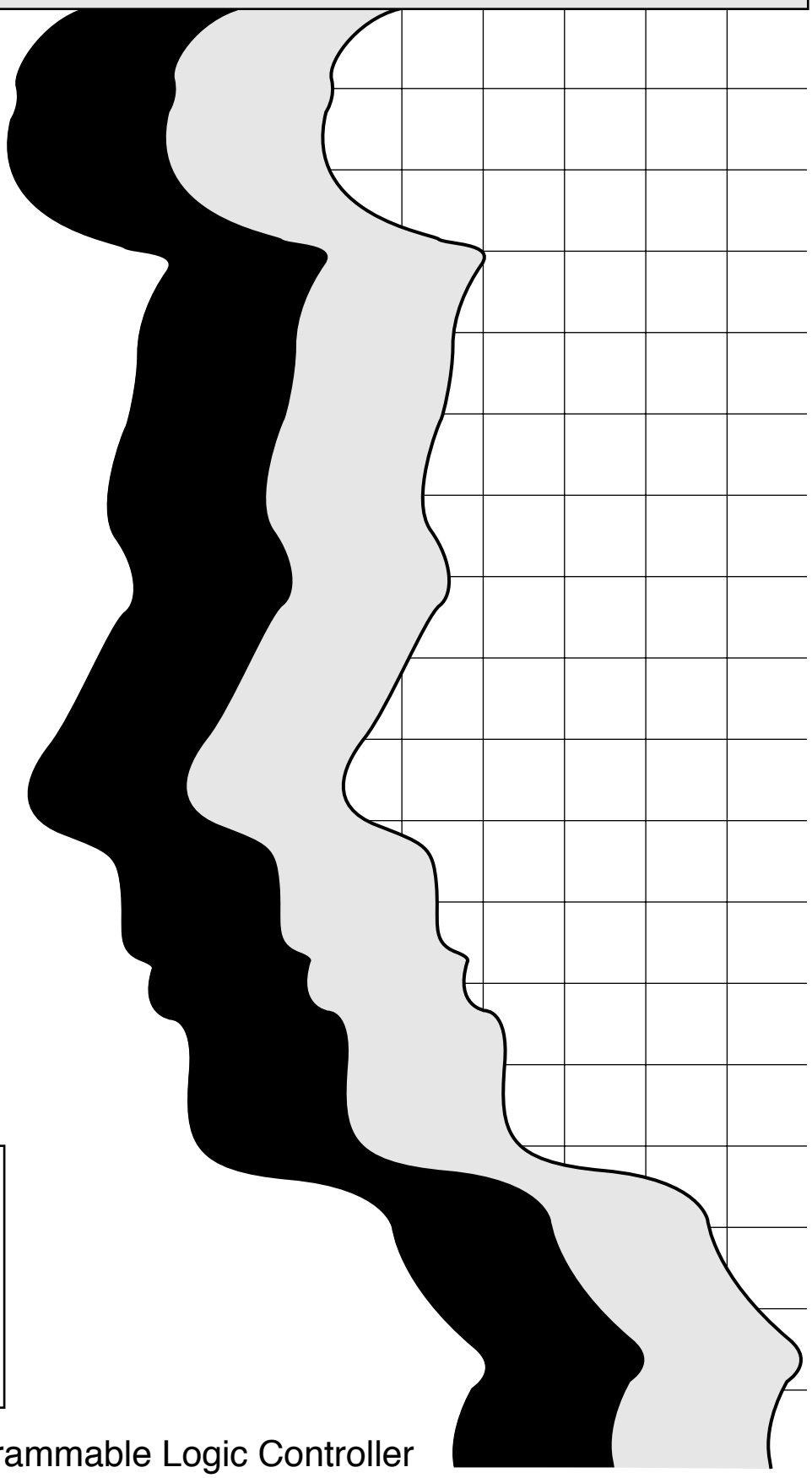
MITSUBISHI

Positioning module Type AD70D

User's Manual



A

MELSEC

Mitsubishi Programmable Logic Controller

● SAFETY PRECAUTIONS ●

(Read these precautions before using.)

When using Mitsubishi equipment, thoroughly read this manual and the associated manuals introduced in this manual. Also pay careful attention to safety and handle the module properly.

These precautions apply only to Mitsubishi equipment. Refer to the CPU module userís manual for a descriprion of the PC system safty precautions.

These ● **SAFETY PRECAUTIONS** ● classifiy the safty precautions into two categories: "DANGER" and "CAUTION".

DANGER	Procedures which may lead to a dangerous condition and cause death or serious injury if not carried out properly.
CAUTION	Procedures which may lead to a dangerous condition and cause superficial to medium injury, or physical damage only, if not carried out properly.

Depending on circumestances, procedures indicated by **CAUTION** may also be linked to serious results.

In many case, it is important to follow the directions for usage.

Store this manual in a safe place so that you can take it out and read it whenever necessary. Always forward it to the end user.

[System Design Precautions]

DANGER

- Safety circuits should be installed external to the programmable controller to ensure that the system as a whole will continue to operate safely in the event of an external power supply malfunction or a programmable controller failure. Erroneous outputs and operation could result in an accident.
  1) Always connect the servo ON signal if the servo amplifier that has the servo ON signal is used. When a servo amplifier which cannot control the stop by the servo ON signal is used, the following processing is necessary.
     - Switch off the power of the PC while the analog voltage is 0 V (while the motor is stopped).
     - Configure the circuit externally so that it turns off ±15 VDC when the PC power is switched off or at the occurrence of a CPU error.

     The analog voltage output (speed command) that is valid immediately before the switching off the power of the PC could be output to cause the motor to run even if the PC power is turned off, the PC CPU is stopped, or the PC CPU error occurs as long as ±15 VDC is applied to the module terminals.
  2) Configure the external interlock circuit, such as emergency stop circuit and upper/lower limits in positioning, that prevents the machine from damage.
  3) The home position return operation is controlled by two sets of data - home position return direction and home position return speed - and deceleration starts in response to the going on of the near-zero point dog signal. Therefore, the motor will keep rotating without decelerated if the direction of home position return is set incorrectly. To protect the machine from troubles occurring due to such nature of the system, it is necessary to configure the measures to protect the machine.

[System Design Precautions]

CAUTION

- Do not bundle control lines or communication wires together with main circuit or power lines, or lay them close to these lines.
  As a guide, separate the lines by a distance of at least 100mm, otherwise malfunctions may occur due to noise.

[Cautions on Mounting]

CAUTION

- Use the PC in an environment that conforms to the general specifications in the manual.
  Using the PC in environments outside the ranges stated in the general specifications will cause electric shock, fire, malfunction, or damage to/deterioration of the product.
- After installing the module by securely engaging the module fixing projection on the module bottom with the module fixing hole in the base unit, tighten the module clamping screws to the specified torque. Unless the module is installed and screwed correctly, the module can malfunction, fail, or drop.
- Plug in the connectors of the drive unit and peripheral equipment securely to the connectors in the module. Otherwise, loose connection will cause input/output errors.
- Do not touch the conductive areas and electronic parts of the module directly. To do so can cause the module to malfunction or fail.

[Cautions on Wiring]

DANGER

- Before starting installation, wiring or other work, make sure that the power is switched off externally in all phases.
  Failure to do so may cause an electric shock or damage to the product.
- When starting power-on or operation after installation, wiring or other work, be sure to fit the accessory terminal cover to the product.
  Failure to do so may cause an electric shock.

[Cautions on Wiring]

CAUTION

- Wire the PLC correctly after confirming the rated voltage and terminal arrangement of the product. Failure to do so can cause a fire or failure. Tighten the terminal screws to the specified torque.
- Undertightening can cause a short circuit, fire or malfunction. Overtightening can damage the screws and module, causing the module to fall, short or malfunction.
- Make sure that no foreign matter such as chips or wiring offcuts gets inside the module. It will cause fire, failure or malfunction.
- Crimp or insulation-displace the external connector with the specified tool, or solder it correctly. For the crimping or insulation displacement tool, refer to Chapter 1 of this Userís Manual. Incomplete connection can cause a short circuit, fire or malfunction.

[Cautions on Startup and Maintenance]

DANGER

- Before starting cleaning or terminal screw retightening, be sure to switch power off externally in all phases. Failure to do so can cause an electric shock.

CAUTION

- Do not disassemble or modify any module. This will cause failure, malfunction, injuries, or fire.
- Be sure to install or remove the module after switching power off externally in all phases. Failure to do so can cause the module to fail or malfunction. Undertightening of screws can cause the module to fall, short, or malfunction. Overtightening can damage the screws and module, causing the module to fall, short or malfunction.
- When replacing fuses, be sure to use the prescribed fuse. A fuse of the wrong capacity could cause a fire.
- Before touching the module, be sure to touch ground metal or similar material to discharge static electricity from human body, etc. Failure to do so can cause the module to fail or malfunction.

[Cautions on Disposal]

CAUTION

- Dispose of this product as industrial waste.

REVISIONS

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

Print Date	*Manual Number	Revision
Feb., 1991	IB (NA) 66265-A	First edition
Dec., 2003	IB (NA) 66265-B	Descriptions of MR-SD and MR-SB-K type Servo amplifier are added. Addition Appendix 4.3, 4.4, WARRANTY Partial Correction SAFETY PRECAUTIONS, CONTENTS, Section 1.2, 2.1, 2.2, 3.5.2, 3.6, 3.8, 3.9, 4.5.3, 4.5.4, 5.2.1, 5.2.3, 5.3.1, 5.3.4, 5.5.4, 5.6.6, 5.8.3, 5.11.12, 6.1.1, Appendix 1 Partial Addition CONTENTS, Chapter 1, 2, Section 2.1, Chapter 3, Section 3.1, 3.2, 3.3, 3.4, 3.5, 3.5.2, 3.6, 3.7, 3.9, 4.1, 4.4, 4.5, 4.6, 4.6.2, Chapter 5, Section 5.1, 5.2, 5.2.1, 5.3, 5.3.1, 5.3.5, 5.4.2, 5.6.2, 5.11.6, 6.1.3, 6.2.6 Deletion Section 2.1, 6.1.6

INTRODUCTION

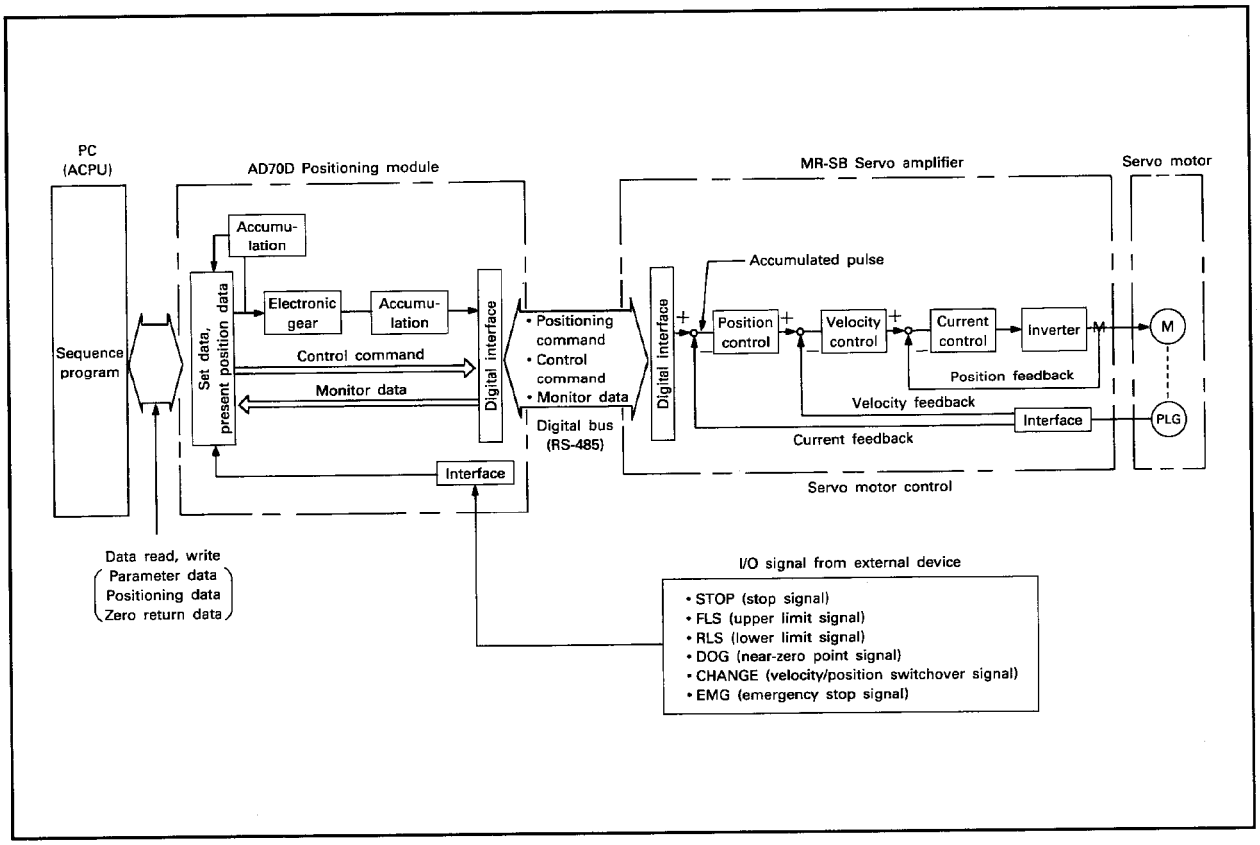
Thank you for choosing the Mitsubishi MELSEC-A Series of General Purpose Programmable Controllers. Please read this manual carefully so that the equipment is used to its optimum. A copy of this manual should be forwarded to the end User.

CONTENTS

1. INTRODUCTION

The AD70D (referred to as AD70D) is a single axis positioning control module for use with the MELSEC A series of programmable controllers. This manual gives the specifications, handling, and programming information for the AD70D.
The AD70D can be connected to the MR-SB servo amplifier (referred to as MR-SB) via a digital bus (RS-485) for high-speed, high accuracy positioning control.
If machine positions are set when starting up the system using absolute position specification servo amplifier and servo motor (MR-SB ⬚ -Z, HA-SA ⬚ -Z), zero return execution is unnecessary because the absolute position of the axis is detected when the power supply is turned ON.
The following can be performed using the A6GPP/A6PHP (SW ⬚ GP-AD70DP).

1) Positioning monitor
2) Servo data monitor such as the motor speed and current
3) Torque trace
4) Servo diagnosis such as high-speed position loop gain check
5) Servo start up check
6) Fixed, servo, and zero return parameter settings
7) JOG operation



IB (NA) 66265-A

POINT

(1) This manual is written for the AD70D module whose software version is G or later.

The MR-SB-K can be connected as the servo amplifier for the AD70D whose software version is G or later. Use SW2GP-AD70DP as the parameter setting software package.

(2) When operating the MR-SB-K using SW1GP-AD70DP with the AD70D whose software version is G or later, set all the following parameters in a sequence program

[Parameter name] [Reference section]

- **Fixed parameters**
- **Servo parameters** } **Section 5.2.3**
- **Variable parameters**
- **Zero return parameters** ··· **Section 5.3.4**

1.1 Features

(1) The servo amplifier is connected to the AD70D via a digital bus (RS-485).
- A command velocity of up to 1MMPS is possible.
- A maximum interval of 30 m (98.43 ft) between the AD70D and the servo amplifier is possible.
- The servo amplifier and AD70D are data linked, allowing control parameters to be sent and servo self-diagnosis results to be received.

(2) Applicability to absolute system
- By using servo amplifier and servo motor products with absolute position specification, if zero return operation is executed after setting up the system and the absolute position is set, then operation is possible without executing zero return operation thereafter when power is applied.

(3) All set data and commands can be set from the sequence program.

(4) Three types of operations are possible: position control, velocity control, and velocity/position control.

(5) Built-in electronic gear function
- Since an electronic gear function is built-in, selecting an encoder to match the mechanical system is unnecessary, permitting the axis travel distance per pulse to be freely adjusted.

(6) By using a peripheral device A6GPP/A6PHP (SW□GP-AD70DP), torque trace, servo diagnosis (velocity loop, position loop gain check), monitor, and parameter settings are possible.

When using the AD70D, refer to the following manuals as required.
SW□GP-AD70DP Operating Manual
□CPU User's Manual
MR-SB Servo Amplifier Operation Manual

Be sure that the following items are included in the package.

Item	Quantity
AD70D positioning module	1
9-pin connector for external wiring (pin type) 17JE-23090-02-D8A	1

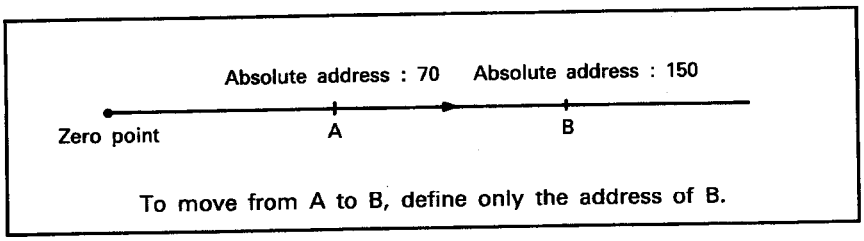
POINT

In this manual, AD70D I/O numbers assigned from the PC CPU assume that the AD70D is loaded in slot 0.

1.2 Glossary of Terms

(1) Absolute mode

In absolute mode positioning, each position has its own address and is reached with reference to a zero point address.

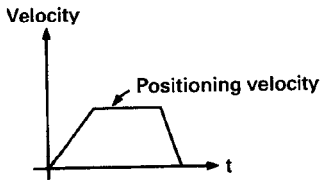


(2) Positioning mode

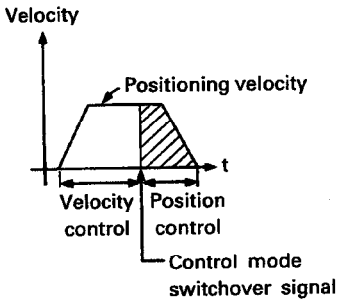
There are 2 positioning control modes.

Positioning mode

- Position control mode:
  Positioning to specified addresses using positioning data is executed in the incremental or absolute mode.



- Velocity/position control switchover mode:
  Starts operation at positioning velocity specified by positioning data, and switches to positioning control when the control switchover signal is input from an external device.



(3) Position loop gain

(a) Position loop gain indicates the control responsiveness during the position control mode. It is related to the number of accumulated pulses in the error counter during operation and STOP operation.
The number of accumulated pulses is calculated using the following formula:

$$\varepsilon = \frac{f}{kp}$$

ε : Accumulated pulses
f : Command pulse frequency (pps)
kp : Position loop gain (rad/sec)

1) When the position loop gain is low, the number of accumulated pulses increases elongating the stabilizing period when the axis stops.
2) If the position loop gain is too high, the overshoot occurring when the axis stops will be excessively large. While an axis is stopped, it has a tendency to vibrate.

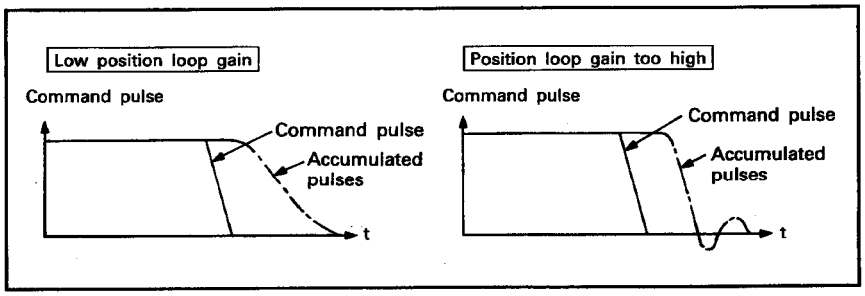


Fig. 1.1 Stop Mode Varies According to Position Loop Gain

(b) Reference values for setting the position loop gain are shown below.

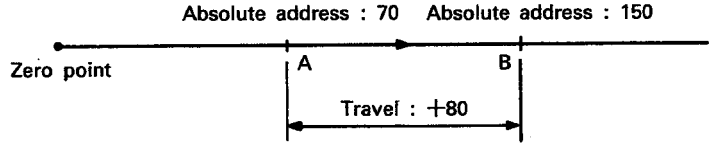
Load inertia ratio (GD_L^2/GD_H^2)		0	1	3	5	Description
Set value (rad/sec)	Standard	35	35	25	15	Setting range: 1 to 999
	Maximum	100	80	40	25	

POINT

If the position loop gain is too low, the number of accumulated pulses in the error counter increases resulting in a servo error (excessive position error: error code 2052) during high-speed operation.

(4) Incremental mode

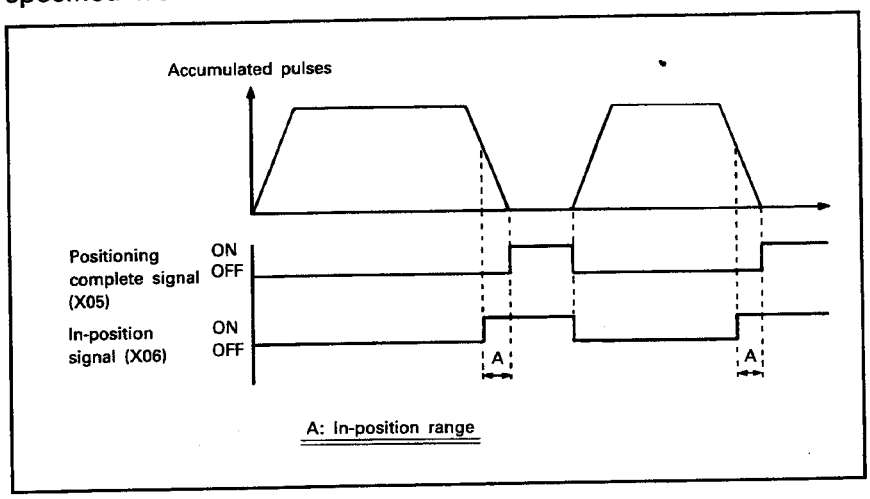
In incremental mode positioning, positions are reached with reference to the previous position.



To move from A to B, define movement in a direction for a specified distance (80).

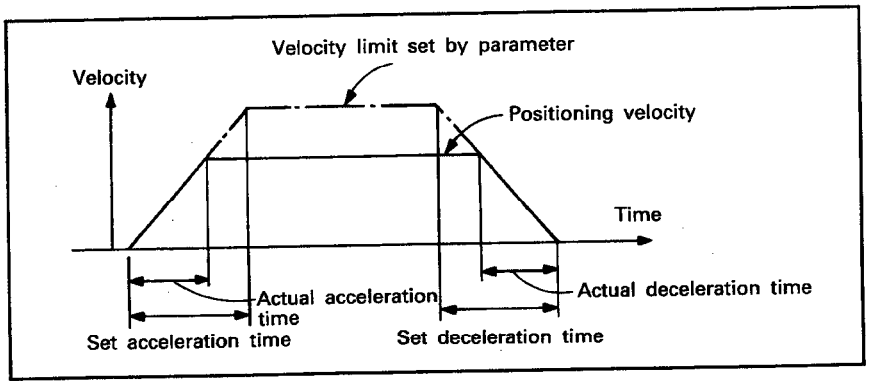
(5) In-position signal

Switches on when the deviation counter pulse value is within the specified range from the target position. The range may be specified from 1 to ±9999.



(6) Acceleration/deceleration time

The time from the start of operation until the velocity limit specified by a parameter is reached is the acceleration time, and the time from the velocity limit to stop is the deceleration time.



Acceleration/Deceleration Time

Acceleration and deceleration time in the AD70D can be set independently.
If the set positioning velocity value is faster than the velocity limit set by a parameter, the acceleration/deceleration time becomes comparatively shorter.
Therefore, set the maximum value of the positioning velocity equal to or approximating the velocity limit set by a parameter. This velocity is valid for zero return, positioning, JOG, and STOP operations.

(7) Creep velocity

This is the low velocity used to approach the zero point position. Motor speed is decelerated from zero return velocity to creep velocity when the near-zero point signal is turned ON.

(8) Jog operation

The drive for the given axis is operated for as long as the jog input is on. Axis feed operation is position is possible while confirming the present position in reference to the target position.

(9) Upper / lower stroke limit

Define the limit values of machine travel.
The upper and lower limits are set independently.

(10) Absolute system

The absolute system monitors and updates the machine absolute position regardless of whether the power supply is turned ON or OFF. Since the machine coordinate system is automatically preset without executing zero return operation after re-application of power, automatic operation is immediately enabled.

(11) Velocity limit

This value controls the maximum velocity for positioning, zero return, and JOG operations.
If the positioning velocity, zero return velocity, and JOG velocity are set at a value greater than the velocity limit, operation will be executed at the velocity limit.

(12) Velocity loop gain

(a) Velocity loop gain indicates the control responsiveness during the velocity control mode.
Increase the velocity loop gain if the velocity loop gain becomes too low, deteriorating responsiveness as the load inertia ratio (GD_L^2/GD_H^2) increases.

(b) Reference values for setting the velocity loop gain are shown below.

Load inertia ratio (GD_L^2/GD_H^2)		0	1	3	5	Description
Set value	Standard	100	100	200	300	Setting range: 1 to 999.
	Low inertia, flat type	30	30	60	100	

POINT

If the velocity loop gain setting is too high, overshoot becomes excessive and a vibration (motor noise) is generated while an axis is stopping.

(13) Velocity integration compensation

(a) Use this parameter to improve the transient characteristics by increasing the frequency response during velocity control.

(b) If overshoot cannot be reduced during acceleration or deceleration after adjusting the velocity loop gain, increase the velocity integration compensation setting.

(c) Reference values for the velocity loop gain setting are shown below.

Load inertia ratio (GD_L^2/GD_H^2)	0	1	3	5	Description
Set value (msec)	20	20	30	40	Setting range: 1 to 999.

(14) Electronic gear

By multiplying the AD70D command pulse outputs, machine travel distance per command pulse can be changed freely. (Refer to Section 5.2.1 for details.)

(15) Feedback pulse

Pulse chain proportional to the angular increments of the motor generated by an encoder and fed to the AD70D.

(16) Deviation counter

A deviation counter is a increment/decrement counter and counts the difference between the number of command pulses and the number of feedback pulses. The difference between the number of command pulses and the number of feedback pulses is retained as accumulated pulses in the deviation counter.
The number of accumulated pulses in the deviation counter is reset to 0 (zero) when positioning is completed.

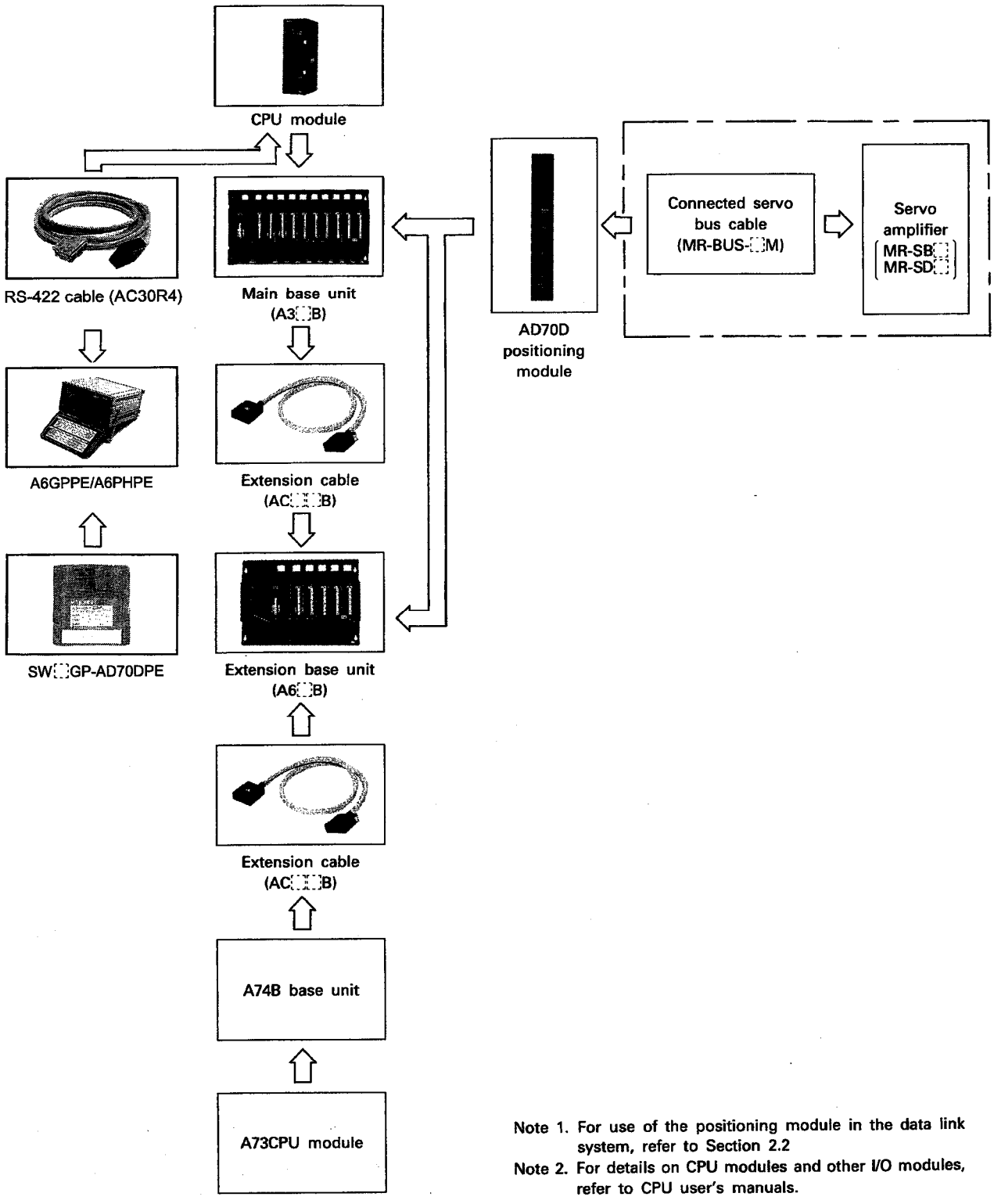
2. SYSTEM CONFIGURATION

This chapter explains the system configuration where the AD70D and A series CPU module can be combined.

2.1 Overall Configuration

Fig. 2.1 and Fig. 2.2 show the overall configuration of the AD70D and A series CPU module.

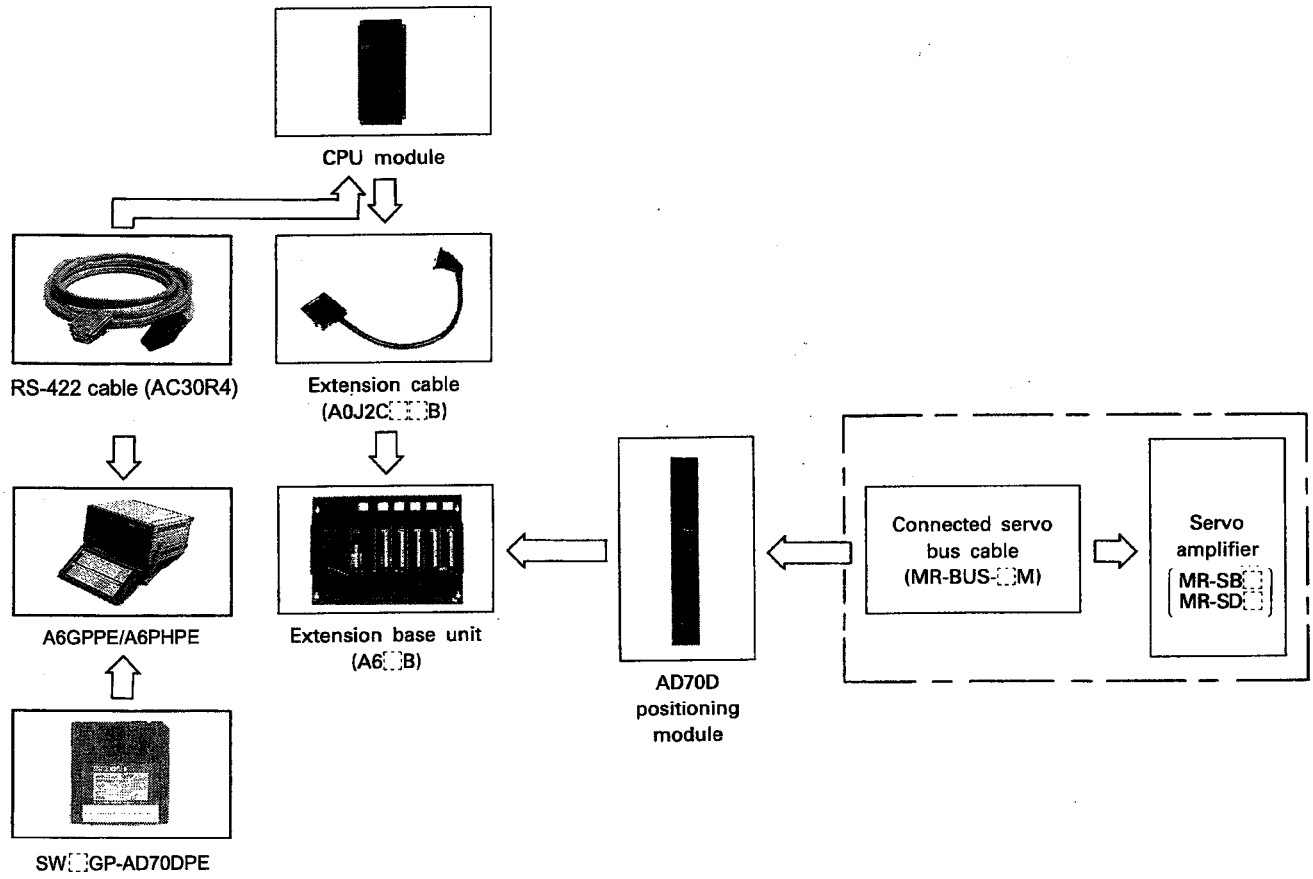
(1) Building block type CPU



Note 1. For use of the positioning module in the data link system, refer to Section 2.2
Note 2. For details on CPU modules and other I/O modules, refer to CPU user's manuals.

Fig. 2.1 Overall Configuration Using Building Block Type CPU

(2) Compact type CPU



Note 1. For use of the positioning module in the data link system, refer to Section 2.2
Note 2. For details on CPU modules and other I/O modules, refer to CPU user's manuals.

Fig. 2.2 Overall Configuration Using Compact Type CPU

2.2 Applicable Systems

The AD70D can be used with the following CPUs.

Applicable model		
A0J2(H)CPU	A52GCPU	A73CPU
A1SJ(H)CPU	A3NCPU	A81CPU
A1S(H)CPU	A3HCPU	A1CPU
A1SCPUC24-R2	A3MCPU	A2CPU
A2S(H)CPU	A2ACPU	A2CPU-S1
A2ASCPU(S1)	A2ACPU-S1	A3CPU
A2USHCPU(S1)	A3ACPU	Q2ACPU
Q2AS(H)CPU	A2UCPU	Q2ACPU-S
A1NCPU	A2UCPU-S1	Q3ACPU
A2NCPU	A3UCPU	Q4ACPU
A2NCPU-S1		

Except for the following, the AD70D can be loaded into any main base and extension base unit slot.

(1) Do not use the AD70D in an extension base which does not include a power supply (i.e. A5 extension base). (Since 5VDC current consumption is large)

(2) In a data link system, the AD70D can be loaded into any of the master, local and remote I/O stations.

POINT

(1) The AD70D cannot be loaded into the A0J2P25/R25 (remote I/O station).

(3) When using the AD70D module with the A0J2(H)CPU, A1SJ(H)CPU, A1S(H)CPU(C24-R2), A2S(H)CPU, A2ASCPU(S1), A2USHCPU(S1), Q2AS(H)CPU, A52GCPU or A73CPU, load the AD70D module into the extension base unit. (A65B, A68B).
For connection and setting of the A0J2(H)CPU, A1SJ(H)CPU, A1S(H)CPU(C24-R2), A2S(H)CPU, A2ASCPU(S1), A2USHCPU(S1), Q2AS(H)CPU, A52GCPU, A0J2 I/O modules and A65B base unit, refer to the A0J2(H)CPU, A1SJ(H)CPU, A1S(H)CPU(C24-R2), A2S(H)CPU, A2ASCPU(S1), A2USHCPU(S1), Q2AS(H)CPU and A52GCPU User's Manuals.
The AD70D cannot be loaded into the main base unit of the A73CPU.
The AD70D is not allowed to perform simultaneous start or interpolation operation with the PCPU control axis of the A73CPU.

(4) The AD70D cannot be loaded into the last slot of the 7th extension stage of the A3CPU.

3. SPECIFICATIONS

3.1 General Specifications

Table 3.1 General Specifications

Item	Specifications				
Operating ambient temperature	0 to 55°C				
Storage ambient temperature	−20 to 75°C				
Operating ambient humidity	10 to 90% RH, non-condensing				
Storage ambient humidity	10 to 90% RH, non-condensing				
Vibration resistance	Conforms to *JIS C 0911	Frequency	Acceleration	Amplitude	Sweep Count
		10 to 55 Hz	—	0.075 mm (0.003 in)	10 times *(1 octave/minute)
		55 to 150 Hz	1G	—	
Shock resistance	Conforms to JIS C 0912 (10 g × 3 times in 3 directions)				
Noise durability	By noise simulator of 1500 Vpp noise voltage, 1 μs noise width and 25 to 60 Hz noise frequency				
Dielectric withstand voltage	500 VAC for 1 minute across DC external terminals and ground				
Insulation ambience	5 MΩ or larger by 500 VDC insulation resistance tester across AC external terminals and ground				
Operating ambience	Free of corrosive gases. Dust should be minimal.				
Cooling method	Self-cooling				

3

REMARK

One octave marked * indicates a change from the initial frequency to double or half frequency.
For example any of the changes from 10 Hz to 20 Hz, from 20 Hz to 40 Hz, from 40 Hz to 20 Hz, and 20 Hz to 10 Hz are referred to as one octave.

Note: *JIS: Japanese Industrial Standard

3.2 Performances and Specifications

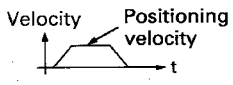
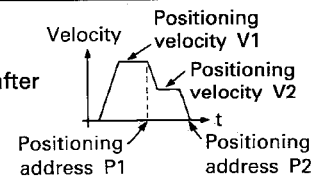
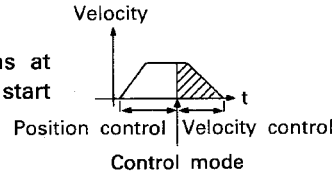
Table 3.2 Performances and Specifications

Item			Performances and Specifications
Number of I/O points			32 points (number of occupied slots: 1)
Number of control axes			1
Positioning data	Capacity		1 data (Two-phase trapezoidal control possible)
	Setting method		Using sequence program
RAM memory back-up			Unavailable (Absolute system standard positions are stored in NOV-RAM.)*
Absolute system			Possible by connecting the absolute system servo amplifier and servo motor
Positioning	Mode		Position control mode Velocity/position control switchover mode } Can be selected
	Method		Absolute and/or incremental method
	Positioning units	Other than the absolute system	−2147483648 to 2147483647 (PULSE)
		Absolute system	−196596000 to 196596000 (PULSE) (when $\frac{CMX}{CDV}=1$)
	Positioning speed		1 to 1000000 (PLS/sec)
	Acceleration and deceleration		Automatic trapezoidal acceleration and deceleration
	Acceleration and deceleration times		Acceleration: 4 to 9999 (msec) Deceleration: 4 to 9999 (msec)
	In-position range		1 to 9999 PLS
	Backlash compensation		Not provided
	Error compensation		Not provided
Zeroing			• With zero address change function Provided with the zero point address change function • With other than the absolute system: Near-zero point dog/count selectable • With the absolute system: Data set/near-zero point dog/count selectable Zero return direction and method are set with switches.
Torque limit function			Provided
Servo OFF function			Provided (Servo lock is released to set the motor to free run state.)
Jog operation function			Provided
M function			Not provided
Internal current consumption			5 VDC 0.8 A
Size (mm)			250 (H) × 37.5 (W) ×121 (D)
Weight (kg)			0.5

* NOV-RAM: Non-volatile CMOS STATIC RAM (battery backed up RAM)

3.3 Functions

Table 3.3 AD70D Positioning Control Functions

Function			Description	Remarks (reference)
Positioning operation	Position control mode	One-phase trapezoidal positioning	Moves from the current position to the set position at set velocity. 	5.4
		Two-phase trapezoidal positioning	Moves consecutively to a series of positions after receiving a single start signal. 	5.5
	Velocity/position control switchover mode (velocity control operation)		Moves consecutively to a series of positions at different velocities after receiving a single start signal. 	5.6
JOG operation (velocity control operation)			The drive for the given axis is operated for as long as the jog input is on. By turning this signal ON, operation is started at the set velocity and velocity control operation can continue until the STOP signal is turned ON.	5.8
Zero return			Returns the drive to a defined start position and refers the zero address to that position. Zero return operation may be executed by the near-zero point signal, in the count mode, or, when using the absolute system, in the data set mode.	5.3
Control change	Velocity change		The velocity can be forcedly changed during positioning or JOG operation from the sequence program.	5.9
	Present value change		The present value can be changed from the sequence program when not BUSY.	
	Axis travel distance change		The positioning address (axis travel distance) can be changed from the sequence program prior to control switchover signal input when positioning is executed in the velocity/position switchover control.	
	Servo parameter change		Position and velocity loop gain can be changed from the sequence program at PC ready or servo ready ON.	
	Torque control value change		The torque limit can be changed from the sequence program during positioning or JOG operations.	
Electronic gear			The axis travel distance and velocity can be controlled by multiplying the AD70D command outputs.	5.2
In-position			When the accumulated pulses in the error counter are within an in-position setting range of 1 to 9999 pulses, the in-position signal is turned ON. The in-position signal can be used as the signal just prior to the completion of AD70D positioning.	1.2
Torque control			Limits the servo motor's torque. When the torque required for control in positioning and JOG operations exceeds the limit value, control will be executed at the set torque limit.	5.2
Follow up			When the servo motor's servolock is released and the motor goes to the free run condition, the motor travel distance during servo OFF will be added to the feed present value.	—
Absolute system			Monitors and updates the machine absolute position regardless of whether the power supply is turned ON or OFF. Since the machine coordinate system is automatically preset without executing zero return operation after re-application of power, automatic operation is immediately enabled.	3.9

3.4 AD70D Interfaces

Fig. 3.1 shows the outline of signal transfer between the AD70, PLC CPU and units connected to the servo amplifier.

- Communication between PC CPU and AD70D
  Control signals and data communication are transferred via base units.
  Control signals: I/O signals given in Section 3.8.
  Data: Set data given in Section 3.6.
  Written to and read from the AD70D buffer memory using PC CPU application instructions.
- Communication between servo amplifier and AD70D
  Control signals for the servo amplifier are transferred via the MR-BUS.

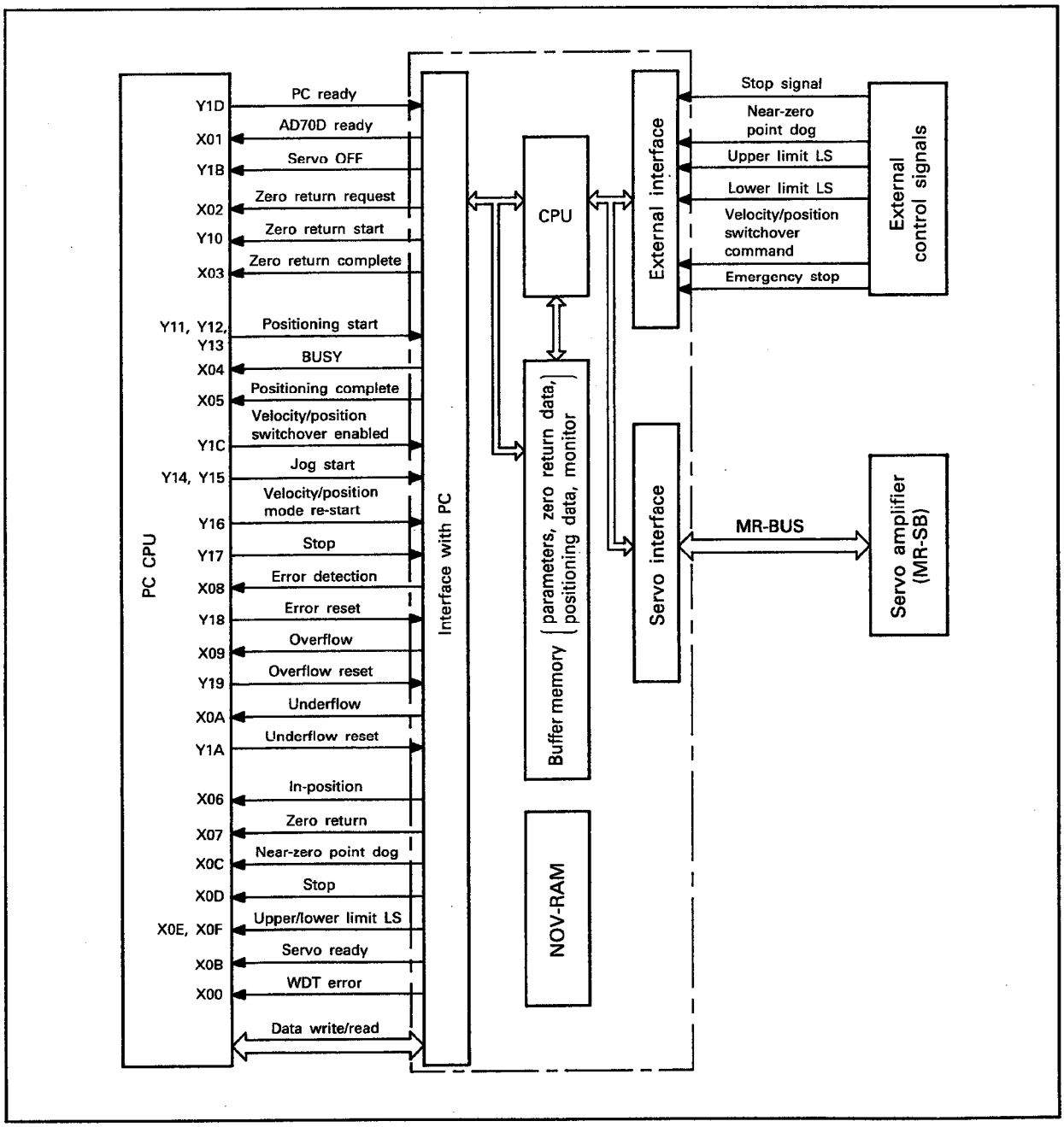


Fig. 3.1 AD70D Functions Block Diagram

3.5 Interface with External Equipment

3.5.1 AD70D electrical specifications

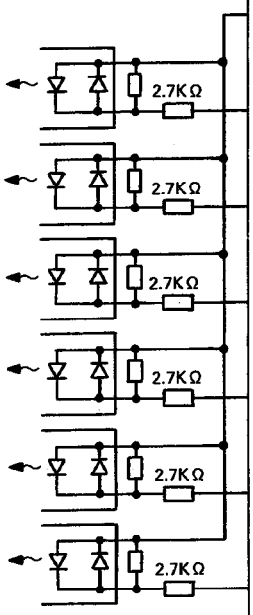
Table 3.4 shows the electrical specifications for AD70D I/O signals.

Table 3.4 AD70D Electrical Specifications

I/O	Signal		Description
Input	Supply	Common Inputs	5 to 24 VDC (Use a 4.75 to 26.4 V stabilized power supply.) Current consumption: 60 mA max. (10 mA per point)
	Stop signal (STOP) Near-zero point signal (DOG) Upper limit ($\overline{\text{FLS}}$) Lower limit ($\overline{\text{RLS}}$) Velocity/position switchover command (CHANGE) Emergency stop ($\overline{\text{EMG}}$)		HIGH (External contact OFF) : (Supply power voltage −1 V) min. (Input current: 0.3 mA max.) LOW (External contact ON) : (Supply power voltage −3 V) min. (Input current: 2.5 mA min.)
Output	——		——

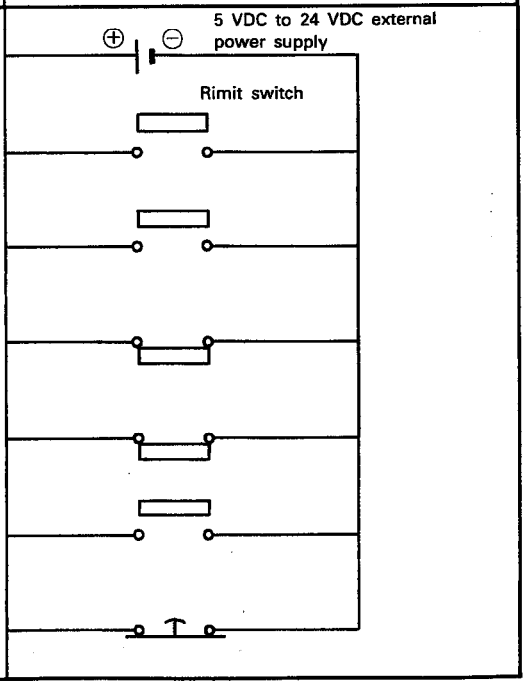
3.5.2 I/O interface with external device and AD70D

Table 3.5 Specifications of the I/O Interface with External Device and AD70D

Connector	I/O	Internal Circuit	Pin Signal	Signal	Description
CONT	Input		5	Power supply	5 VDC to 24 VDC
			1	Near-zero point signal DOG	Used to detect the "near-zero point" during zero return operation. The signal is turned on when near-zero point dog is detected.
			9	Stop signal STOP	Low to stop positioning. Signal duration should be longer than 20 msec.
			7	Upper limit LS $\overline{\text{FLS}}$	Upper stroke limit switch. Positioning stops when OFF. *1
			6	Lower limit LS $\overline{\text{RLS}}$	Lower stroke limit switch. Positioning stops when OFF. *1
			8	Velocity/position switchover command $\overline{\text{CHANGE}}$	Used as the control switchover command in the velocity/position control switchover mode.
			2	Emergency stop $\overline{\text{EMG}}$	Outputs an emergency stop command to the servo amplifier. Emergency stop when OFF.
SERVO	S bus		—	—	Used for communication with servo amplifier.

*1 Leave ON when not using FLS or RLS.

[Connection example]

Signal	Pin Signal	External Equipment
Power supply	5	
Near-zero point signal DOG	1	
Stop signal STOP	9	
Upper limit LS $\overline{\text{FLS}}$	7	
Lower limit LS $\overline{\text{RLS}}$	6	
Velocity/position switchover command $\overline{\text{CHANGE}}$	8	
Emergency stop $\overline{\text{EMG}}$	2	

3.6 Set Data

The following three blocks of data are required for positioning using the AD70D and are set from the sequence program.

- Set data
  - Parameters
    - Fixed parameters
    - Servo parameters
    - Variable parameters
  - Zero return data
  - Positioning data

Table 3.6 Set Data (Continue)

Data No.	Item			Setting Range	Default	Reference
Parameter / Servo parameters	1	Upper stroke limit		−2147483648 to 2147483647 PLS	2147483647 PLS	5.2
	2	Lower stroke limit		−2147483648 to 2147483647 PLS	0 PLS	
	3	Electronic gear	Command pulse multiplication ratio numerator (CMX)	1 to 9999	1	
	4		Command pulse multiplication ratio denominator (CDV)	1 to 9999 But $\frac{1}{50} \leqq \frac{CMX}{CDV} \leqq 50$	1	
Parameter / Fixed parameters	1	System setting		0: MR-SB (Standard) 1: MR-SB (Absolute system) 2: MR-SD/MR-SB-K (Standard) 3: MR-SD/MR-SD-K (Absolute system)	0	
	2	Regenerative resistance	When MR-SB/SD is used	0: None 3: RB100,101 1: RB30 4: RB082 2: RB50, 51 5: RB32	0	
			When MR-SB-K is used	0: When no regenerative resistance is provided or accessory regenerative resistance is connected externally (Dynamic brake: Not provided) 6: When accessory regenerative resistance is provided and cooling fan is used (Dynamic brake: Not provided) 9: When power regeneration converter (FR-RC) is used (Dynamic brake: Not provided) 10: When no regenerative resistance is provided or accessory regenerative resistance is connected externally (Dynamic brake: Provided) 16: When accessory regenerative resistance is provided and cooling fan is used (Dynamic brake: Provided) 19: When power regeneration converter (FR-RC) is used (Dynamic brake: Provided)		

Table 3.6 Set Data

Data No.	Item			Setting Range	Default	Reference
Parameter	Fixed parameters	3	Motor type	0: Standard SA 1: Low inertia L 2: Flat U 3: Standard SC	0	5.2
		4	Motor capacity	Set the motor output capacity (Kw) to 10 times (Example) 1.5 kw → 15	0	
		5	Motor rpm	2: 2000 rpm 3: 3000 rpm	2	
		6	Position loop gain	1 to 999 rad/sec	25 rad/sec	
		7	Velocity loop gain	1 to 9999	100	
		8	Velocity integration compensation	1 to 9999 ms	20 ms	
		9	In-position range	1 to 9999 PLS	100 PLS	
		10	Number of feedback pulses per motor rotation	12000 PLS fixed	12000 PLS	
		11	Rotation direction	0: Counterclockwise by addresses increasing 1: Clockwise by addresses increasing	0	
		12	Torque limit	1 to 500%	300%	
	Variable parameters	1	Velocity control value	10 to 1000000 PLS/sec (Set in units of 10 PLS/sec)	200000 PLS/sec	5.2
		2	Acceleration time	4 to 9999 ms	300 ms	
		3	Deceleration time	4 to 9999 ms	300 ms	
		4	Positioning mode	0: Positioning mode 1: Velocity/position control switchover mode	0	
Zero return data *1		1	Zero address	−2147483648 to 2147483647 PLS	0 PLS	5.3
		2	Zero return velocity	1 to 1000000 PLS/sec	10000 PLS/sec	
		3	Creep velocity	1 to 1000000 PLS/sec	1000 PLS/sec	
		4	Axis travel distance setting after turning near-zero point signal ON	0 to 2147483647 PLS *2	75 PLS	

Table 3.6 Set Data

Data No.		Item	Setting Range	Default	Reference
Positioning data	1	Positioning pattern	0: One-phase trapezoidal positioning 1: Two-phase trapezoidal positioning	0	5.4 5.5
	2	Positioning address P1 (Axis travel distance in the velocity/position control switchover mode or in the incremental mode)	−2147483648 to 2147483647 PLS (0 to 2147483647 in the velocity/position control switchover or in the incremental mode *2)	0 PLS	
	3	Positioning velocity V1	1 to 1000000 PLS/sec	0 PLS/sec	
	4	Positioning address P2 (Axis travel distance in the velocity/position control switchover or in the incremental mode	−2147483648 to 2147483647 PLS (0 to 2147483647 in the velocity/position control switchover or in the incremental mode *2)	0 PLS	
	5	Positioning velocity V2	1 to 1000000 PLS/sec	0 PLS/sec	

*1 Some data items in zero return data are set using slide switches.
1. Zero return direction
2. Zero return mode
Refer to Section 4.5 for details.

*2 0 to 196596000 PLS when using the absolute system.

POINT

Command positions (operation range) when using the absolute system are −196596000 to +196596000 (when $\frac{CMX}{CDV} = 1$).
The present position value cannot be restored when the power supply is turned on if a value outside the range indicated above is set.

3.7 Buffer Memory

The AD70D has a buffer memory (not battery backed) for communication of data with the PC CPU. Data shown in Fig. 3.2 is stored in the buffer memory and used by the AD70D to execute positioning.
Data shown in Fig. 3.2 is read and written as follows.

Buffer memory data read
Buffer memory addresses are specified by access commands in the sequence program's buffer memory and can be read directly any time in units of 1 word (16 bits) or 2 words.

Buffer memory data write
The writing of data may be restricted depending on the state of the AD70D.

General conditions for writing are shown in Fig. 3.2. For further details, refer to Section 5.2 to 5.12.
Buffer memory addresses are specified by access commands in the sequence program's buffer memory and can be written directly in units of 1 word (16 bits) or 2 words.

			Address (Decimal)	Read	Write	Write Condition	Reference
Fixed parameters	Upper stroke limit		1, 0	○	○	Y1D is OFF.	Section 5.2
	Lower stroke limit		3, 2				
	Electronic gear	Command pulse multiplication ratio numerator	4				
		Command pulse multiplication ratio denominator	5				
Servo parameters	System setting		10	○	○	Y1D is OFF.	Section 5.2
	Regenerative resistance		11				
	Motor type		12				
	Motor capacity		13				
	Motor rotations		14				
	Position loop gain		15				
	Velocity loop gain		16				
	Velocity integration compensation		17				
	In-position range		18				
	Number of feedback pulses per motor rotation		19				
	Rotation direction		20				
	Torque limit		21				
Variable parameters	Velocity limit		41, 40	○	○		Section 5.2
	Acceleration time		42				
	Deceleration time		43				
	Positioning mode		44				

Fig. 3.2 Buffer Memory Map (Continue)

		Address (Decimal)	Read	Write	Write Condition	Refer-ence
Zero return data	Zero address	31, 30	○	○	Y1D is OFF.	Section 5.3
	Zero return velocity	33, 32				
	Creep velocity	35, 34				
	Axis travel distance setting after turning near-zero point signal ON	37, 36				
Positioning data	Positioning pattern	60	○	○		Section 5.4 5.5
	Positioning address P1	62, 61				
	Positioning velocity V1	64, 63				
	Positioning address P2	66, 65				
	Positioning velocity V2	68, 67				
Control change area	Present value change area	81, 80	○	○		Section 5.9
	Velocity change area	83, 82				
	JOG velocity area	85, 84				
	Velocity/position axis travel distance change area	87, 86				
	Servo parameter change area	88				
	Torque limit change area	89				
Monitor area	Feed present position value	101, 100	○	×		Section 5.11
	Actual present position value	103, 102				
	Error counter value	105, 104				
	Axis travel distance after near-zero point signal is turned ON	107, 106				
	Zero return correction travel distance	109, 108				
	Motor rpm	110				
	Motor current	111				
	Regenerative level	112				
	Maximum torque	113				
	— Amplifier version	114				
	—	115				
	—	116				
	—	117				
	Velocity/position switchover command	118				
	Velocity operation in progress	119				
	Torque control in progress	120				
	Error code (minor)	121				
	Error code (major)	122				
	Servo error code	123				
	Emergency stop	124				
	Test mode in progress	125				
	Slide switch setting	126				

Fig. 3.2 Buffer Memory Map

POINT

During the various processes of the special function module, the access from the PLC CPU is processed as a priority. Thus, if the special function module's buffer memory is frequently accessed from the PLC CPU, the PLC CPU scan time will increase and a delay will occur in the special function module's processes.Access the buffer memory from the PLC CPU with the FROM/TO command, etc., only when necessary.

3.8 I/O Signals To and From PC CPU

The AD70D uses 16 inputs and outputs for non-numerical communications with the PC CPU.
I/O signal assignment and functions are given below.
Table 3.7 shows I/O signals with the AD70D loaded in slot 0 of the main base unit.
Device X indicates an input signal from the AD70D to the PC CPU.
Device Y indicates an output signal from the PC CPU to the AD70D.

Table 3.7 I/O Signal List

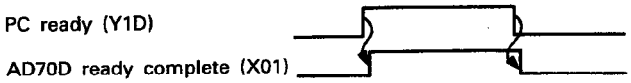
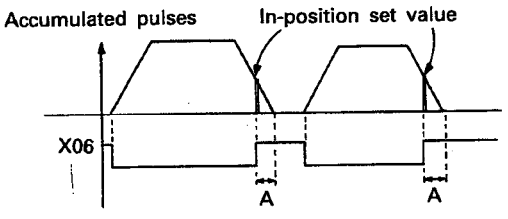
Signal Direction: AD70D to PC CPU		Signal Direction: PC CPU to AD70D	
Device No.	Signal	Device No.	Signal
X00	WDT error	Y00 to Y0C	Reserved for use by the OS
X01	AD70D ready complete		
X02	Zero return request		
X03	Zero return completion		
X04	BUSY		
X05	Positioning complete		
X06	In-position		
X07	Zero return		
X08	Error detection		
X09	Overflow		
X0A	Underflow		
X0B	Servo ready		
X0C	Near-zero point dog		
X0D	Stop (external stop signal)	Y0D to Y0F	Used when AD70D is used in a remote I/O station and when executing data link using RFRP and RTOP instructions
X0E	Upper limit LS		
X0F	Lower limit LS		
X10 to X1C	Reserved (ON when X10 to X1F are monitored.)	Y10	Zero return start
		Y11	Absolute positioning start
		Y12	Forward start (in the incremental mode and velocity/position control switchover mode)
		Y13	Reverse start (in the incremental mode and velocity/position control switchover mode)
		Y14	Forward JOG start
		Y15	Reverse JOG start
		Y16	Velocity/position mode re-start
		Y17	Stop
		Y18	Error reset
		Y19	Overflow reset
		Y1A	Underflow reset
		Y1B	Servo OFF
		Y1C	Velocity/position switchover enabled
X1D to X1F	• Used only when AD70D is used in a remote I/O station. • Interlock signal for RFRP and RTOP instructions	Y1D	PC ready
		Y1E to Y1F	Reserved for use by the OS

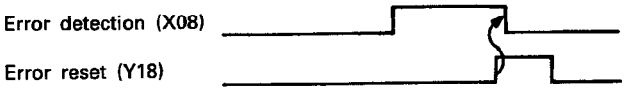
IMPORTANT

X10 to X1F and Y00 to Y0F, Y1E, and Y1F are reserved for use by the OS.
If the above devices are switched ON/OFF from the sequence program, AD70D normal functions cannot be guaranteed.
Y0D to Y0F must be switched OFF from the user program only when the AD70D is loaded into a remote I/O station. Refer to Section 5.12 for details.

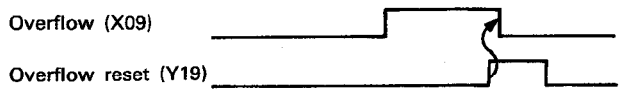
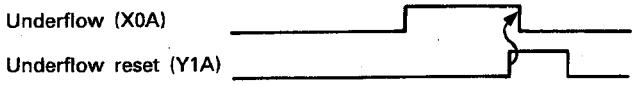
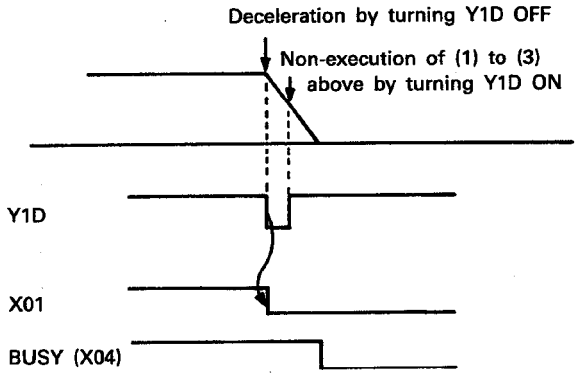
I/O signal details

I/O signal ON/OFF timing and conditions will be explained.
For details on timing, refer to Section 5.3.4, 5.4.4, and 5.8.4.

Data No.	Item	Description
X00	WDT error	Turns ON when the AD70D self-diagnosis detects a WDT error, at which time, the servo motor immediately stops.
X01	AD70D ready complete	• Checks the fixed parameters and servo parameters and turns ON the AD70D ready complete signal (X01) when the PC ready (Y1D) is switched ON from the sequence program. • X01 goes OFF when Y1D is switched OFF. Used for interlocking, etc. in the sequence program. 
X02	Zero return request	Not in absolute system Turns ON in the following cases and OFF when zero return operation is complete. 1) At re-start of the AD70D and PC reset 2) During zero return operation With absolute system Turns ON in the following cases and OFF when zero return operation is complete. 1) At servo battery error 2) During zero return operation 3) When the PC ready is turned ON and at back up data sum check error
X03	Zero return complete	• Turns ON to indicate completion of zero return operation. Does not turn ON if an axis stops during zero return operation. • Turns OFF at JOG start and positioning start. • Turns OFF at zero return start in the count and data set modes.
X04	BUSY	• Turns ON at positioning start, JOG start, and zero return start. • Turns OFF at command output complete. A start while BUSY is ON results in an error.
X05	Positioning complete	• Turns ON at positioning start, JOG start, and zero return start (command output complete). Turns OFF at the next start (positioning, zero return, JOG). • If positioning is stopped midway, the positioning complete signal does not turn ON.
X06	In-position	Turns ON when the accumulated pulses in the error counter become less than the set value of the in-position range set in servo parameters, and is turned OFF at each start. In-position check is executed as follows. 1) After start of deceleration 2) At zero return operation and after the near-zero point signal is turned ON  A: In-position range

Data No.	Item	Description
X07	Zero point passing	Turns ON when the encoder's zero point (phase Z) is passed even once. (Only when not using the absolute system) Turns OFF when the power supply is turned OFF.
X08	Error detection	Sets the corresponding error code and turns X08 ON by major error, minor error, or servo error. Turns OFF when the error reset signal (Y18) is turned ON. 
X09	Overflow	• Turns ON when the present value exceeds 2147483647 by JOG operation (velocity control operation). • Turns OFF by when overflow reset is turned ON. • The present value 2147483647 becomes -2147483648 to 0.
X0A	Underflow	• Turns ON when the present value exceeds -2147483648 in the minus direction by JOG operation (velocity control operation). • Turns OFF when underflow reset is turned ON. • The present value -2147483648 becomes 2147483647 to 0.
X0B	Servo ready	Indicates the connected servo's ready state.
X0C	Near-zero point dog	Indicates the ON/OFF state of the external near-zero point dog signal (DOG).
X0D	Stop	Indicates the ON/OFF state of the external stop signal (STOP).
X0E	Upper limit LS	Indicates the ON/OFF state of the external upper limit LS signal (FLS).
X0F	Lower limit LS	Indicates the ON/OFF state of the external lower limit LS signal (RLS).

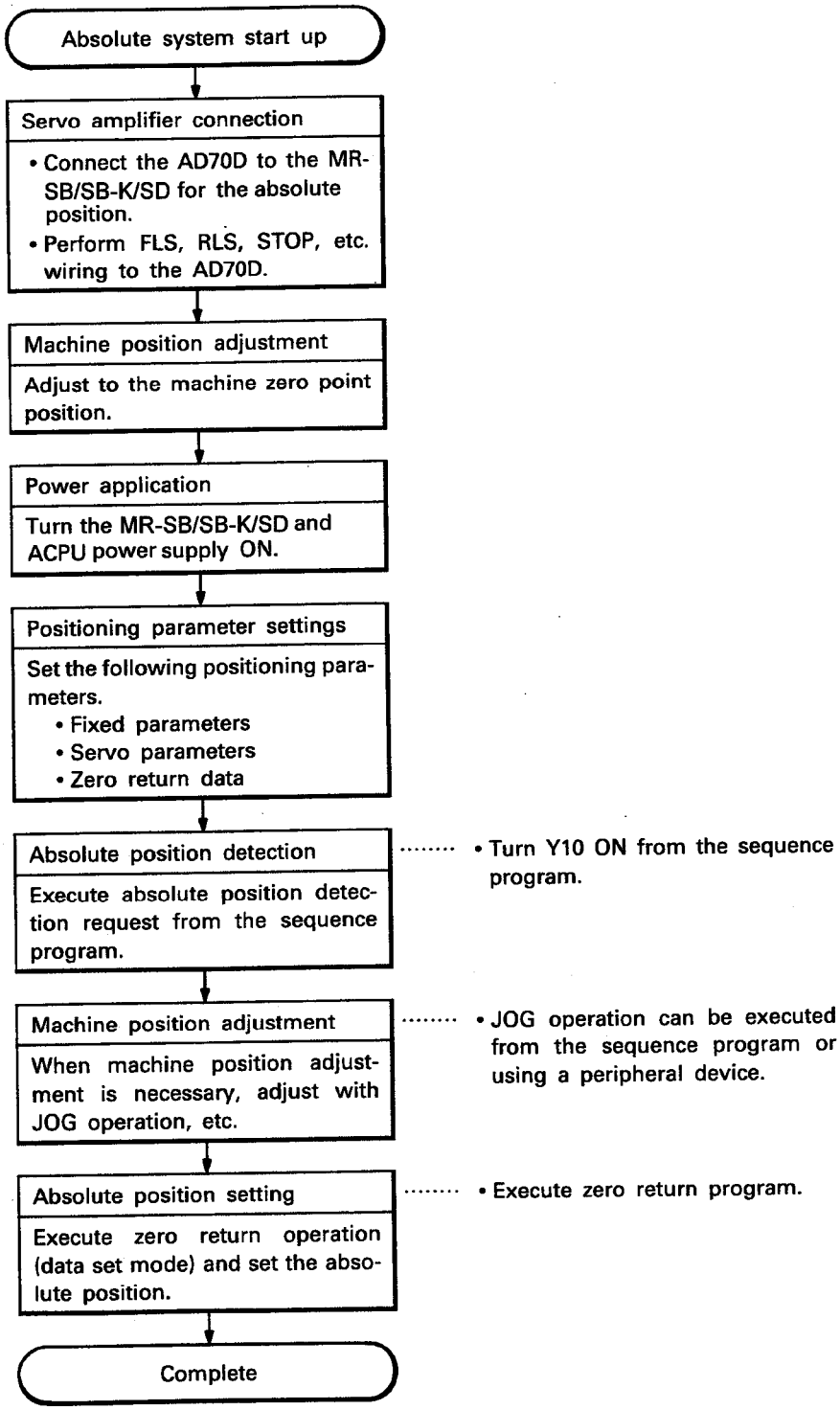
<table>
<tr><th>Data No.</th><th>Item</th><th>Description</th></tr>
<tr><td>Y10</td><td>Zero return start</td><td>Valid at start up. The zero return request signal (X02) and the BUSY signal (X04) are switched ON by zero return start.</td></tr>
<tr><td>Y11</td><td>Absolute positioning start</td><td>Valid at start up. The BUSY signal (X04) is turned ON by positioning start.</td></tr>
<tr><td>Y12</td><td>Forward start</td><td>A forward (addresses increasing) start signal valid at start up. Depending on the positioning mode, however, the following results.
<table>
<tr><th>Positioning mode</th><th>Description</th></tr>
<tr><td>Positioning</td><td>Incremental forward start</td></tr>
<tr><td>Velocity/positioning</td><td>Forward start</td></tr>
</table>
The BUSY signal (X04) turns ON by forward start.</td></tr>
<tr><td>Y13</td><td>Reverse start</td><td>Reverse (addresses decreasing) start signal valid at start up. Depending on the positioning mode, however, the following results.
<table>
<tr><th>Positioning mode</th><th>Description</th></tr>
<tr><td>Positioning</td><td>Incremental reverse start</td></tr>
<tr><td>Velocity/positioning</td><td>Reverse start</td></tr>
</table>
The BUSY signal (X04) turns ON by reverse start.</td></tr>
<tr><td>Y14</td><td>Forward JOG start</td><td>Address increase JOG start signal, executes JOG operation when switched ON, and the axis stops after deceleration when switched OFF.
The BUSY signal (X04) is turned ON by forward JOG start.</td></tr>
<tr><td>Y15</td><td>Reverse JOG start</td><td>Address decrease JOG start signal, executes JOG operation when switched ON, and the axis stops after deceleration when switched OFF.
The BUSY signal (X04) is turned ON by reverse JOG start.</td></tr>
<tr><td>Y16</td><td>Velocity/ position mode re-start</td><td>Executes re-start when the stop signal has been input in the velocity/position control switchover mode; valid at start up.
The BUSY signal (X04) is turned ON by the velocity/position mode re-start.</td></tr>
<tr><td>Y17</td><td>Stop</td><td>• Valid at start up. When switched ON, zero return, positioning, and JOG operations decelerate and stop.
• When the stop signal (Y17) is turned ON during zero return operation, the error detection signal (X08) is turned ON.</td></tr>
</table>

Data No.	Item	Description
Y18	Error reset	Clears the buffer memory error codes (addresses 121, 122, 123) to 0 and the error detection signal (X08) is turned OFF. Valid when ON.
Y19	Overflow reset	Resets the overflow signal (X09). Valid when ON. 
Y1A	Underflow reset	Resets the under flow signal (X0A). Valid when ON. 
Y1B	Servo OFF	• Releases the servolock and sets the motor to the free run condition. OFF: Servolock ON: Servo OFF • When servo OFF is turned ON, the axis travel distance is continuously added to the feed present value until the servo OFF is turned OFF.
Y1C	Velocity/ position switchover enabled	Enables/disables the control switchover signal in the velocity/position control switchover mode. Enabled when ON, disabled when OFF.
Y1D	PC ready	• Indicates correct PC CPU operation. At the start of zero return, positioning, and jog operation, this signal must be ON. • To write fixed parameters, servo parameters, and zero return data, this signal must be OFF. • The following control actions occur when the PC ready signal is turned ON. (1) Fixed and servo parameter check (2) AD70D ready complete signal (X01) ON (3) Initial communication with servo (servo parameter transmission) • Turning Y1D OFF while the AD70D is BUSY causes the positioning to decelerate to a stop. If Y1D is turned ON while the AD70D is BUSY, the control actions above will not be executed. 

3.9 Absolute System

Positioning control in the absolute system can be executed using the absolute system MR-SB/SB-K/SD.
In the absolute system, if machine positions are set when starting up the system, zero return execution is unnecessary because the absolute positions of the axis is detected when the power supply is turned ON.

(1) Absolute system start up procedure
The absolute system start up procedure is shown below.



(2) The absolute system might lose the absolute position in the following cases.
In such a case, establish the absolute position by executing zero return operation or changing the present position data after setting the machine to the zero position.

(a) When an absolute position encoder is removed or changed.

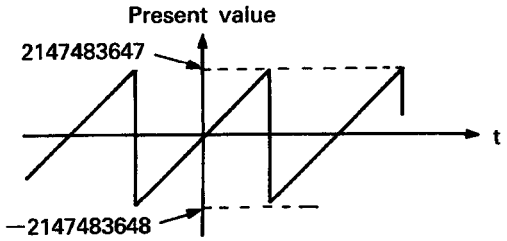
(b) When the cable connecting the absolute position encoder to the servo amplifier is removed or changed.

(c) When the servo amplifier is changed.

(d) When a servo battery alarm occurs (detected when the servo amplifier power is turned ON).

(e) When mechanical system is misaligned due to collision.

(3) The absolute system's command range is −196596000 to +196596000 (when $\frac{CMX}{CDV} = 1$).
The present value address range is −2147483648 to + 2147483647. If this range is exceeded, the data change as shown below.

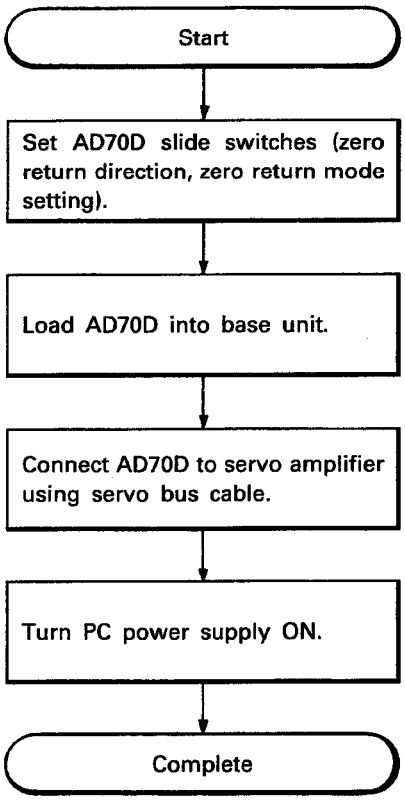


For example, when the zero point address is set to 10000, specifying 196596000 as the positioning travel distance sets the present value address after positioning to 196606000.

4. PRE-OPERATION SETTINGS AND PROCEDURES

4.1 Pre-operation Settings and Procedures

This section explains the hardware setting procedure for starting up the system that uses the AD70D.



4.2 Handling Instructions

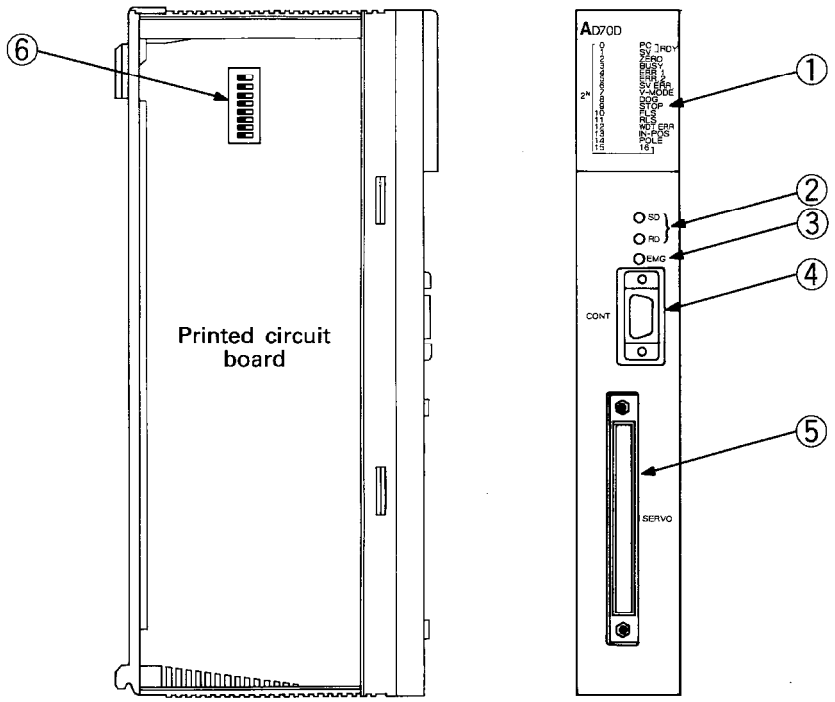
(1) Protect the AD70D from mechanical shock and vibration.

(2) Keep conductive debris out of the unit.

(3) Turn OFF the PC power supply before loading or unloading the unit to or from the base.

(4) Turn OFF the PC and servo amplifier power supply before connecting or disconnecting the servo amplifier connector. Insert the connector directly from the front after confirming the correct insertion direction. Tighten the two fixing screws after installation. Keep the connector area cover closed when the servo amplifier is not connected.

4.3 Nomenclature



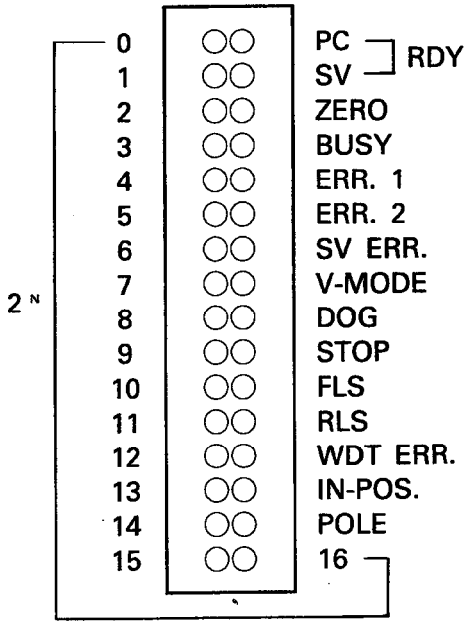
No.	Name	Description
①	32-point LED	Indicate AD70D operation and error states. Refer to Section 4.4 (1) for details.
②	2-point LED	Indicate AD70D communication state. Refer to Section 4.4 (2) for details.
③	EMG LED	Indicates servo amplifier emergency stop. OFF when stopped. Lights when stop is canceled.
④	CONT	Control signal connector. Refer to Section 3.5.2 for pin signal names.
⑤	SERVO	Servo amplifier connector
⑥	Slide switches	For switch settings for zero return direction and mode, and GPP/PHP setting selection, refer to Section 4.5.

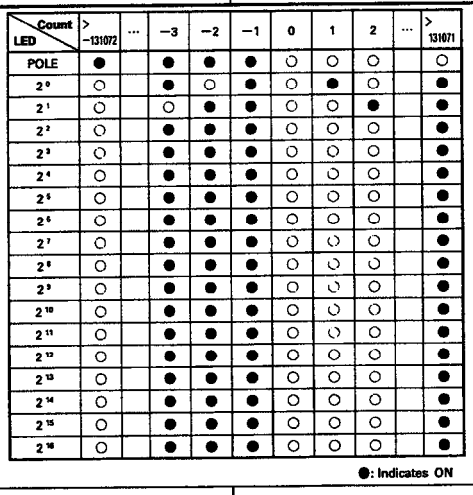
4.4 LED Indications

(1) LED indications of operation and error states

This section explains the front LEDs that indicate the operating status and error status of the AD70D.

LED details



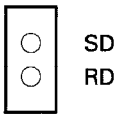
LED		Indication	ON Condition	OFF Condition	Initial*1 State
2^N	Error counter value	Error counter count value indication Indication range −131072 to +131071			All OFF
PC RDY	PC ready	Indicates AD70D operation ready state	PC ready (Y1D) ON	PC ready (Y1D) OFF	OFF
SV RDY	Servo ready	Indicates servo ready (READY) signal state	READY signal ON	READY signal OFF	By external input
ZERO	Zero return request	Indicates zero return request signal ON/OFF state	Zero return request signal (X02) ON	Zero return request signal (X02) OFF	ON
BUSY	BUSY	Indicates BUSY signal ON/OFF state	BUSY signal (X04) ON	BUSY signal (X04) OFF	OFF

*1 The initial state is the CPU STOP state with the CPU power supply turned ON.

LED		Indication	ON Condition	OFF Condition	Initial *1 State
ERR. 1	Minor error	AD70D minor error state *2	ON at minor error	No minor error, or OFF after error reset	OFF
ERR.2	Major error	AD70D major error state *2	ON at major error	No major error, or OFF after error reset	OFF
SV ERR.	Servo error	Servo amplifier error state *2	ON at servo error	No servo error, or OFF after error reset	OFF
V-MODE	OFF during position control	Velocity/position control switchover mode operation state	ON during velocity operation	OFF during position control	OFF
DOG	Near-zero point dog	Near-zero point signal (DOG) state	Near-zero point signal ON	Near-zero point signal OFF	By external input
STOP	Stop	Stop signal (STOP) state	Stop signal ON	Stop signal OFF	By external input
FLS	Upper limit LS	Upper limit LS signal (FLS) state	Upper limit LS signal ON	Upper limit LS signal OFF	By external input
RLS	Lower limit LS	Lower limit LS signal (RLS) state	Lower limit LS signal ON	Lower limit LS signal OFF	By external input
WDT ERR.	WDT error	Indicates AD70D WDT state	WDT error (X00) ON Hard ware error	WDT error (X00) OFF H/W error	OFF
IN-POS	In-position	Indicates in-position state	Within in-position range	Outside in-position range	ON
POLE	Error counter polarity	Indicates error counter polarity state	Negative	0 or positive	OFF

*1 The initial state is the CPU STOP state with the CPU power supply turned ON.
*2 Refer to SECTION 6 TROUBLESHOOTING for error details.

(2) Communication state LED
The LEDs on the front of the AD70D indicating communication state will be explained.



SD: ON when the AD70D has sent a transmission request to the servo amplifier.
RD: ON when the servo amplifier has enabled transmission to the AD70D.

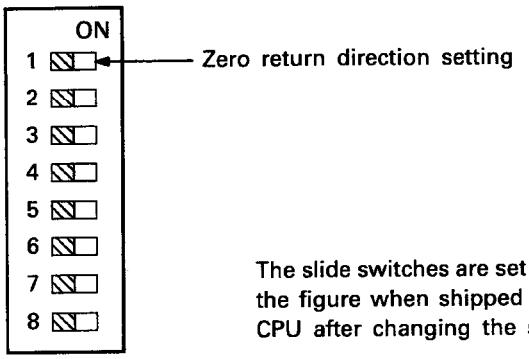
SD and RD flicker at high speeds during AD70D and servo amplifier communication.

4.5 Settings

Slide switch settings will be explained.
Set SW1 to SW4 when setting the parameters and zero return data from the sequence program, or set SW4 and SW6 when setting the parameters and zero return data using the GPP/PHP (SW□GP-AD70DP).

4.5.1 Zero return direction setting

Slide switches



The slide switches are set in the OFF position as shown in the figure when shipped from the factory. Reset the PC CPU after changing the switch settings.

Set the zero return direction.

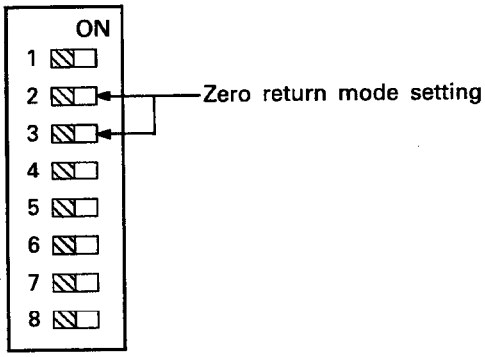
SW1	OFF	Reverse direction (addresses decreasing)
	ON	Forward direction (addresses increasing)

IMPORTANT

Zero return operation is controlled by both the zero return direction and the zero return velocity. Turning the near-zero point dog ON starts deceleration. Be sure to set the zero return direction correctly.

4.5.2 Zero return mode setting

Slide switches

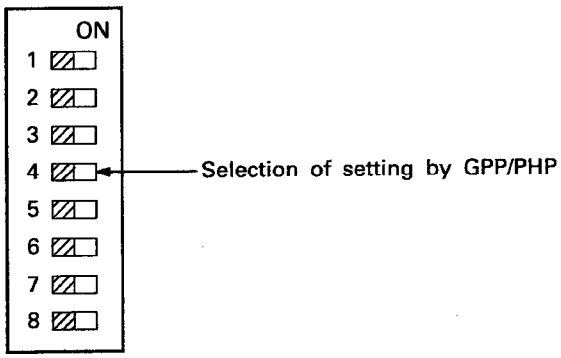


There are three zero return operation modes shown below. Refer to Section 5.3.1 for details.

SW2	SW3	Zero Return Mode
OFF	OFF	Near-zero point dog mode
ON	OFF	Count mode
OFF	ON	Data set mode
ON	ON	Setting disabled

4.5.3 GPP/PHP setting selection

Slide switches

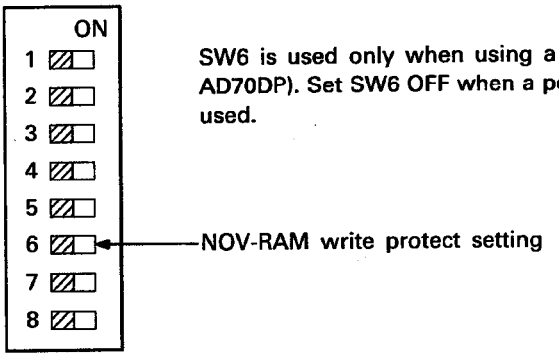


The zero return direction and mode can be set using the GPP/PHP (SW□GP-AD70DP) as well as the setting by slide switches (SW1 to SW3).

SW4	OFF	Setting by GPP/PHP invalid, setting by slide switches (SW1 to SW3) valid
	ON	Setting by GPP/PHP valid, setting by slide switches (SW1 to SW3) invalid; all parameters are set with a peripheral device

4.5.4 NOV-RAM write protect setting

Slide switches



SW6 is used only when using a peripheral device (SW□GP-AD70DP). Set SW6 OFF when a peripheral device is not being used.

SW6	OFF	Enabled
	ON	Write protect

IMPORTANT

Do not change the settings of SW5, SW7, and SW8 (set when shipped from the factory).

4.6 Wiring

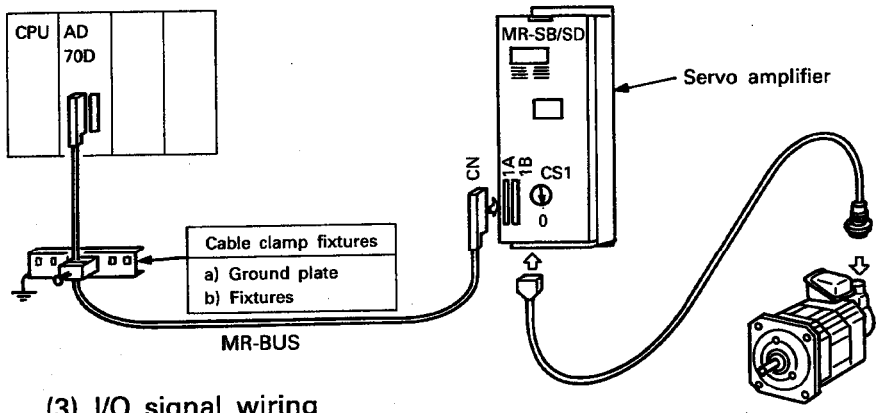
This section explains the items to be noted for wiring of the AD70D and external device and how to connect the external wiring connector.

4.6.1 Wiring precautions

This section provides the precautions for wiring the AD70D and external device (including the servo amplifier).

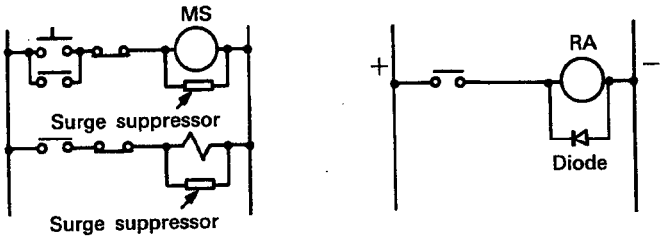
(1) Connection cable length
For the length of the cable connecting the AD70D with the servo amplifier, use the 5 m (16.41 ft) servo bus cable (MR-SB 5M). 2 m (6.56 ft), 10 m (32.81 ft), and 30 m (98.43 ft) cables are available.

(2) Fixing the servo bus cable
Fix the servo bus cable using a special cable clamp fixtures (accessory).



(3) I/O signal wiring
- Do not bundle I/O signal wires with power cables or main cables. Run these wires away from the cables. (min. distance of 20 cm (7.87 in))
- Separate I/O signal wires from other cables and use separate conduit where applicable.
- If the I/O signal wires are to be bundled with the power cables and/or main cables, use the shield cable and ground it at the PC side.
- When running I/O signal wires in metal conduit, the conduit should be grounded.

(4) Arrange in rows surge suppressors for AC relays, DC bulbs, and electric breakers, and diodes for DC relays, bulbs, etc. connected to the servo amplifier. Refer to the servo amplifier manual for details.

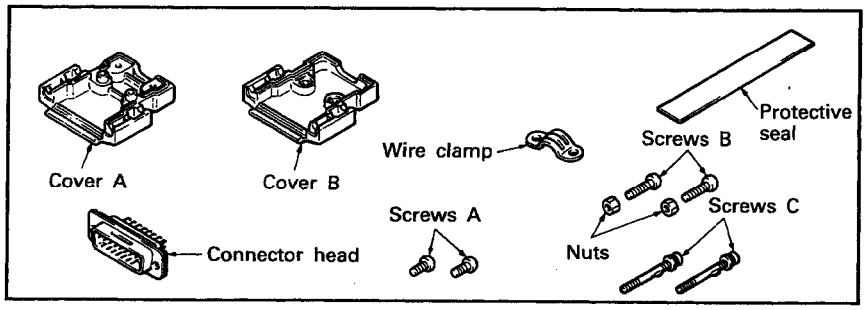


(a) Mounted to AC relays, bulbs, etc. (b) Mounted to DC relays, etc.

Surge Suppressor Installation Example

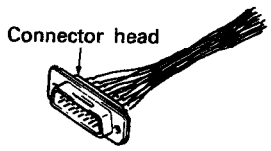
4.6.2 External wiring connectors

This section explains how to connect the external wiring connector.
The AD70D is provided with the following connector:
9-pin connector (plug) for CONT connector
The connector consists of the following parts.



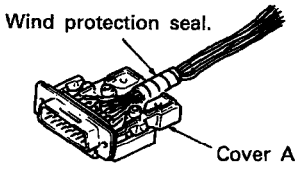
Assemble the connectors as follows:

(1) Solder the wires to the connector head. ····· (See 4.6.3 for details.)



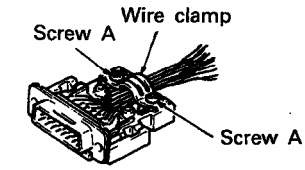
⇩

(2) Fit the connector head to cover A and wind the protective seal around the cables to prevent wearing of the insulation. ·····



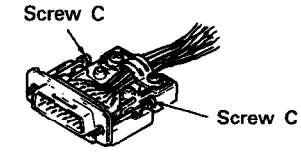
⇩

(3) it the wire clamp using screws A. ·····



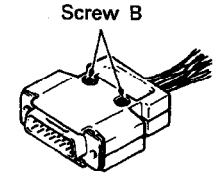
⇩

(4) Fit screws C. ·····



⇩

(5) Fasten cover B onto cover A using screws B and the two nuts. ·····

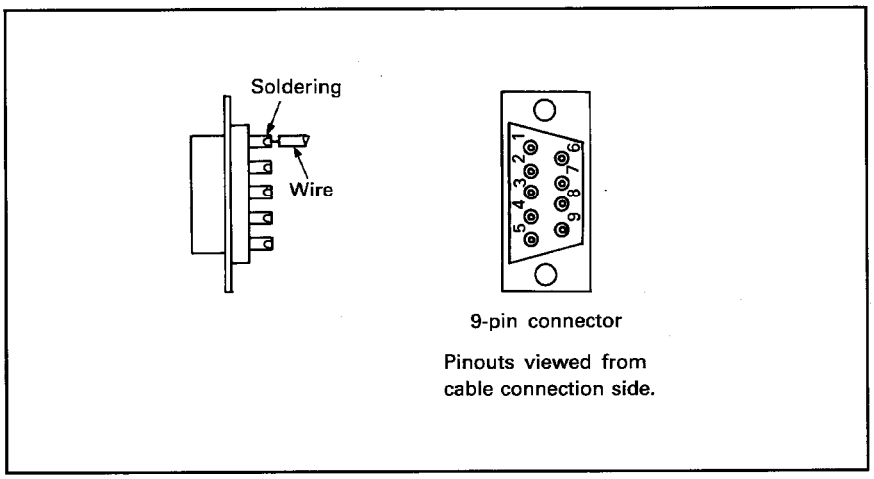


4.6.3 Connectors

Wiring for connector pins is shown below. Connect according to I/O numbers as shown in Section 3.5.

(1) Use 0.3 mm^2 (22 AWG) wire.
Wires thicker than this cannot run in cable clamps.

(2) Solder the wires to the pins and finish with insulating tubing.



9-pin connector

Pinouts viewed from cable connection side.

4.7 Maintenance

For maintenance of other units/modules (such as power supply modules, CPU modules, I/O modules, and special units), refer to the corresponding units' user's manuals.

4.7.1 Storage

The AD70D should be stored in the following environments.

(1) Ambient temperature of −20 to 75°C

(2) Ambient humidity of 10 to 90% RH

(3) No condensation (due to sudden temperature changes)

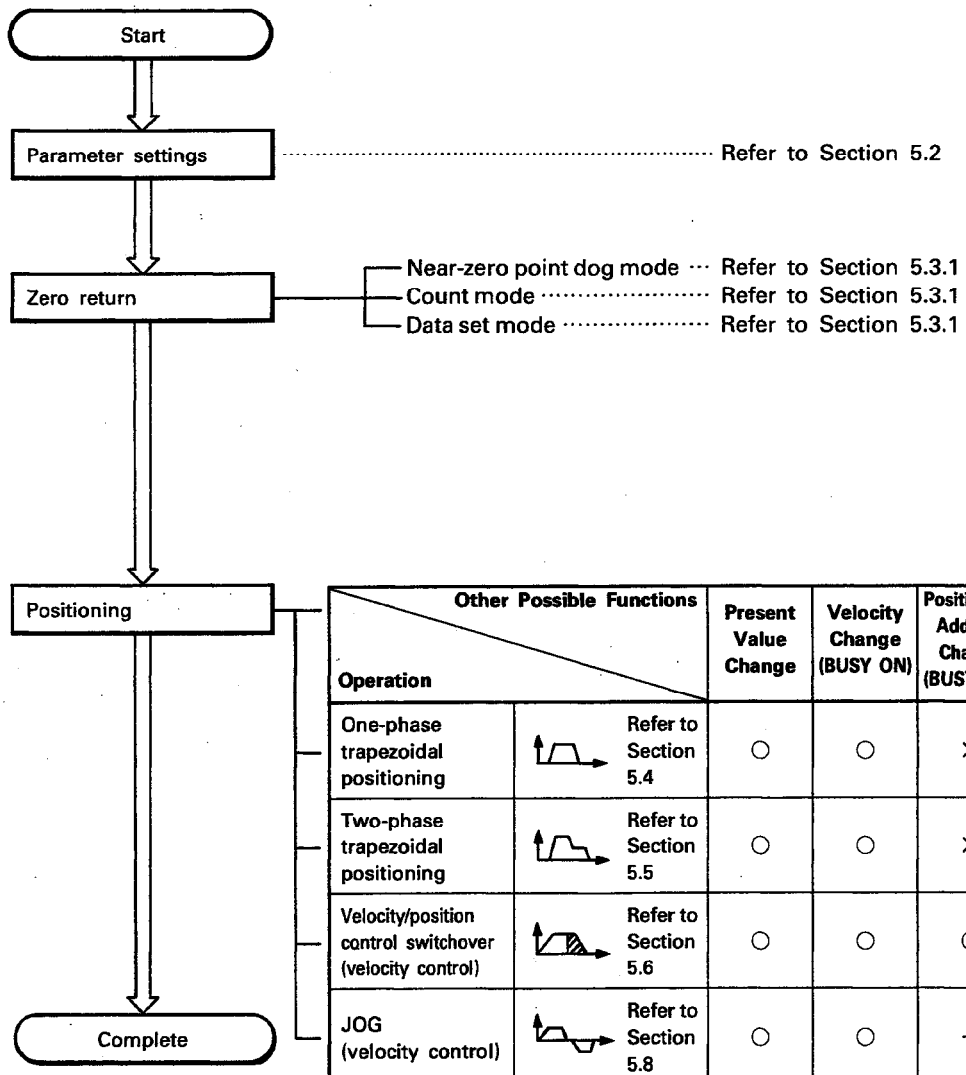
(4) No direct exposure to sunlight or rain

(5) Free from excessive amounts of conductive powder such as dust, iron filings, oil mist, salt, or organic substances.

A two hour "warming up" period should be allowed if the AD70D has not been powered up for over 12 months. This is to allow the electrolyte in the electrolyte capacitor to stabilize.

5. PROGRAMMING

To perform the positioning control of the AD70D, the zero return method and positioning operation method must be determined, the parameters, zero return data and positioning data must be set from the sequence program, and the set data must be stored into the buffer memory. This chapter explains the programming method and operation method for that purpose. A rough procedure for positioning is as follows.



Operation \ Other Possible Functions		Present Value Change	Velocity Change (BUSY ON)	Positioning Address Change (BUSY ON)	Torque Limit Change	Re-start after Stop (positioning continues)
One-phase trapezoidal positioning	Refer to Section 5.4	○	○	×	○	○ (Absolute mode only)
Two-phase trapezoidal positioning	Refer to Section 5.5	○	○	×	○	○ (Absolute mode only)
Velocity/position control switchover (velocity control)	Refer to Section 5.6	○	○	○	○	○
JOG (velocity control)	Refer to Section 5.8	○	○	–	○	○
Incremental feed	Refer to Section 5.7	○	○	×	○	○ (Absolute mode only)
		Refer to Section 5.9				Refer to Section 5.10

5.1 Notes on Programming

(1) PC ready reset
Where necessary, the PC ready signal should be disabled when an error is detected.

(2) Zero return
Execute zero return before positioning is started and when a zero return request is received from the AD70D.

(3) Near-zero point dog limit switch
Ensure that the limit switch is serviceable and reliable. Failure to receive an input from this switch will cause an axis to continuously move at the zero return velocity.

(4) Overrun precautions
The upper and lower stroke limits will only be operable if the AD70D is functioning normally. Upper and lower limit switches should be hard wired into the system.

(5) Emergency stop signal
Hard wire emergency stop circuits into the system.

(6) Upper and lower stroke limit values
Upper and lower stroke limit values should be checked before operation.

(7) Velocity limit value
The velocity limit parameter should be checked before operation.

(8) Jog velocity
Set the jog velocity low when initially setting up the system.

REMARK

Unless otherwise specified, I/O numbers used in this manual assume that the AD70D is loaded at slot 0 of the main base.

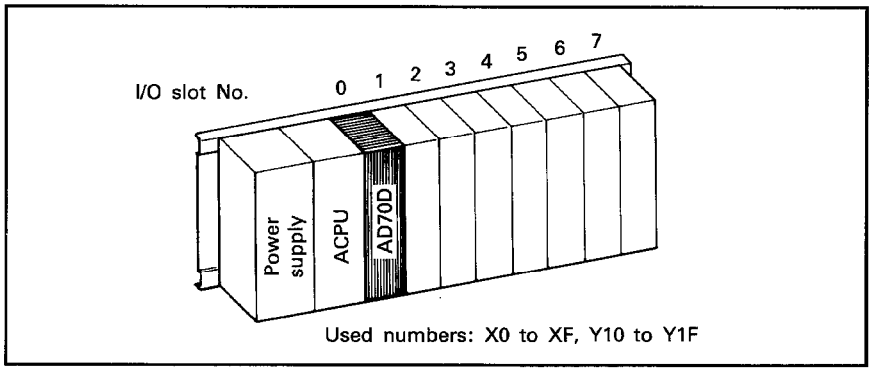
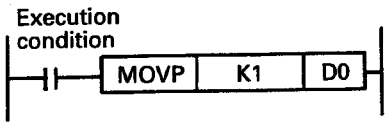
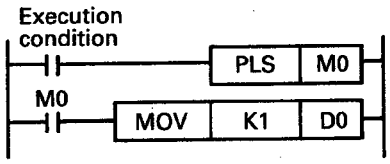
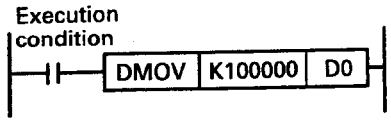
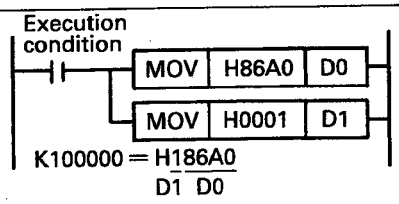


Fig. 5.1 AD70D Location for the Following Examples

Device numbers (M, D, T etc.) used in the program example can be changed freely.

(9) Precautions when using the A0J2CPU
There are limits to the instructions and devices which can be used in the A0J2CPU when compared to the ACPU.
For details, refer to A0J2CPU Programming Manual.

CPU / Instruction	ACPU	A0J2CPU
Pulse instruction (MOV) P		
DMOV		

(10) The sequence program example in this section uses the direct mode for the ACPU input control mode. When the refresh mode is used, the SET and RST instructions are used within the same scan and pulses cannot be output to the AD70D. To output pulses to the AD70D, execute the partial refresh instruction (SEG). Refer to the ACPU Programming Manual for the partial refresh instruction (SEG).

(11) This chapter explains programming performed when an absolute position system is not used. When an absolute position system is used, the positioning command range (travel distance) is 0 to 196596000 (0 to 2147483647 when an absolute position system is not used).

5.2 Parameters

The parameters must be set first to perform the positioning control of the AD70D. There are the following parameter types: Fixed parameters preset according to a mechanical system, etc., servo parameters set on the basis of the servo motor and servo amplifier models connected to the AD70D, and variable parameters set variably according to positioning.

5.2.1 Parameter settings

Table 5.1 shows the parameters set by the sequence program.

Table 5.1 Parameters

Data		No.	Item		Setting Range	Default	Setting Enable Conditions	Set Data Check Timing
Parameters	Fixed parameters	1	Upper stroke limit		−2147483648 to 2147483647 PLS (32-bit signed data)	2147483647	PC ready signal (Y1D) must be OFF.	When PC ready signal (Y1D) is turned ON
		2	Lower stroke limit		−2147483648 to 2147483647 PLS (32-bit signed data)	0		
		3	Electronic gear	Command pulse multiplication ratio numerator (CMX)	1 to 9999	1		
		4		Command pulse multiplication ratio denominator (CDV)	1 to 9999	1		
	Servo parameters	1	System setting		0: MR-SB (Standard) 1: MR-SB (Absolute system) 2: MR-SD/MR-SB-K (Standard) 3: MR-SD/MR-SB-K (Absolute system)	0	PC ready signal (Y1D) must be OFF. (Except for position loop gain and velocity loop gain)	When PC ready signal (Y1D) is turned ON
		2	Regenerative resistance	When MR-SB/SD is used	0: None 3: RB100,101 1: RB30 4: RB082 2: RB50, 51 5: RB32	0		
				When MR-SB-K is used	0: When no regenerative resistance is provided or accessory regenerative resistance is connected externally (Dynamic brake: Not provided) 6: When accessory regenerative resistance is provided and cooling fan is used (Dynamic brake: Not provided) 9: When power regeneration converter (FR-RC) is used(Dynamic brake: Not provided) 10: When no regenerative resistance is provided or accessory regenerative resistance is connected externally (Dynamic brake: Provided) 16: When accessory regenerative resistance is provided and cooling fan is used (Dynamic brake: Provided) 19: When power regeneration converter (FR-RC) is used (Dynamic brake: Provided)	0		

Table 5.1 Parameters

Data		No.	Item	Setting Range	Default	Setting Enable Conditions	Set Data Check Timing
Parameters	Servo parameters	3	Motor type	0: Standard 1: Low inertia L 2: Flat U	0	PC ready signal (Y1D) must be OFF. (Except for position loop gain and velocity loop gain)	When PC ready signal (Y1D) is turned ON
		4	Motor capacity	Set the motor output capacity (Kw) to 10 times (Example) 1.5 kw → 15	0		
		5	Motor rpm	2: 2000 rpm 3: 3000 rpm	2		
		6	Position loop gain	1 to 999 rad/sec	25		
		7	Velocity loop gain	1 to 9999	100		
		8	Velocity integration compensation	1 to 9999 ms	20		
		9	In-position range	1 to 9999 PLS	100		
		10	Number of feedback pulses per motor rotation	1 to 65535 PLS fixed	12000		
		11	Rotation direction	0: Counterclockwise by addresses increasing 1: Clockwise by addresses increasing	0		
		12	Torque limit	1 to 500%	300		
	Variable parameters	1	Velocity control value	10 to 1000000 PLS/sec (Set in units of 10 PLS/sec)	200000	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, if written while the BUSY signal is turned ON, they will be fetched when the next start signal is turned ON.	1 When positioning start signal (Y11 to Y13) is turned ON 2 When JOG start signal (Y14, Y15) is turned ON 3 When zero return start signal (Y10) is turned ON
		2	Acceleration time	4 to 9999 ms	300 ms		
		3	Deceleration time	4 to 9999 ms	300 ms		
		4	Positioning mode	0: Positioning mode 1: Velocity/position control switchover mode	0		

(1) Parameter default values
If parameters are not set default values are used. If an error is found upon checking the parameter setting range, all data for fixed parameters, but only error data for variable parameters default to the values shown in Table 5.1.

(2) Refer to the terminology of Section 1.2 for parameters other than those of the electronic gear.

(3) Electronic gear function
By multiplying AD70D command pulse outputs, machine travel distance per command pulse can be changed freely using the electronic gear.
Selecting an encoder appropriate for the mechanical system is unnecessary, and flexible positioning is possible.
The electronic gear is valid for zero return, positioning, and JOG operations.

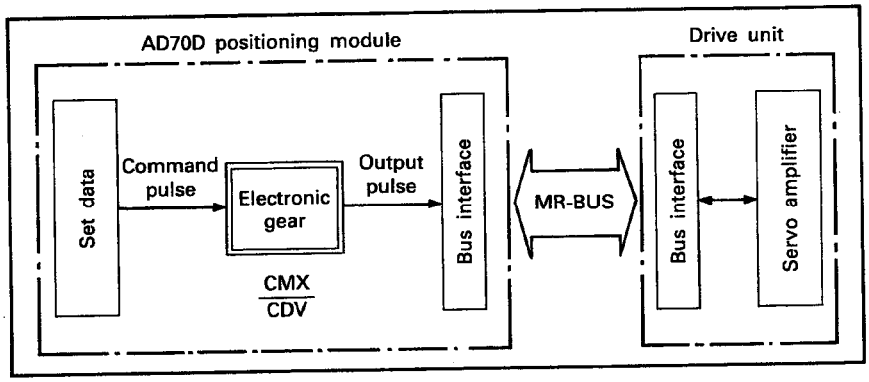


Fig. 5.2 Electronic Gear

The electronic gear's command pulse multiplication ratio numerator (CMX) and denominator (CDV) are set by parameters.

However, $\frac{1}{50} \leqq \frac{CMX}{CDV} \leqq 50$.

When using the electronic gear, the positioning velocity and axis travel distance are controlled by electronic gear multiples. However, positioning velocity $\times$ electronic gear $\leqq$ 1000 kpps.
If there are fractional pulses below the decimal point, they are internally stored and accumulated at the next start.
An example of the positioning velocity command pulse frequency and output pulse frequency with the electronic gear is given below.

- Velocity limit value 105KPLS/sec
- Electronic gear $(\frac{CDV}{CMX}) = 10$

Example of command and output pulses when setting the electronic gear

	Setting	1	2	3
Positioning velocity	Command pulses (set values)	100 KPLS/s	105 KPLS/s	110 KPLS/s ↓ 105K*
	Command pulses × CMX/CDV	1000 KPLS/s	1050 KPLS/s	1050 KPLS/s
	Output pulses	1000 KPLS/s	1000 KPLS/s	1000 KPLS/s
	Error code	—	213	52, 213

* Since command pulse set values exceed velocity limits, an error occurs (error code 52), and control will be carried out at a velocity limit of 105 KPLS/s.

POINT

(1) If positioning continues after the PC has been reset, zero return operation must be executed because mis-location occurs due to fractional pulses caused by electronic gears ($\frac{CMX}{CDV} \neq 1$).

(2) The value by which the electronic gear has multiplied the positioning velocity will not be controlled even if the velocity limit is exceeded. If 1000 kpps is exceeded, error code 213 will be set, and since the velocity will be controlled at 1000 kpps, mis-location will occur. Set the positioning velocity × electronic gear ≦ 1000 kpps.

(Example of use of electronic gear)

In the positioning system using a ball screw,

Ball screw lead: 10 mm (3.94 in)

Servo motor feedback pulse: 12000 pulse/1 rotation of the motor

Feed distance per pulse is

$$\triangle \ell = \frac{10}{12000} = 0.000833 \cdots\cdots \text{mm (in)/pulse}$$

If the electronic gear is used and set to $\frac{CMX}{CDV} = \frac{6}{5}$,

$$\triangle \ell' = \frac{10}{12000} \times \frac{6}{5} = 0.001 \cdots\cdots \text{mm (in)/pulse}$$

In this way any value for axis travel distance per pulse can be obtained using the electronic gear. This means that no fraction is generated in feed per pulse regardless of ball screw load.

(4) Number of feedback pulses

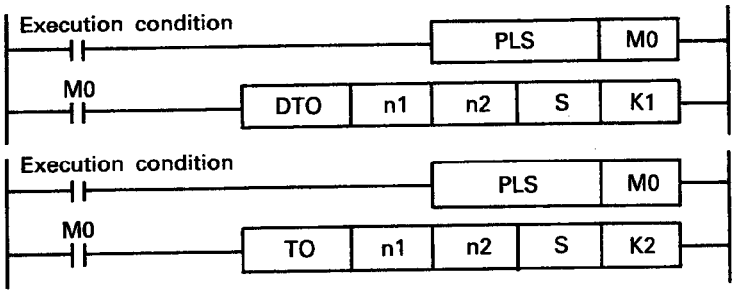
As the number of feedback pulses, set the "number of used detector pulses ×4".

Servo Type	Detector Type	Number of Feedback Pulses p/r
MR-SB	Standard	3000
	Absolute system	
MR-SB-K	Standard	3000
	Absolute system	4096
MR-SD	Standard	2000
		3000
	Absolute system	4096

5.2.2 Buffer memory

Parameter data from the user program is stored in the buffer memory areas shown in Figs. 5.3, 5.4, and 5.5.
Read and write of 2-word data such as upper and lower stroke limits and velocity limits from and to the buffer memory should be done simultaneously for 2-words. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



(1) Fixed parameters

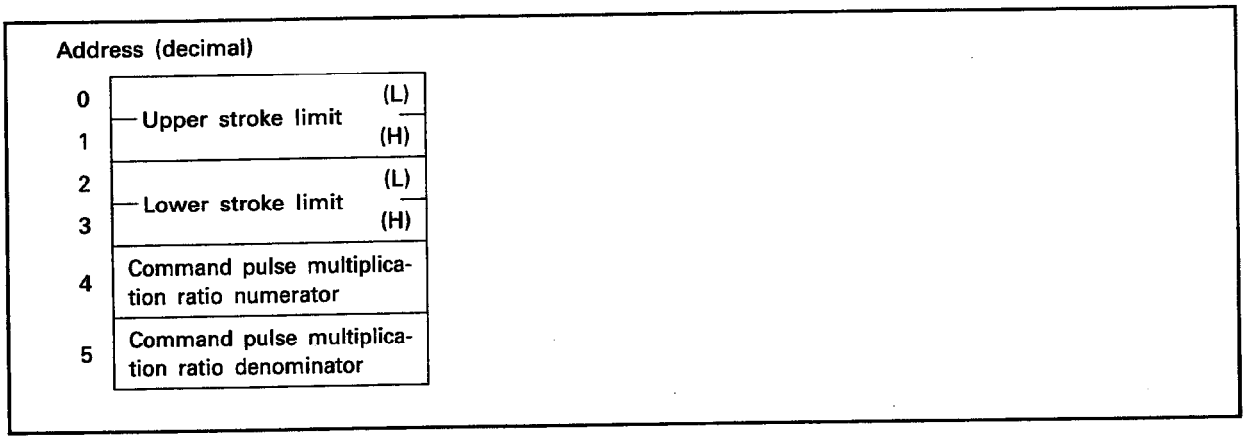


Fig. 5.3 Fixed Parameter Area

(2) Servo parameters

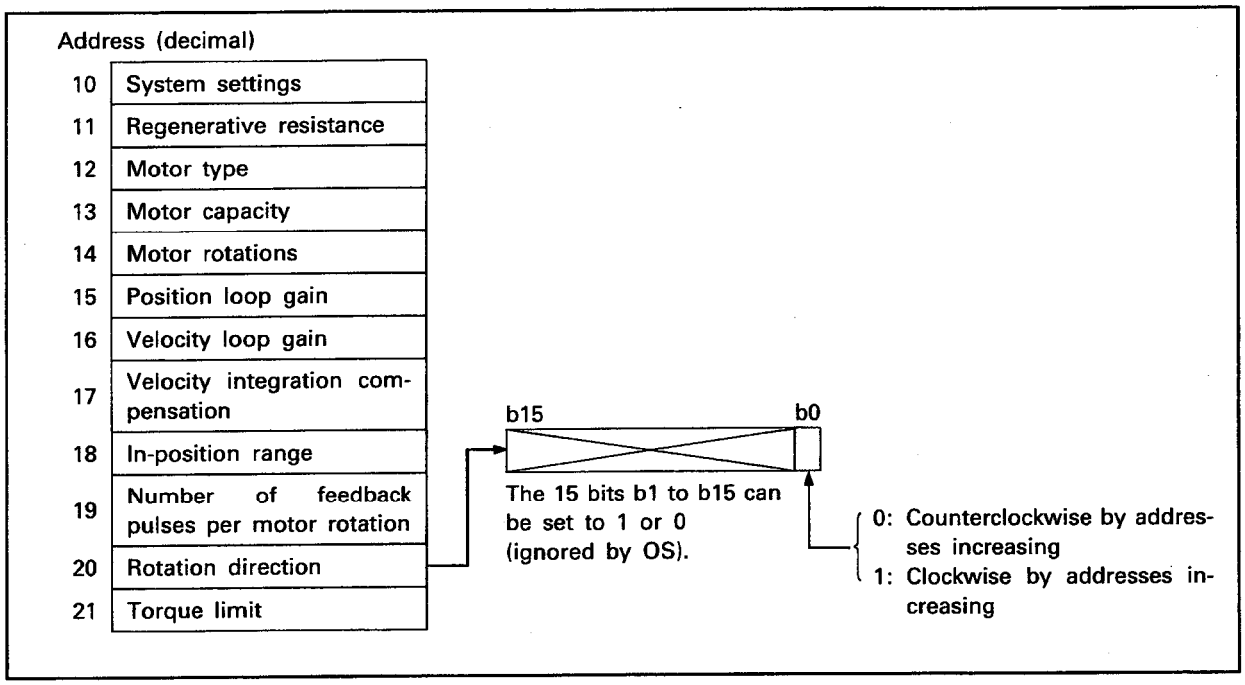


Fig. 5.4 Servo Parameter Area

(3) Variable parameters

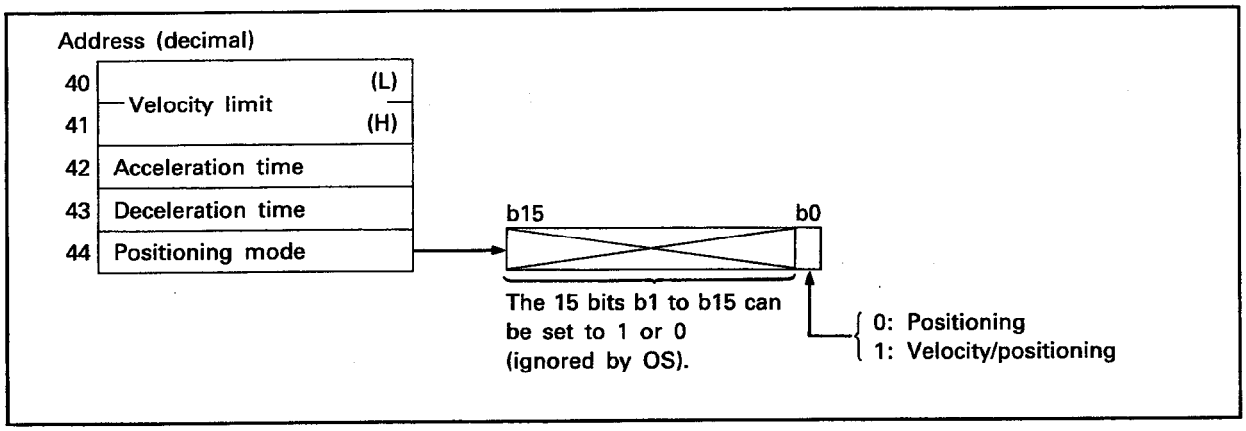


Fig. 5.5 Variable Parameter Area

As shown in Fig. 5.5, the positioning mode is determined by the LSB in the positioning mode area.

POINT

Since the default is set in the buffer memory at power application or PC reset, use the sequence program to change the default value.

5.2.3 Example parameter setting program

An example program of parameter settings for fixed, servo, and variable parameters is shown below.

(Conditions)
Fixed and servo parameter settings

1) Writes in 1 scan after CPU RUN.

2) Writes only when PC ready (Y1D) is turned OFF.

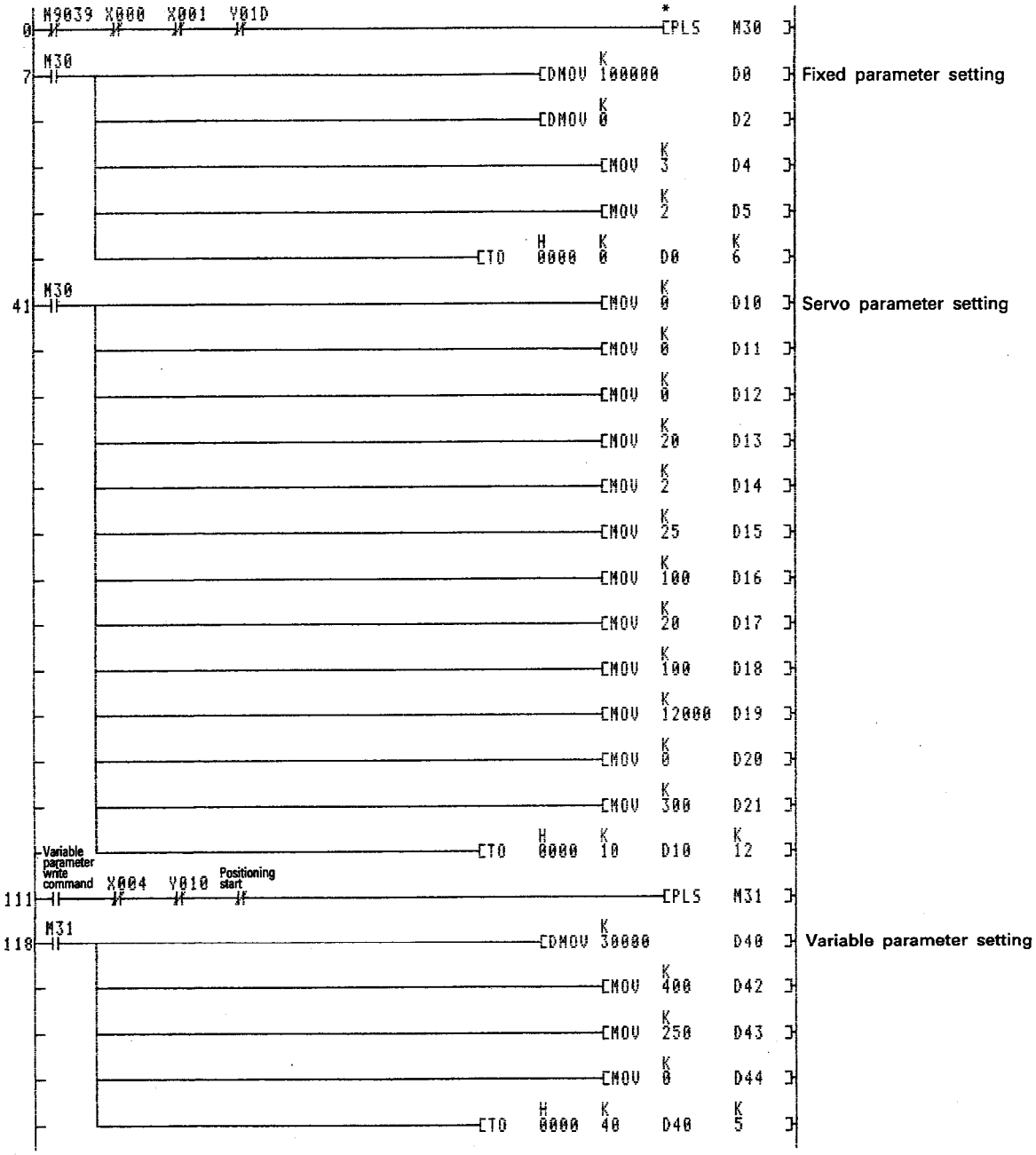
3) Data below is set as fixed and servo parameters.

Variable parameter settings

1) Writes using the write command when BUSY (X04) is OFF.

2) Data below is set as variable parameters.

		Set Value	Device Used	Buffer Memory Address
Fixed parameters	Upper stroke limit	100000 PLS	D1, D0	1, 0
	Lower stroke limit	0 PLS	D3, D2	3, 2
	Command pulse multiplication ratio numerator	3	D4	4
	Command pulse multiplication ratio denominator	2	D5	5
Servo parameters	System setting	0	D10	10
	Regenerative resistance	0	D11	11
	Motor type	0	D12	12
	Motor capacity	20	D13	13
	Motor rotations	2	D14	14
	Position loop gain	25 rad/sec	D15	15
	Velocity loop gain	100	D16	16
	Velocity integration compensation	20 ms	D17	17
	In-position range	100 PLS	D18	18
	Number of feedback pulses per motor rotation	12000 PLS	D19	19
	Rotation direction	0	D20	20
	Torque limit	300 %	D21	21
Variable parameters	Velocity limit	30000 PLS/sec	D41, D40	41, 40
	Acceleration time	400 ms	D42	42
	Deceleration time	250 ms	D43	43
	Positioning mode	0	D44	44



* When using instructions such as the MOVP and TOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

REMARK

Variable parameters can be written regardless of whether the PC ready (Y1D) is ON or OFF.

5.3 Zero Return

This section explains the zero return method, zero return data and programming.

5.3.1 Zero return modes

When applying power to the AD70D or at the start of operation, zero return execution is required to confirm the zero point. Zero return operation should also be executed when the zero return request signal (X02) is turned ON.
When using the absolute system, executing zero return operation once after establishing the absolute system is sufficient, even when the power supply is turned OFF. Should an absolute position error occur, execute zero return operation again.
Since addresses are monitored even during zero return operation, if zero return operation is started with the default settings, the upper stroke limit (default value 0) will be exceeded resulting in error 207 because the zero return direction is that of addresses decreasing. Zero return operation will be completed normally, however.

The three zero return operation modes shown below are set using slide switches. (Refer to Section 4.5 Settings.)

1) Near-zero point dog mode

2) Count mode

3) Data set mode (with absolute system only)

(1) Near-zero point zero return
As shown in Fig. 5.6, the reference point from the pulse generator (PLG) appearing first after the signal triggered by the near-zero point dog is turned OFF is established as the zero point.

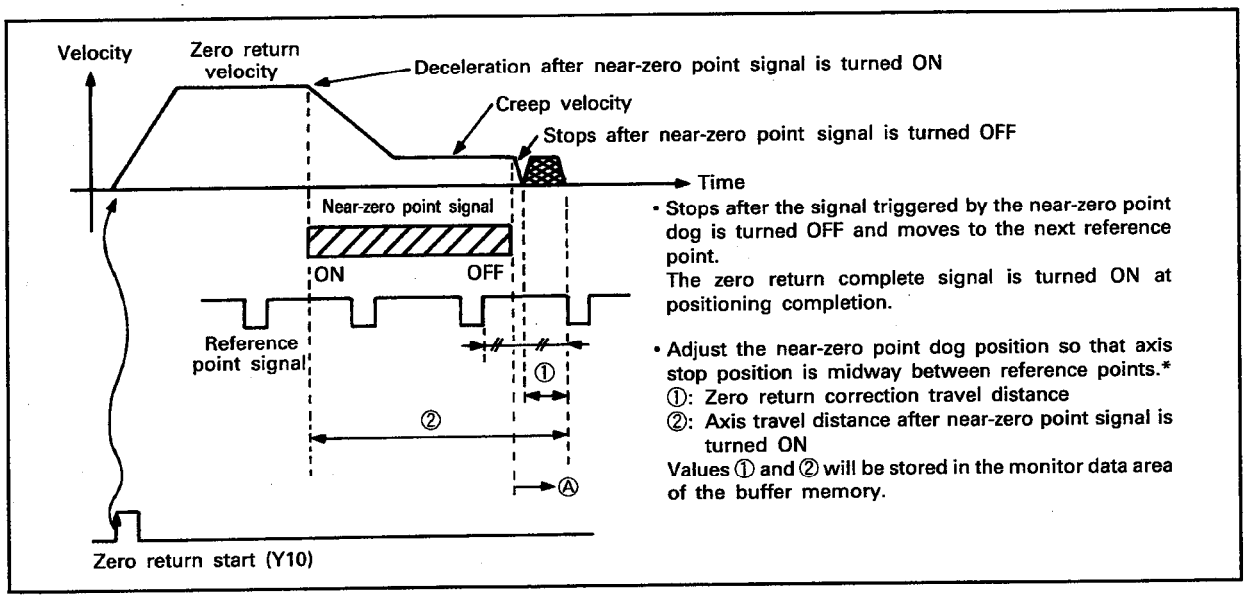


Fig. 5.6 Zero Return Operation Sequence Near-zero Point Dog

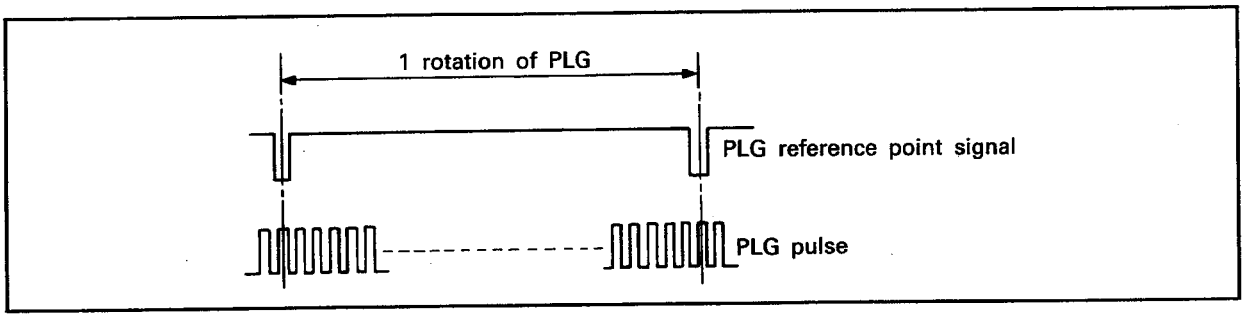
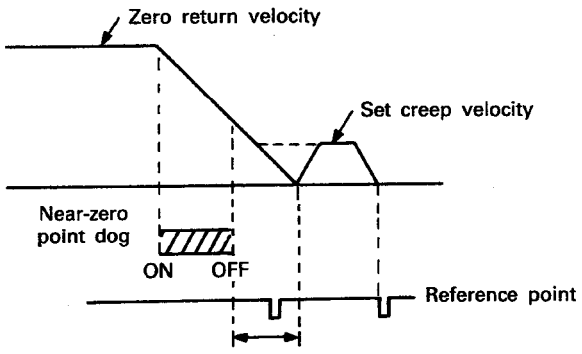


Fig. 5.7 Feedback Pulses

* If the position reached after the signal triggered by the near-zero point dog is turned OFF is close to the reference point signal, the reference point signal might be mis-read. Since the zero point might be offset by one rotation of the motor, adjust the dog position or set value so that the signal triggered by the dog will turn OFF as close as possible to the center of the reference point signal high range.

Keep the near-zero point signal ON until velocity is decelerated to creep velocity.
If this signal is turned OFF before the velocity is decelerated to creep velocity, the axis will continuously decelerate at the same rate and stop at the next reference point which is established as the zero point.



Because the signal triggered by the near-zero point dog is turned OFF, the axis passes the reference point during continuous deceleration. The reference point appearing within this range is not taken as the zero point. The reference point appearing next is taken as the zero point.

POINT

Note the following points when executing near-zero point zero return operation.

(1) Zero return start operation cannot be executed in the near-zero point dog mode. Execute zero return start operation after returning the axis to a position away from the near-zero point dog position by JOG operation.
(2) Zero return operation cannot be started twice consecutively. Interlock using the sequence program.

IMPORTANT

If the PC is reset at a position after the position where the signal triggered by the near-zero point dog is turned OFF (Fig. 5.6 A position) after the completion of zero return, zero return start operation can be executed. However, since there is no zero return direction signal, the axis cannot decelerate and will stop due to the upper/lower stroke limit LS.

(2) Count zero return
As shown in Fig. 5.8, the reference point from the PLG appearing first after the axis has moved the "PLS-designated axis travel distance after near-zero point signal ON" is established as the zero point.

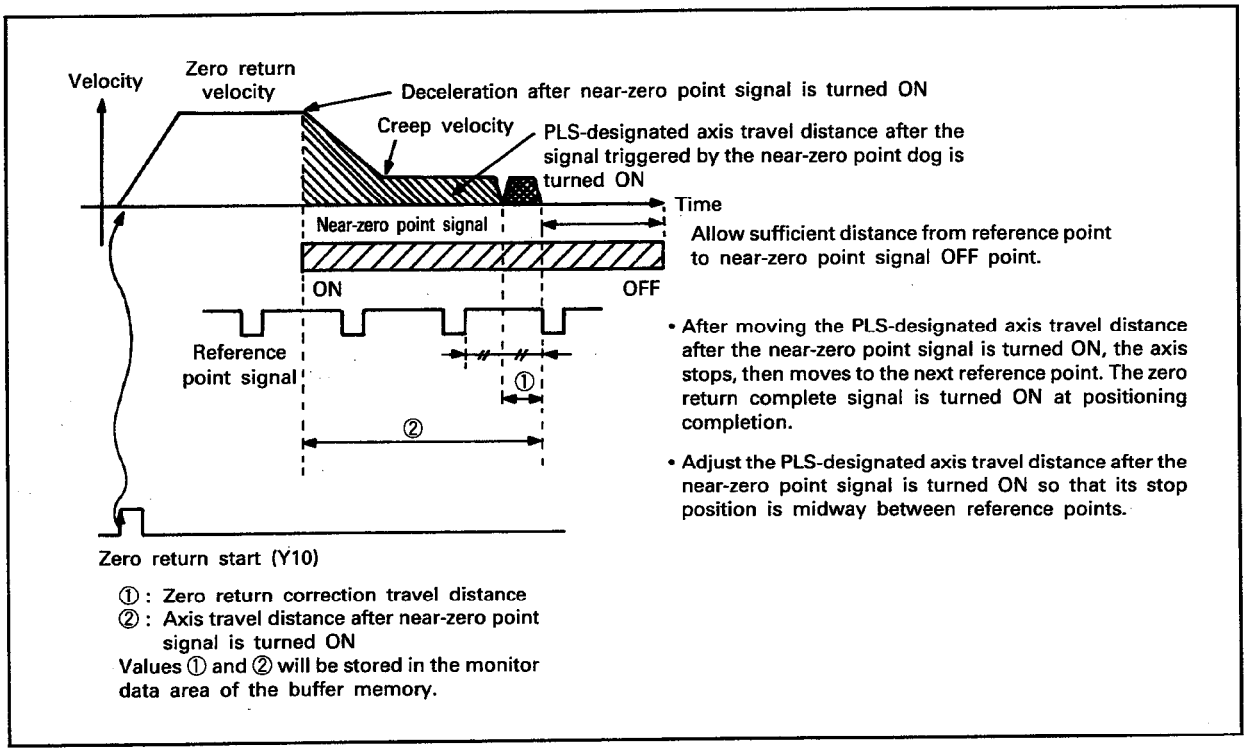


Fig. 5.8 Zero Return Operation Sequence in Count Mode

POINT

In this mode, zero return can be started while the near-zero point signal is ON or it can be started continuously. If zero return operation is started while the near-zero point signal is ON, the axis is automatically returned to the position before the near-zero point signal is turned ON and zero return operation is executed from that position.

(a) Axis travel distance setting after the near-zero point signal is turned ON

Set the axis travel distance set pulse after the near-zero point signal is turned ON so that it does not overlap with the reference point signal position where it is greater than the zero return velocity deceleration distance.

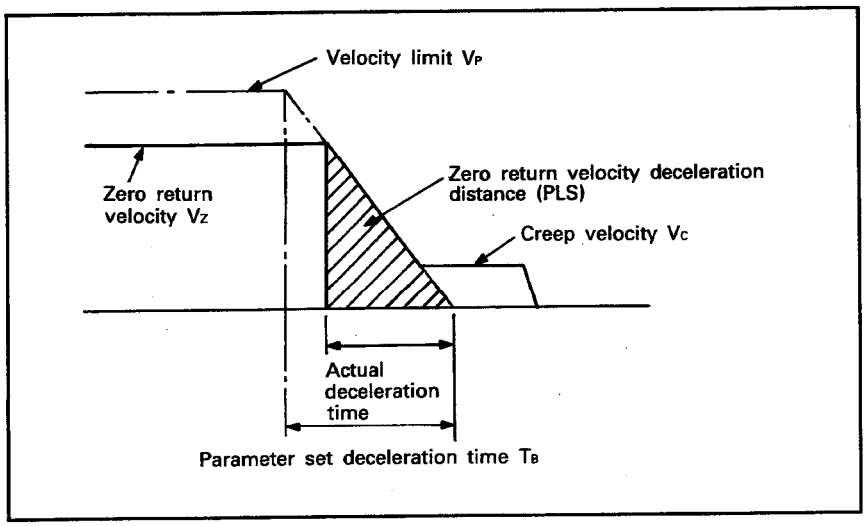


Fig. 5.9 Zero Return Velocity Deceleration Distance

As the condition for the deceleration distance from zero return velocity, set the value that satisfies both of the following two points.

- Number of pulses equivalent to one or more servo revolutions from when the near-zero point signal turns on
- $\frac{1}{2}$ × zero return velocity × actual deceleration time

$$= \frac{1}{2} V_Z \times \frac{V_Z \cdot T_B}{V_P} = \frac{V_Z^2 T_B}{2V_P} \text{ PLS}$$

Round up below the decimal point. Refer to Section 5.3.2 for calculation examples.

(b) Adjustment of position where the near-zero point signal is turned ON

The axis travel distance position after the near-zero point signal is turned ON must be set so that it is not close to the reference point signal.

If this position is close to the reference point signal, the reference point signal might be mis-read and the zero point might be offset by one rotation of the motor.

One way to avoid this, for example, is to set this position near the center of the reference point signal high range, and then set the axis travel distance after the near-zero point signal is turned ON to a multiply of one rotation of the servo motor.

(3) Data set zero return (used only in the absolute system)
In the absolute system's zero return operation, the data set mode does not require the near-zero point dog as do the near-zero point dog mode and the count mode.
In this mode, by operations such as the JOG operation, the axis moves to an arbitrary position and the zero return start signal is output. Zero return operation is completed by re-writing that position to the zero point address (motor does not rotate).

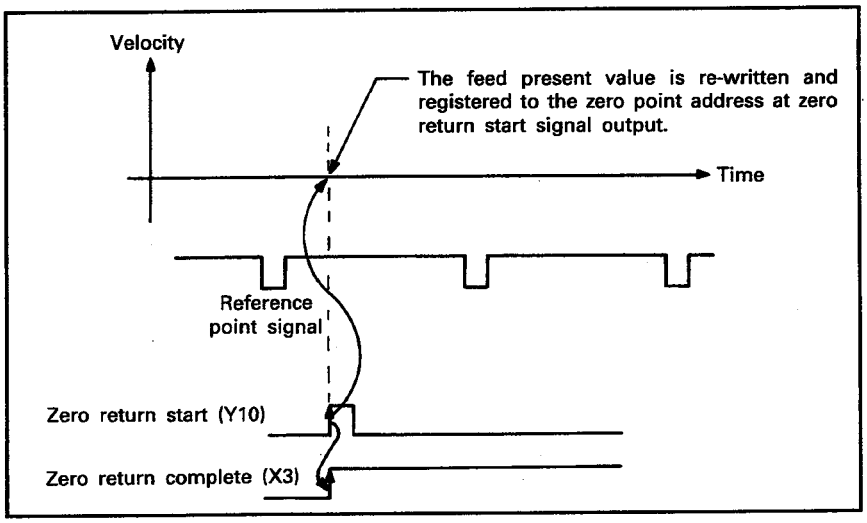
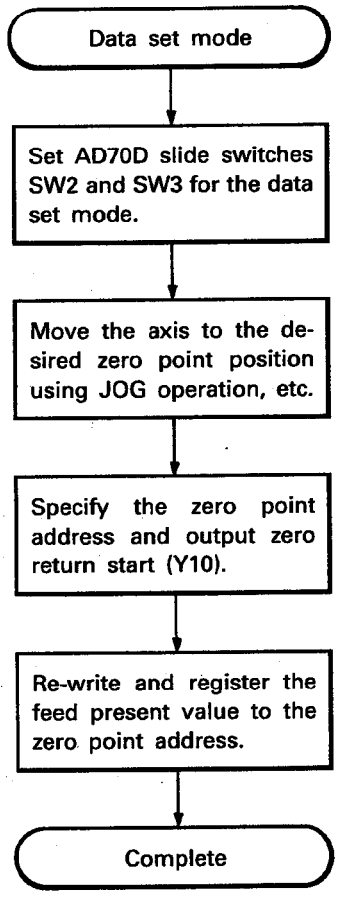


Fig. 5.10 Zero Return Operation Sequence-Data tions



It is necessary to pass the reference point before outputting zero return start (Y10) after applying power. If zero return start is output even once without passing the reference point, the "reference point not passing error" (error code 1110) will occur. If this occurs, reset the error, execute JOG operation so that the servo motor rotates more than one revolution, and re-output zero return start. Since, in this mode, the zero return velocity set data and the axis travel distance set data after near-zero point signal ON are not used, setting the data is unnecessary.

The data set mode zero return operation, if attempted with a system other than the absolute system, has the same effect as the present position data change function.

POINT

When data set mode zero return operation is performed in an absolute position system, two or more zero returns cannot be made while power is on.
To do so will cause a position shift.

5.3.2 Zero return data settings

For the AD70D to execute zero return control, zero return data must be set. If the data is not set, control defaults to the values shown in Table 5.2.
Default values are set at power application and when the PC is reset.
Table 5.2 shows zero return data to be set using the sequence program, data setting enable conditions, and data check timing.

Table 5.2 Zero-Return Data

No.	Item	Setting Range	Default	Setting Enable Condition	Set Data Check Timing
1	Zero point address	−2147483648 to 2147483647 PLS	0	PC ready signal (Y1D) must be turned OFF.	When zero return start signal (Y10) is turned ON
2	Zero return velocity	1 to 1000000 PLS/s	10000PLS/s		
3	Creep velocity	1 to 1000000 PLS/s	1000 PLS/s		
4	Axis travel distance after near-zero point signal ON (only in the count mode)	0 to 2147483647 PLS	75 PLS		

* Set the zero return direction and mode using slide switches. (Refer to Section 4.5.)

(1) Axis travel distance set pulse after near-zero point signal ON
Set the number of pulses so that the position does not overlap with the reference point signal where it is greater than the zero return velocity deceleration distance.

$$\text{Deceleration distance} = \frac{1}{2} \times \text{zero return velocity} \times \text{actual deceleration time}$$

(Example)
Zero return velocity: 10 kpps (default value)
Creep velocity: 1 kpps (default value)
Deceleration time: 300 msec (default value)

Deceleration distance

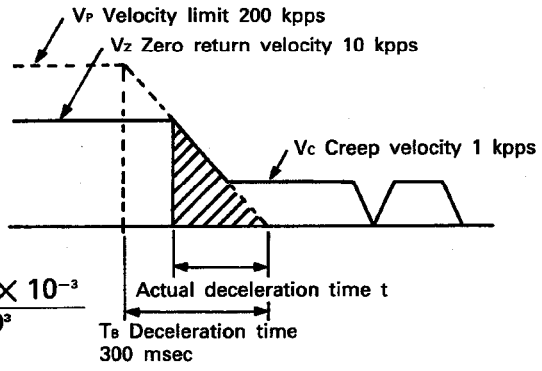
$$= \frac{1}{2} V_Z \, t$$

$$= \frac{1}{2} V_Z \times \frac{V_Z}{V_P} T_B$$

$$= \frac{V_Z^2 T_B}{2V_P}$$

$$= \frac{(10 \times 10^3)^2 \times 300 \times 10^{-3}}{2 \times 200 \times 10^3}$$

$$= 75 \text{ PLS}$$



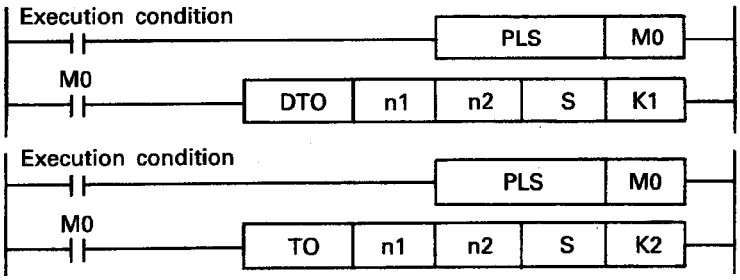
Note: Do not include the electronic gear in deceleration distance calculations.

When setting the near-zero point dog position near the center of the reference point signal high range, if the axis travel distance after near-zero point signal ON is turned to a multiply of the number of output pulses in one rotation of the servo motor, the axis travel distance position after near-zero point signal ON will not overlap with the reference point signal.

5.3.3 Buffer memory

As shown in Fig. 5.11, zero return data is stored in the buffer memory using the user program. Read and write 2-words of data simultaneously from and to the buffer memory. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



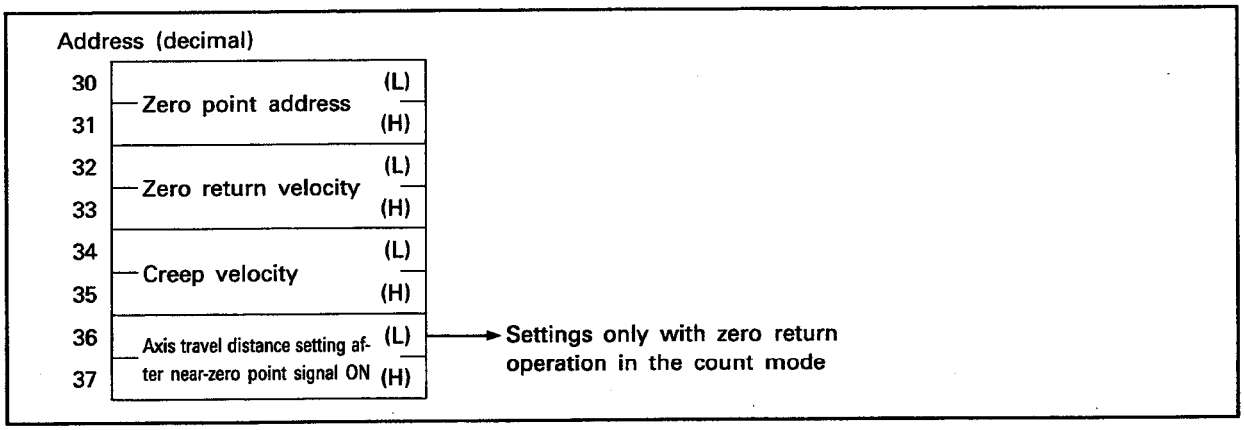
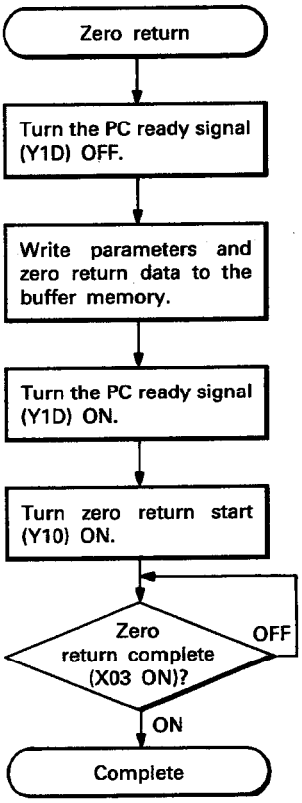


Fig. 5.11 Zero Return Data Area

5.3.4 Example zero return program

(1) Program flow



(2) Start conditions

Table 5.3 Zero Return Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at forward zero return direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at forward zero return direction
	DOG	Near-zero point dog	OFF	Only in near-zero point dog mode
Interface signal	X01	AD70D ready completion	ON	
	X03	Zero return completion	OFF	Only in near-zero point dog mode
	X04	BUSY	OFF	
	X07	Reference point pass	ON	Valid if ON at zero return correction travel distance in the near-zero point dog and count modes
	X0B	Servo ready	ON	Servo ready must be ON.
	Y17	Stop signal	OFF	
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	Zero return data		No error	No data start at error.

(3) Related signal timing

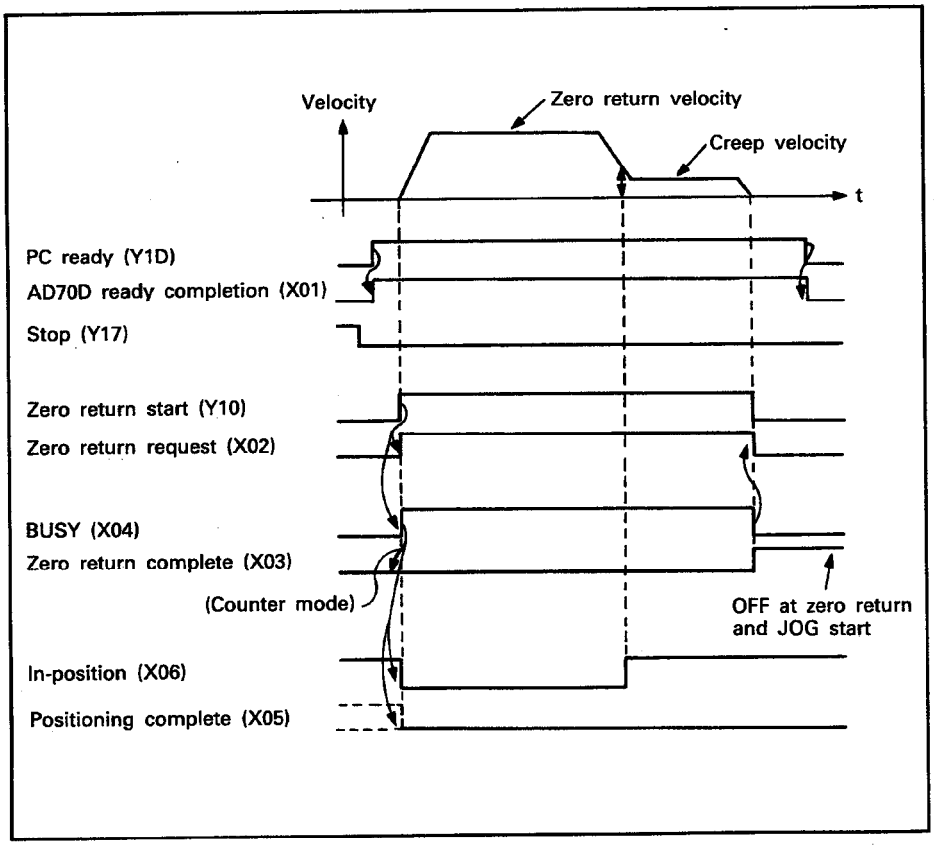


Fig. 5.12 Zero Return Timing

Refer to Section 3.8 for I/O signal details.

(4) Example zero return program in near-zero point dog mode

(Conditions)

1) Writes in one scan after CPU RUN.

2) Execute zero return operation using zero return command.

3) Fixed, servo, and variable parameter settings (Section 5.2.3 Program) are regarded to be completed.

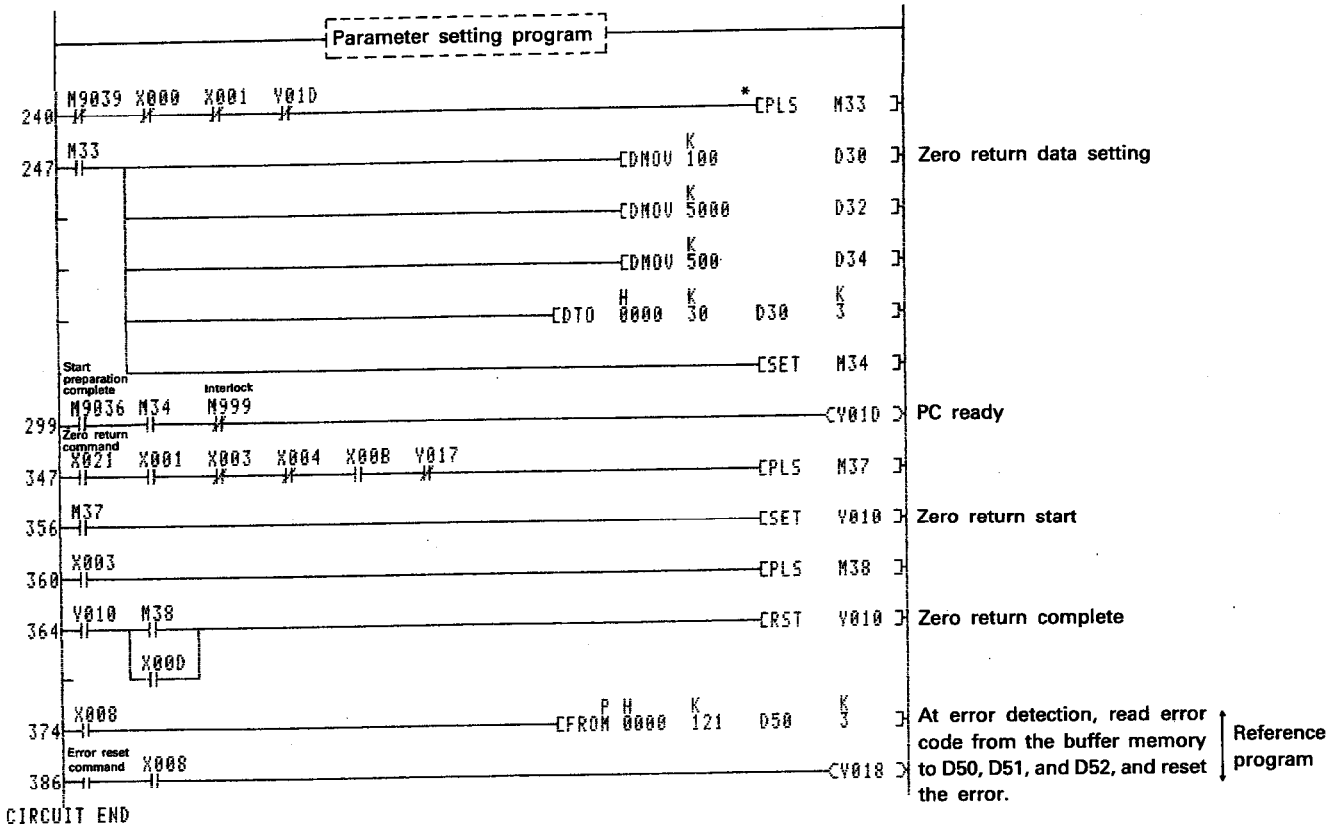
4) Start conditions are given in Section 5.3.

5) Slide switch settings for SW2 and SW3 OFF (near-zero point dog mode).

6) Turn PC ready (Y1D) ON after the completion of writing of fixed and servo parameters and zero return data.

7) Set the following data as zero return data.

	Set Value	Device Used	Buffer Memory Address
Zero point address	100 PLS	D31, D30	31, 30
Zero return velocity	5000 PLS/sec	D33, D32	33, 32
Creep velocity	500 PLS/sec	D35, D34	35, 34



* When using instructions such as the MOVP and DTOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

(5) Example zero return program in count mode

(Conditions)

1) Writes in one scan after CPU RUN.

2) Execute zero return operation using zero return command.

3) Fixed, servo, and variable parameter settings (Section 5.2.3 Program) are regarded to be completed.

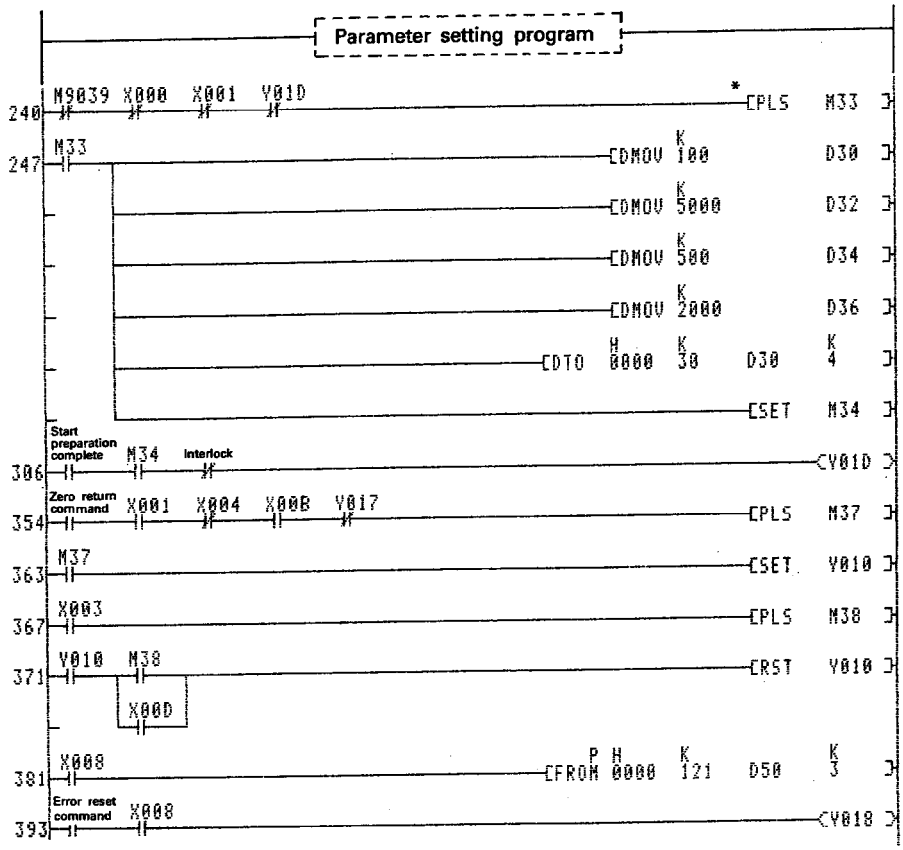
4) Start conditions are given in Section 5.3.

5) Slide switch settings for SW2 ON and SW3 OFF (count mode).

6) Turn PC ready (Y1D) ON after the completion of writing of fixed and servo parameters and zero return data.

7) Set the following data as zero return data.

	Set Value	Device Used	Buffer Memory Address
Zero point address	100 PLS	D31, D30	31, 30
Zero return velocity	5000 PLS/sec	D33, D32	33, 32
Creep velocity	500 PLS/sec	D35, D34	35, 34
Axis travel distance after the signal triggered by passing the near-zero point dog is turned ON	2000 PLS	D37, D36	37, 36



* When using instructions such as the MOVP and DTOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

(6) Example zero return program in the data set mode

(Conditions)

1) Writes in one scan after CPU RUN.

2) Execute zero return operation using zero return command.

3) Fixed, servo, and variable parameter settings (Section 5.2.3 Program) are regarded to be completed.

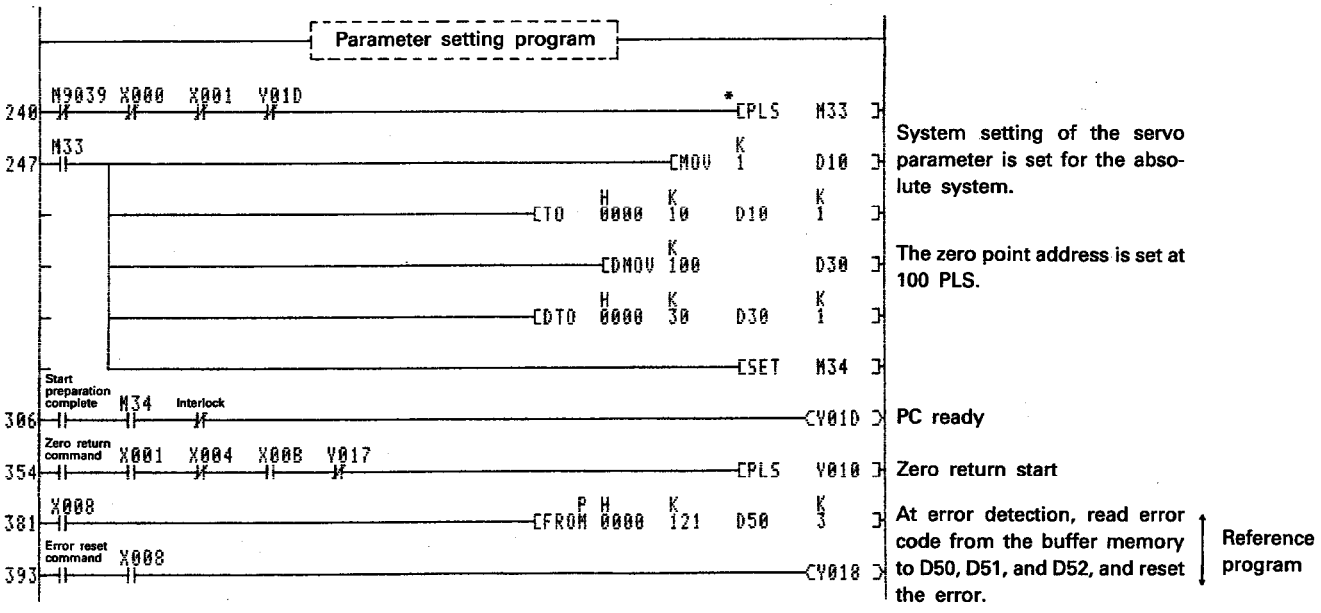
4) Start conditions are given in Section 5.3.

5) Slide switch settings for [SW2] OFF and [SW3] ON (data setting mode).

6) Turn PC ready (Y1D) ON after the completion of writing of fixed and servo parameters and zero return data.

7) Set the following data as zero return data.

	Set Value	Device Used	Buffer Memory Address
Zero point address	100 PLS	D31, D30	31, 30



* When using instructions such as the MOVP and DTOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

5.3.5 Stop processing during zero return operation and re-start after stop

(1) Factors which stop processing during zero return operation are given below.

Table 5.4 Stop Processing During Zero Return Operation

No.	Stop Factor	Stop Processing		
		Error Detection (X8)	Error Code	Stop Mode
1	External stop signal is turned ON.	X8 ON	Error code reset	*1 Deceleration processing, with No. 4, 5, and 8 at free run.
2	Stop signal (Y17) is turned ON.			
3	PC ready signal (Y1D) is turned OFF.			
4	Servo ready signal (X0B) is turned ON.			
5	Servo OFF signal (Y1B) is turned ON.			
6	Upper limit LS (FLS) is turned OFF.			
7	Lower limit LS (RLS) is turned OFF.			
8	PC power supply is turned OFF.	—	Error code reset	
9	Servo alarm	X8 ON	Error code reset	Depending on error content *2
10	Emergency stop signal is turned ON.	—	Error code reset	Immediate stop

*1 Deceleration is deter mind by the parameter set deceleration time and velocity limit. For No. 6 and 7, stop processing is executed only when the LS in the same direction as the axis is moving is turned OFF.

*2 Occurrence of any of the servo error codes 2010 to 2055 and 2147 results in a sudden stop. When any of 2100 to 2146 occurs, operation continues, Error detection X8 remains OFF, and only the servo error code is set.

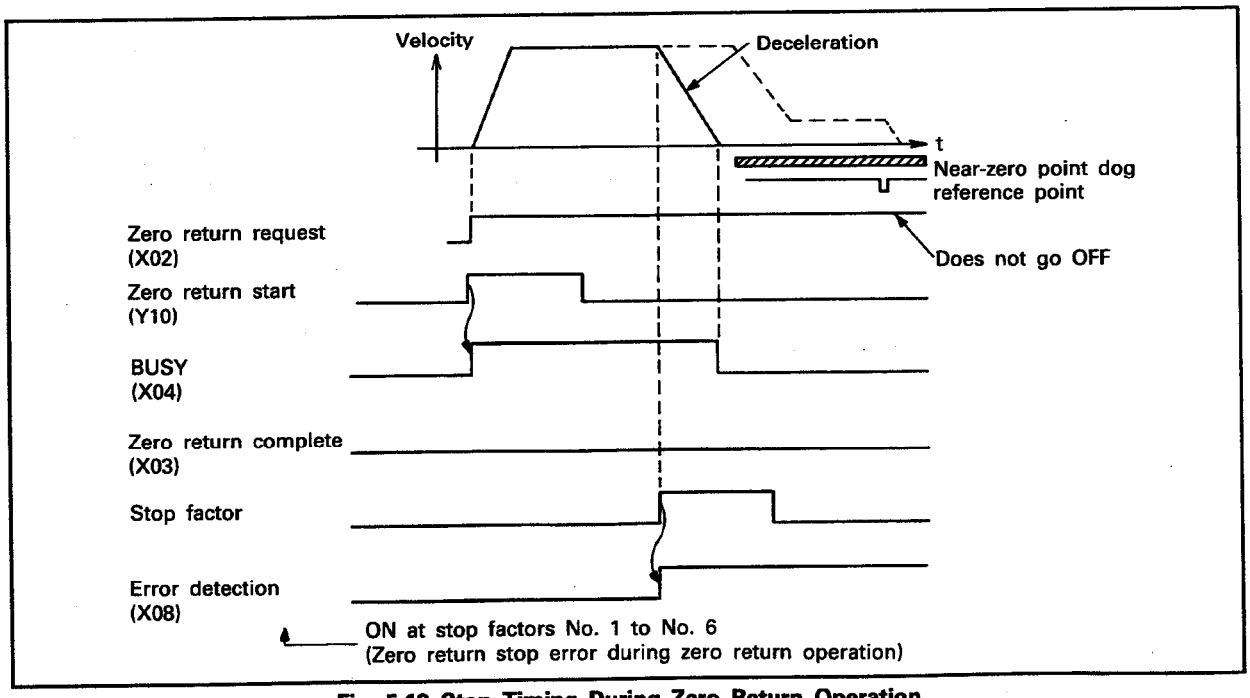


Fig. 5.13 Stop Timing During Zero Return Operation

(2) Re-start after stop during zero return operation

Whether re-start can be executed or not after stop during zero return operation is as indicated below.

Stop Position	Zero return Mode	
	Near-zero Point Zero Return	Count Mode
Before near-zero point signal is turned ON	Enabled	Enabled
At near-zero point dog	Disabled *1	Enabled
After near-zero point signal is turned OFF	Disabled *2	Disabled *2

*1 Operation does not start due to error code 1003.

*2 If zero return start is executed after the near-zero point signal is turned OFF, the CPU will malfunction. Re-start using the user program.

In both *1 and *2, restart using the JOG operation after returning to a restartable position.

5.4 One-phase Trapezoidal Positioning

5.4.1 Positioning mode

(1) Set the positioning pattern, address, and velocity from the user program and execute positioning in the incremental or absolute mode using the positioning start command from the PC CPU.
Specify incremental or absolute mode (refer to Section 1.2) using the start signal.

Start Signal	Positioning Start
Y11	Absolute mode positioning start
Y12	Incremental mode forward start (addresses increasing)
Y13	Incremental mode reverse start (addresses decreasing)

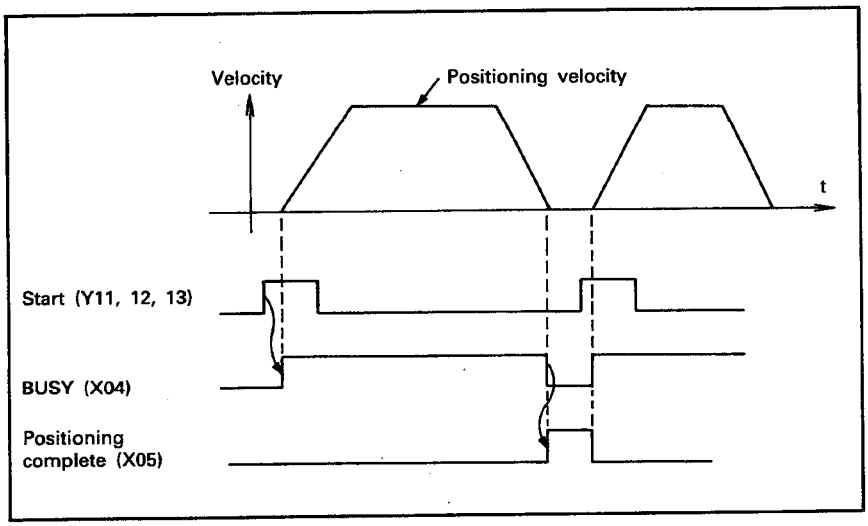


Fig. 5.14 Positioning

(2) Refer to Section 5.10 for stop processing and re-starting after a stop during positioning.

(3) The following control changes can be executed by writing data to the buffer memory control change area from the user program. (Refer to Section 5.9.)

1) Present value change

2) Velocity change

3) Servo parameter change

4) Torque limit change

(4) Since the present value is monitored during positioning, if incremental mode positioning or a combination of incremental and absolute mode positioning is repeatedly executed, the stroke limit range will be exceeded, resulting in an error. In this case, change present value to within the stroke limit range.

(5) Since there is no dwell time function, set the timer from the user program using the positioning complete signal (X05) if the dwell is required.

5.4.2 Positioning data settings

Table 5.5 shows the positioning data, data setting enable conditions, and data check timing.

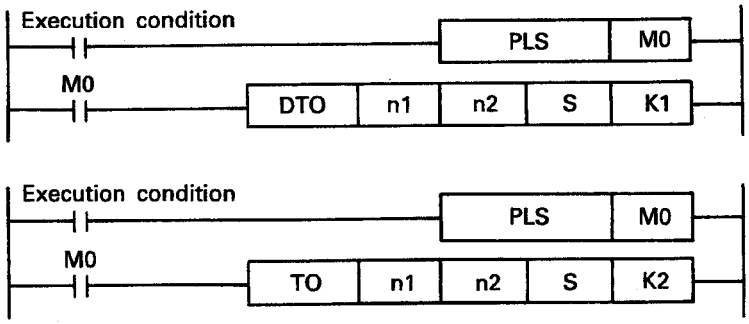
Table 5.5 Positioning Data

No.	Item	Setting Range	Default	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0: One-phase trapezoidal positioning 1: Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON if written while the BUSY signal is turned ON.	When positioning start signal (Y11 to Y13) is turned ON
2	Positioning address P_1 (Axis travel distance at velocity/position control switchover mode or in the incremental mode)	−2147483648 to 2147483647 PLS (0 to 2147483647 PLS at velocity/position control switchover mode or in the incremental mode)	0		
3	Positioning velocity V_1	1 to 1000000 PLS/sec	0		

5.4.3 Buffer memory

Positioning data from the user program is stored in the buffer memory area shown in Fig. 5.15.
Read and write of 2-word data such as upper and lower stroke limits and velocity limits from and to the buffer memory should be done simultaneously for 2-words. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



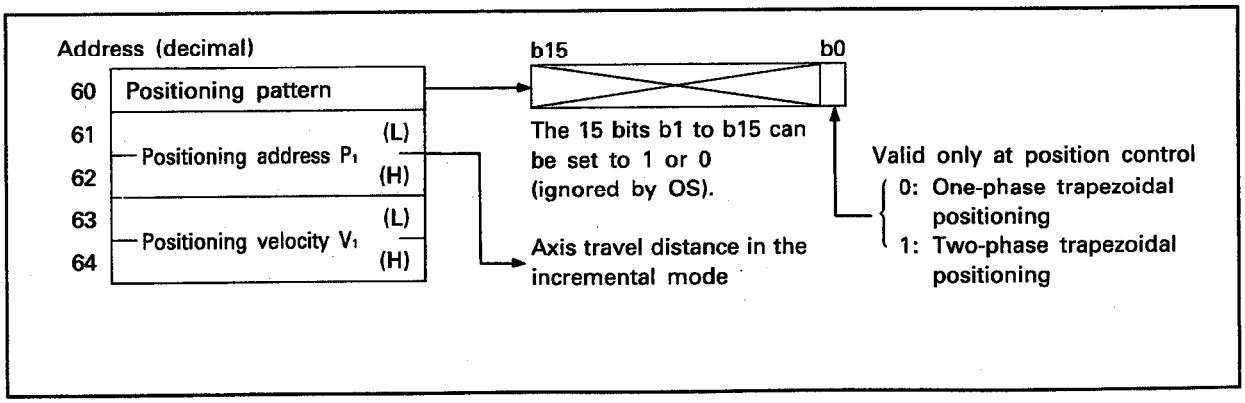
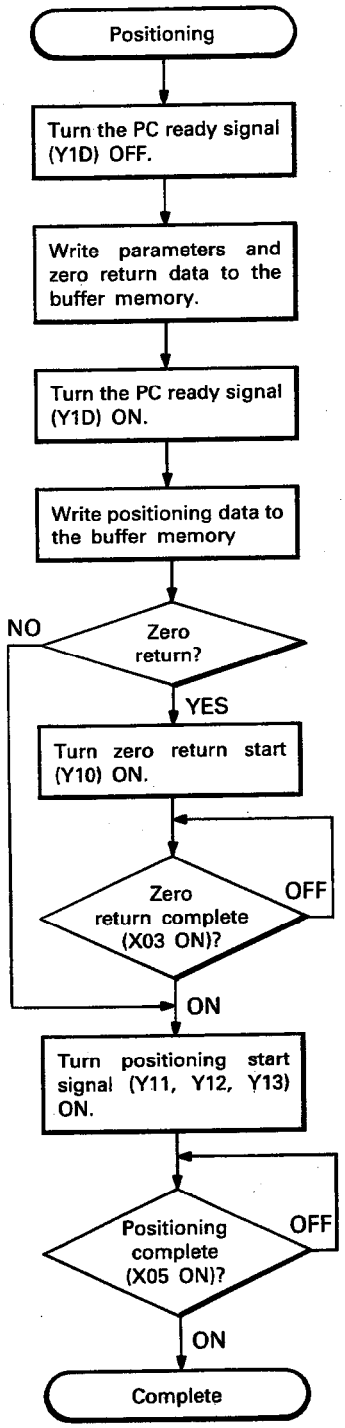


Fig 5.15 Positioning Data Area

5.4.4 Example positioning start program

(1) Program flow



(2) Start conditions

Table 5.6 Positioning Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at start of positioning in the forward direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at start of positioning in the reverse direction
Interface signal	X01	AD70D ready completion	ON	
	X04	BUSY	OFF	
	X0B	Servo ready	ON	Servo ready must be ON.
	Y17	Stop signal	OFF	
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	Positioning data		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(3) Related signal timing

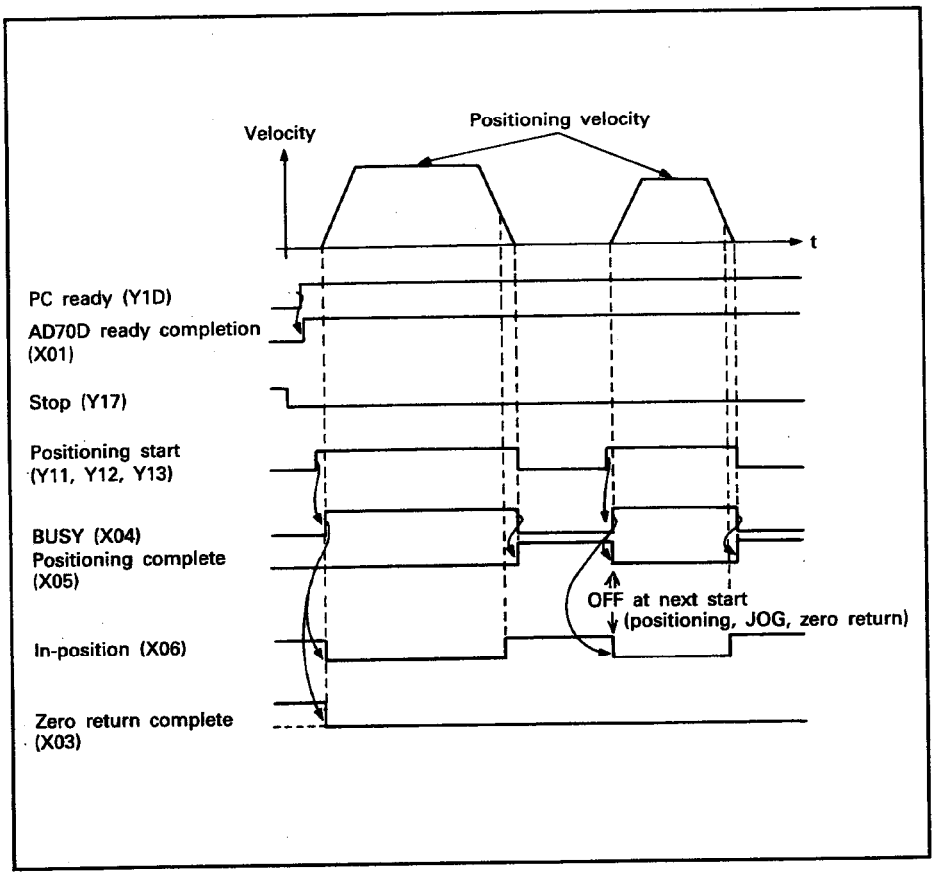


Fig. 5.16 Positioning Timing

(4) Example positioning program

(Conditions)

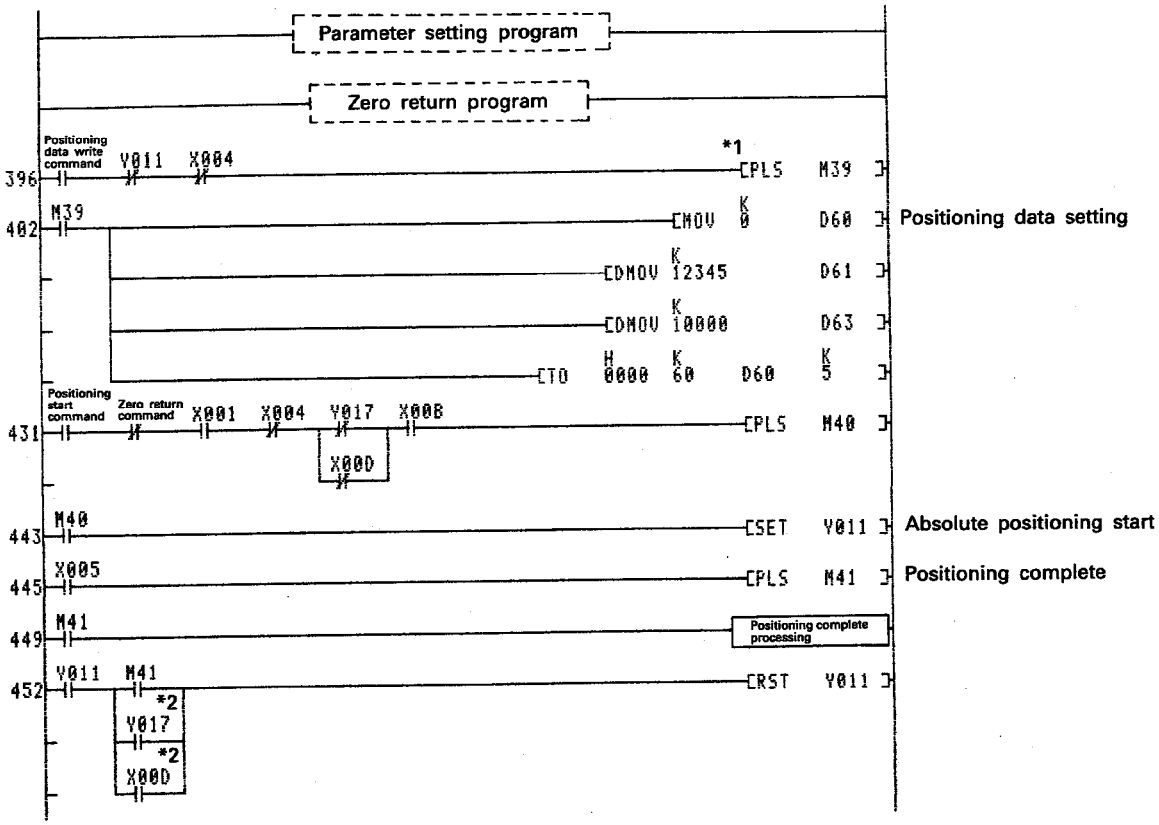
1) Execute absolute positioning using positioning start command.

2) Parameters settings (Section 5.2.3 Program) zero return (Section 5.3.4 Program) are regarded to be completed.

3) Start conditions are shown in Table 5.6.

4) Positioning data indicated below is set.

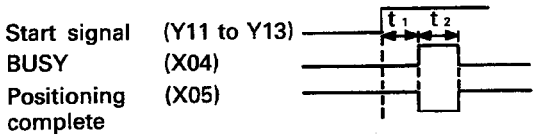
	Set Value	Device Used	Buffer Memory Address
Positioning pattern	0	D60	60
Positioning address	12345 PLS	D62, D61	62, 61
Positioning velocity	10000 PLS/s	D64, D63	64, 63

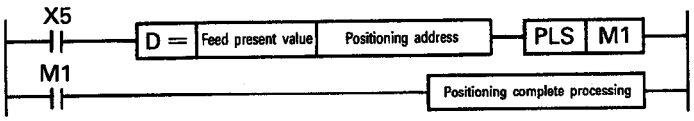


*1 When using instructions such as the MOVP and TOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.
*2 When stopping during positioning using the stop command, reset the start signal so that positioning can re-started.

REMARK

When the positioning operation time (t_2) after the second positioning in repeated positioning operation is shorter than the scan time, the sequence program cannot detect the (ON/OFF status change (ON → OFF → ON) positioning complete signal (X05). If this timing must be detected, set the positioning complete timing using the following program.





Positioning complete signal

Refer to Section 5.11 for how to read the feed present value.

5.5 Two-Phase Trapezoidal Positioning

5.5.1 Positioning

(1) Set the positioning pattern, address (P1 and P2), and velocity (V1 and V2) from the user program. After reaching positioning address P1 using 1 positioning start command from the PC CPU, the positioning velocity is automatically changed to V2. Execute positioning in the incremental or absolute mode. Execute incremental and absolute mode specification (refer to Section 1.2) using the start signal.

Start Signal	Positioning Start
Y11	Absolute mode positioning start
Y12	Incremental mode forward start (addresses increasing)
Y13	Incremental mode reverse start (addresses decreasing)

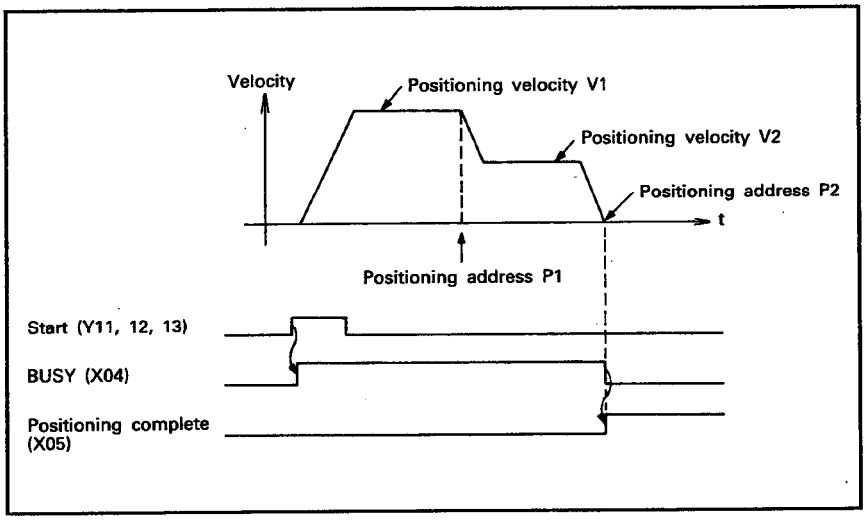
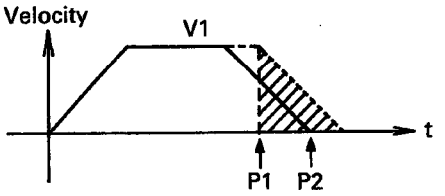


Fig. 5.17 Two-phase Trapezoidal Positioning

(2) When the axis travel distance from positioning address P1 to P2 is less than the deceleration distance at P1, two-phase positioning cannot be executed.
Positioning is executed according to positioning address P2 and velocity V1.



P1 deceleration distance

$$= \frac{1}{2} \times \text{actual deceleration time} \times \text{positioning velocity V1}$$

$$\geqq P2 - P1$$

(3) When starting positioning in the absolute mode, set the positioning address so that the direction from the present value to P1 is the same as that from P1 to P2. An error occur if address P2 is set in the reverse direction.

Setting Example		Positioning Direction (present value to P1)	
		Addresses increasing	Addresses decreasing
1	P1 = 10000 PLS, P2 = 5000 PLS	Error	OK
2	P1 = 10000 PLS, P2 = 15000 PLS	OK	Error

(4) It is possible to set positioning velocity V2 to greater than V1 (V2 > V1).

(5) Refer to Section 5.10 for stop processing and re-starting after a stop during positioning.

(6) The following control changes can be executed by writing data to the buffer memory control change area from the user program. (Refer to Section 5.9.)

1) Present value change

2) Velocity change

3) Servo parameter change

4) Torque limit change

(7) Since the present value is monitored during positioning, if incremental mode positioning or a combination of incremental and absolute mode positioning is repeatedly executed, the stroke limit range will be exceeded, resulting in an error. In this case, change present value to within the stroke limit range.

(8) Since there is no dwell time function, set the timer from the user program using the positioning complete signal (X05) if the dwell is required.

5.5.2 Positioning data settings

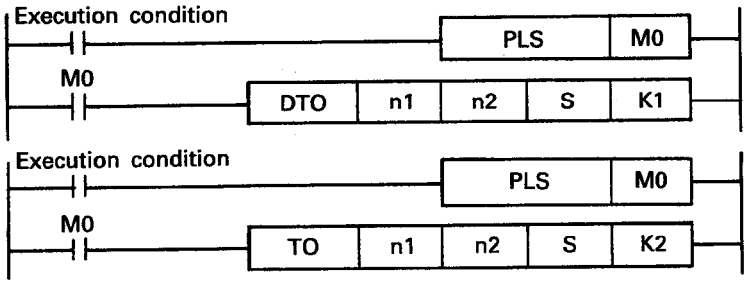
Table 5.7 Positioning Data

No.	Item	Setting Range	Default	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0: One-phase trapezoidal positioning 1: Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, if written while the BUSY signal is turned ON, they will be fetched when the next start signal is turned ON.	When positioning start signal (Y11 to Y13) is turned ON
2	Positioning address P_1 (Switchover point to axis travel distance P_2, V_2 in the incremental mode)	−2147483648 to 2147483647 PLS (0 to 2147483647 PLS in the incremental mode)	0		
3	Positioning velocity V_1	1 to 1000000 PLS/sec	0		
4	Positioning address P_2 (Axis travel distance in the incremental mode)	−2147483648 to 2147483647 PLS (0 to 2147483647 PLS in the incremental mode)	0		
5	Positioning velocity V_2	1 to 1000000 PLS/sec	0		

5.5.3 Buffer memory

Positioning data from the user program is stored in the buffer memory area shown in Fig. 5.18.
Read and write of 2-word data values such as upper and lower stroke limits and velocity limits from and to the buffer memory should be done simultaneously for 2-words. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



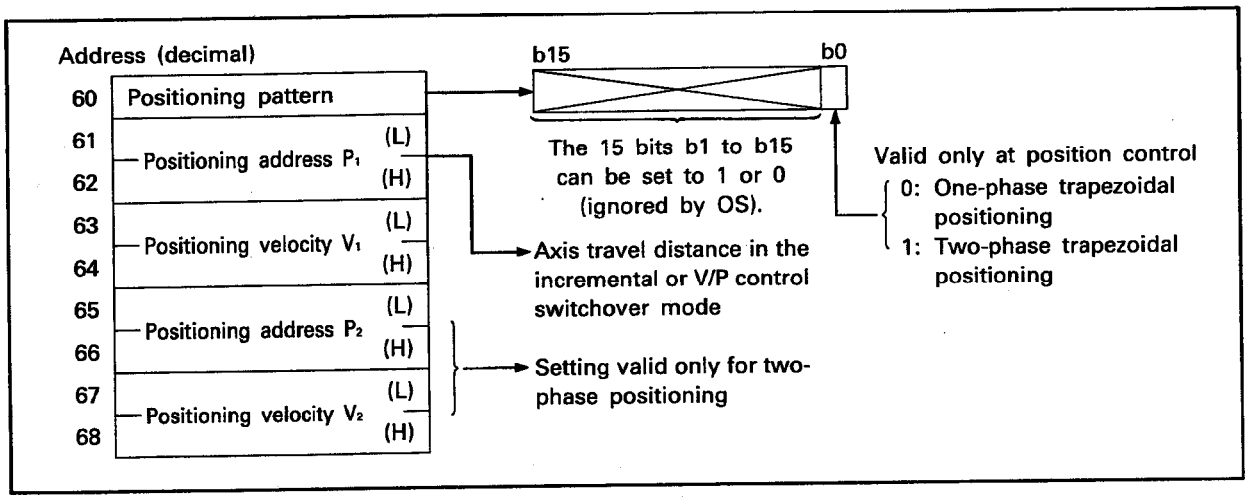
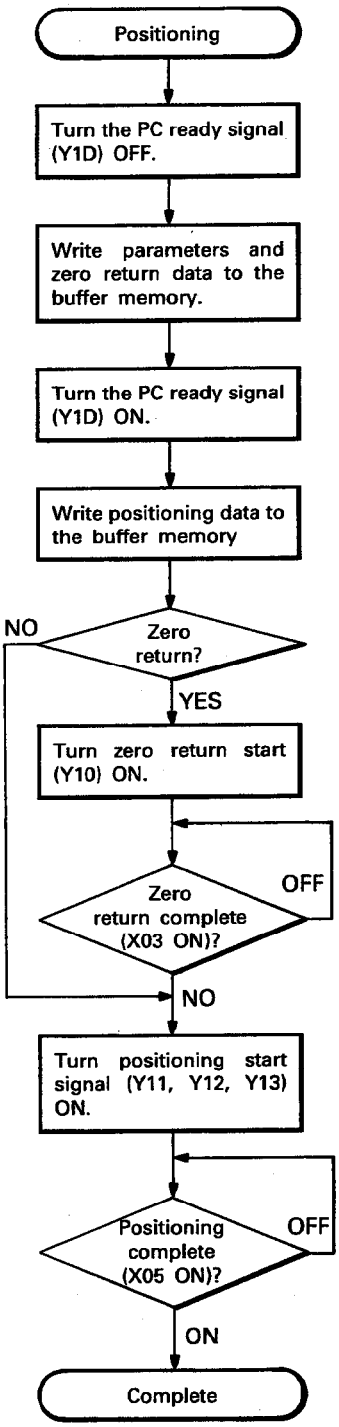


Fig 5.18 Positioning Data Area

5.5.4 Example two-phase positioning program

(1) Program flow



(2) Start conditions

Table 5.8 Positioning Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at start of positioning in the forward direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at start of positioning in the reverse direction
Interface signal	X01	AD70D ready completion	ON	
	X04	BUSY	OFF	
	X0B	Servo ready	ON	Servo ready must be ON.
	Y17	Stop signal	OFF	
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	Positioning data		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(3) Related signal timing

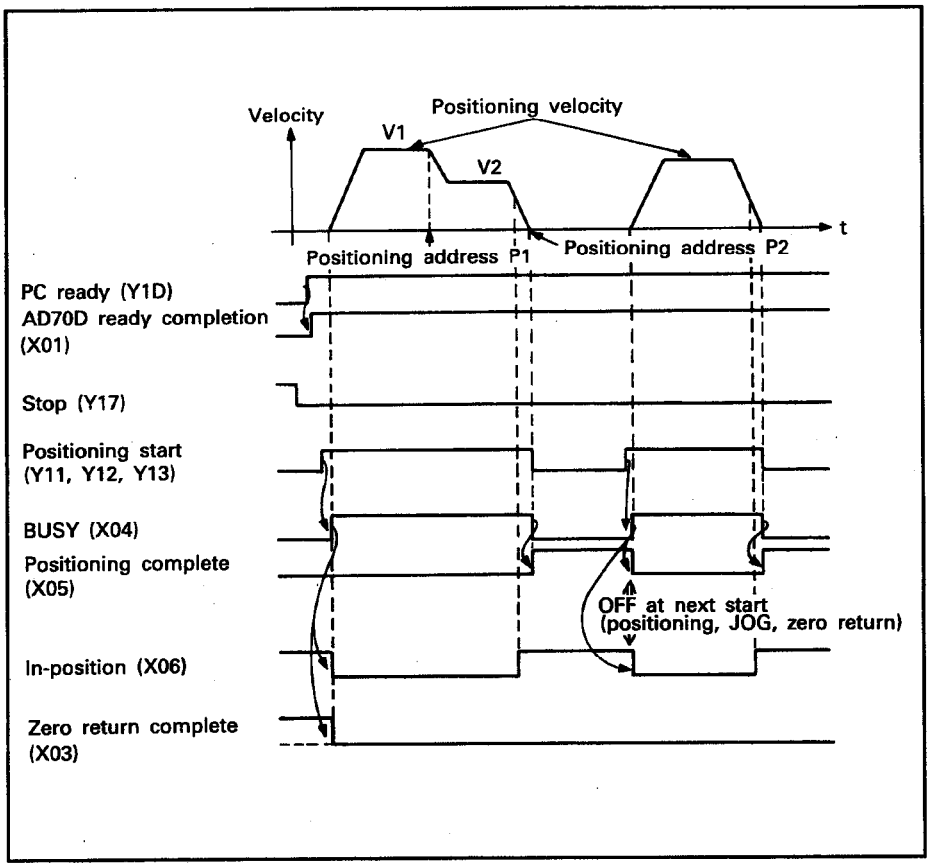


Fig. 5.19 Positioning Timing

(4) Example positioning program

(Conditions)

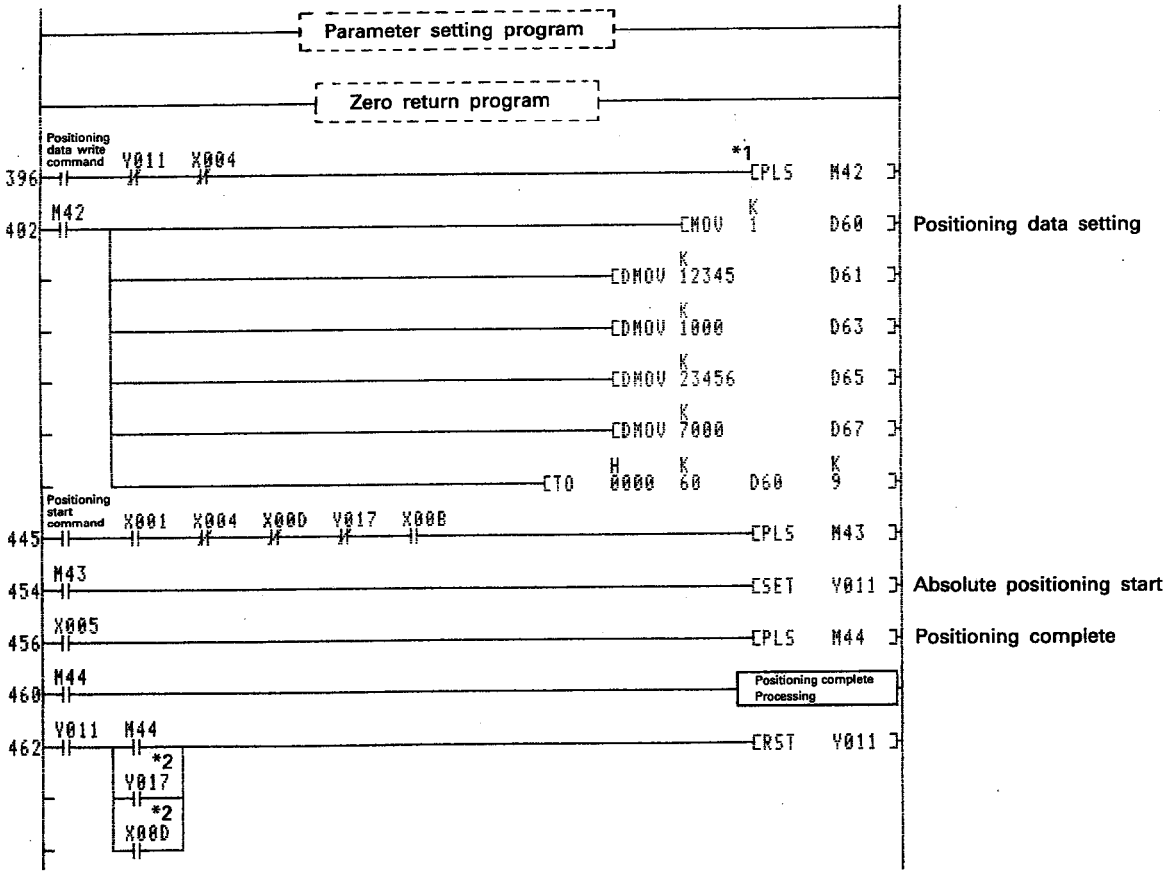
1) Execute positioning in the absolute mode for a two-phase positioning pattern using the positioning start command

2) Parameters settings (Section 5.2.3 Program) zero return (Section 5.3.4 Program) are regarded to be completed.

3) Start conditions are shown in Table 5.8.

4) Positioning data indicated below is set.

	Set Value	Device Used	Buffer Memory Address
Positioning pattern	1	D60	60
Positioning address P1	12345 PLS	D62, D61	62, 61
Positioning velocity V1	10000 PLS/s	D64, D63	64, 63
Positioning address P2	23456 PLS	D66, D65	66, 65
Positioning velocity V2	7000 PLS/s	D68, D67	68, 67



*1 When using instructions such as the MOVP and TOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

*2 When stopping during two-phase positioning using the stop command, reset the start signal so that positioning can be re-started.

5.6 V/P Control Switchover

5.6.1 Positioning

(1) Set the V/P control switchover mode, positioning address, and positioning velocity from the user program and start positioning operation according to positioning velocity previously set by a single start signal from the PC CPU. In response to the control mode switchover signal input from an external device, control mode is changed to the positioning control mode, in which positioning is executed according to the positioning address.
Since there is only one positioning pattern, as shown below, two-phase positioning cannot be executed.
Set the positioning direction using the start signal.

Start Signal	Positioning Start
Y12	Forward start (addresses increasing)
Y13	Reverse start (addresses decreasing)

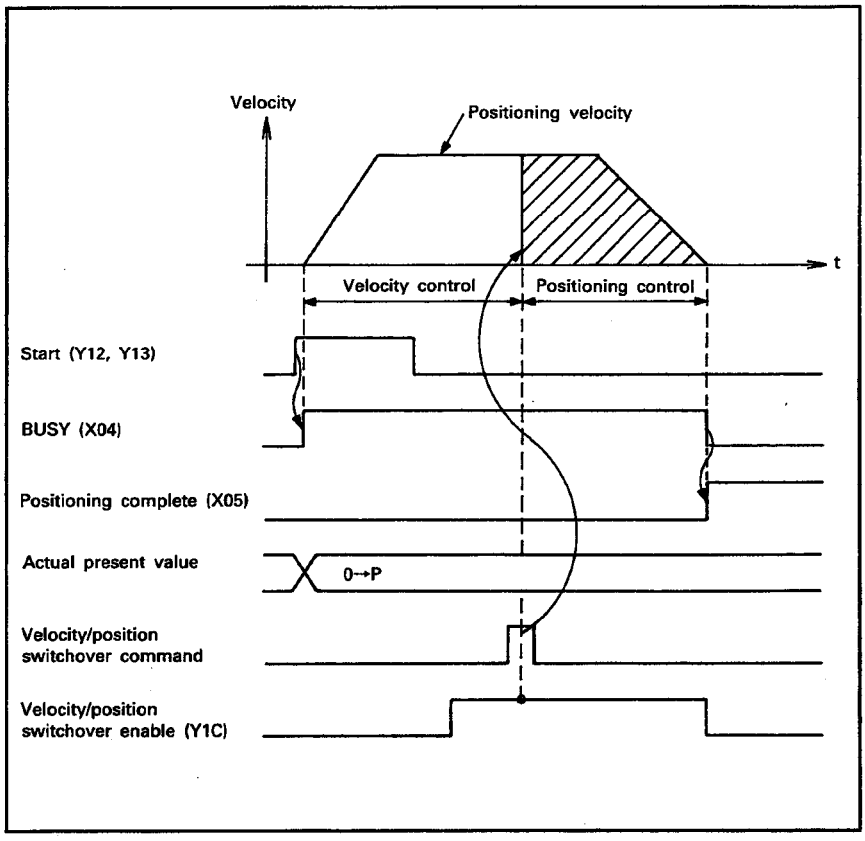


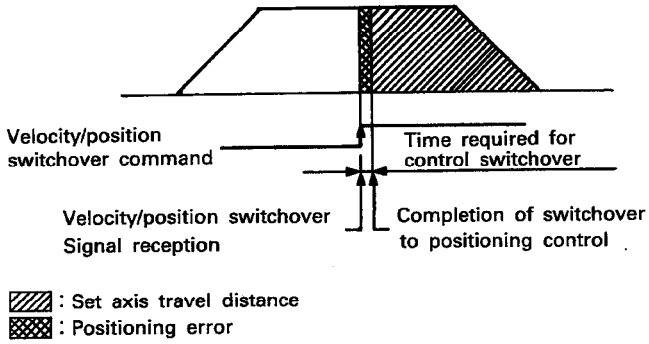
Fig. 5.20 V/P Control Switchover

(2) The present value will be set to "0" at the start of operation and is continuously updated after control is switched to velocity control.

(3) When the velocity/position control switchover enable signal (Y1C) and the velocity switchover command are turned ON at the start of operation, positioning is executed in positioning control only.

(4) When velocity switchover command and the velocity/position control switchover enable signal do not turn ON, operation continues in velocity control. Turn ON the stop signal to stop operation.

(5) Positioning error in V/P control switchover mode
In the V/P control switchover mode, control is switched by receiving a control switchover signal from an external device during velocity output. After receiving the signal, the OS requires some time to the completion of switchover to positioning control. If pulses are output during this time, distance equivalent to these pulses is regarded as positioning error.



Assume that the time required for the completion of control switchover is t μ sec, and the positioning error is calculated as follows.

$$\text{Positioning error (PLS)} = \left(\frac{\text{output velocity PLS/sec}}{10^6} \times t \right) \pm 1$$

Refer to Appendix 3 for the time t required for control switchover.

(6) Since there is no dwell time function in the AD70D, set the timer from the user program using the positioning complete signal (X05) if the dwell is required.

(7) Refer to Section 5.10 for stop processing and re-starting after a stop during positioning.

(8) The following control changes can be executed by writing data to the buffer memory control change area from the user program. (Refer to Section 5.9.)
1) Present value change
2) Velocity change
3) Velocity/position axis travel distance change
4) Servo parameter change
5) Torque limit change

5.6.2 Parameter and positioning data settings

Table 5.9 shows the required parameter and positioning data settings. Set other parameters as required. (Refer to Section 5.2.)

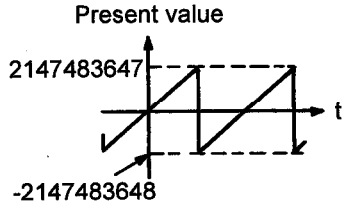
Table 5.9 Parameter and Positioning Data

No.	Item	Setting Range	Default	Setting Enable Conditions	Set Data Check Timing
1	Positioning mode (parameter)	0: Positioning 1: Velocity/positioning	0	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, if written while the BUSY signal is turned ON, they will be fetched when the next start signal is turned ON.	When positioning start signal (Y12 to Y13) is turned ON
2	Positioning address (Axis travel distance at V/P control switchover mode)	−2147483648 ~ 2147483647 (0 to 2147483647 at V/P control switchover mode)	0		
3	Positioning velocity	1 to 1,000,000PLS/sec	0		

POINT

In the V/P control switchover mode, be sure to use the travel distance from start (velocity control) within the range "0 to 2147483647". If re-start is executed in the V/P control switchover mode using the velocity/position mode re-start signal (Y16) after stop midway during operation, the present value is updated and the following positioning operation is performed.

1) If the present value exceeds the AD70D control range (-2147483648 to 2147483647) during velocity control, the overflow (X09) or underflow (X0A) signal turns ON and the present value changes again as shown below.

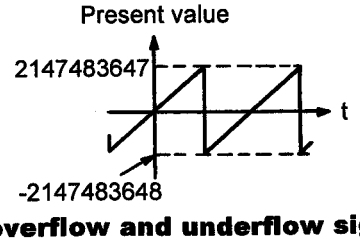


Reset the overflow and underflow signals using Overflow reset (Y19) and Underflow reset (Y1A).

2) If the present value exceeds the stroke limit range in the following position control operation status, the error code 207 is set and positioning operation continues.

- **When velocity control switches to position control**
- **During positioning control**

After the error code 207 has occurred, the overflow (X09) or underflow (X0A) signal turns ON and the present value changes again as shown below.



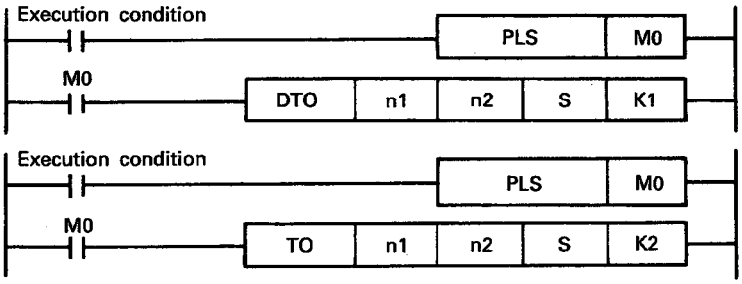
Reset the overflow and underflow signals using Overflow reset (Y19) and Underflow reset (Y1A).

5.6.3 Buffer memory

Parameter and positioning data from the user program is stored in the buffer memory area shown in Fig. 5.21.

Read and write of 2-word data values such as upper and lower stroke limits and velocity limits from and to the buffer memory should be done simultaneously for 2-words. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



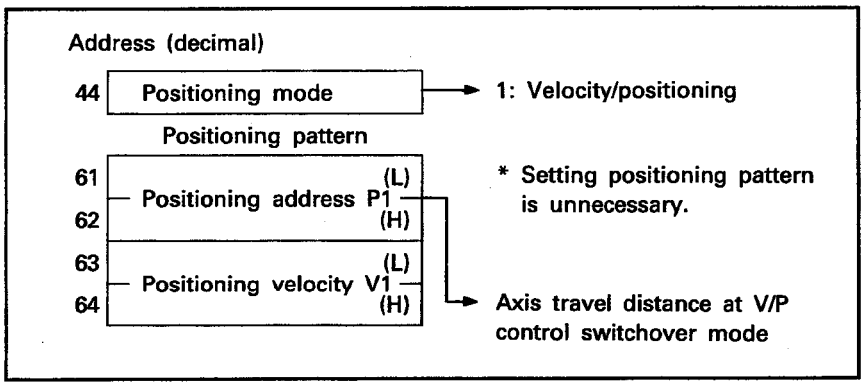
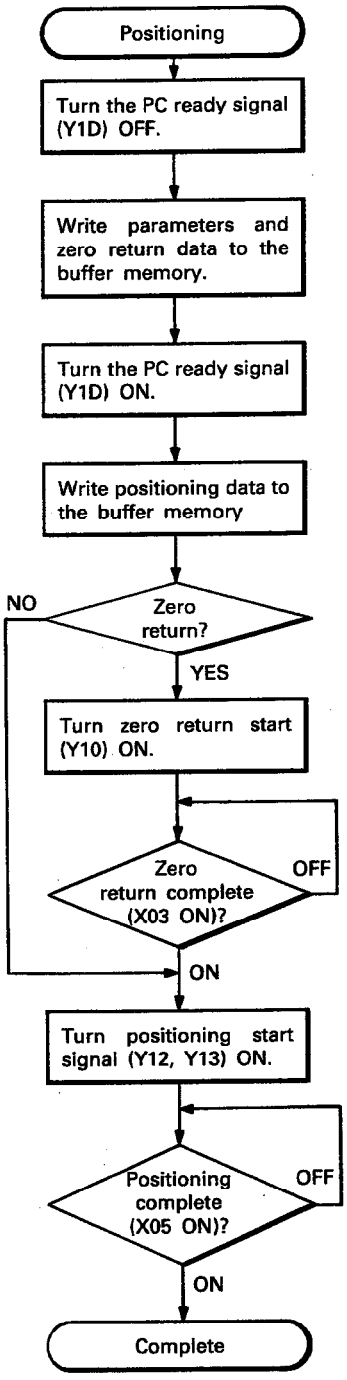


Fig. 5.21 Parameter and Positioning Data Areas

5.6.4 Example two-phase positioning program

(1) Program flow



(2) Start conditions

Table 5.10 Positioning Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at start of positioning in the forward direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at start of positioning in the reverse direction
Interface signal	X01	AD70D ready completion	ON	
	X04	BUSY	OFF	
	X0B	Servo ready	ON	Servo ready must be ON.
	Y17	Stop signal	OFF	
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	Positioning data		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(3) Related signal timing

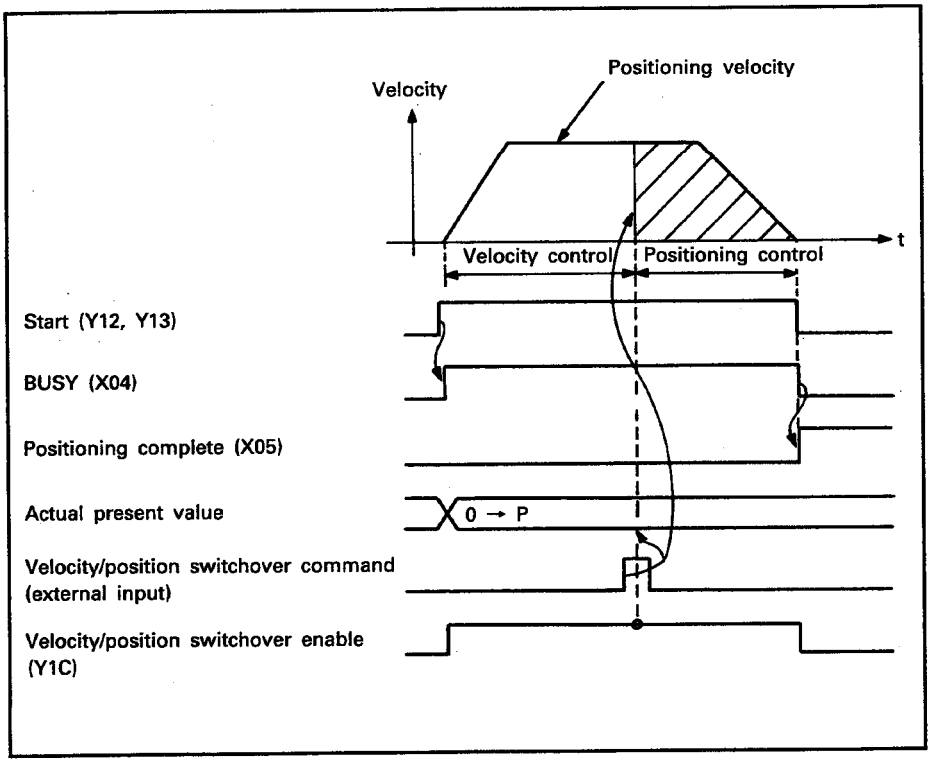


Fig. 5.22 V/P Control Switchover Timing

(4) Example V/P control switchover program

(Conditions)

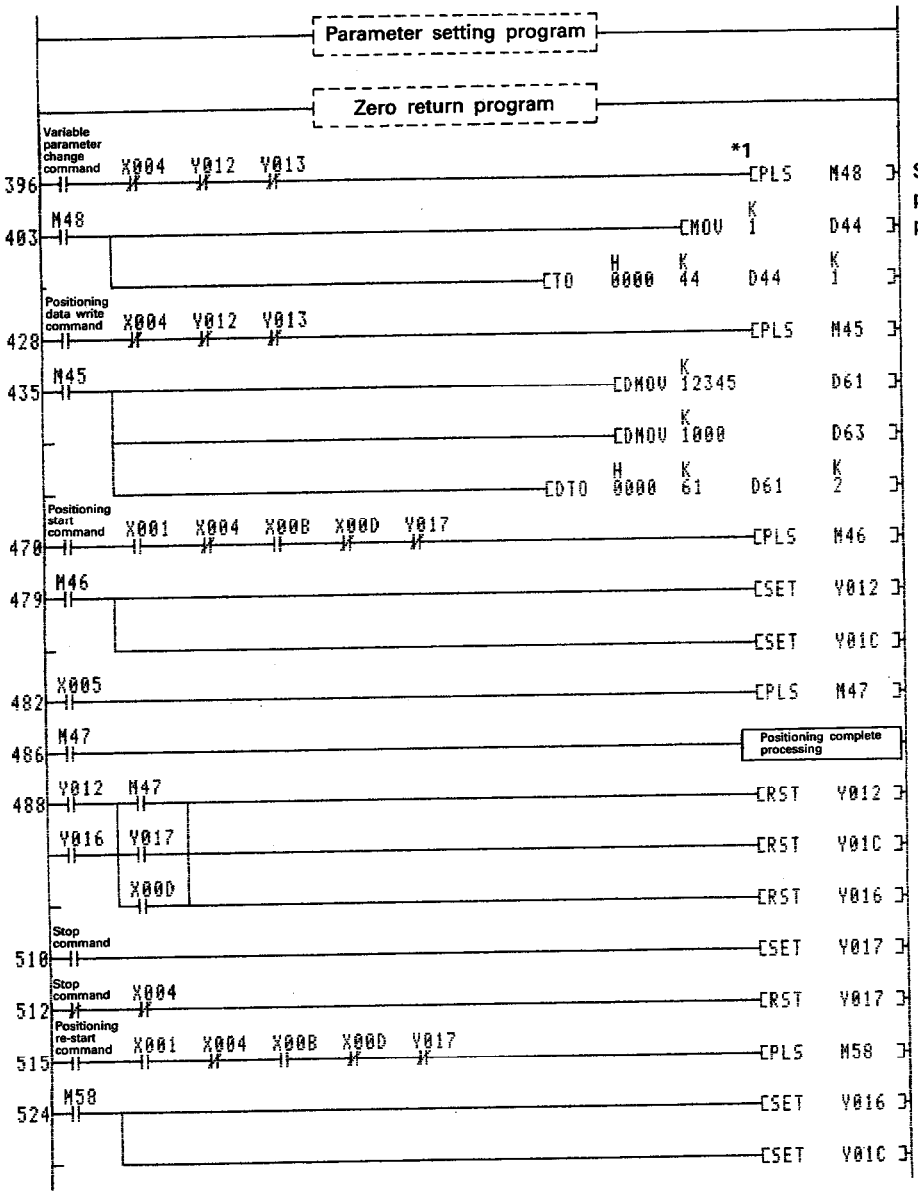
1) Start operation in velocity control using the positioning start command and execute positioning by switching to positioning control using the control switchover signal from an external device.

2) Parameters settings (Section 5.2.3 Program) zero return (Section 5.3.4 Program) are regarded to be completed.

3) Start conditions are shown in Table 5.10.

4) Variable parameter, positioning data indicated below is set.

		Set Value	Device Used	Buffer Memory Address
Variable parameter	Positioning mode	1	D44	44
Positioning data	Positioning address	12345PLS	D62, D61	62, 61
	Positioning velocity	1000PLS/sec	D64, D63	64, 63



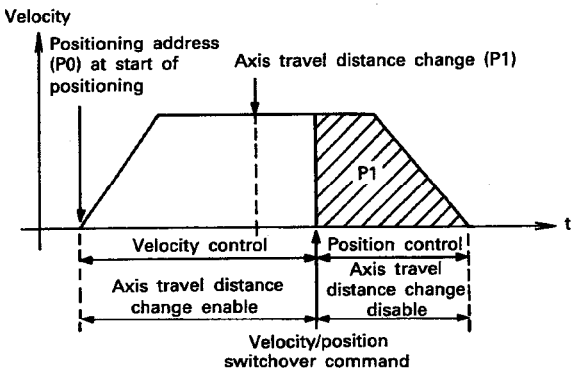
*1 When using instructions such as the MOVP and TOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

5.6.5 Velocity/position axis travel distance change

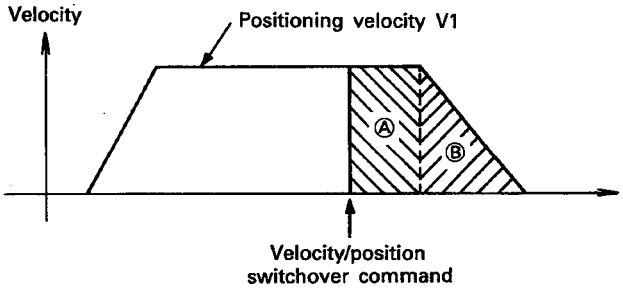
This mode is used to change the positioning address (axis travel distance) during operation in the V/P control switchover mode.

Table 5.11 Velocity/position Axis Travel Distance Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Velocity/position axis travel distance change	Lower stroke limit to upper stroke limit	1. Valid during BUSY 2. Axis travel distance change data to be written before velocity/position switchover command input	Velocity/position axis travel distance change area (86, 87)



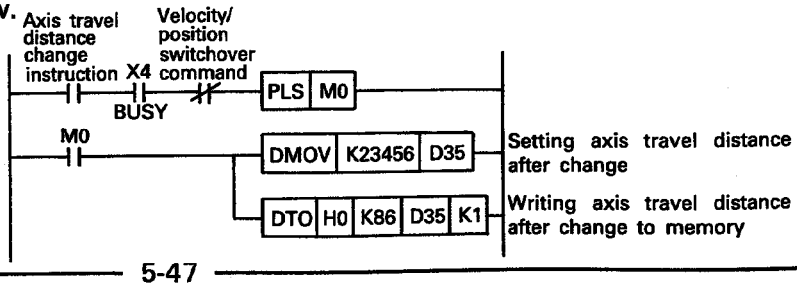
Set positioning address (axis travel distance) P1 so that it is greater than the distance shown below. If the set distance is less than the specified distance, the axis will exceed the required distance.



Axis travel distance P1 > (accumulated pulses Ⓐ when switchover command is input + deceleration distance Ⓑ)

$$= \frac{\text{positioning velocity}}{\text{position loop gain}} + \frac{1}{2} \times \text{actual deceleration time} \times \text{positioning velocity}$$

An example program which changes the axis travel distance during operation in the V/P control switchover mode is shown below.



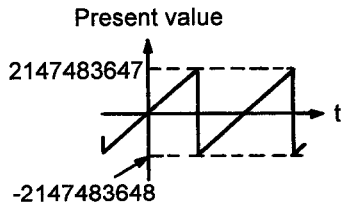
5.6.6 Example velocity control mode operation program

(1) Velocity control mode operation can be executed using the velocity control function of the V/P control switchover mode. Set the positioning velocity in the V/P control switchover mode from the user program and execute velocity mode operation using the start signal from the PC CPU. Use the stop command to stop operation. Specify forward and reverse direction for positioning using the start signal.

Start Signal	Positioning Mode
Y12	Forward (addresses increasing)
Y13	Reverse (addresses decreasing)

(2) The present value will also be updated during velocity mode operation.

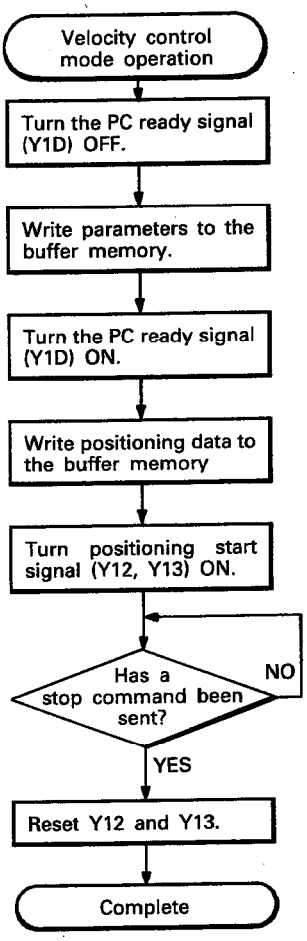
- When re-start is executed by Y16 after a stop, the present value will be continuously updated. However, when re-start is executed by Y12 or Y13, the present value will be updated after being cleared.
- If the present value exceeds the AD70D control range (-2147483648 to 2147483647) during velocity mode operation, the overflow (X09) or underflow (X0A) signal turns ON and the present value changes again as shown below.



Reset the overflow and underflow signals using Overflow reset (Y19) and Underflow reset (Y1A).

(3) Velocity control mode operation is possible within the range between the upper and lower limit LS.

(4) Program flow



(5) Start conditions

Table 5.12 Positioning Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at start of positioning in the forward direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at start of positioning in the reverse direction
Interface signal	X01	AD70D ready completion	ON	
	X04	BUSY	OFF	
	X0B	Servo ready	ON	Servo ready must be ON.
	Y17	Stop signal	OFF	
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	Positioning data		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(6) Related Signal Timing

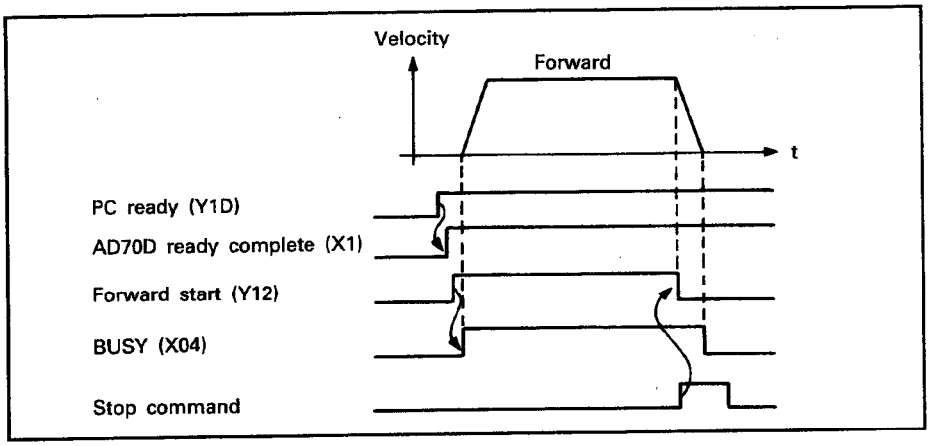


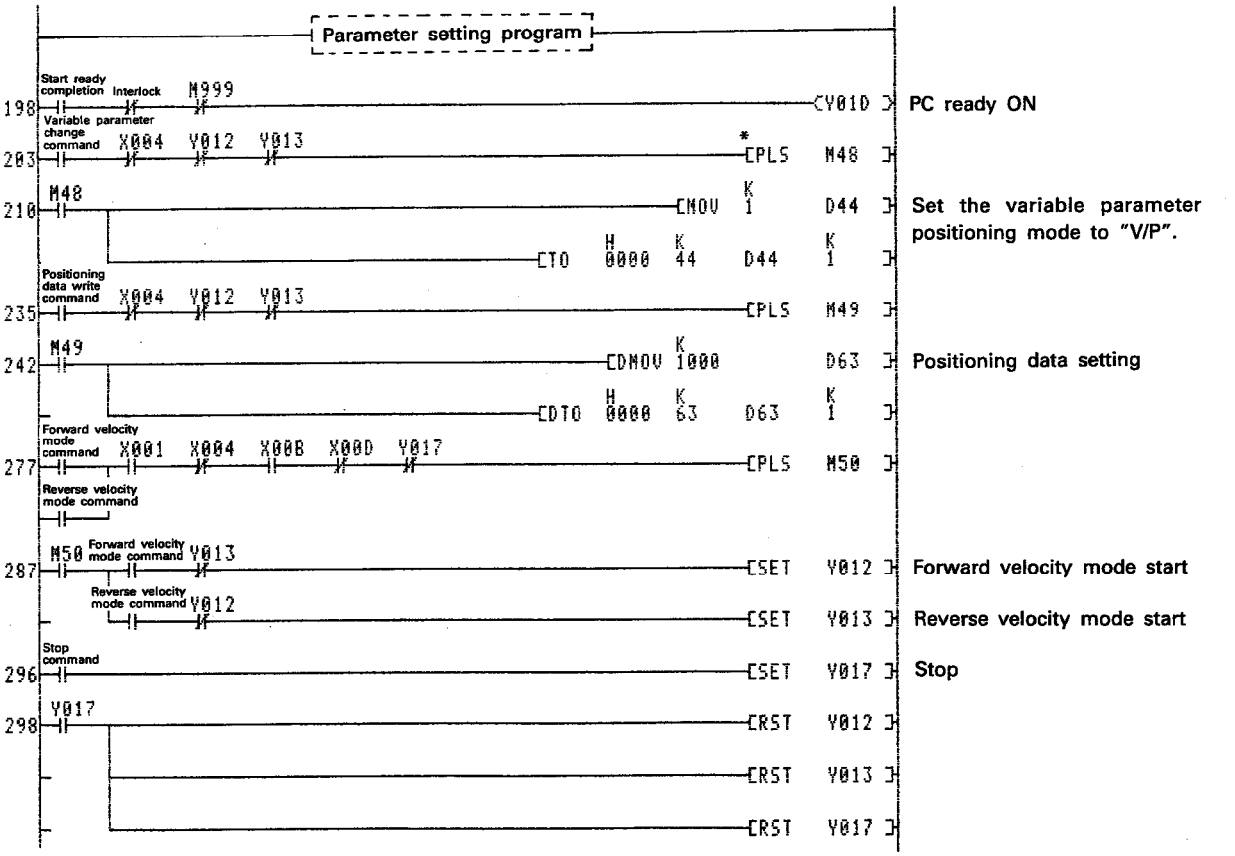
Fig. 5.23 Velocity Control Mode Operation

(7) Example velocity mode operation program

(Conditions)

1) Execute velocity mode operate using the start command and stop using the stop command.
2) Parameter settings (Section 5.2.3 Program) are regarded to be completed.
3) Start conditions are given in Table 5.12.
4) Turn PC ready (Y1D) ON after write completion of fixed and servo parameters.
5) Set the following data as variable parameters and positioning data.

		Set Value	Device Used	Buffer Memory Address
Variable parameter	Positioning mode	1	D44	44
Positioning data	Positioning velocity V1	1000PLS/sec	D64, D63	64, 63



*1 When using instructions such as the MOVP and TOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

5.6.7 Re-start in the V/P control switchover mode after stopping

To continue positioning by re-starting after stopping an axis during operation, turn ON the re-start signal (Y16) in the V/P mode. If re-started by Y12 or Y13, positioning starts from the beginning.

The timing for re-starting by the re-start signal is as follows.

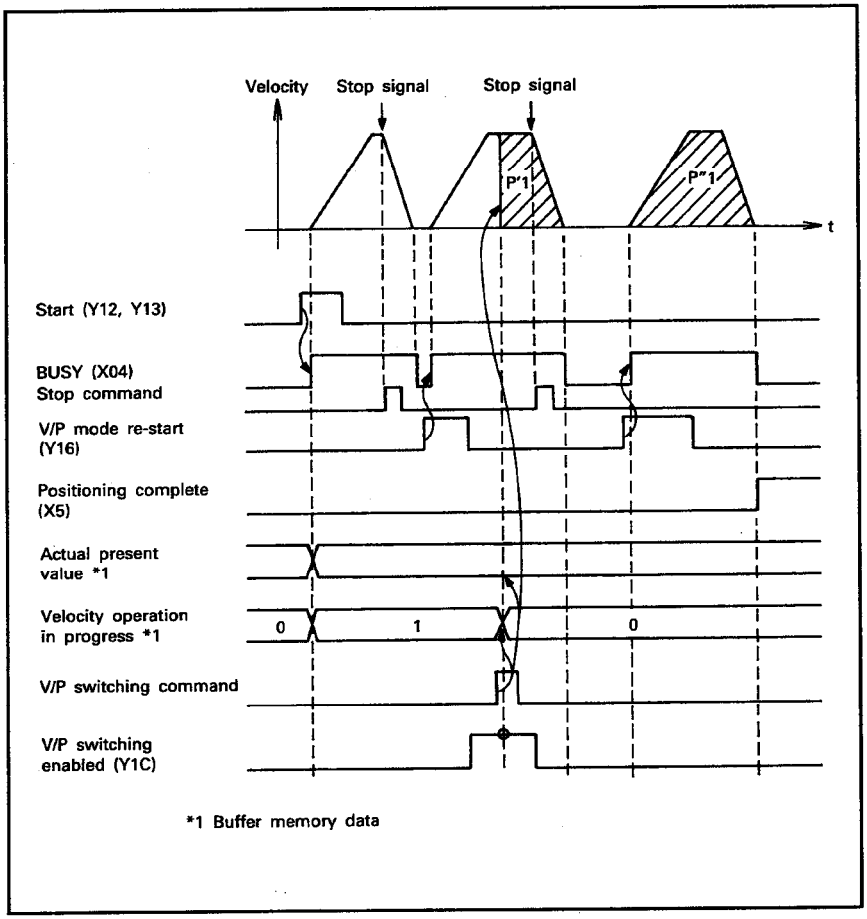


Fig. 5.24 Re-start in the V/P Control Switchover Mode After Stopping

If velocity is changed during positioning, the stop signal is input and the operation stops. When positioning is re-started by turning on Y16, positioning is executed in the position control mode at the velocity set by the positioning data, i.e., the velocity before change.

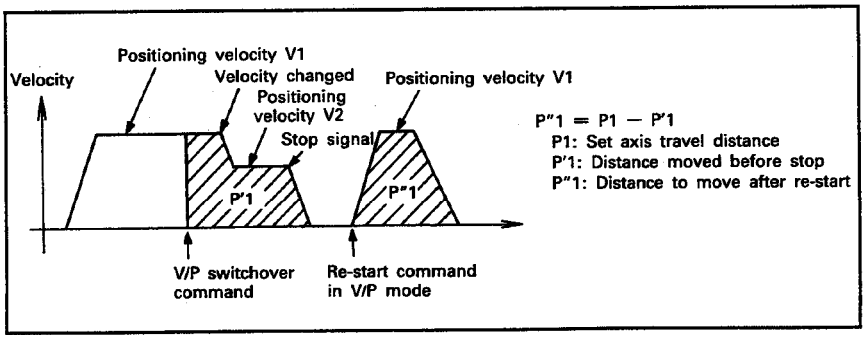


Fig. 5.25 Re-start in the V/P Control Switchover Mode After Changing Velocity

5.7 Incremental Feed

5.7.1 Positioning

(1) In the positioning programs in Sections 5.4 and 5.5, incremental feed control can be executed by re-writing the present value using the re-start command.
Execute incremental and absolute mode specification (refer to Section 1.2) by the start signal.

Start Signal	Positioning Mode
Y11	Absolute mode positioning start
Y12	Incremental mode forward start (addresses increasing)
Y13	Incremental mode reverse start (addresses decreasing)

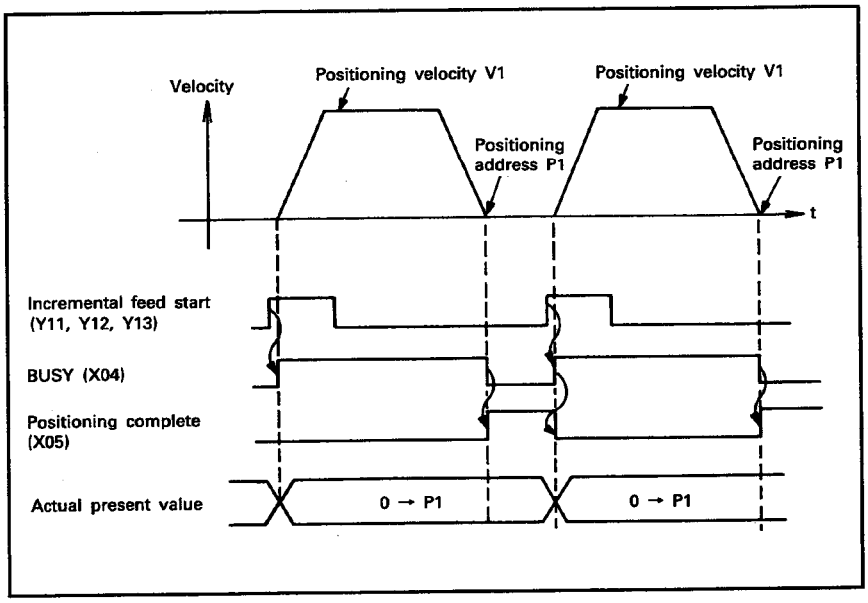


Fig. 5.26 Incremental Feed

(2) Refer to Section 5.10 for stop processing and re-starting after a stop during positioning.

(3) The following control changes can be executed by writing data to the buffer memory control change area from the user program. (Refer to Section 5.9.)
1) Present value change
2) Velocity change
3) Servo parameter change
4) Torque limit change

(4) Since the present value is monitored during positioning, if the present value exceeds the stroke limit range, an error will occur.

(5) Since there is no dwell time function, set the timer from the user program using the positioning complete signal (X05) if the dwell is required.

5.7.2 Positioning data settings

Table 5.13 Positioning Data

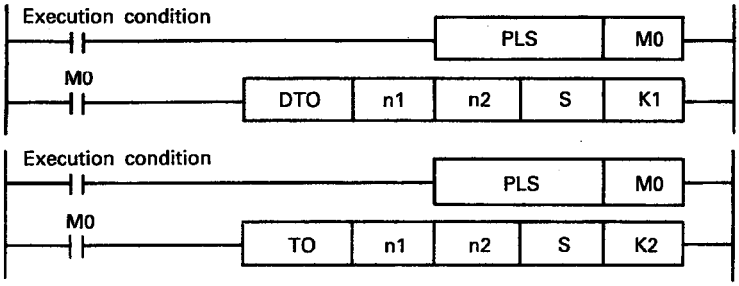
No.	Item	Setting Range	Default	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0: One-phase trapezoidal positioning 1: Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, if written while the BUSY signal is turned ON, they will be fetched when the next start signal is turned ON.	When positioning start signal (Y11 to Y13) is turned ON
2	Positioning address P1 (Switchover point to axis travel distance P2, V2 in the incremental mode)	−2147483648 to 2147483647PLS (0 to 2147483647 PLS in the incremental mode)	0		
3	Positioning velocity V1	1 to 1,000,000PLS/sec	0		
4	Positioning address P2 (Axis travel distance in the incremental mode)	−2147483648 to 2147483647PLS (0 to 2147483647 PLS in the incremental mode)	0		
5	Positioning velocity V2	1 to 1,000,000PLS/sec	0		

5.7.3 Buffer memory

As shown in Fig. 5.27, positioning data and present value change data are stored in the buffer memory area from the user program.

Read and write of 2-word data values such as upper and lower stroke limits and velocity limits from and to the buffer memory should be done simultaneously for 2-words. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



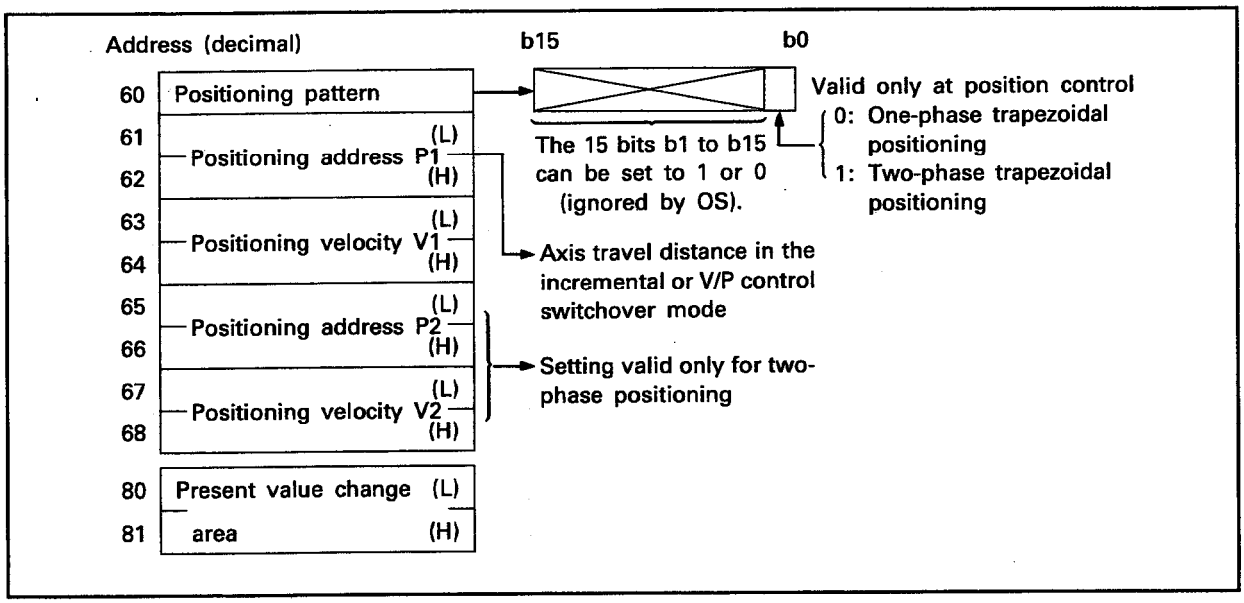
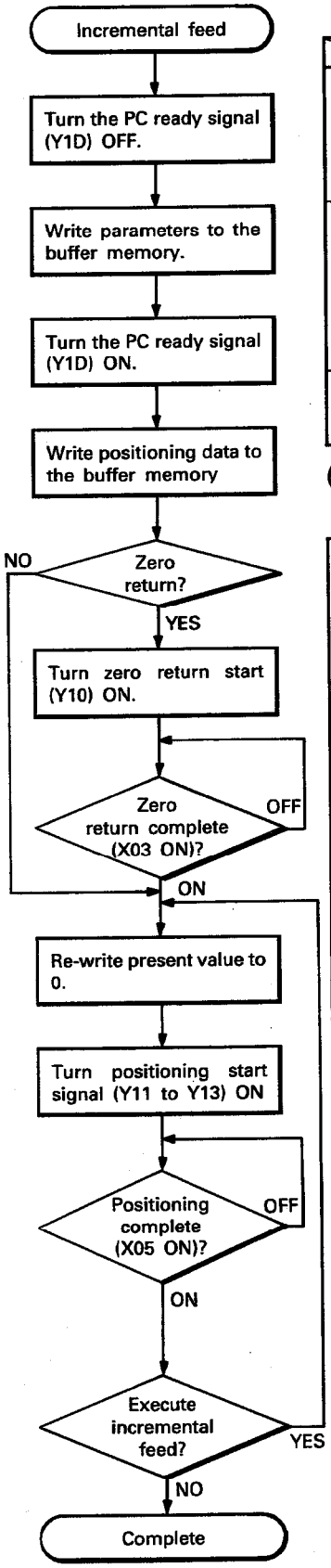


Fig. 5.27 Positioning Data Present Value Change Area

5.7.4 Example positioning program

(1) Program flow



(2) Start conditions

Table 5.14 Positioning Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at start of positioning in the forward direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at start of positioning in the reverse direction
Interface signal	X01	AD70D ready completion	ON	
	X04	BUSY	OFF	
	X0B	Servo ready	ON	Servo ready must be ON.
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	Positioning data		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(3) Related signal timing

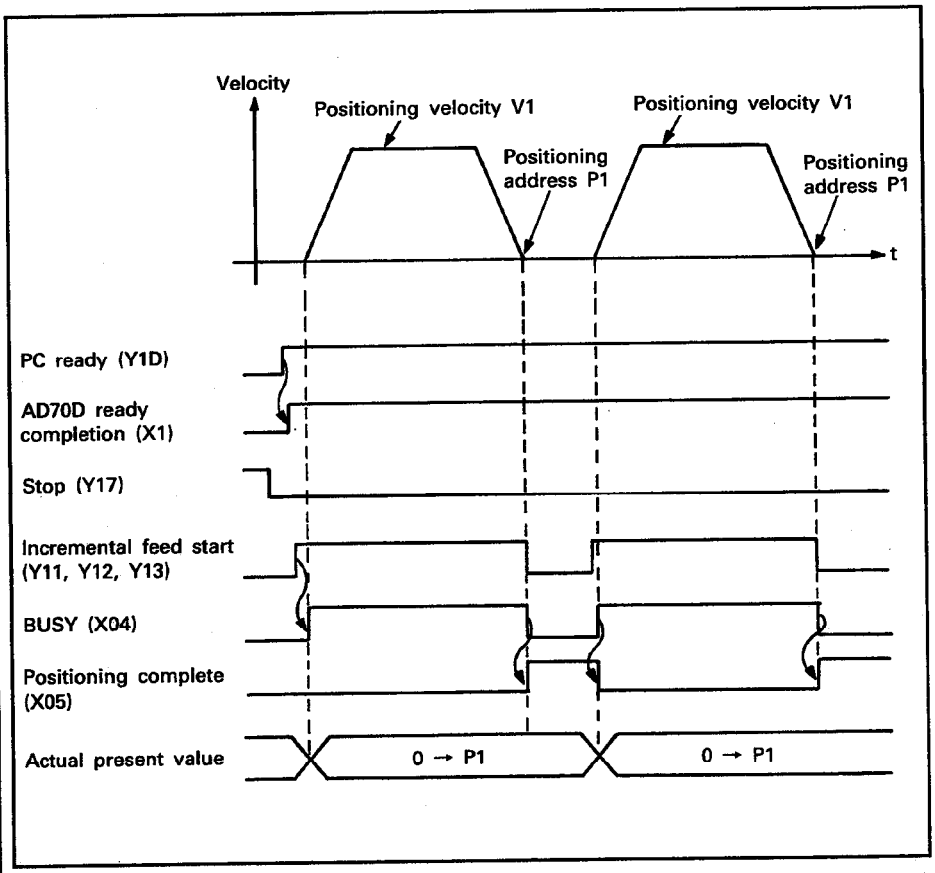


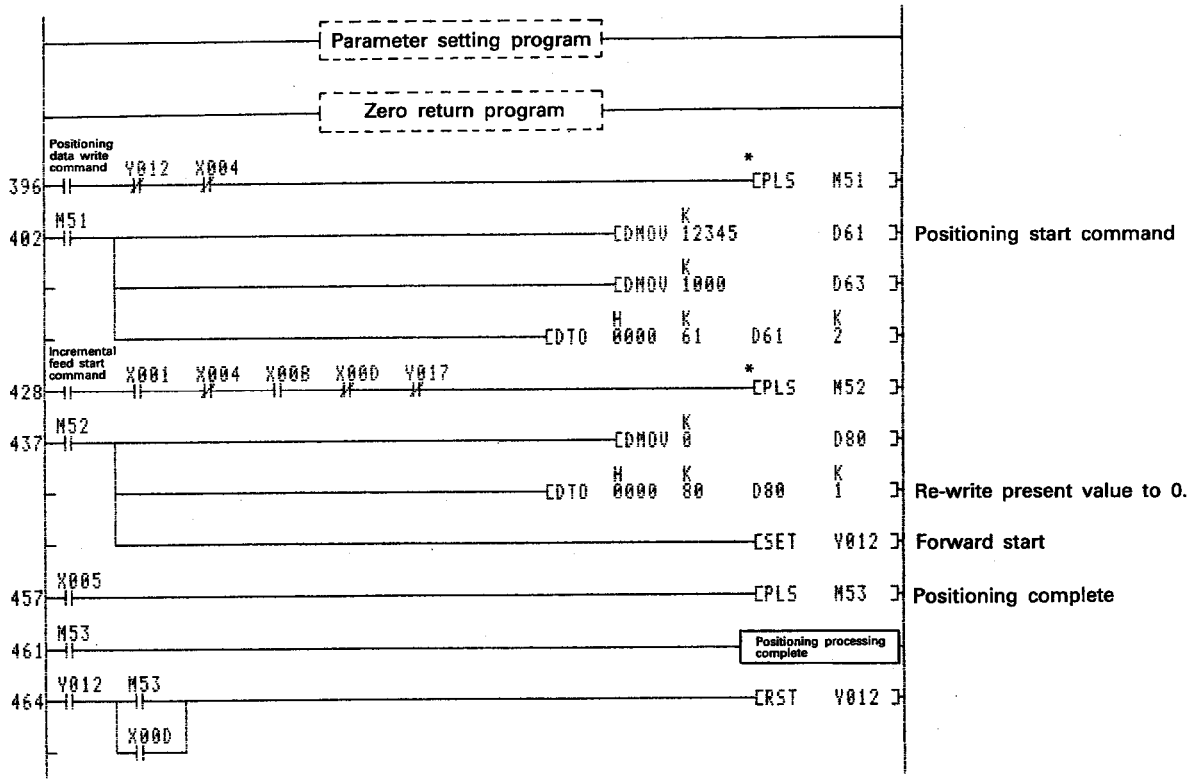
Fig. 5.28 Incremental Feed Timing

(4) Example positioning program

(Conditions)

1) Using the incremental feed start command, execute incremental feed operation by re-starting the incremental feed start command which executes positioning of the set axis travel distance at the set positioning velocity.
2) Parameters settings (Section 5.2.3 Program) zero return (Section 5.3.4 Program) are regarded to be completed.
3) Start conditions are shown in Table 5.14.
4) Positioning data indicated below is set.

	Set Value	Device Used	Buffer Memory Address
Positioning address P1	12345PLS	D62, D61	62, 61
Positioning velocity V1	1000PLS/sec	D64, D63	64, 63
Present value	0PLS	D81, D80	81, 80



* When using instructions such as the DMOVP and DTOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

5.8 JOG (velocity control)

5.8.1 JOG operation

(1) Set the JOG velocity from the user program and execute JOG operation by the PC CPU JOG start signal. Specify forward and reverse by the start signal.

Start Signal	Operation Direction
Y14	Forward JOG start (addresses increasing)
Y15	Reverse JOG start (addresses decreasing)

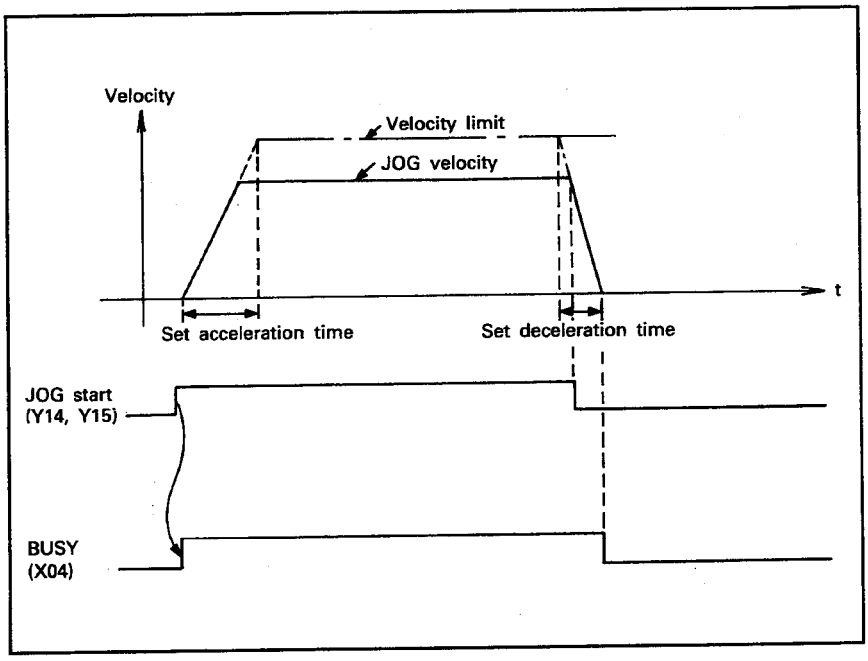


Fig. 5.29 JOG Operation

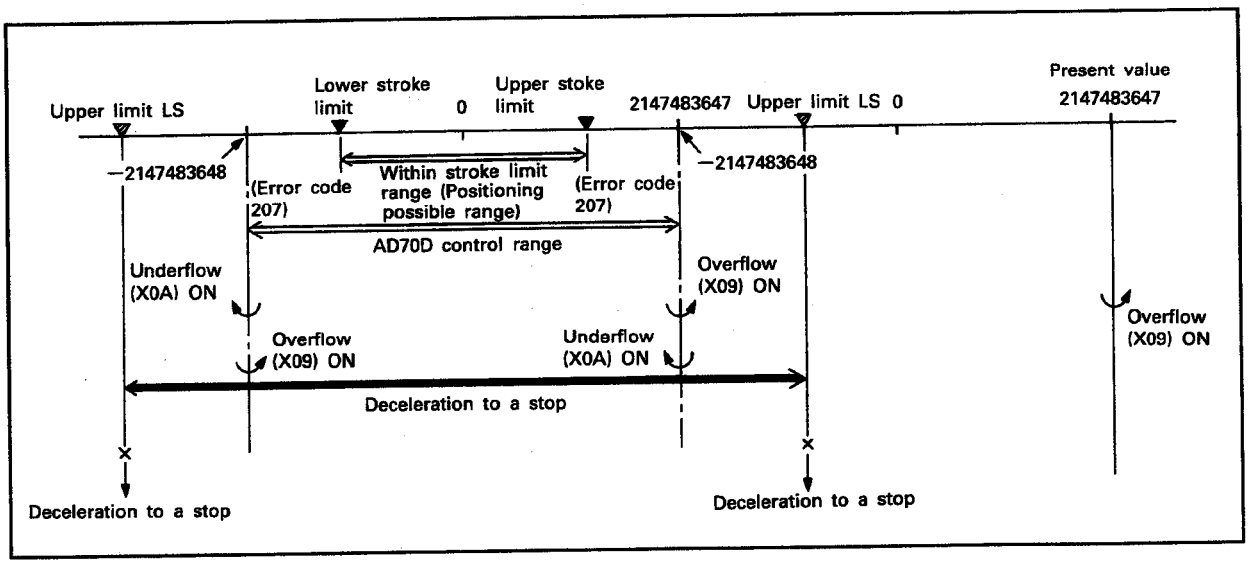
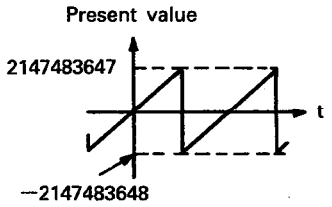


Fig. 5.30 JOG Operation Range

(2) JOG operation can be executed within the range between the upper and lower limit LS. Note that the upper and lower stroke limits will be ignored.

(3) If the upper limit LS signal is turned OFF during forward JOG operation or the lower limit LS signal is turned OFF during reverse JOG operation, the axis will decelerate and stop.

(4) If the present value exceeds the AD70D control range (−2147483648 to 2147483647) during JOG operation, either the overflow (X09) or the underflow (X0A) signal turns ON, and the present value changes as follows.



Reset the overflow and underflow signals by turning ON overflow reset (Y19) or underflow reset (Y1A).

(5) If the stoke limit range is exceeded during JOG operation, error code 207 will be set; if the upper or lower limit LS is turned OFF, error code 1101/1102 will be set.

(6) If the stroke limit range is exceeded, positioning start cannot be executed at that position. Use the JOG operation to return to within the stroke limit range. Positioning start can be executed by returning to within the stoke limit range using zero return operation or present value change.

(7) The following control changes can be executed by writing data to the buffer memory control change area from the user program. (Refer to Section 5.9.)

1) Present value change
2) JOG velocity change
3) Servo parameter change
4) Torque limit change

(8) If the same JOG start is turned ON during deceleration to a stop after having been turned OFF, the axis begins to accelerate again and JOG operation can be executed.

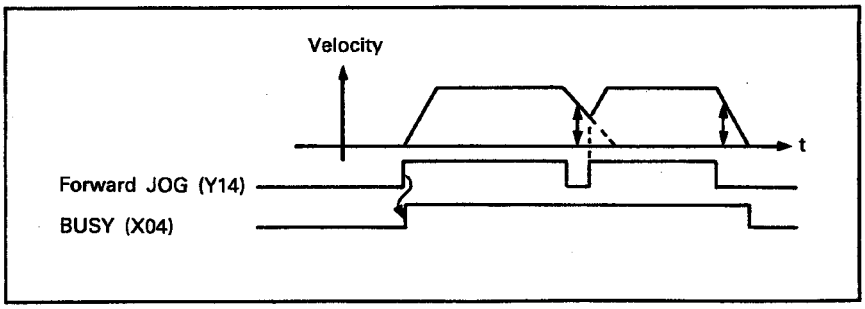


Fig. 5.31 Re-start During JOG Operation Deceleration to a Stop (1)

(9) If the reverse JOG start is turned ON during deceleration to a stop after JOG start has been turned OFF, reverse JOG start will be executed after deceleration completion.

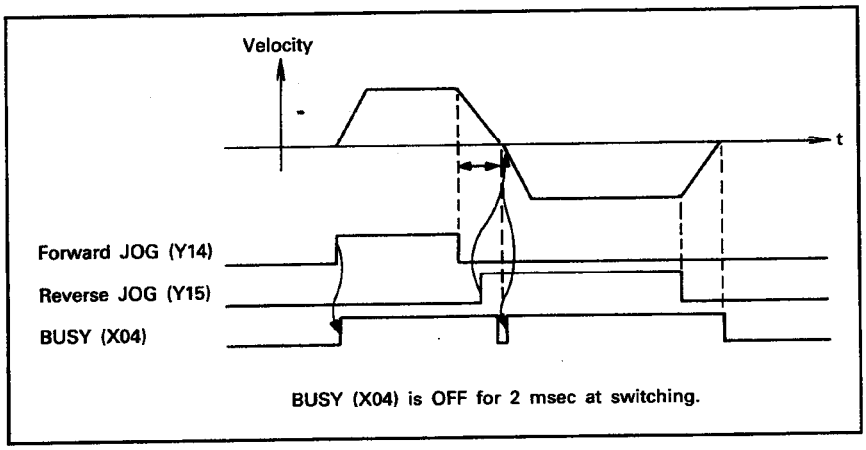


Fig. 5.32 Re-start During JOG Operation Deceleration to a Stop (2)

(10) Even if zero return or the positioning start signal is turned ON during deceleration to a stop after JOG start has been turned OFF, an error occurs and start cannot be executed.

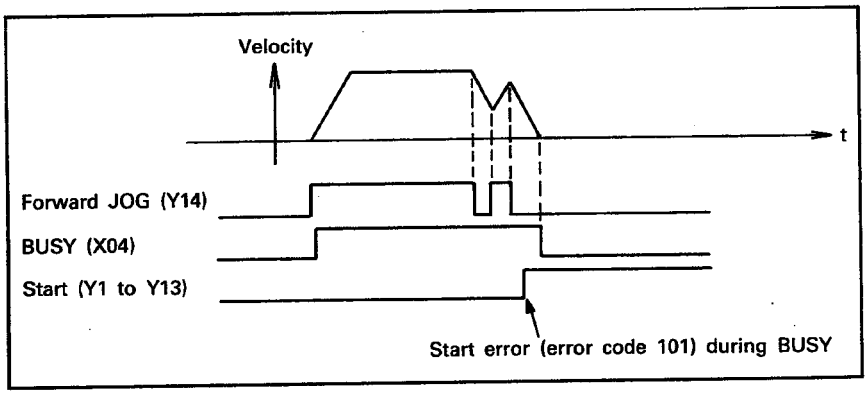


Fig. 5.33 Zero Return, Positioning Re-start During Deceleration to a Stop After JOG Operation

(11) If forward or reverse JOG start is turned ON during forward or reverse operation, an error will occur (error code 101) and the intended JOG operation will not be executed.

(12) If forward and reverse JOG start are turned ON simultaneously, an error will occur (error code 101) and forward JOG operation will be executed.

(13) Velocity mode operation is possible even if the JOG operation function is being used. Since the present value is monitored during velocity mode operation, error code 207 will be set if the stroke limit range is exceeded.

5.8.2 JOG data settings

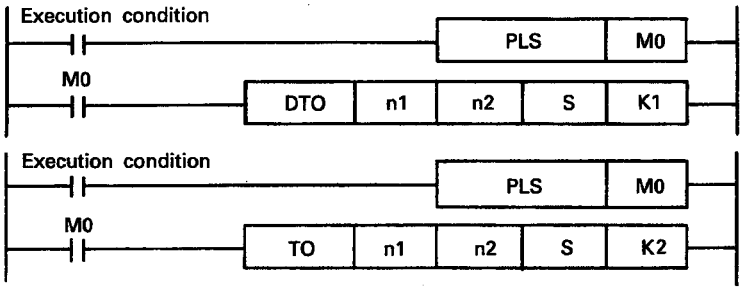
To execute JOG operation, variable parameter velocity limits, acceleration and deceleration times, and JOG velocities must be set and stored in the buffer memory.
Refer to Section 5.2 for variable parameter settings.

Table 5.15 Shows JOG Data

Item	Setting range	Default	Setting Enable Conditions	Set Data Check Timing
JOG velocity	1 to 1,000,000 PLS/s	—	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, if written while the BUSY signal is turned ON, they will be fetched when the next start signal is turned ON.	When JOG start signal (Y14 or Y15) is turned ON

5.8.3 Buffer memory

As shown in Fig. 5.34, parameters and JOG data are stored in the buffer memory area from the user program.
Read and write values from and to the buffer memory as 2-word data. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.
2-word data can be written as follows.



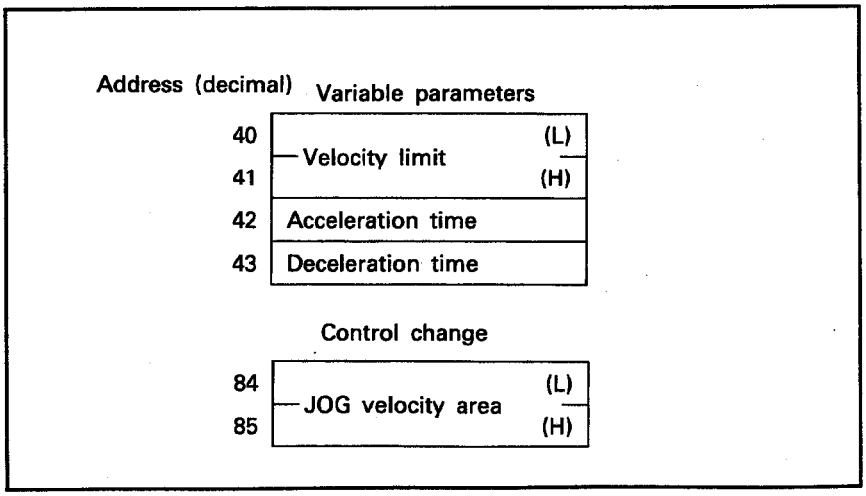
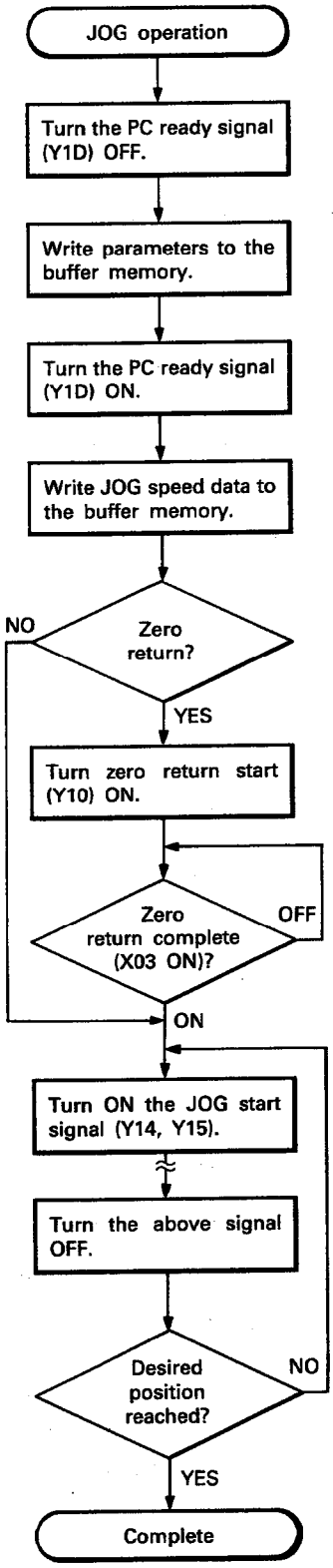


Fig. 5.34 JOG Data Area

5.8.4 Example JOG operation program

(1) Program flow



(2) Start conditions

Table 5.16 JOG Operation Start Conditions

	Check Item		State	Remarks
External signal	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	Upper limit LS must be turned ON at start of positioning in the forward direction
	RLS	Lower limit LS	ON	Lower limit LS must be turned ON at start of positioning in the reverse direction
Interface signal	X01	AD70D ready completion	ON	
	X04	BUSY	OFF	
	X0B	Servo ready	ON	Servo ready must be ON.
	Y17	Stop signal	OFF	
	Y1B	Servo OFF	OFF	
	Y1D	PC ready	ON	
Data	JOG speed		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(3) Related signal timing

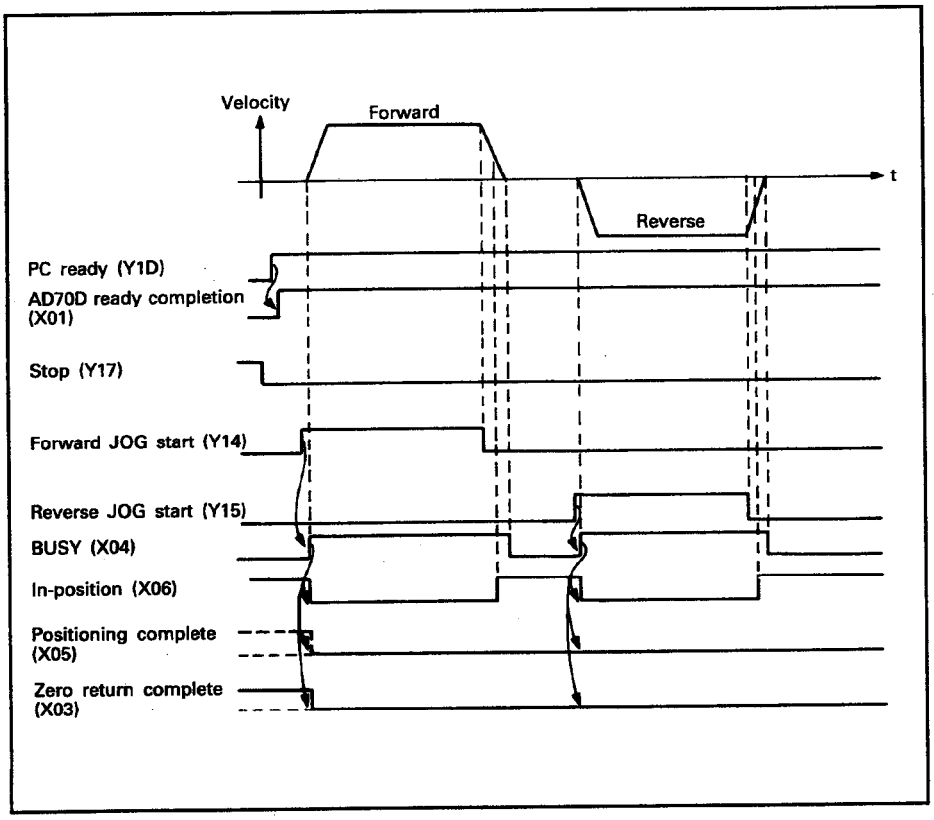


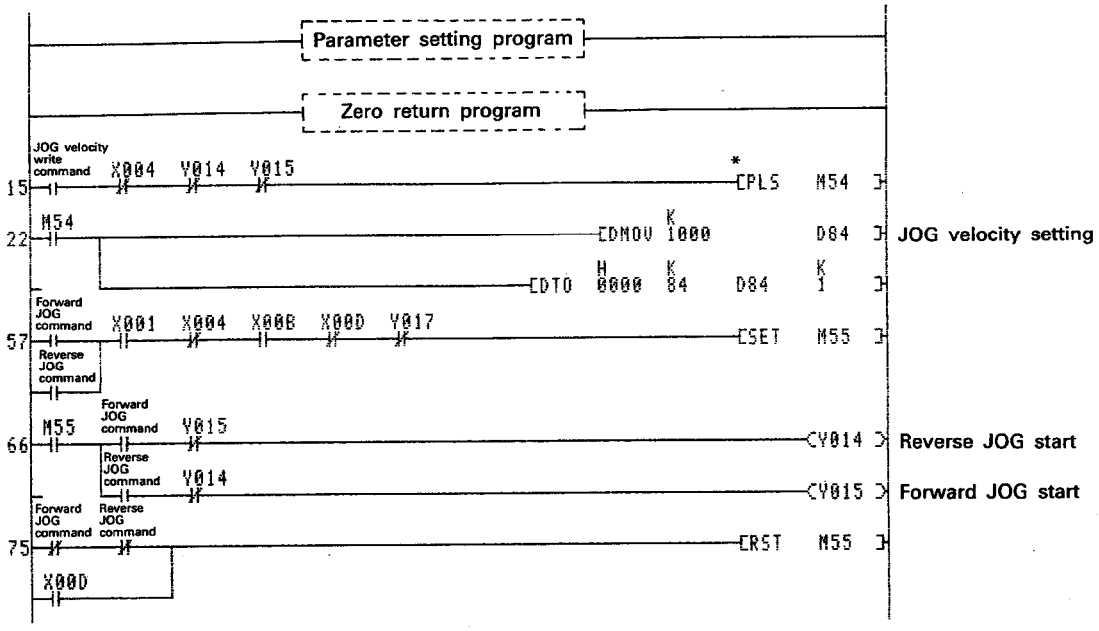
Fig. 5.35 JOG Operation Timing

(4) Example JOG operation program

(Conditions)

1) Execute JOG operation while the JOG start command stops ON.
2) Parameter settings (Section 5.2.3 Program) are regarded to be completed.
3) Start conditions are given in Table 5.16.
4) Set the following data as JOG velocity data.

	Set Value	Device Used	Buffer Memory Address
JOG velocity	1000PLS/sec	D85, D84	85, 84



* When using instructions such as the MOVP and DTOP instructions with building block type CPUs, converting execution conditions into pulses is unnecessary.

5.8.5 Stop during positioning and JOG operation

(1) Stopping before deceleration starting point while positioning or JOG BUSY is ON

If a stop factor occurs before the deceleration starting point while positioning or JOG BUSY signal is ON, the axis decelerates from that point and stops. The deceleration mode is determined by the parameter settings (deceleration time and the velocity limit).

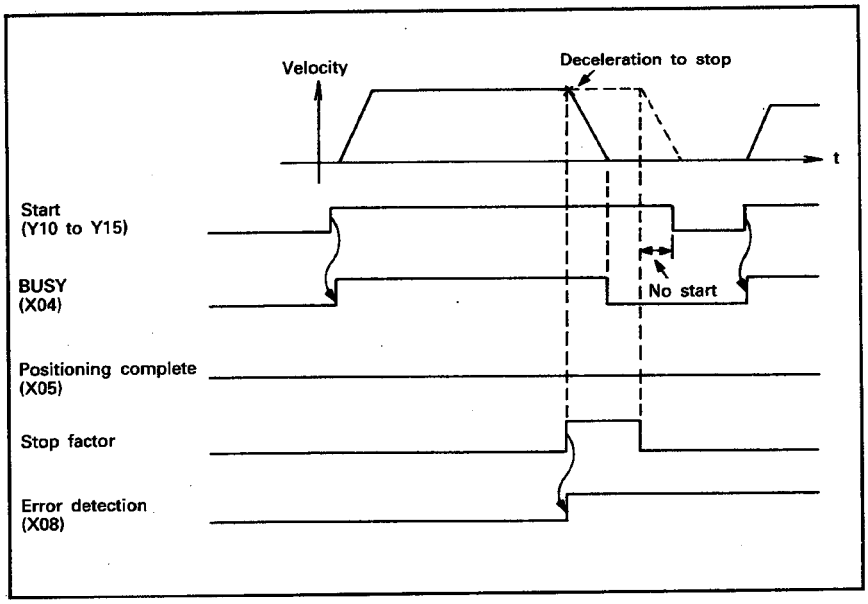


Fig. 5.36 Stop During Positioning

(2) Stopping during deceleration while positioning or JOG BUSY signal is ON.

If a stop factor occurs during deceleration, the axis decelerates and stops to complete positioning.

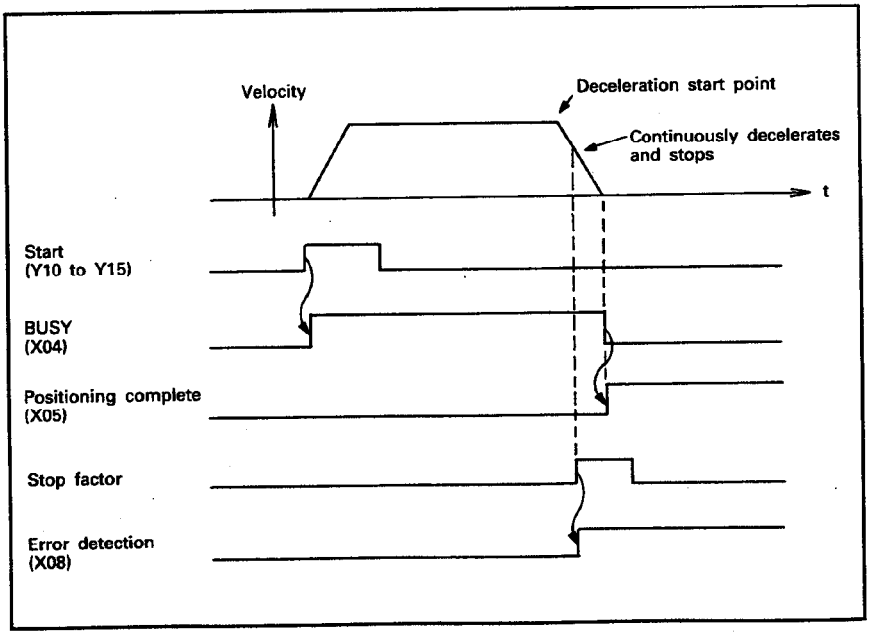


Fig. 5.37 Stop During Deceleration While Positioning

(3) Stop by upper and lower limit LS while JOG BUSY is ON

When the upper or lower limit LS has been detected during JOG BUSY, the axis decelerates from that point and stops. Set the upper and lower limit LS taking this acceleration to stop distance into consideration.

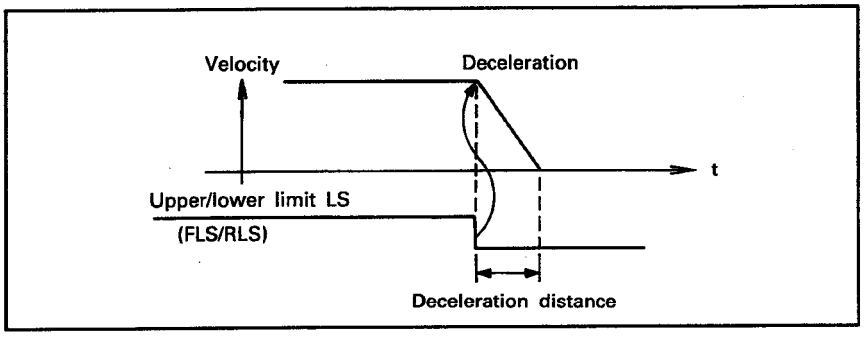


Fig. 5.38 Stop by Upper and Lower limit LS During JOG BUSY

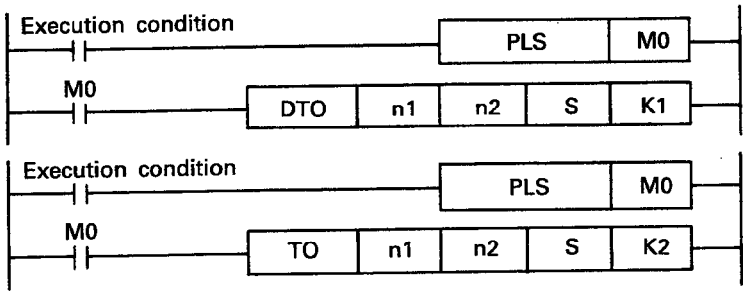
5.9 Control Change

Control can be changed by writing data from the user program to the buffer memory control change area. Written data is checked before processing execution. If processing is not possible due to a data error or an execution condition error, the data in the buffer memory is overwritten.

Control change data is stored in the buffer memory areas as shown in Fig. 5.39 from the user program.

Read and write values from and to the buffer memory as 2-word data. Writing 1-word data to a 2-word area will cause an error and the written data will be ignored.

2-word data can be written as follows.



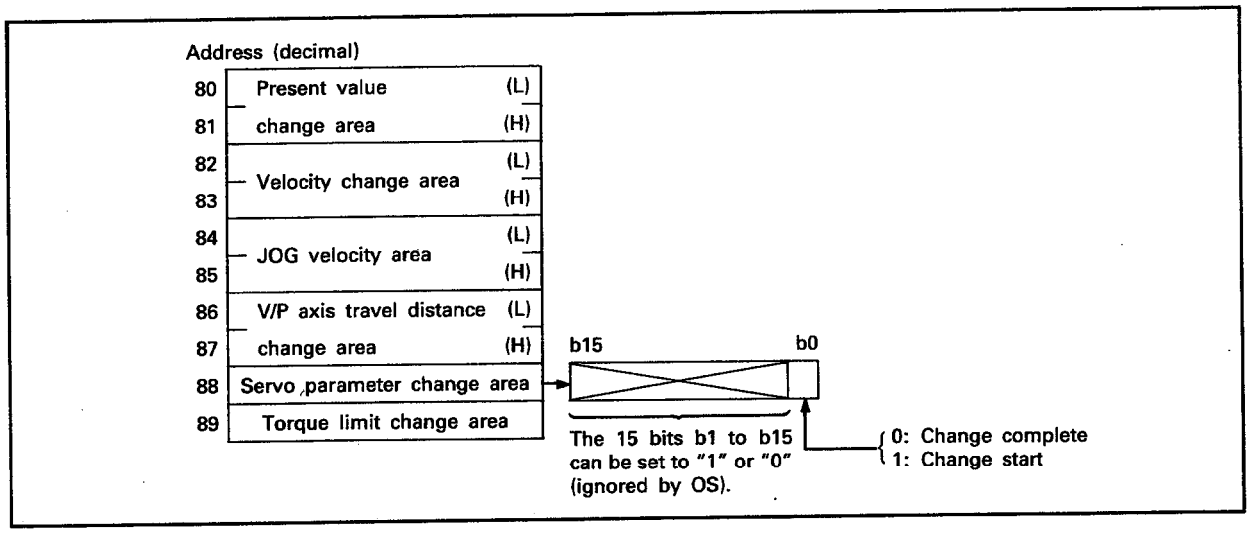
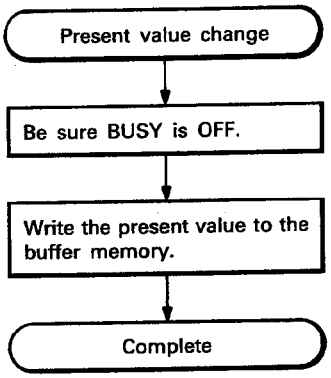


Fig. 5.39 Control Change Area

5.9.1 Present value change

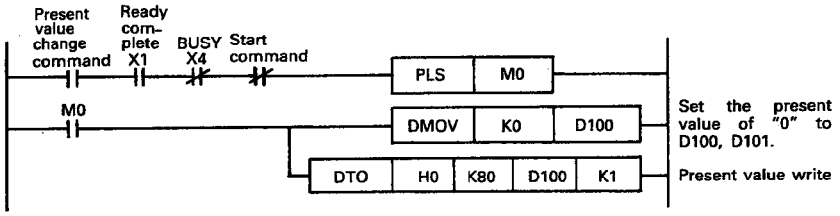


Change the present value when the AD70D present value data is to be changed, when the present value is outside the stroke range, or when a start error occurs.

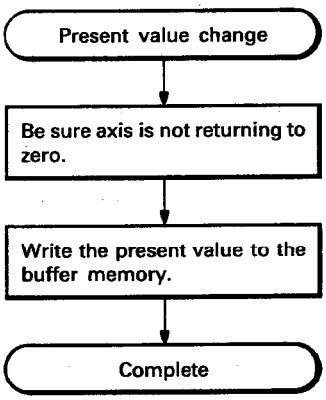
Table 5.17 Present Value Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Present value change	Lower stroke limit to upper stroke limit	AD70D ready complete (X1) is ON Disabled during BUSY	Present value change area (80, 81)

The program to change the present value to "0" is shown below.



5.9.2 Velocity change

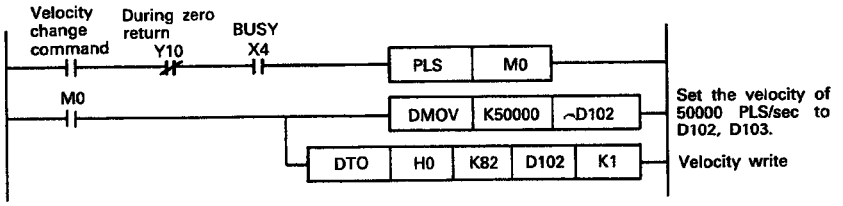


The velocity can be forcedly changed during positioning or JOG operation.

Table 5.18 Velocity Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Velocity change	1 to velocity limit PLS/sec (Max. 1,000,000 PLS/sec)	1. Valid during BUSY 2. Velocity change is disabled in the following cases: After automatic deceleration starting point After input of stop command (Y17, STOP) After JOG signal turns OFF during JOG During zero return	Velocity change area (82,83)

An example program to change the velocity is shown below.



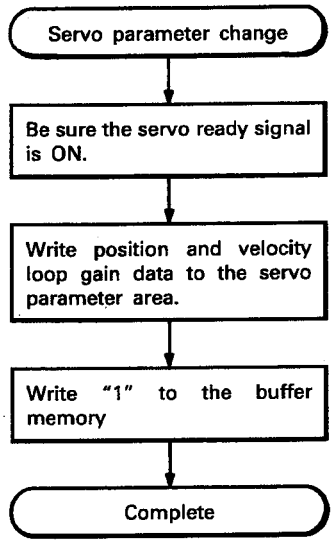
5.9.3 JOG velocity change

Refer to Section 5.8 JOG (velocity control).

5.9.4 V/P axis travel distance change

Refer to Section 5.6 V/P control switchover.

5.9.5 Servo parameter change

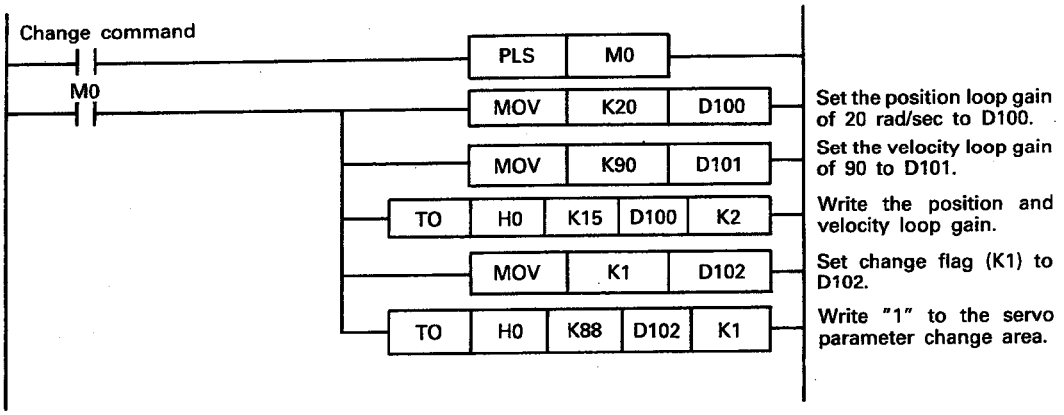


When adjusting the servo, position loop gain and velocity loop gain can be changed in the servo ready state. Write the velocity and position loop gain in advance to the servo parameter buffer memory.

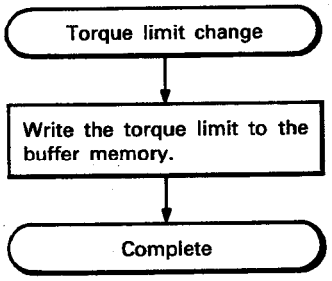
Table 5.19 Servo Parameter Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Servo parameter change	0.1	1. Valid during BUSY	Servo parameter change area (88) { Position loop gain (buffer memory: 15), velocity loop gain (buffer memory: 16) }

An example program to change the position and velocity loop gain is shown below.



5.9.6 Torque limit change

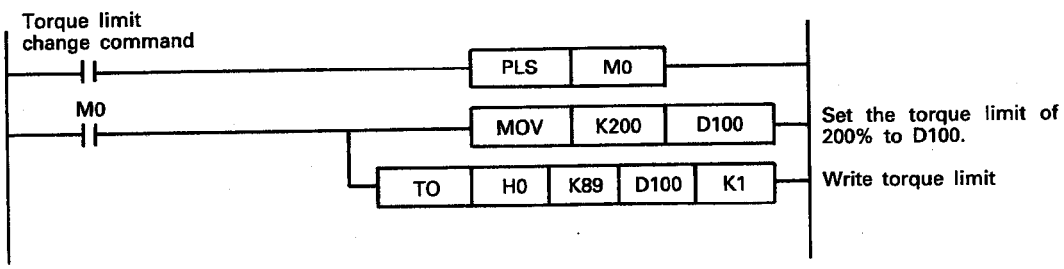


The torque limit can be changed while the motor is being stopped or started.

Table 5.20 Torque Limit Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Torque limit change	1 to 500%	Possible anytime	Torque limit change area (89)

An example program to change the torque limit is shown below.



5.10 Stop Processing During Positioning and Re-starting After a Stop

5.10.1 Stop processing during positioning

Factors which stop processing during BUSY are given below along with stop processing.

Table 5.22 Stop Factors and Stop Processing

No.	Stop Factor	Stop Processing		
		Error Detection (X8)	Error Code	Stop Mode
1	External stop signal is turned ON.	ON only during zero return	Error code reset only during zero return	Deceleration processing
2	Stop signal (Y17) is turned ON.			
3	PC ready signal (Y1D) is turned OFF.			Free run
4	Servo ready signal (X0B) is turned OFF.	ON	Error code reset	Free run
5	Servo OFF signal (Y1B) is turned ON.	ON	Error code reset	Deceleration processing
6	Upper limit LS (FLS) is turned OFF. *1	ON	Error code reset	Deceleration processing
7	Lower limit LS (RLS) is turned OFF. *1			
8	Servo alarm	ON	Error code reset	*2
9	PC power supply is turned OFF.	—	—	Free run
10	Emergency stop signal is turned ON.	—	Error code reset	Immediate stop

*1 Stop processing is executed only when the LS in the same direction as axis feed direction is turned OFF.

*2 If any of the following servo errors occurs, the axis immediately stops.
Servo error code: 2010 to 2055
In the case of error code 2100 to 2147, operation continues (immediate stop at 2147), and only the servo error code will be set with the error detection signal (X08) remaining OFF.

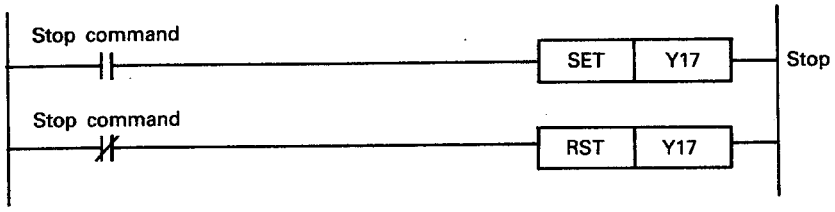
POINT

Hard wire emergency stop circuits into the system.

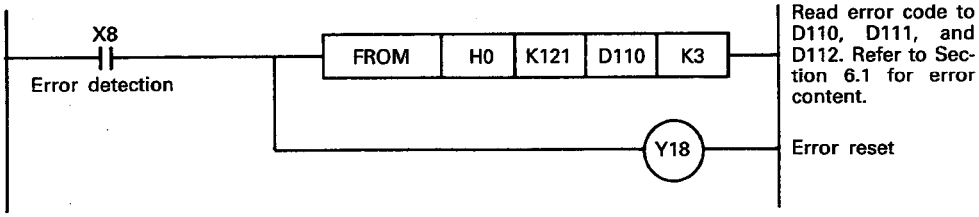
5.10.2 Program for stopping during positioning

Table 5.22 shows factors, other than stop signals, which stop processing during BUSY. When an error occurs, read the error code and re-start after error processing.

Example stop program



Example error reset program



5.10.3 Re-starting after stopping during positioning

After an axis has been stopped during positioning or JOG operation. The axis can re-start by the re-start signal if the conditions necessary for re-starting are established.
When continuing positioning in the V/P control switchover mode, use the V/P mode re-start signal (Y16) to re-start.

Positioning status conditions for re-starting after stopping are as follows.

Table 5.23 Conditions for Re-starting After Stopping

Positioning Mode	Operation Conditions After Re-starting
Absolute positioning	Positioning continues
Incremental positioning	New positioning
V/P	New positioning Positioning continues if re-started by the V/P mode re-start signal (Y16).

5.11 Monitor Buffer Memory

Data such as AD70D operation status data is stored in the monitor area of the buffer memory shown below. Read this data from the sequence program and use as required.

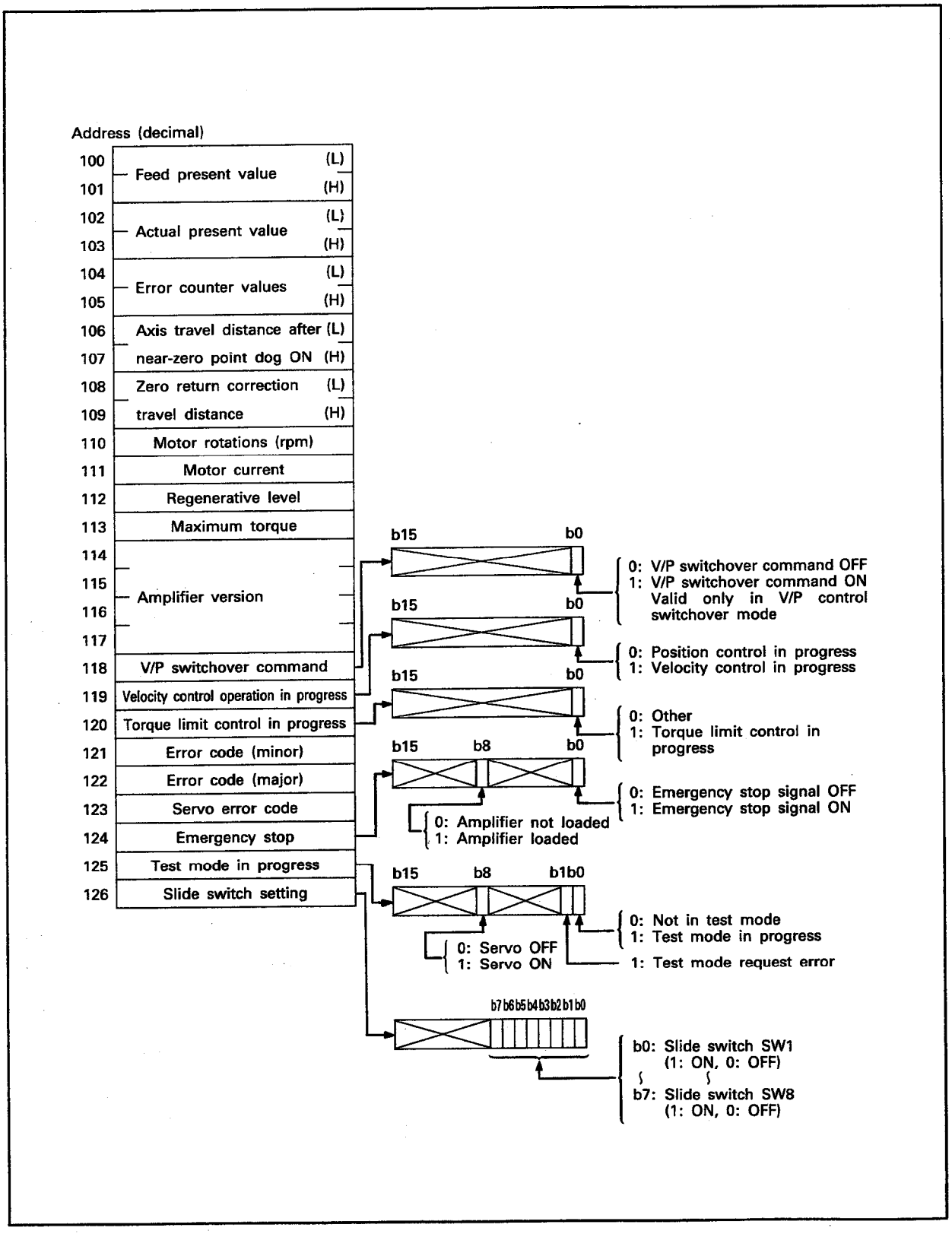


Fig. 5.40 Monitor Buffer Memory

5.11.1 Feed present value

- The AD70D feed present value (command pulses), calculated based on the command value, is stored.
- The value when the electronic gear is not used is stored.
- The unit is PLS.
- Address (101, 100)

5.11.2 Actual present value

- The actual servo axis travel distance (number of feedback pulses) calculated based on feedback pulses is stored.
- The value when the electronic gear is not used is stored.
- The unit is PLS.
- Address (103, 102)

5.11.3 Error counter value

- Error counter value when the electronic gear is used is stored.
- Error counter values is the difference between the AD70D command pulses × CMX/CDV and feedback pulses.
- The unit is PLS.
- Address (105, 104)

5.11.4 Axis travel distance after near-zero point dog ON

- After zero return start, the axis travel distance from the time the signal triggered by near-zero point dog is turned ON to the completion of zero return is counted and stored. (Both near-zero point dog mode and count mode)
- The value when the electronic gear is not used is stored.
- The unit is PLS.
- Address (107, 106)

5.11.5 Zero return corrective travel distance

- After zero return start, the signal triggered by the near-zero point dog is turned OFF and the axis decelerates to a stop. The axis travel distance from the deceleration start point to zero return completion is stored.
- The value when the electronic gear is not used is stored.
- This data should be verified when adjusting the near-zero point dog position so that the zero point is not offset.
- The unit is PLS.
- Address (109, 108)

5.11.6 Motor rotations (rpm)

- The actual number of motor rotations is stored. The sign indicates the direction of the motor rotation.
- The unit is rpm.
  +: Counterclockwise viewed from the load side
- Address (110)
  −: clockwise viewed from the load side
- The monitor value varies ±3rpm.

5.11.7 Motor current

- Motor current in reference to the rated current (100%) is stored.
- The unit is %.
- Address (111)

5.11.8 Regenerative level

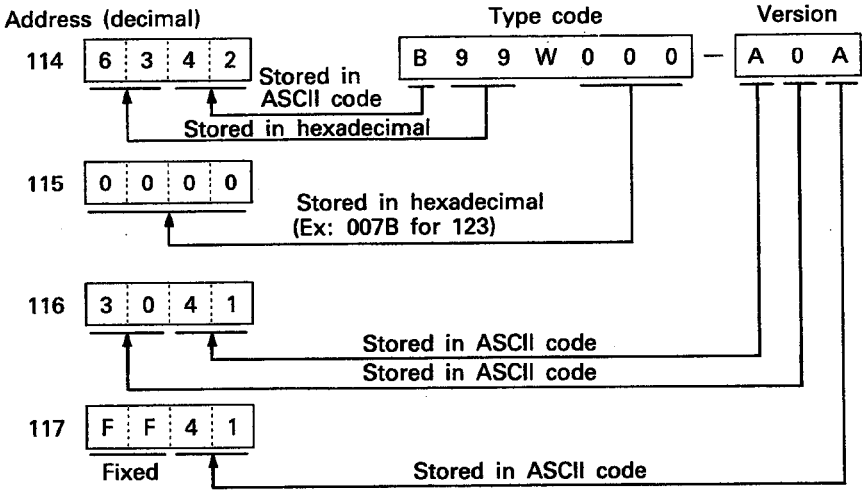
- Data for monitoring the load of the regenerative resistance is stored.
- The unit is %.
- Address (112)

5.11.9 Maximum torque

- The maximum torque in reference to the rated torque (100%) is stored.
- The maximum torque is determined by the motor capacity. (Fixed value)
- The unit is %.
- Address (113)

5.11.10 Amplifier version

- The amplifier version is stored.



5.11.11 V/P switchover command

- The ON/OFF status of the V/P switchover command input is stored.
- "1" is stored when ON and "0" when OFF.
- Address (118)

5.11.12 Velocity control operation in progress

- The control mode at V/P switchover mode is stored.
- "0" is stored during position control and "1" is stored during velocity control.
- Address (119)

5.11.13 Torque limit control in progress

- Whether or not the torque command to the motor (current command) is limited by the motor catalogue entry's rated torque x torque limit is stored.
- "1" is stored when limited and "0" is stored when the motor is turning within the set torque limit.
- Address (120)

5.11.14 Error code (minor)

- The error code when a minor error occurs in the AD70D is stored.
- The error codes of the error which can be corrected from the sequence program such as data error or starting during BUSY is stored.
- Address (121)

5.11.15 Error code (major)

- The error code when a major error occurs in the AD70D is stored.
- The error codes of the error such as stopping at or during starting is stored.
- Address (122)

5.11.16 Servo error code

- The error code output from the servo amplifier is converted to the error code for AD70D and then stored.
- Address (123)

5.11.17 Emergency stop

- The ON/OFF status of the servo amplifier's emergency stop command signal is stored in the 1st bit. "1" is stored when ON and "0" when OFF.
- The actual loading status of the servo amplifier is stored in the 8th bit. "1" is stored when loaded and "0" when not loaded.
- Address (124)

5.11.18 Test mode in progress

- Valid when using a peripheral device (SW⬚GP-AD70DP)
- The mode used is stored in the 1st bit. "1" is stored when the test mode is in progress and "0" is stored when it is not.
- The status of the test mode request error is stored in the 2nd bit. "1" is stored at test mode request error and "0" is stored when not at test mode request error.
- The servo state is stored in the 8th bit. "1" is stored when servo ready is turned ON and "0" is stored when turned OFF.
- Address (125)

5.11.19 Slide switch

- The AD70D slide switch setting positions are stored.
- SW1 in the 1st bit, SW2 in the 2nd bit, etc. "1" is stored when ON and "0" when OFF.
- Address (126)

5.12 Remote I/O Station Programming

5.12.1 Notes on programming

Although direct/refresh mode is used for input control by an ACPU, data communication with a remote I/O station is on a batch refresh mode after the END (or FEND) instruction is executed.

Therefore, pay attention to the following items when an AD70D is used in a remote I/O station. For details of data link specifications, refer to the MELSECNET (II) Data Link System Reference Manual.

(1) There is a short time delay in the communication of control data between the master station and AD70D in a remote I/O station. This delay must be taken into account for determining timing.

(2) The following data communication instructions are used between master and remote stations.

Data write from master station to AD70D: RTOP instruction
Data read from AD70D to master: RFRP instruction

Note that link registers W are used for data communication between the master station and AD70D in a remote station. Therefore, write a program to transmit the data in the link register to other device after the execution of the RFRP instruction or to transmit the data to be transmitted to the link register before the execution of the RTOP instruction.

(3) The RTOP and RFRP instructions cannot be executed in the same scan for one AD70D in a remote station. (These may be used in the same scan if addressed to separate AD70D modules.)

(4) Control signals between master and remote stations

The PLS instruction must not be used for control I/O communication.

Because data communication between a master and remote I/O stations is made in batch refresh mode after the execution of the END (FEND) instruction, a pulse output that executes the RST instruction after the execution of the SET instruction cannot be used.

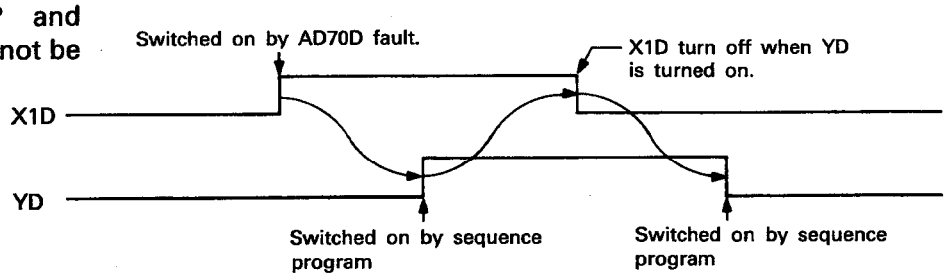
POINT

When an AD70D is used in a remote station, control timing will make programming complicated. Therefore, it is recommended to install an AD70D into a master or local station.

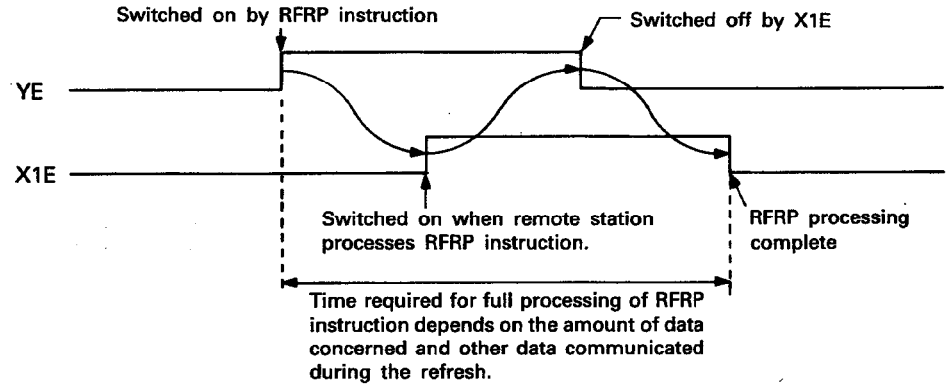
Table 5.24 Input and Output Signals

Signal Direction: PC CPU to AD70D		Signal Direction: AD70D to PC CPU	
Device No.	**Signal**	**Device No.**	**Signal**
Y0 to YC	Reserved	X10 to X1C	Reserved
YD	Switches X1D OFF.	X1D	ON when RFRP and RTOP instructions cannot be used due to faulty AD70D.
YE	Switches ON by master station CPU when RFRP instruction is executed (data transferred from link module to master station CPU). To be reset in user program after ensuring that X1E is ON.	X1E	ON while AD70D in remote station is processing RFRP instruction.
YF	Switches ON by master station CPU when RTOP instruction is executed (data transferred from master station CPU to link module). To be reset in user program after ensuring that X1F is ON.	X1F	ON while AD70D in remote station is processing RTOP instruction.

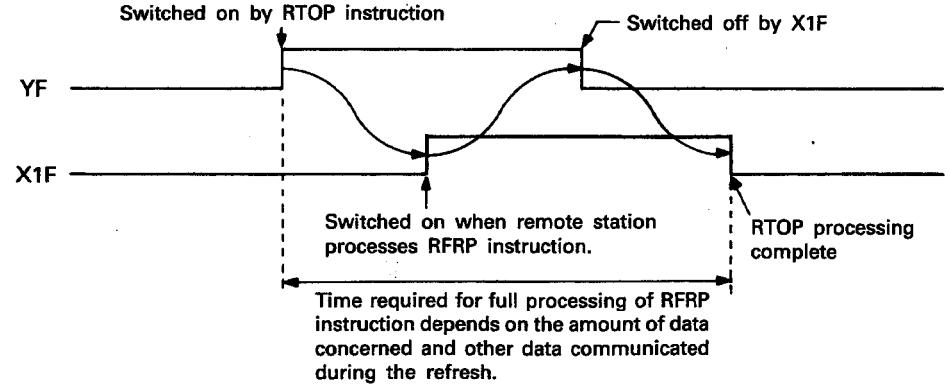
Timing AD70D fault. RTOP and RFRP instructions cannot be used.



Execution of RFRP instruction



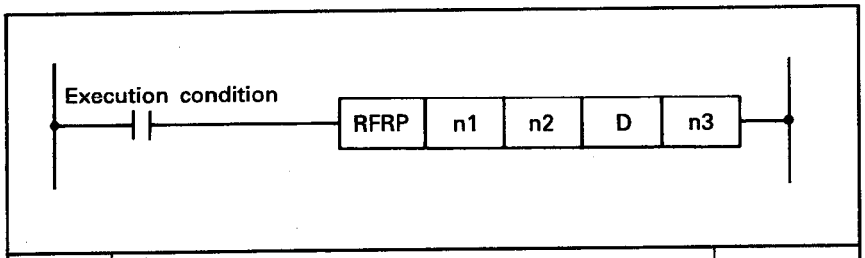
Execution of RTOP instruction



5.12.2 Read and write data

(1) Read from remote I/O station AD70D

[Format]

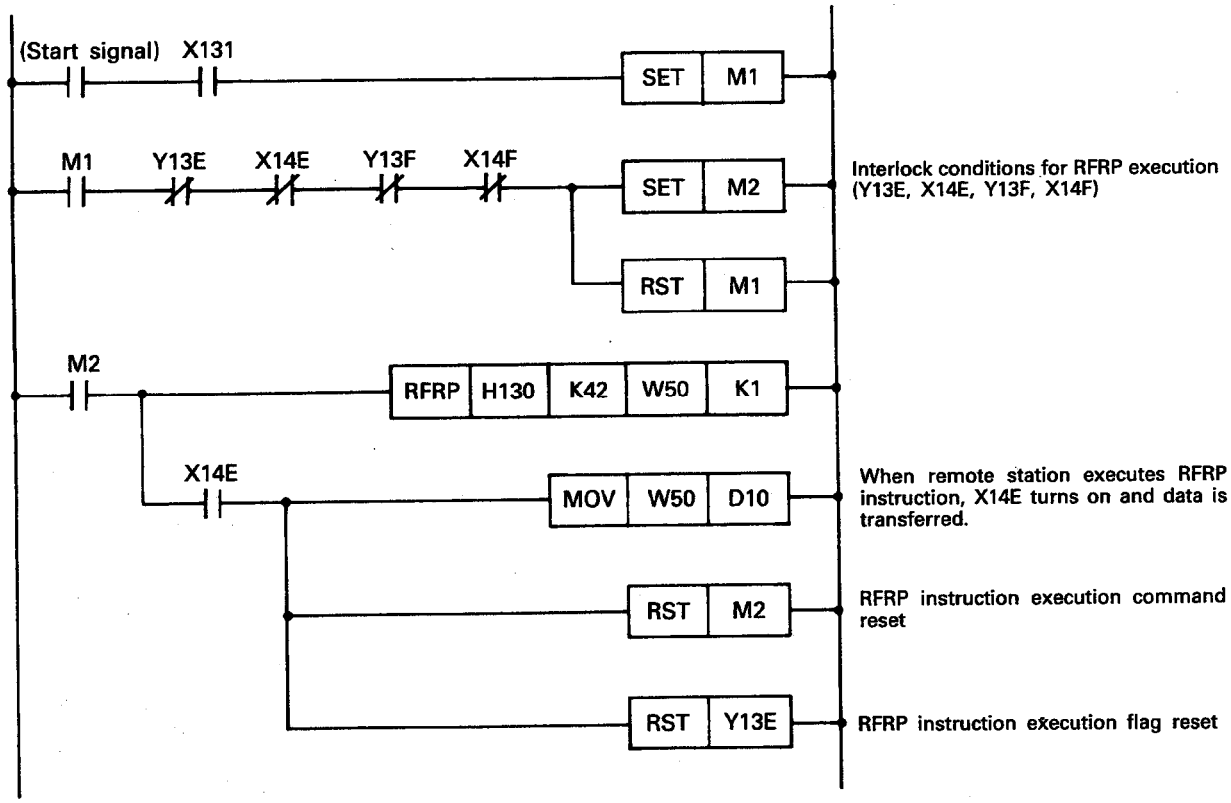


Symbol	Description	Available Device
n1	AD70D I/O number assignment from master station	K, H
n2	Head buffer address to be read	K, H
D	Head link register to which data will be written	W
n3	Number of data words to be read (1 to 16)	K, H

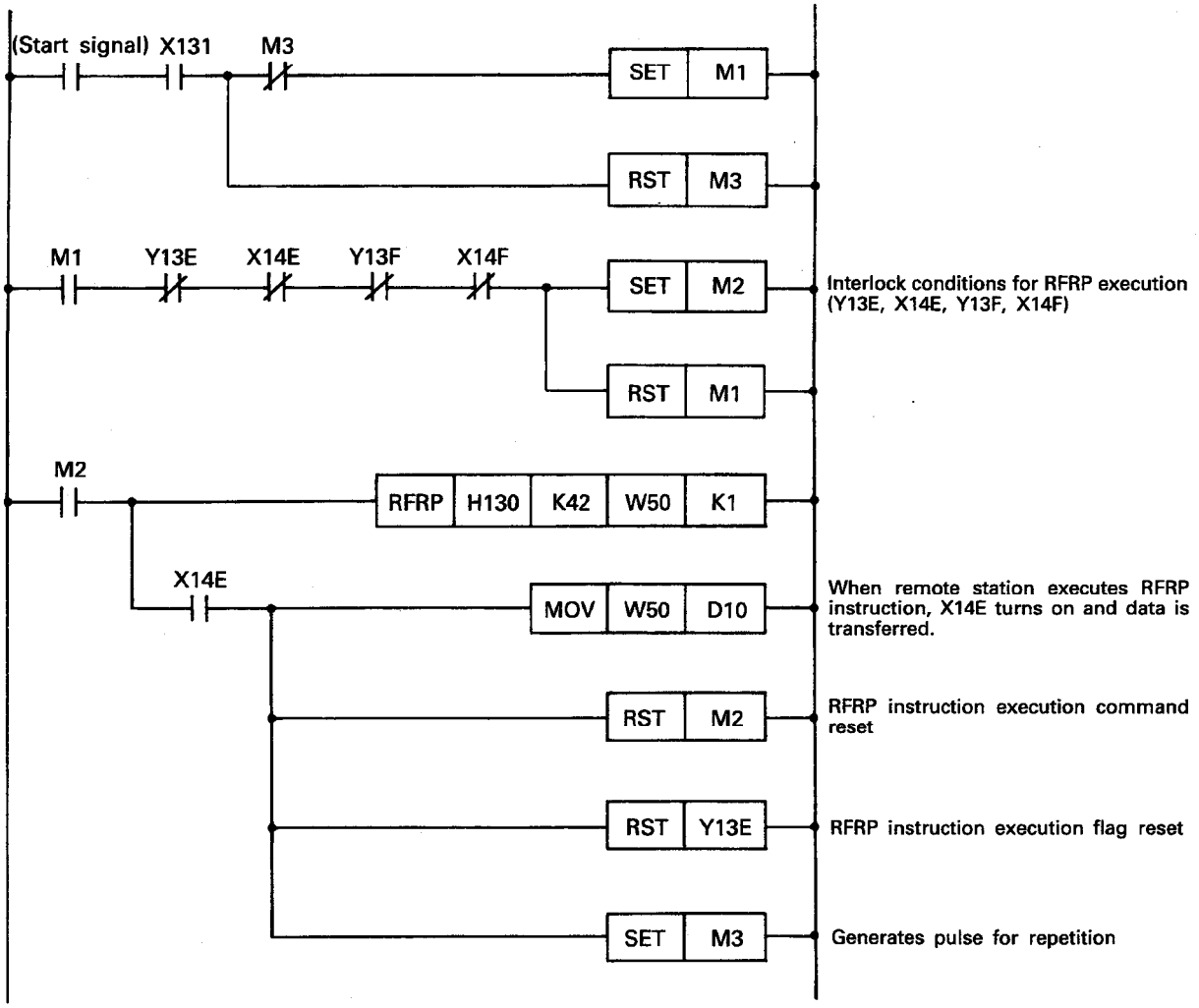
Fig. 5.41 Read Command RFRP

Example: Reading one word from buffer address 42 of the AD70D. located at I/O address X, Y130 to 14F in a remote I/O station to W50.

To read once on receiving the start signal



To continually read while start signal is on.

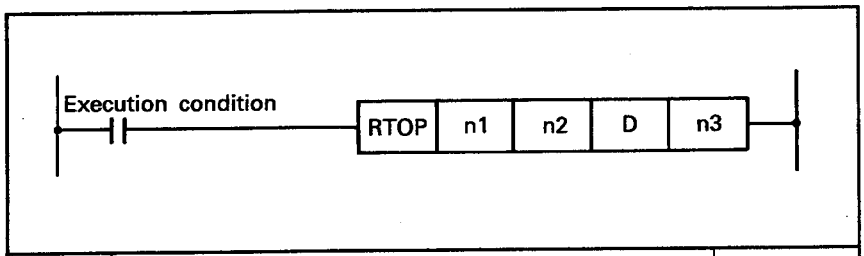


POINT

The head I/O number, designated by n1, is a 3-digit number in the RFRP and RTOP instructions.

(2) Write to remote I/O station AD70D

[Format]

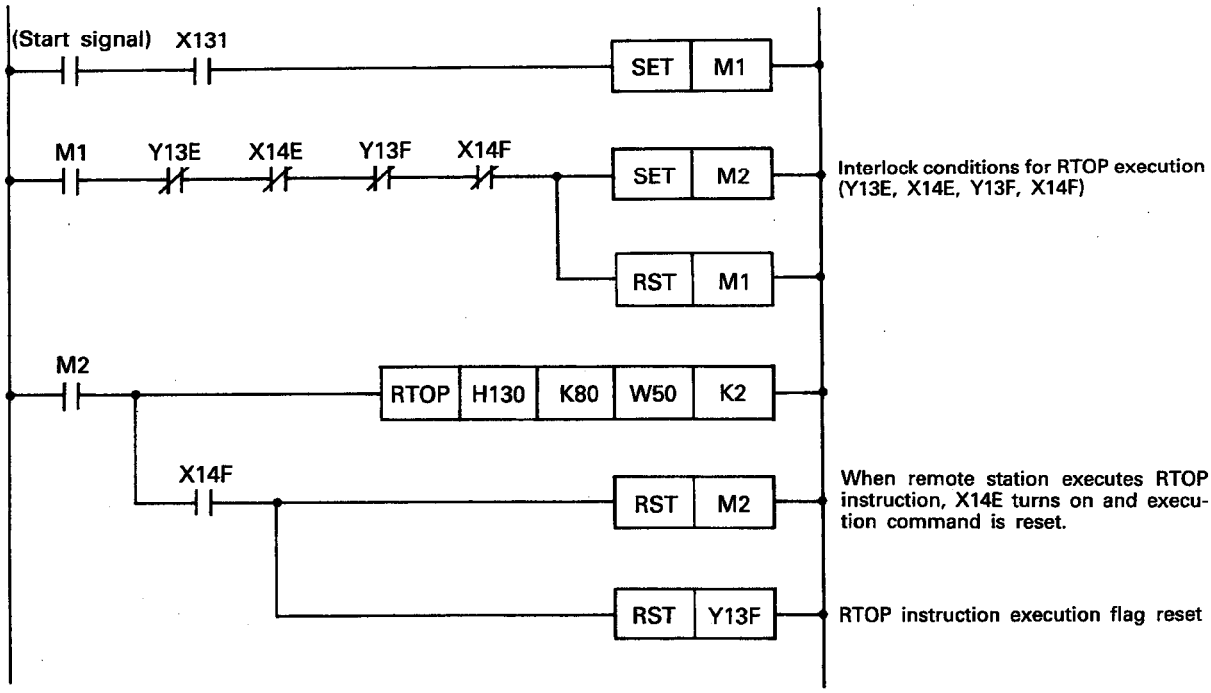


Symbol	Description	Available Device
n1	First 3 digits AD70D I/O number assignment from master station	K, H
n2	Head buffer address to which data will be written	K, H
D	Head link register to which data will be read	W
n3	Number of data words to be written (1 to 16)	K, H

Fig. 5.42 Write Command RTOP

Example: Writing two words from W50 to buffer address 80 and 81 of the AD70D located at I/O address X, Y130 to 14F in a remote I/O station.

To write once on receiving the start signal



POINT

The head I/O number, designation by n1, is a 3-digit number in the RFRP and RTOP instructions.

5.12.3 Program example

The program to write fixed and variable parameters, and positioning data from the master station to the AD70D in a remote I/O station 1 and execute zero return and positioning, and then to read the actual present value from the AD70D is shown below.

Conditions:

1. Fixed parameters and servo parameters are written after CPU RUN, and variable parameters and positioning data written using the start command. Absolute positioning is executed after count type zero return execution.
   The actual present value is read to D102, D103.
   For zero return data, defaults are used.

2. The AD70D is assigned to X, Y100 to 11F in the master station and to X, Y100 to 1F in the remote I/O station.

3. 64 link registers are used (W100 to 13F) for the RTOP instruction and 64 (W200 to 23F) for RFRP.

4. Set the following data as parameters and positioning data.

		Set Value	Device Used	Buffer Memory Address
Fixed parameters	Upper stroke limit	2,000,000,000PLS	W106, W105	1, 0
	Lower stroke limit	−2,000,000,000PLS	W108, W107	3, 2
Servo parameters	Motor capacity	5	W120	13
Variable parameters	Velocity limit	300,000PLS/sec	W116, W115	41, 40
	Acceleration time	400ms	W117	42
	Deceleration time	450ms	W118	43
Positioning data	Positioning pattern	0	W110	60
	Positioning address P1	12345PLS	W112, W111	62, 61
	Positioning velocity V1	1000PLS/sec	W114, W113	64, 63
Monitor	Actual present value	——	W203, W202	103, 102

* LINK *

MAS-TER	SLAVE PC STATIONS	M → ALL L		W.D.T. FOR LINK 10ms	INTER-MITTENT 10ms
		B	W		
M	1	-	-	20	XXXX

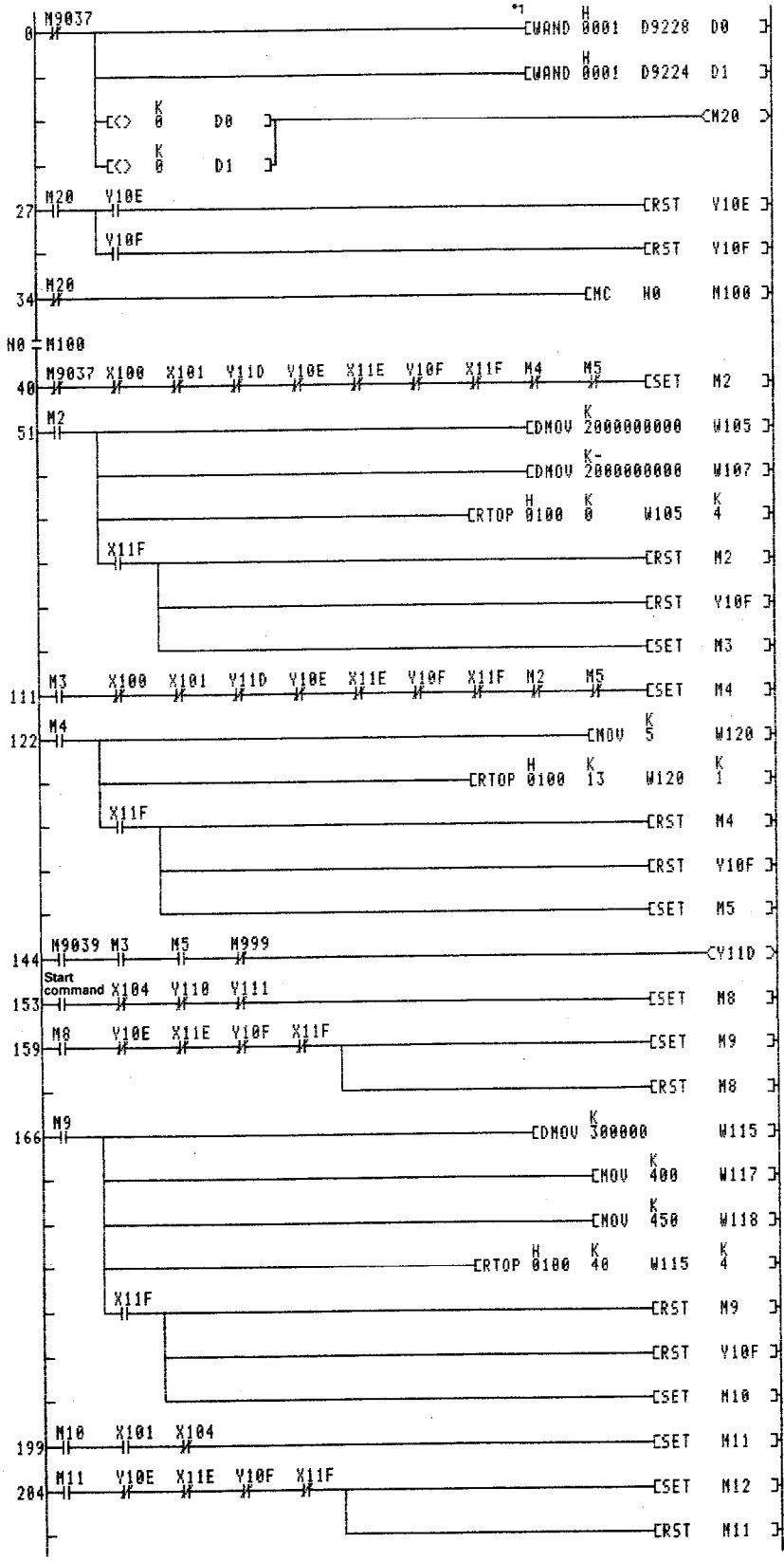
M:B ⟷ ALL L:B -
M:W ⟷ ALL L:W -
M:W ⟶ ALL R:W 100-13F
M:W ⟵ ALL R:W 200-23F
M:Y ⟶ ALL L:X -
M:Y ⟶ ALL R:Y 100-19F
M:X ⟵ ALL L:Y -
M:X ⟵ ALL R:X 100-15F

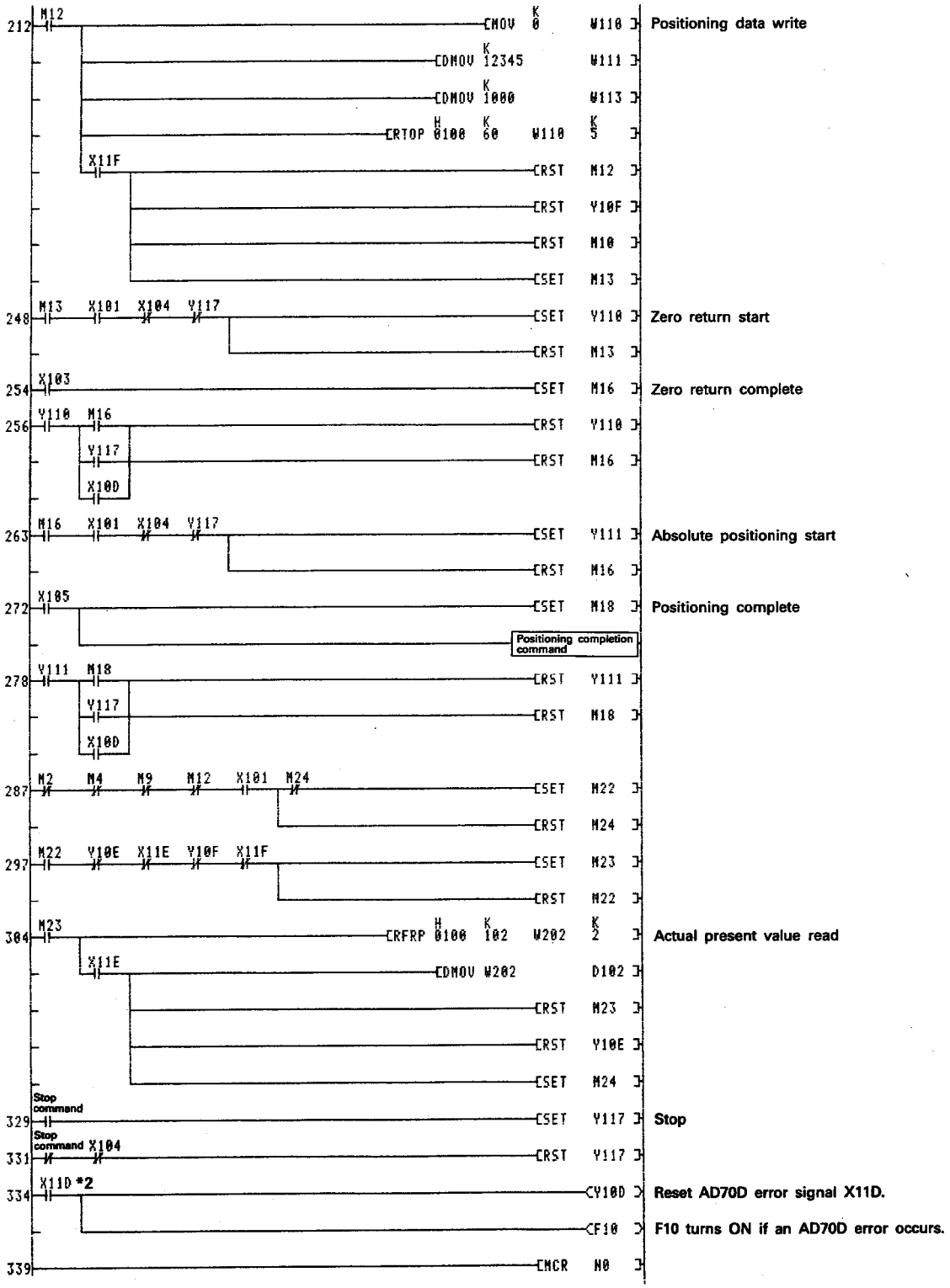
L/R NO.	M ← L		M → R	M ← R	M → L/R		M ← L/R	
	B	W	W	W	Y	X/Y	X	Y/X
R 1	--------	--------	100-13F	200-23F	100-19F	000-09F	100-15F	000-05F
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-

M:MASTER L:LOCAL R:REMOTE

↑
L:LOCAL
R:REMOTE

[redacted] PARAMETER [redacted] A3 [redacted]


M9037
*1
WAND H0001 D9228 D0
WAND H0001 D9224 D1
<> K0 D0
<> K0 D1
M20
Error detection in remote I/O station 1
Detection of parameter communication in remote I/O station 1
M20 turns ON if an error occurs in remote I/O station 1.
M20 V10E
RST V10E
V10F
RST V10F
Reset handshake signal (Y10E, Y10F) if a communication error occurs during PFRP and RTOP instruction execution in a remote I/O station.
M20
CMC H0 M100
N0 M100
M9037 X100 X101 V11D V10E X11E V10F X11F M4 M5
SET M2
M2
DMOV K2000000000 W105
Fixed parameter write
DMOV K-2000000000 W107
RTOP H0100 K0 W105 K4
X11F
RST M2
RST V10F
SET M3
M3 X100 X101 V11D V10E X11E V10F X11F M2 M5
SET M4
M4
MOV K5 W120
Servo parameter write
RTOP H0100 K13 W120 K1
X11F
RST M4
RST V10F
SET M5
M9039 M3 M5 M999
V11D
PC ready ON
Start command X104 V110 V111
SET M8
M8 V10E X11E V10F X11F
SET M9
RST M8
M9
DMOV K300000 W115
Variable parameter write
MOV K400 W117
MOV K450 W118
RTOP H0100 K40 W115 K4
X11F
RST M9
RST V10F
SET M10
M10 X101 X104
SET M11
M11 V10E X11E V10F X11F
SET M12
RST M11



*1 If error occurs in a remote I/O station, this circuit detects from the error occurrence to the completion of the initial communication. If a remote I/O station executing the RFRP or RTOP instruction is down, handshake signals Y10E, and Y10F (YnE, YnF) are reset to allow normal communication after restoring the error.

*2 If the RFRP and RTOP instructions cannot be executed due to a special function module (AD70D) error, error signal X11D ($X_{n+1}D$) turns ON, and F10 turns ON. Check the special function module in which the error has occurred. When Y10D (YnD) turns ON, X11D ($X_{n+1}D$) turns OFF.

6. TROUBLESHOOTING

6.1 Errors Detected by AD70D

The AD70D has various error check functions. When an error occurs, the LED on the front panel of the AD70D lights and an error code is written to address 121 (minor error code), 122 (major error code), 123 (servo error code) in the buffer memory and the error detection signal X8 turns ON.

(1) A new error will overwrite the previous one in the buffer memory.

(2) Error code "0" indicates no error.

(3) Errors are reset by turning Y18 ON.
When servo errors 2010 to 2037 occur, error reset (Y18) does not turn ON. Turn OFF the PC CPU reset, the power supply, or PC ready (Y1D). Error detection (X8) turns OFF when the error is reset.

Table 6.1 Error Code Classification

Error Code	Error Classification		LED Indicator	Remarks
1 to 9	Set data range error	Fixed parameters	ERR. 1 flickers	Refer to Section 6.1.1
10 to 29		Servo parameters		
30 to 39		Zero return data		
40 to 49		Variable parameters		
50 to 59		Positioning data		
60 to 69		Control change area		
70 to 79	Buffer memory write disable error		ERR. 1 flickers	Refer to Section 6.1.2
1000 to 1099	AD70D start error		ERR. 2 flickers	Refer to Section 6.1.3
100 to 199			ERR. 1 flickers	
1100 to 1199	AD70D operation error		ERR. 2 flickers	Refer to Section 6.1.4
200 to 299			ERR. 1 flickers	
300 to 399	Control change error		ERR. 1 flickers	Refer to Section 6.1.5
2000 to 2999	Servo error		SV ERR. flickers	Refer to Section 6.1.8
3100 to 3199	Servo communication error		ERR. 2 flickers	Refer to Section 6.1.7
4100 to 4199	Absolute system error		ERR. 2 flickers	Refer to Section 6.1.6

Errors are classified into three levels an ERR.1 ERR.2, and SV ERR.

ERR. 1 (minor error) : Can be corrected from the sequence program
ERR. 2 (major error) : Originates in an external signal
SV ERR. (servo error) : Error detected by servo amplifier

6.1.1 Set data range errors

Table 6.2 Data Range Check

Data	Operation
Fixed parameters	• At power ON • When PC ready signal (Y1D) turns ON
Servo parameters	• At power ON • When PC ready signal (Y1D) turns ON
Variable parameters	• When positioning start signal (Y11 to Y13) turns ON • When JOG start signal (Y14, Y15) turns ON • When zero return start signal (Y10) turns ON
Zero return data	• When zero return start signal (Y10) turns ON
Positioning data	• When positioning start signal (Y11 to Y13) turns ON
Control change area	• Before control change processing execution

When an error occurs, check the data corresponding to the error code, change the data to within the setting range, and then set it again.
A list of error codes is shown in Table 6.3.

Table 6.3 Data Range Error Codes (Continue)

Error Code	Data Type	LED Indicator	Check point		Check Range	Control at Error	Error Code Set Address
1	Fixed parameters	ERR. 1 lights	Lower stroke limit		−214783648 to upper stroke limit	If only 1 data is set outside the setting range, an error will occur and control is executed with default values of all fixed parameters.	121
2			Electronic gear	Specified pulse multiplication ratio numerator (CMX)	1 to 9999		
3				Specified pulse multiplication ratio numerator (CDV)	1 to 9999, $\frac{1}{50} \leqq \frac{CMX}{CDV} \leqq 50$		
10	Servo parameters		System settings		0 to 9		
11			Regenerative resistance		0 to 9		
12			Motor type		0 to 9		
13			Motor capacity		0 to 999		
14			Motor rpm		1 to 9		
15			Position loop gain		1 to 999 rad/sec		
16			Velocity loop gain		1 to 9999		
17			Velocity integration compensation		1 to 9999 ms		
18			In-position range		1 to 9999 PLS		
19			Number of feedback pulses per motor rotation		1 to 65535 PLS		
20			Rotation direction		0, 1		
21			Torque limit		1 to 500 %		

Table 6.3 Data Range Error Codes

Error Code	Data Type	LED Indicator	Check point	Check Range	Control at Error	Error Code Set Address
32	Zero return data	ERR. 1 flickers	Zero return velocity	1 to velocity limit PLS/sec	No data start at error.	121
33			Creep velocity	1 to velocity limit PLS/sec		
34			Axis travel distance setting after near-zero point dog ON	Must be greater than the deceleration distance from the zero return velocity to the creep velocity Checked only in the count mode		
40	Variable parameters		Velocity control	10 to 1000000 PLS	Error parameters are replaced with default values.	
41			Acceleration time	4 to 9999 ms		
42			Deceleration time	4 to 9999 ms		
43			Positioning mode	0, 1		
51	Positioning data		Positioning address P1	Within the stroke limit range	No start	
52			Positioning velocity V1	1 to velocity limit	No start at "0". When an error occurs at values other than "0", control will be executed at the velocity limit value.	
53			Positioning address P2	Within the stroke limit range The positioning direction from P1 to P2 at two-phase trapezoidal positioning in the absolute positioning mode will, if reversed, from the present value to P1, result in an error.	No start	
54			Positioning velocity V2	1 to velocity limit	No start at "0". When an error occurs at values other than "0", control will be executed at the velocity limit value.	
60	Control change area		Velocity change	1 to velocity limit		
61			JOG velocity	1 to velocity limit		
62			Servo parameter change	0, 1	Control is not changed if data outside the setting range is set.	
63			Torque limit change	1 to 500 %		

6.1.2 Buffer memory write errors

Writing data from the sequence program to prohibited buffer addresses or writing when the buffer cannot accept the data prompts the error codes shown in Table 6.4.
Check and correct the sequence program.

Table 6.4 Buffer Memory Write Error Codes

Error Codes	Buffer Memory Address	LED Indicator	Error Definition	Error Code Set Address
* 70	0 to 5 10 to 22 30 to 37	ERR. 1 lights	Data written from PC while Y1D is ON. (Fixed parameters, servo parameters, zero return data)	121
71	100 to 138		Data written to a write prohibit address. (Monitor area)	
72	0 to 90		1-word data written to 2-word data area.	

* No error occurs if the setting for the position loop gain and/or velocity loop gain servo parameters is incorrect.

6.1.3 AD70D start errors

Table 6.5 AD70D Start Error Codes (major errors)

Error Code	Data Type	LED Indicator	Error Definition	Corrective Action	Error Code Set Address
1000	At start	ERR. 2 lights	STOP signal ON at start	Turn STOP signal OFF.	122
1001			Upper limit LS (FLS) signal OFF at start	Return present value to within the stroke limit range using JOG operation.	
1002			Lower limit LS (RLS) signal OFF at start	Return present value to within the stroke limit range using JOG operation.	
1003			Near-zero point dog signal ON at zero return start (near-zero point dog mode only)	Return the axis to a position away from the near-zero point dog position by JOG operation (positioning).	
1004			Servo ready (READY) signal OFF at start	Turn the servo ready (READY) signal ON.	

Table 6.5 AD70D Start Error Codes (minor errors)

Error Code	Data Type	LED Indicator	Error Definition	Corrective Action	Error Code Set Address
100	At start	ERR. 1 lights	AD70D ready completion (X01) and PC ready (Y1D) are OFF at start.	Turn PC ready (Y1D) ON.	121
101			Start signal does not turn ON because BUSY (X04) is ON at start.	Provide interlock from the sequence program so that start is not executed during BUSY.	
103			STOP (Y17) ON at start.	Turn STOP (Y17) OFF and re-start.	
106			Present value is outside stroke limit range at start.	• Return present value to within the stroke limit range using JOG operation. • Execute zero return operation. • Set present value to within the stroke limit range by present value change.	
111			(1) Re-start attempted in the V/P mode at positioning completion in the V/P control switchover mode. (2) Re-start attempted in the V/P mode while in the positioning mode. (3) Re-start attempted by turning OFF the emergency stop signal or canceling servo OFF after stopping positioning control by turning ON the emergency stop or servo OFF (Y1B) signal during V/P switchover control.	(1) Start by forward start (Y12) or reverse start (Y13). (2) Start by absolute positioning start (Y11), forward start (Y12), or reverse start (Y13). (3) Turn OFF the emergency stop signal or cancel servo OFF to start V/P switchover control, and then start by forward start (Y12) or reverse start (Y13).	
115			Zero return start attempted with zero return completion (X03) ON.	• Zero return cannot be repeated consecutively. (Near-zero point dog mode only) • Move to a position in front of near-zero point dog using JOG or positioning operation, and re-start.	
131			Servo OFF (Y1B) is ON at start.	Turn servo OFF (Y1B) OFF and re-start.	
132			Axis travel distance changed to outside stroke limit range.	Change the axis travel distance to within the stroke limit range.	
133			Positioning start (Y11) attempted in the V/P control switchover mode.	Start by forward start (Y12) or reverse start (Y13).	

6.1.4 AD70D operation errors

Table 6.6 AD70D Operation Error Codes (major errors)

Error Code	Data Type	LED Indicator	Error Definition	Processing	Corrective Action	Error Code Set Address
1101	During operation	ERR. 2 lights	Upper limit LS (FLS) signal is OFF during BUSY.	Decelerates to stop	Return present value to within the stroke limit range using JOG operation.	122
1102			Lower limit LS (RLS) signal is OFF during BUSY.	Decelerates to stop	Return present value to within the stroke limit range using JOG operation.	
1103			External stop (STOP) signal is ON during zero return.	Decelerates to stop	• Re-start if stopped on the near-zero point dog in count mode. • Return to the position before near-zero point dog ON using JOG or positioning operation, and re-start(near-zero point dog type). • Re-start if stopped before the near-zero point dog.	
1104			Servo error detected during BUSY.	Immediate stop	Can be re-started after servo error correction.	
1105			Servo ready (READY) signal OFF during BUSY.	Decelerates to stop	Check the servo amplifier and turn servo ready ON.	
1110			The reference point has not been passed before outputting zero return start.	No re-start	Rotate the motor more than one revolution using the JOG or positioning operation.	

Table 6.6 AD70D Operation Error Codes (minor errors)

Error Code	Data Type	LED Indicator	Error Definition	Processing	Corrective Action	Error Code Set Address
200	During operation	ERR. 1 lights	PC ready (Y1D) is OFF during BUSY (positioning, JOG).	Decelerates to stop	Turn the PC ready (Y1D) ON.	121
201			PC ready (Y1D) is OFF during zero return.	Decelerates to stop	• Re-start if stopped on the near-zero point dog in count mode. • Return to the position before near-zero point dog ON using JOG or positioning operation, and re-start(near-zero point dog type). • Re-start if stopped before the near-zero point dog	
202			STOP (Y17) is ON during zero return.	Decelerates to stop	• Re-start if stopped on the near-zero point dog in count mode. • Return to the position before near-zero point dog ON using JOG or positioning operation, and re-start(near-zero point dog type). • Re-start if stopped before the near-zero point dog	
207			Present value has exceeded the stroke limit range.	JOG enabled	Change present value to within the stroke limit range.	
213			By the electronic gear, the velocity has exceeded 1,000 kpps. (Zero return, positioning, JOG)	Limited to 1,000 kpps	Change the velocity to less than 1,000 kpps.	
220			The servo OFF (Y1B) is ON during BUSY (positioning, JOG).	Decelerates to stop	Turn the servo OFF (Y1B) ON.	

6.1.5 Control change errors (minor) during AD70D operation

Table 6.7 Control Change Error Codes During AD70D Operation

Error Code	Data Type	LED Indicator	Error Definition	Corrective Action	Error Code Set Address
300	At control change uring operation	ERR. 1 lights	Attempted to change the present value (buffer memory address 80, 81) during BUSY.	Provide interlock using the sequence program.	121
301			Attempted to change the velocity (buffer memory address 82, 83) during zero return.		
303			Attempted to change the velocity (buffer memory address 82, 83) after automatic deceleration has started.		
304			Attempted to change the velocity (buffer memory 82,83) using JOG operation after JOG signal turned OFF.		

6.1.6 Servo errors

Servo errors are errors detected by the servo amplifier. Their error codes are 2000 to 2999.

Table 6.8 Servo Error List

Error Code	Error Causes		Error Check Point	Processing	Corrective Action
	Name	Error Details			
2010	Low voltage 1	• AC power supply voltage (200/220 VAC) is lowered below 160 ±5 VDC. (Detected at S- and T-phase)	Always	Immediate stop	
2012	Internal memory error	• EPROM check sum error or SRAM or 2-port RAM check error • EPROM, SRAM, or 2-port RAM error	• When servo power is turned ON • Leading edge of the PC ready Y1D)		• Reset the ACPU. • Replace the servo amplifier.
2013	External clock error	• Data processing for the position command given by the AD70D is not completed within the specified period. • Timing signal error (BCLK, SCLK) from the AD70D.	Always	Immediate stop	• Hardware fault of the AD70D or servo. • Reset the ACPU and check if the same error occurs.
2014	WD	• Timing signal error or 2-port RAM signal error of the AD70D.			
2015	2-port memory error	• 2-port RAM check error or parity error detected during receiving the initial parameters. • Faulty cable connecting to AD70D or 2-port RAM error.	• When servo power is turned ON • Leading edge of the PC ready Y1D)		
2016	Magnetic pole error	• In the initial magnetic pole detection, the magnetic pole position cannot be detected correctly (U, V, W phase error). • Faulty cable or encoder.			
2017	PC board error	• AD converter output during initialization is incorrect; higher than ±0.5 V. • Faulty AD converter on the PCB.			
2020	No-signal ME	• Signal error of the encoder connected to the RF01 card (U, V, W, A, B, Z error). • Faulty cable or encoder.	Always	Immediate stop	• Encoder hardware fault (connected to the servo) • Replace the servo amplifier.
2021	No-signal AE	• Signal error of the encoder connected to the RF31 or RF33 card (A, B, Z error). • Faulty cable or encoder.			
2022	No-signal IX	• Signal error of the resolver connected to the RF32 or RF33 card. • Faulty cable or resolver or an excitation signal error.			• Resolver hardware fault (connected to the servo). • Replace the servo.

Table 6.8 Servo Error List (Continue)

Error Code	Error Causes		Error Check Point	Processing	Corrective Action
	Name	Error Details			
2025	Battery alarm	• Backup battery voltage for the RF32 or RF33 card absolute position detection circuit is low. • Absolute values might have been lost; execute zero return again.	• When servo power is turned ON • Leading edge of the PC ready (Y1D)	Zero return request X02 is turned ON.	• This check is available only in the absolute system. • Replace the servo battery.
2030	Excessive regeneration	• Regeneration control power transistor is turned ON and OFF too frequently. (Regenerative resistor will be overheated.) Lower acceleration/deceleration frequency or positioning velocity.	Always	Immediate stop	• Reset the AD70D. • Turn the servo amplifier power supply ON.
2031	Over-speed	• Excessive motor rpm: Max. 2400 rpm ····· HA40, 80, 100, 200, and 300 Max. 3600 rpm ····· HA43, 83 • Command velocity is too high or overshoot occurs during acceleration.			
2032	Over-current	• Excessive current flows from the DC bus line (+ side). Motor wiring grounded or shorted.			
2033	Over-voltage	• Voltage applied to the DC bus line is higher than 400 V. • Acceleration/deceleration is repeated too frequently, exceeding regeneration performance. • Connecting error at the regeneration circuit terminals.			
2034	Communication error	• Parity error in the data sent from the AD70D. • Faulty cable or noise.			
2035	Data error	• Excessive variation rate of position data given by the AD70D. • Velocity too high, faulty cable, or noise existing.			
2036	Transmission error	• Communication with the AD70D is disabled. • Faulty cable or noise.			
2037	Parameter error	• The parameters transmitted during initial processing were incorrect. • Check the parameters.	• When servo power is turned ON • Leading edge of the PC ready (Y1D)		
2045	Fin overheat	• The thermal protector for the fin in the amplifier power circuit has tripped. • The servo is operated exceeding the allowable continuous output current.	Always	Immediate stop	• Reset the error (Y18: ON). • Lower the load.
2046	Motor overheat	• The thermal protector in the motor has tripped. • The motor is operated exceeding the allowable continuous output current.			

Table 6.8 Servo Error List (Continue)

Error Code	Error Causes		Error Check Point	Processing	Corrective Action
	Name	Error Details			
2050	Overload 1	• Duration of time in which motor current, converted into the stall rating, exceeds the overload detection level exceeds the overload time constant. • Load inertia or friction is too high.	Always	Immediate stop	• Reset the servo error (Y8: ON)
2051	Overload 2	• Current command exceeding 95% of the current limit is present for more than 0.5 sec. • Collision of the machine or load inertia is too high.			
2052	Excessive error	• An error between the actual position data and the command position data exceeds the error limit range. (65 KPLS) • Due to excessively high inertia, acceleration is not as designated, or overshoot or hunting occurs.			
2055	External emergency stop	• Terminals B and R, usually shorted, are opened.			
2100	Initial communication warning	• Serial signal is error or the absolute counter data does not match when the PC ready (Y1D) is turned ON.	Always	Immediate stop	• Replace the cable or card. • Replace the position encoder/resolver.
2101	Serial communication warning	• Serial signal communications from the absolute position encoder are abnormal.			
2102	Battery warning	• The voltage of the battery set on the RF371 card is lower than 3.2 ±0.2 V.			• Replace the battery.
2103	Battery cable open warning	• The voltage supplied to the absolute position encoder is lower than 2.8 ±0.2 V.			
2104	Position offset warning	• The relationship between the feedback position data and Z-phase of the encoder is incorrect.			
2143	Absolute position counter warning	• The relationship between the feedback position data and the absolute position counter is incorrect.	Always (Valid after zero point initial setting completion.)	Continuous	• This check is available only in the absolute system. • After resetting the servo error (Y18: ON), establish the absolute coordinate system by executing the zero return operation.
2144	Parameter error	• Illegal parameters are set. • The illegal parameter and the following parameters are ignored. • Check the parameters. (Servo is not turned OFF.)	• When servo power is turned ON • Leading edge of the PC ready (Y1D)		• After resetting the servo error (Y18: ON), set the PC ready (Y1D). • Reset the ACPU.

Table 6.8 Servo Error List

Error Code	Error Causes		Error Check Point	Processing	Corrective Action
	Name	Error Details			
2145	Absolute position error	• The value "1X" of absolute position detection system is incorrect. • Absolute position detection is not executed correctly. (Servo is not turned OFF.)	• When servo power is turned ON • Leading edge of the PC ready (Y1D)		• This check is available only in the absolute system. • After resetting the servo error (Y18: ON), establish the absolute coordinate system by executing the zero return operation.
2147	PC emergency stop	• The emergency stop signal is output from the AD70D.			

6.1.7 Servo communication error (major)

Table 6.9 Servo Communication Error Codes

Error Code	Data Type	LED Indicator	Error Definition	Corrective Action	Error Code Set Address
3100	At servo communication	ERR. 2 lights	The AD70D cannot communicate with the servo during initial communication. (No amplifier loaded)	• Check if the servo amplifier is correctly loaded. (Axis number selection switch, cable connection, amplifier input power supply, etc.) • Reset the PC or re-apply power.	122
3101			Communication with the servo attempted but there is no response output from the servo. (Immediate stop)	• Check if the servo amplifier is correctly loaded. • Reset the PC or re-apply power.	
3102			Parity error during communication with the servo. (Immediate stop)	• Check cable connections. • Reset the PC or re-apply power.	

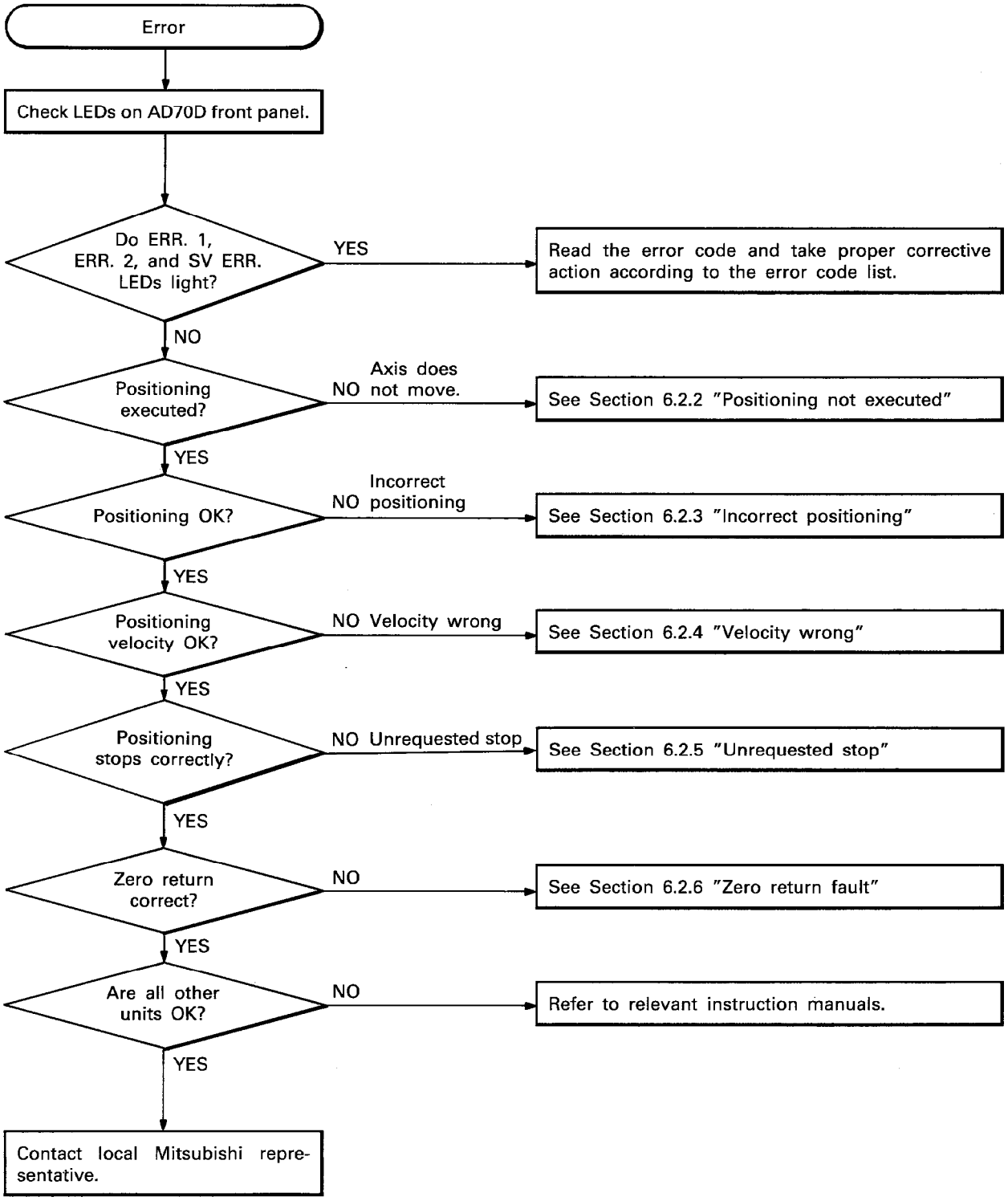
6.1.8 Absolute system errors (major)

Table 6.10 Absolute System Error Codes

Error Code	Data Type	LED Indicator	Error Definition	Corrective Action	Error Code Set Address
4101	Absolute system	ERR. 2 lights	Backup data (reference value) check sum error occurred when the power was turned ON.	• Execute zero return operation after resetting error. • Recurrence of the error indicates AD70D memory (NOV-RAM) error (life). Replace the module.	122

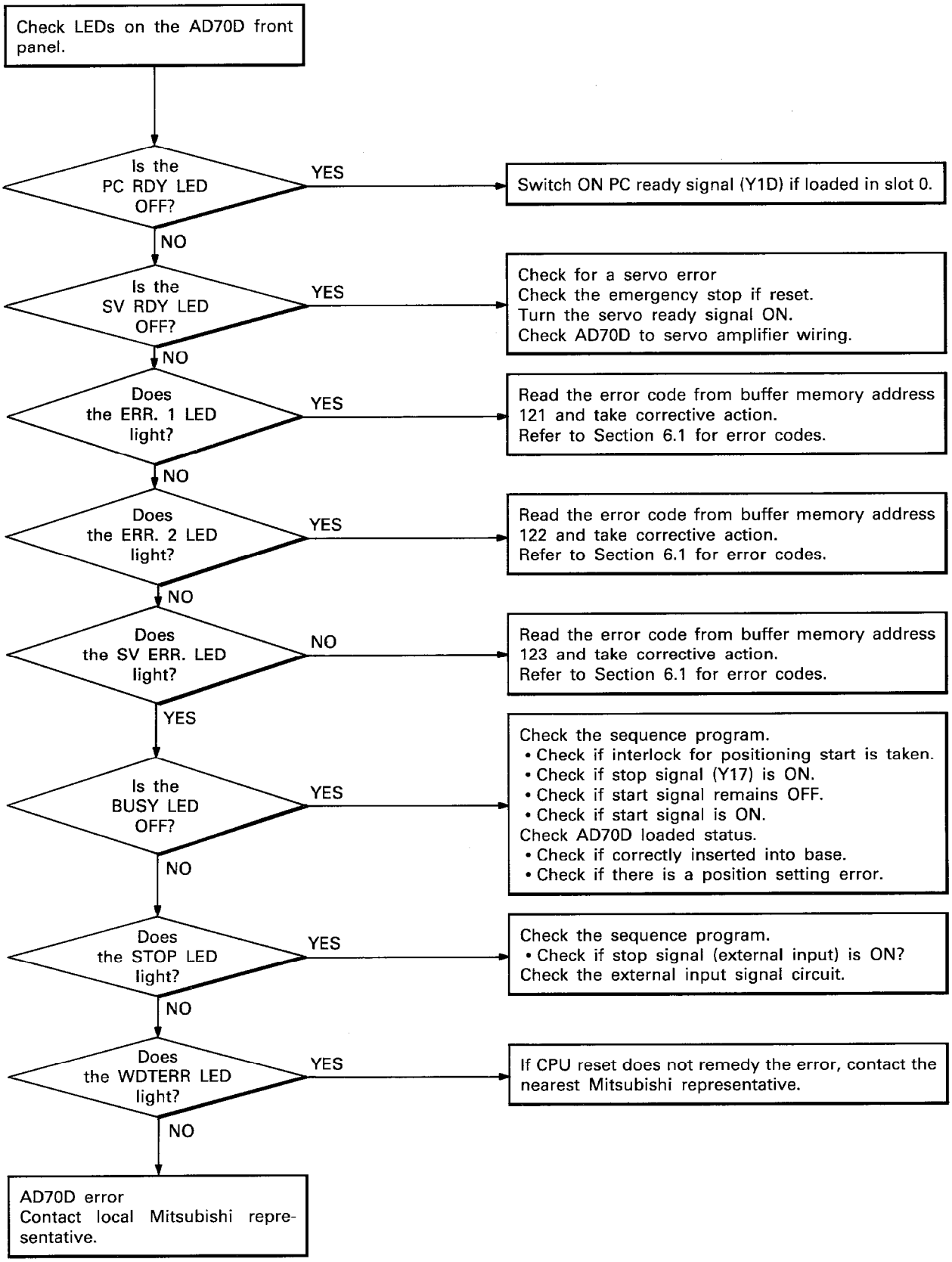
6.2 Troubleshooting

6.2.1 General troubleshooting

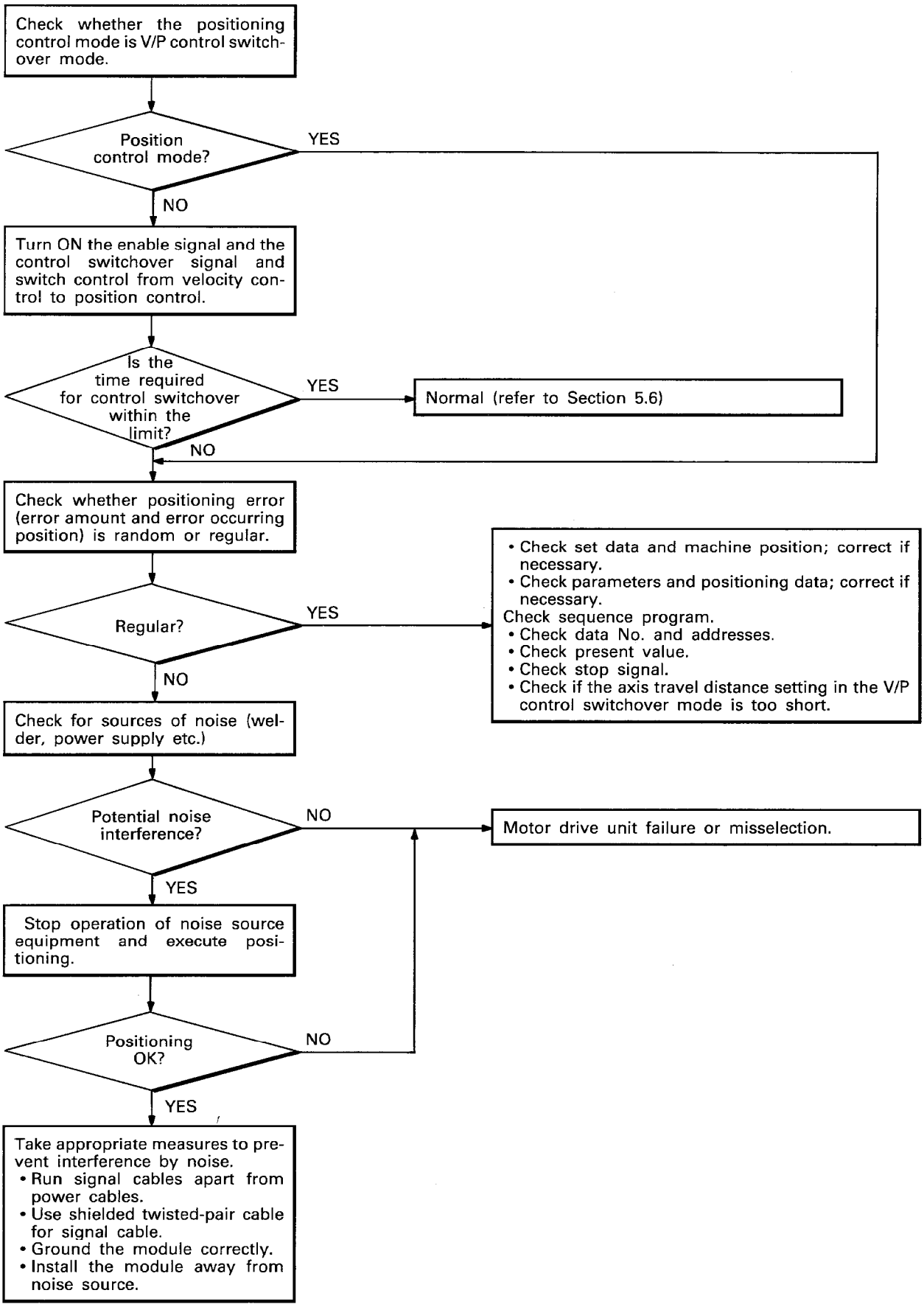


IB (NA) 66265-A

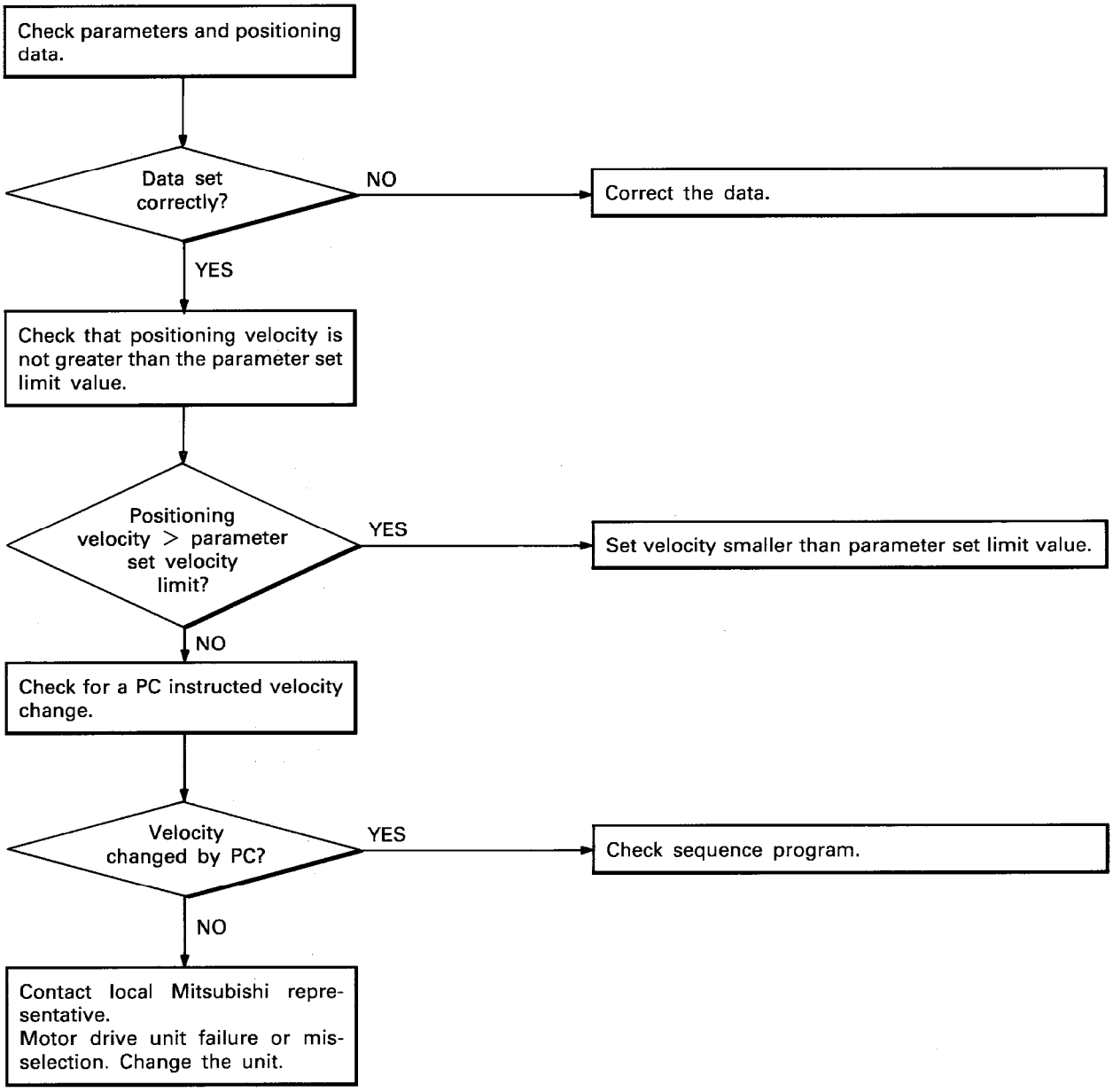
6.2.2 Positionings not executed



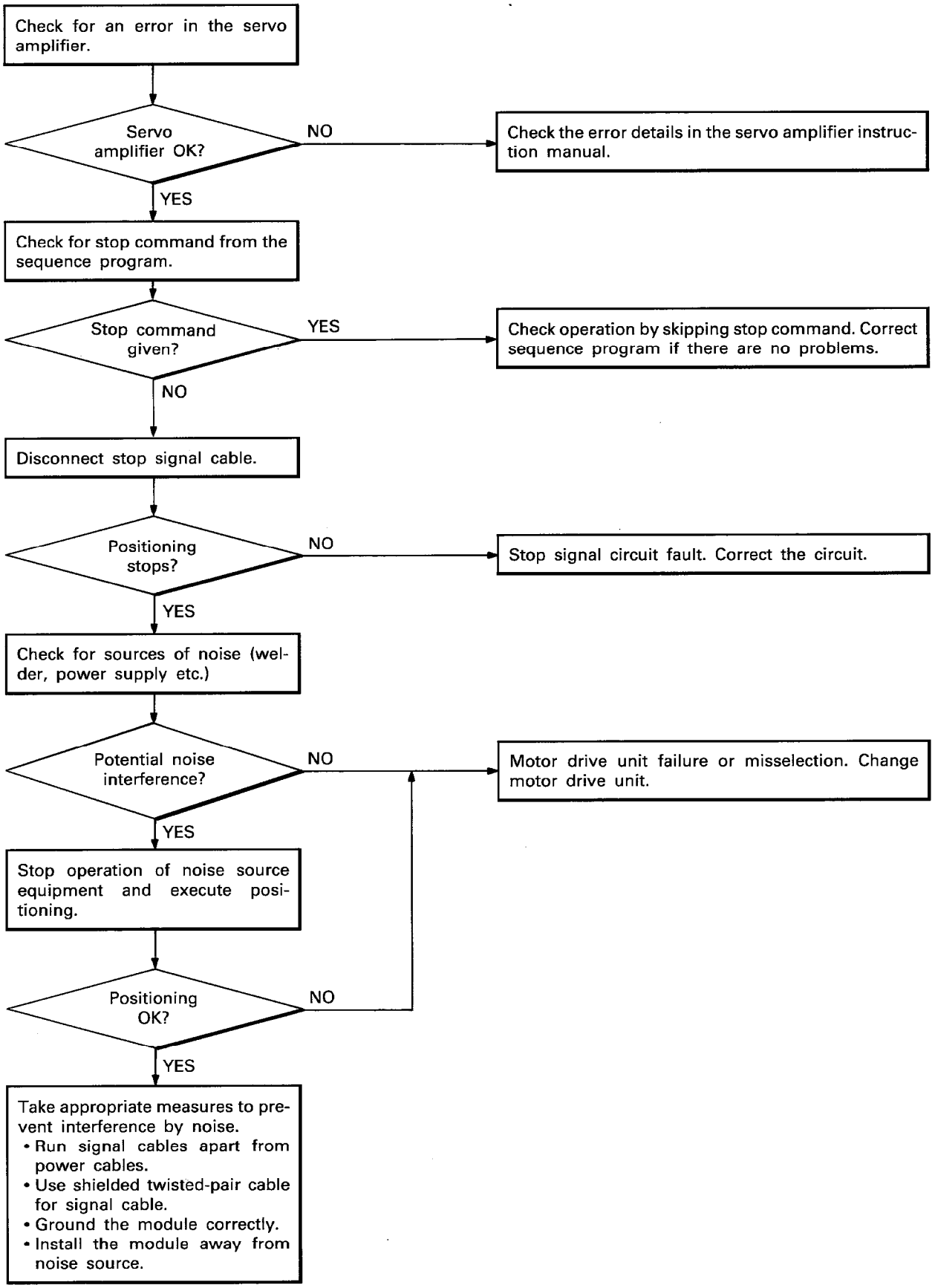
6.2.3 Incorrect positioning



6.2.4 Velocity wrong

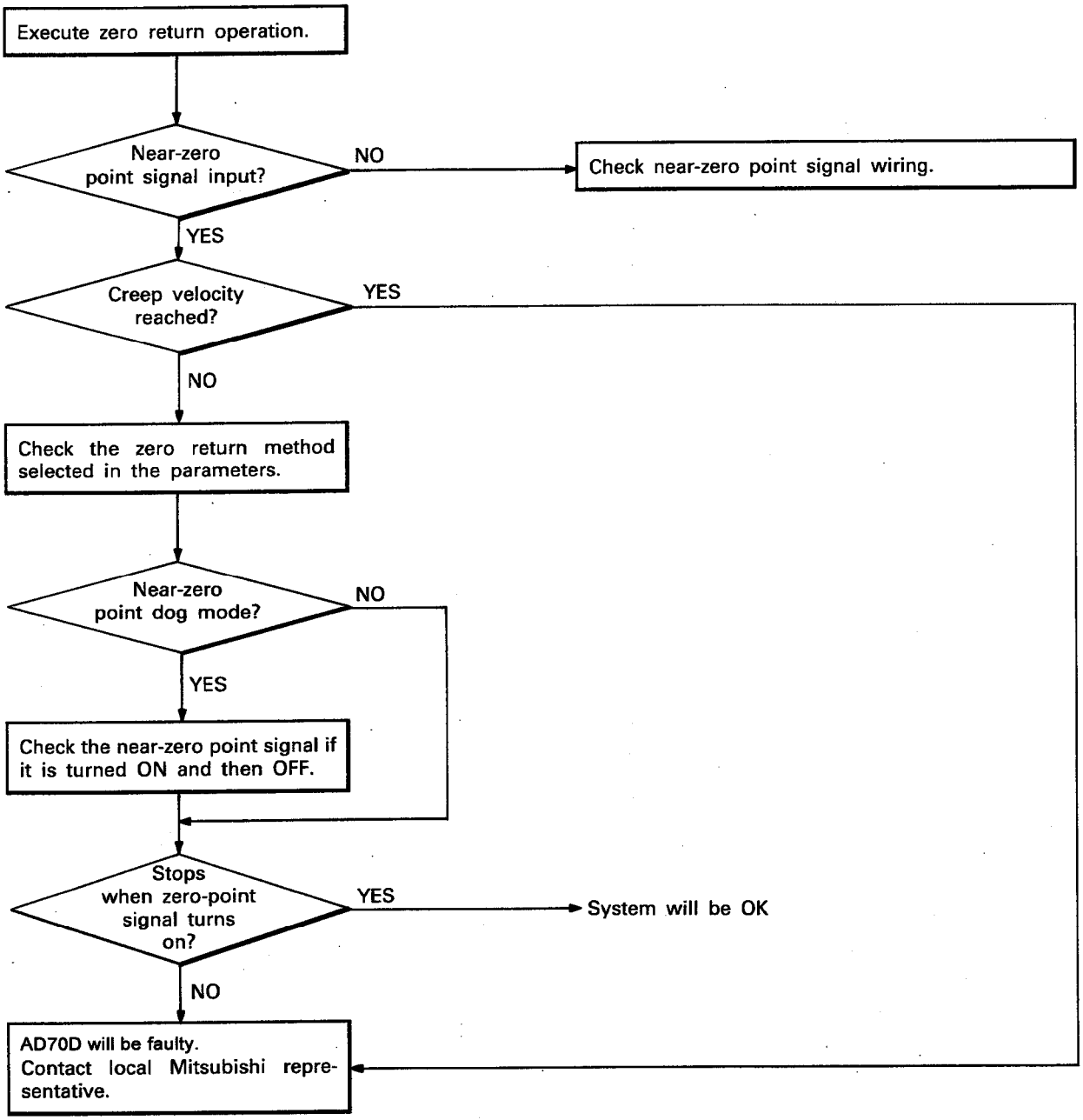


6.2.5 Unrequested stop

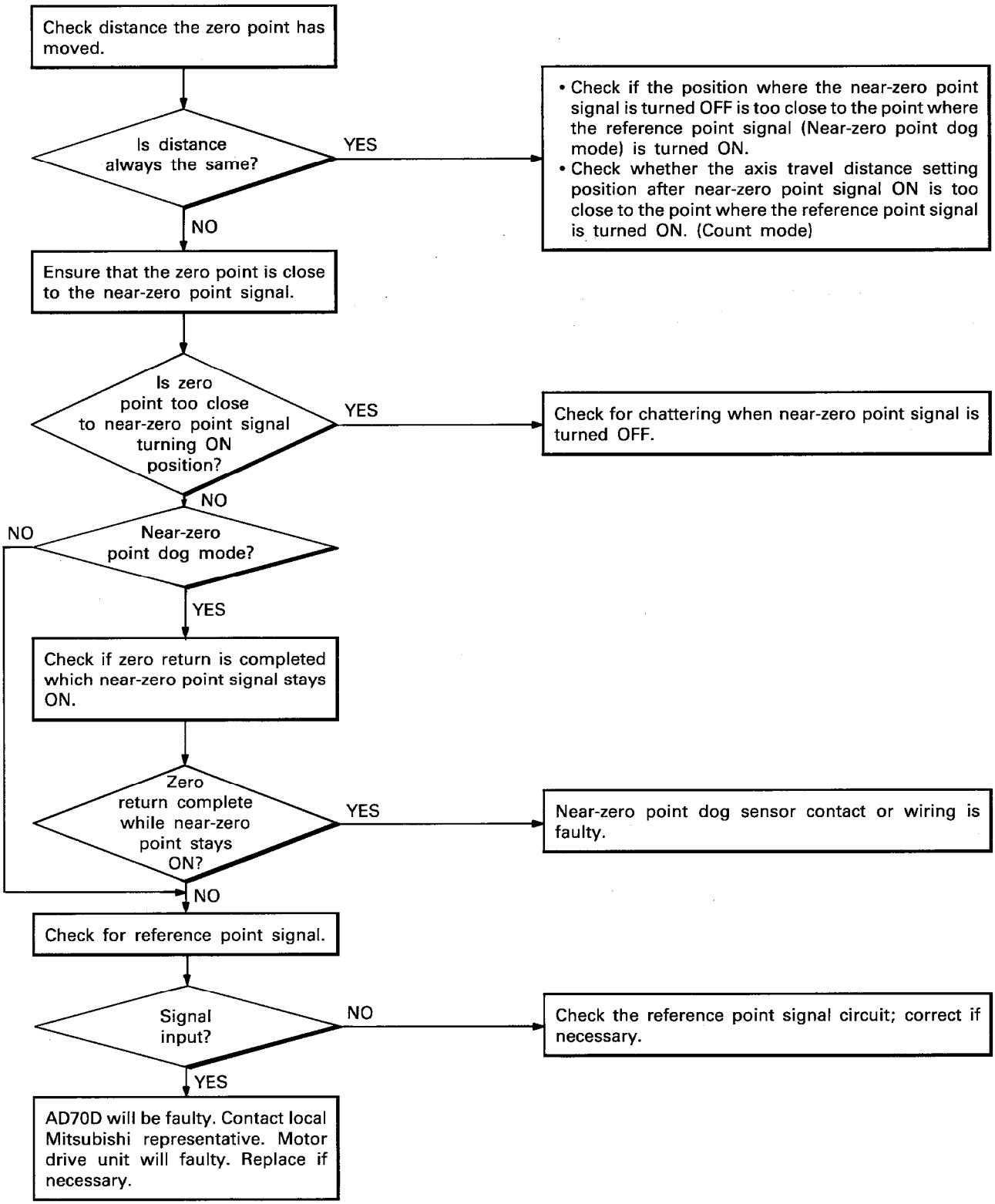


6.2.6 Zero return fault

(1) Zero return incomplete



(2) Zero point position has shifted



(3) Although zero return is completed, axis travel distance after the near-zero point signal ON is more than one revolution shorter than the correct distance.
Chattering when the near-zero point signal is turned off is suspected.

APPENDICES

Appendix 1 Comparison of AD70D and AD70 Functions

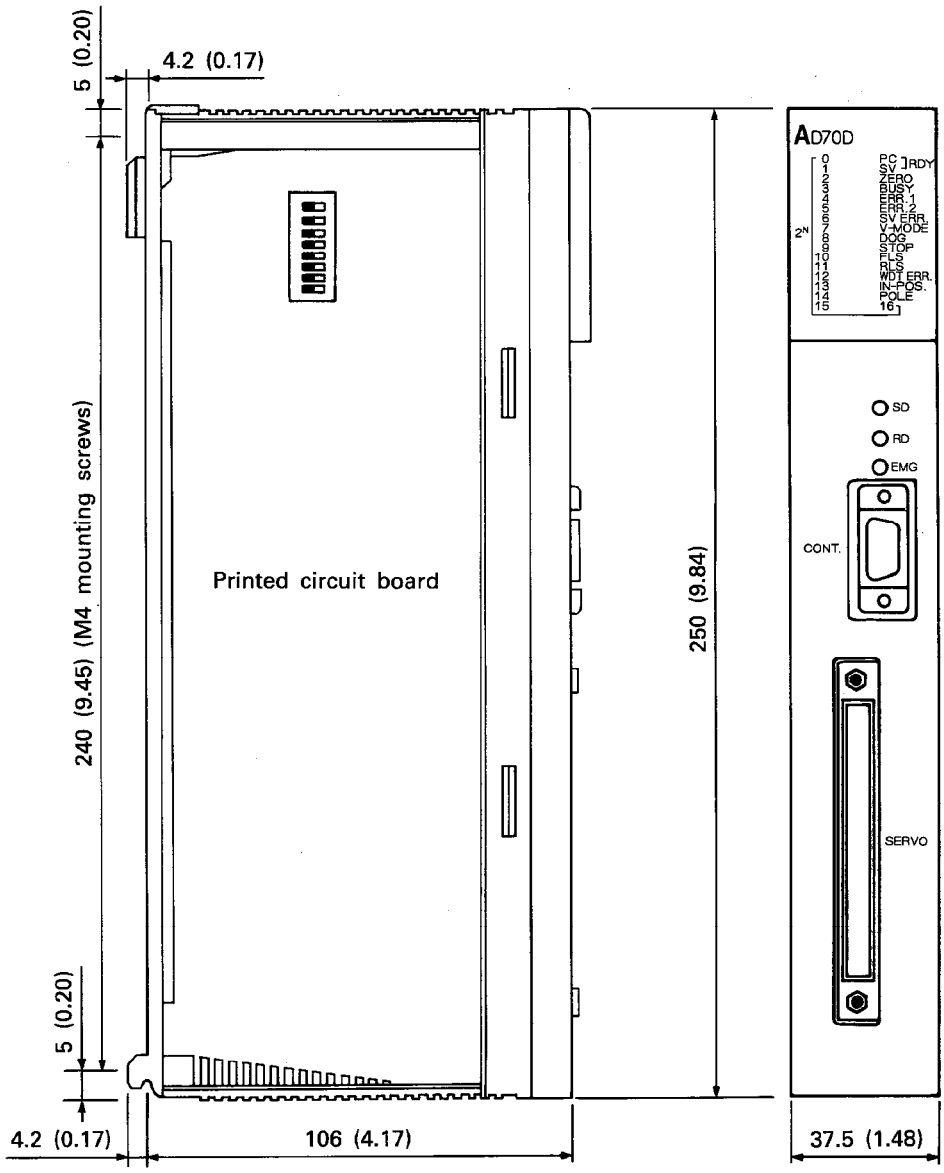
Item \ Module	AD70D	AD70
Number of control axes	1 axis	1 axis
Output command to the servo amplifier	Digital	Analog voltage
Positioning control function	Available	Available
Velocity control function	Available	Available
Velocity → position switching	Available	Available
Manual pulse generator operation	Not available	Not available
Jog operation	Available	Available
Absolute system	Available by connecting a servo motor and a servo amplifier compatible with the absolute system.	Not available
Velocity command	Max. 1M pps	Max. 400K pps
Torque limit function	Positive and negative torque can be limited.	Depends on the type of servo amplifier to be used.
Acceleration/deceleration time setting	4 to 9999 ms Acceleration and deceleration are set individually.	2 to 9999 ms Acceleration and deceleration are set individually.
Emergent stop deceleration time setting	Not provided	Not provided
In-position function	Within the range of 1 to ±9999	Within the range of 1 to ±2047
Multiplication ratio setting	Not provided	Ratios 4, 2, 1 and 1/2 are selectable.
Pulse quantity setting function	Not provided	3480, 6960, 10440 and 13920 are selectable.
Electric gear function	Within the range of $\frac{1}{50}$ to 50	Within the range of $\frac{1}{50}$ to 50
Servo off function	Provided	Not provided
Follow-up function	Provided	Not provided
Torque trace function	Provided *	Not provided
Servo diagnosis function	Provided (Velocity and position loop gain check)*	Not provided
Use of a stepping motor	Not available	Not available
Peripheral device	Not available	Not available
External power supply (DC)	Not necessary	±15 V
Internal current consumption 5 VDC (A)	0.8	0.3
Number of Occupied I/O (number of slots)	32 (1)	32 (1)
Outside dimensions (mm)	250 (H) × 37.5 (W) × 111 (D)	250 (H) × 37.5 (W) × 119 (D)
Weight (kg)	0.5	0.5

* Peripheral device A6GPP/A6PHP (SW□GP-AD70DP) is required.

APP

IB (NA) 66265-A

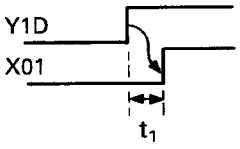
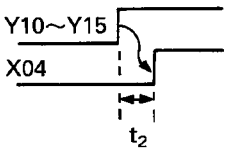
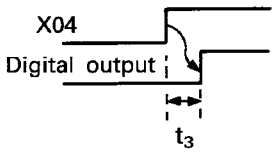
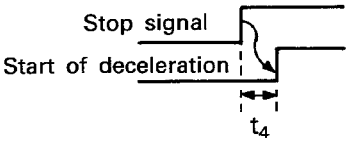
Appendix 2 AD70D Dimensions



Unit: mm (in)

APP

Appendix 3 Processing Time

Item	Signal Type		Processing Time (msec)
1. PC ready to AD70D ready completion (Y1D) (X04) 			1
2. Start ON to BUSY ON (Y10~Y15) (X04) 	Start signal		
	Y10	Near-zero point dog mode	0.9
		Count mode	2.3
		Data set mode	1
	Y11	Absolute one-phase	1
		Absolute two-phase	1.2
	Y12	Incremental one-phase	1.2
	Y13	Incremental two-phase	1.4
	Y14 Y15	JOG	0.8
3. BUSY ON to Digital output (X04) 			7.1
4. STOP ON to start of deceleration 	Stop signal		
	Y17		8.3
	External signal STOP		8.5
	External signal FLS		8.2
	External signal RLS		8.2
5. Control switchover time in V/P control switchover mode			1

Appendix 4 Servo Parameter Settings

4.1 MR-SB system

Series Name	Amplifier Type	Motor Type	Motor Output (Kw)	Servo Parameters					
				1	2 *	3	4	5	10
				System settings	Regenera-tive resistance	Motor type	Motor capacity	Motor speed (rpm)	Number of feedback pulses per motor rotation
Standard (2000 rpm) series	MR-SB20	HA-SA22	0.2	0		0	2	2	12000
	MR-SB50	HA-SA52	0.5				5		
	MR-SB100	HA-SA102	1.0				10		
	MR-SB100	HA-SA152	1.5				15		
	MR-SB200	HA-SA202	2.0				20		
	MR-SB350	HA-SA352	3.5				35		
	MR-SB500	HA-SA502	5.0				50		
	MR-SB700	HA-SA702	7.0				70		
Standard (3000 rpm) series	MR-SB20	HA-SA33	0.3	0		0	3	3	12000
	MR-SB50	HA-SA53	0.5				5		
	MR-SB100	HA-SA103	1.0				10		
	MR-SB200	HA-SA153	1.5				70		
Low inertia series (2000 rpm)	MR-SB50	HA-SA52L	0.5	0		1	5	2	12000
	MR-SB100	HA-SA102L	1.0				10		
	MR-SB100	HA-SA152L	1.5				15		
	MR-SB200	HA-SA202L	2.0				20		
	MR-SB350	HA-SA302L	3.0				30		
	MR-SB500	HA-SA502L	5.0				50		
	MR-SB700	HA-SA702L	7.0				70		
Flat series (2000 rpm)	MR-SB20	HA-SA32U	0.3	0		2	3	2	12000
	MR-SB50	HA-SA52U	0.5				5		
	MR-SB100	HA-SA102U	1.0				10		
	MR-SB200	HA-SA202U	2.0				20		
	MR-SB350	HA-SA302U	3.0				30		
	MR-SB500	HA-SA502U	5.0				50		

* Set servo parameter No. 2 (regenerative resistance) using the external regenerative resistance unit type connected to the servo amplifier.

External Regenerative Resistance	Set Value
Not available	0
RB30	1
RB50, RB51	2
RB100, RB101	3

4.2 MR-SB absolute system

Series Name	Amplifier Type	Motor Type	Motor Output (Kw)	Servo Parameters					
				1	2 *	3	4	5	10
				System settings	Regenera-tive resistance	Motor type	Motor capacity	Motor speed (rpm)	Number of feedback pulses per motor rotation
Standard (2000 rpm) series	MR-SB20	HA-SA22-Z	0.2	1		0	2	2	12000
	MR-SB50	HA-SA52-Z	0.5				5		
	MR-SB100	HA-SA102-Z	1.0				10		
	MR-SB100	HA-SA152-Z	1.5				15		
	MR-SB200	HA-SA202-Z	2.0				20		
	MR-SB350	HA-SA352-Z	3.5				35		
	MR-SB500	HA-SA502-Z	5.0				50		
	MR-SB700	HA-SA702-Z	7.0				70		
Standard (3000 rpm) series	MR-SB20	HA-SA33-Z	0.3	1		0	3	3	12000
	MR-SB50	HA-SA53-Z	0.5				5		
	MR-SB100	HA-SA103-Z	1.0				10		
	MR-SB200	HA-SA153-Z	1.5				70		
Low inertia series (2000 rpm)	MR-SB50	HA-SA52L-Z	0.5	1		1	5	2	12000
	MR-SB100	HA-SA102L-Z	1.0				10		
	MR-SB100	HA-SA152L-Z	1.5				15		
	MR-SB200	HA-SA202L-Z	2.0				20		
	MR-SB350	HA-SA302L-Z	3.0				30		
	MR-SB500	HA-SA502L-Z	5.0				50		
	MR-SB700	HA-SA702L-Z	7.0				70		
Flat series (2000 rpm)	MR-SB20	HA-SA32U-Z	0.3	1		2	3	2	12000
	MR-SB50	HA-SA52U-Z	0.5				5		
	MR-SB100	HA-SA102U-Z	1.0				10		
	MR-SB200	HA-SA202U-Z	2.0				20		
	MR-SB350	HA-SA302U-Z	3.0				30		
	MR-SB500	HA-SA502U-Z	5.0				50		

* Set servo parameter No. 2 (regenerative resistance) using the external regenerative resistance unit type connected to the servo amplifier.

External Regenerative Resistance	Set Value
Not available	0
RB30	1
RB50, RB51	2
RB100, RB101	3

4.3 MR-SD system and MR-SD absolute system

	Series Name	Amplifer Type	Motor Type	Motor Output (Kw)	Servo Prameters					
					1	2 *	3	4	5	10
					System settings	Regenera-tive resistance	Motor type	Motor capacity	Motor speed (rpm)	Number of feedback pulses per motor rotation
MR-SD system	MR-SD system (3000rpm)	MR-SD10	HA-SC053	0.05	2		3	5	3	8000
		MR-SD10	HA-SC13	0.1				1		
		MR-SD20	HA-SC23	0.2				2		
		MR-SD40	HA-SC43	0.4				4		
		MR-SD60	HA-SC63	0.6				6		
	Standard SA (2000rpm) series	MR-SD40	HA-SA22	0.2	2		0	2	2	12000
		MR-SD60	HA-SA52	0.5				5		
		MR-SD100	HA-SA102	1.0				10		
	Standard SA (3000rpm) series	MR-SD40	HA-SA33	0.3	2		0	3	3	12000
		MR-SD60	HA-SA53	0.5				5		
		MR-SD100	HA-SA103	1.0				10		
	Low inertia series (2000rpm)	MR-SD60	HA-SA52L	0.5	2		1	5	2	12000
		MR-SD100	HA-SA102L	1.0				10		
	Flat series (2000rpm)	MR-SD40	HA-SA32U	0.3	2		2	3	2	12000
		MR-SD60	HA-SA52U	0.5				5		
		MR-SD100	HA-SA102U	1.0				10		
MR-SD absolute position system	Standard SC series (3000rpm)	MR-SD10	HA-SC053-Y	0.05	3		3	5	3	16384
		MR-SD10	HA-SC13-Y	0.1				1		
		MR-SD20	HA-SC23-Y	0.2				2		
		MR-SD40	HA-SC43-Y	0.4				4		
		MR-SD60	HA-SC63-Y	0.6				6		

* Set servo parameter No. 2 (regenerative resistance) using the external regenerative resistance unit type connected to the servo amplifier.

External Regenerative Resistance	Set Value
Not available	0
RB082	4
RB32	5

4.4 MR-SB-K system and MR-SB-K absolute system

	Series Name	Amplifer Type	Motor Type	Motor Output (Kw)	Servo Prameters					
					1	2*	3	4	5	10
					System settings	Regenera-tive resistance	Motor type	Motor capacity	Motor speed (rpm)	Number of feedback pulses per motor rotation
MR-SB-K system	MR-SB-K	MR-SB11K	HA-SA11K2L	11	2		1	110	2	12000
		MR-SB15K	HA-SA15K2L	15				150		
		MR-SB22K	HA-SA22K2L	22				220		
MR-SB-K absolute position system	MR-SB-K	MR-SB11K	HA-SA11K2L-Y	11	3		1	110	2	16384
		MR-SB15K	HA-SA15K2L-Y	15				150		
		MR-SB22K	HA-SA22K2L-Y	22				220		

* Set servo parameter No. 2 (regenerative resistance) using the external regenerative resistance unit type connected to the servo amplifier.

	External Regenerative Resistance	Set Value
Without dynamic brake	Without regenerative option (Accessory regenerative resistance is connected externally)	0
	When accessory regenerative resistance is cooled by fan to improve capability	6
	When power regeneration converter FR-RC is used	9
With dynamic brake	Without regenerative option (Accessory regenerative resistance is connected externally)	10
	When accessory regenerative resistance is cooled by fan to improve capability	16
	When power regeneration converter FR-RC is used	19

WARRANTY

Please confirm the following product warranty details before starting use.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the dealer or Mitsubishi Service Company. Note that if repairs are required at a site overseas, on a detached island or remote place, expenses to dispatch an engineer shall be charged for.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place.

Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
7. Any other failure found not to be the responsibility of Mitsubishi or the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

(2) Product supply (including repair parts) is not possible after production is discontinued.

3. Overseas service

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. Exclusion of chance loss and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to damages caused by any cause found not to be the responsibility of Mitsubishi, chance losses, lost profits incurred to the user by Failures of Mitsubishi products, damages and secondary damages caused from special reasons regardless of Mitsubishi's expectations, compensation for accidents, and compensation for damages to products other than Mitsubishi products and other duties.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

6. Product application

(1) In using the Mitsubishi MELSEC programmable logic controller, the usage conditions shall be that the application will not lead to a major accident even if any problem or fault should occur in the programmable logic controller device, and that backup and fail-safe functions are systematically provided outside of the device for any problem or fault.

(2) The Mitsubishi general-purpose programmable logic controller has been designed and manufactured for applications in general industries, etc. Thus, applications in which the public could be affected such as in nuclear power plants and other power plants operated by respective power companies, and applications in which a special quality assurance system is required, such as for Railway companies or National Defense purposes shall be excluded from the programmable logic controller applications.

Note that even with these applications, if the user approves that the application is to be limited and a special quality is not required, application shall be possible.

When considering use in aircraft, medical applications, railways, incineration and fuel devices, manned transport devices, equipment for recreation and amusement, and safety devices, in which human life or assets could be greatly affected and for which a particularly high reliability is required in terms of safety and control system, please consult with Mitsubishi and discuss the required specifications.

Positioning module Type AD70D

User's Manual

MODEL	AD70D-USERS-E
MODEL CODE	13J658
IB(NA)-66265-B(0312)MEE	

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : 1-8-12, OFFICE TOWER Z 14F HARUMI CHUO-KU 104-6212,JAPAN
NAGOYA WORKS : 1-14 , YADA-MINAMI 5-CHOME , HIGASHI-KU, NAGOYA , JAPAN