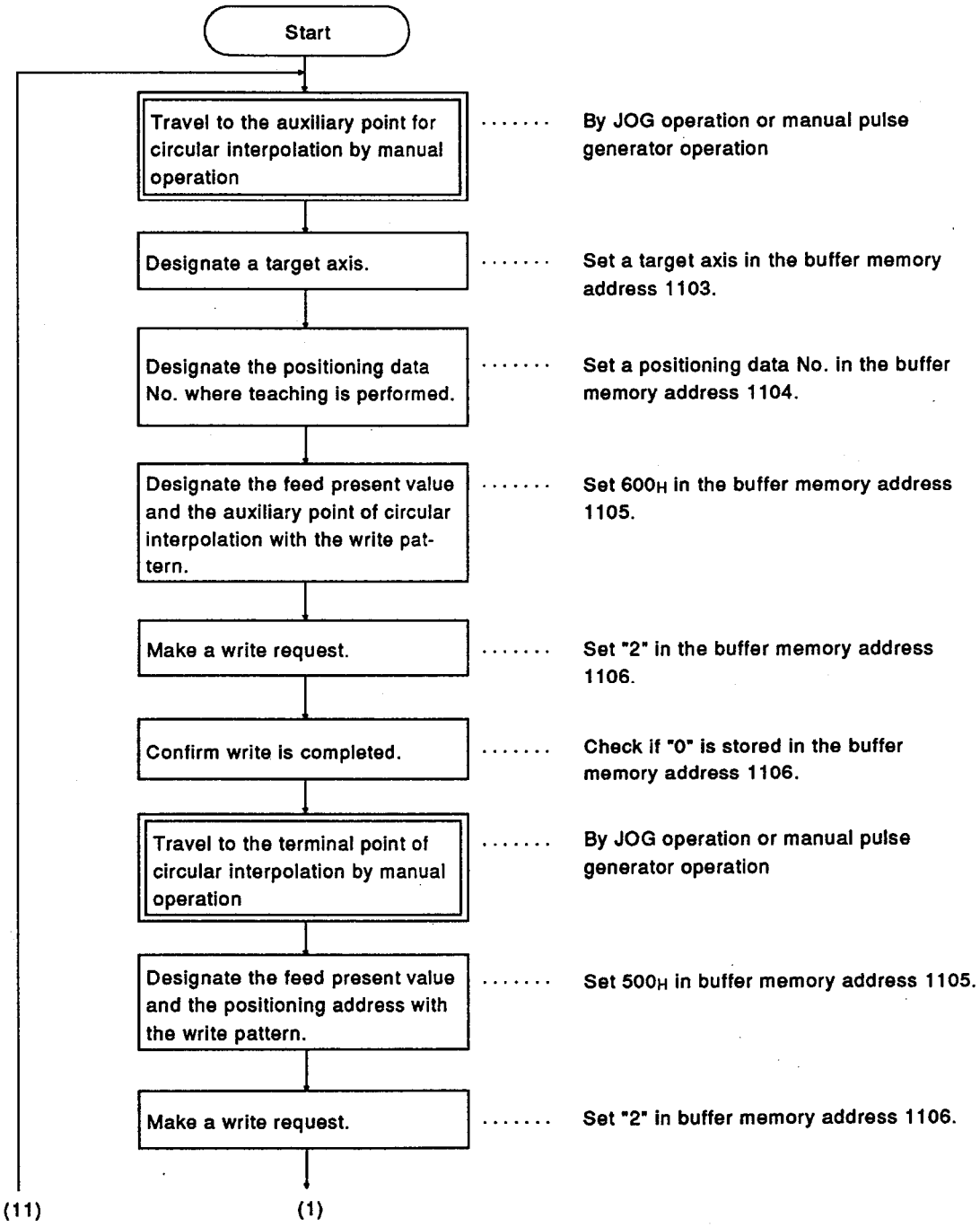
POINT

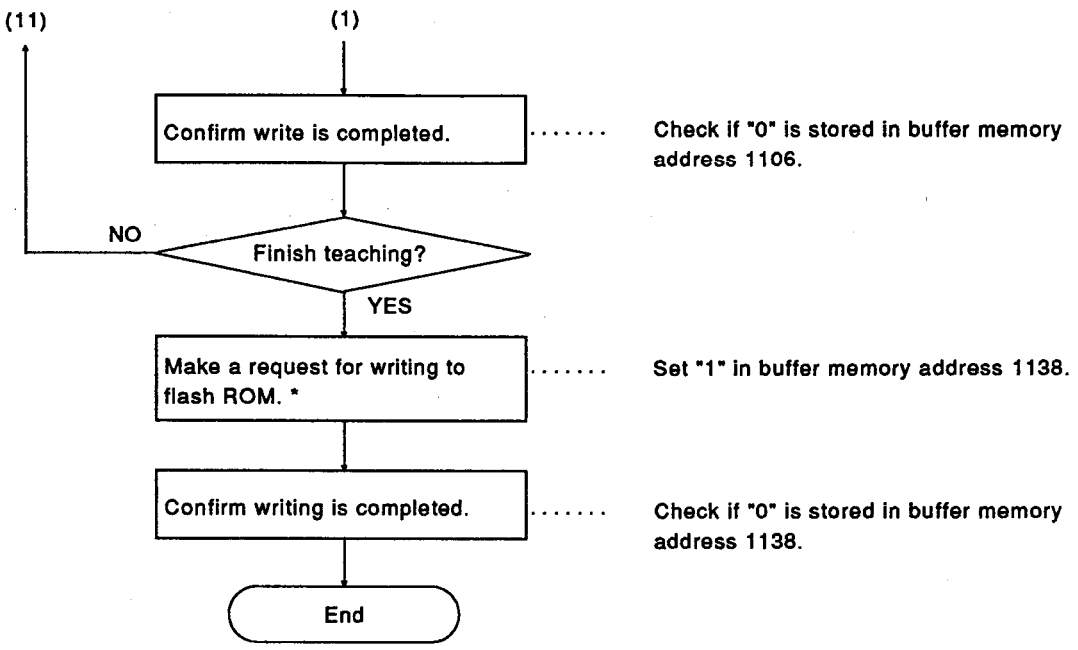
*: Writing to the flash ROM is possible up to 100,000 times.
Once the flash ROM has been writen to 100,000 times, writing to the flash ROM will no langer be possible.

(b) Procedure for controlling circular interpolation with a designated auxiliary point

In the case of circular interpolation with a designated auxiliary point, the teaching function enables the auxiliary point and the final address to be changed.

(In the case of circular interpolation with a designated center point, the teaching function enables the final address to be changed. See (a) for details about the teaching procedure.)





POINT

*: Writing to the flash ROM is possible up to 100,000 times.
Once the flash ROM has been writen to 100,000 times, writing to the flash ROM will no longer be possible.

3.3.24 Override function

(1) Override function

(a) Changes the positioning speed (current speed) to 1 to 300 % of the commanded speed.

(b) This is accomplished by writing the required override value (1 to 300 %) in the buffer memory area for the positioning speed override setting.

(2) Description of the operation

(a) The override function continues to be effective for the current speed even after a speed change is executed.

(b) The current speed remains unchanged when the override value is set to 100 %.

(c) The override function is ineffective for the speed during deceleration due to a stop command, or for automatic deceleration during position control.
The override function will take effect again after deceleration to a stop.

(d) Any value set for this function is invalid if it exceeds the speed control limit; the positioning will be performed at the speed control limit.
In this case, a warning (warning No. 501) occurs, turning the speed control flag ON.

(e) If it is not possible to secure a sufficient distance for this function to change the current speed to the designated override speed, the current speed is changed to the highest possible speed within the given distance.
However, no speed change occurs if the operation pattern is "11" (continuous locus control).

(f) During interpolation control, the override function uses the buffer memory area for the positioning speed override setting for the reference axis as shown below.

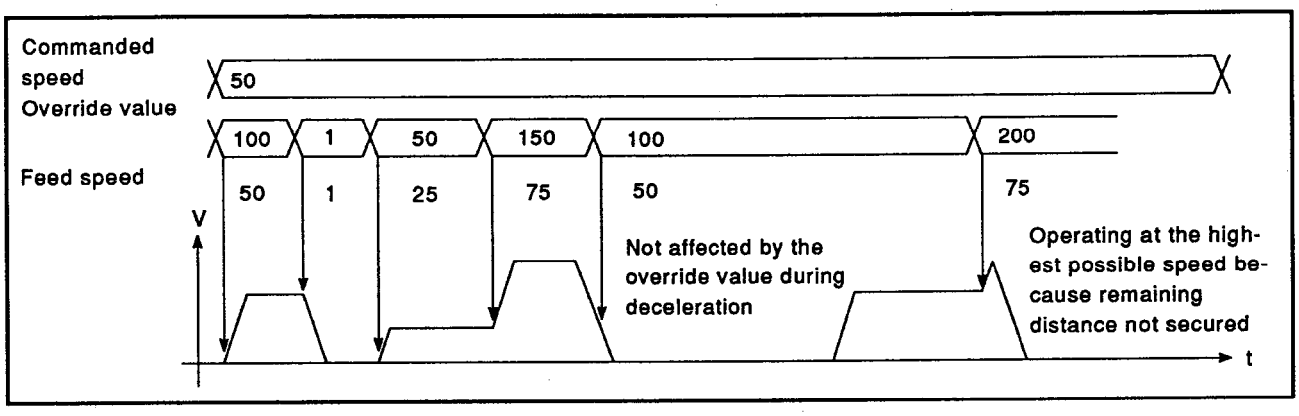
Interpolation Axis	Reference Axis	Buffer Memory for Positioning Speed Override Setting
During interpolation with axis 1 and axis 2	Axis 1	1159
During interpolation with axis 2 and axis 3	Axis 2	1209
During interpolation with axis 3 and axis 1	Axis 3	1259

(g) The value in the feed speed storing buffer memory in the axis monitor area changes according to the override value.

(h) If a feed speed of 1 or less results from setting an override value of 100 % or less, feed is performed at the speed of "1" in the current speed units.

(i) If the set override value is outside the setting range, operation is performed using the value indicated below.

- For 0 % : Operation at 100 %
- For 301 % : Operation at 300 %

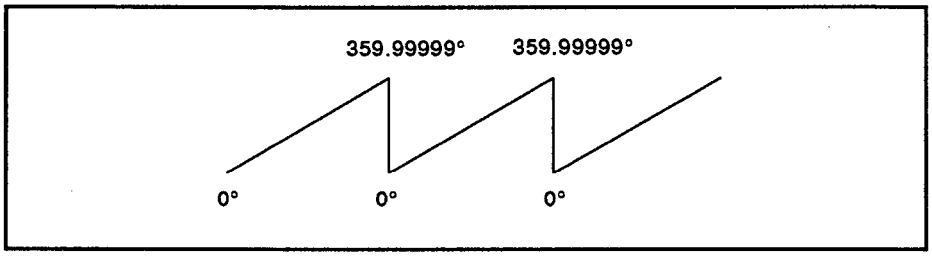


3.3.25 Control unit "degrees"

The control unit "degrees" differs from other control units as described below.

(1) Addresses of the feed present value and machine feed value

Ring addresses of 0° to 359.99999° are assigned to feed present values and machine feed values.

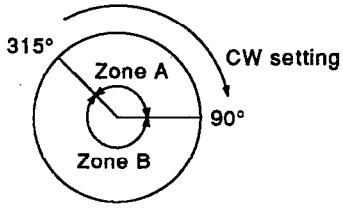


(2) Validating/invalidating software stroke limits

The software stroke limit value range is from 0° to 359.9999°.

(a) How to validate software stroke limits

To validate software stroke limits, set the lower limit value first and then the upper limit value clockwise.



1) To define travel range A, perform the following setting:

- Set the lower limit value to 315.00000°
- Set the upper limit value to 90.00000°

2) To define travel range B, perform the following setting:

- Set the lower limit value to 90.00000°
- Set the upper limit value to 315.00000°

(b) How to invalidate software stroke limits

To invalidate software stroke limits, define the lower software stroke limit value and the upper software stroke limit value as follows:

(Lower software stroke limit value) = (Upper software stroke limitvalue)

This stops software stroke limit settings from affecting the operation.

(3) Positioning control

This section describes the positioning control when the control unit is degrees.

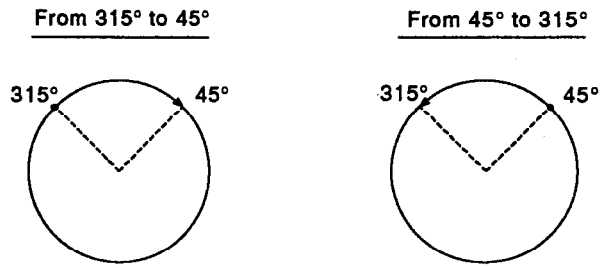
(a) In the absolute data method:

1) When the stroke limit is invalid

Positioning is performed taking the shortcut from the present value. (Shortcut positioning control)

Example

(1) Move clockwise to go from the present value of 315° to 45°.
(2) Move counterclockwise to go from the present value of 45° to 315°.

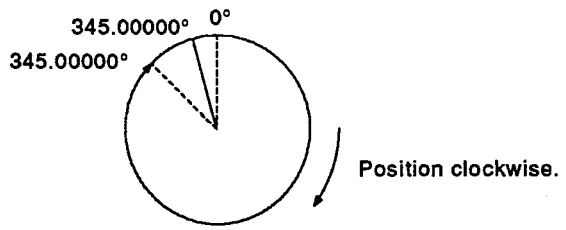


2) When the stroke limit is valid

The positioning direction (clockwise or counterclockwise) is determined by the software stroke limit settings.
Accordingly, shorter path selection may be impossible, depending on the settings.

Example

Move clockwise to go from the present value of 0° to 315° when the software stroke upper limit is 0° and the upper limit is 345°.



POINT

The positioning address range is from 0° to 359.99999°.
To perform positioning that completes a full revolution or more, use the incremental method.

(b) In the incremental method:

Positioning of a designated travel value is performed in a designated direction.

The plus or minus sign placed before each travel value determines the travel direction.

- Minus sign . . Clockwise
- Plus sign . . . Counterclockwise

POINT

The incremental method allows positioning of over 360°.
In order to do this, it is necessary to invalidate the software stroke limits by setting the lower and upper software stroke limit values to the same value (lower software stroke limit value = upper software stroke limit value).

3.4 Parameters

This section describes the parameters of the AD75.

The parameters of the AD75 are set for each axis.

Each parameter is set to its initial value (default) on shipment from the factory.
When memory "all clear" is executed, all parameters are set to defaults.

3.4.1 Basic parameters

The basic parameters are divided into basic parameters #1 and #2.

Basic parameters

- Basic parameters #1

  - Basic parameters #1 includes the control unit parameter, the travel value per pulse parameter, the pulse output mode parameter, and the direction of rotation parameter.
    Set these parameters to suit the mechanical system or applicable motor when booting the system.
  - Note that if basic parameters #1 is set inappropriately, rotation may be reversed or no operation may be performed.
    Be sure to set the parameters to suit the system.
  - Parameters can be changed only when the PC READY flag (Y1D) is OFF.
    Make sure the PC READY flag (Y1D) is OFF before changing Basic parameters #1.

- Basic parameters #2

  - Basic parameters #2 are the speed control parameter and the acceleration/deceleration curve parameters.
    Set these parameters when starting up the system.
  - The system will operate even if basic parameters #2 are set to the initial values.
  - These parameters can be changed regardless of the ON/OFF status of the PC READY flag.

The basic parameters can be set in the following two ways:

- With a peripheral device in the edit mode
- With a sequence program

Table 3.6 List of Basic Parameters

Basic Parameter Group No.	Item \ Unit		Setting Ranges				Initial Value
			mm	inch	degree	pulse	
1	Unit setting		0: mm	1: inch	2: degree	3: pulse	3
	Travel value per pulse (A)	Number of pulses per revolution (Ap)	1 to 65535 (pulse)				20000
		Travel value per revolution (Al)	0.1 to 6553.5 (μm)	0.00001 to 0.65535 (inch)	0.00001 to 0.65535 (degree)	1 to 65535 (pulse)	20000
		Unit magnification (Am)	• 1 • 10 • 100 • 1000				1
	Pulse output mode		• 0: PLS/SIGN mode • 1: CW/CCW mode • 2: A-phase/B-phase mode				0
	Direction of rotation		• 0: Present value increases when forward pulse is output • 1: Present value increases when reverse pulse is output				0
2	Speed control		0.01 to 6000000.00 (mm/min)	0.001 to 600000.00 (inch/min)	0.001 to 600000.000 (degree/min)	1 to 1000000 (pulse/s)	200000
	Acceleration time		1 to 65535 (ms)				1000
	Deceleration time		1 to 65535 (ms)				1000

REMARK

For details on the buffer memory address and setting range when setting basic parameters #1 and #2 with a sequence program. See Sections 3.6.2(1) and (2).

(1) Unit setting

(a) Sets the command unit for positioning control.

(b) Changing the command unit does not affect the parameters and the positioning data.
After changing the command unit, check if the parameters and the positioning data are within the setting ranges.
The AD75 will go into an error status upon detecting any data outside the setting range.

(2) Travel value per pulse

The travel value per pulse is the mechanical system value used for positioning control by the AD75. It sets the number of pulses for one revolution of the mechanical system motor, the travel value for one revolution of the motor, and the magnification of the travel value per pulse.

(a) Calculation of the travel value per pulse

1) Mechanical system specification

The following data are required for calculation of the travel value per pulse:

i) Feed screw pitch ..... P_B(mm/rev)

ii) Number of gear teeth of motor shaft ..... Z_1

iii) Number of gear teeth of feed screw shaft..... Z_2

Reduction ratio $\frac{Z_1}{Z_2} = \frac{1}{n}$ (Gear ratio)

iv) Number of pulses per revolution ..... P_f (pulse/rev)

2) For the above mechanical system specification, the number of pulses per revolution, the travel value per revolution, and the unit magnification are as follows:

i) Number of pulses per revolution = P_f

ii) Travel value per revolution = $P_B \times (1/n) \times 10^3$

iii) Unit magnification = M

3) The travel value per pulse is calculated using the following

$$A = \frac{\text{Travel value per revolution}}{\text{Number of pulses per revolution}} \times \text{Unit magnification}$$

$$= \frac{P_B \times (1/n) \times 10^3}{P_f} \times M(\mu m/\text{pulse})$$

Calculation example

[Condition]

- PB = 5(mm/rev)
- $\frac{1}{n} = \frac{1}{1}$
- Pf = 12000(pulse/rev)
- M = 1

[Equation]

$$A = \frac{5 \times (1/1) \times 10^3}{12000}$$

$$= 0.4167(\mu m/\text{pulse})$$

(b) Error compensation

A mechanical error may occur between the command travel value and the actual travel value when positioning is performed based on a travel value per pulse.
With the AD75, this error can be compensated for by changing the number of pulses per revolution, the travel value per revolution, and the unit magnification.
The following explains how to perform this error compensation.

1) Set command travel value L (mm) and perform positioning.

2) Measure actual travel value L' (mm) after positioning.

3) The number of pulses per revolution and the travel value per revolution for compensation are given by the following expressions based on the above command travel value and actual travel value as follows.

i) Travel value per pulse (mm/pulse) A for command travel value L (mm)

$$A = \frac{\text{Travel value per revolution } (A_L)}{\text{Number of pulses per revolution } (A_P)} \times \text{Unit magnification } (A_M)$$

ii) Required number of pulses P (pulse)

$$P = \frac{L}{A} \text{ (pulse)}$$

iii) Apparent travel value per pulse A' for actual travel value L' (mm)

$$A' = \frac{L'}{P} \text{ (mm/pulse)}$$

$$\therefore P = \frac{L'}{A'}$$

$$\therefore A' = A \frac{L'}{L}$$

$$= \frac{\text{Travel value per revolution } (A_L) \times \text{Unit magnification } (A_M)}{\text{Number of pulses per revolution } (A_P)} \times \frac{\text{Actual travel value } (L')}{\text{Command travel value } (L)}$$

$$= \frac{\text{Travel value per revolution } (A_L) \text{ for compensation } (A_L' = A_L \times L')}{\text{Number of pulses per revolution for compensation } (A_P' = A_P \times L)} \times \text{Unit magnification } (A_M)$$

Reduce the fraction A_L'/A_P' to obtain the desired compensation values.

Example

[Condition]
Travel value per revolution..... 5000 (μm/rev)
Number of pulses per revolution ... 12000 (pulse/rev)
Unit magnification..... 1

[Result of positioning]
Command travel value..... 100 mm
Actual travel value ..... 101 mm

[Compensation value]

$$\frac{A_L'}{A_P'} = \frac{5 \times 10^3}{12000} \times \frac{101 \times 10^3}{100 \times 10^3} = \frac{5050}{12000} = \frac{101}{240}$$

Travel value per revolution: 101 (μm/rev)
Number of pulses per revolution: 240 (pulse/rev)

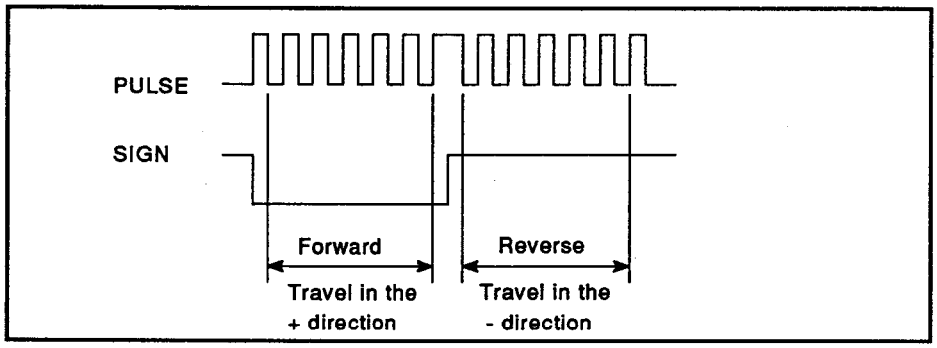
(3) Pulse output mode

This sets the pulse output mode compatible with the servo amplifier to be used.

(a) PLS/SIGN mode

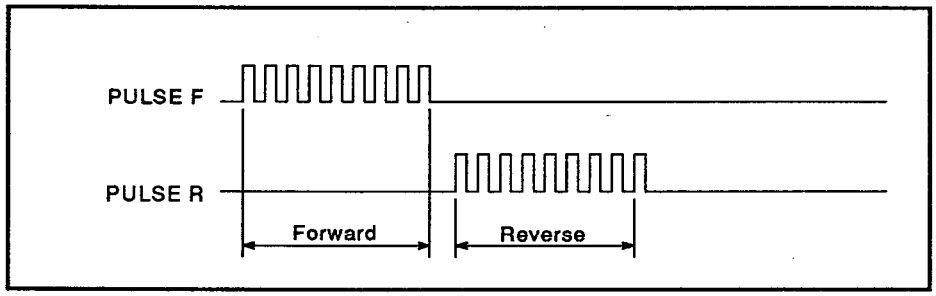
Controls forward/reverse rotation by turning on/off the direction sign (SIGN).

- When the direction sign is LOW: Forward rotation
- When the direction sign is HIGH: Reverse rotation



(b) CW/CCW mode

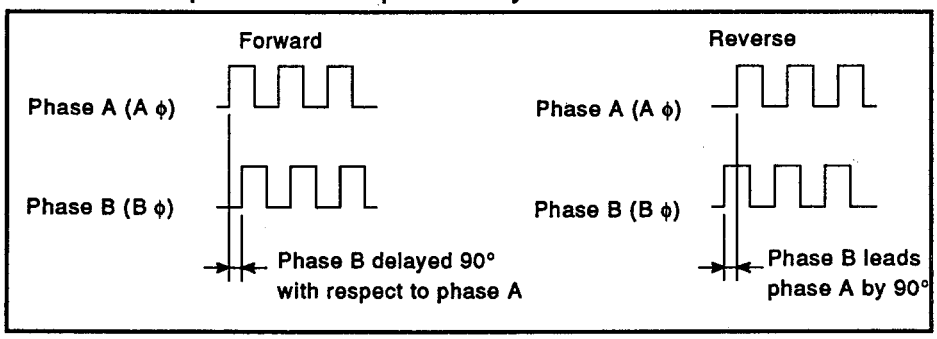
Outputs forward field pulses (PULSE F) in forward rotation.
Outputs reverse field pulses (PULSE R) in reverse rotation.



(c) A/B phase mode

Controls forward/reverse rotation according to the phase difference between phase A (A ϕ) and phase B (B ϕ).

- When phase B is behind phase A by 90° : Forward rotation
- When phase B leads phase A by 90° : Reverse rotation



(4) Direction of rotation setting

This sets the direction of rotation (forward/reverse) when the present value is increasing.
With the AD75, a limit switch ON/OFF check is performed with the upper limit in the direction of increase of the present value and the lower limit in the direction of decrease.
Because of this the relationship between the actual direction of rotation of the motor and arrangement of the upper and lower limit switches is as shown below.

Direction of Rotation Setting	Motor Rotation and Arrangement of External Hardware Stroke Limit Switches
Forward	Reverse ← Forward (present value) Reverse ← Forward (direction of motor rotation) AD75 lower limit switch — AD75 upper limit switch
Reverse	Reverse ← Forward (present value) Forward ← Reverse (direction of motor rotation) AD75 lower limit switch — AD75 upper limit switch

(5) Speed limit value

(a) This sets the maximum speed for positioning operation (including home position return) and manual pulse generator operation.

(b) If the commanded speed and home position return speed in positioning operation are set greater than the speed limit value, they are restrained within the designated speed limit value.

(c) In manual pulse generator operation, if the speed expressed as the number of input pulses for the designated time exceeds the speed limit value, it is restrained within the speed limit value.
The input pulses exceeding the speed limit value are discarded, and the travel value is therefore reduced by the corresponding amount.

(d) If the target speed is greater than the speed limit value due to speed change or override in positioning operation, it is restrained within the speed limit value.
"Speed control flag" of the axis monitor is turned on while the speed is restrained within the speed limit value.

(e) When the speed is being restrained, the warning "over the speed limit value" is given.

(f) For linear interpolation and circular interpolation operation, the speed is restrained within the speed limit value of the reference axis.

1) For interpolation with axis 1 and axis 2, the speed is restrained within the speed limit value of axis 1.

2) For interpolation with axis 2 and axis 3, the speed is restrained within the speed limit value of axis 2.

3) For interpolation with axis 3 and axis 1, the speed is restrained within the speed limit value of axis 3.

(6) Acceleration time 0

(a) This sets the time taken to reach the speed limit value from speed 0 in positioning operation.

(7) Deceleration time 0

(a) This sets the time taken to reach speed 0 from the speed limit value in positioning operation.

REMARK

For the relationship between the speed limit value, acceleration time, and deceleration time. See Section 3.3.15.

3.4.2 Extended parameters

The extended parameters consist of extended parameters #1 and extended parameters #2.

Extended parameters

- Extended parameters #1

  - Extended parameters #1 are data such as the backlash compensation amount and software stroke limit.
    Set these parameters at system start-up using the AD75.
  - These parameters can be reset only when the PC READY flag (Y1D) is OFF.
    Check that the PC READY flag is OFF before resetting extended parameters #1.

- Extended parameters #2

  - Extended parameters #2 are data allowing full use of the functions of the AD75.
    Set these parameters as required.
  - Extended parameters# 2 can be used at their initial values.
  - These parameters can be reset regardless of whether the PC READY flag is ON or OFF.

The following methods are used for setting the detailed parameters.

- Setting in the edit mode of a peripheral device
- Setting with a sequence program

Table 3.7 Extended Parameter List

Extended Parameter No.	Item / Unit	Setting Ranges				Initial Value
		mm	inch	degree	pulse	
1	Backlash compensation amount	0 to 6553.5 μm	0 to 0.65535 inch	0 to 0.65535 degree	0 to 65535 pulse	0
	Software upper stroke limit	-214748364.8 to 214748364.7 μm	-21474.83648 to 21474.83647 inch	0 to 359.99999 degree	-2147483648 to 2147483647 pulse	2147483647
	Software lower stroke limit	-214748364.8 to 214748364.7 μm	-21474.83648 to 21474.83647 inch	0 to 359.99999 degree	-2147483648 to 2147483647 pulse	-2147483648
	Software stroke limit selection	• 0: Multiply the feed present value by the software stroke limit. • 1: Multiply the machine feed value by the software stroke limit.				0
	Software stroke limit valid/invalid setting in manual pulse generator operation	• 0: The software stroke limit is invalid in JOG operation and manual pulse generator operation. • 1: The software stroke limit is valid in JOG operation and manual pulse generator operation.				0
	Command in-position	0.1 to 3276700.0 μm	0.00001 to 327.67000 inch	0.00001 to 327.67000 degree	1 to 32767 pulse	100
	Torque limit value setting	• 1 to 500 %				300
	M code ON signal output timing	• 0: WITH mode • 1: AFTER mode				0
	Speed change type	• 0: Standard speed switching mode • 1: Advance speed switching mode				0
	Interpolation speed designation	• 0: Resultant speed • 1: Reference axis speed				0
	Feed present value update request during speed control	• 0: Feed present value is not updated during speed control. • 1: Feed present value is updated during speed control.				0
	Manual pulse generator selection	• 0: Manual pulse generator operation not allowed. • 1: Manual pulse generator 1 used. • 2: Manual pulse generator 2 used. • 3: Manual pulse generator 3 used.				Axis 1: 1 Axis 2: 2 Axis 3: 3

Table 3.7 Extended Parameter List (continued)

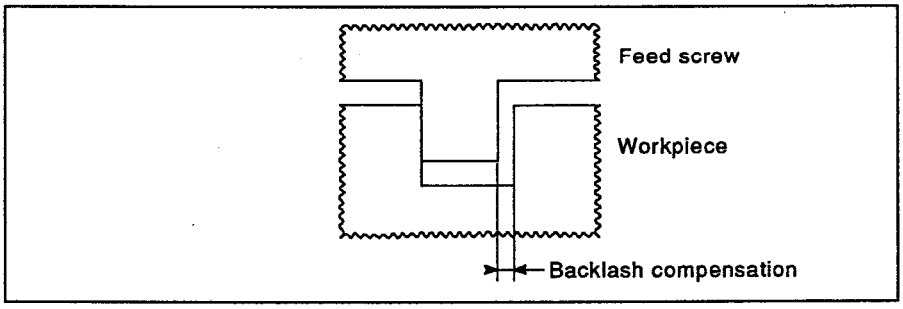
Extended Parameter No.	Item \ Unit	Setting Ranges				Initial Value
		mm	inch	degree	pulse	
2	Acceleration time 1 to 3	1 to 65535 ms				1000
	Deceleration time 1 to 3	1 to 65535 ms				1000
	JOG speed limit value	0.01 to6000000.00 mm/min	0.001 to 600000.000 inch/min	0.001 to 600000.000 degree/min	1 to 1000000 pulse/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: Trapezoidal acceleration/deceleration processing • 1: S pattern acceleration/deceleration processing				0
	S curve ratio	1 to 100 %				100
	Rapid stop deceleration time	1 to 65535 ms				1000
	Stop group 1 to 3 Rapid stop selection	• 0: Normal deceleration stop • 1: Rapid stop				0
	Positioning completed signal output time	0 to 65535 ms				300
	Allowable error range for circular interpolation	0 to 10000.0 μm	0 to 1.00000 inch	0 to 1.00000 degree	0 to 100000 pulse	100
	External positioning start selection	• 0: External positioning start • 1: External speed change request • 2: Skip request				0

REMARK

For details on the buffer memory address and setting range when setting extended parameters #1 and #2 with a sequence program, see Sections 3.6.2(3) and (4).

(1) Backlash compensation amount

(a) This sets the backlash amount (play) of the machine.



(b) Set the backlash compensation amount within the following range:

$$0 \leq \frac{\text{Backlash compensation amount}}{\text{Travel value per pulse}} \leq 255$$ (Decimal point fractions are rounded off.)

(c) When the backlash compensation amount is set, compensation by the backlash compensation amount is executed for each change of positioning direction at the start of positioning.

(2) Software stroke limit *1

(a) The software stroke limits are the upper/lower limit values for machine travel.

1) Upper software stroke limit: upper limit value of machine travel

2) Lower software stroke limit: lower limit value of machine travel

(b) If a command exceeding the setting range of the software stroke limits is given, the positioning corresponding to the command is not carried out.

(3) Software stroke limit selection

(a) This sets whether the software stroke limit is multiplied by the feed present value or the machine present value.

(4) Software stroke limit valid/invalid setting

(a) This sets whether the software stroke limits are valid or invalid in JOG or manual pulse generator operation.

(5) Command in-position range

(a) This sets the ON position [(positioning address) - (present value)] for the command in-position signal.

(6) Torque limit

(a) This sets the torque limit value.

(7) "M code ON" signal output timing

(a) This sets "M code ON" signal output to WITH mode or AFTER mode.

- WITH mode: Sets the M code and turns on the "M code ON" signal when positioning operation starts.
- AFTER mode: Sets the M code and turns on the "M code ON" signal when positioning operation ends.

REMARK

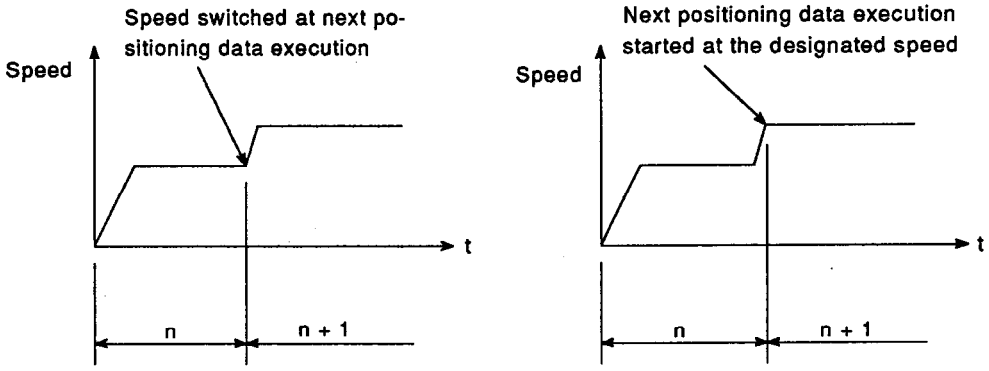
*1: For details on software stroke limits, see Section 3.3.11.

(8) Speed switching type

(a) This sets the speed switching mode to standard switching or advance switching.

- Advance switching: The speed is switched at the end of current positioning data.
- Standard switching: The speed is switched when next positioning data is executed.

(b) When positioning data No. n is executed, the speed is switched as follows:

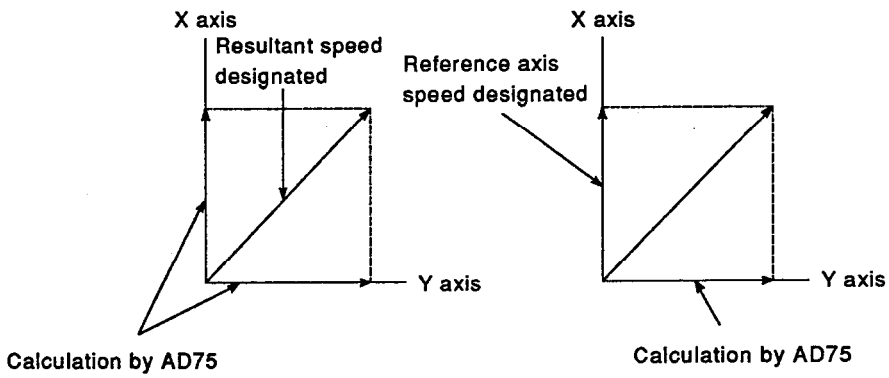


(a) Standard switching (b) Advanced switching

(9) Interpolation speed designation

(a) When the linear/circular interpolation is carried out, either the resultant speed or the reference axis speed is set.

- Resultant speed: Designates the travel speed for control. The speed of each axis is calculated by the AD75.
- Reference axis speed: Designates the axis speed set for the reference axis. The speed of the other axis used for interpolation is calculated by the AD75.



(a) Resultant speed designation (b) Reference axis designation (when X axis is the reference)

(b) In circular interpolation, or if different unit groups are designated for the interpolation axes, an error may occur and positioning according to the designated positioning data may not be carried out.

Interpolation Control	Speed Designation	Execution of Positioning	
		Matching of Unit Groups	Mismatching of Unit Groups
Linear interpolation	Resultant speed designation	Executed	Not executed
	Reference axis speed designation	Executed	Executed
Circular interpolation	Resultant speed designation	Executed	Not executed
	Reference axis speed designation	Not executed	Not executed

POINT

When the speed calculated by the AD75 exceeds the speed limit value during interpolation control, control is carried out without acknowledging the speed limit value.
When designating the interpolation speed, pay attention to the following:

- For the resultant speed, designate the value so that the speed of each axis does not exceed the speed limit value.
- For the reference axis speed, set the long axis as the reference axis. If the reference axis is set to the short axis, the speed on the long axis may exceed the speed limit value.

REMARK

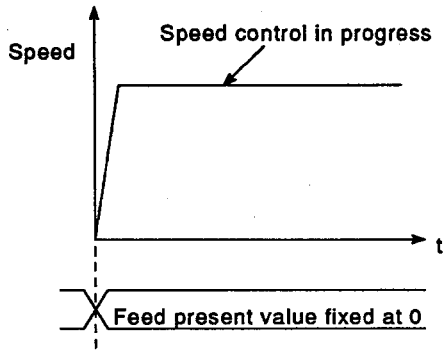
Unit groups are as follows:

- Group 1: mm, inches
- Group 2: degrees
- Group 3: pulses

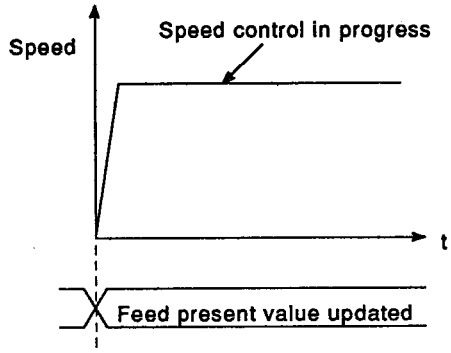
(10) Feed present value during speed control

(a) This parameter sets whether the feed present value is updated or not during speed control, and during speed control in speed/position switching control.

- When the feed present value is not updated:
  During speed control, the feed present value remains at 0.
  During speed/position switching control, the feed present value is updated on switching to position control.
- When the feed present value is updated:
  During speed control, the feed present value is updated from 0.



(a) Feed present value not updated



(b) Feed present value updated

(11) Manual pulse generator selection

(a) This sets which of the manual pulse generators connected to axes 1 to 3 is used for the control.

- For the manual pulse generator of axis 1:
  Manual pulse generator 1
- For the manual pulse generator of axis 2:
  Manual pulse generator 2
- For the manual pulse generator of axis 3:
  Manual pulse generator 3

(12) Acceleration times 1 to 3

(a) These set the time from speed 0 to the speed limit value for positioning operations.
Acceleration times 1 to 3 operate in the same way as acceleration time 0 of the basic parameters #2.
(For details of acceleration time 0, see Section 3.4.1.)

(13) Deceleration times 1 to 3

(a) These set the time from the speed limit value to speed 0 for positioning operations.
Deceleration times 1 to 3 operate in the same way as deceleration time 0 of the basic parameters #2.
(For details of deceleration time 0, see Section 3.4.1.)

(14) JOG speed limit value

(a) This sets the maximum speed in JOG operation.

(b) Set the JOG speed limit value to the speed limit value or lower.
If the JOG speed limit value exceeds the speed limit value, a setting range error occurs.

(c) When the JOG speed value is greater than the JOG speed limit, the actual speed is restrained within the JOG speed limit value.

- The "speed limit flag" of the axis monitor is turned ON while the speed is restrained within the JOG speed limit value.
- When the speed is being restrained, the warning "over JOG speed limit" is issued

(15) JOG operation acceleration time selection

(a) This sets which of the acceleration times 0 to 3 is used for the acceleration time in JOG operation.

- Acceleration time 0: Set in the basic parameters [See Section 3.4.1.]
- Acceleration time 1 to 3: Set in the extended parameters [See item (12).]

(16) JOG operation deceleration time selection

(a) This sets which of the deceleration times 0 to 3 is used for the deceleration time in JOG operation.

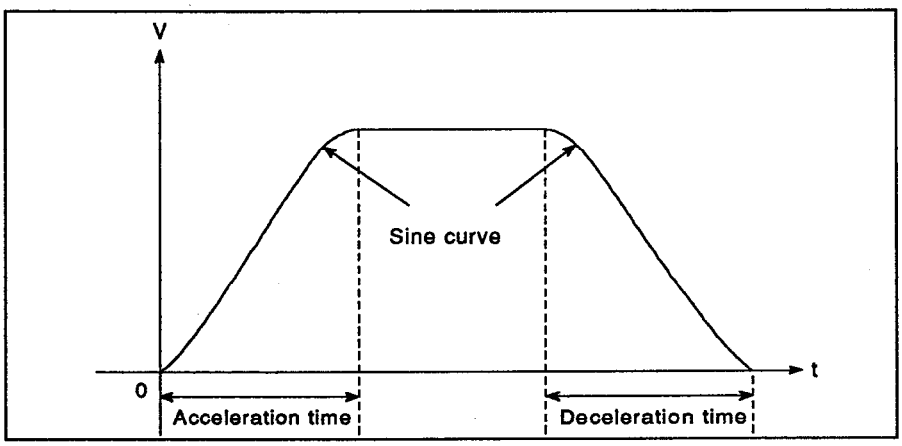
- Deceleration time 0: Set in the basic parameters [See Section 3.4.1.]
- Deceleration time 1 to 3: Set in the detailed parameters [See item (13).]

(17) Acceleration/deceleration processing selection

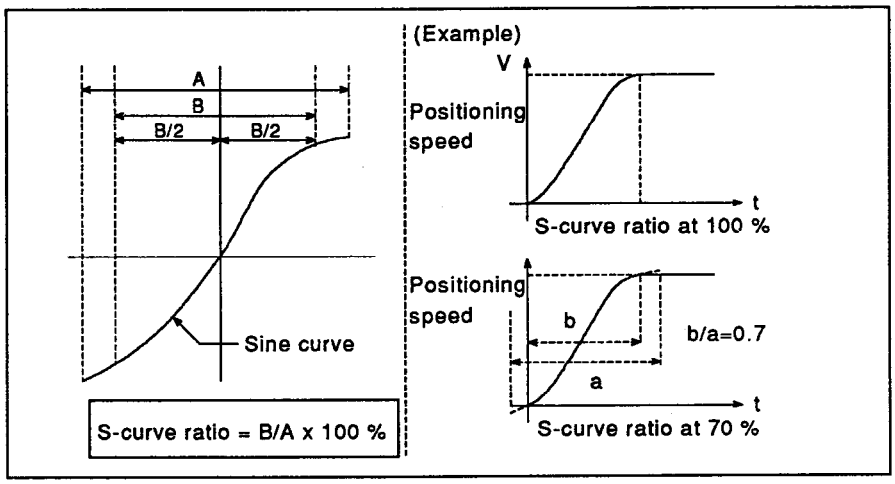
(a) This sets the acceleration/deceleration processing to trapezoidal processing or S pattern processing.

(18) S curve ratio

(a) This sets the S curve ratio when the S pattern acceleration/deceleration processing is carried out.
When an S curve ratio is set, the acceleration/deceleration processing is carried out smoothly.
The smaller the value of the S curve ratio, the closer the processing curve becomes to a straight line.
The S pattern acceleration/deceleration graph takes the form of a sine curve, as follows:



The S curve ratio sets which part of the sine curve is used to describe the acceleration/deceleration curve, as shown below.



(19) Rapid stop deceleration time

(a) This sets the time taken to reach speed 0 from the speed limit value when a rapid stop is executed.

(20) Rapid stop selection (Stop group 1 to 3)

(a) This selects whether a normal deceleration stop or rapid stop is executed when a stop cause occurs.
The setting is valid for positioning operation, home position return, and JOG operation.

(b) Once rapid stop has been selected, rapid stop deceleration is carried out when the stop signal of stop groups 1 to 3, corresponding to the following stop causes, is input.

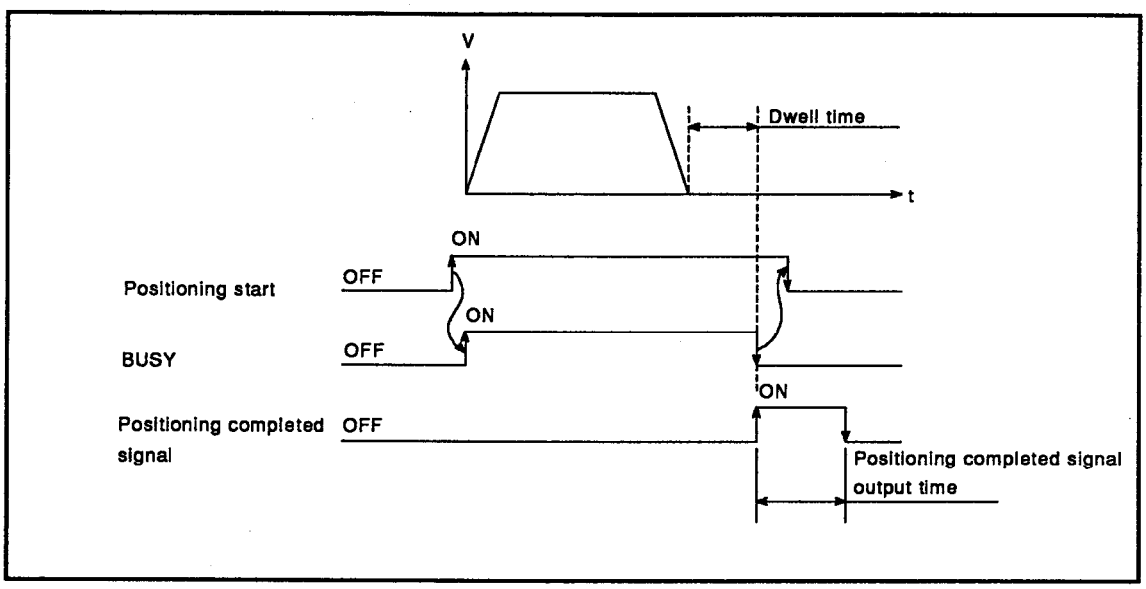
- Stop group 1: Stop due to hardware stroke limit
- Stop group 2: Stop due to software stroke limit
  Stopped by a peripheral device
  Stop due to PC READY OFF
- Stop group 3: Stop due to the external stop signal
  Stop due to stop signal from the programmable controller.
  Stop due to error occurrence
  (other than stop group 1 or 2)

(c) If the "rapid stop selection" setting is changed during rapid stop or deceleration, rapid /deceleration stop continues using the setting when the stop signal was input.

(d) In case of linear/circular interpolation, stop or rapid stop is carried out according to the rapid stop setting of the axis where the stop cause has occurred.

(21) Positioning completed signal output time

(a) This sets the time of output of the "positioning completed signal" from the AD75.



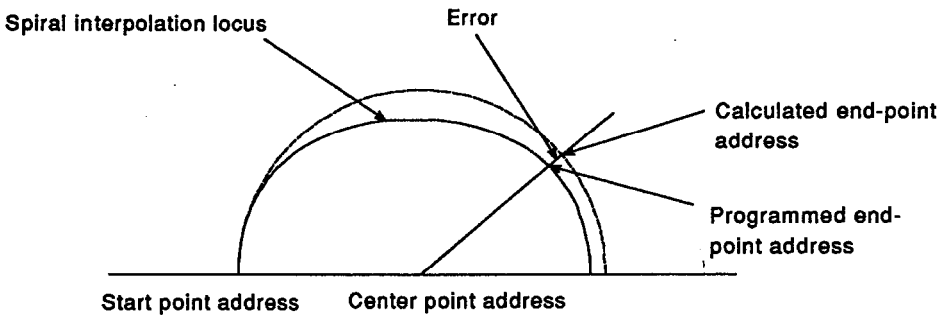
(22) Allowable error range for circular interpolation

(a) When the circular interpolation control is executed by center point designation, the circular locus calculated from the start address and center point address may deviate from the end address.

(b) The allowable error range for circular interpolation is set as the tolerance between the calculated circular locus and the end address. When the calculated circular arc error and the end address error are within the set allowable error range, circular interpolation is carried out at the end address while compensating for the error by spiral interpolation.

(c) The allowable error range for circular interpolation tolerance is set in the extended parameters #2 for the following axes:

- In case of circular interpolation with axes 1 and 2: Axis 1
- In case of circular interpolation with axes 2 and 3: Axis 2
- In case of circular interpolation with axes 3 and 1: Axis 3



(23) External start function selection

(a) This sets what function applies to the external start signal.

1) External positioning start setting

- The positioning operation is started by the external start signal input.

2) External speed change request setting

- The current positioning operation speed is changed by external start signal input.
- When the external speed is to be changed, set the speed change value as the "positioning operation speed change value" of the axis control data.

3) Skip request setting

- The current positioning operation is skipped by the external start signal input.

3.4.3 Basic parameters for home position return

Table 3.8 Basic Parameters for Home Position Return

Item \ Unit	Setting Ranges				Initial Value
	mm	inch	degree	pulse	
Home position return method	• 0:Near-zero point dog metho • 1:Stopper stop (1) (caused by time-out of the dwell timer) • 2:Stopper stop (2) (caused by the zero point signal when in contact with the stopper) • 3:Stopper stop (3) (method without near-zero point dog) • 4:Count method (1) (zero point signal is used) • 5:Count method (2) (zero point signal is not used)				0
Home position return direction	• 0:Forward direction (address increases) • 1:Reverse direction (address decreases)				0
Zero position address	-214748364.8 to 214748364.7 µm	-21474.83648 to 21474.83647 inch	0 to 359.99999 degree	2147483648 to 2147483647 pulse	0
Home position return speed	0.01 to 6000000.00 mm/min	0.001 to 600000.000 inch/min	0.001 to 600000.000 degree/min	1 to 1000000 pulse/s	1
Creep speed	0.01 to 6000000.00 mm/min	0.001 to 600000.000 inch/min	0.001 to 600000.000 degree/min	1 to 1000000 pulse/s	1
Home position return retry	• 0:home position return is not retried in accordance with the upper/lower limit switch. • 1:home position return is retried in accordance with the upper/lower limit switch.				0

(1) Home position return method

(a) Designates the home position return method when home position return is carried out.
(For details of the home position return method, see Section 3.3.8.)

(2) Home position return direction

(a) Designates the direction for home position return.
Allows travel in the designated direction on home position return start.

IMPORTANT

(1) Home position return is controlled according to the home position return direction and speed. When the near-zero point dog is turned ON, deceleration is started.
Caution: incorrect setting of the home position return direction may cause the drive system to overrun.

(2) If the home position return direction is not the same every time, use the home position return retry function.
For details of the home position return retry function, see Section 3.3.8.

REMARK

For details on the buffer memory address and setting range when setting home position return basic parameters with a sequence program, see Section 3.6.2 (5).

(3) Home position return address

(a) This address sets the present value of the home position upon completion of home position return.

(b) Upon normal completion of home position return, the home position return address set as the feed present value and machine feed value is stored.

(c) It is recommended the home position return address be set to either the upper or lower software stroke limit value.

(d) Even if the set value of the home position return address falls outside the software stroke limits, no setting error warning is given.
Check the value set for the software stroke limit in detailed parameters 1 and set the home position return address to a value within the software stroke limit.

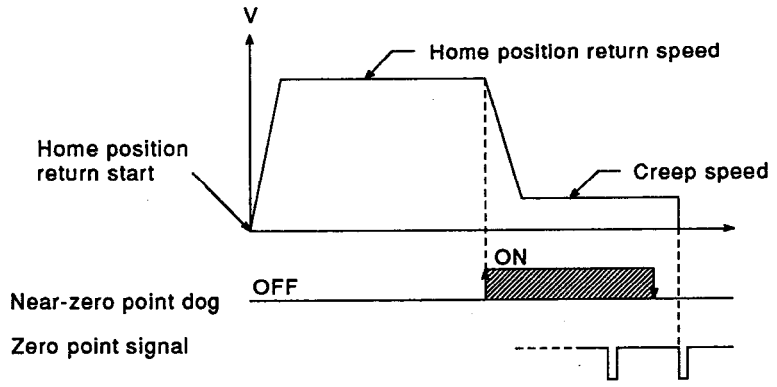
(4) Home position return speed

(a) This sets the home position return speed.

(b) Set a value within the speed limit value designated by basic parameter 2.

(5) Creep speed

(a) This sets the creep speed (low speed up until stopping after decelerating from the home position return speed) after near-zero point dog ON.



(b) Set a value within the home position return speed.

(c) The creep speed is related to the detection error in the case of home position return by a zero phase signal and to the size of the impact with the stopper in the case of home position return by stopper.
Therefore, take the error range and the size of impact into consideration when setting the creep speed.

(6) Home position return retry

(a) This sets whether or not a home position return is retried in accordance with the upper/lower limit switch

(b) Using the home position return retry function, the home position return operation can start wherever the machine position is designated.
For details of the home position return retry function, see Section 3.3.8.

REMARK

In order to use the home position return retry function, input from the upper/lower limit switches to the AD75 is required.