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MELSEC A Series

Programmable Logic Controller

User's Manual

AD70
Positioning module

01 04 1991
IB(NA)66309
Version A

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● 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 user's manual for a description of the PC system safety precautions.

These ● SAFETY PRECAUTIONS ● classify the safety 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 circumstances, procedures indicated by ⚠ CAUTION may also be linked to serious results.

In any 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.

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[DESIGN PRECAUTIONS]

⚠ DANGER

- Install a safety circuit external to the PC that keeps the entire system safe even when there are problems with the external power supply or the PC module. Otherwise, trouble could result from erroneous output or erroneous operation.
  (1) Outside the PC, construct mechanical damage preventing interlock circuits such as emergency stop, protective circuits, positioning upper and lower limits switches and interlocking forward /reverse operations.
  (2) When the PC detects the following problems, it will stop calculation and turn off all output.
    - The power supply module has over current protection equipment and over voltage protection equipment.
    - The PC CPUs self-diagnostic functions, such as the watchdog timer error, detect problems. In addition, all output will be turned on when there are problems that the PC CPU cannot detect, such as in the I/O controller. Build a fail safe circuit exterior to the PC that will make sure the equipment operates safely at such times. See Section 8.1 of this user's manual for example fail safe circuits.

    See this user's manual for example fail safe circuits.
  (3) Output could be left on or off when there is trouble in the outputs module relay or transistor. So build an external monitoring circuit that will monitor any single outputs that could cause serious trouble.
- When overcurrent which exceeds the rating or caused by short-circuited load flows in the output module for a long time, it may cause smoke or fire. To prevent this, configure an external safety circuit, such as fuse.
- Build a circuit that turns on the external power supply when the PC main module power is turned on. If the external power supply is turned on first, it could result in erroneous output or erroneous operation.
- When there are communication problems with the data link, the communication problem station will enter the following condition.
  Build an interlock circuit into the PC program that will make sure the system operates safely by using the communication state information. Not doing so could result in erroneous output or erroneous operation.
  (1) For the data link data, the data prior to the communication error will be held.
  (2) The MELSECNET (II,/B,/10) remote I/O station will turn all output off.
  (3) The MELSECNET/MINI-S3 remote I/O station will hold the output or turn all output off depending on the E.C. remote setting.

  Refer to the data link manuals regarding the method for setting the communication problem station and the operation status when there are communication problem.
- When configuring a system, do not leave any slots vacant on the base. Should there be any vacant slots, always use a blank cover (A1SG60) or dummy module (A1SG62).
  When the extension base A1S52B, A1S55B or A1S58B is used, attach the dustproof cover supplied with the product to the module installed in slot 0.
  If the cover is not attached, the module's internal parts may be dispersed when a short-circuit test is performed or overcurrent/overvoltage is accidentally applied to the external I/O area.

⚠ CAUTION

- Do not bunch the control wires or communication cables with the main circuit or power wires, or install them close to each other. They should be installed 100 mm (3.94 inch) or more from each other. Not doing so could result in noise that would cause erroneous operation.

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[DESIGN PRECAUTIONS]

⚠ CAUTION

- When controlling items like lamp load, heater or solenoid valve using an output module, large current (approximately ten times greater than that present in normal circumstances) may flow when the output is turned OFF→ON. Take measures such as replacing the module with one having sufficient rated current.

[INSTALLATION PRECAUTIONS]

⚠ DANGER

- Use the PC in an environment that meets the general specifications contained in this manual. Using this PC in an environment outside the range of the general specifications could result in electric shock, fire, erroneous operation, and damage to or deterioration of the product.
- Install so that the pegs on the bottom of the module fit securely into the base unit peg holes, and use the specified torque to tighten the module's fixing screws. Not installing the module correctly could result in erroneous operation, damage, or pieces of the product falling.
- Tightening the screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.
- When installing more cables, be sure that the base unit and the module connectors are installed correctly. After installation, check them for looseness. Poor connections could result in erroneous input and erroneous output.
- Correctly connect the memory cassette installation connector to the memory cassette. After installation, be sure that the connection is not loose. A poor connection could result in erroneous operation.
- Do not directly touch the module's conductive parts or electronic components. Doing so could cause erroneous operation or damage of the module.

[WIRING PRECAUTIONS]

⚠ DANGER

- Completely turn off the external power supply when installing or placing wiring. Not completely turning off all power could result in electric shock or damage to the product.
- When turning on the power supply or operating the module after installation or wiring work, be sure that the module's terminal covers are correctly attached. Not attaching the terminal cover could result in electric shock.

⚠ CAUTION

- Be sure to ground the FG terminals and LG terminals to the protective ground conductor. Not doing so could result in electric shock or erroneous operation.
- When wiring in the PC, be sure that it is done correctly by checking the product's rated voltage and the terminal layout. Connecting a power supply that is different from the rating or incorrectly wiring the product could result in fire or damage.

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[WIRING PRECAUTIONS]

⚠ CAUTION

- Do not connect multiple power supply modules in parallel. Doing so could cause overheating, fire or damage to the power supply module. If the terminal screws are too tight, it may cause falling, short circuit or erroneous operation due to damage of the screws or module.
- Tighten the terminal screws with the specified torque. If the terminal screws are loose, it could result in short circuits, fire, or erroneous operation.
- Tightening the terminal screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.
- Be sure there are no foreign substances such as sawdust or wiring debris inside the module. Such debris could cause fires, damage, or erroneous operation.
- External connections shall be crimped or pressure welded with the specified tools, or correctly soldered. For information regarding the crimping and pressure welding tools, see the I/O module's user's manual. Imperfect connections could result in short circuit, fires, or erroneous operation.

[STARTUP AND MAINTENANCE PRECAUTIONS]

⚠ DANGER

- Do not touch the terminals while power is on. Doing so could cause shock or erroneous operation.
- Correctly connect the battery. Also, do not charge, disassemble, heat, place in fire, short circuit, or solder the battery. Mishandling of battery can cause overheating or cracks which could result in injury and fires.
- Switch all phases of the external power supply off when cleaning the module or tightening the terminal screws. Not doing so could result in electric shock. If the screws are too tight, it may cause falling, short circuit or erroneous operation due to damage of the screws or modules.
- Tightening the screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.

⚠ CAUTION

- The online operations conducted for the CPU module being operated, connecting the peripheral device (especially, when changing data or operation status), shall be conducted after the manual has been carefully read and a sufficient check of safety has been conducted. Operation mistakes could cause damage or trouble of the module.
- Do not disassemble or modify the modules. Doing so could cause trouble, erroneous operation, injury, or fire.
- Switch all phases of the external power supply off before mounting or removing the module. If you do not switch off the external power supply, it will cause failure or malfunction of the module.

[DISPOSAL PRECAUTIONS]

⚠ CAUTION

- When disposing of this product, treat it as industrial waste.

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REVISIONS

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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.

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1. INTRODUCTION

The AD70 (hereafter called the AD70) is a single positioning control module for use with the MELSEC A series of programmable controllers. This manual gives the specifications, handling, and programming information for the AD70.

The AD70 can be connected to a servo motor for positioning a single axis. The positioning can be done by designating the positioning distance and rotation speed of the motor.

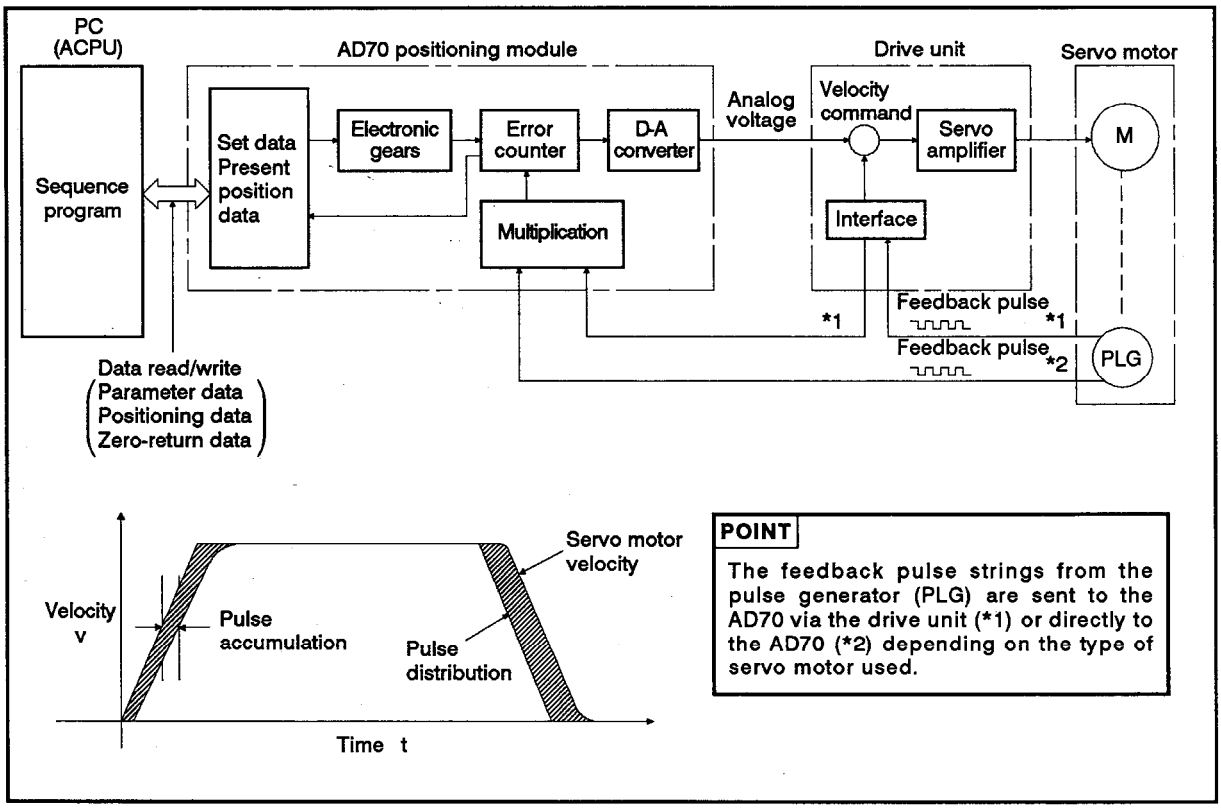
As shown below, the AD70 incorporates an error counter and a digital to analog (hereafter D-A) converter. The error counter accumulates the error pulses when a chain of positioning command pulses comes out. The accumulated pulses are then converted to DC analog voltage to be treated as a speed command.

When the motor starts, the pulse generator gives out feedback pulses in proportion to the rotating speed by subtracting the number of accumulated pulses from the command pulses.

While the motor is operating, the error counter adds up the number of accumulated pulses. When the AD70 has stopped outputting the command pulses, the accumulated pulses begin to be outputted and the motor slows down. The motor continues to operate until all accumulated pulses are outputted.

The motor rotates in proportion to the command pulse frequency, while the rotating angle changes in proportion to the number of command pulses.

Therefore, the axis can be put in a given position if a certain feed rate per pulse is determined. The pulse frequency determines the rotation speed of the motor.



POINT

The feedback pulse strings from the pulse generator (PLG) are sent to the AD70 via the drive unit (*1) or directly to the AD70 (*2) depending on the type of servo motor used.

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1.1 Features

(1) Analog output with error counter and D-A converter

Positioning command pulses can be converted to an analog voltage within the AD70 module and outputted to the servo amplifier.

(2) Applicability to analog-input servo amplifier

It is not necessary to attach an additional D-A converter to the servo amplifier. Any standard servo amplifier can be used with the AD70.

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

(4) Since all set data and commands can be set from the sequence program, a peripheral device for the positioning module is unnecessary.

(5) Built-in electronic gear function

Since an electronic gear function is built in, selecting an encoder to match the mechanical system is unnecessary. This function allows free adjustment of the axis travel distance per pulse.

When using the AD70, see the following manuals as required:

CPU User's Manual

The appropriate driving module manual

Make sure that you have the following items:

Item	Quantity
AD70 positioning module	1
9-pin connector for external wiring (pin type)	1
15-pin connector for external wiring (pin type)	1

POINT

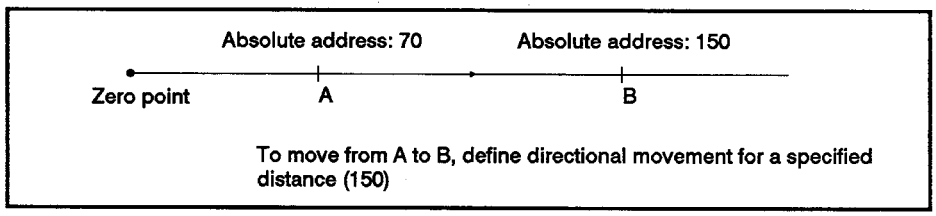
In this manual, AD70 I/O numbers assigned by the PC CPU assume that the AD70 is installed in slot 0.

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1.2 Glossary of Terms

(1) Absolute mode

In absolute mode positioning, each position has its own address and is reached by referencing a zero point address.



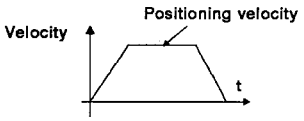
(2) Positioning mode

There are two positioning control modes:

Positioning modes

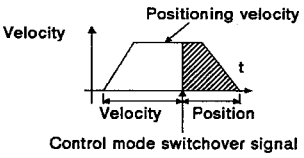
Position control mode:

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



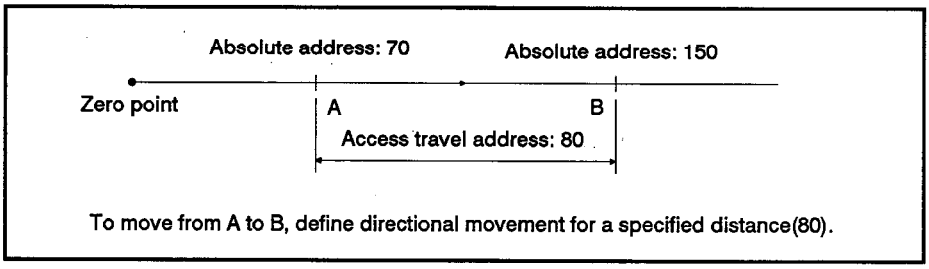
Velocity/position control switchover mode:

Starts operating at the positioning velocity specified by the positioning data. It switches to positioning control when the control switchover signal is input from an external device.



(3) Incremental mode

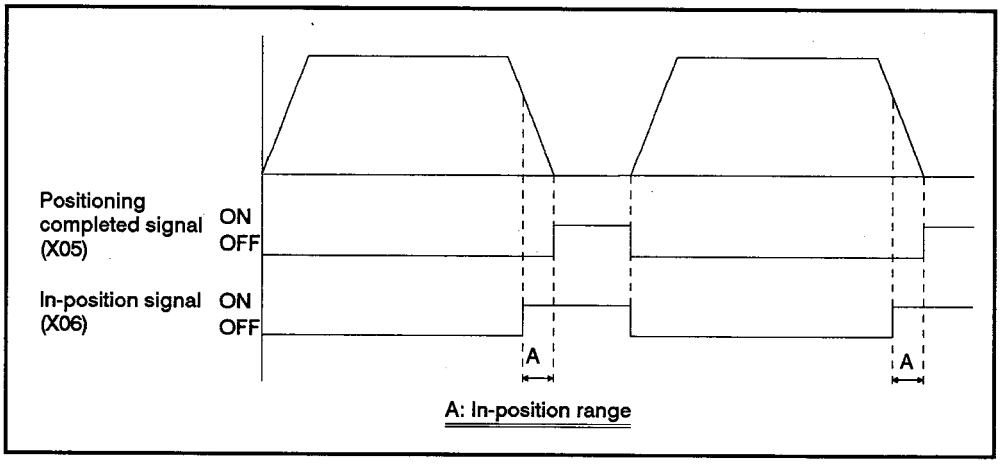
In incremental mode positioning, positions are reached by referencing the previous position.



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(4) 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 ±2047.

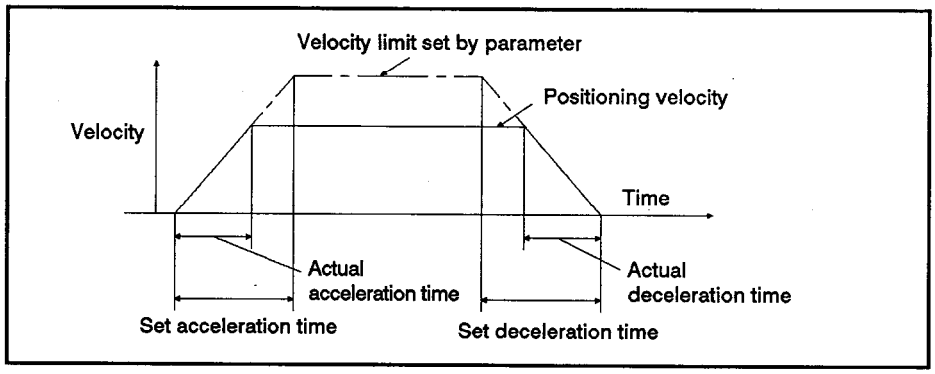


(6) Rotating direction setting

This function determines the motor rotating direction according to the polarity of the output voltage from the AD70. The polarity of the voltage to be output can be set during the increase in a positioning address.

(6) Acceleration/deceleration time

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



Acceleration/Deceleration Time

Acceleration and deceleration times in the AD70 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.

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(7) Creep velocity

This is the low velocity used for approaching the zero point position. When the near-zero point signal is turned ON, motor speed is decelerated from zero return velocity to creep velocity.

(8) Excessive error

When the number of pulses exceeds the upper limit set in the counter.

The AD70 can select any of the following four ranges to determine the counter's upper limit:

1) 0 - 3700
2) 0 - 7400
3) 0 - 11100
4) 0 - 14800

} Use the accumulated pulse setting switch for setting.

(9) Jog operation

The drive for the given axis is operated for as long as the jog input is ON. Axis feed operation is possible while confirming the present position by referencing the target position.

(10) Upper/lower stroke limit

Defines the limit values of machine travel.

Upper and lower limits are set independently.

(11) Velocity limit

This value controls the maximum velocity for positioning, zero return, and JOG operations.

Even if the positioning velocity, zero return velocity, and JOG velocity are set at a value greater than the velocity limit, the operation will still be executed at the velocity limit.

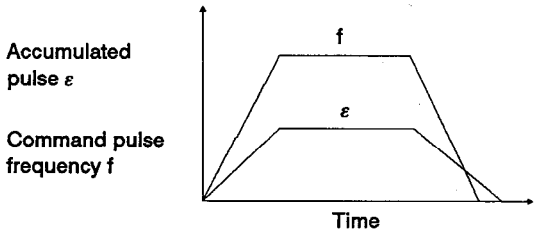
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(12) Accumulated pulses

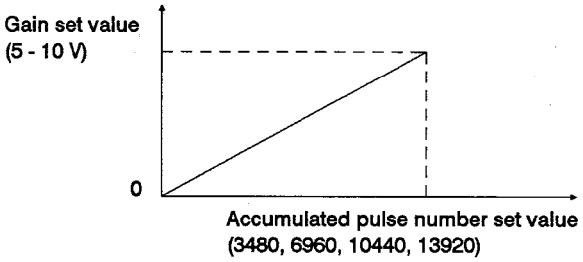
These are produced by subtracting the number of field back pulses from the command pulses. They are accumulated in the error counter.

While the AD70 is operating, accumulated pulses occur in proportion to the frequency of command pulses.

When the positioning is done, the counter returns to "0".



The AD70 voltage is outputted in proportion to the number of accumulated pulses.



(13) Multiplication data setting

This function multiplies the feedback pulse frequency from the encoder by 4, 2, 1, or 1/2.

(14) Electronic gear

By multiplying the AD70 command pulse outputs, machine travel distance per command pulse can be freely changed (see Section 5.2.1).

(15) Feedback pulse

The pulse chain is proportional to the angular increments of the motor generated by an encoder and fed to the AD70.

(16) Error counter

Works as an increment/decrement counter by finding the difference between the number of command pulses and that of feedback pulses. The difference is retained in the error counter as accumulated pulses.

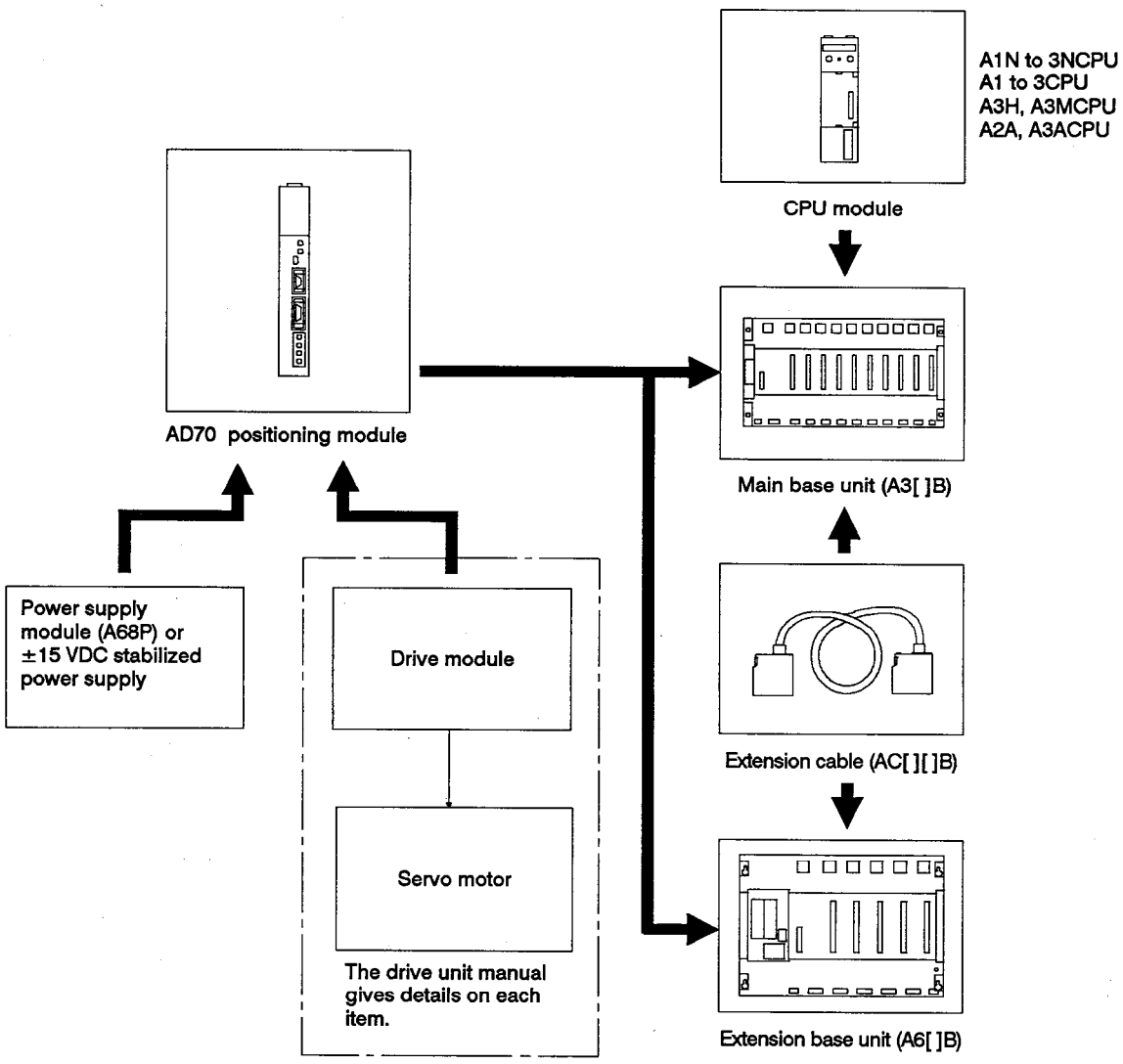
The number of accumulated pulses in the error counter is reset to 0(zero) when positioning is completed.

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2. SYSTEM CONFIGURATIONS

2.1 Overall Configurations

(1) Building block-type CPU



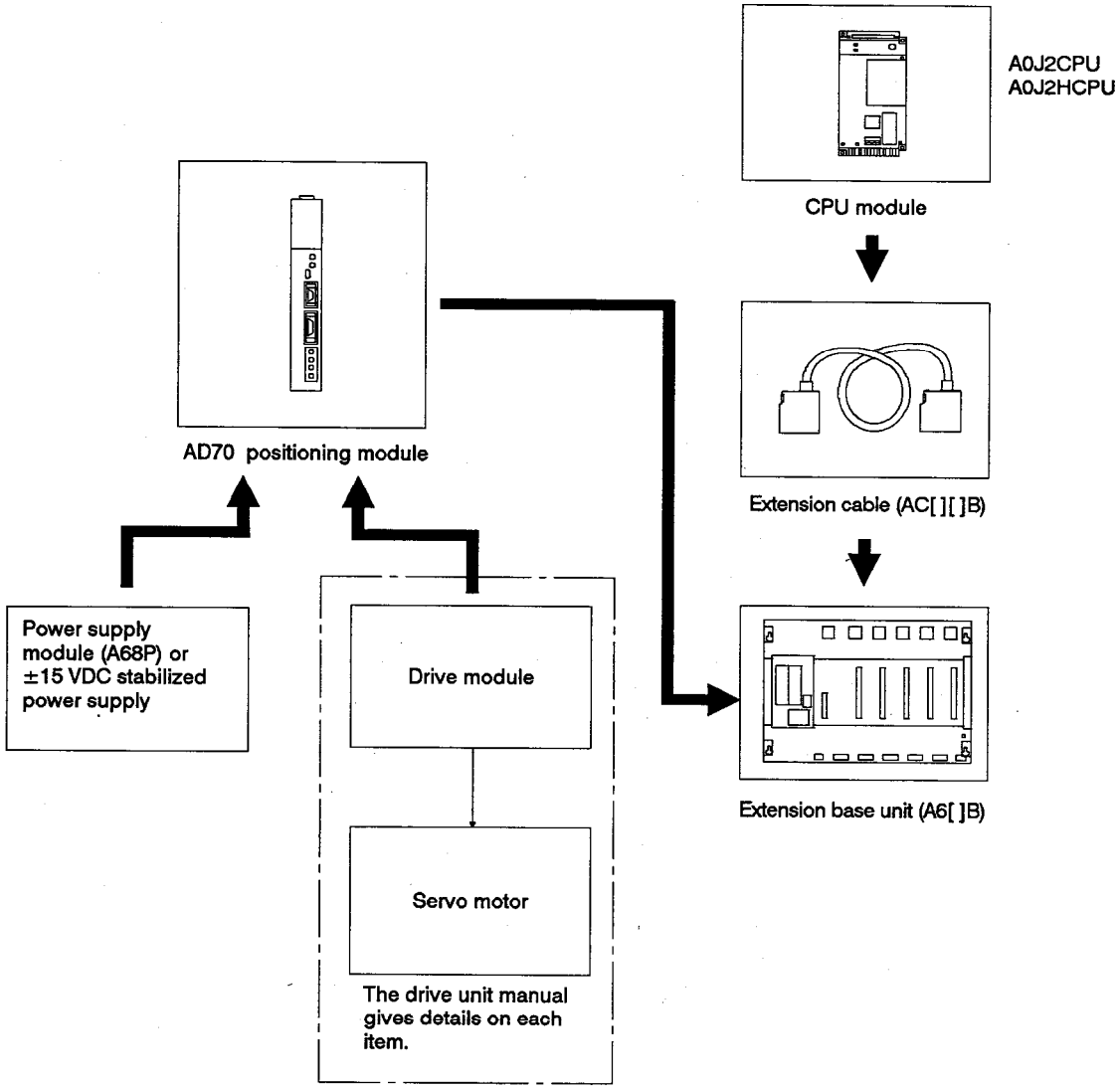
Note 1. Section 2.2 explains how to use the positioning module in the data link system.

Note 2. The appropriate User's Manuals give details on CPU modules and other I/O modules.

Fig. 2.1 Overall Configuration Using a Building Block Type

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(2) Compact-type CPU



Note 1. Section 2.2 explains how to use the positioning module in the data link system.

Note 2. The appropriate User's Manuals give details on CPU modules and other I/O modules.

Fig. 2.2 Overall Configuation Using a Compact-Type CPU

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2.2 Applicable Systems

The AD70 can be used with the following independent CPUs:

Applicable types	A0J2CPU	A0J2HCPU	
	A1CPU	A1NCPU	
	A2CPU	A2NCPU	A2ACPU
	A2CPU-S1	A2NCPU-S1	A2ACPU-S1
	A3CPU	A3NCPU	A3ACPU
	A3HCPU	A3MCPU	

With the exceptions noted below, the AD70 can be loaded into any main base and extension base unit slot. The number of AD70s which can be used per CPU is unlimited.

(1) Do not use the AD70 with an extension base which does not include a power supply (i.e. A5[ ]), since the power supply capacity is insufficient. Before installing, check the selection of the power supply module and extension cables in the CPU User's Manual.

(2) The following CPU types are required for a data link system employing master, local, and remote I/O stations.

These CPUs can be used as a master station, remote station, or remote I/O station (The same configurations can be applied to either coaxial or optical link).

Applicable to master stations		
A1CPUP21/R21	A1NCPUP21/R21	
A2CPUP21/R21	A2NCPUP21/R21	A2ACPUP21/R21
A2CPUP21/R21-S1	A2NCPUP21/R21-S1	A2ACPUP21/R21-S1
A3CPUP21/R21	A3NCPUP21/R21	A3ACPUP21/R21
A3HCPUP21/R21	A3MCPUP21/R21	

Applicable to local stations		
A0J2CPUP23/R23	A1NCPUP21/R21	
A1CPUP21/R21	A2NCPUP21/R21	A2CPUP21/R21
A2CPUP21/R21	A2NCPUP21/R21-S1	A2ACPUP21/R21-S1
A2CPUP21/R21-S1	A3NCPUP21/R21	A3ACPUP21/R21
A3CPUP21/R21	A3MCPUP21/R21	
A3HCPUP21/R21		

Applicable to remote I/O stations	AJ72P25/R25

(3) The A0J2CPU and A0J2HCPU can be used with an extension base (A65B, A68B).

(4) The AD70 cannot be loaded into the last slot of the 7th extension stage of the A3CPU.

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3. SPECIFICATIONS

This chapter describes the general specifications performance specifications, and I/O conversion characteristics of the AD70.

3.1 General Specifications

Table 3.1 shows the general specifications of the AD70 .

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 55Hz	—	0.075mm (0.003 in)	10 times *(1 octave/minute)
		55 to 150Hz	1g	—	
Shock resistance	Conforms to *JIS C 0912 (10g x 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 resistance	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				

* JIS = Japanese Industrial Standard

REMARK

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

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3.2 Performances and Spcifications

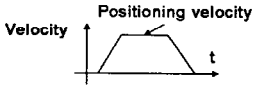
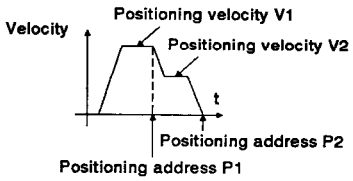
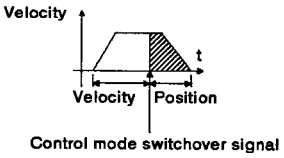
Table 3.2 Performances and Specifications

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
Positioning	Mode	Position control mode Velocity/position control switchover mode } Can be selected
	Method	Position control mode: Absolute/incremental selectable Velocity/position control mode: Incremental
	Positioning units	–2147483648 to 2147483647 (PULSE) (signed 32-bit)
	Positioning speed	1 to 400000 (PLS/sec)
	Acceleration and deceleration	Automatic trapezoidal acceleration and deceleration
	Acceleration and deceleration times	Acceleration ····· 2 to 9999 (msec) Deceleration ····· 2 to 9999 (msec)
	In-position range	1 to 2047 PLS
	Backlash compensation	Not provided
	Error compensation	Not provided
Velocity command output		–0 to ±10 VDC (adjustable between ±5 and ±10 V)
Positioning feedback pulse input		Pulse frequency 100 KPPS Connectable encoder: Open collector, TTL, and differential output types Multiplication setting : Number of feedback pulses x 4, x 2, x 1, and x 1/2
Zero return function		With zero address change function Zero return direction and method are set with switches.
Jog operation function		The jog operation is enabled by inputting the jog start signal.
M function		Not provided
Internal current consumption		5 VDC 0.3 A
External power supply voltage and current terminal block		+15 VDC 0.2 A, –15 VDC 0.02 A
Size (mm) (inch)		250(H) x 3.75(W) x 121(D) (9.84 x 0.15 x 4.76)
Weight (kg) (lb)		0.5 (1.1)

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3.3 Functions

Table 3.3 AD70 Positioning Control Functions

Function			Description	Remarks
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. Position control is enabled by an external control switching signal. If the operation is stopped by a stop signal after an external control switching signal has been received, positioning can be restarted by turning on the velocity/position control mode. Positioning addresses (axis travel distances) can be changed before an external control switching signal is input. 	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.	5.3
Multiplication setting			The number of feedback pulses sent from the pulse generator is multiplied by 4, 2, 1, and 1/2.	4.5.6
Electronic gear			The axis travel distance and velocity can be controlled by multiplying the AD70 command outputs.	5.2.1
Error counter clear			The amount of accumulated pulses stored in the error counter is cleared. The function is used to clear the amount of accumulated pulses in the error counter when the power to the servo motor is turned off by an emergency stop command during positioning. This function allows the servo motor not to start running when the power to the servo motor is restored.	5.9.3
Velocity change			The velocity can be forcedly changed during positioning or JOG operation from the sequence program.	5.9.2
Present value change			The present value can be changed from the sequence program when not BUSY.	5.9.1
In-position			When the accumulated pulses in the error counter are within an in-position setting range of 1 to 2047 pulses, the in-position signal is turned ON. The in-position signal can be used as the signal just prior to the completion of AD70 positioning.	1.2

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3.4 AD70 Interfaces

Communications between the PC CPU and an AD70

- Control signals and data communications are transferred via base units.

  Control signals: Section 3.8 gives I/O signals.

  Data: Section 3.6 discusses set data.
  Set data is written to and read from the AD70 buffer memory using PC CPU application instructions.

- Communications between the drive unit and an AD70

  The AD70 sends and receives control signals to and from the drive unit, and outputs the velocity commands (analog voltage). Section 3.5 gives details on I/O interfaces.

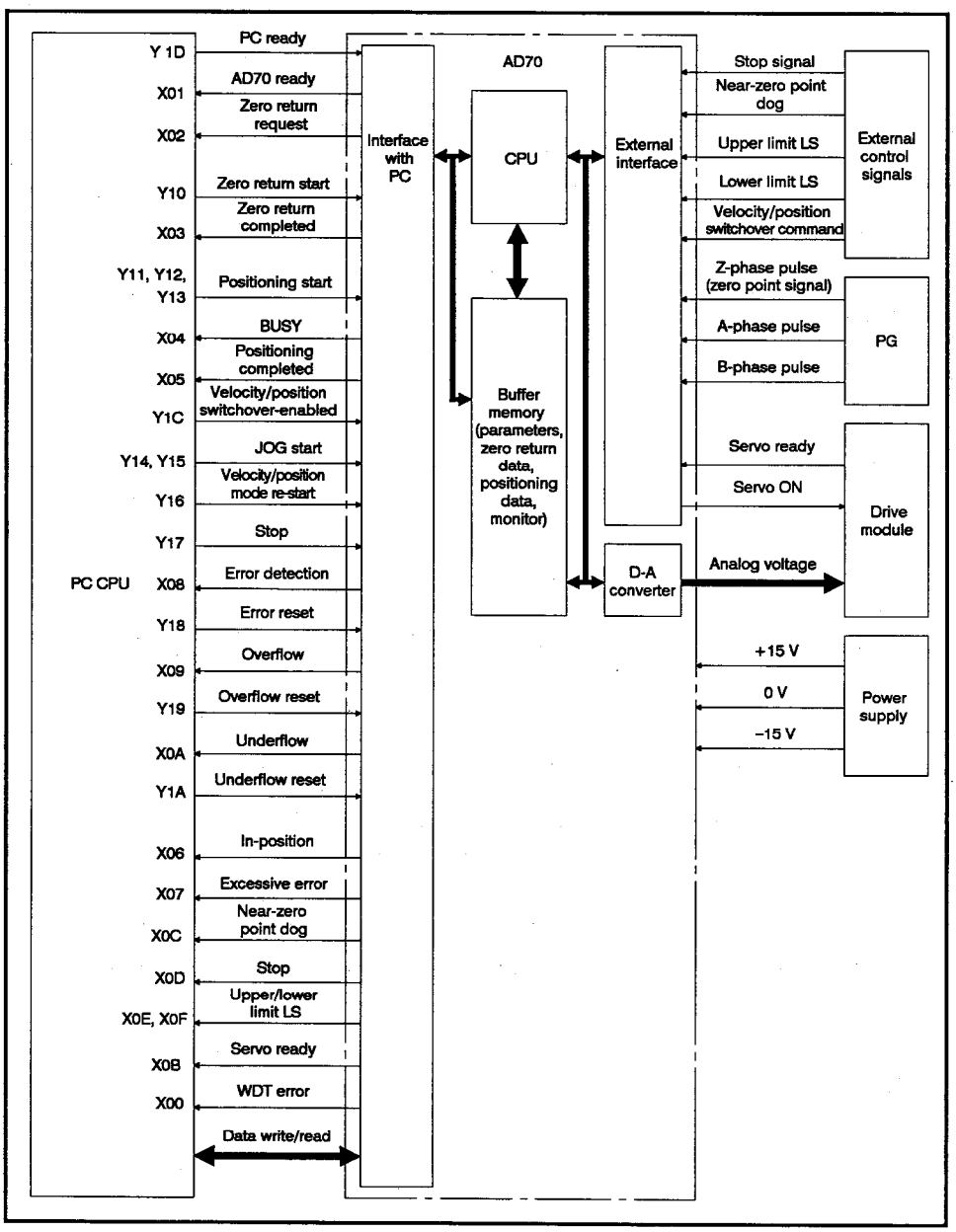


Fig. 3.1 AD70 Functions Block Diagram

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3.5 Interface with External Device

3.5.1 AD70 electrical specifications

Table 3.4 gives the electrical specifications for AD70 I/O signals.

Table 3.4 AD70 Electrical Specifications

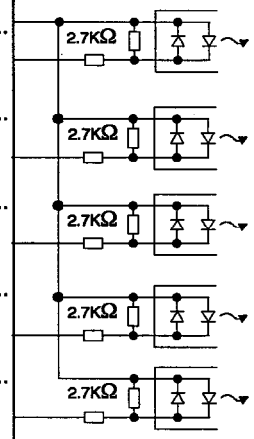
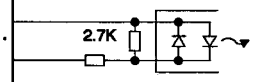
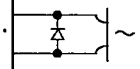
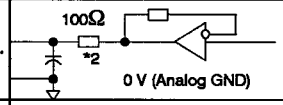
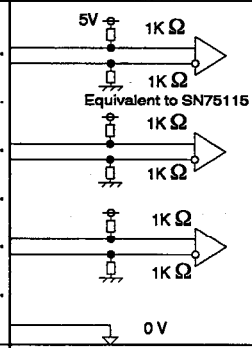
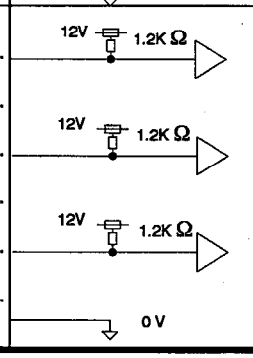
I/O	Signal		Description
Input	Power supply	Common inputs	5 to 24 VDC (Use a 4.75 to 26.4 V stabilized power supply.) Current consumption: 60 mA max. (10 x 6 mA per point)
		Terminal block	±15 VDC (Either use an A68P or a ±14.55 to 15.45 V stabilized power supply equivalent to an A68P.) Appendix 5 gives details on power supply specifications. Current consumption: + 15 V 200 mA – 15 V 200 mA Up to 5 AD70s can be used with a single A68P.
	Servo ready (READY) Stop signal (STOP) Near-zero point signal (DOG) Upper limit (FLS) Lower limit (RLS) Velocity/position switchover command (CHANGE)		HIGH: (Supply power voltage – 1 V) min. (External contact OFF) (Input current: 0.3 mA max.) LOW: (Supply power voltage – 3 V) min. (External contact ON) (Input current: 2.5 mA min.)
	(Open collector method) A-phase feedback pulse (PULSE A) B-phase feedback pulse (PULSE B) Z-phase feedback pulse (PULSE Z)		Pulse frequency: 100K PPS or less Pulse rise time: 1 μsec or less Pulse fall time: 1 μsec or less HIGH: 4 V or more LOW: 1 V or less
	(TTL method) A-phase feedback pulse (PULSE A) B-phase feedback pulse (PULSE B) Z-phase feedback pulse (PULSE Z)		Pulse frequency: 100K PPS or less HIGH: 2.8 V or more LOW: 0.8 V or less
	Differential output method A-phase feedback pulse (PULSE A) B-phase feedback pulse (PULSE B) Z-phase feedback pulse (PULSE Z)		Pulse frequency: 100K PPS or less The receiver used conforms to RS-422. Use a driver equivalent to SN75113.
Output	Servo ON (SVON)		Output method: Open collector Load voltage: 4.75 to 26.4 VDC Load current: 30 mA max. *1 Max. voltage drop at Servo ON: 1.0 V or less Leakage current at Servo OFF: 0.1 mA or less
	Velocity command (analog signal)		Output voltage: 0 to ±10 V (10 mA)

*1 Since the maximum load voltage of Servo ON signal is 30 mA, pay close attention to the load voltage when a device like a miniature relay is used.

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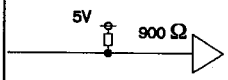
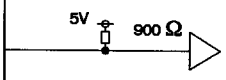
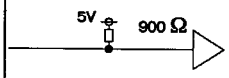
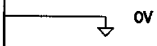
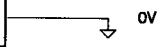
3.5.2 I/O Interface between an external device and an AD70

Table 3.5 Specifications of the I/O Interface with External Device and AD70

Connector	I/O		Pin No.	Internal Circuit	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/FLS	Upper stroke limit switch. Positioning stops when OFF.*1
			6		Lower limit LS/RLS	Lower stroke limit switch. Positioning stops when OFF.*1
			8		Velocity/position switchover command/CHANGE	Used as the control switchover command in the velocity/position control switchover mode.
SERVO	Input		1		Servo ready/ READY	Turns ON when the servo drive unit is normal and ready to receive feed pulse signals.
			2			
	Output		3		Servo ON/ SVON	The servo OFF signal is output when servo error is excessive or when an AD70 self-check error has occurred.
			4			
			15		Velocity command	The amount of accumulated pulses is converted into analog voltage output.
			14			
	Input	Near-zero point signal	13		Phase A feedback pulse	Connect to the encoder pulse output.
			11			
			5		Phase B feedback pulse	
			10			
			6		Phase Z feedback pulse	
			7			
			9		Analog GND	
		Open collector input	13		Phase A feedback pulse	The input voltage is raised to 12 V inside the module. Connect to the encoder pulse output.
			11			
			5		Phase B feedback pulse	
			10			
			6		Phase Z feedback pulse	
			7			
			9		Analog GND	

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Table 3.5 Specifications of the I/O Interface with External Device and AD70 (continued)

Connector	I/O		Pin No.	Internal Circuit	Signal	Description
SERVO	Input	TTL input	13		Phase A feedback pulse	Connect to the encoder pulse output.
			11			
			5		Phase B feedback pulse	
			10			
			6		Phase Z feedback pulse	
			7			
			9		Analog GND	
Terminal block	Input		+15V		External power supply	Connect to ±15V power supply.
			0V			
			– 15V			
			FG			

*1: Leave ON when not using the FLS or RLS.

*2: When the input impedance of the servo amplifier is small, the analog output level could be lowered by this resistance. Therefore, if necessary, readjust the gain in the state of the connected servo amplifier.

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3.6 Set Data

When using the AD70, the following three blocks of data are required for positioning. They are set from the sequence program.

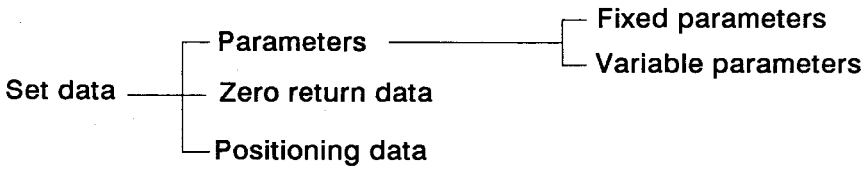


Table 3.6 Set Data

Data No. / Item					Setting Range	Default	Reference
Parameters	Fixed parameters	1	Upper stroke limit		–2147483648 to 2147483647 PLS (signed 32-bit data)	2147483647PLS	5.2
		2	Lower stroke limit		–2147483648 to 2147483647 PLS (signed 32-bit data)	0PLS	
		3	Electronic gear	Command pulse multiplication ratio numerator	1 to 9999	1	
		4		Command pulse multiplication ratio denominator	1 to 9999	1	
	Variable parameters	5	Velocity control value		10 to 400,000 PLS/sec (Set in units of 10 PLS/sec)	200,000 PLS/sec	
		6	Acceleration time		2 to 9999 msec	300 msec	
		7	Deceleration time		2 to 9999 mesc	300 msec	
		8	In-position range		1 to 2047 PLS	5 PLS	
		9	Positioning mode		0: Positioning 1: Velocity/positioning	0	
Zero return data		10	Zero address		–2147483648 to 2147483647 PLS	0	5.3
		11	Zero return velocity		1 to 400,000 PLS/sec	10,000PLS/sec	
		12	Creep velocity		1 to 400,000 PLS/sec	1,000PLS/sec	
		13	Axis travel distance setting after turning near-zero point signal ON		0 to 2147483647 PLS	75 PLS	
Positioning data		14	Positioning pattern		0: Positioning 1: Two-phase trapezoidal positioning	0	5.4
		15	Positioning address (Axis travel distance in the velocity/position control switchover mode or in the incremental mode)		–2147483648 to 2147483647 (0 to 2147483647 in the velocity/position control switchover or in the incremental mode)	0	
		16	Positioning velocity		1 to 400,000 PLS/sec	0	

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3.7 Buffer Memory

The AD70 has a buffer memory (not battery backed) for data communications with the PC CPU. The data shown in Figure 3.2 is stored in the buffer memory and used by the AD70 to execute positioning.

Buffer memory data read

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

Buffer memory data write

Data writing may be restricted depending on the state of the AD70.

General conditions for writing are given in Figure 3.2. Sections 5.2 to 5.12 give further details.

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

			Address (Decimal)	Read	Write	Write Condition	Reference
Fixed parameters	Upper stroke limit		0, 1	o	o	Y1D is OFF	5.2
	Lower stroke limit		2, 3				
	Electronic gear	Command pulse multiplication ratio numerator	4				
		Command pulse multiplication ratio de-nominator	5				
Variable parameters	Velocity limit		20, 21	o	o		5.2
	Acceleration time		22				
	Deceleration time		23				
	In-position range		24				
	Positioning mode		25				
Zero return data	Zero address		40, 41	o	o	Y1D is OFF	5.3
	Zero return velocity		42, 43				
	Creep velocity		44, 45				
	Axis travel distance setting after turning near-zero point signal ON		46, 47				
Positioning pattern	Positioning pattern		60	o	o		5.4
	Positioning address P1		61, 62				
	Positioning velocity V1		63, 64				
	Positioning address P2		65, 66				
	Positioning velocity V2		67, 68				

Fig. 3.2 Buffer Memory Map

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		Address (Decimal)	Read	Write	Write Condition	Reference
Control change area	Present value change area	80, 81	o	o		5.9
	Velocity change area	82, 83				
	JOG velocity area	84, 85				
	Error counter clear command	86				
	Analog output adjustment area	87				
	Velocity/position axis travel distance change area	88, 89				
Monitor area	Feed present position value	100, 101	o	x		5.11
	Actual present position value	102, 103				
	Error code (ERR. 1)	104				
	Error code (ERR. 2)	105				
	Error counter value	106, 107				
	Axis travel distance after near-zero point signal is turned ON	108, 109				
	Velocity/position switchover command	110				
	Velocity operation in progress	111				

Fig. 3.2 Buffer Memory Map (continued)

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3.8 I/O Signals To and From the PC CPU

The AD70 uses 16 inputs and outputs for non-numerical communications with the PC CPU.

I/O signal assignments and functions are given below.

Table 3.7 gives the I/O signals when the AD70 is installed in slot 0 of the main base unit.

Device X indicates an input signal from the AD70 to the PC CPU. Device Y indicates an output signal from the PC CPU to the AD70.

Table 3.7 I/O Signals

Signal Direction: AD70 to PC CPU		Signal Direction: PC CPU to AD70	
Device No.	Signal	Device No.	Signal
X00	WDT error, H/W error	Y00 to Y0C	Reserved for use by the OS
X01	AD70 ready complete		
X02	Zero return request		
X03	Zero return completion		
X04	BUSY		
X05	Positioning completion		
X06	In-position		
X07	Servo error excessive		
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 AD70 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
		Y1D	PC READY

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Table 3.7 I/O Signals (continued)

Signal Direction: AD70 to PC CPU		Signal Direction: PC CPU to AD70	
Device No.	Signal	Device No.	Signal
X1D to X1F	• Used only when AD70 is used in a remote I/O station. • Interlock signal for RFRP and RTOP instructions.	Y1E, Y1F	Reserved for use by the OS

IMPORTANT

X10 to X1F and Y00 to Y0F, Y1E, and Y1F are reserved for OS use.

If the above devices are switched ON/OFF from the sequence program, normal functions of the AD70 cannot be guaranteed.

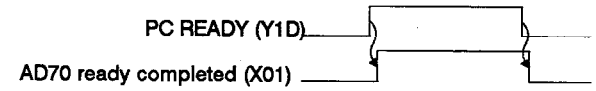
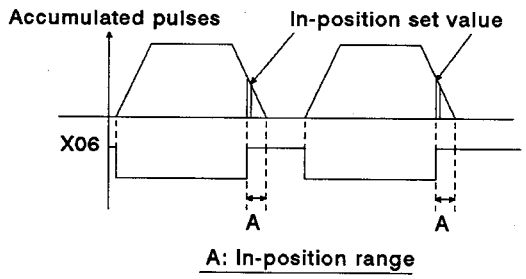
Y0D to Y0F must be switched OFF from the user program only when the AD70 is installed in a remote I/O station. Section 5.12 gives details.

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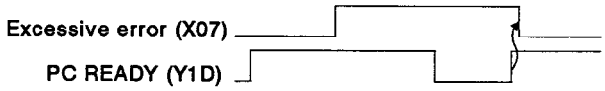
I/O signal details

I/O signals, ON/OFF timing, and operating conditions are explained below.

Sections 5.3.4, 5.4.4, and 5.8.4 give timing details.

Device No.	Signal	Description
X00	WDT error	Turns ON when the AD70 self-diagnosis detects a WDT error. The servo motor immediately stops.
X01	AD70 ready completed	Checks the fixed parameters and servo parameters. It turns ON the AD70 ready complete signal (X01) when the PC READY (Y1D) is switched ON from the sequence program. X01 goes OFF when the Y1D is switched OFF. It is used for interlocking, etc., in the sequence program. 
X02	Zero return request	Turns ON in the following cases and OFF when zero return operations are completed: 1) At re-start of the AD70 and PC reset 2) During zero return operations 3) When the READY signal of drive module is turned OFF at BUSY When the PC READY (Y1D) changes from OFF to ON, the X02 cannot be turned ON.
X03	Zero return completed	Goes ON to indicate completion of zero return operations. Does not go ON if an axis stops during zero return operation. Goes OFF at JOG start and positioning start. Goes OFF at zero return start in the count.
X04	BUSY	Goes ON at positioning start, JOG start, and zero return start. Goes OFF at pulse output complete. If started while BUSY is ON, an error results.
X05	Positioning completed	Goes ON at positioning start, JOG start, and zero return start (pulse output complete). Goes OFF at the next start (positioning, zero return, JOG). If positioning is stopped midway, the positioning complete signal does not go ON.
X06	In-position	Turns ON when accumulated pulses in the error counter are within the in-position setting range after deceleration is started. Turns OFF at positioning start. Comparison between accumulated pulses and the in-position set value is executed in the following cases: 1) At power ON 2) When deceleration starts after starting positioning 3) When turning OFF the JOG start signal decelerates the rotation after the JOG operation is started 4) When the rotation slows down to creep speed by turning ON the near-zero point dog  A: In-position range

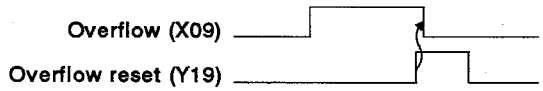
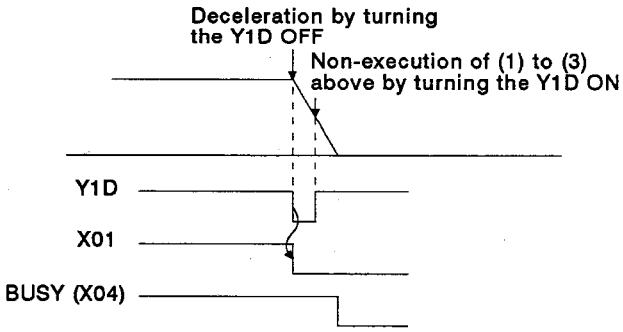
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Device No.	Signal	Description
X07	Excessive error	Goes ON when the accumulated pulses exceed the set range (X1 to X4). The AD70 shows the following in that state: 1) 0 volts output voltage 2) Accumulated pulses reset to zero 3) "EEX" LED turned ON 4) Actual current data equals feed position data When the PC READY (Y1D) changes from OFF to ON, this signal goes OFF.  The error detection signal is not turned ON.
X08	Error detection	Sets the corresponding error code. A major, minor, or servo error turns X08 ON. Goes OFF when the error reset signal (Y18) is turned ON. 
X09	Overflow	Goes ON when the present value exceeds 2147483647 using the JOG operation (velocity control operation). Goes OFF when the overflow reset is turned ON. The present value 2147483647 becomes -2147483648 to 0.
X0A	Underflow	Goess ON when the present value exceeds -2147483648 in the negative direction using the JOG operation (velocity control operation). Goes OFF when the underflow reset is turned ON. The present value -214748368 becomes 2147483647 to 0.
X0B	Servo ready	Indicates the connected servo's ready state.
X0C	Near-zero point dog	Indicates the ON/OFF status of the external near-zero point dog signal (DOG).
X0D	Stop	Indicates the ON/OFF status of the external stop signal (STOP).
X0E	Upper limit LS	Indicates the ON/OFF status of the external upper limit LS signal (FLS).
X0F	Lower limit LS	Indicates the ON/OFF status of the external lower limit LS signal (RLS).

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<table>
<tr><th>Device No.</th><th>Signal</th><th>Description</th></tr>
<tr><td>Y10</td><td>Zero return start</td><td>Valid at startup. The zero return request (X02) and the BUSY (X04) signals are switched ON by the zero return start.</td></tr>
<tr><td>Y11</td><td>Absolute positioning start</td><td>Valid at startup. The BUSY signal (X04) is turned ON by the positioning start.</td></tr>
<tr><td>Y12</td><td>Forward start</td><td>A forward (addresses increasing) start signal is valid at startup. However, depending on the positioning mode,the following will happen:
<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) is turned ON by the forward start.</td></tr>
<tr><td>Y13</td><td>Reverse start</td><td>A reverse (addresses decreasing) start signal is valid at startup. However, depending on the positioning mode, the following will happen:
<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) is turned ON by the reverse start.</td></tr>
<tr><td>Y14</td><td>Forward JOG start</td><td>The address increase JOG start signal executes the JOG operation when switched ON. When switched OFF, the axis stops after decelerating.
The BUSY signal (X04) is turned ON by the forward JOG start.</td></tr>
<tr><td>Y15</td><td>Reverse JOG start</td><td>The address decrease JOG start signal executes the JOG operation when switched ON. When switched OFF, the axis stops after decelerating.
The BUSY signal (X04) is turned ON by the 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. it is valid at startup.
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 operations, the error detection signal (X08) goes ON.</td></tr>
</table>

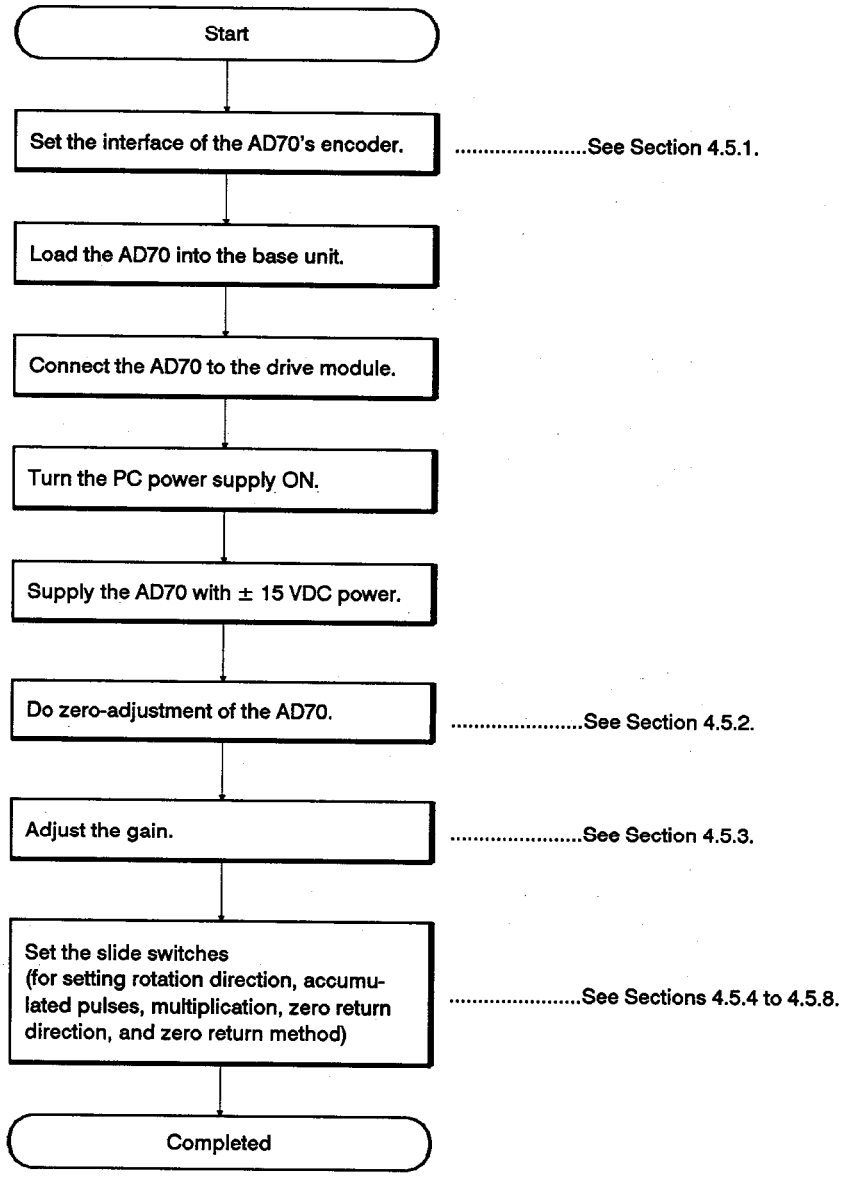
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Device No.	Signal	Description
Y18	Error reset	Clears the buffer memory error codes (addresses 104 and 105) to 0. The error detection signal (X08) goes OFF. Valid when ON.
Y19	Overflow reset	Resets the overflow signal (X09). Valid when ON. 
Y1A	Underflow reset	Resets the under flow signal (X0A). Valid when ON. 
Y1B	—	Unavailable
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 the correct PC CPU operation. This signal must be ON at the start of zero return, positioning, and jog operations. This signal must be OFF to write fixed parameters, servo parameters, and zero return data. The following control actions occur when the PC READY signal is turned ON: (1) Fixed and servo parameter checks (2) AD70 ready complete signal (X01) ON (3) Initial servo communications (servo parameter transmission) Turning the Y1D OFF while the AD70 BUSY signal is ON causes the positioning to decelerate and stop. If the Y1D is turned ON while the BUSY signal is ON, the control actions above will not be executed. 

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4. PRE-OPERATION SETTINGS AND PROCEDURES

4.1 Pre-Operation Settings and Procedures



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4.2 Handling Instructions

(1) Protect the AD70 from vibrations and mechanical shocks.

(2) Keep conductive debris out of the unit.

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

(4) Turn the PC and drive module power supply OFF before connecting or disconnecting the drive module connector. After confirming the correct insertion direction, insert the connector directly from the front. Then, tighten the two fixing screws. When the drive module is not connected, keep the connector area cover closed.

IMPORTANT

The analog voltage (velocity command) continues to be outputted at PC power OFF until the AD70's block power supply is turned OFF (The analog voltage is outputted at the same level as before the PC power went OFF). This should be taken into consideration during use.

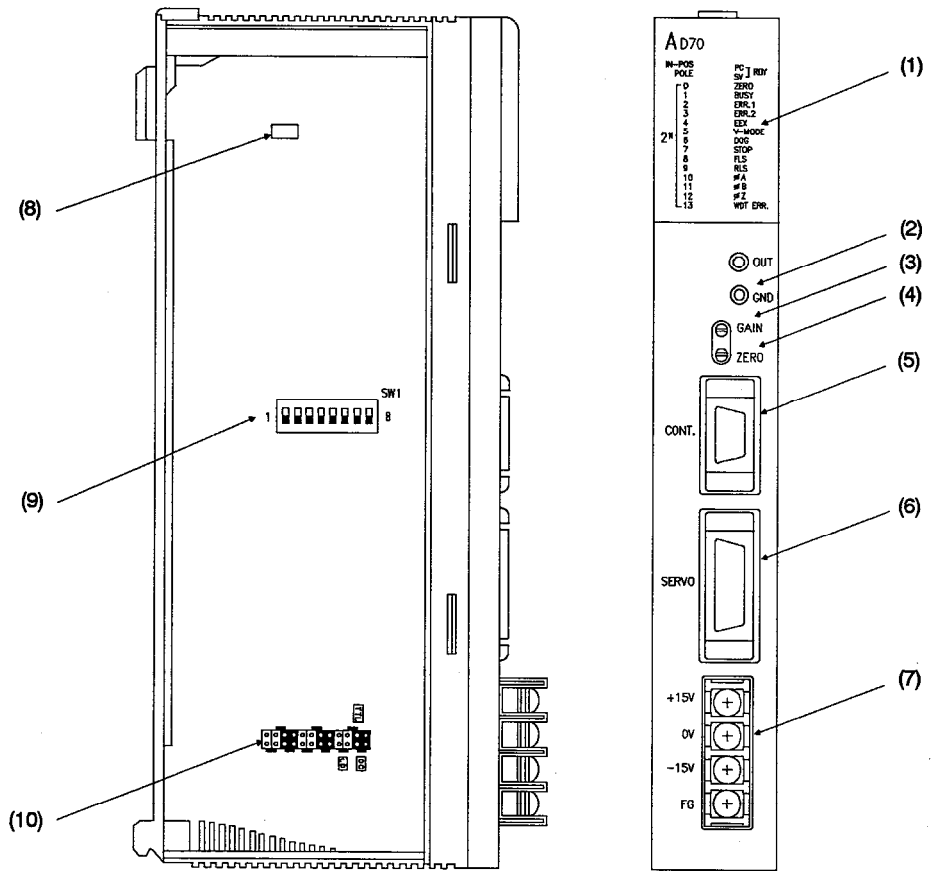
However, the AD70's Servo ON signal is turned OFF at PC power OFF. Therefore, when a servo amplifier to be controlled by the servo signal is used, make sure to connect the AD70 and the servo amplifier's Servo ON signal.

When an amplifier which cannot be controlled by a servo signal is used, the following measures should be taken:

- If the PC power is turned OFF, make sure that the analog voltage is 0 V (the motor is stopped);
- Prepare an external circuit that turns OFF the terminal block's power the moment the PC power is turned OFF.

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4.3 Nomenclature

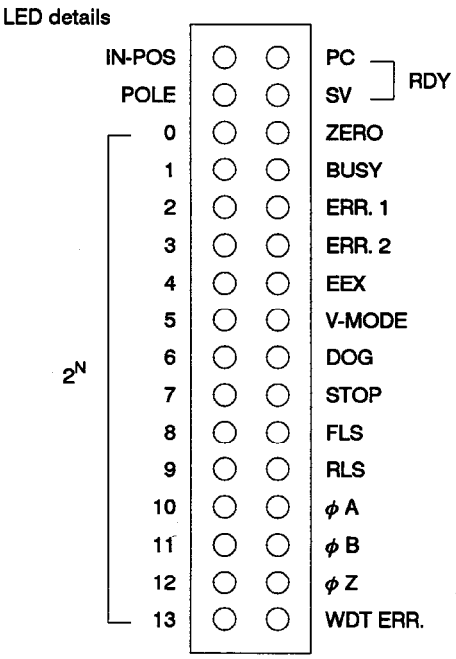


No.	Name	Description
(1)	LED	Indicates the operation and error states of the AD70 (see Section 4.4).
(2)	OUT and GND terminals	Check pins for measuring output voltage.
(3)	GAIN volume	For adjusting the output voltage gain. Section 4.5.3 explains adjustment procedures.
(4)	ZERO volume	For zero-adjusting the output voltage Section 4.5.2 explains adjustment procedures.
(5)	CONT	Control signal connector. Section 3.5.2 lists pin signal names.
(6)	SERVO	Drive module connector. Section 3.5.2 lists pin signal names.
(7)	Terminal block	Terminal used for supplying power (± 15 VDC) to the AD70. Grounded terminal FG.
(8)	ACPU-A70CPU setting pin	The setting pin should not be adjusted (set to the ACPU).
(9)	Slide switches	Set the rotation direction, accumulated pulse, multiplication, zero-return direction, and adjustment mode. Section 4.5 explains setting procedures.
(10)	Encoder interface setting pin	Sets output types for phases A, B, and Z. Section 4.5.1 explains setting procedures.

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4.4 LED Indications

Operation and error LED indications



LED		Indication	ON Condition	OFF Condition	*1 Initial State
IN-POS	In-Position	In-position state	Internal in-position	External in-position	ON
POLE	Error counter polarity	Error counter polarity state	Negative	Zero or positive	OFF
2^N	Error counter value	Error counter count value indication (Indication range: from −14800 to +14800)	See table below		All OFF
PC RDY	PC READY	Indicates the AD70 operation ready state	PC READY (Y1D) ON	PC READY (Y1D) OFF	OFF

Count / LED	-16384 More than	...	-3	-2	-1	0	1	2	...	16383 More than
POLE	●		●	●	●	o	o	o		o
2^0	o		●	o	●	o	●	o		●
2^1	o		o	●	●	o	o	●		●
2^2	o		●	●	●	o	o	o		●
2^3	o		●	●	●	o	o	o		●
2^4	o		●	●	●	o	o	o		●
2^5	o		●	●	●	o	o	o		●
2^6	o		●	●	●	o	o	o		●
2^7	o		●	●	●	o	o	o		●
2^8	o		●	●	●	o	o	o		●
2^9	o		●	●	●	o	o	o		●
2^{10}	o		●	●	●	o	o	o		●
2^{11}	o		●	●	●	o	o	o		●
2^{12}	o		●	●	●	o	o	o		●
2^{13}	o		●	●	●	o	o	o		●

● : Indicates ON

* 1 When the CPU power supply is turned ON, the initial state is the CPU STOP state.

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LED		Indication	ON Condition	OFF Condition	*1 Initial State
SV. RDY	Servo READY	Indicates the servo ready (READY) signal state	READY signal ON	READY signal OFF	By external input
ZERO	Zero-return request	Indicates the ON/OFF state of the zero-return request signal	Zero return request signal (X02) ON	Zero return request signal (X02) OFF	ON
BUSY	BUSY	Indicates the ON/OFF state of the BUSY signal	BUSY signal (X04) ON	BUSY signal (X04) OFF	OFF
ERR. 1	Minor error	AD70 minor error state *2	ON at minor error	No minor error, or OFF after error reset	OFF
ERR. 2	Major error	AD70 major error state *2	ON at major error	No major error, or OFF after error reset	OFF
EEX	Error excessive	Accumulated pulse state (Error excessive state) *2	ON when the number of accumulated pulses exceeds the set value.	OFF to the extent that the number of accumulated pulses doesn't exceed the set value.	OFF
V-MODE	During velocity operation	Velocity/positioning control switch over mode operation state	ON during the velocity operation	OFF during positioning control	OFF
DOG	Near-zero point dog	Near-zero point signal $\overline{(DOG)}$ state	Near-zero point signal ON	Near-zero point signal OFF	By external input
STOP	Stop	Stop signal $\overline{(STOP)}$ state	Stop signal ON	Stop signal OFF	By external input
FLS	Upper limit LS	Upper limit LS signal $\overline{(FLS)}$ state	Upper limit LS signal ON	Upper limit LS signal OFF	By external input
RLS	Lower limit LS	Lower limit LS signal $\overline{(RLS)}$ state	Lower limit LS signal ON	Lower limit LS signal OFF	By external input
ϕ A	Encoder phase A	Encoder phases A, B, and Z pulse states	ON when the encoder input level pins 5, 6, and 13 are HIGH	OFF when the encoder input level pins 5, 6, and 13 are LOW	By external input
ϕ B	Encoder phase B				
ϕ Z	Encoder phase Z				
WDT ERR	WDT error	Indicates the AD70 WDT state	WDT error (X00) ON hardware error	WDT error (X00) OFF H/W error	OFF

* 1 When the CPU power supply is turned ON, the initial state is the CPU STOP state.

* 2 Section 6 gives error details.

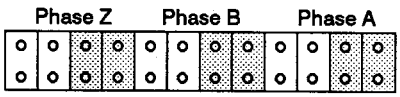
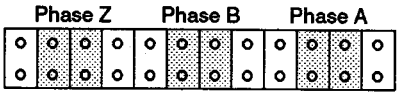
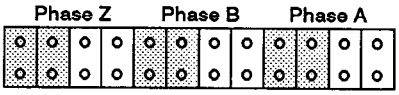
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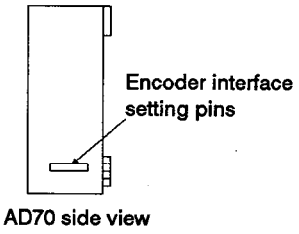
4.5 Settings

4.5.1 Encoder interface setting

Set the encoder interface setting pins on the side of the AD70 for phases A, B, and Z by short circuiting. Make sure to match the type of encoder output.

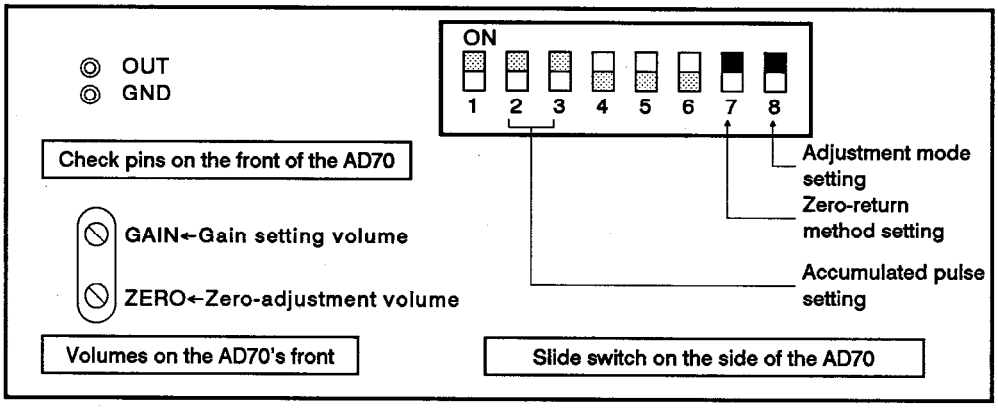
The pins are factory-set for open collector output.

	Short Circuit Pin Setting
Open collector output	
TTL output	
Differential output	



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4.5.2 Zero adjustment



The analog output is factory-adjusted to zero.

Always make sure that it is correctly adjusted.

Zero adjustment is done as follows:

Turn ON the slide switches (SW7 and SW8) on the side of the AD70;

Adjust the ZERO volume so that the voltage at both ends of the check pins measure 0 V.

Since the AD70's analog output was factory-adjusted to zero, connecting the servo motor could effect accuracy.

If inaccurately adjusted, the motor will rotate slightly at power ON.

The AD70 must be readjusted in the servo lock state. Adjust the ZERO volume so that the error counter LED indicates 0.

After completing the adjustment, turn the SW7 ON and the SW8 OFF.

4.5.3 Gain adjustment

This function adjusts the analog output voltage in the accumulated pulses.

The accumulated pulses can be initially set within the range of ± 1 to ± 14800 PLS. The default value is 13920 PLS.

The gain value was factory-adjusted so that the analog output gain value is 10 V when the number of accumulated pulses remains in default.

When the accumulated pulses are changed (select 1 to 4), gain readjustment is not necessary. This is because the gain value was adjusted to be output in analog 10 V along with the default value of the accumulated pulses.

Gain adjustment can be made within the range of 5 to 10 V.

The adjustment must be done according to the rated velocity command voltage of the amplifier to be used.

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Setting		1	2	3	4
SW2		OFF	ON	OFF	ON
SW3		OFF	OFF	ON	ON
Accumulated pulses	Setting range	± 1 to ± 3700 PLS	± 1 to ± 7400 PLS	± 1 to ± 11100 PLS	± 1 to ± 14800 PLS
	Default value	3480 PLS	6960 PLS	10440 PLS	13920 PLS
Error excessive		3700 PLS or more	7400 PLS or more	11100 PLS or more	14800 PLS or more

The default value or a given number of accumulated pulses is used to adjust the accumulated pulses.

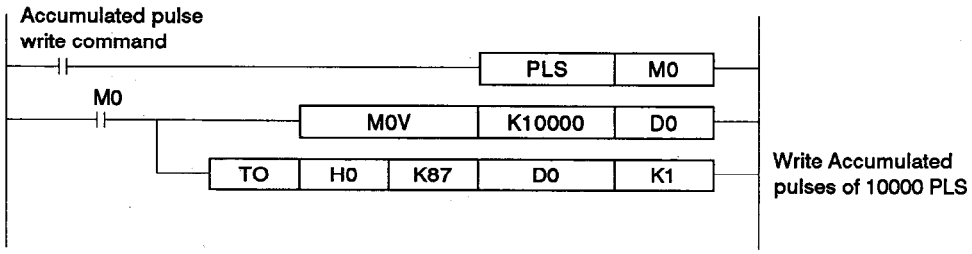
(1) Gain adjustment with accumulated pulses

1) Turn the SW7 switch OFF and the SW8 switch ON.
2) Turn the gain setting volume on the front of the AD70 so that both ends of the check pins have enough voltage.
3) After completing the adjustment, make sure to turn the SW7 switch ON and the SW8 switch OFF.

(2) Gain adjustment by setting the number of accumulated pulses

1) Turn the SW7 switch OFF and turn the SW8 switch ON.
2) Set the SW2 and SW3 switches according to the accumulated pulses to be set, so that the maximum number of accumulated pulses does not exceed the setting range (see Section 4.5.5).
3) Set the accumulated pulses in the analog output adjustment area (buffer memory 87).

   Use the sequence program to write the accumulated pulses.



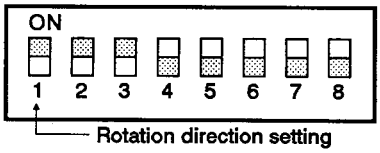
4) Turn the gain setting volume on the front of the AD70 so that both ends of the check pins are receiving enough voltage.
5) After completing the adjustment, make sure to turn the SW7 switch ON and the SW8 switch OFF.

When the servo motor is connected, readjust the ZERO volume dial so that the error counter LED indicates 0 (LEDs 2^0 to 2^{13} are all OFF).

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4.5.4 Rotation direction setting

Slide switches



The slide switches are factory-set as shown in the figure. Reset the PC CPU after changing the switch settings.

Sets the rotation direction when the positioning addresses increase:

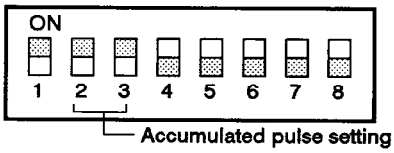
[SW1]	OFF	Negative voltage is output when the positioning addresses increase.
	ON	Positive voltage is output when the positioning addresses increase.

The rotation direction of the motor depends on the polarity of the voltage loaded into the servo amplifier. The appropriate servo amplifier User's Manual gives details.

Section 4.7.2 describes connections between the AD70 and the encoder.

4.5.5 Accumulated pulse setting

Slide switches



The slide switches regulate the maximum number of accumulated pulses within the range the error counter can count.

When a servo motor is used, the number of accumulated pulses is found by using the following formula:

$$\text{Max.accumulated pulses} = \frac{\text{Velocity command [PPS]}}{\text{Position loop gain [sec}^{-1}\text{]}}$$

Position loop gain is a parameter set on the servo side.

This influences the operation of the servo motor at STOP and the accumulated pulses in the error counter. If the position loop gain is low, the accumulated pulses increase and the stabilization time is increased.

If the position loop gain is too high, the overshoot at STOP could be large, or the motor could vibrate.

The position loop gain is normally adjusted from 20 through 30 sec^{-1}. Fine tune if necessary. The appropriate servo User's Manual gives details.

Use the accumulated pulse switches to set the accumulated pulses so that the maximum number of accumulated pulses (estimated with the above formula) do not exceed the following setting ranges:

1) Selection 1..... 0 to 3700 pulses

2) Selection 2..... 0 to 7400 pulses

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3) Selection 3..... 0 to 11100 pulses

4) Selection 4..... 0 to 14800 pulses

Slide switches	1	2	3	4
[SW2]	OFF	ON	OFF	ON
[SW3]	OFF	OFF	ON	ON

As shown in Figure 4.1 below, voltage outputted from the AD70 is controlled by the accumulated pulses.

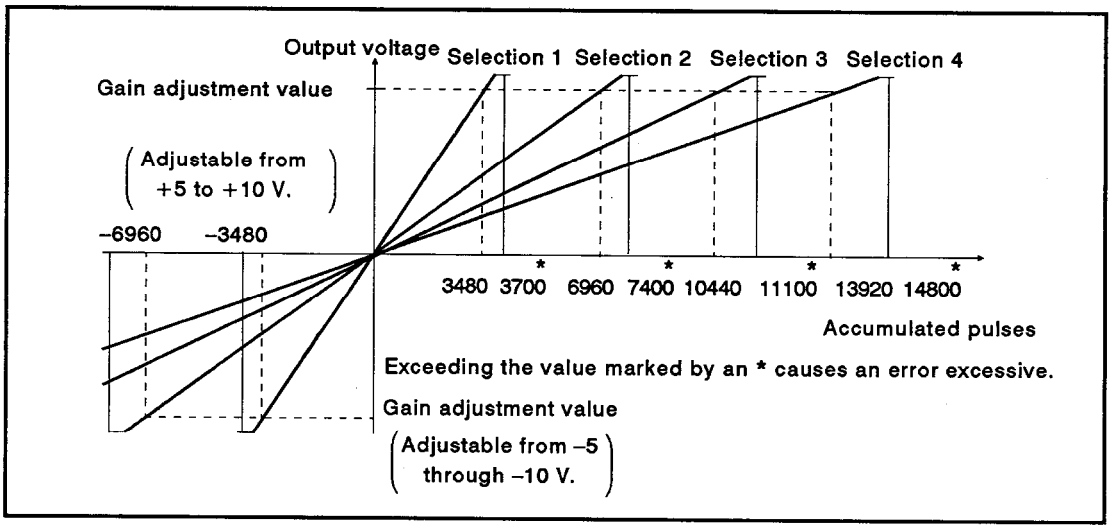


Fig. 4.1 Relationship Between Accumulated Pulses and Analog Voltage Output.

Select a slide switch as shown below:

Example : Maximum speed..... 400 KPPS,

Position loop gain..... 30 sec $^{-1}$, When,

$$\text{Accumulated pulses} = \frac{\text{Max.speed}}{\text{Position loop gain}} = \frac{400000}{30} = 13333$$

Thus, if the number of the accumulated pulses is 13333, "Selection 4" should be selected so the output voltage will not be saturated.

When the accumulated pulses exceed the value marked with an *, an error excessive occurs. An error excessive indicates the following conditions:

Output voltage : 0 V

Accumulated pulses : reset to 0

Servo ON signal : OFF

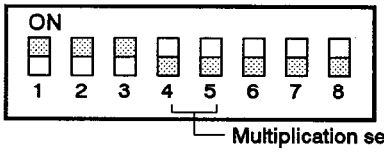
EEX LED (on front) : ON

When resetting the error excessive, change the PC READY signal (Y1D) from OFF to ON.

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4.5.6 Multiplication setting

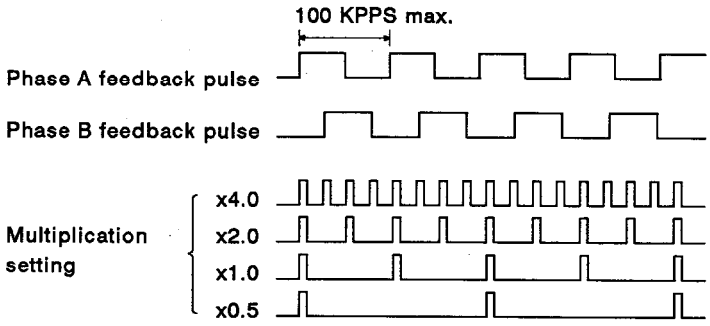
Slide switches



Sets the multiplication of feedback pulses from the pulse generator (PLG). By using this function, the feedback pulse count can be multiplied by 4, 2, 1, and 0.5.

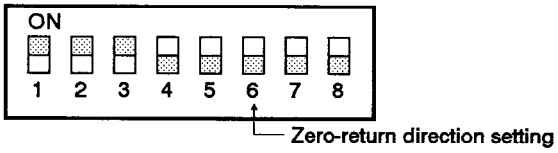
In other words, This function can change the axis travel distance by 1/4, 1/2, 1, and 2.

Slide Switches	x4.0	x2.0	x1.0	x0.5
[SW4]	OFF	ON	OFF	ON
[SW5]	OFF	OFF	ON	ON



4.5.7 Zero-return direction setting

Slide switches



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

Set the zero-return direction.

[SW6]	OFF	Reverse direction (addresses decreasing)
	ON	Forward direction (addresses increasing)

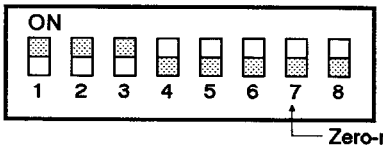
IMPORTANT

The 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. Make sure to set the zero return direction correctly.

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4.5.8 Zero-return mode setting

Slide switches



There are two zero-return operation modes as shown below (see Section 5.3.1).

[SW7]	OFF	Near-zero point dog mode
	ON	Count mode

4.6 Precautions During Module Installation

(1) The AD70 can be installed in any given slot of the main base or extension unit. However, the AD70 should not installed in a extension base (A5 [ ] type extension base) without a power supply module. Doing so could cause a power shortage.

(2) The AD70 cannot be installed in the last slot on the seventh stage of an extension to an A3CPU.

(3) If an A0J2CPU is used, install the AD70 into an extension base (A65B or A68B type).

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4.7 Wiring

This section describes (a) precautions when doing wiring between the AD70 and external devices, and (b) how to use the external wiring connector.

4.7.1 Wiring precautions

Precautions when doing wiring between the AD70 and external devices (including a drive unit) are described below. (A connection example is given in Appendix 2.)

(1) Length of connection cable between AD70 and drive module

The length of the connection cable between the AD70 and the drive module is generally 1 to 3 meters (3 to 10 feet). However, the distance depends on the drive module specifications. Make sure to confirm the correct specifications.

(2) I/O signal wiring

- Don't put the connection cable next to the power or main circuit cable. If possible, keep the connection cable more than 20 cm (8 in) away from them. If the connection cable has to be brought close to them, either separate the ducts or use conduit.
- If the cables must be bundled together, use a batch-sealed cable and ground them on the PC side.
- If the cables are wired with conduit, make sure to ground the conduit.

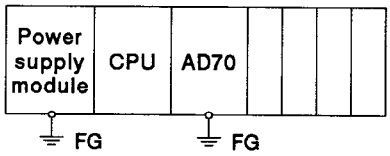
(3) The general lengths of the connection cable between the AD70 and an encoder is shown below. However, the distance depends on the encoder specifications. Make sure to confirm the correct specifications

Connect the AD70 to the encoder with a twisted-pair sealed cable.

Differential output type..... 30 m (100 ft) max.

TTL or open collector type..... 3 m (10 ft) max.

(4) Since the AD70 is completely noise proof, it usually does not need special grounding. However, if the AD70 is put in (a) noisy surroundings, or (b) in an unstable place, ground it as show below:

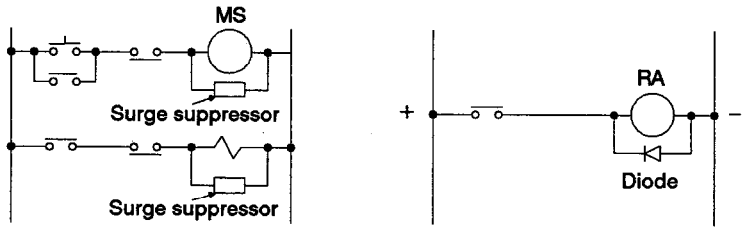


1) The FG terminals of the power supply module and the AD70 must be grounded separately and individually. Grounding should conform to JIS Class 3 grounding.

2) The electric wire used for grounding must be larger than 2 mm^2. Grounded points should be as close as possible to the PC.

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(5) Arrange surge suppressors in parallel for AC relays, bulbs, electric breakers, diodes for DC relays, bulbs, etc. connected to the drive module. The appropriate drive module User's Manual gives details.



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

(b) Mounted to DC relays, etc.

Example of Surge Suppressor Installation

(6) Make sure to connect the AD70 to the servo ON signal of the drive module. Otherwise, the motor cannot operate during a CPU error, etc.

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4.7.2 Precautions when connecting the encoder

Encoder connecting is described in this section.

The AD70's error counter works by addition and subtraction.

Addition/subtraction switching can be done through the phases of feedback pulses.

As shown in Fig.4.2, if feedback pulses of Phase A leading B by 90° are input, the number of the pulses is added to the number of command pulses in the counter.

As shown in Fig.4.3, if feedback pulses of Phase A leading B by 90°, the number of the pules is added to the number of command pulses in the counter.

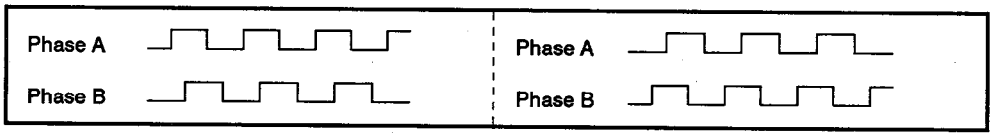


Fig.4.2 Phase A leading B by 90° Feedback Pulse **Fig.4.3 Phase B leading A by 90° Feedback Pulse**

When positive command pulses are counted with the velocity command of positive voltage (the motor rotates forward), as shown in Fig.4.2, appropriate feedback pulses should be inputted.

When negative command pulses are counted with the velocity command of negative voltage (the motor rotates reverse), as shown in Fig.4.3, appropriate feedback pulses should be inputted.

If the phase sequence of A and B is reversed, the number of command pulses and that of feedback pulses are compounded.

That could cause an error excessive (which means the encoder goes out of control). Make sure to take this possibility into consideration.

The following cases influence the counting of command pulses or feedback pulses:

1) When the rotation direction of the slide switches is set :

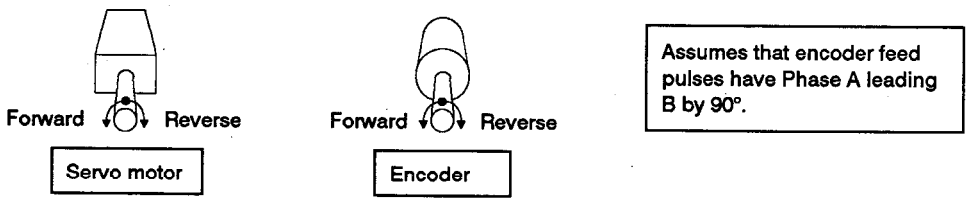
   The rotation direction of the motor and the positive/negative counting of command pulses

2) When the rotation directions of the motor and encoder are different:

   At motor rotation, the encoder rotates reverse, so the phase sequence of feedback pulses is reversed.

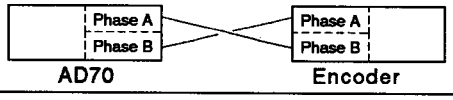
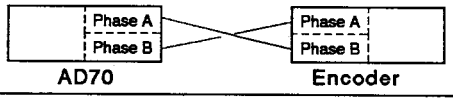
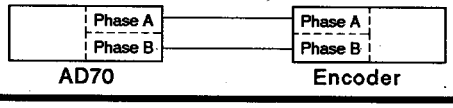
Fig 4.1 shows the rotation direction setting of slide switches and how to connect the encoder to the AD70 in the above cases.

The following example shows the setting when the voltage loaded to the servo amplifier is negative and the motor rotates forward:



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Table 4.1 Connections

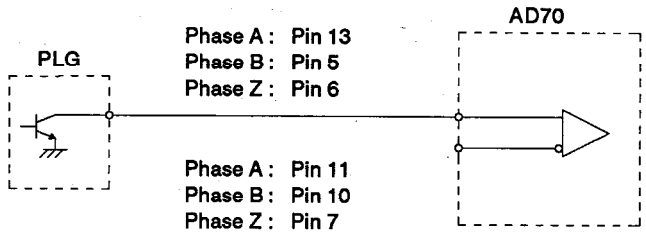
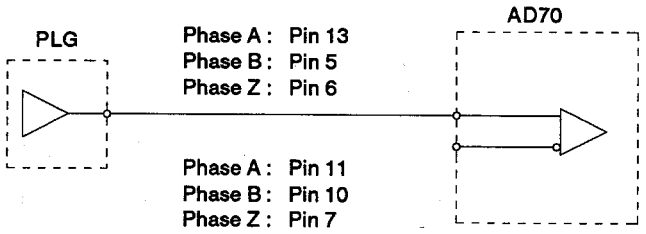
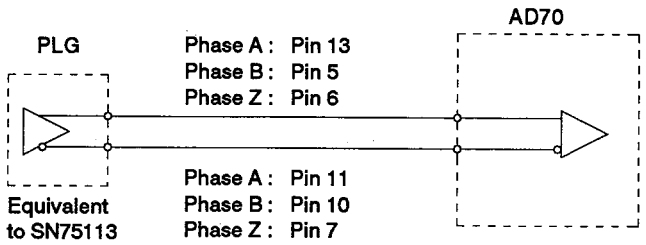
Motor Direction	Slide Switch Direction Setting	Connection	Description
Forward	[SW1] ON		When the rotations of the motor and the encoder are the same.
			When the rotations of the motor and the encoder are different.
Reverse	[SW1] OFF		When the rotations of the motor and the encoder are the same.
			When the rotations of the motor and the encoder are different.

POINT

If the encoder is incorrectly connected to the AD70, the motor rotations at power start-up cause an error excessive (EEX).

Table 4.2 shows the connections between the encoder and the AD70.

Table 4.2 Connections between the Encoder and the AD70.

Encoder Type	Connection
Open collector output	
TTL output	
Differential output	

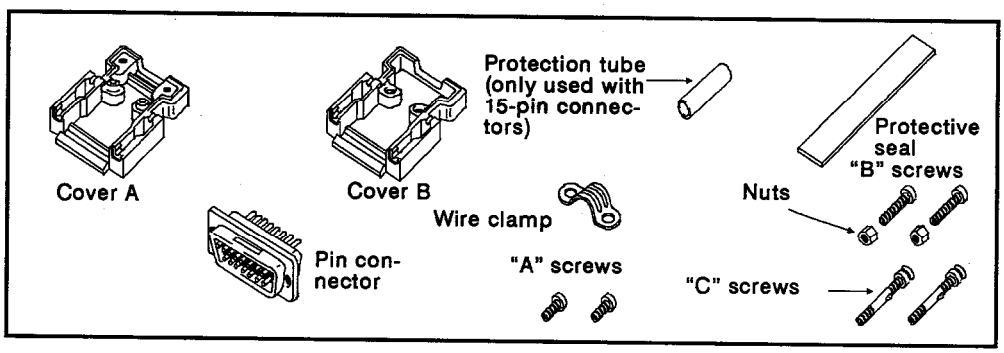
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4.7.3 External wiring connectors

The AD70 has the following connectors:

9-pin connector (plug) for CONT connections

15-pin connector (plug) for SERVO connections

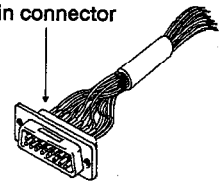


Assemble the connectors as follows:

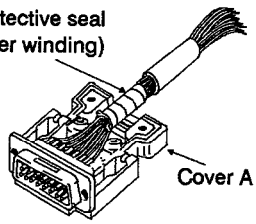
1) Thread wires through the protection tube (only used with 15-pin connectors).....



2) Solder the wires to the pin connector (see Section 4.7.4).....

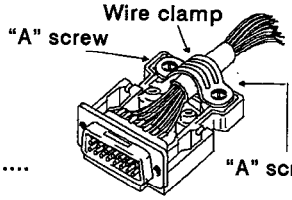


3) Attach the pin connector to cover A, and wrap protective seal around the part of the wires where the wire clamp is fitted.....

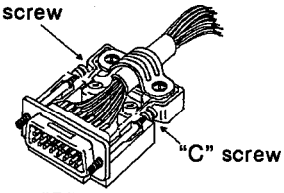


4) Slide the protection tube over the protective seal. (Only used with 15-pin connectors)

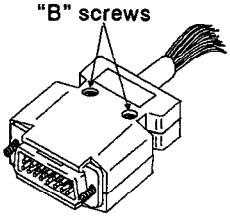
5) Wind protective seal around the cables to protect the insulation.....



6) Attach the wire clamp using the "A" screws.....



7) Attach the "C" screws
Fasten cover B to cover A using the "B"screws and the two nuts.....



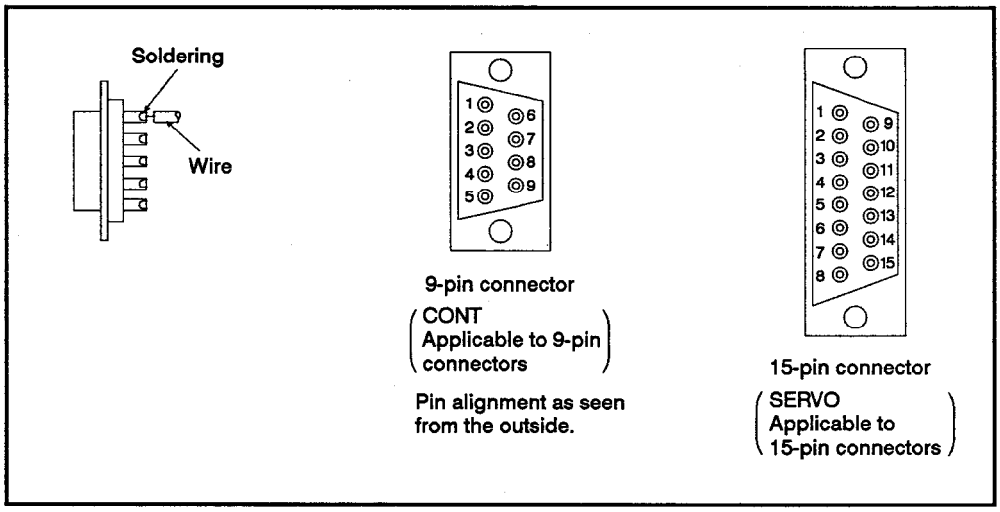
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4.7.4 Connectors

Connector pin wiring is shown below. Connect in accordance with the I/O numbers (see Section 3.5).

(1) Use 0.3 mm^2 (22 AWG) wire.
(Thicker wires cannot pass through the cable clamps.)

(2) Solder the wires to the pins.
(They should be threaded through an insulating tube.)



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4.8 Maintenance

Maintenance of other units/modules (power supply modules, CPU modules, I/O modules, special units, etc.) are described in the appropriate User's Manuals.

4.8.1 Storage

The AD70 should be stored in the following environments.

(1) Ambient temperature within the range of –20 to 75° C (4 to 167° F)

(2) Ambient humidity within the range of 10 to 90% RH

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

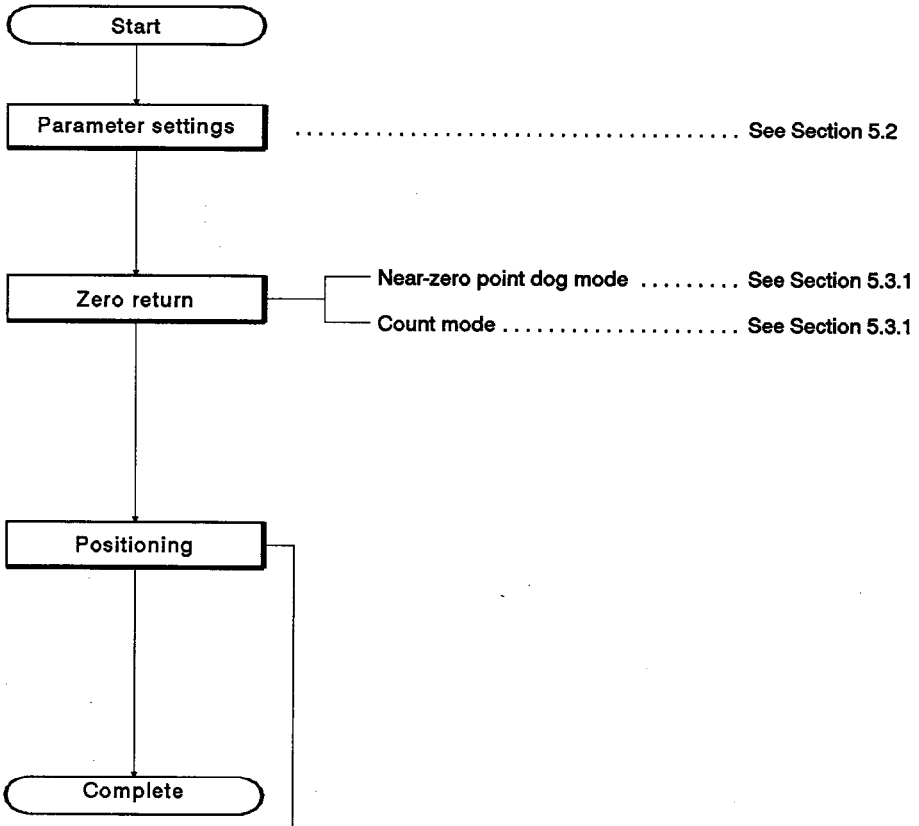
(4) No direct exposure to sunlight or rain

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

If the AD70 has not been turned ON for over 12 months, it should be warmed up for two hours before using. (This warm-up period allows the electrolyte in the electrolyte capacitor to stabilize.)

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5. PROGRAMMING



Operating Direction \ Other functions that can be Combined		Present Value Change	Velocity Change (while BUSY is ON)	Positioning Address Change (while BUSY is ON)	Accumulated Pulse Clear	Re-start After Stop (positioning continues)
One-phase trapezoidal positioning	See Section 5.4	O	O	X	O	O (Absolute mode only)
Two-phase trapezoidal positioning	See Section 5.5	O	O	X	O	O (Absolute mode only)
Velocity/position control switchover (velocity control)	See Section 5.6	O	O	O	O	O
JOG (velocity control)	See Section 5.8	O	O	–	O	O
Incremental feed	See Section 5.7	O	O	X	O	O (Absolute mode only)
		See Section 5.9				See Section 5.10

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5.1 Notes on Programming

(1) PC READY reset

When appropriate, the PC READY signal should be disabled when an error is detected.

(2) Zero return

Execute zero return (a) before positioning is started, and (b) when a zero-return request is received from the AD70.

(3) Near-zero point dog limit switch

Make sure that the limit switch is serviceable and reliable. Unless a near-zero signal is inputted during a zero-return operation, the axis will continue to operate at the same velocity.

(4) Overrun precautions

The upper and lower stroke limits will only be operable if the AD70 is functioning normally. Upper and lower limit switches should be hardwired into the system.

(5) Emergency stop signal

Hardwire 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.

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REMARK

Unless otherwise specified, I/O numbers used in this manual assume that the AD70 is installed in slot 0 of the main base.

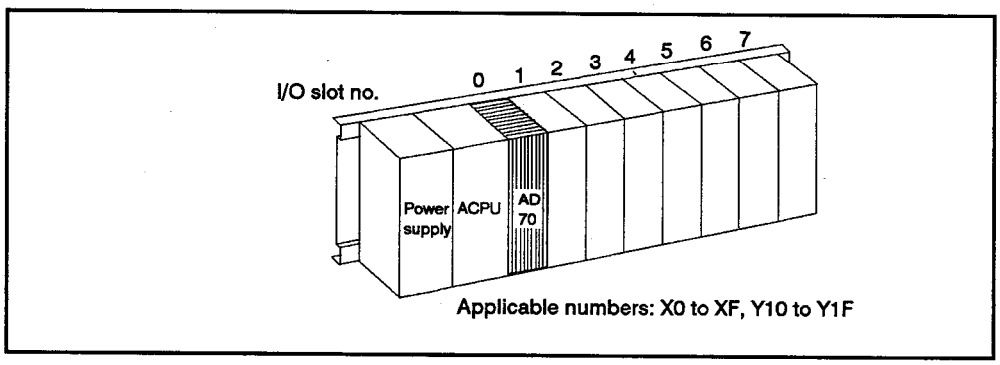


Fig. 5.1 Example of AD70 Installation in a Base Unit

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 with the ACPU).

The A0J2CPU Programming Manual gives details.

CPU / Instruction	A CPU	A0J2 CPU
(MOV)P	Execution condition — MOVP K1 D0	Execution condition — PLS M0; M0 — MOV K1 D0
DMOV	Execution condition — DMOV K100000 D0	Execution condition — MOV H86A0 D0; MOV H0001 D1; K100000 = H186A0 (D1 D0)

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5.2 Parameters

5.2.1 Parameter settings

The parameters are divided into fixed parameters and variable parameters.

Table 5.1 shows the parameters set by the sequence program.

Table 5.1 Parameters

Data		No.	Item		Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
Parameters	Fixed parameters	1	Upper stroke limit		-2147483648 to 2147483647 PLS (32-bit signed data)	2147483647 PLS	PC ready signal (Y1D) must be OFF.	When the PC READY signal (Y1D) is turned ON
		2	Lower stroke limit		-2147483648 to 2147483647 PLS (32-bit signed data)	0PLS		
		3	Electronic gear	Designated pulse multiplication ratio numerator (CMX)	1 to 9999	1		
		4		Designated pulse multiplication ratio denominator (CDV)	1 to 9999 however $\frac{1}{50} \leq \frac{CMX}{CDV} \leq 50$	1		
	Variable parameters	5	Velocity limit		10 to 400,000 PLS/S (10 PLS fixed)	200,000 PLS/S	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, if they are 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 the JOG start signal (Y14, Y15) is turned ON 3. When the zero return start signal (Y10) is turned ON
		6	Acceleration time		2 to 9999 msec	300 msec		
		7	Deceleration time		2 to 9999 msec	300 msec		
		8	In-position range		1 to 2047 PLS	5 PLS		
		9	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 when checking the parameter setting range, all data for fixed parameters (but only error data for variable parameters) defaults to the values shown in Table 5.1.

(2) Section 1.2 gives details on non-electronic gear parameters.

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(3) Electronic gear functions

By multiplying the AD70 command pulse outputs, machine travel distance per command pulse can be freely changed using the electronic gear.

It is not necessary to select an encoder appropriate for the mechanical system (flexible positioning can be done). The electronic gear is valid for zero return, positioning, and JOG operations.

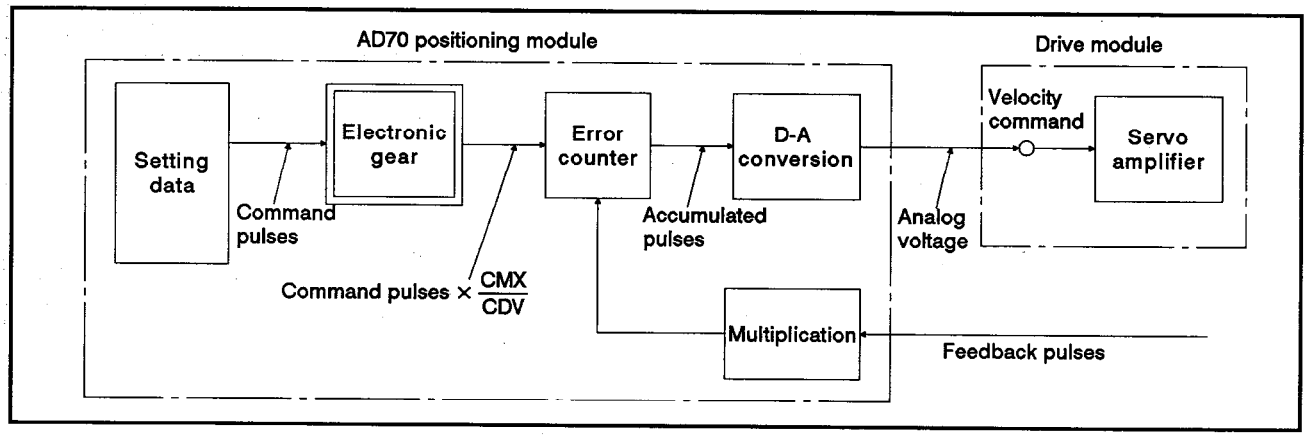


Fig. 5.2 Electronic Gear

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

(However, $\frac{1}{50} \leq \frac{CMX}{CDV} \leq 50$)

When using the electronic gear, the positioning velocity and axis travel distance are controlled by electronic gear multiples. However, positioning velocity x electronic gear ≤ 400 Kpps. If there are fractional pulses below the decimal point, they are stored internally 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 105 KPLS/sec

Electronic gear ($\frac{CMX}{CDV}$) 4

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 ↓ 105*
	Command pulses × CMX/CDV	400	420	420
	Output pulses	400	400	400
	Error code	–	104	104 (32)

* 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/sec.

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POINT

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

(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 400 Kpps is exceeded, error code 104 will be set, and (since the velocity will be controlled at 400 Kpps) mispositioning will occur. Set the positioning velocity × electronic gear ≤ 400 Kpps.

[Example of electronic gear usage]

In the positioning system using a ball screw,

Ball screw lead : 10 mm (0.39 in)

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

Feed distance per pulse is

$$\Delta l = \frac{10}{12000} = 0.000833 = \text{mm /pulse}$$

If electronic gear is used and set to

$$\Delta l' = \frac{10}{12000} \times 12 = 0.01 \text{ mm /pulse}$$

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 the ball screw load.

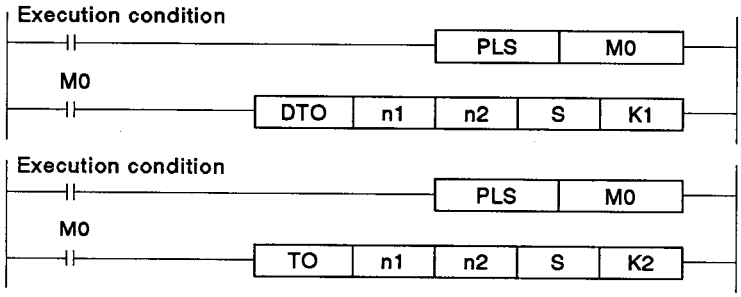
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5.2.2 Buffer memory

Parameter data from the user program is stored in the buffer memory areas shown in Fig. 5.3 and 5.4.

Read/write of 2-word data (such as upper and lower stroke limits and velocity limits) from/to 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

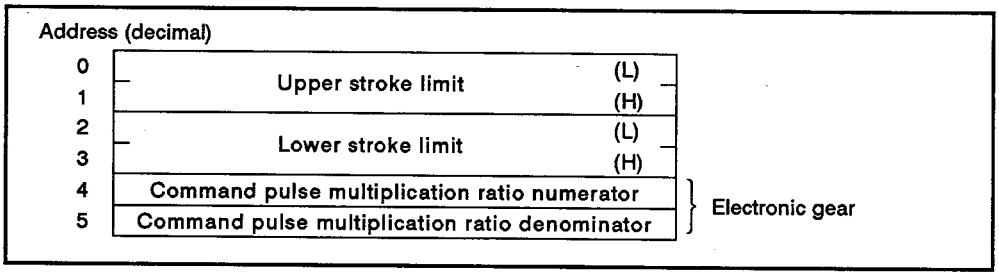


Fig. 5.3 Fixed Parameter Areas

(2) Variable parameters

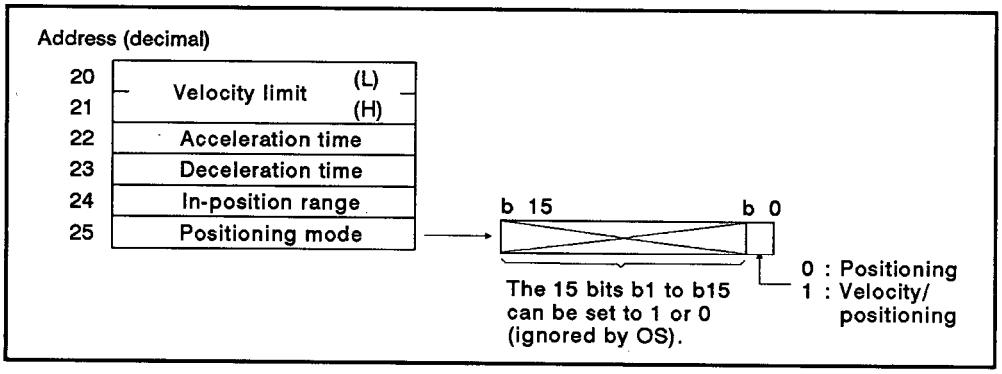


Fig. 5.4 Variable Parameter Areas

As shown in Fig. 5.4, the positioning mode is determined by the lowest single bit in the positioning mode area.

POINT

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

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5.2.3 Sample parameter setting program

A sample program of parameter settings for fixed and variable parameters is shown below.

[Conditions]

Fixed 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 parameters.

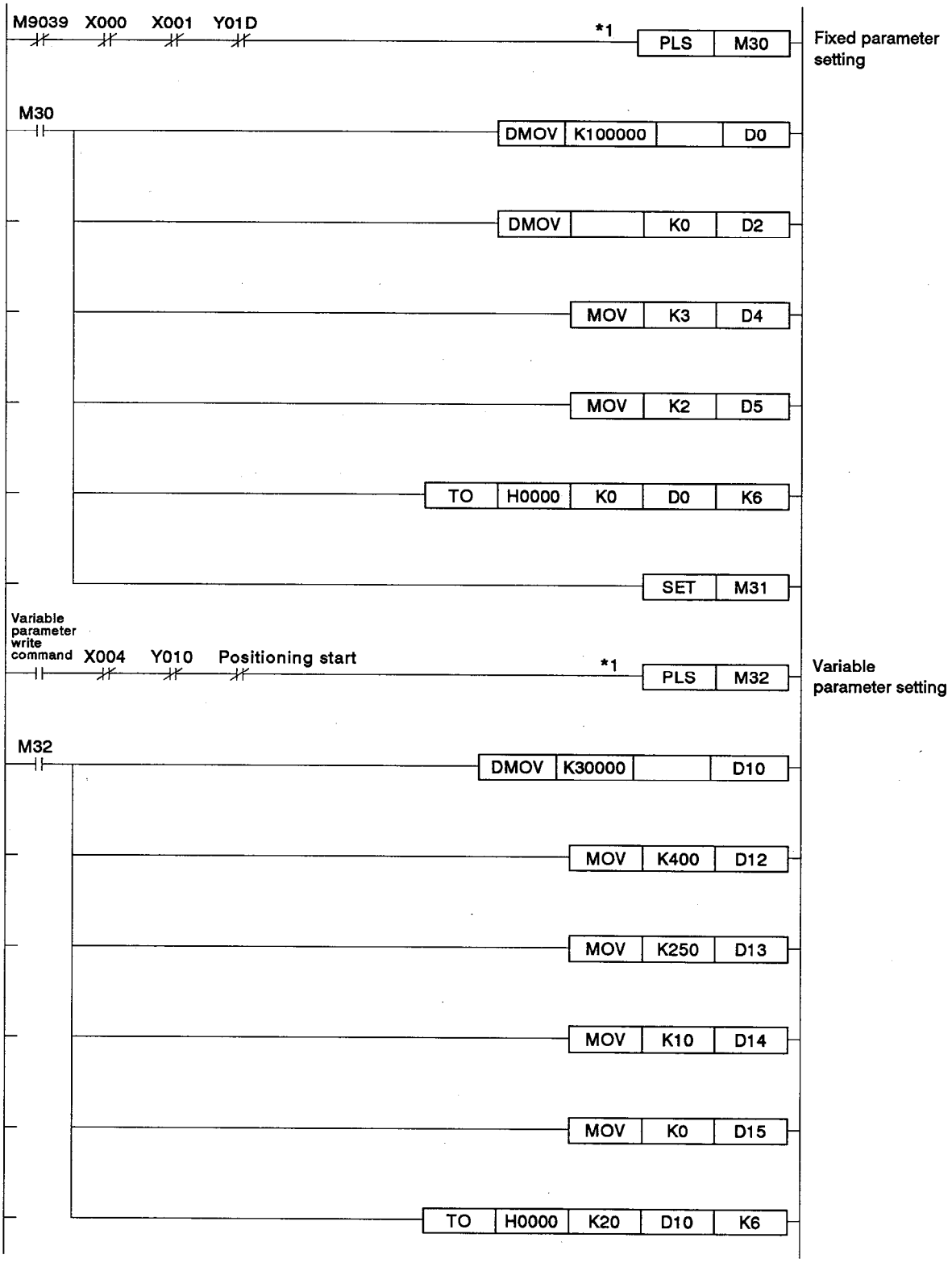
Variable parameter settings

(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	D0, D1	0, 1
	Lower stroke limit		0 PLS	D2, D3	2, 3
	Electronic gear	Command pulse multiplication ratio numerator	3	D4	4
		Command pulse multiplication ratio denominator	2	D5	5
Variable parameters	Velocity limit		30000 PLS	D10, D11	20, 21
	Acceleration time		400 msec	D12	22
	Deceleration time		250 msec	D13	23
	In-position mode		10 PLS	D14	24
	Positioning mode		0	D15	25

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

REMARK

Variable parameters can be written whether or not the PC READY (Y1D) is ON.

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5.3 Zero Return

5.3.1 Zero-return operation

When applying power to the AD70 or at the start of operation, a zero-return execution is required to confirm the zero point. The zero-return operation should also be executed when the zero-return request signal (X02) is turned ON.

Zero return is executed by the zero-return start command from the PC CPU. Then, axis travel distance from the zero point to the near-zero point dog is estimated. The present value is corrected to the zero point address after completing the zero return.

Since addresses are monitored even during zero-return operations, if a zero-return operation is started with the default settings, the upper stroke limit (default value 0) will be exceeded resulting in error 100 because the zero-return direction is that of addresses decreasing. However, the zero-return operation will be completed normally.

The two zero-return operation modes shown below are set with slide switches (see Section 4.5.8).

- Near-zero point dog mode
- Count mode

(1) Near-zero point zero return

As shown in Fig. 5.5, the reference point from the pulse generator (PLG) which first appears after the signal triggered by the near-zero point dog is turned OFF is established as the zero point.

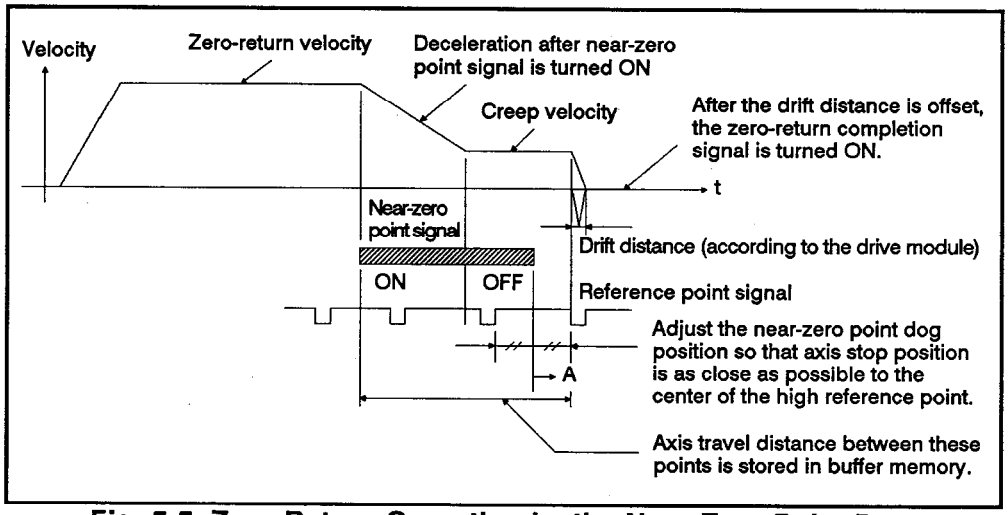


Fig. 5.5 Zero-Return Operation by the Near-Zero Point Dog

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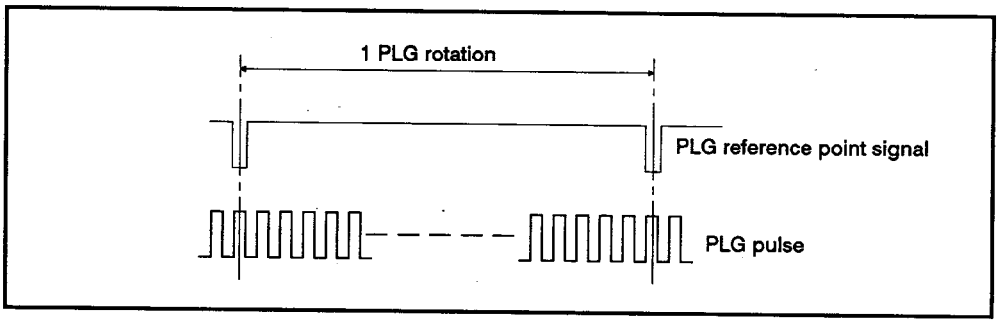


Fig. 5.6 Feedback Pulses

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 misread. 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 near as possible to the center of the reference point signal high range.

The reference point can be confirmed by rotating the motor at a lower speed and observing the lit Phase Z light (LED indication) on the front of the AD70.

If a zero-return operation is started while the near-zero point signal is ON, error code 74 prevents the start. Use the JOG operation to keep the reference point far enough away from the near-zero point dog. Start the zero-return operation.

POINT

Observe the following when executing near-zero point zero-return operations:

(1) Zero-return start operations cannot be executed in the near-zero point dog mode. Execute the zero-return start operation after returning the axis to a position away from the near-zero point dog position. Do this by using a JOG operation.

(2) Zero-return operations cannot be started two times in a row. Interlock by 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 (Position A in Fig. 5.5) after completing zero return, a 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.

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(2) Count mode zero return

As shown in Fig. 5.7, the reference point from the PLG (which first appears after the axis has moved the "PLS-designated axis travel distance after near-zero point signal ON") is established as the zero point.

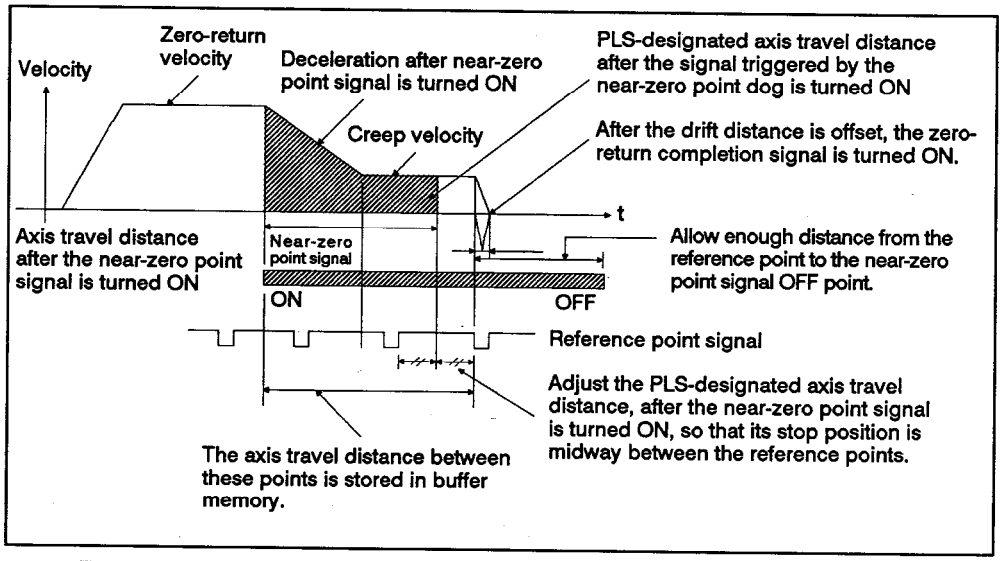


Fig. 5.7 Zero-Return Operation Sequence in the Count Mode

POINT

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

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

After the near-zero point signal is turned ON, set the axis travel distance set pulse. This is because the distance must not overlap the reference point signal position where it is greater than the zero-return velocity deceleration distance.

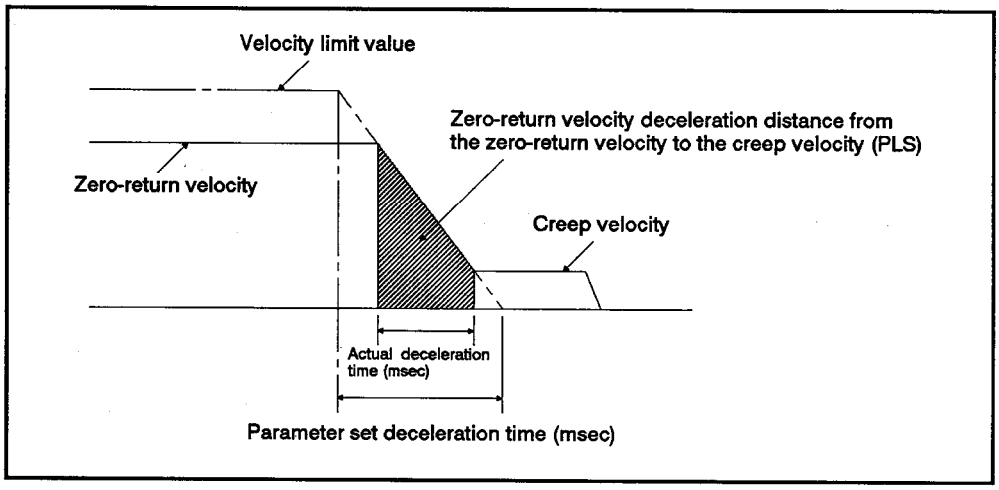


Fig. 5.8 Deceleration Distance from Zero-Return Velocity to Creep Velocity

Zero-return velocity deceleration distance from the zero-return velocity to the creep velocity

$$\frac{(\text{zero-return velocity} + \text{creep velocity})\ (\text{PLS/sec})}{1000} \times \frac{\text{actual deceleration time (msec)}}{2}$$

Round off below the decimal point. Section 5.3.2 gives calculation examples.

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(b) Position where the near-zero point signal is turned ON

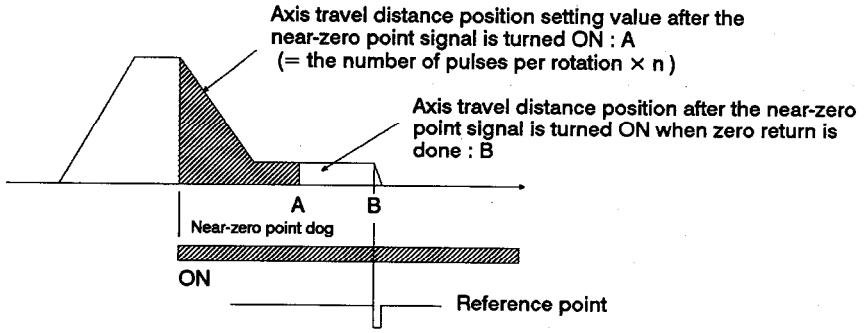
After the near-zero point signal is turned ON, the axis travel distance position must be set so that it is not close to the reference point signal.

If it is close to the reference point signal, the reference point signal might be misread and the zero point might be offset by one rotation of the motor.

One way to avoid this is to set this position near the center of the reference point signal high range. Then, after the near-zero point signal is turned ON, set the axis travel distance to a multiple of the number of output pulses in one rotation of the servo motor.

[Sample position adjustment where the near-zero point signal is turned ON]

(1) Execute zero return in count mode.



(2) Read the axis travel distance (B) from monitor areas 108 and 109 in buffer memory.

(3) Adjust the position after the near-zero point signal is turned ON so that the subtraction result (B – A) is half the number of pulses output by one rotation of the servo motor.

Adjust as follows:

$A \leq B < A +$ the number of pulses output by one rotation of the servo motor;

$B \cong A +$ number of pulses output by one rotation of the servo motor $\times \frac{1}{2}$

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5.3.2 Zero-return data settings

For the AD70 to execute zero-return control, zero-return data must be set. If the data is not set, defaults shown in Table 5.2 are used.

Default values are set (a) at power ON, and (b) 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 Value	Setting Enable Condition	Set Data Check Timing
1	Zero point address	−2147483648 to 214748364 PLS	0	PC READY signal (Y1D) must be turned OFF.	When the zero-return start signal (Y10) is turned ON
2	Zero-return velocity	1 to 400,000 PLS/s	10,000 PLS/s		
3	Creep velocity	1 to 400,000 PLS/s	1,000 PLS/s		
4	Axis travel distance after near-zero point signal goes ON (only in the count mode)	0 to 2147483647 PLS	75 PLS		

(1) Axis travel distance set pulse after near-zero point signal goes 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.

$$\text{Deceleration distance} = \frac{\text{zero return velocity + creep velocity (PLS)}}{1000} \times \frac{\text{actual deceleration time (msec.)}}{2}$$

Example:

Zero-return velocity : 10 Kpps (default value)
Creep velocity : 1 Kpps (default value)
Deceleration time : 300 msec (default value)
Deceleration distance

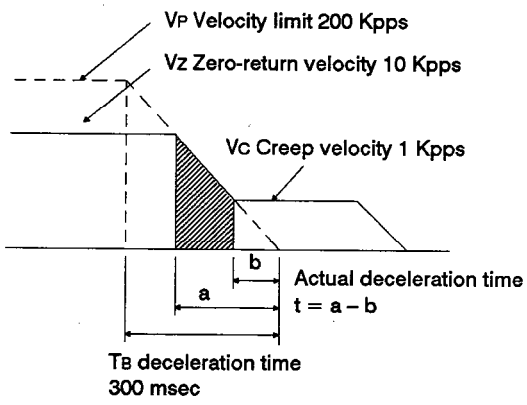
$$= \frac{Vz + Vc}{1000} \times \frac{t}{2}$$

$$= \frac{Vz + Vc}{1000} \times \frac{1}{2} \times \frac{T_B (Vz - Vc)}{V_P}$$

$$\frac{(10K + 1K) \times 300\,(10K - 1K)}{2000 \times 200K}$$

$$= 74.25$$

= 75 (Round off below the decimal point) PLS



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

The following is applicable when setting the near-zero point dog position near the center of the reference point signal high range. If the axis travel distance after the near-zero point signal is turned ON is a multiple of the number of output pulses in one rotation of the servo motor, the axis travel distance position after the near-zero point signal goes ON will not overlap with the reference point signal.

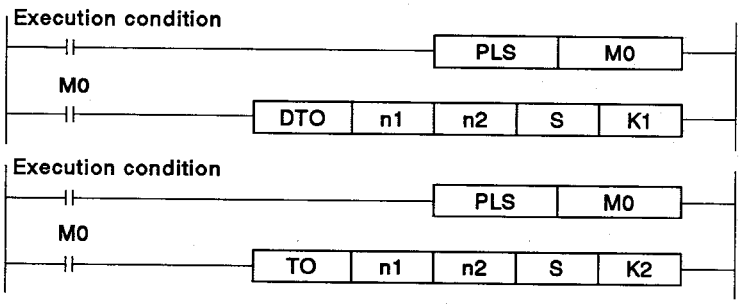
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Therefore, if the number of pulses for one rotation of the servo motor is 2000, set the number of pulses to 2000 PLS.

5.3.3 Buffer memory

As shown in Fig. 5.9, zero-return data is stored in buffer memory using the user program. Read/write 2-word data simultaneously from/to 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.



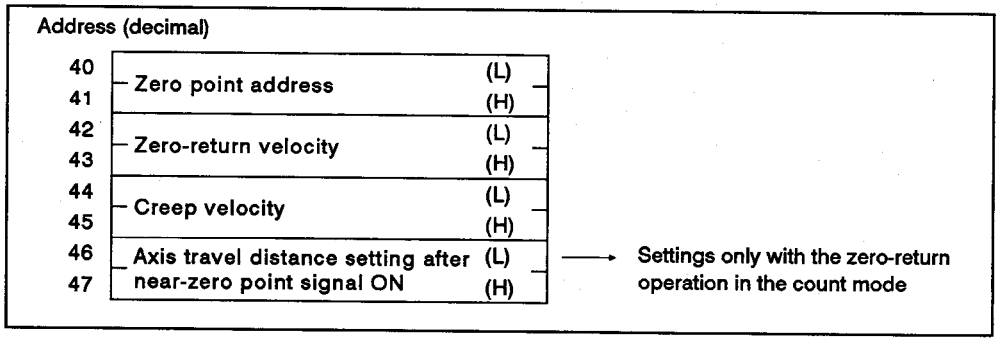


Fig. 5.9 Zero-Return Data Area

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5.3.4 Zero-return program

(1) Sample flowchart (2) Start conditions

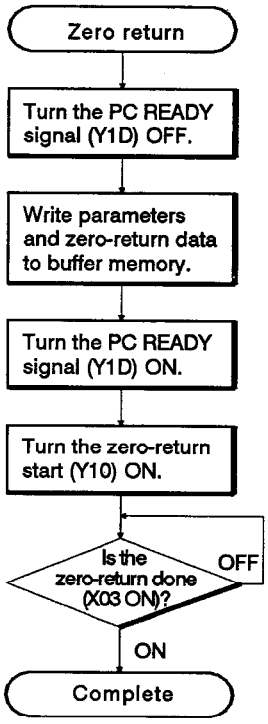


Table 5.3 Zero-Return Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo ready	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
	DOG	Near-zero point dog	OFF	Only in near-zero point dog mode
Interface signal	X01	AD70 ready completed	ON	
	X03	Zero-return completed	OFF	Only in near-zero point dog mode
	X04	BUSY	OFF	
	Y10	Zero-return start	OFF	
	Y17	Stop signal	OFF	
	Y1D	PC ready	ON	
Data	Zero-return data		No error	No start at an error.

(3) Related signal timing

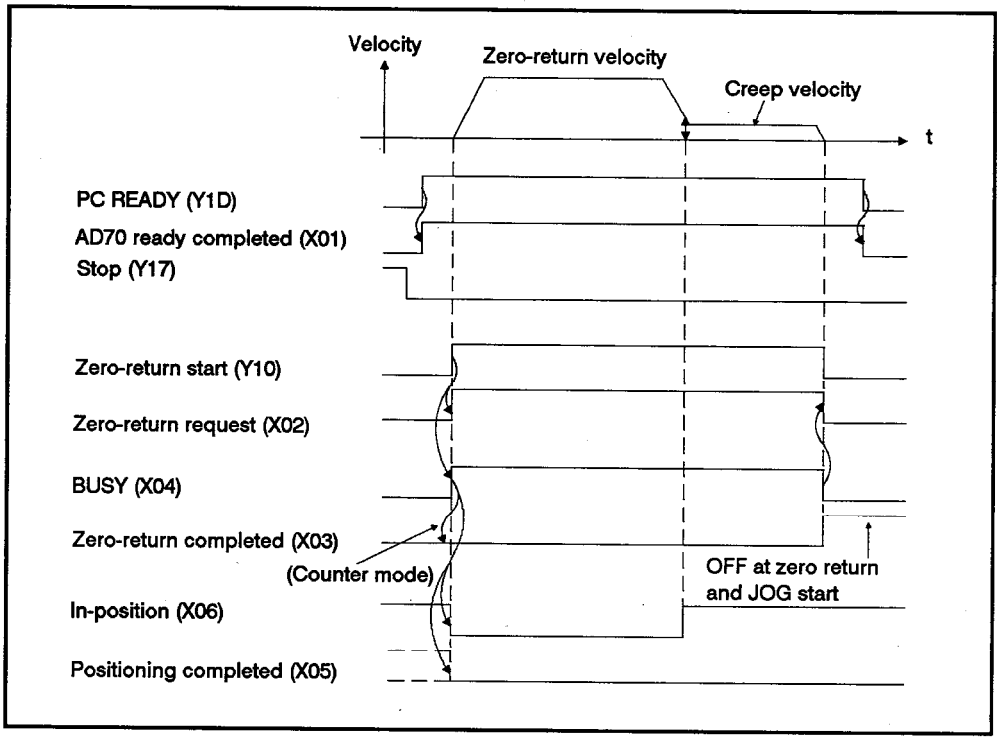


Fig. 5.10 Zero-Return Timing

Section 3.8 gives I/O signal details.

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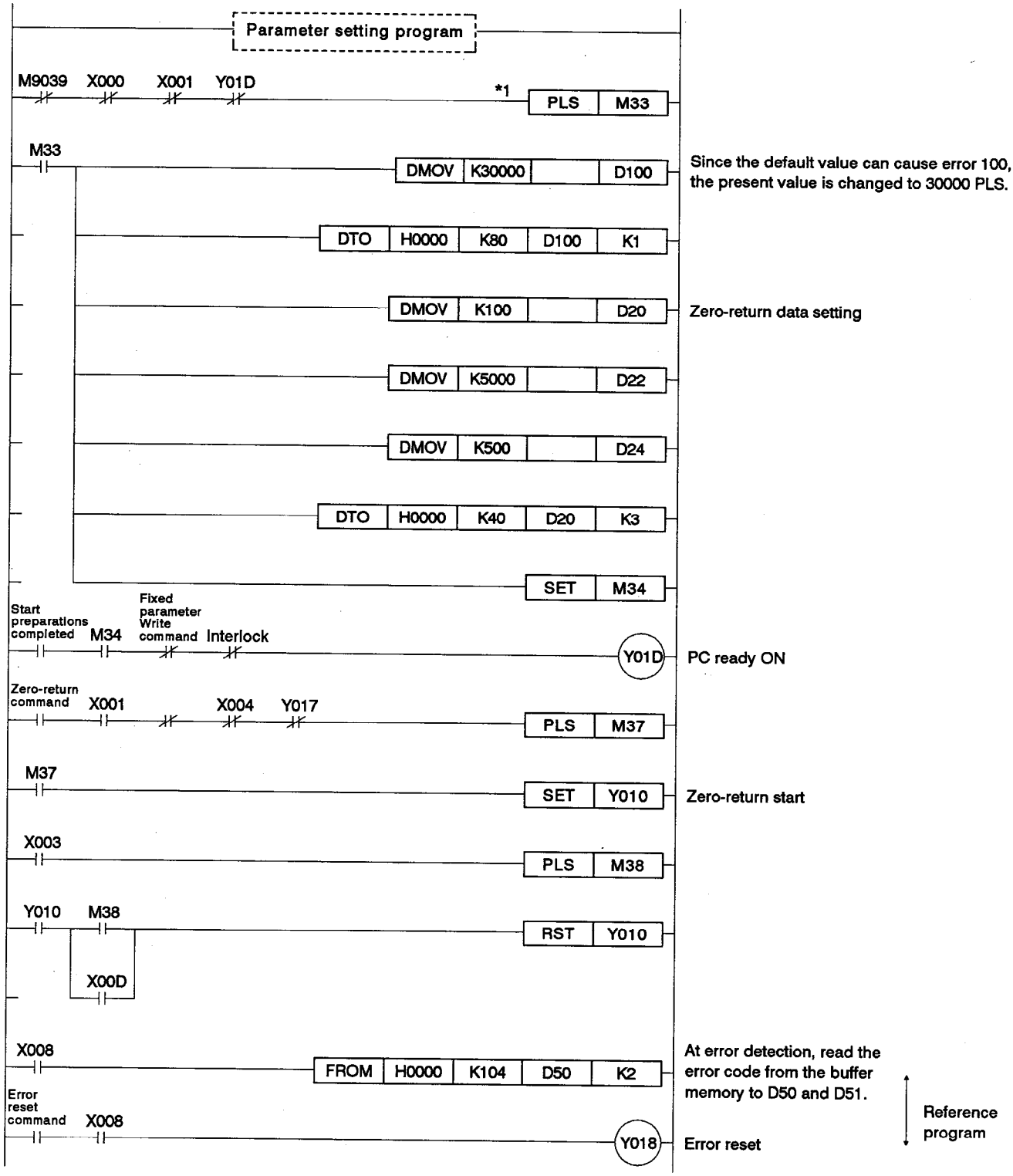
(4) Sample zero-return program in the near-zero point dog mode

[Conditions]

1) Write in one scan after the CPU RUN.
2) Execute a zero-return operation using the zero-return command.
3) Fixed and variable parameter settings (Section 5.2.3 Program) are regarded as completed.
4) Start conditions are given in Section 5.3.
5) Slide switch setting for SW7 is OFF (near-zero point dog mode).
6) Turn the PC READY (Y1D) ON after the writing of fixed parameter and zero-return data is completed.
7) Set the following data as zero-return data:

	Setting Value	Device Used	Buffer Memory Address
Zero point address	100 PLS	D20, D21	40, 41
Zero-return velocity	5000 PLS/sec	D22, D23	42, 43
Creep velocity	500 PLS/sec	D24, D25	44, 45
Present value	30000 PLS	D100, D101	80, 81

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

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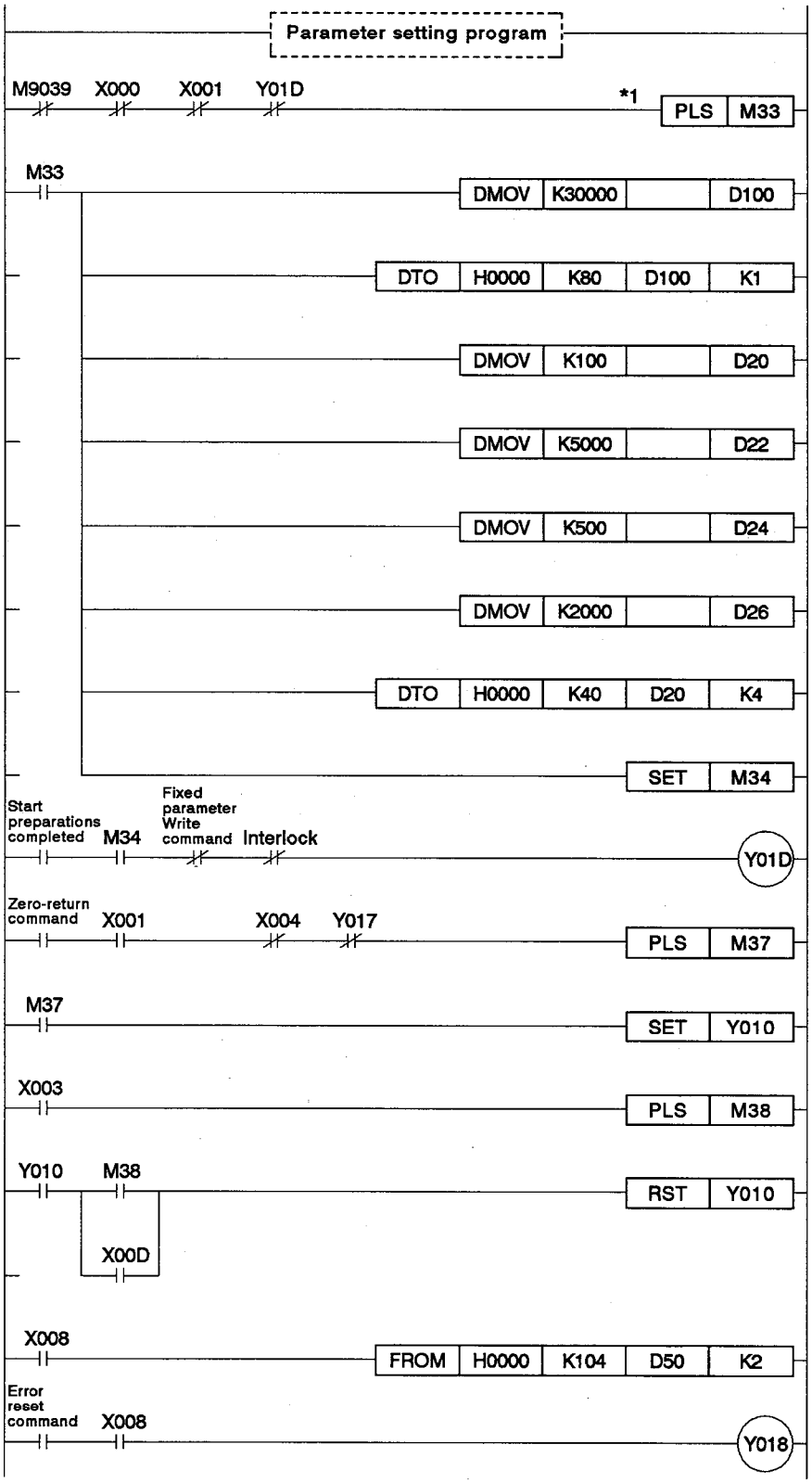
(5) Sample zero-return program in the count mode

[Conditions]

1) Write in one scan after CPU RUN.
2) Execute a zero-return operation using the zero-return command.
3) Fixed, servo, and variable parameter settings (Section 5.2.3 Program) are regarded as completed.
4) Start conditions are given in Section 5.3.
5) Slide switch setting for SW7 is ON (count mode).
6) Turn PC READY (Y1D) ON after the writing of fixed parameter and zero-return data is completed.
7) Set the following data as zero-return data:

	Setting Value	Device Used	Buffer Memory Address
Zero point address	100 PLS	D20, D21	40, 41
Zero-return velocity	5000 PLS/sec	D22, D23	42, 43
Creep velocity	500 PLS/sec	D24, D25	44, 45
Travel distance after setting the zero-point dog signal ON	2000 PLS	D26, D27	46, 47
Present value	30000 PLS	D100	80, 81

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

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5.3.5 Stop processing during zero-return operations and re-starting after stopping

(1) The factors which cause stop processing during zero-return operations are given below.

Table 5.4 Stop Processing Causes During Zero-Return Operations

No.	Stop Factor	Stop Processing		
		Error Detection (X8)	Error Code	Stop Mode
1	External stop signal is turned ON.	X8 ON	Error code reset	* Deceleration processing, with Nos. 4 and 7 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	Upper limit LS (FLS) is turned OFF.			
6	Lower limit LS (RLS) is turned OFF.			
7	PC power supply goes OFF	–	–	

* The deceleration velocity is determined by the deceleration time parameters and the velocity limit value.

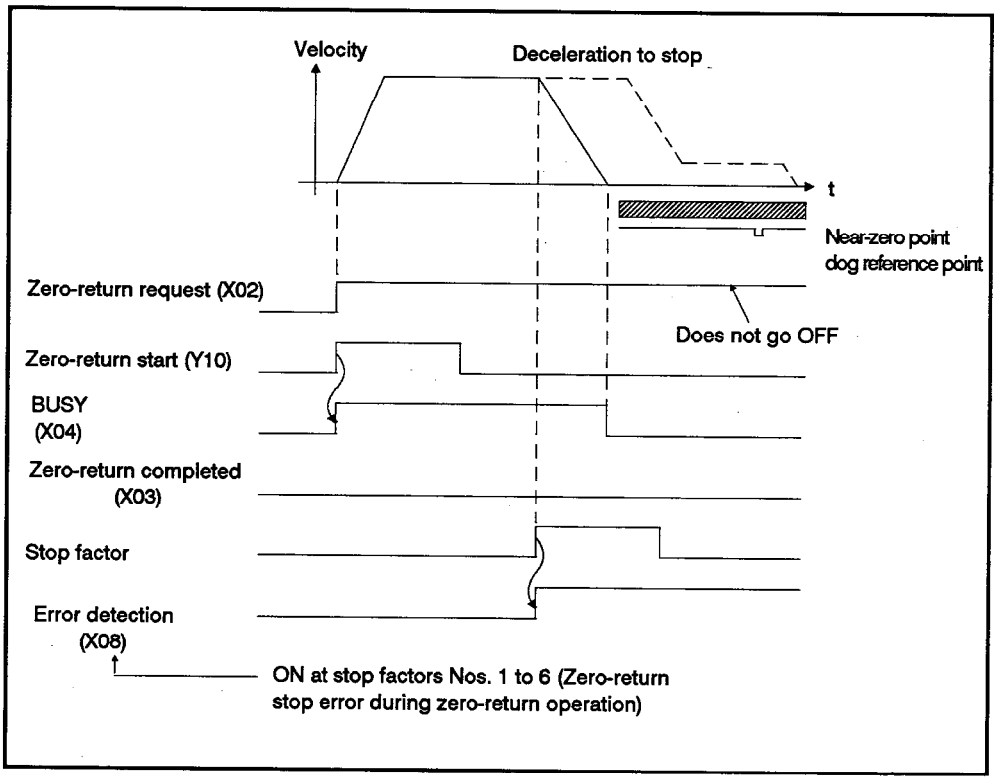


Fig. 5.11 Stop Timing During Zero-Return Operations

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(2) Restarting after stopping during zero-return operations

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 74.

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

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

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5.4 Positioning

5.4.1 Positioning mode

(1) Set the positioning pattern, address, and velocity from the user program. Execute positioning in the incremental or absolute mode using the positioning start command from the PC CPU.

Use the start signal to specify incremental or absolute mode (see Section 1.2).

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

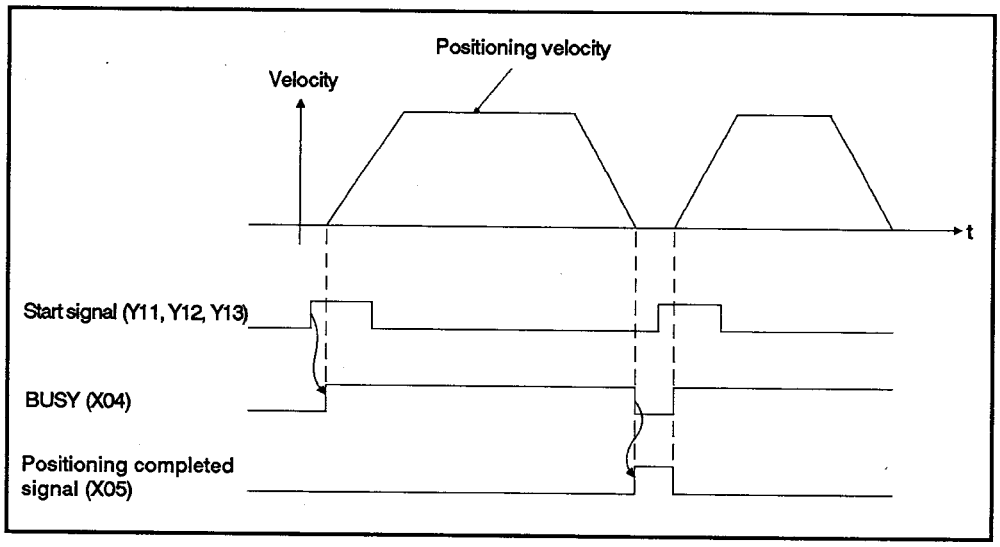


Fig. 5.12 Positioning

(2) Section 5.10 discusses stop processing and restarting 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 (see Section 5.9).

- Present value changes
- Velocity changes during positioning
- Error counter clear

(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. If this happens, move the present value within the stroke limit range.

(5) Since there is no dwell-time function, set the timer from the user program. If a dwell is required, use the positioning completed signal (X05).

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5.4.2 Positioning data settings

Table 5.5 Positioning Data

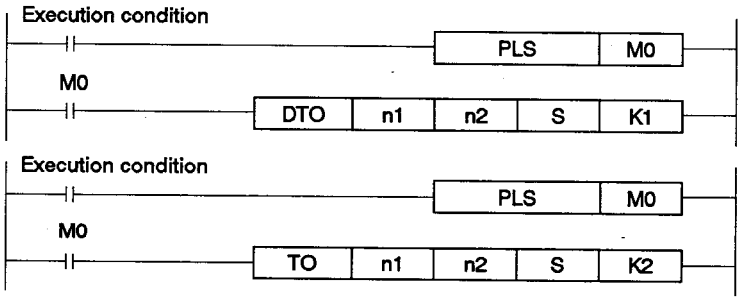
No.	Item	Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0 : One-phase trapezoidal positioning 1 : Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by the data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON (if they are written while the BUSY signal is ON).	When the positioning start signal (Y11 to Y13) is turned ON
2	Positioning address [Axis travel distance in the velocity/position control switchover mode or the incremental mode]	-2147483648 to 2147483647 [0 to 2147483647 at velocity/position control switchover mode or in the incremental mode]	0		
3	Positioning velocity	1 to 400, 000 PLS/s	0		

5.4.3 Buffer memory

Positioning data from the user program is stored in buffer memory as shown in Fig. 5.13.

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

Two-word data can be written as follows:



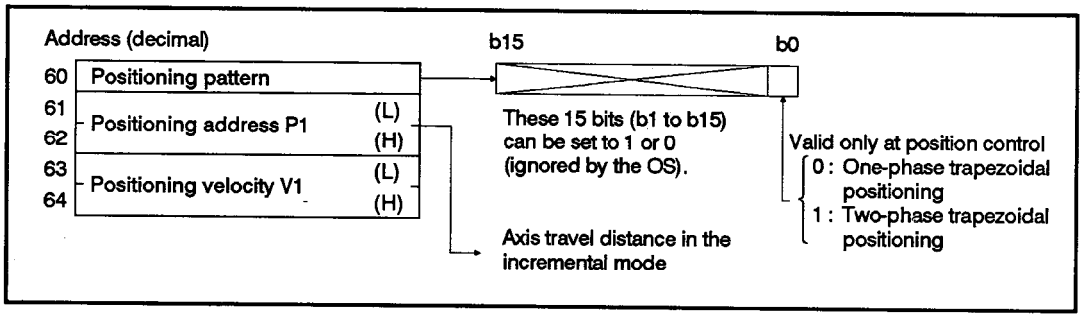


Fig. 5.13 Positioning Data Area

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5.4.4 Sample positioning start program

(1) Sample flowchart (2) Start conditions

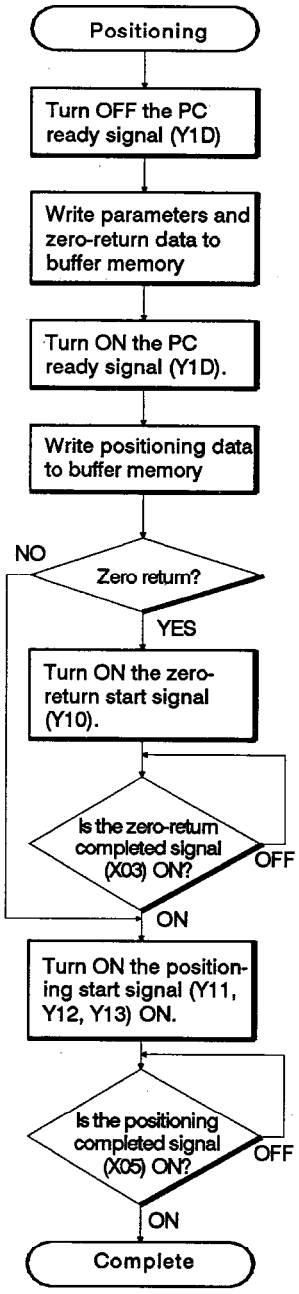


Table 5.6 Positioning Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo READY	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
Interface signal	X01	AD70 ready completed	ON	
	X04	BUSY	OFF	
	Y11 to Y13	Positioning start	OFF	
	Y17	Stop signal	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

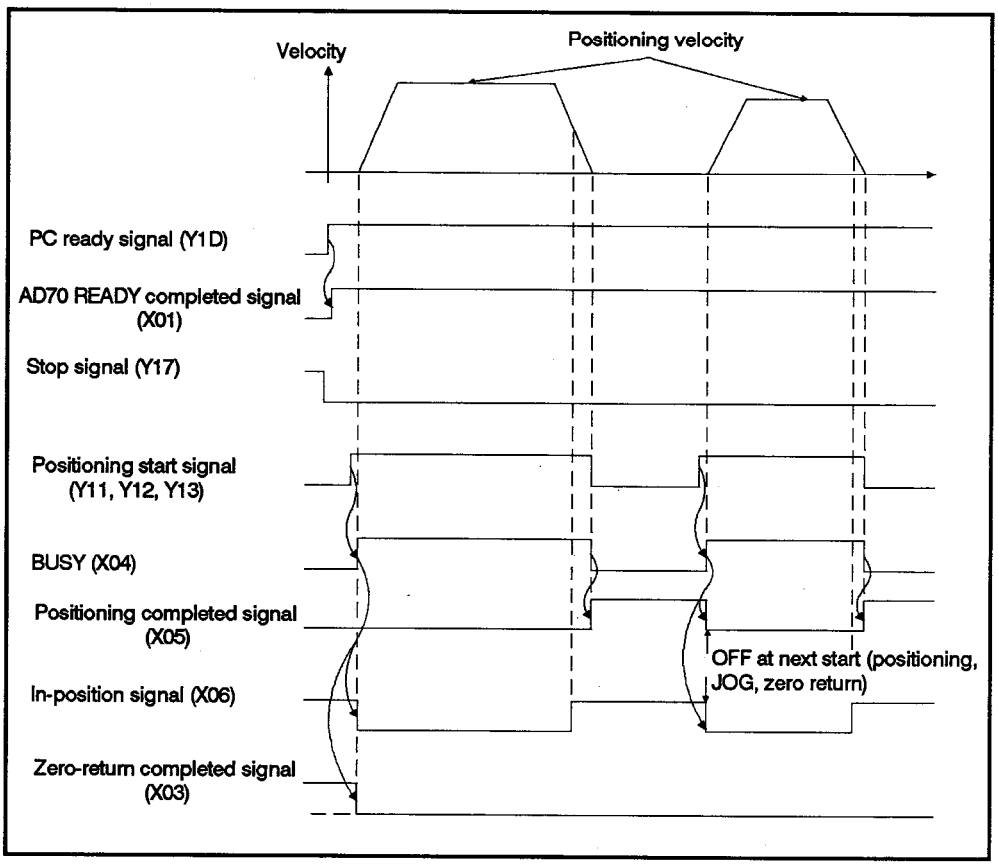


Fig. 5.14 Positioning Timing

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(4) Sample positioning program

(Conditions)

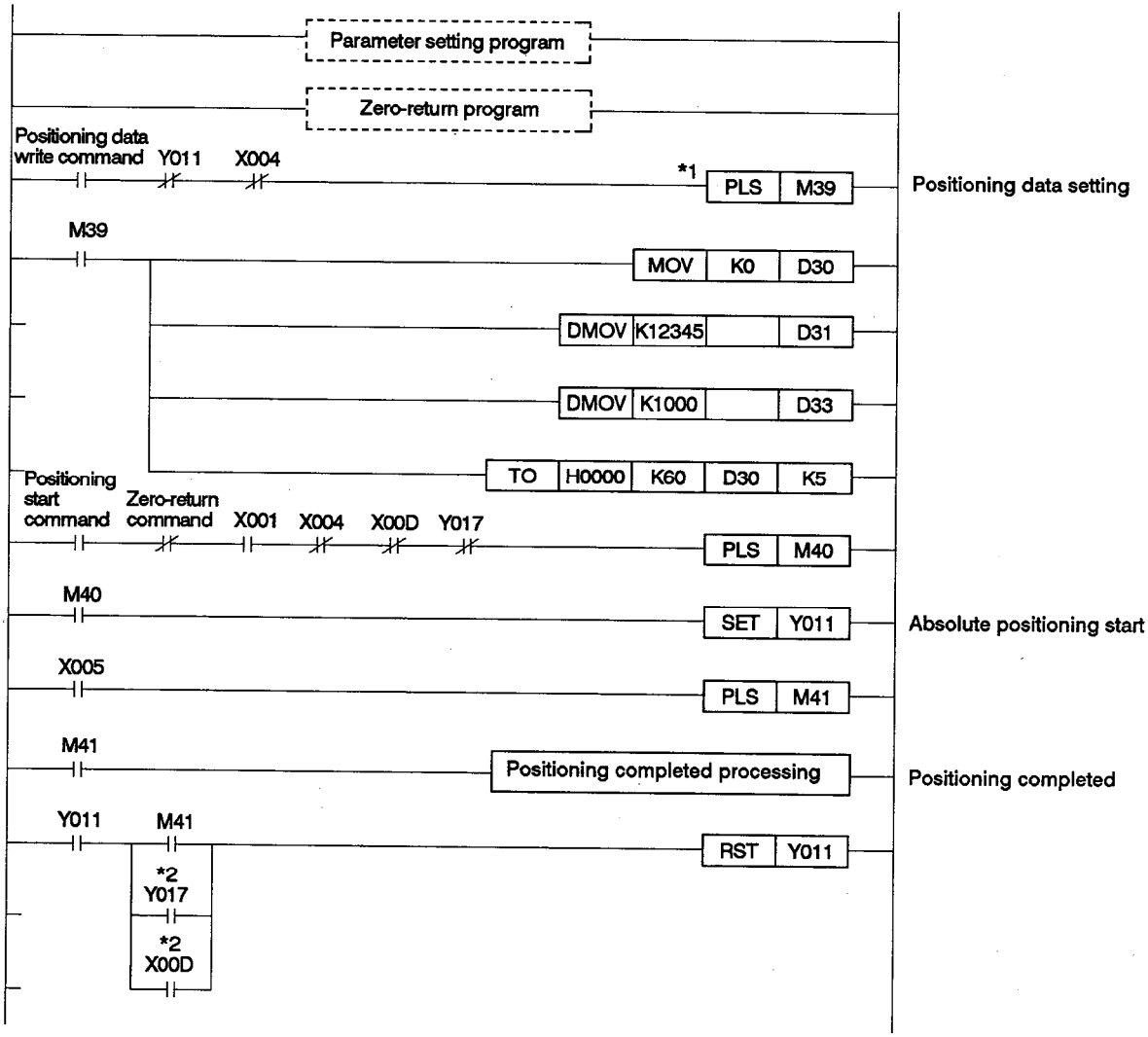
1) Execute absolute positioning using the positioning start command.

2) Parameter settings (Section 5.2.3 Program) and zero return (Section 5.3.4 Program) are regarded as completed.

3) Start conditions are shown in Table 5.6.

4) The positioning data indicated below is set.

	Setting Value	Device Used	Buffer Memory Address
Positioning pattern	0	D30	60
Positioning address	12345 PLS	D31, D32	61, 62
Positioning velocity	10000 PLS/sec	D33, D34	63, 64



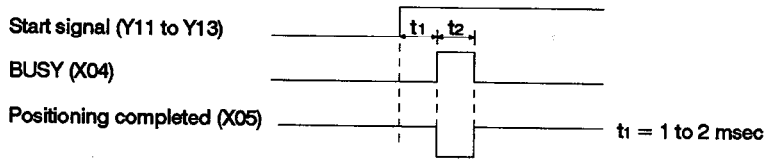
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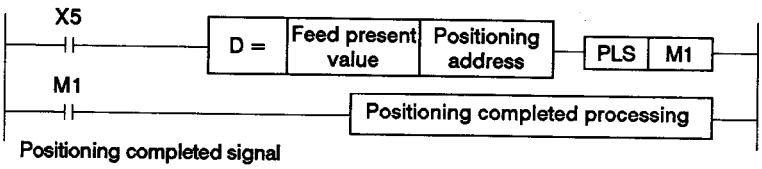
* 1 When using instructions (such as MOVP and TOP instructions) with building block-type CPUs, converting execution conditions into pulses is unnecessary.

* 2 If the stop command is used during positioning, reset the start signal so that positioning can be restarted.

REMARK

If, after the second positioning in repeated positioning operations, the positioning operation time (t2) is shorter than the scan time, the sequence program cannot detect the ON/OFF status change (ON → OFF → ON) positioning signal (X05). To detect this change, set the positioning completed timing using the following program.





Positioning completed signal

Section 5.12 explains how to read the feed present value.

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5.5 Two-Phase Trapezoidal Positioning

5.5.1 Positioning

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

Use the start signal to execute incremental and absolute mode specifications (see Section 1.2).

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

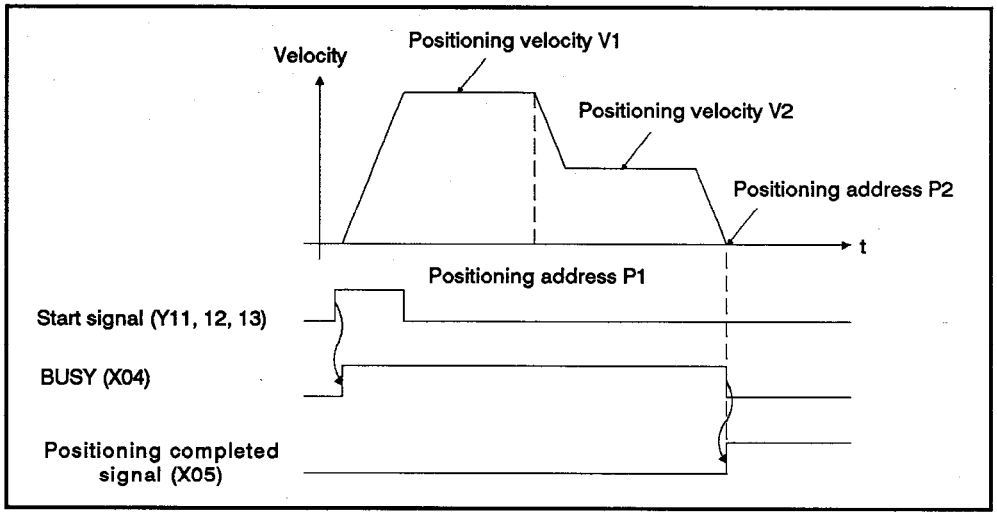
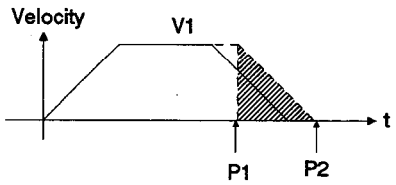


Fig. 5.15 Two-Phase Trapezoidal Positioning

(2) If the axis travel distance from the 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 position $= \frac{1}{2} \times$ actual deceleration time $\times$ positioning velocity V1 $\geq$ P2 – P1

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(3) If the starting positioning is 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 occurs if the P2 address is set in the reverse direction.

Setting Examples		Positioning Direction (present value → P1)	
		Addresses Increasing	Addresses Decreasing
1	P1=10,000 PLS, P2=5,000 PLS	Error	OK
2	P1=10,000 PLS, P2=15,000 PLS	OK	Error

(4) The positioning velocity V1 can be smaller than V2.

(5) Section 5.10 gives details on stop processing and restarting 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 (see Section 5.9).

- Present value change
- Velocity change during positioning
- Error counter clear

(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. If this happens, move the present value within the stroke limit range.

(8) Since there is no dwell-time function, set the timer from the user program. If a dwell is required, use the positioning completed signal (X05).

5.5.2 Positioning data setting

Table 5.7 shows the data to be used in positioning.

Table 5.7 Positioning Data

No.	Item	Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0 : Positioning 1 : Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by the data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON (if they are written while the BUSY signal is ON).	1. When the positioning start signal (Y11 to Y13) is turned ON
2	Positioning address [Axis travel distance in the incremental mode]	-2147483648 to 2147483647 [0 to 2147483647 PLS in the incremental mode]	0		
3	Positioning velocity	1 to 400, 000 PLS/s	0		

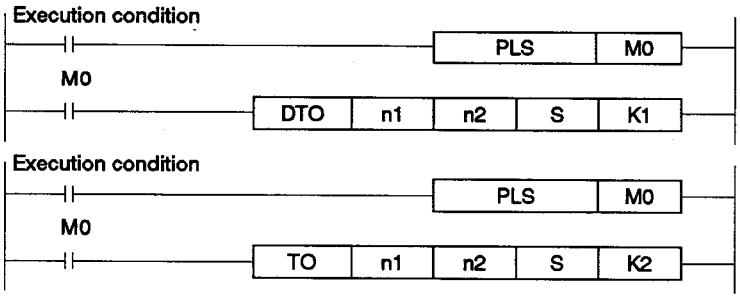
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5.5.3 Buffer memory

Positioning data from the user program is stored in buffer memory as shown in Fig. 5.16.

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

Two-word data can be written as follows.



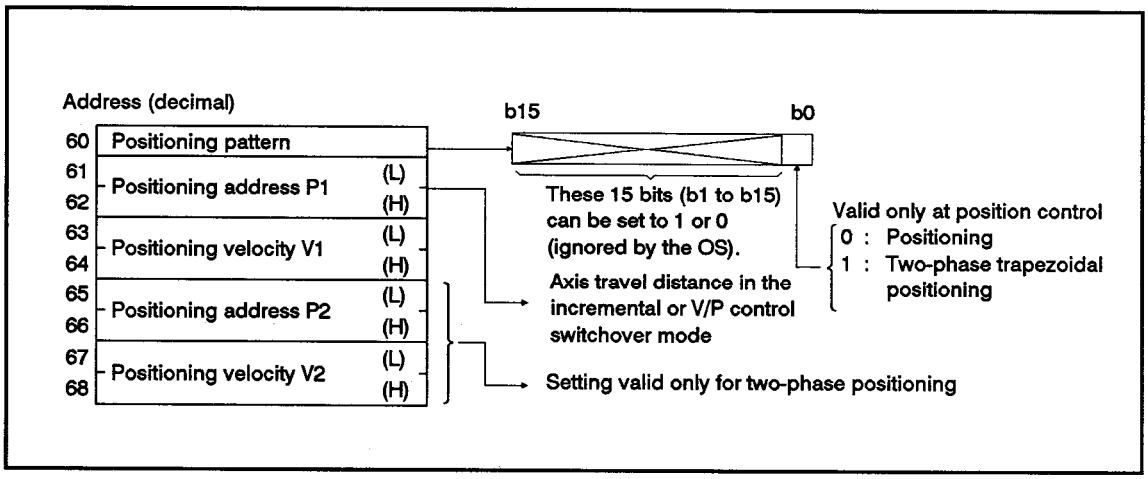


Fig. 5.16 Positioning Data Area

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5.5.4 Sample two-phase positioning program

(1) Sample flowchart (2) Start conditions

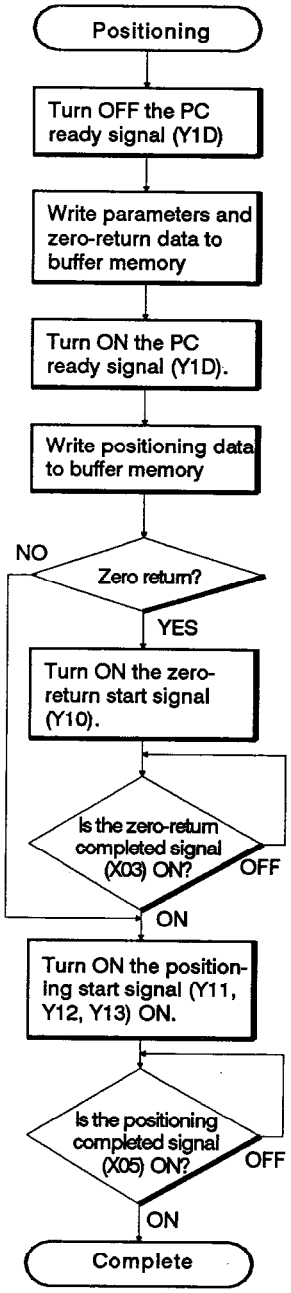


Table 5.8 Positioning Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo ready	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
Interface signal	X01	AD70 ready completed	ON	
	X04	BUSY	OFF	
	Y11 to Y13	Positioning start	OFF	
	Y17	Stop signal	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

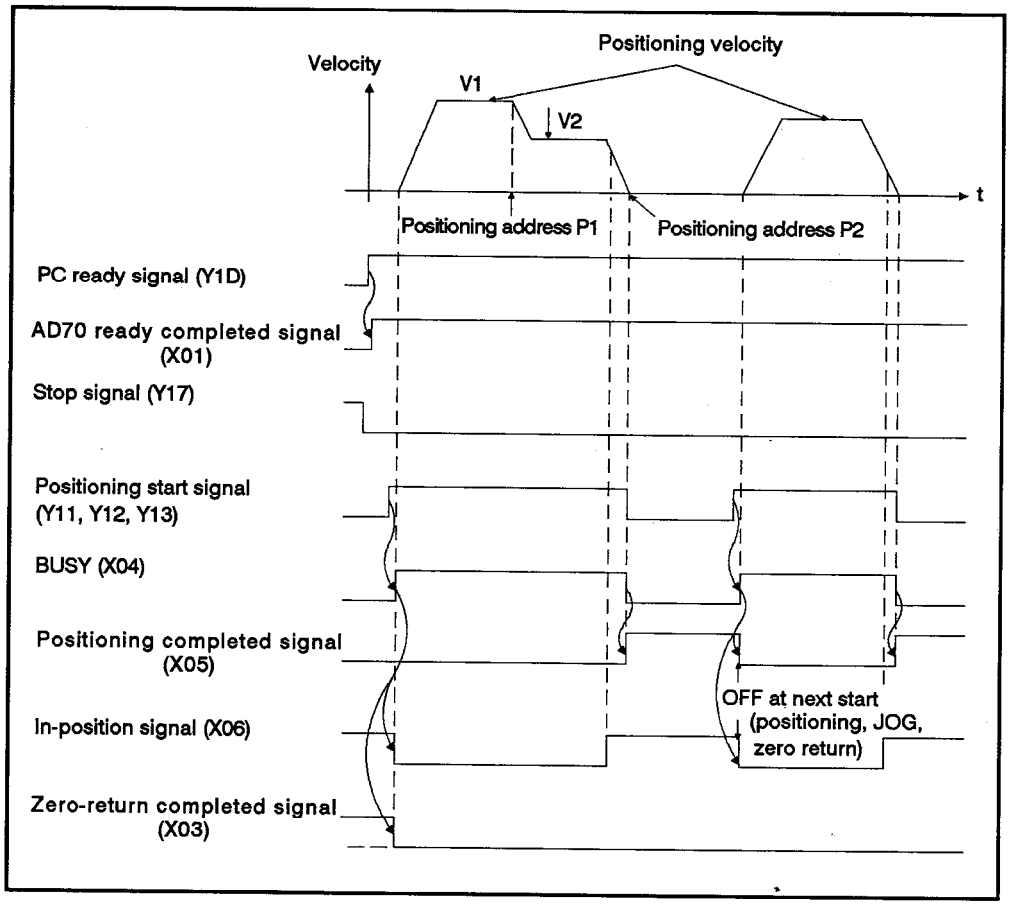


Fig. 5.17 Positioning Timing

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(4) Sample positioning program

(Conditions)

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

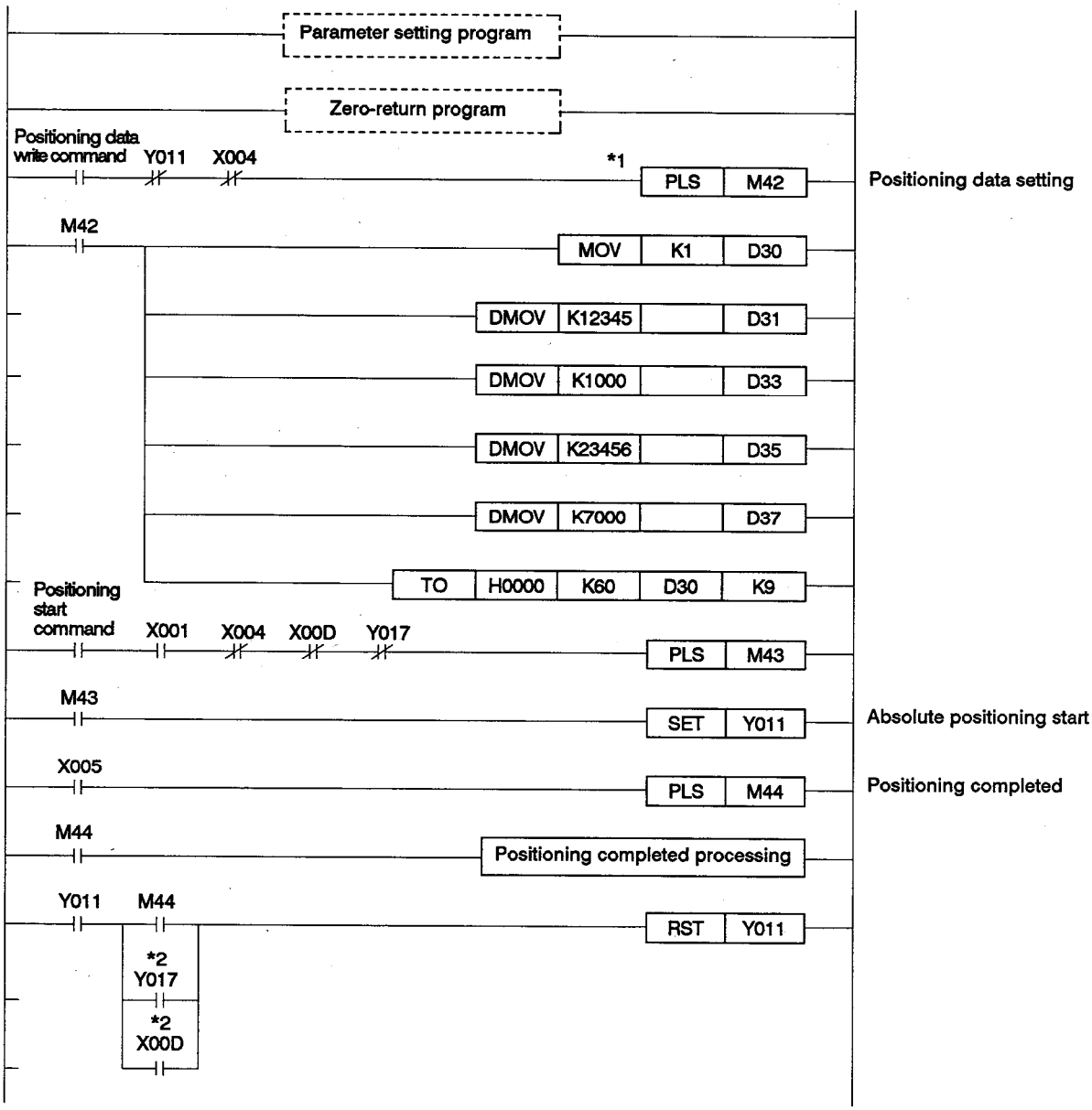
2) Parameter settings (the Section 5.2.3 Program) zero return (the Section 5.3.4 Program) are regarded as completed.

3) Start conditions are shown in Table 5.8.

4) Positioning data indicated below is set.

	Setting Value	Device Used	Buffer Memory Address
Positioning pattern	1	D30	60
Positioning address P_1	12345 PLS	D31, D32	61, 62
Positioning velocity V_1	10000 PLS/sec	D33, D34	63, 64
Positioning address P_2	23456 PLS	D35, D36	65, 66
Positioning velocity V_2	7000 PLS/sec	D37, D38	67, 68

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

* 2 If the stop command is used during two-phase positioning, reset the start signal so that positioning can be restarted.

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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. Start the positioning operation according to the 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, the control mode is changed to the positioning control mode (where positioning is executed according to the positioning address).

Since there is only one positioning pattern (as shown below) two-phase positioning cannot be executed.

Use the start signal to set the positioning direction.

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

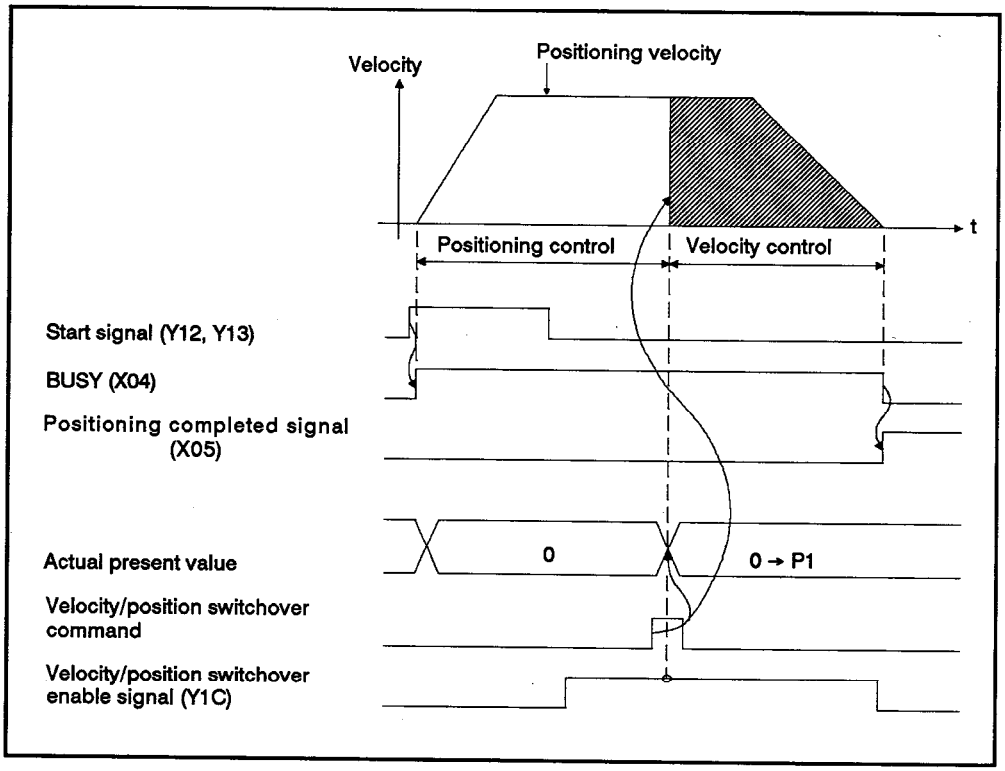


Fig. 5.18 V/P Control Switchover

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

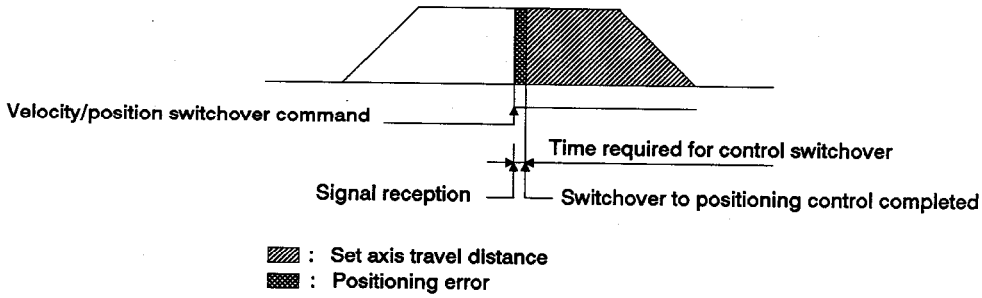
(3) If the velocity/position control switchover enable signal (Y1C) and the velocity switchover command are turned ON at the start of the operation, positioning is only executed in positioning control.

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(4) If the velocity switchover command and the velocity/position control switchover enable signal do not go ON, the operation continues in velocity control. To stop the operation, turn the stop signal ON.

(5) Positioning error in the 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 complete the switchover to positioning control. If pulses are output at this time, the distance equivalent to these pulses is regarded as a positioning error.



Assuming that the time required for the completion of control switchover is t μsec, a positioning error is calculated as follows:

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

Appendix 4 gives the time t required for control switchover.

(6) Since there is no dwell-time function in the AD70, set the timer from the user program. If a dwell is required, use the positioning completed signal (X05).

(7) Section 5.10 details stop processing and restarting 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 (see Section 5.9).

- Present value change
- Velocity change during positioning
- Error counter clear

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5.6.2 Parameter and positioning data settings

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

Table 5.9 Parameter and Positioning Data

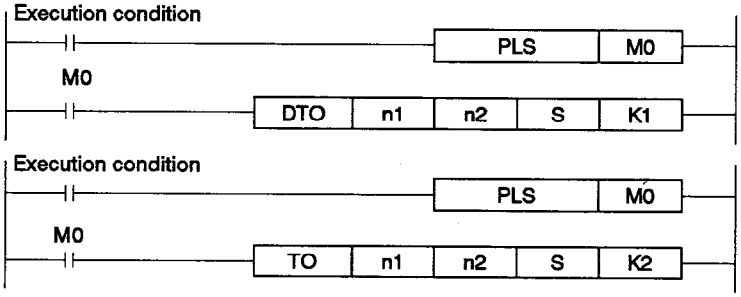
No.	Item	Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
1	Positioning mode	0 : Positioning 1 : Velocity/positioning	0	Setting enabled. However, since these parameters are controlled by the data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON (if they are written while the BUSY signal is ON).	When the positioning start signal (Y12, Y13) is turned ON
2	Positioning address [Axis travel distance at V/P control switchover mode]	-2147483648 to 2147483647 [0 to 2147483647 at V/P control switchover mode]	0		
3	Positioning velocity	1 to 400, 000 PLS/sec	0		

5.6.3 Buffer memory

Parameter and positioning data from the user program is stored in buffer memory as shown in Fig. 5.19.

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

Two-word data can be written as follows.



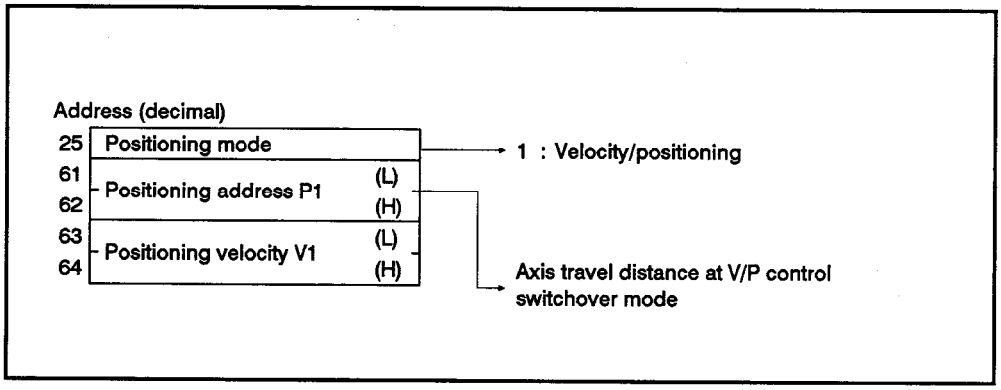


Fig. 5.19 Positioning Data Areas

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5.6.4 Sample V/P control switchover program

(1) Program flowchart (2) Start conditions

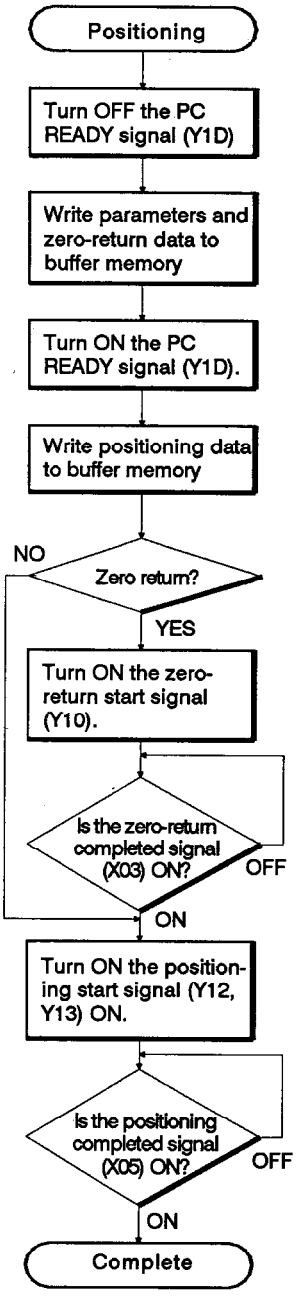


Table 5.10 Positioning Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo READY	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
Interface signal	X01	AD70 ready completed	ON	
	X04	BUSY	OFF	
	Y12, Y13	Positioning start	OFF	
	Y17	Stop signal	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

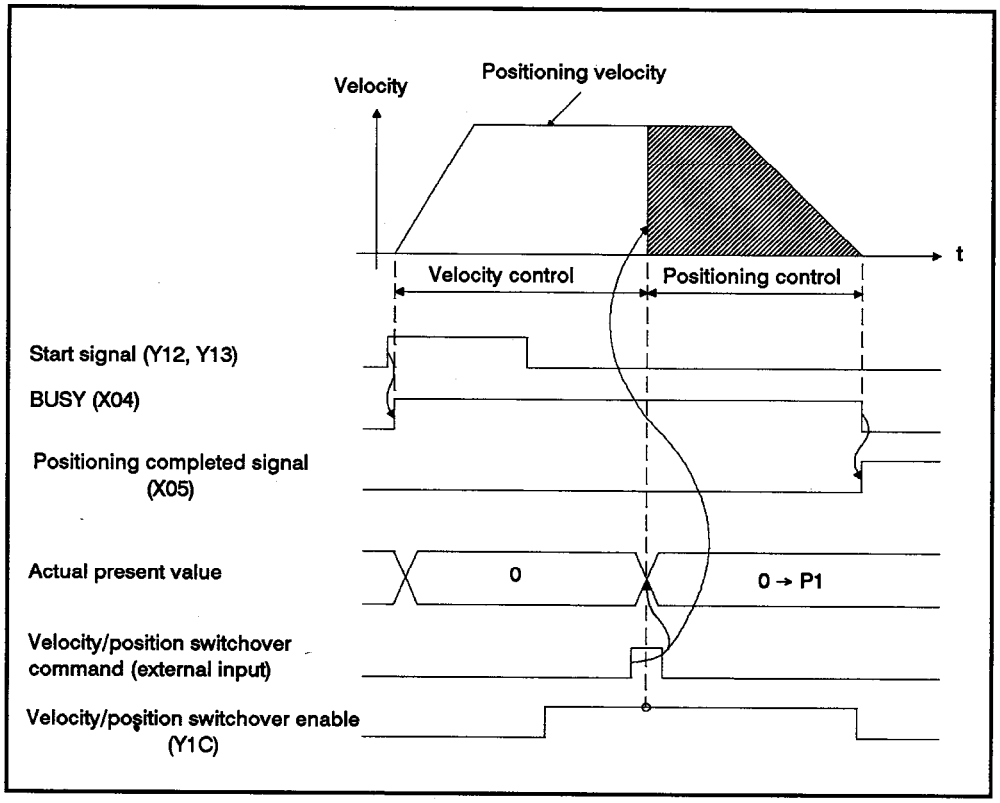


Fig. 5.20 V/P Control Switchover Timing

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(4) Sample V/P control switchover program

(Conditions)

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

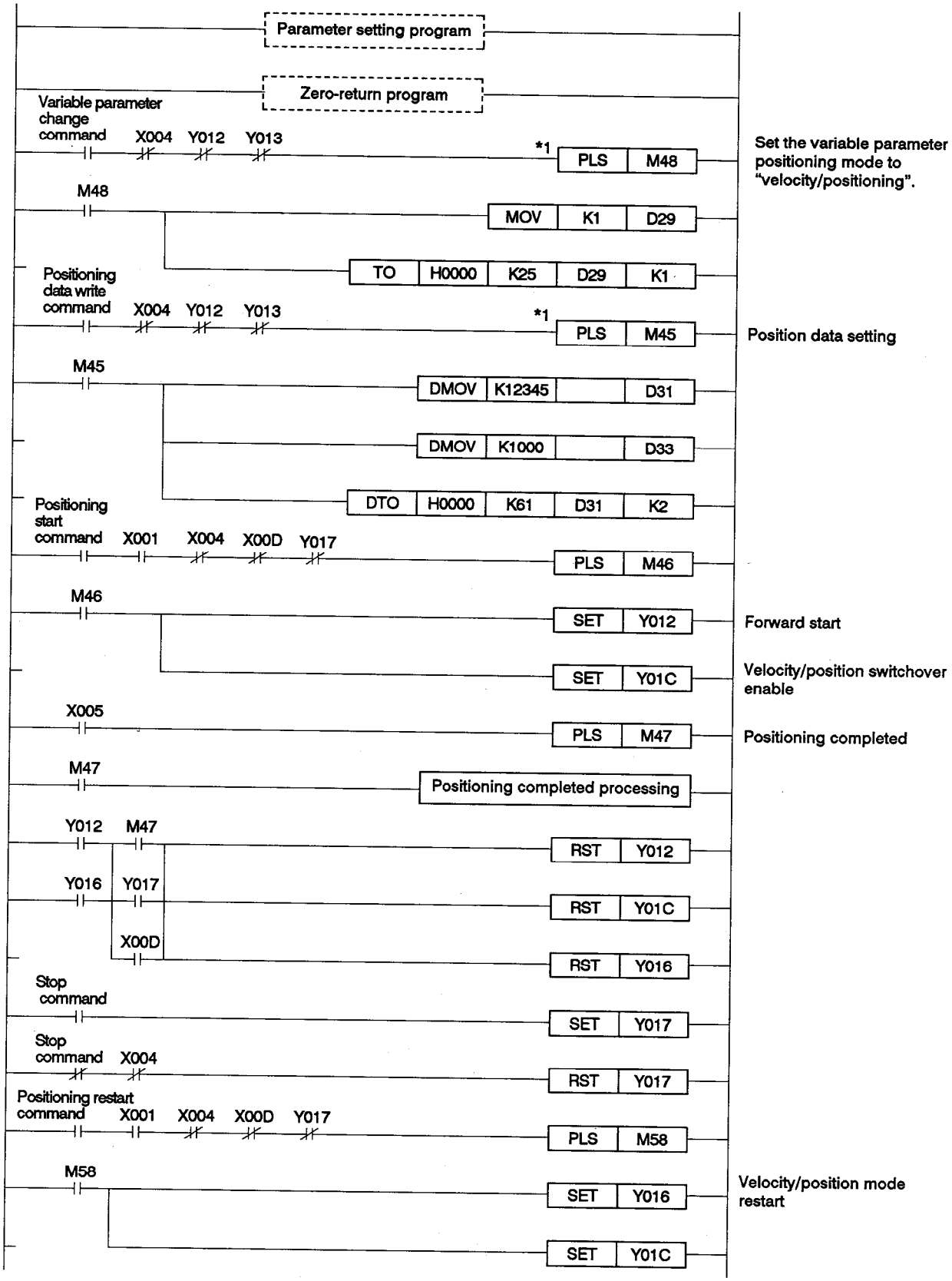
2) Parameters settings (Section 5.2.3 Program) zero return (Section 5.3.4 Program) are regarded as completed.

3) Start conditions are shown in Table 5.10.

4) The variable parameter and positioning data indicated below are set.

		Setting Value	Device Used	Buffer Memory Address
Variable parameter	Positioning mode	1	D29	25
Positioning data	Positioning address	12345 PLS	D31, D32	61, 62
	Positioning velocity	10000 PLS/sec	D33, D34	63, 64

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

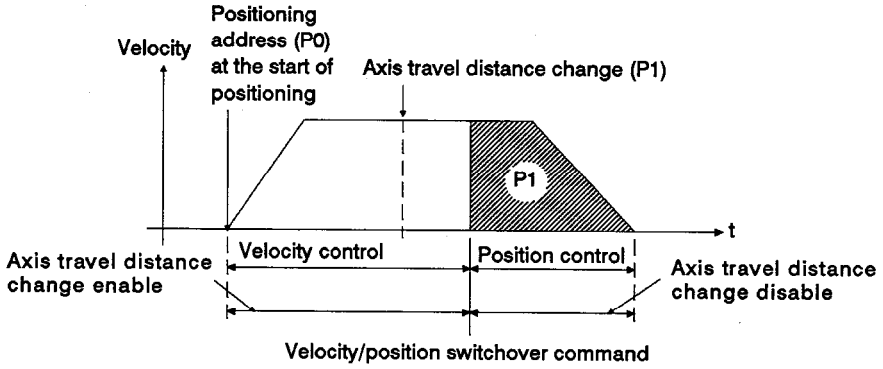
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5.6.5 Velocity/position axis travel distance change

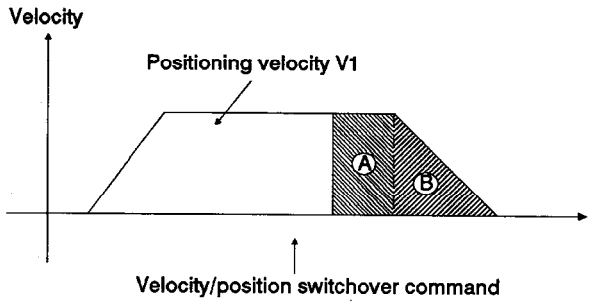
This mode is used to change the positioning address (axis travel distance) during operations in the V/P control switchover mode.

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 (88, 89)

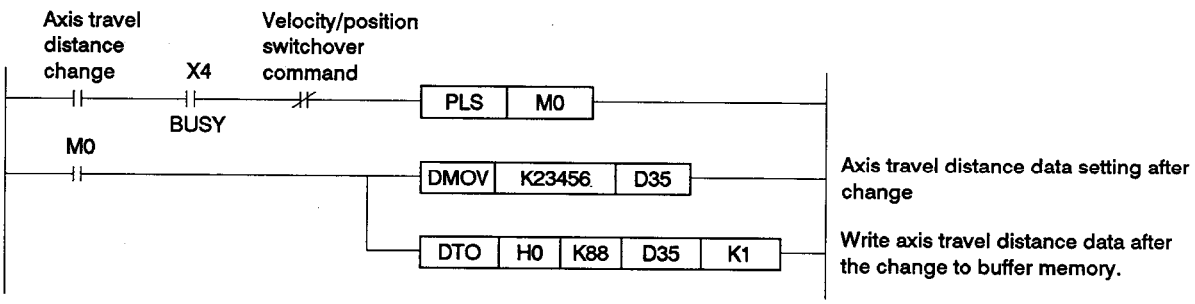


Set positioning address (axis travel distance) P1 so that it is greater than the distance shown below. If the set distance is less than the specified distance, the axis will exceed the required distance.



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

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



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An sample program which changes the axis travel distance during operations in the V/P control switchover mode is given below.

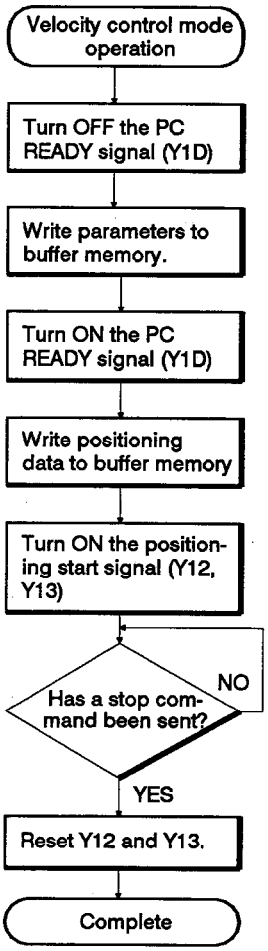
5.6.6 Sample velocity mode operation program

(1) Velocity mode operations 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 the velocity mode operation using the start signal from the PC CPU. Use the stop command to stop the operation. Use the start signal to specify forward and reverse positioning directions.

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

(4) Sample flowchart



(2) The present value during the operation in the velocity control mode is "0".

(3) Velocity mode operations can be done within the range between the upper and lower limit LSs.

(5) Start conditions

Table 5.12 Velocity Mode Operating Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo READY	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
Interface signal	X01	AD70 ready completed	ON	
	X04	BUSY	OFF	
	Y12, Y13	Positioning start	OFF	
	Y17	Stop signal	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.

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(6) Related Signal Timing

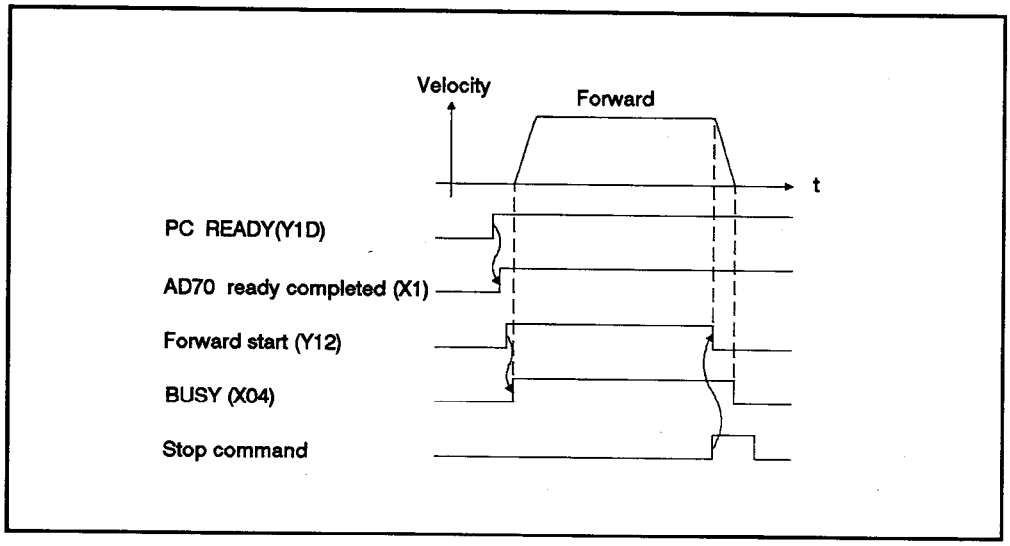


Fig. 5.21 Velocity Control Mode Operation

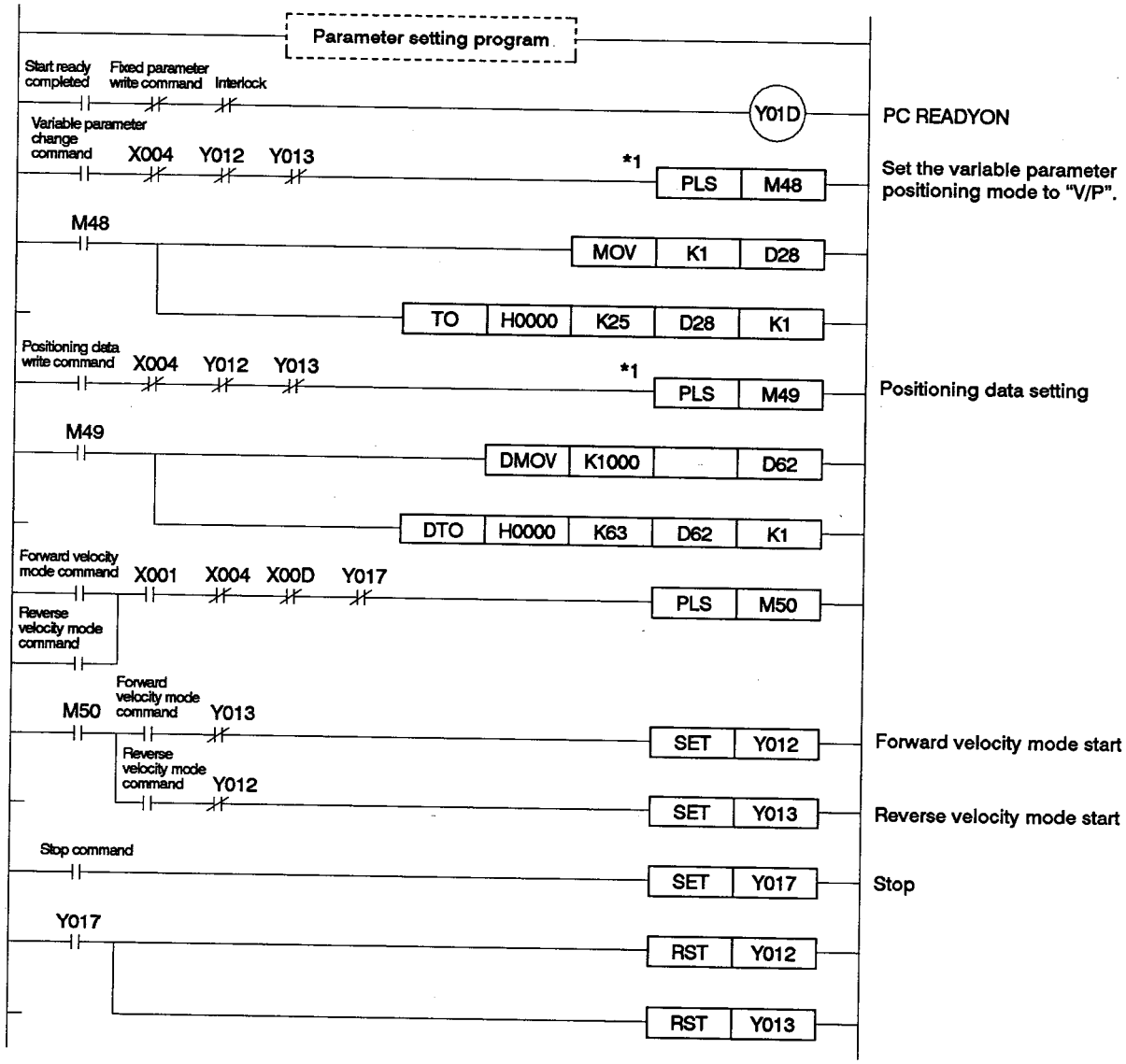
(7) Sample velocity mode operation program

(Conditions)

1) Use the start command to execute the velocity mode operation. Use the stop command to stop it.
2) Parameter settings (the Section 5.2.3 Program) are regarded as completed.
3) Table 5.16 gives the start conditions.
4) Turn ON the PC ready signal (Y1D) after write completion of fixed parameters.
5) Set the following data as variable parameters and positioning data:

		Setting Value	Device Used	Buffer Memory Address
Variable parameter	Positioning mode	1	D28	25
Positioning data	Positioning velocity	1000 PLS/sec	D62, D63	63, 64

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

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5.7 Incremental Feed

5.7.1 Positioning

(1) In the positioning programs in Sections 5.4 and 5.5, incremental feed control is executed by rewriting the present value using the restart command.

Use the start signal to execute incremental and absolute mode specifications (see Section 1.2).

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

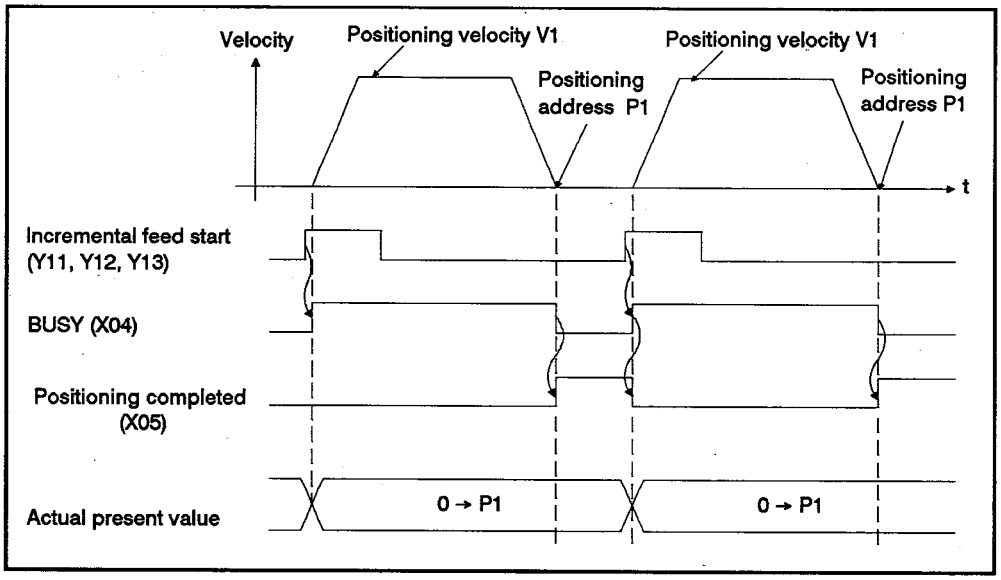


Fig. 5.22 Incremental Feed

(2) Section 5.10 discusses stop processing and restarting 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 (see Section 5.9).

- Present value change
- Velocity change during positioning
- Error counter clear

(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. If a dwell is required, use the positioning completed signal (X05).

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5.7.2 Positioning data settings

Positioning data settings are shown in Table 5.13 below.

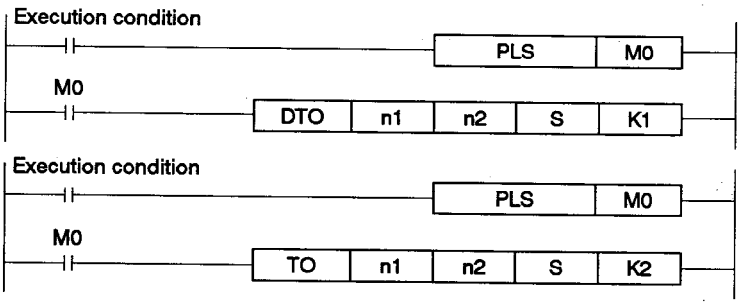
Table 5.13 Positioning Data

No.	Item	Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0 : 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 they are written while the BUSY signal is ON).	When the positioning start signal (Y11 to Y13) is turned ON
2	Positioning address [Axis travel distance in the incremental mode]	−2147483648 to 2147483647 [0 to 2147483647 PLS in the incremental mode]	0		
3	Positioning velocity	1 to 400, 000 PLS/sec	0		

5.7.3 Buffer memory

As shown in Fig. 5.23, positioning data and present value change data are stored in buffer memory with 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.



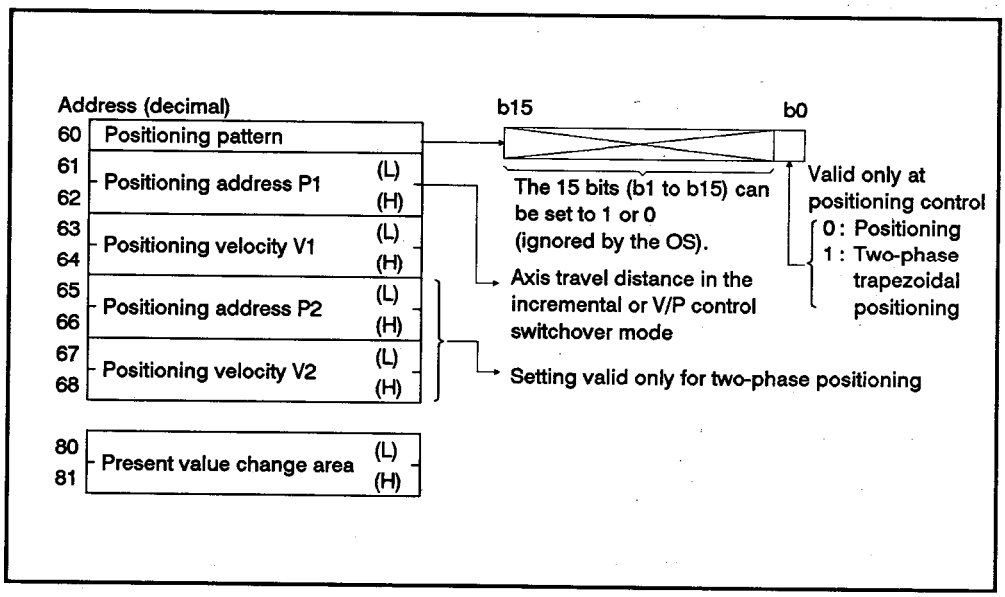


Fig 5.23 Positioning Data Present Value Change Area

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5.7.4 Incremental feed program

(1) Program flowchart (2) Start conditions

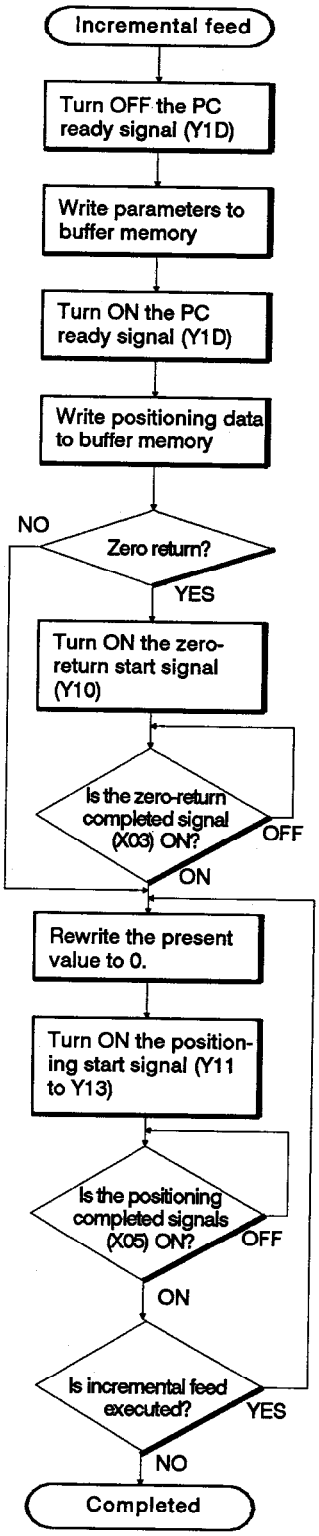


Table 5.14 Positioning Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo READY	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
Interface signal	X01	AD70 ready completed	ON	
	X04	BUSY	OFF	
	Y11 to Y13	Positioning start	OFF	
	Y17	Stop signal	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) Relevant Signals Timing

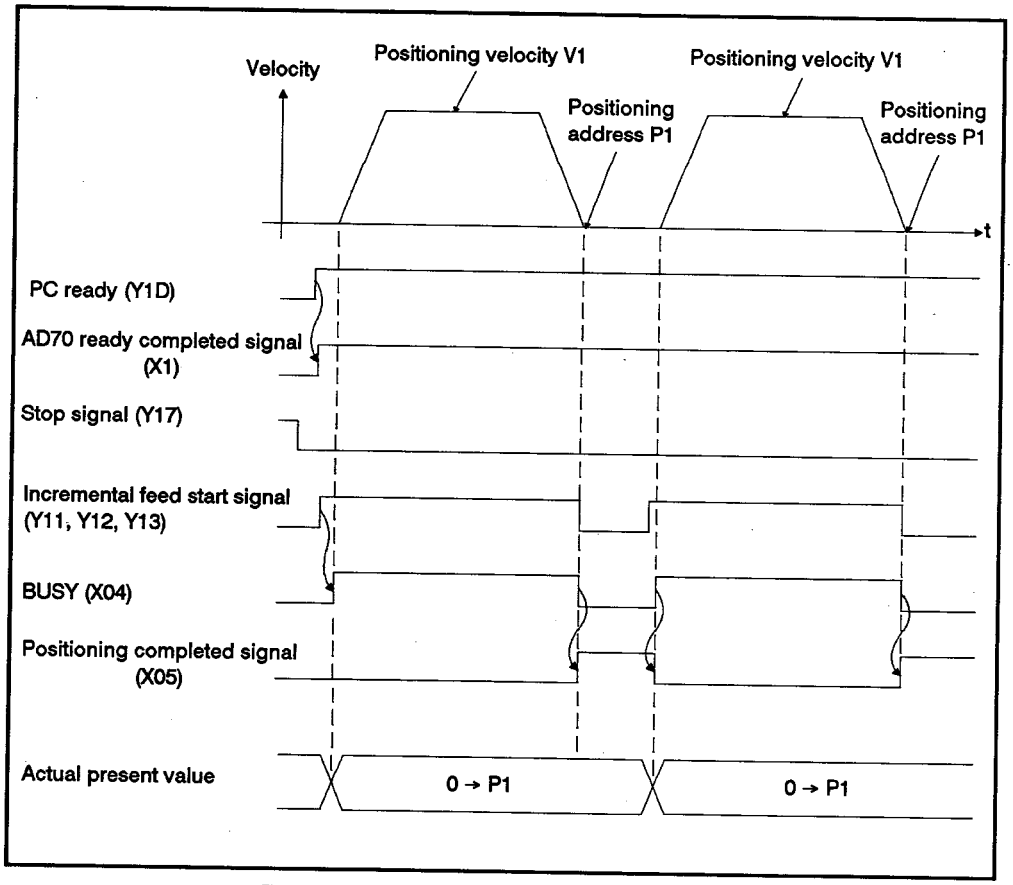


Fig. 5.24 Incremental Feed Timing

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(4) Sample positioning program

(Conditions)

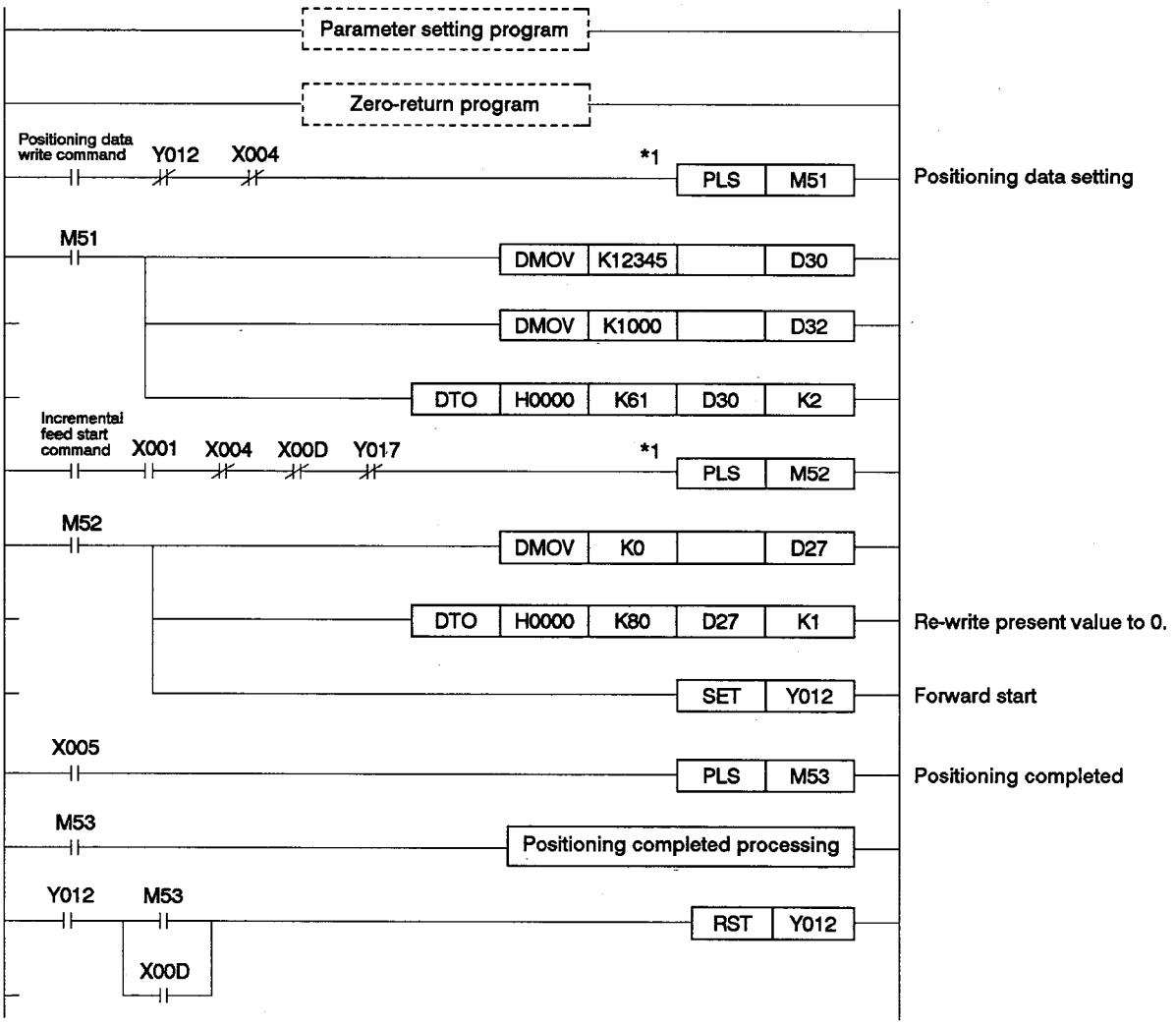
1) Using the incremental feed start command, execute incremental feed operation by restarting the incremental feed start command which executes positioning of the set axis travel distance at the set positioning velocity.

2) Parameters settings (Section 5.2.3 Program) zero return (Section 5.3.4 Program) are regarded as 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	12345 PLS	D30, D31	61, 62
Positioning velocity	1000 PLS/S	D32, D33	63, 64
Present value	0 PLS	D27, D28	80, 81



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

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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)

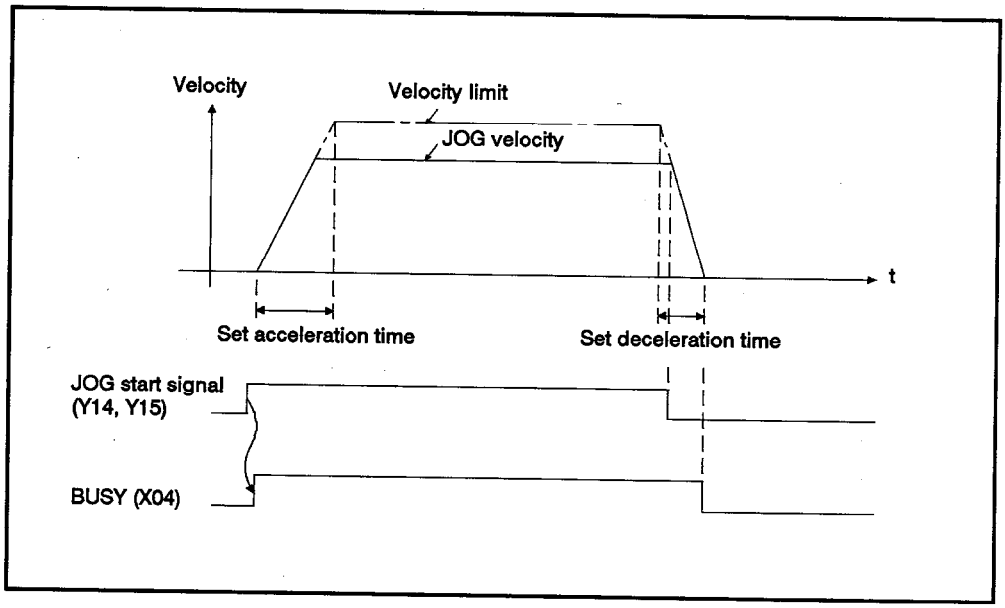


Fig. 5.25 JOG Operation

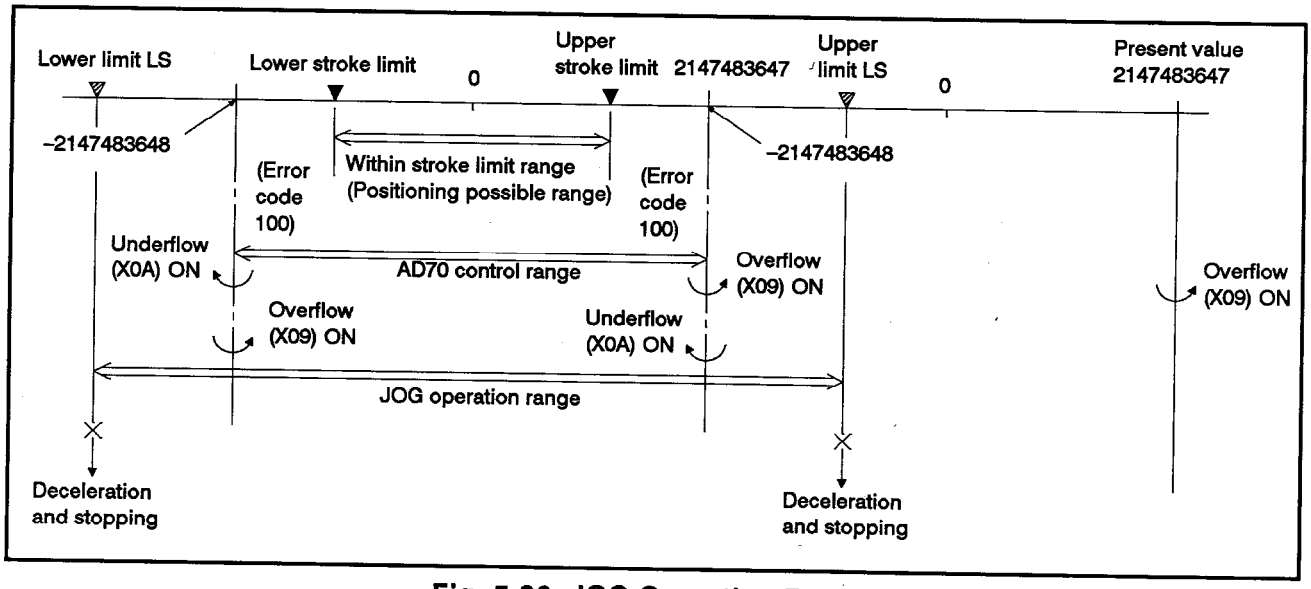


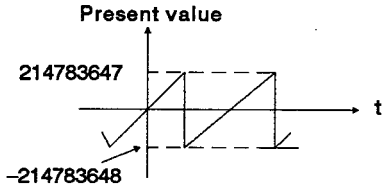
Fig. 5.26 JOG Operation Range

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(2) JOG operations 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 (a) the upper limit LS signal is turned OFF during a forward JOG operation, or (b) 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 AD70 control range (-2147483648 to 2147483647) during a JOG operation, either the overflow (X09) or the underflow (X0A) signal goes ON, and the present value changes as follows:



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

(5) If the stroke limit range is exceeded during a JOG operation, error code 100 will be set. If the upper or lower limit LS is turned OFF, error code 91/92 will be set.

(6) If the stroke limit range is exceeded, positioning start cannot be executed. Use the JOG operation to return to the stroke limit range.? Positioning start can be executed by returning to the stoke limit range. Use a zero-return operation or present value change to do so.

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

- Present value change
- Velocity change during positioning
- Error counter clear

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

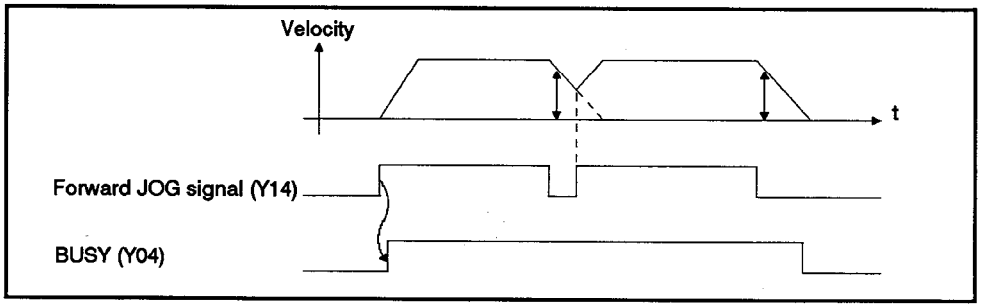


Fig. 5.27 Restarting During a JOG Operation Deceleration and Stopping (1)

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(9) If, after the JOG start has been turned OFF, the reverse JOG start is turned ON during deceleration and stopping, a reverse JOG start will be executed after deceleration is completed.

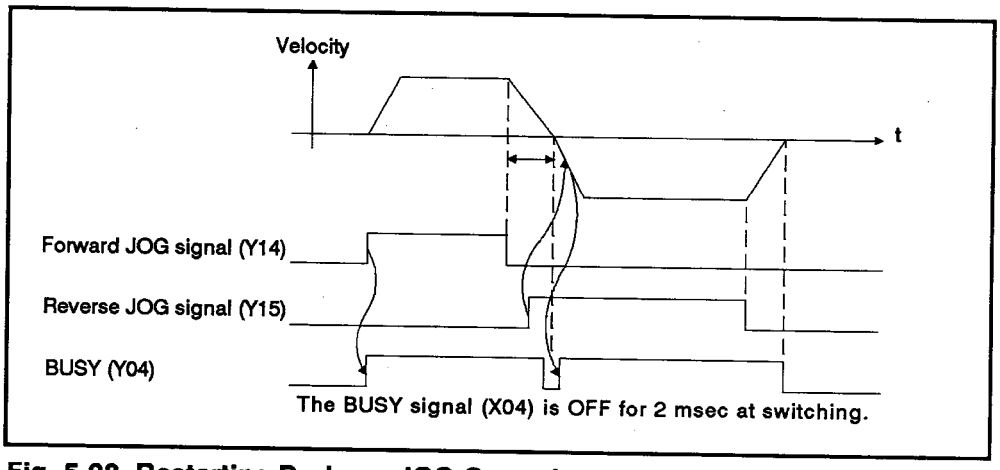


Fig. 5.28 Restarting During a JOG Operation Deceleration and Stopping (2)

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

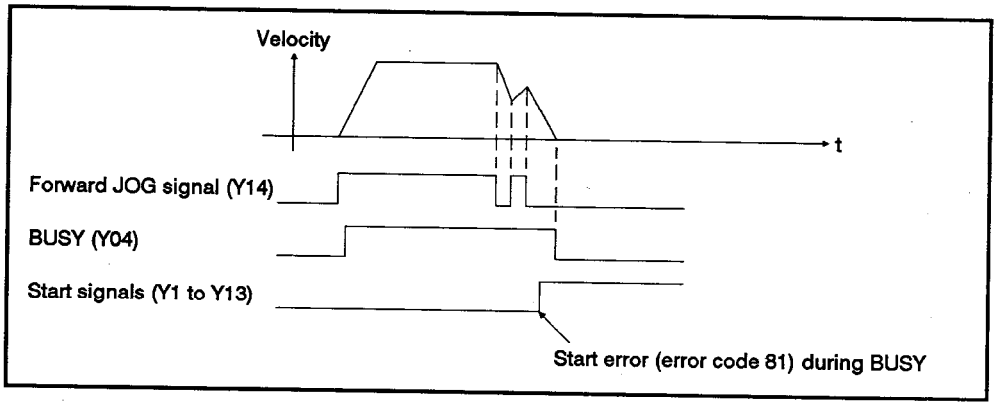


Fig. 5.29 Zero Return/Positioning Restart During Deceleration and Stopping After a JOG Operation

(11) If the forward or reverse JOG start is turned ON during a forward or reverse operation, an error will occur (error code 81) and the intended JOG operation will not be executed.

(12) If forward and reverse JOG starts are turned ON simultaneously, an error will occur (error code 81) and a forward JOG operation will be executed.

(13) A velocity mode operation is possible even if the JOG operation function is being used. Since the present value is monitored during a velocity mode operation, error code 100 will be set if the stroke limit range is exceeded.

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5.8.2 Jog data settings

In order to execute a JOG operation, variable parameter velocity limits, acceleration and deceleration times, and JOG velocities must be set and stored in buffer memory.

Section 5.2 discusses variable parameter settings.

JOG data is shown in the following table.

Table 5.15 JOG Data

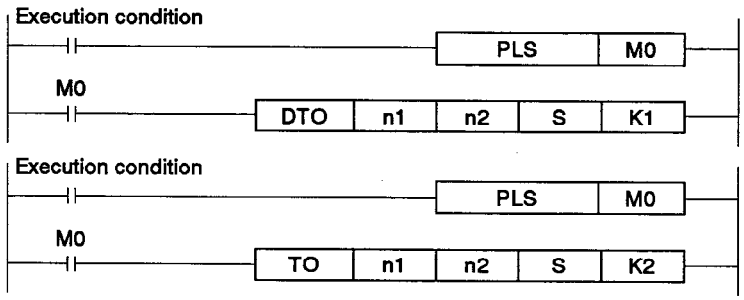
Item	Setting range	Default Value	Setting Enable Conditions	Set Data Check Timing
JOG velocity	1 to 400.000 PLS/s	—	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON (if they are written while the BUSY signal is ON).	When the JOG start signal (Y14 or Y15) is turned ON

5.8.3 Buffer memory

As shown in Fig. 5.30, parameters and JOG data are stored in buffer memory from the user program.

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

Two-word data can be written as follows:



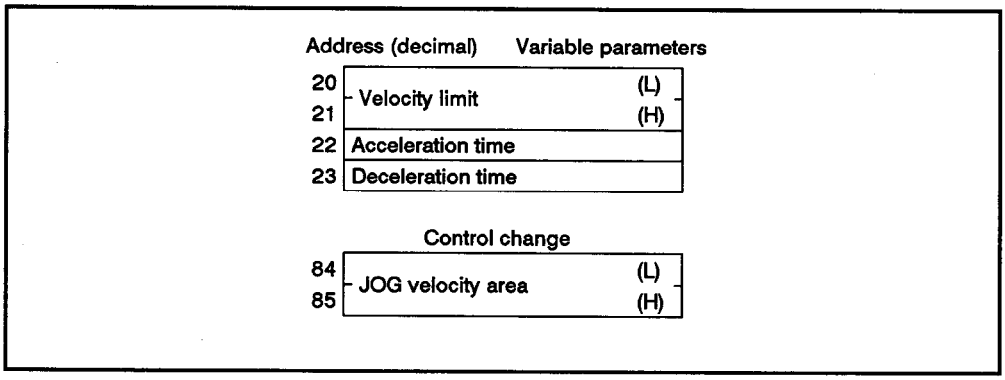


Fig. 5.30 Jog Data Area

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5.8.4 Sample jog operation program

(1) Sample flowchart (2) Start conditions

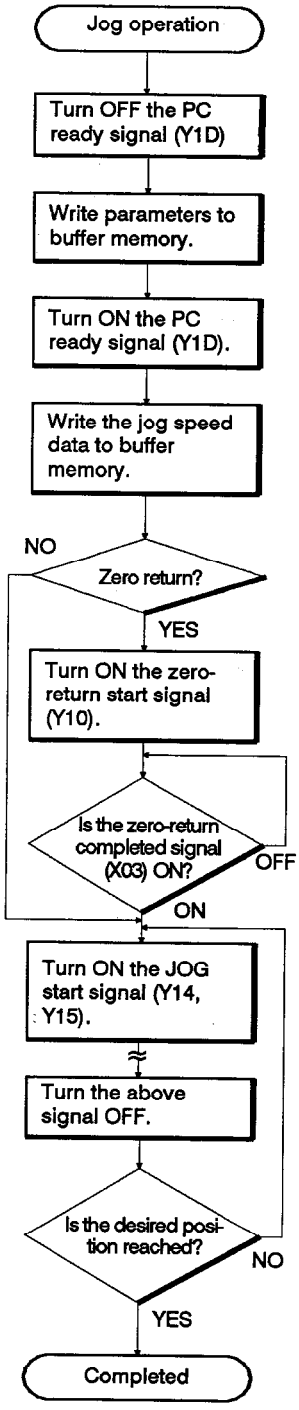


Table 5.16 Jog Operation Start Conditions

	Check Item		Condition	Remarks
External signal	READY	Servo READY	ON	
	STOP	Stop signal	OFF	
	FLS	Upper limit LS	ON	
	RLS	Lower limit LS	ON	
Interface signal	X01	AD70 ready completed	ON	
	X04	BUSY	OFF	
	Y17	Stop signal	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) Timing of relevant signals

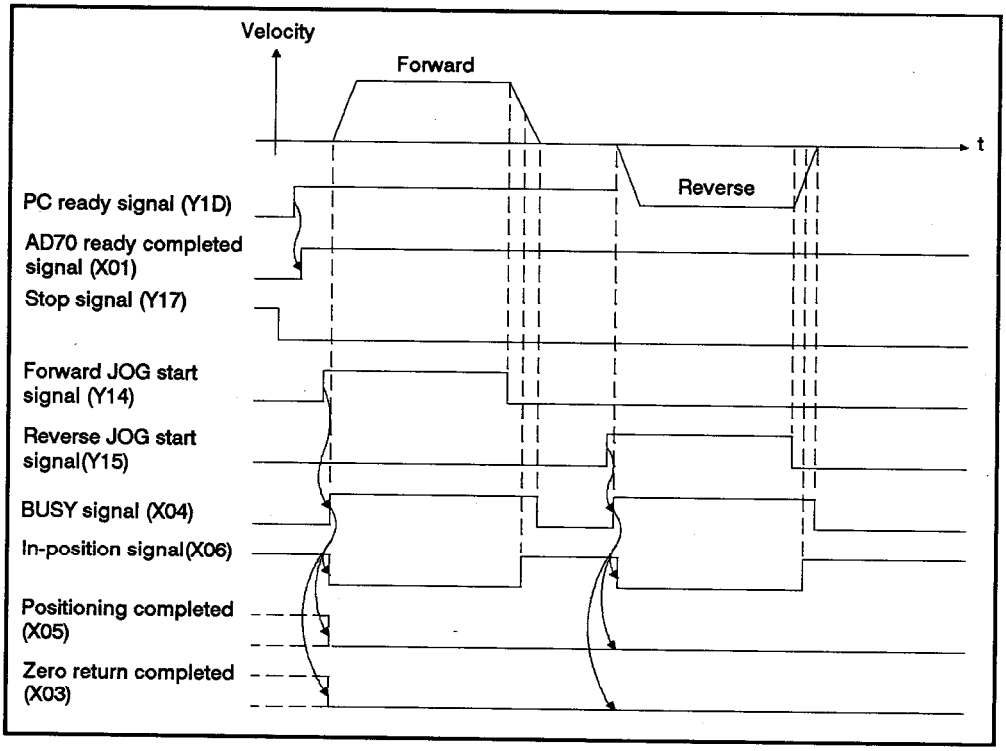


Fig. 5.31 JOG Operation Timing

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(4) Sample JOG operation program

(Conditions)

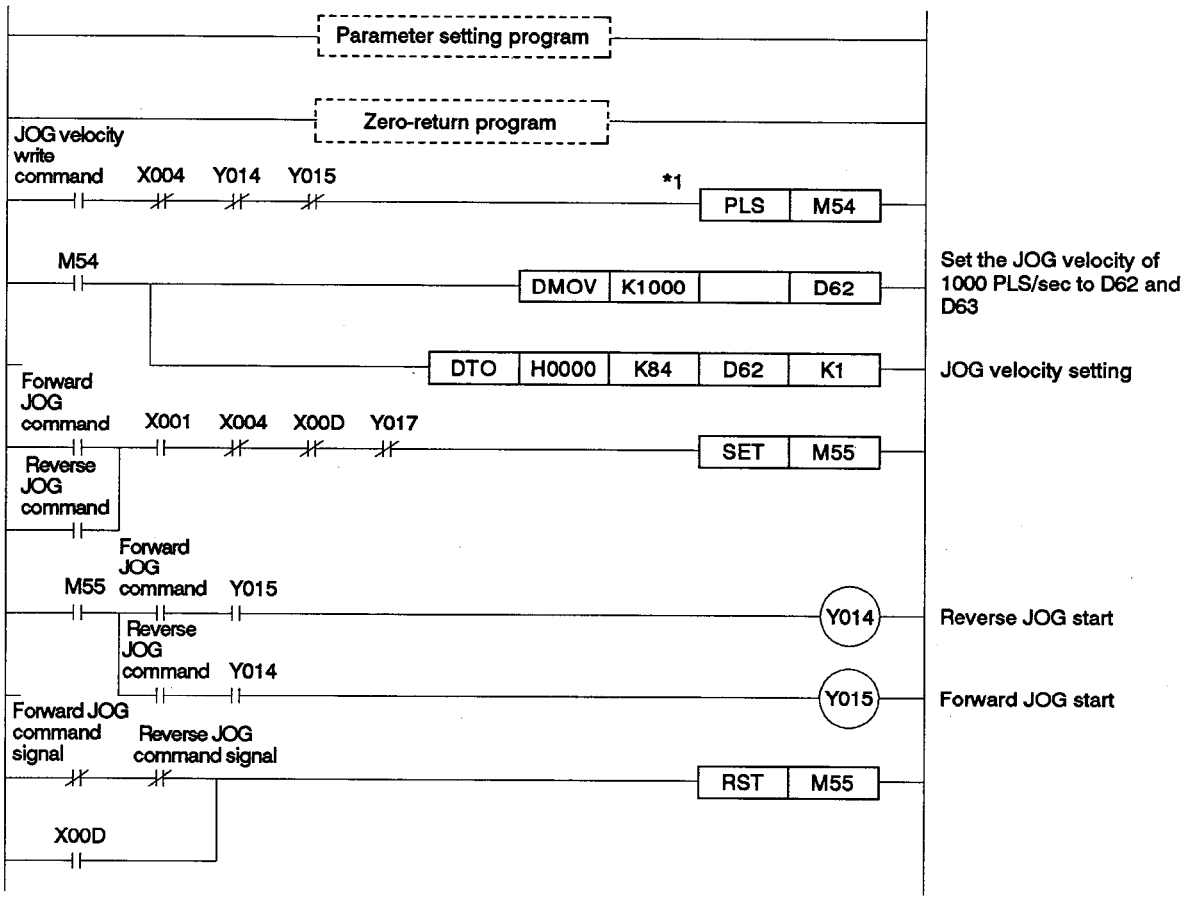
1) JOG operation can be executed while the JOG start command signal is ON.

2) Parameter settings (the Section 5.2.3 Program) are regarded as completed.

3) Table 5.16 gives start conditions.

4) Set the following data as JOG velocity data:

	Setting Value	Device Used	Buffer Memory
JOG velocity	1000 PLS/S	D62, D63	84, 85



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

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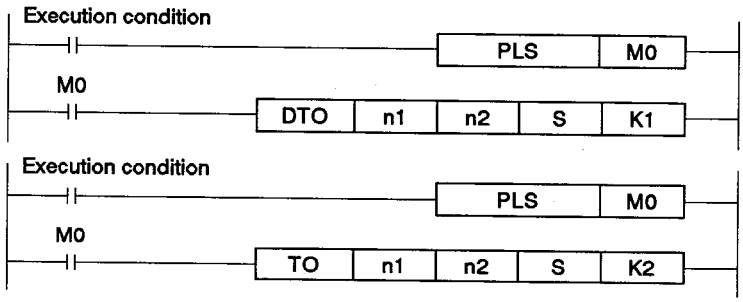
5.9 Control Changes

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

As shown in Fig. 5.3.2, control change data is stored in buffer memory from the user program.

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

Two-word data can be written as follows:



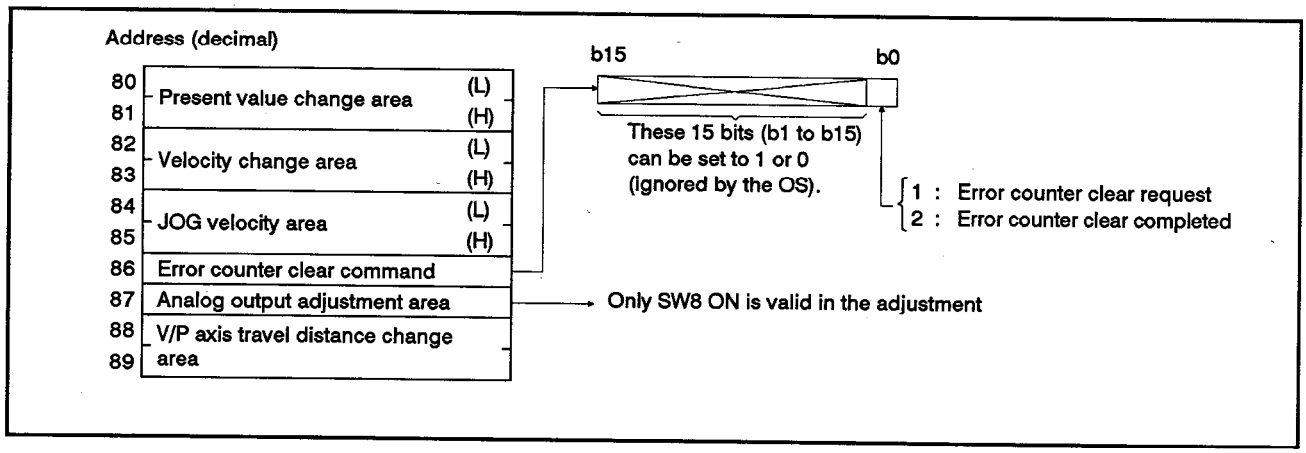
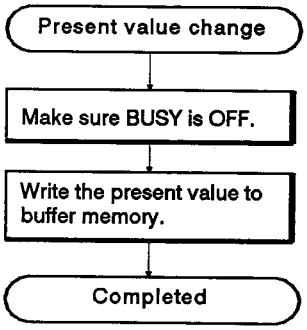


Fig. 5.32 Control Change Area

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5.9.1 Present value changes

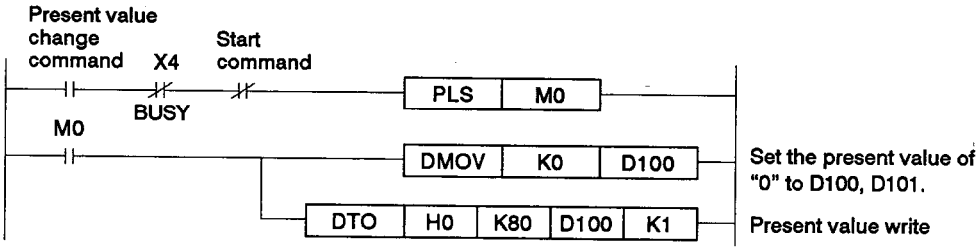


Change the present value when (a) the AD70 present value data is to be changed, (b) the present value is outside the stroke range, or (c) a start error occurs.

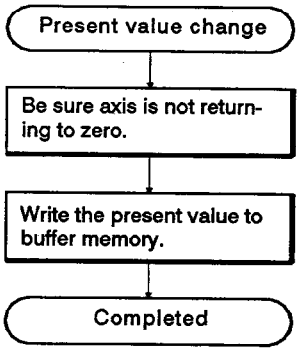
Table 5.17 Present Value Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Present value change	Lower stroke limit to upper stroke limit	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 changes

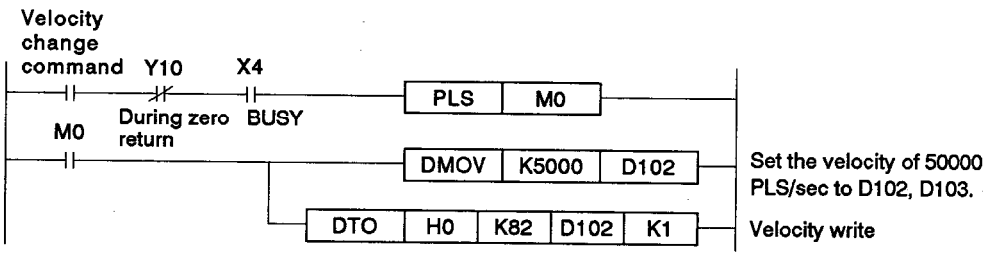


The velocity can be changed by force during positioning or a JOG operation.

Table 5.18 Velocity Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Velocity change	1 to velocity limit PLS/sec (Max. 400,000 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 signal (Y17, STOP) After JOG signal turns OFF during JOG During zero return	Velocity change area (82,83)

A Sample program to change velocity is shown below.



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5.9.3 Error counter clear

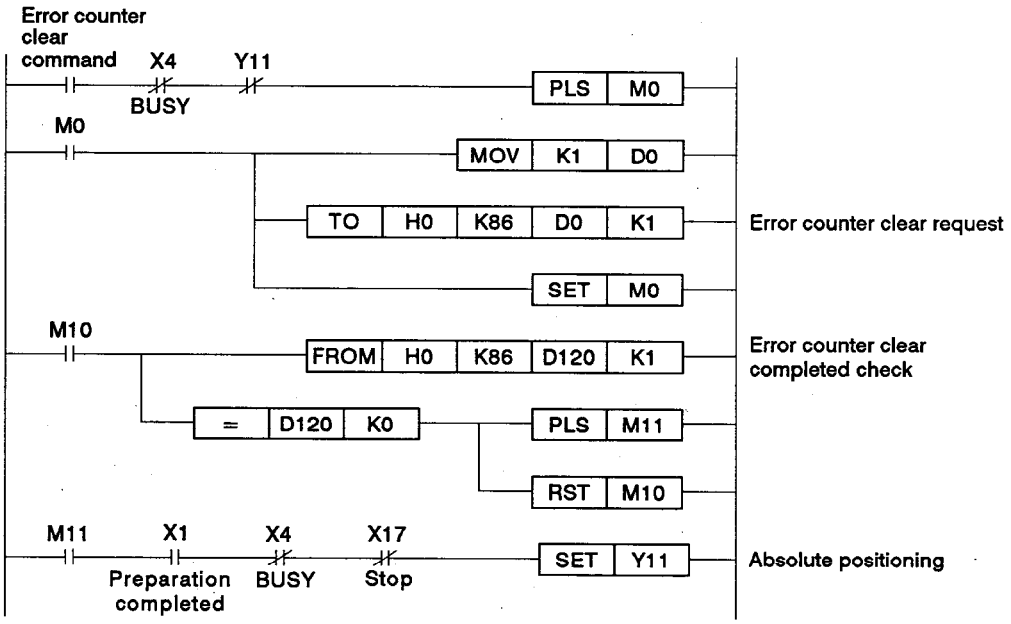
This function clears feedback pulses that were manually inputted from the encoder and restarts the positioning.

Table 5.19 Error Counter Clear Command

Item	Setting Range	Execution Enable Conditions	Buffer memory
Error Counter Clear	1	Disabled during BUSY	Error Counter Clear Command (86)

If positioning is restarted after executing an error counter clear command, confirm that buffer memory is "0" and no error has occurred.

A sample program to restart positioning after executing an error counter clear command is shown below.



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5.10 Stop Processing During Positioning and Restarting After a Stop

5.10.1 Stop processing during positioning

The following table shows (a) factors which stop processing during BUSY, and (b) stop processing.

Table 5.20 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, except for 4) and 7).
2	Stop signal (Y17) is turned ON.			
3	PC ready signal (Y1D) is turned OFF.	ON	Error code reset	
4	Servo ready signal (X0B) is turned OFF.			
5	Upper limit LS (FLS) is turned OFF.			
6	Lower limit LS (RLS) is turned OFF.			
7	PC power supply is turned OFF.	—	—	

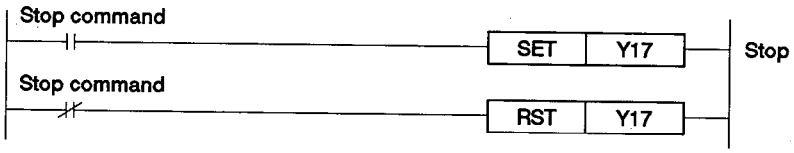
POINT

Hardware emergency stop circuits into the system.

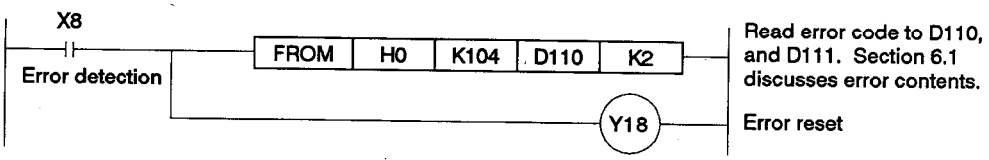
5.10.2 Program for stopping during positioning

Table 5.20 shows the factors (other than stop signals) which stop processing during BUSY. If an error occurs, read the error code and restart after error processing.

Sample stop program



Sample error reset program



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5.10.3 Stop during positioning/JOG operation

(1) Stop before deceleration begins during a positioning or JOG operation

During positioning or a JOG operation, if a stop factor occurs before the deceleration begins, the axis decelerates from that point. The deceleration velocity depends on the parameter's deceleration time and velocity limit.

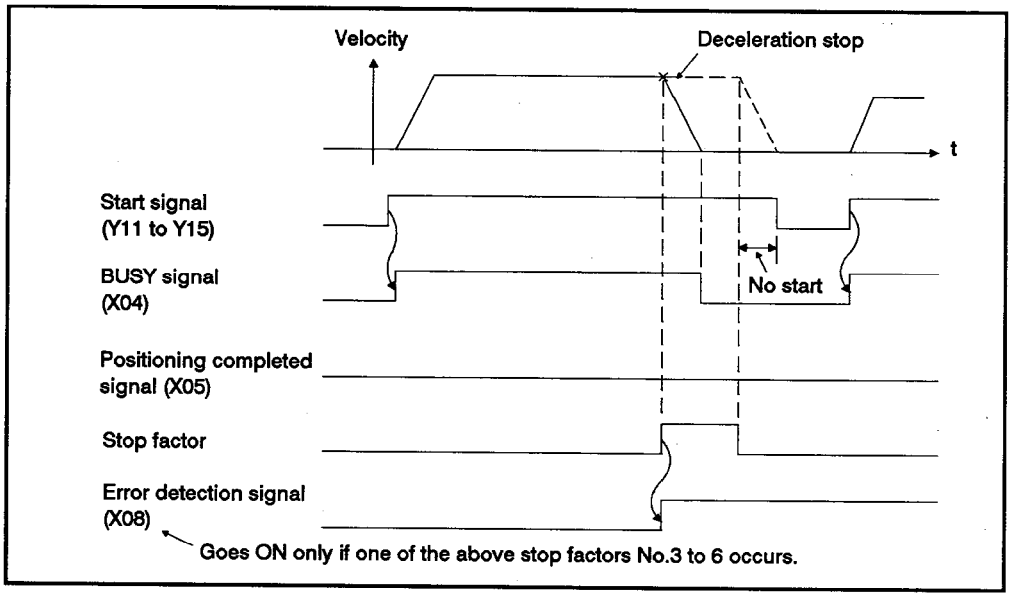


Fig. 5.33 Positioning During a Stop

(2) Stop during a positioning/JOG BUSY deceleration

If a stop factor occurs during deceleration, a deceleration stop is executed, and the positioning is completed.

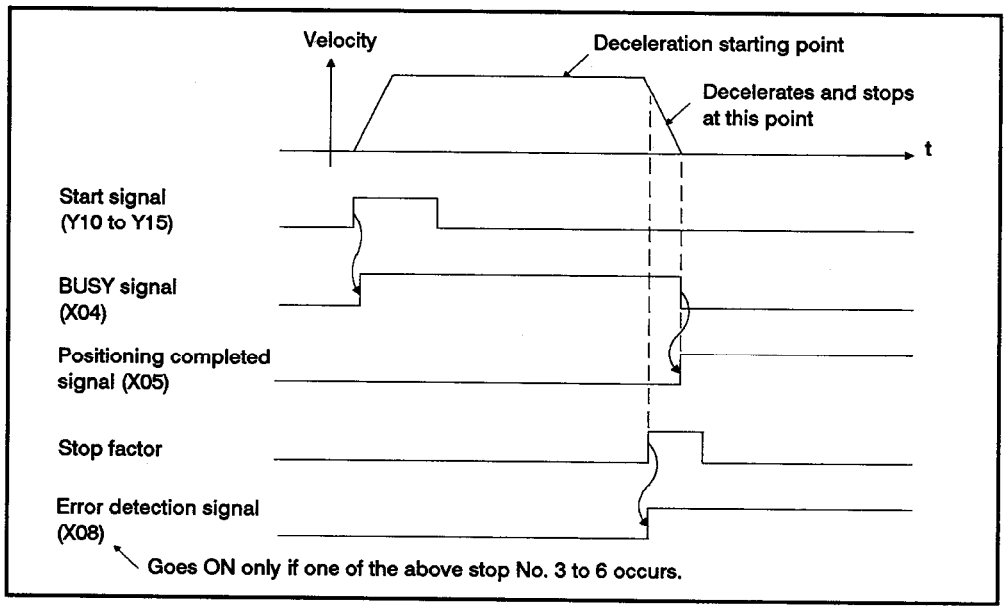


Fig. 5.34 Positioning Deceleration During a Stop

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(3) Stop during JOG BUSY by using upper-limit LS or lower-limit LS

If the upper-limit or lower-limit LS is detected, the axis subsequently decelerates and stops. When setting the upper-limit or lower-limit LS, make sure to allow for the distance needed to decelerate.

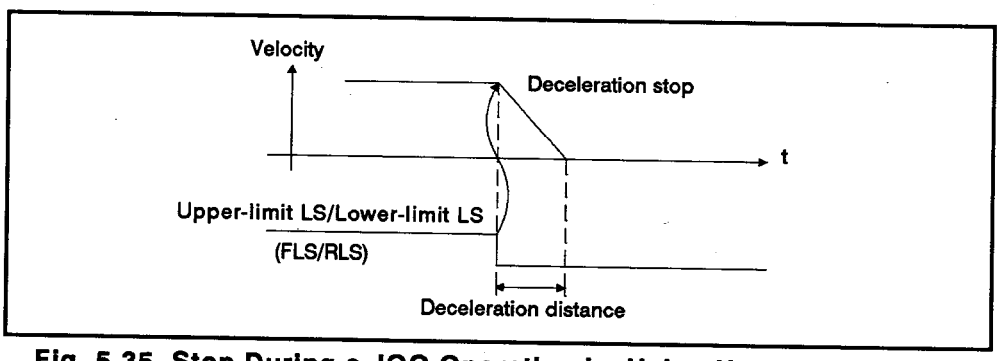


Fig. 5.35 Stop During a JOG Operation by Using Upper-Limit LS or Lower-Limit LS

5.10.4 Restarting after stopping during positioning

After an axis has been stopped during positioning or a JOG operation, it can be restarted by the restart signal if the conditions necessary for restarting have been established.

If positioning is continued in the V/P control switchover mode, use the V/P mode restart signal (Y16) to restart.

The positioning status conditions for restarting after stopping are as follows:

Table 5.21 Conditions for Restarting After Stopping

Positioning Mode	Operating Conditions After Restarting
Absolute positioning	Positioning continues
Incremental positioning	New positioning
V/P	New Positioning Positioning continues if restarted by the V/P mode restart signal (Y16).

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5.10.5 Restarting after stopping in the velocity/positioning switchover mode

If positioning is continued by restarting after a stop during the operation, use the velocity positioning mode restart signal (Y16). If the Y12 or Y13 signal is used, it is considered a new positioning.

The timing chart used when the positioning is restarted by the restart signal is shown below:

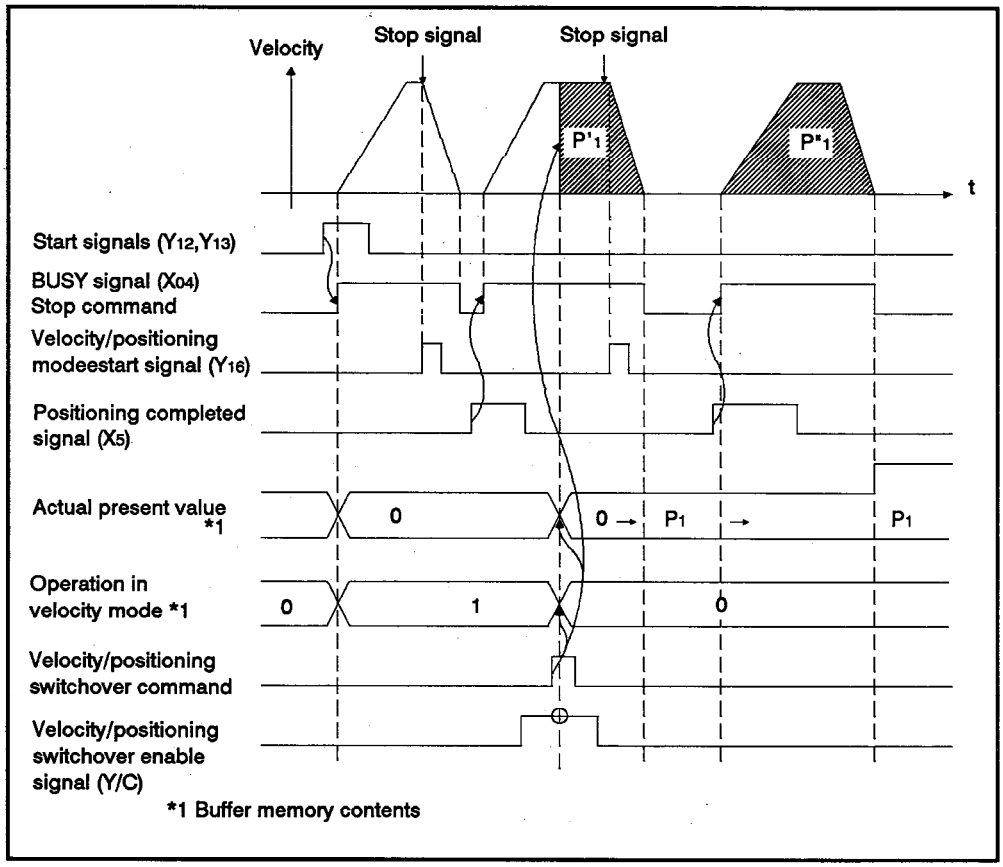


Fig. 5.36 Restarting After Stopping in the Velocity/Positioning Switchover Mode

When the velocity is changed during positioning, a stop signal is input. Restarting after the stop operates the axis at the rate previously set in the positioning data in the positioning mode.

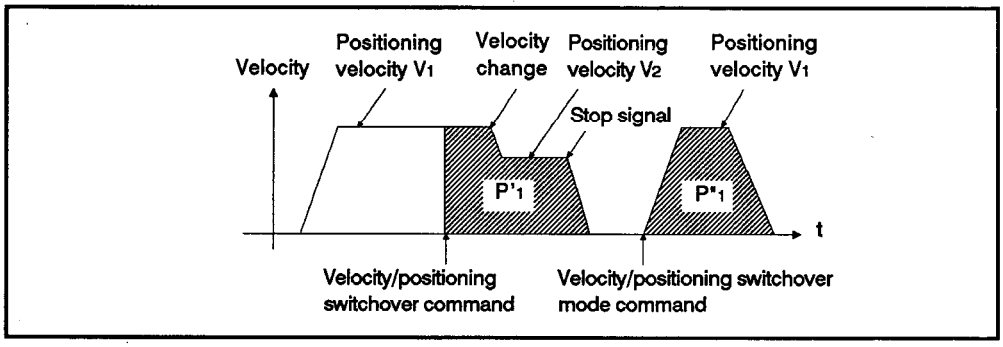


Fig. 5.37 Restarting After a Velocity Change in the Velocity/Positioning Switchover Mode

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5.11 Monitoring Buffer Memory

Data (such as AD70 operation status data) is stored in the buffer memory monitor area as shown below. Read this data from the sequence program and use as required.

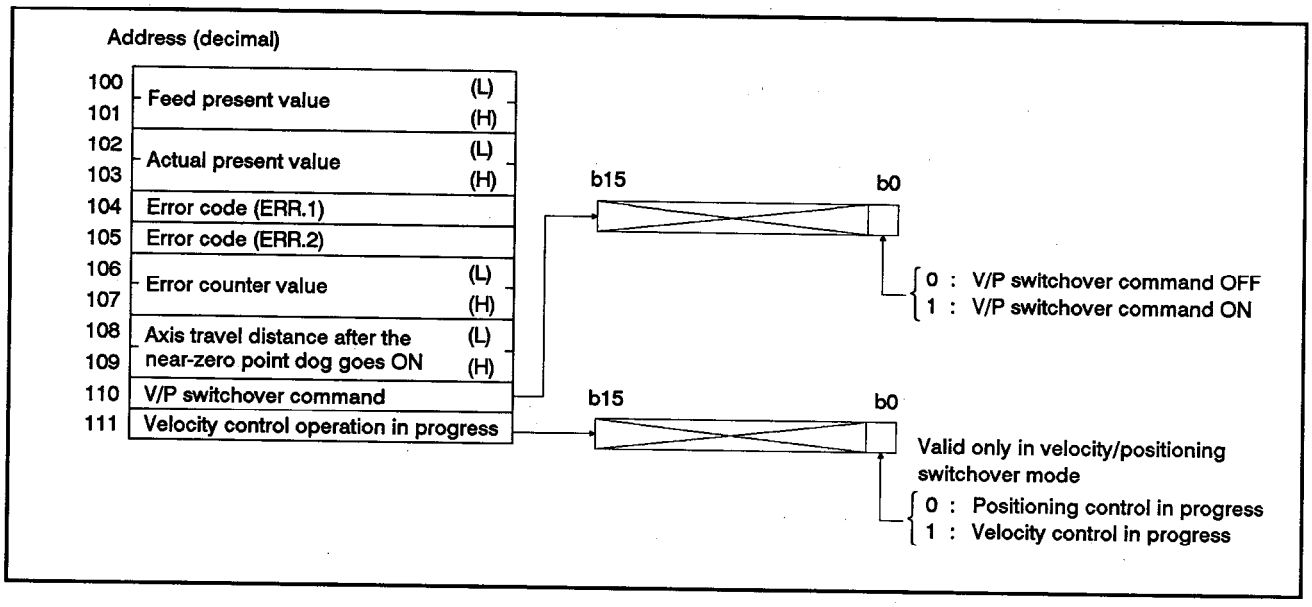


Fig. 5.38 Monitoring Buffer Memory

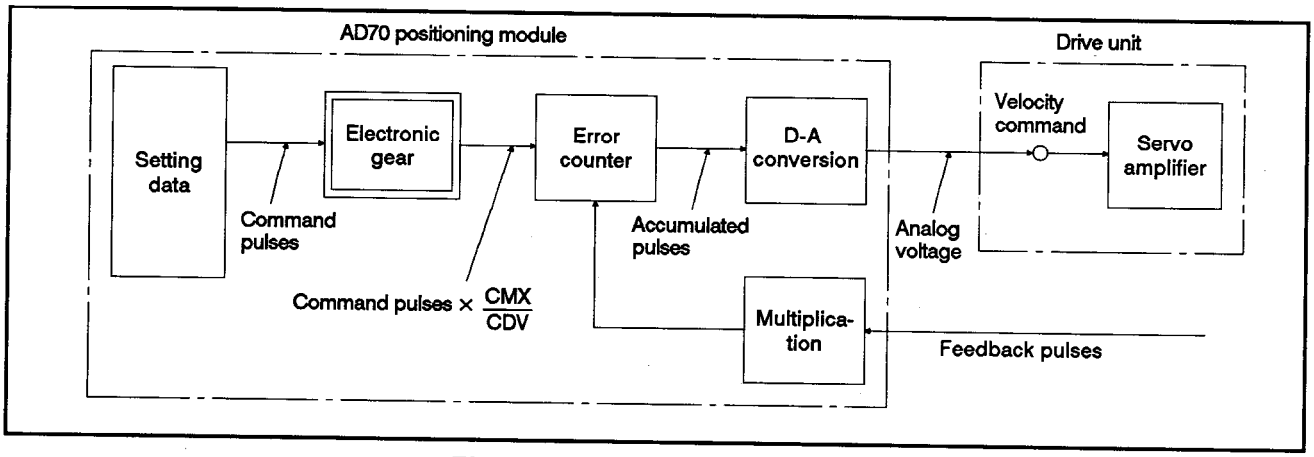


Fig. 5.39 Positioning Control

The contents of the data in each area are shown below:

(1) Feed present value

The AD70 feed present value (command pulses), which is calculated with the command value, is stored.

(2) Actual present value

The actual servo axis travel distance (number of feedback pulses) calculated with feedback pulses is stored.

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(3) Error code (ERR.1)

If an ERR.1 error occurs in an AD70, this error code is stored.

The error code of ERR.1 error (such as a data error or starting during BUSY) which can be corrected from the sequence program is stored. Section 6.1 gives details.

(4) Error code (ERR.2)

If an ERR.2 error occurs in an AD70, this error code is stored.

The error code of an ERR.2 error (such as stopping at or during starting) is stored. Section 6.1. gives details.

(5) Error counter value

An error counter value is the difference between the AD70 command pulses × CMX/CDV and feedback pulses. This value is stored as an error counter value.

(6) Axis travel distance after near-zero point dog goes ON

After a zero-return start, the axis travel distance (from the time the signal triggered by a near-zero point dog is turned ON to the completion of zero return) is counted and stored. (Both in the near-zero point dog mode and the count mode)

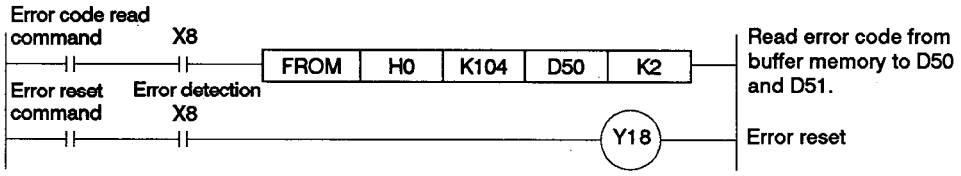
(7) V/P switchover command

The ON/OFF status of the V/P switchover command input is stored.

(8) Velocity control operation in progress

The control mode at V/P switchover mode is stored.

(9) Sample error code read program



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5.12 Remote I/O Station Programming

5.12.1 Notes on programming

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

Therefore, pay close attention to the following items when an AD70 is used in a remote I/O station. (The MELSECNET (II) Data Link System Reference Manual gives details on data link specifications.)

(1) There is a short time delay when control data is communicated between the master station and an AD70 in a remote I/O station. When determining timing, this delay must be taken into account.

(2) The following data communications instructions are used between master and remote stations:

Data write from a master station to an AD70 : RTOP instruction

Data read from an AD70 to a master : RFRP instruction

Note that link register W are used for data communications between the master station and an AD70 in a remote station.

Therefore, a program should be written to (a) transmit the data in the link register to another device after the execution of the RFRP instruction, or (b) transmit the data to be transmitted to the link register before the execution of the RTOP instruction.

(3) RTOP and RFRP instructions cannot be executed in the same scan to a single AD70 in a remote station. (However, they may be used in the same scan if addressed to separate AD70 modules.)

(4) Control signals between master and remote stations

- The PLS instruction must not be used for control I/O communications.
- Because data communications between a master station and remote I/O stations is made in the 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

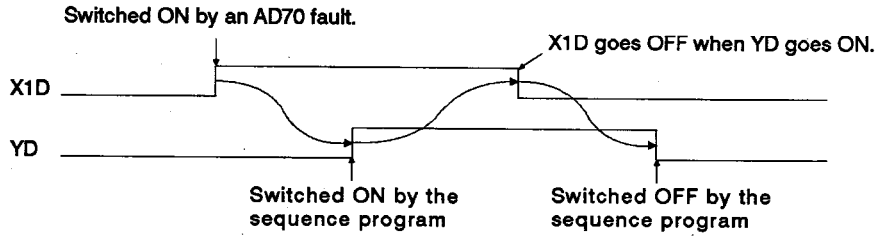
When an AD70 is used in a remote station, control timing will make programming complicated. Therefore, an AD70 should be installed in a master or local station.

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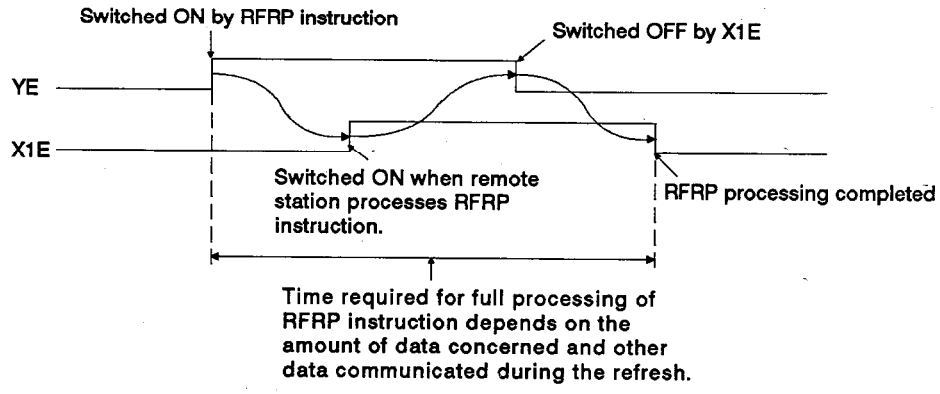
Table 5.22 I/O Signals

Signal Direction : PC CPU to an AD70		Signal Direction : AD70 to a PC CPU	
Device No.	**Signal**	**Device No.**	**Signal**
Y0 to YC	Reserved	X10 to X1C	Reserved
YD	Switches X1D OFF.	X1D	Goes ON when RFRP and RTOP instructions cannot be used because of a faulty AD70.
YE	Switched ON by a master station CPU when an RFRP instruction is executed (data transferred from a link module to a master station CPU). To be reset in the user program after making sure that X1E is ON.	X1E	ON while the AD70 in a remote station is processing an RFRP instruction.
YF	Switched ON by a master station CPU when an RTOP instruction is executed (data transferred from a master station CPU to a link module). To be reset in the user program after making sure that X1F is ON.	X1F	ON while the AD70 in a remote station is processing an RTOP instruction.

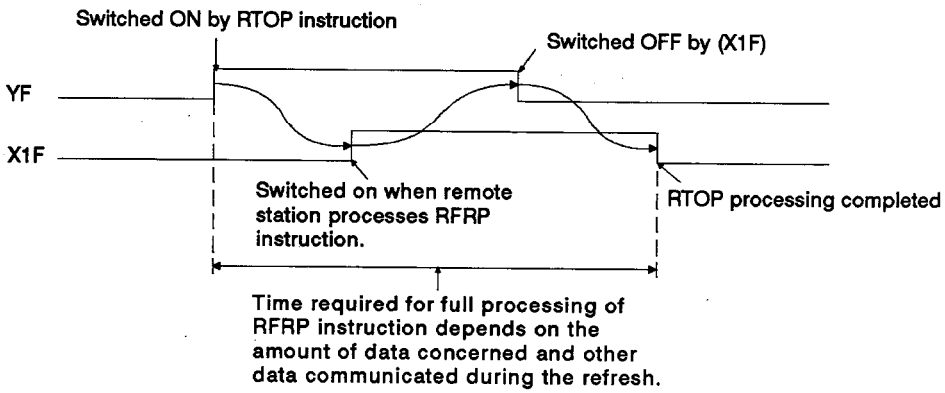
Timing
AD70 fault. RTOP and RFRP instructions cannot be used.



Execution of RFRP instruction



Execution of RTOP instruction

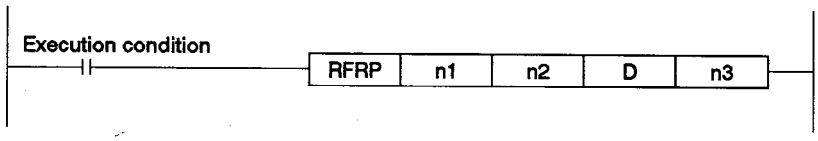


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5.12.2 Reading and writing data

(1) Reading from a remote I/O station AD70

[Format]



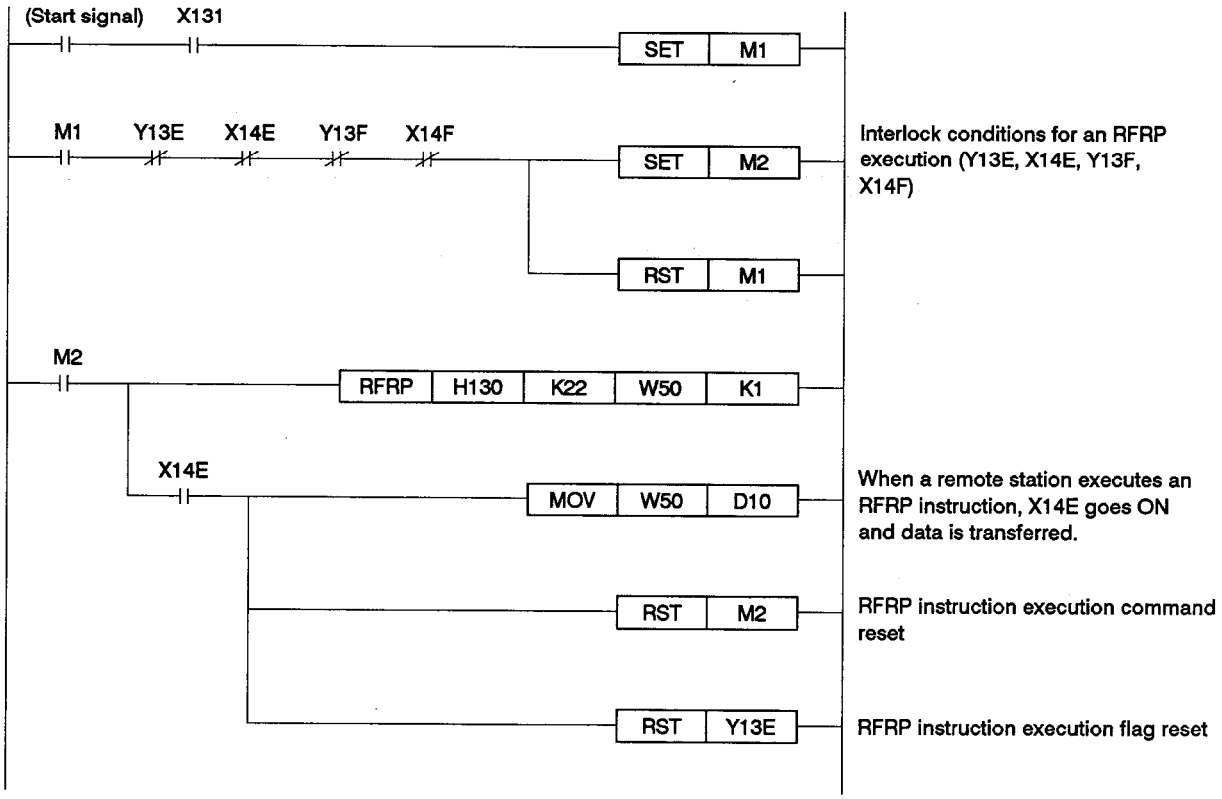
Symbol	Description	Device Used
n1	The first three digits of AD70 I/O numbers assigned by the master station	K, H
n2	The head address of the AD70 buffer memory contains the data to be read	K, H
D	The head link register stores the data that has already been read	W
n3	Number of data words to be read (1 to 16)	K,H

Fig. 5.40 PFRP Read Instruction

Example:

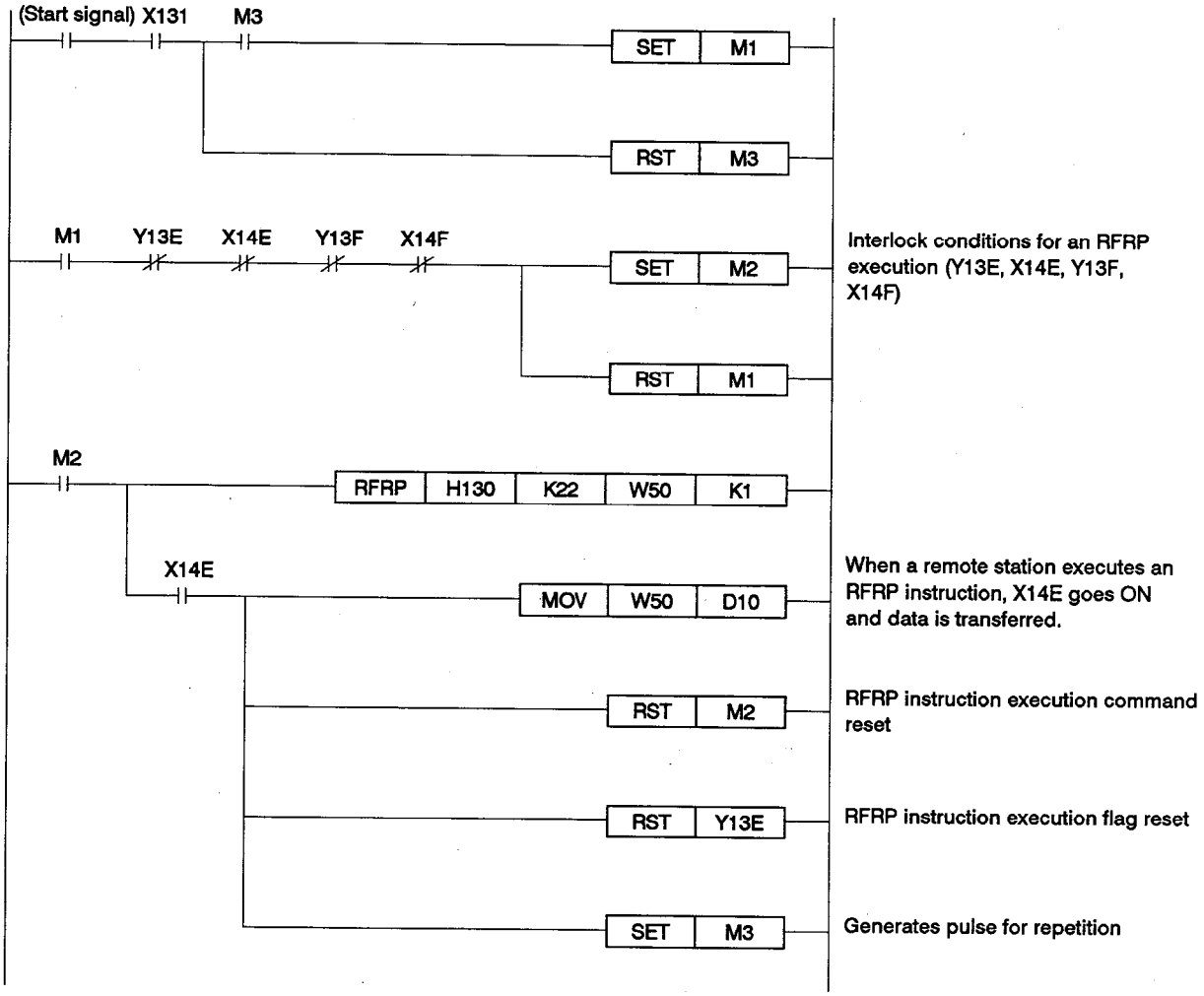
When reading one word from buffer address 22 of the AD70, located at I/O address X, Y130 to 14F in a remote I/O station to W50.

To read one time when a start signal is received:



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To continuously read while the start signal is ON:



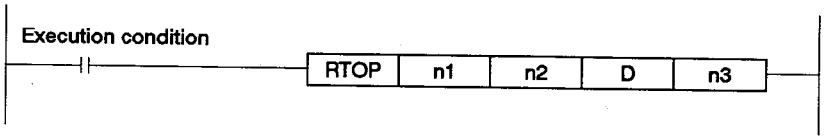
POINT

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

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(2) Writing to a remote I/O station AD70

[Format]



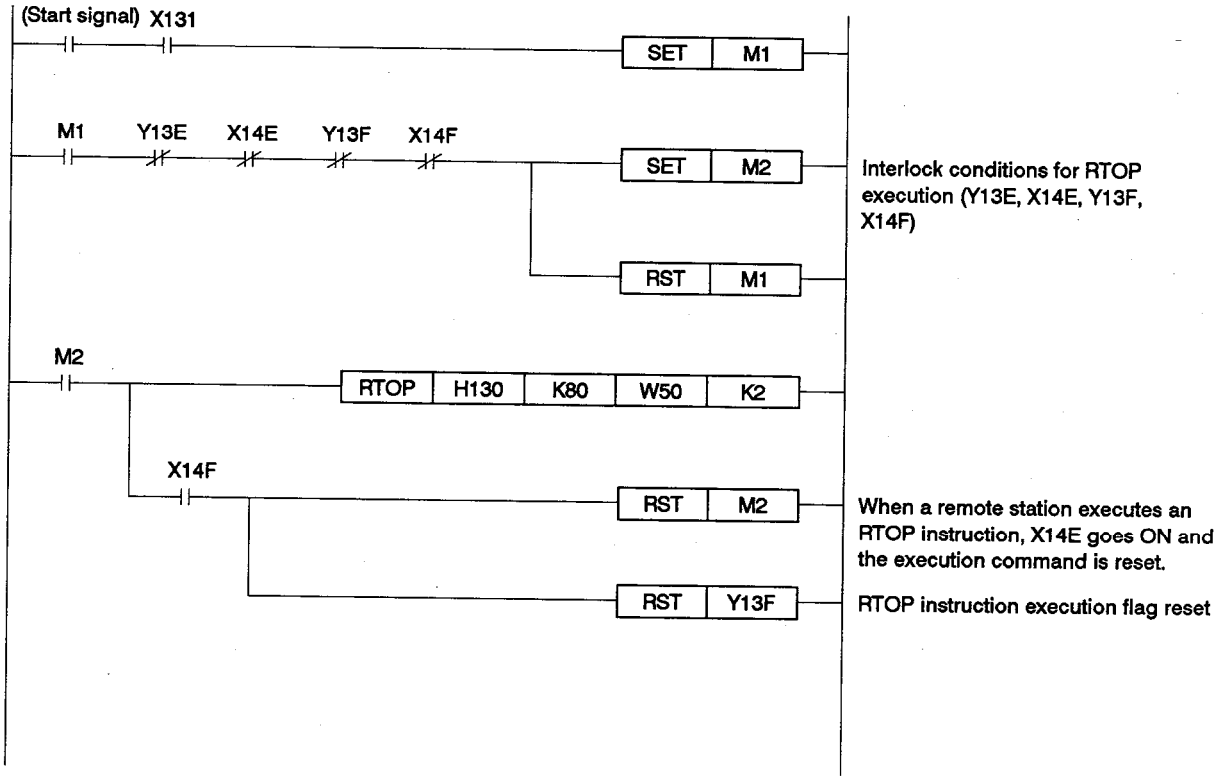
Symbol	Description	Device Used
n1	The first three digits of AD70 I/O numbers assigned by the master station?	K, H
n2	The head address of the AD70 buffer memory contains the data to be read.	K, H
D	The head link register stores the data which has already been read?	W
n3	Number of data words to be written (1 to 16)	K,H

Fig. 5.41 PTOP Write Instruction

Example:

When writing two words from W50 to buffer address 80 and 81 of an AD70 located at I/O address X, Y130 to 14F in a remote I/O station.

To write one time when a start signal is received:



POINT

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

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5.12.3 Sample program

The following program writes fixed and variable parameters and positioning data from the master station to the AD70 in remote I/O station No. 1, after which it executes zero return and positioning. Then, it reads the actual present value from the AD70.

Conditions:

(1) Fixed parameters and servo parameters are written after CPU RUN. Variable parameters and positioning data written using the start command. Absolute positioning is executed after count type zero return is executed.

The actual present value is read to D102 and D103.

Defaults are used for zero return data.

(2) The AD70 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. 64 (W200 to 23F) are also used for the RFRP instruction.

(4) Set the following data as parameters and positioning data:

		Setting Value	Device Used	Buffer Memory Address
Fixed parameters	Upper stroke limit	2,000,000,000 PLS	W105, W106	0, 1
	Lower stroke limit	–2,000,000,000 PLS	W107, W108	2, 3
Variable parameters	Velocity limit	300, 000 PLS/S	W115, W116	20, 21
	Acceleration time	400 ms	W117	22
	Deceleration time	450 ms	W118	23
Positioning data	Positioning pattern	0	W110	60
	Positioning address	12345 PLS	W111, W112	61, 62
	Positioning velocity	1000 PLS/S	W113, W114	63, 64
Monitor	Actual present value	–	W202, W203	102, 103

* Link Settings

MS	Number of Stations to be Linked	M → ALL L		Monitoring Time	Interval
		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

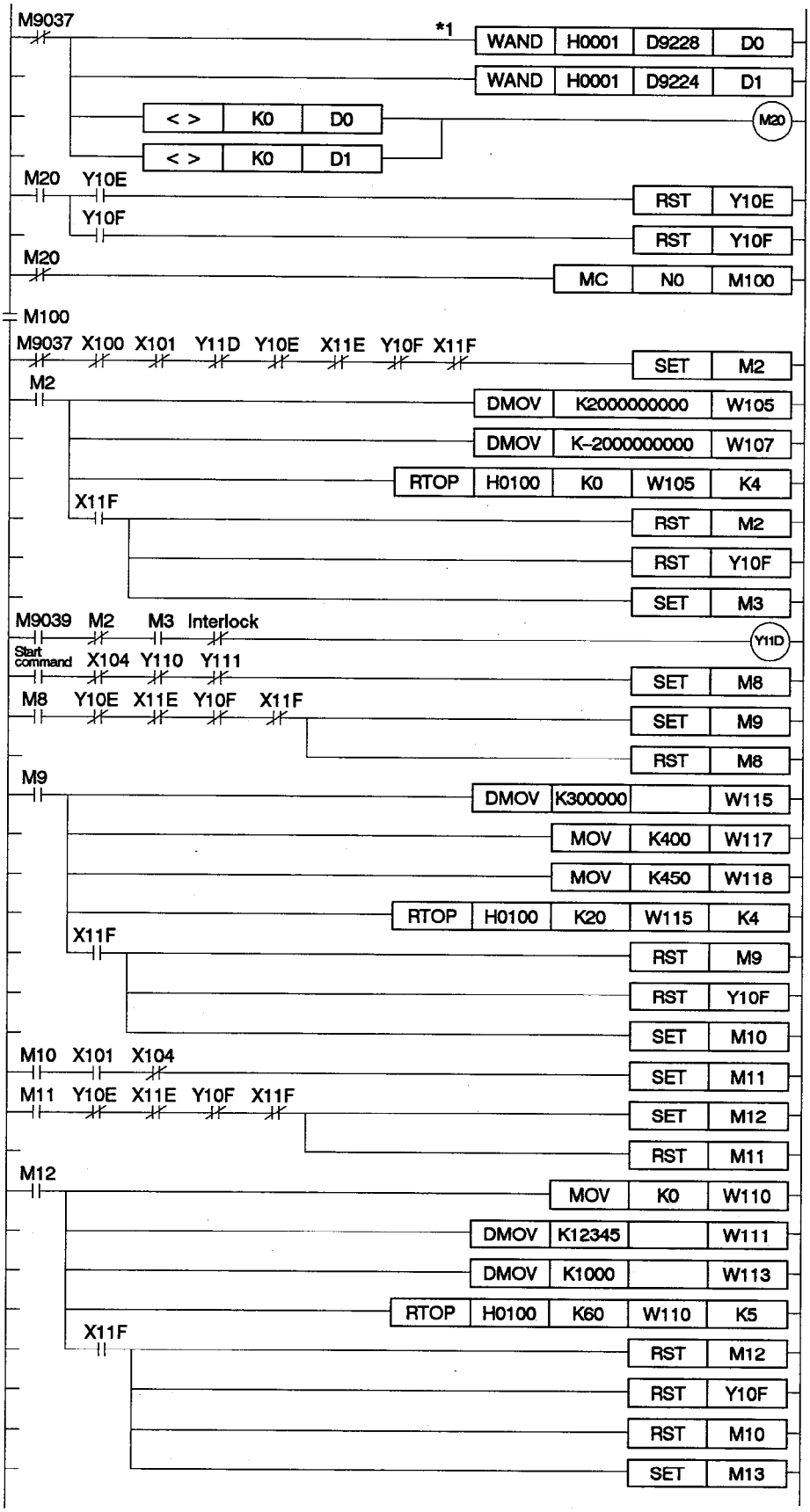
L/R NO.	M ← L		M → R	M ← R	M → L/R		M ← L/R	
	B	W	W	W	Y	X/Y	X	Y/X
R1	------	------	100 – 13F	200 – 23F	100 – 19F	000 – 09F	100 – 15F	000 – 05F
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–

M : Master Station, L : Local Station, R : Remote I/O Station

MEMORY USED 8 Kbytes

MODE PARAMETER FUNCTION PC A3 GPP
KEY-IN-DATA
MESSAGE

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Error detection in remote I/O station No. 1.

Detection of parameter communications in remote I/O station No. 1.

M20 goes ON if an error occurs in remote I/O station No. 1.

Reset the handshake signal (Y10E, Y10F) if a communications error occurs during PFRP and RTOP instruction execution in a remote I/O station.

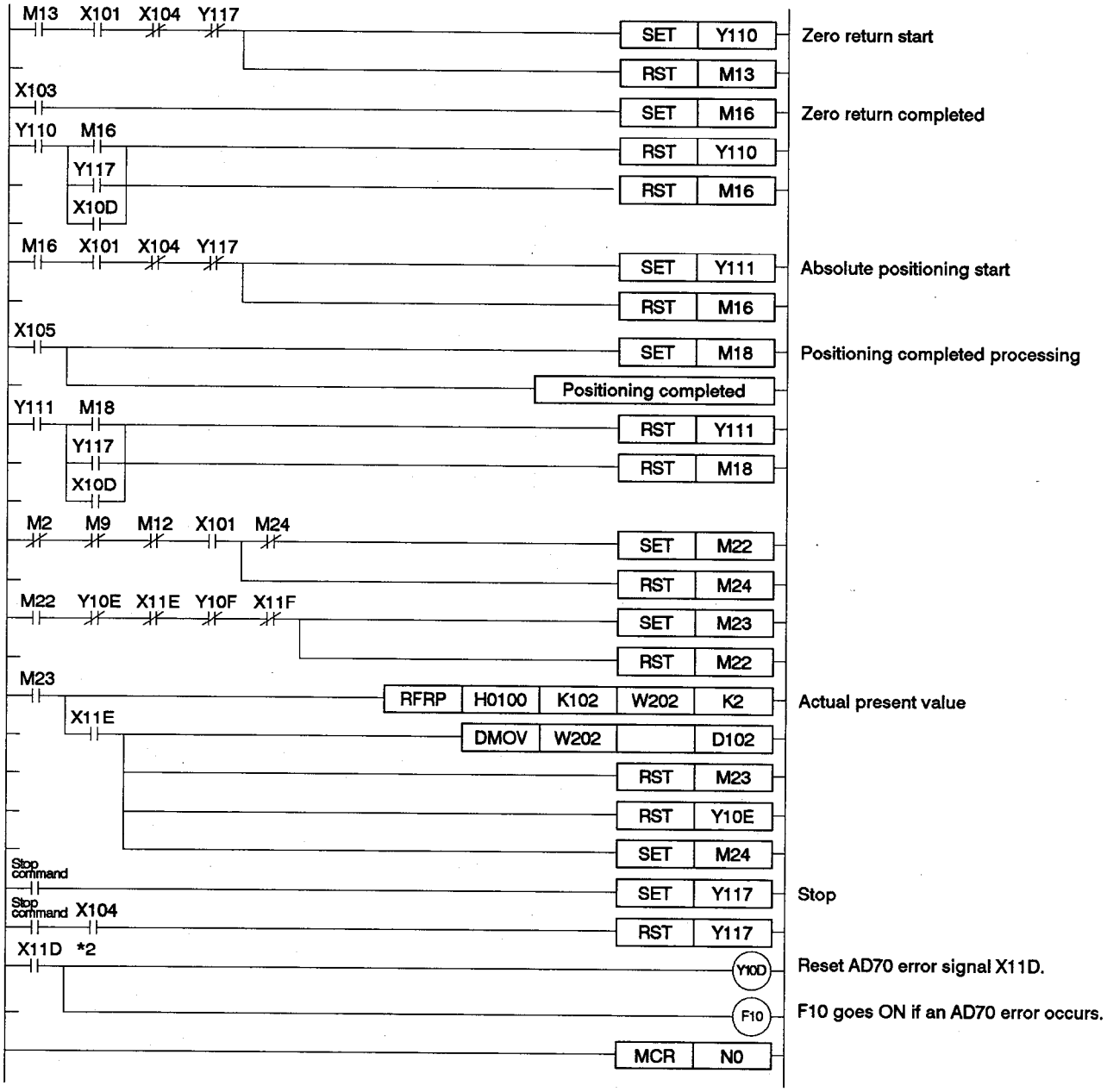
Fixed parameter write

PC ready ON

Variable parameter write

Positioning data write

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*1. If an error occurs in a remote I/O station, this circuit goes on detecting from the time the error occurred until initial communications is completed. If a remote I/O station executing the RFRP or RTOP instruction is down, Y10E is signalled by a handshake, and Y10F (YnE, YnF) are reset to allow normal communications after correcting the error.

*2. If the RFRP and RTOP instructions cannot be executed due to a special function module (AD70) error, the error signal X11D (Xn + 1D) goes ON, and F10 turns ON. Check the special function module in which the error has occurred. When Y10D (YnD) goes ON, X11D (Xn + 1D) goes OFF.

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6. TROUBLESHOOTING

6.1 Errors Detected by AD70

The AD70 has various error check functions. When an error occurs, the LED on the front panel of the AD70 goes ON and an error code is written to addresses 104, 105 in buffer memory and the error detection signal X8 turns ON.

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

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

(3) Errors are reset by turning Y18 ON.

The error detection signal (X8) turns OFF when the error is reset.

Section 5.11 tells how to read error codes.

The error codes are classified as shown in Table 6.1.

Table 6.1 Error Code Classification

Error Code	Error Classification		LED Indicator	Remarks
1 to 3	Setting data range error	Fixed parameters	ERR. 1 lights	See Section 6.1.1
10 to 14		Variable parameters		
20 to 22		Zero-return data		
30 to 32		Positioning data		
40, 41		Control change area		
60 to 62	Buffer memory write disable error		ERR. 1 lights	See Section 6.1.2
70 to 74	AD70 start error		ERR. 2 lights	See Section 6.1.3
80 to 87			ERR. 1 lights	
90 to 93	AD70 operation error		ERR. 2 lights	See Section 6.1.4
100 to 105			ERR. 1 lights	
110 to 114	Control change error		ERR. 1 lights	See Section 6.1.5

Errors are classified in two categories: ERR.1 and ERR.2.

ERR. 1 (minor error) : Can be corrected from the sequence program
ERR. 2 (major error) : Originates in an external signal

6.1.1 Setting data range errors

Table 6.2 Data Range Check

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

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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.

Table 6.3 shows a list of error codes.

Table 6.3 Data Range Error Codes

Error Code	Type of Operation	LED Indicator	Check Point		Check Range	Control During an Error	Error Code Set Address
1	Fixed parameters	ERR. 1 lights	Lower stroke limit		−214783648 to upper stroke limit	If only one data is set outside the setting range, an error will occur and control is executed with default values on all fixed parameters.	104
2			Electronic gear	Specified pulse multiplication ratio numerator (CMX)	1 to 9999		
3				Specified pulse multiplication ratio numerator (CDV)	1 to 9999 $\frac{1}{50} \leq \frac{CMX}{CDV} \leq 50$		
10	Variable parameters		Velocity control		10 to 400,000 PLS/sec	Error parameters are replaced with default values.	
11			Acceleration time		2 to 9999 msec		
12			Deceleration time		2 to 9999 msec		
13			In-position range		1 to 2047 PLS		
14			Positioning mode		A value other than 0.1 causes error		
20	Zero-return data		Zero-return velocity		1 to velocity limit PLS/sec	No data start at error.	
21			Creep velocity		1 to velocity limit PLS/sec		
22			Axis travel distance setting after the near-zero point dog goes ON		Must be greater than the deceleration distance from the zero-return velocity to the creep velocity [Checked only in the count mode]		
30	Positioning data		Positioning address [Axis travel distance in the velocity/positioning switchover mode or during increment positioning]		Within the stroke limit range	No start	
31					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.		
32			Positioning velocity		1 to velocity limit "0" causes error	No start at "0". If an error occurs at values other than "0", control will be executed at the velocity limit value.	
40	Control change area		Velocity change		1 to velocity limit "0" causes error		
41			JOG velocity				

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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 triggers 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 Description	Error Code Set Address
60	0 to 6 40 to 47	ERR. 1 lights	Data written from the PC while the Y1D is ON. (Fixed parameters, zero-return data)	104
61	100 to 111		Data written to a write prohibited address. (Monitor area)	
62	1 to 85		One-word data written to a two-word data area.	

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6.1.3 AD70 start errors

Table 6.5 AD70 Start Error Codes

Error Code	When Error Occurs	LED Indicator	Error Description	Corrective Action	Error Code Set Address
70	At start	ERR. 2 lights	Servo ready (READY) signal is OFF at the start	Turn the servo ready (READY) signal ON.	105
71			STOP signal is ON at the start	Turn the STOP signal OFF.	
72			Upper limit LS (FLS) signal is OFF at the start	Return the present value to within the stroke limit range using a JOG operation.	
73			Lower limit LS (RLS) signal is OFF at the start	Return the present value to within the stroke limit range using a JOG operation.	
74			Near-zero point dog signal is ON at the zero-return start (near-zero point dog mode only)	Return the axis to a position away from the near-zero point dog position using a JOG operation (positioning).	
80	At start	ERR. 1 lights	AD70 ready completion signal(X01) and PC ready signal (Y1D) are OFF at the start.	Turn the PC ready signal (Y1D) ON.	104
81			The start signal does not go ON because the BUSY signal (X04) is ON at the start.	Provide an interlock from the sequence program so that the start is not executed during BUSY.	
82			The STOP signal (Y17) is ON at the start.	Turn the STOP signal (Y17) OFF and restart.	
83			The present value is outside the stroke limit range at the start.	• Return the present value to within the stroke limit range using a JOG operation. • Execute a zero-return operation. • Set the present value to within the stroke limit range by a present value change.	
84			Zero-return start is attempted with the zero-return completed signal (X03) ON.	• Zero returns cannot be repeated consecutively. (Near-zero point dog mode only) • Move to a position in front of the near-zero point dog using a JOG or positioning operation, and restart.	
85			(1) Restart attempted in the V/P mode at positioning completion in the V/P control switchover mode. (2) Restart attempted in the V/P mode while in the positioning mode.	(1) Start by a forward start signal (Y12) or reverse start signal (Y13). (2) Start by an absolute positioning start signal (Y11), forward start signal (Y12), or reverse start signal(Y13).	
86			Positioning start signal (Y11) attempted in the V/P control switchover mode.	Start by a forward start signal (Y12) or reverse start signal (Y13).	
87			Axis travel distance changed to outside the stroke limit range.	Change the axis travel distance to within the stroke limit range.	

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6.1.4 AD70 operation errors

Table 6.6 AD70 Operation Error Codes

Error Code	When Error Occurs	LED Indicator	Error Description	Processing	Corrective Action	Error code set address
90	During operation	ERR. 2 lights	Servo READY signal is OFF during BUSY.	Decelerates to a stop	Check the drive module, and turn ON the servo READY signal.	105
91			Upper limit LS (FLS) signal is OFF during BUSY.	Decelerates to a stop	Return the present value to within the stroke limit range using a JOG operation.	
92			Lower limit LS (RLS) signal is OFF during BUSY.	Decelerates to a stop	Return the present value to within the stroke limit range using a JOG operation.	
93			External stop (STOP) signal is ON during zero return.	Decelerates to a stop	• Restart if stopped on the near-zero point dog in the count mode. • Return to the position before the near-zero point dog went ON using a JOG or positioning operation, and restart (near-zero point dog type). • Restart if stopped before the near-zero point dog.	
100		ERR. 1 lights	The present value has exceeded the stroke limit range.	JOG enabled	Change the present value to within the stroke limit range.	104
102			The STOP signal (Y17) is ON during zero return.	Decelerates to a stop	• Restart if stopped on the near-zero point dog in the count mode. • Return to the position before the near-zero point dog went ON using a JOG or positioning operation, and restart (near-zero point dog type). • Restart if stopped before the near-zero point dog	
103			The PC ready signal (Y1D) is OFF during zero return.	Decelerates to a stop	• Restart if stopped on the near-zero point dog in the count mode. • Return to the position before the near-zero point dog went ON using a JOG or positioning operation, and restart (near-zero point dog type). • Restart if stopped before the near-zero point dog	
104			By the electronic gear, the velocity has exceeded 1,000 kpps. (Zero return, positioning, JOG)	Limited to 400 KPPS	Change the velocity to less than 400 KPPS.	
105			The PC ready signal (Y1D) is OFF during BUSY (positioning, JOG).	Decelerates to a stop	Turn the PC ready signal (Y1D) ON.	

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6.1.5 Control change errors during an AD70 operation

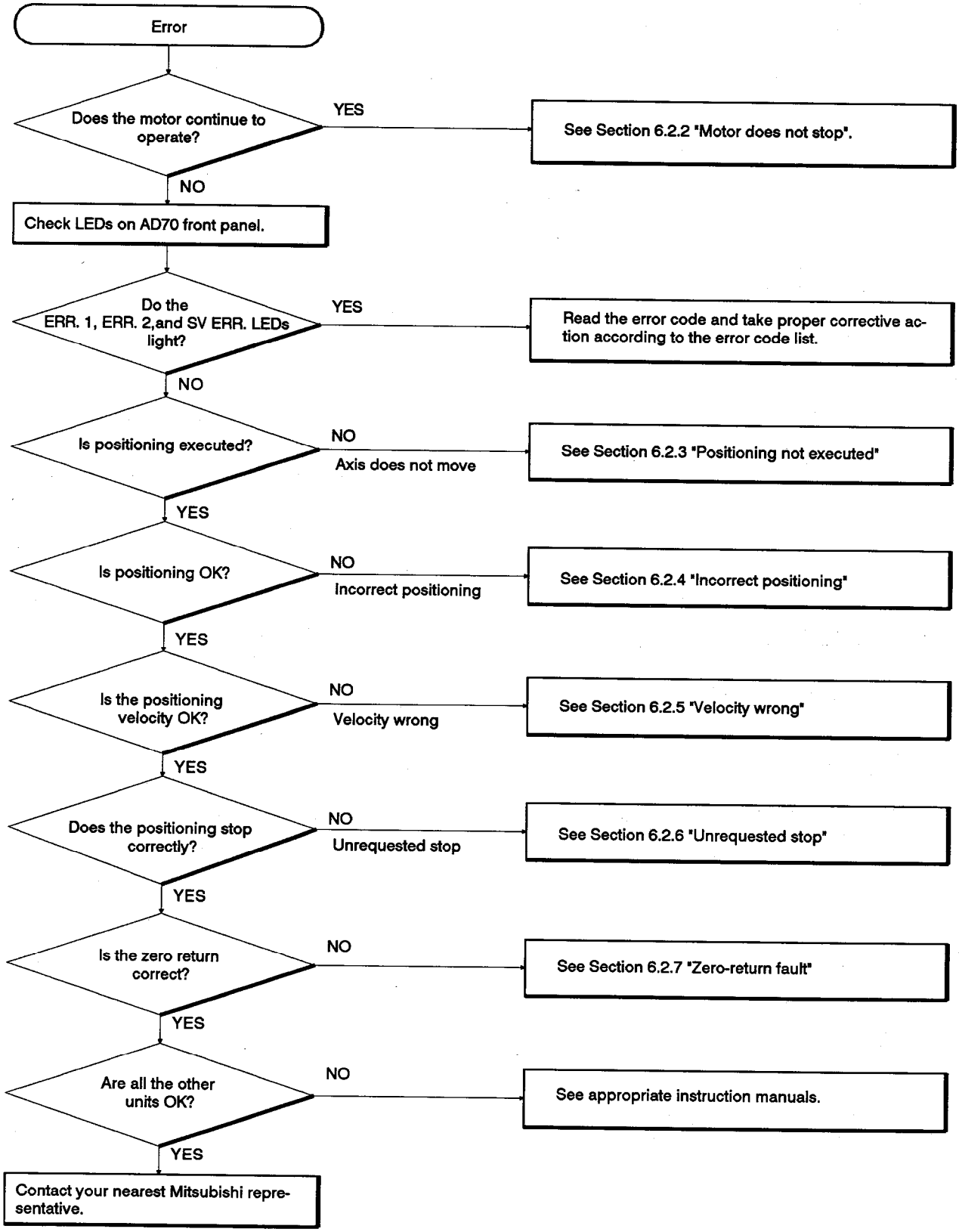
Table 6.7 Control Change Error Codes During an AD70 Operation

Error Code	When Error Occurs	LED Indicator	Error Description	Corrective Action	Error code set address
110	At control change during operation	ERR. 1 lights	Attempted to change the present value (buffer memory addresses 80 and 81) during BUSY.	Provide interlock using the sequence program.	104
111			Attempted to change the velocity (buffer memory addresses 82 and 83) during zero return.		
112			Attempted to change the velocity (buffer memory addresses 82 and 83) after automatic deceleration has started.		
113			Attempted to change the velocity (buffer memory addresses 82 and 83) using a JOG operation after the JOG signal went OFF.		
114			Attempted to clear the error counter (buffer memory address 86).		

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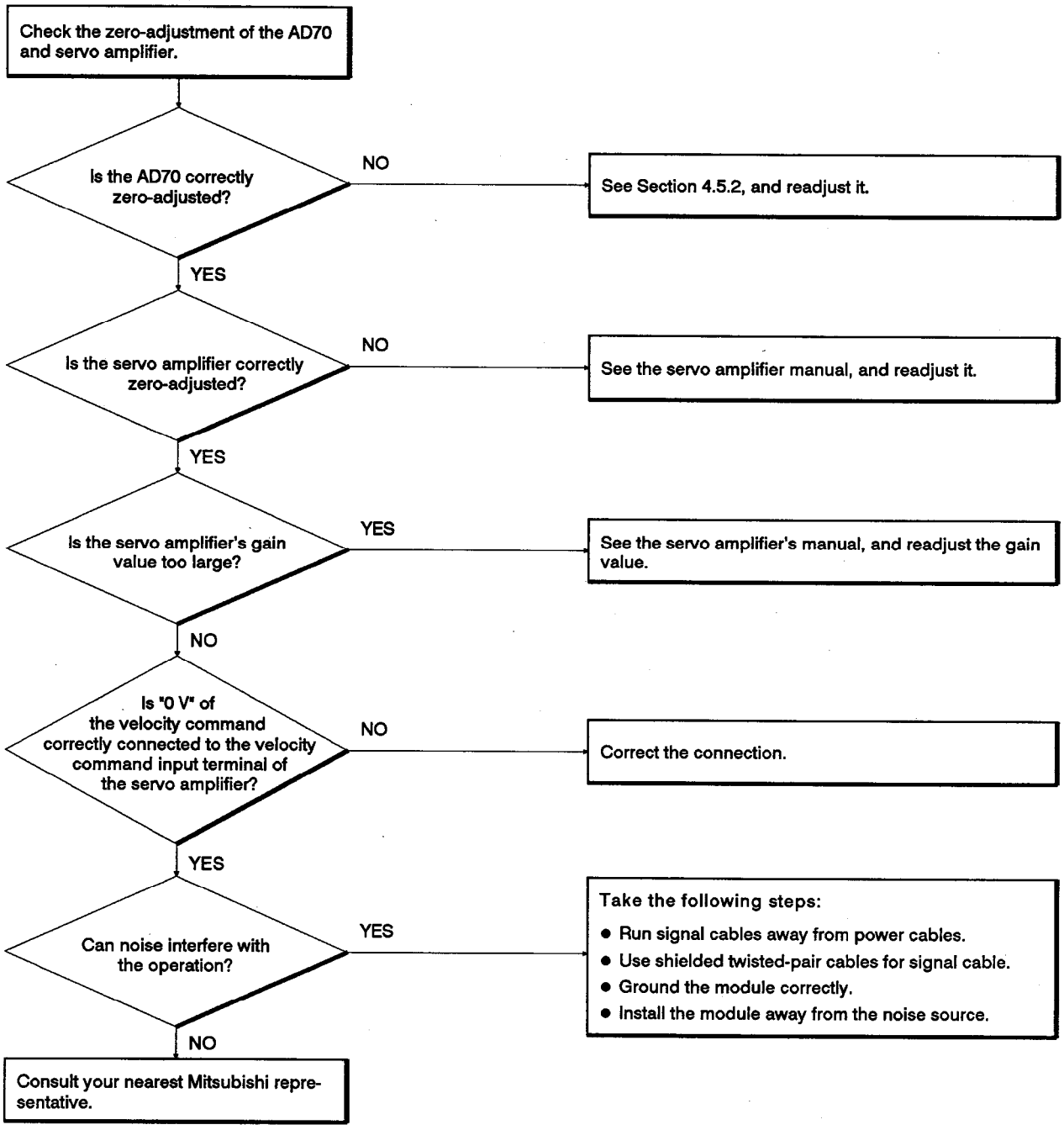
6.2 Troubleshooting

6.2.1 General troubleshooting



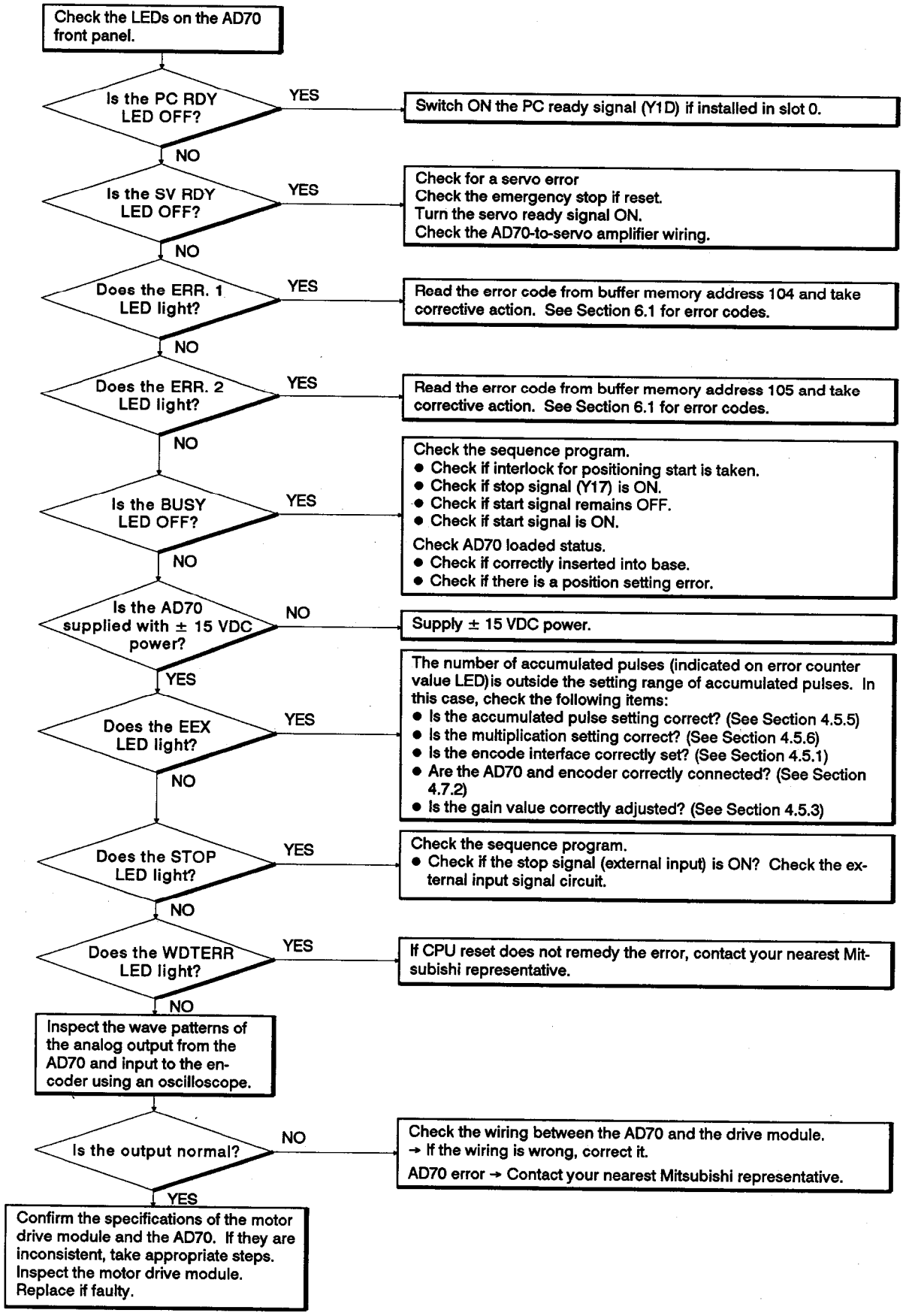
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6.2.2 Motor does not stop



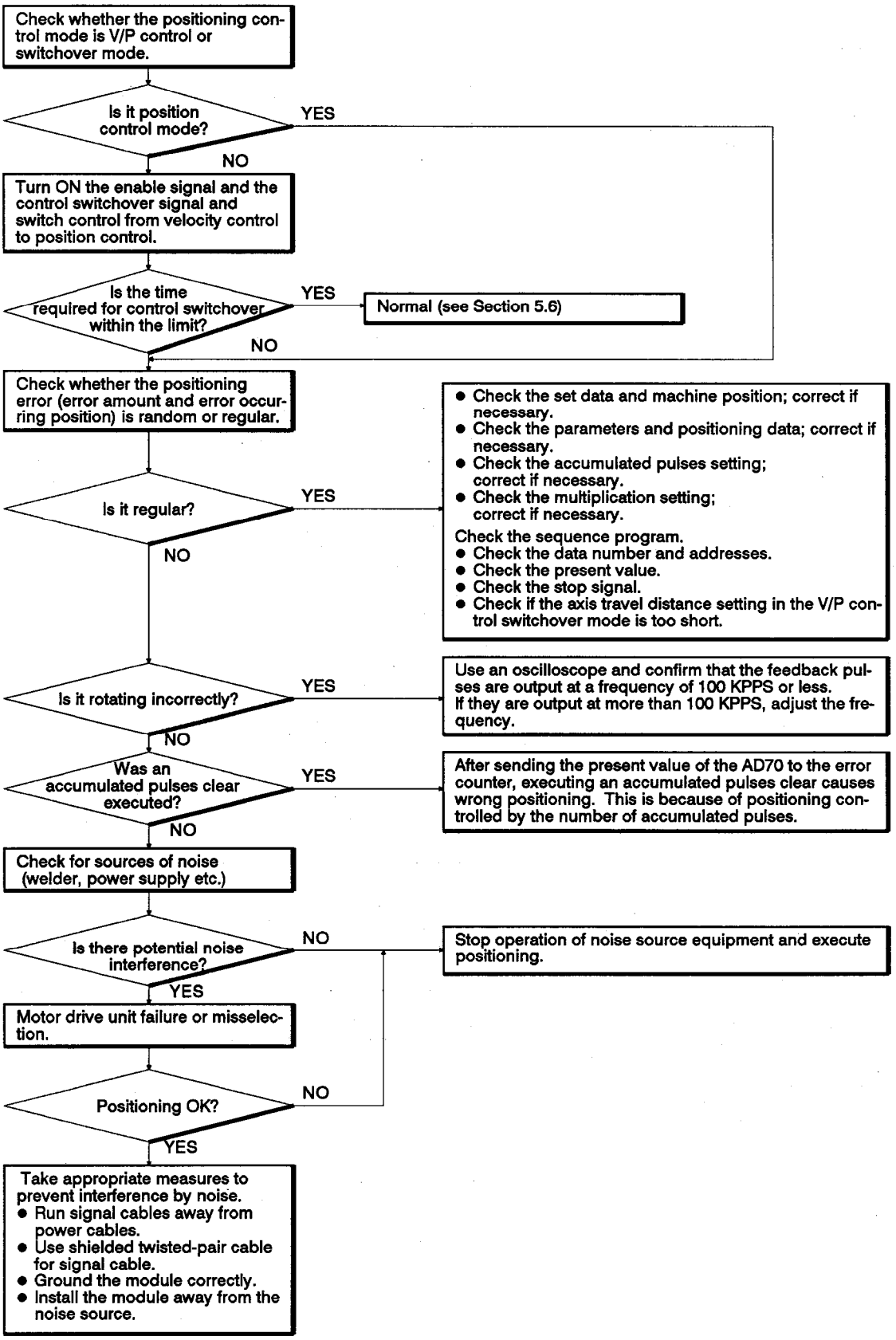
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6.2.3 Positionings not executed



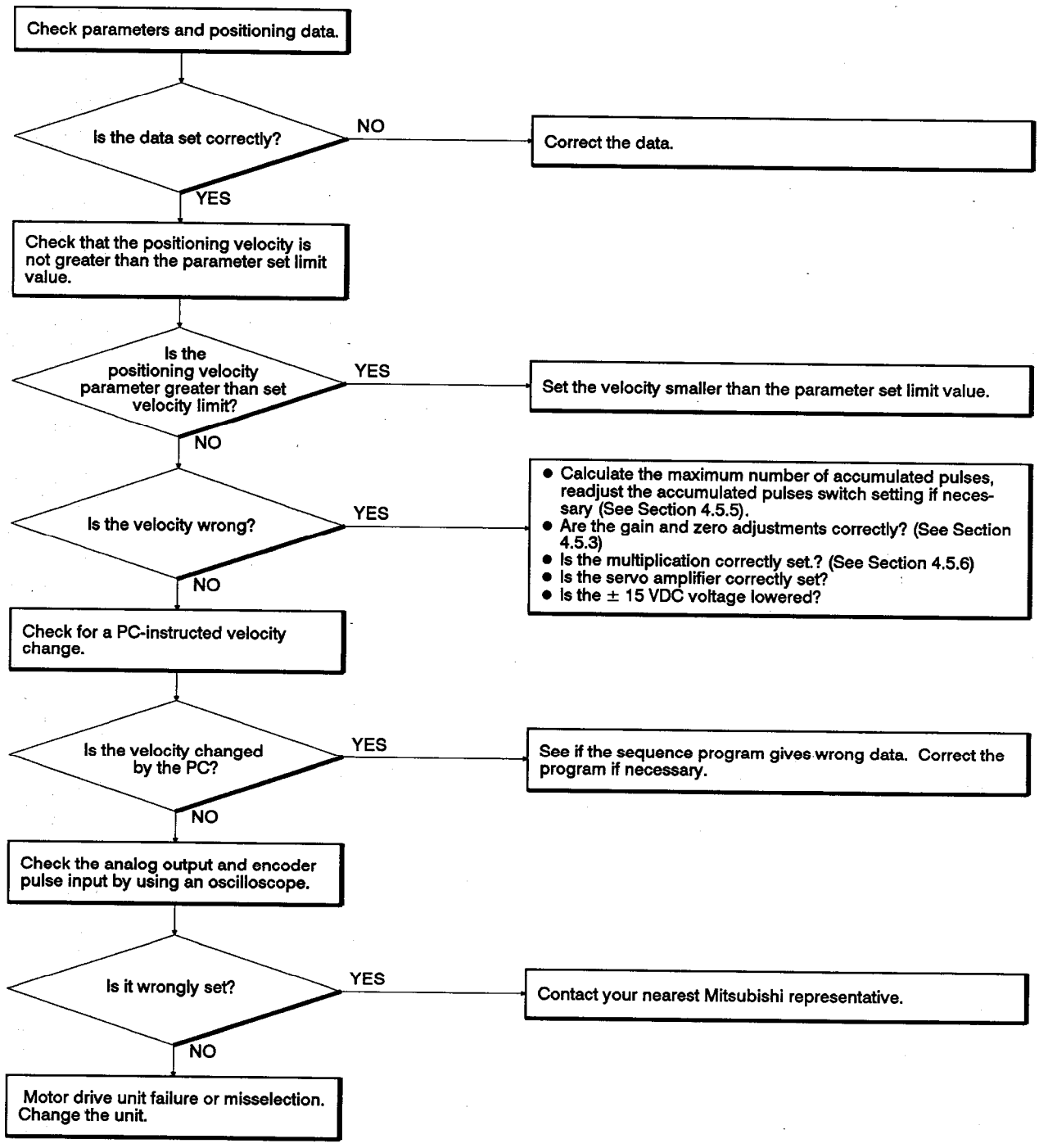
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6.2.4 Incorrect positioning



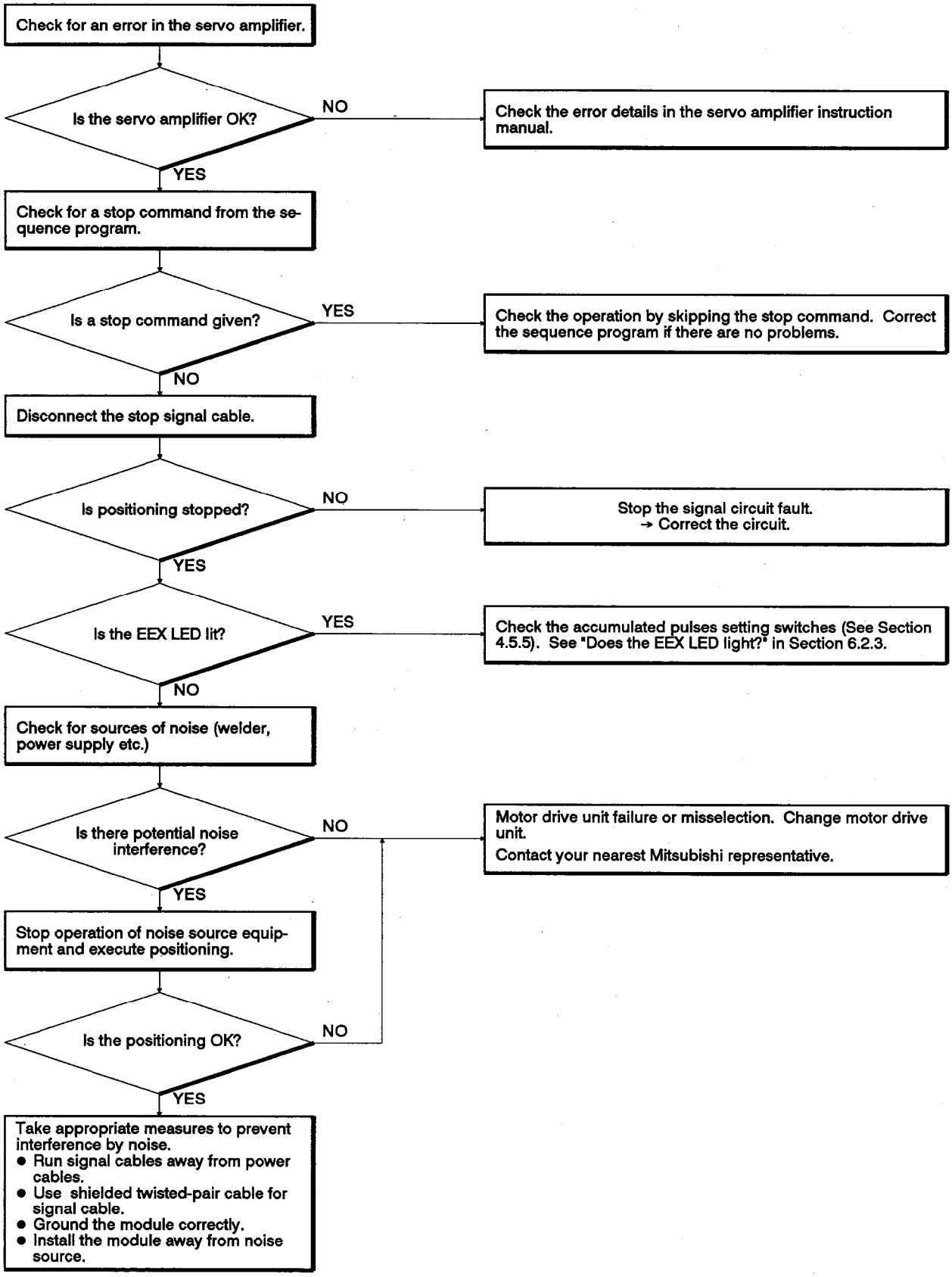
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6.2.5 Velocity wrong



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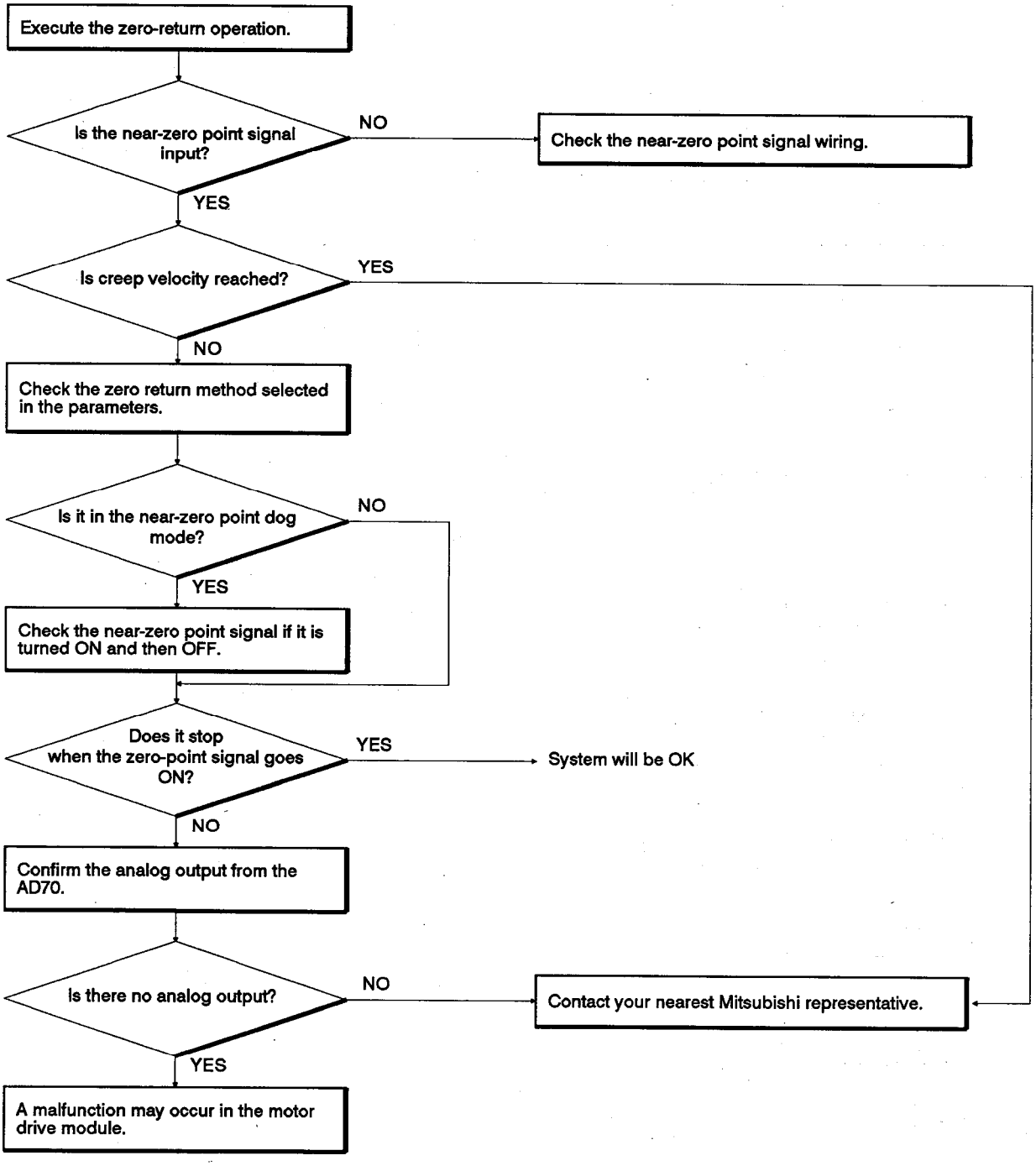
6.2.6 Unrequested stop



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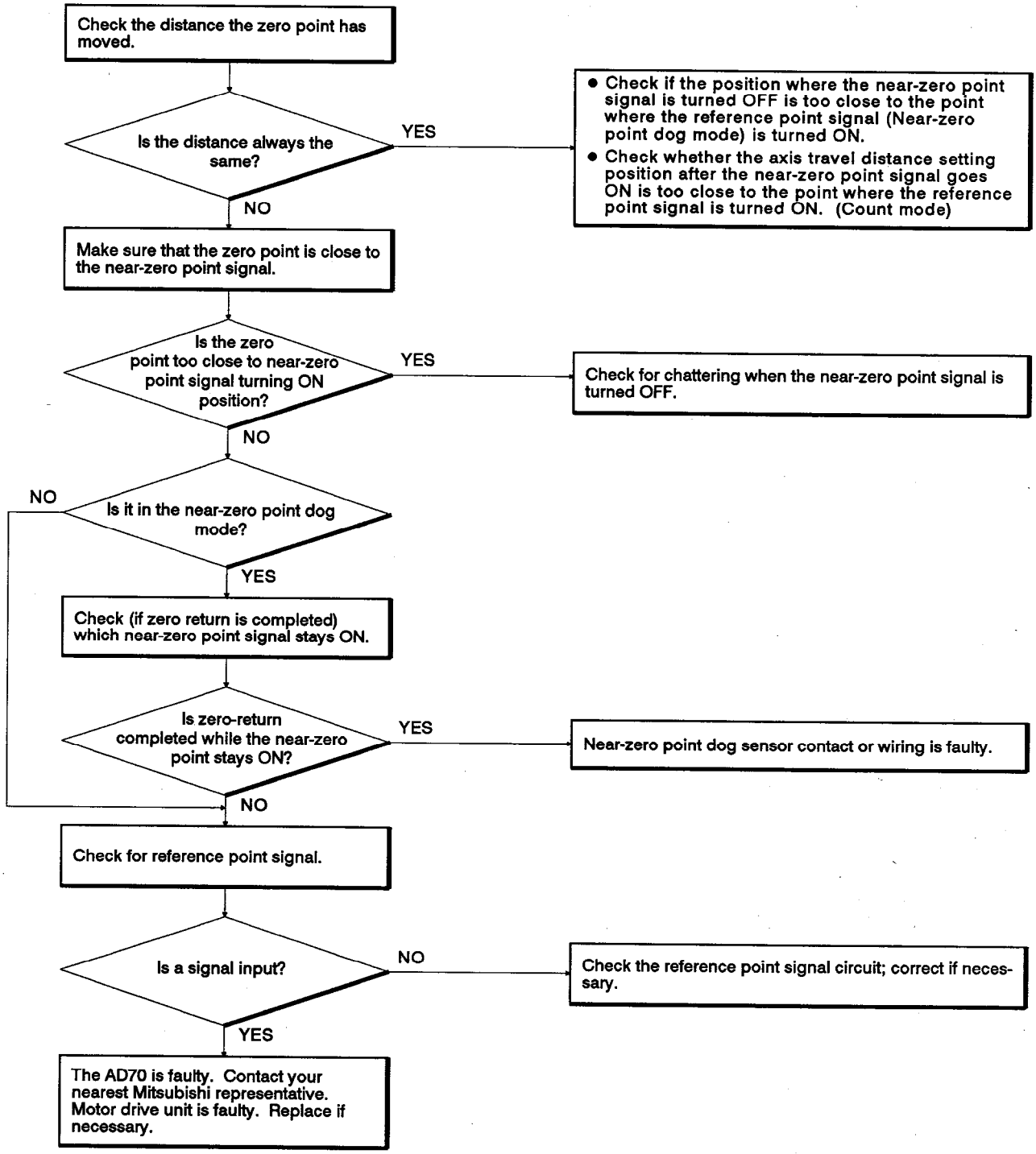
6.2.7 Zero-return fault

(1) Zero-return incomplete



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(2) Zero point position has shifted



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

Chattering when the near-zero point signal is turned off is suspected.

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APPENDICES

Appendix1 Comparison of Functions

Item	AD70	AD72	AD71(S1)	AD71S2
Output command to the servo amplifier	Analog voltage	Analog voltage	Pulse chain	
Number of control axis	1 axis	2 axis	2 axis	
Positioning control function	Available	Available	Available	
Velocity control function	Available	Unavailable	Unavailable	Available
In-position function	Within the range of 1 to ± 2047	Within the range of 1 to ± 2047	These functions depend on the type of the servo amplifier used. (Makes use of the servo amplifier's functions)	
Multiplication ratio setting function	Ratios 4, 2, 1, and 0.5 can be selected	Ratios 4, 2, 1, and 0.5 can be selected		
Pulse quantity setting function	3480, 6960, 10440, and 13920 can be selected	The maximum accumulated pulses can be set to 2047, 4095, 8191, and 16383.		
Electronic gear function	Within the range of 1/50 to 50	Makes use of one of the servo amplifier's functions		
Manual pulse generator operation	Unavailable	Available	Available	Unavailable
JOG operation	Available	Available	Available	
Use of a stepping motor	Unavailable	Unavailable	Available in combination with an AD76 stepping motor drive module.	
Acceleration/deceleration time setting	2 to 9999 msec Acceleration and deceleration are set individually.	64 to 4999 msec	64 to 4999 msec	64 to 50000 msec
Emergent stop deceleration time setting	Not provided	Not provided	Not provided	Provided
Peripheral device	Not provided	A6GPP(SW0GP-AD71P) or AD71TU	A6GPP(SW0GP-AD71P) or AD71TU	
Number of occupied I/O points	32 points	48 points	32 points	32 points
Internal current consumption 5 VDC (A)	0.3	0.9	1.5	1.5
Outside dimensions (mm) (in)	250(H) x 37.5(W) x 121(D) 9.84(H) x 0.15(W) x 4.76(D)	250(H) x 75.5(W) x 121(D) 9.84(H) x 2.97(W) x 4.76(D)	250(H) x 37.5(W) x 121(D) 9.84(H) x 0.15(W) x 4.76(D)	250(H) x 37.5(W) x 121(D) 9.84(H) x 0.15(W) x 4.76(D)
Weight (kg) (lb)	0.5 (1.1)	1.5 (3.3)	0.63 (1.39)	0.63 (1.39)

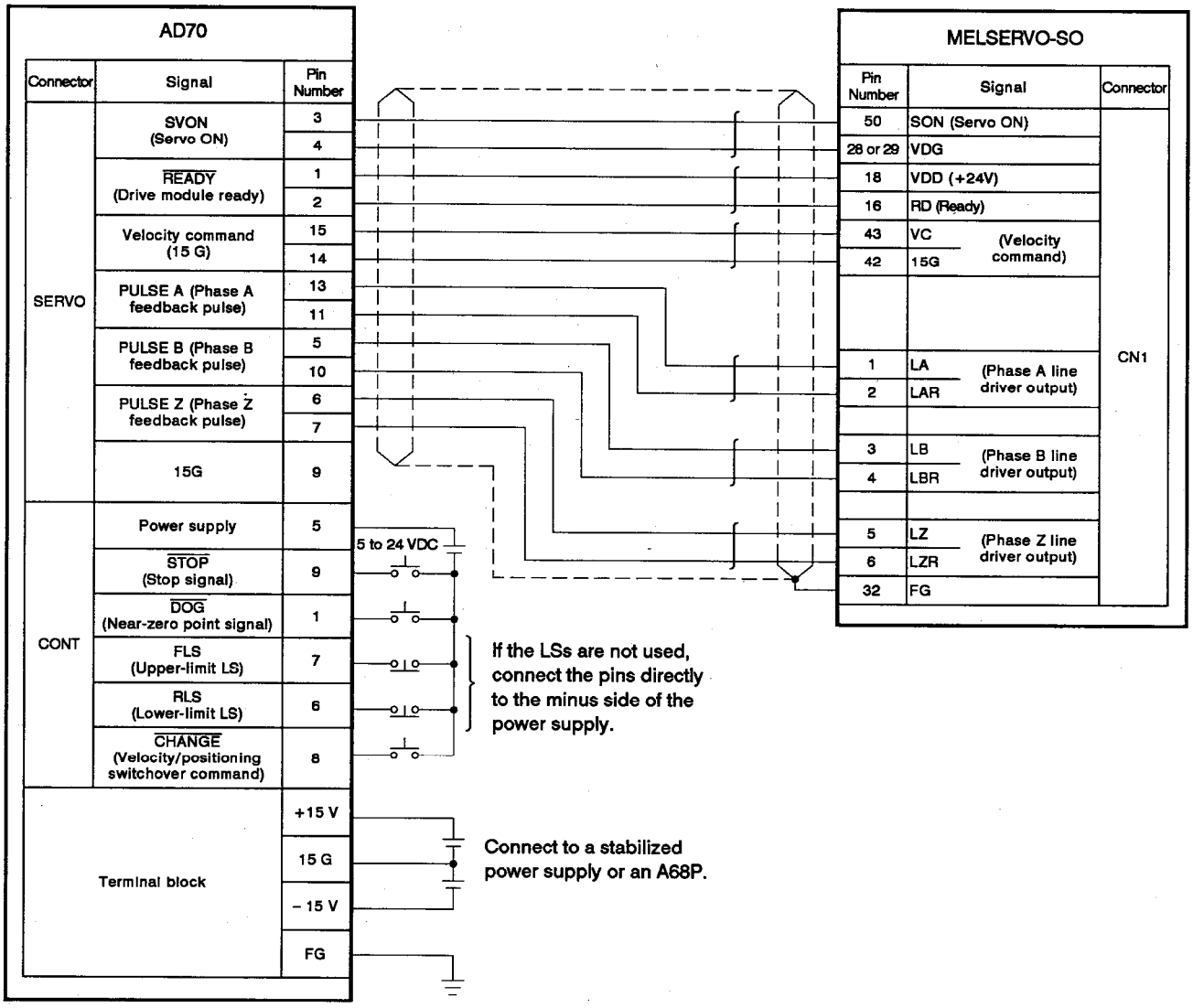
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Appendix 2 Sample Servo Amplifier Connection

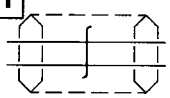
Several types of amplifiers can be connected to the AD70.

A sample connection (using a 1987 servo amplifier) is given below.

2.1 Sample Connection Using a MELSERVO-SO (Feedback Pulses Input: Differential Output Model)



POINT

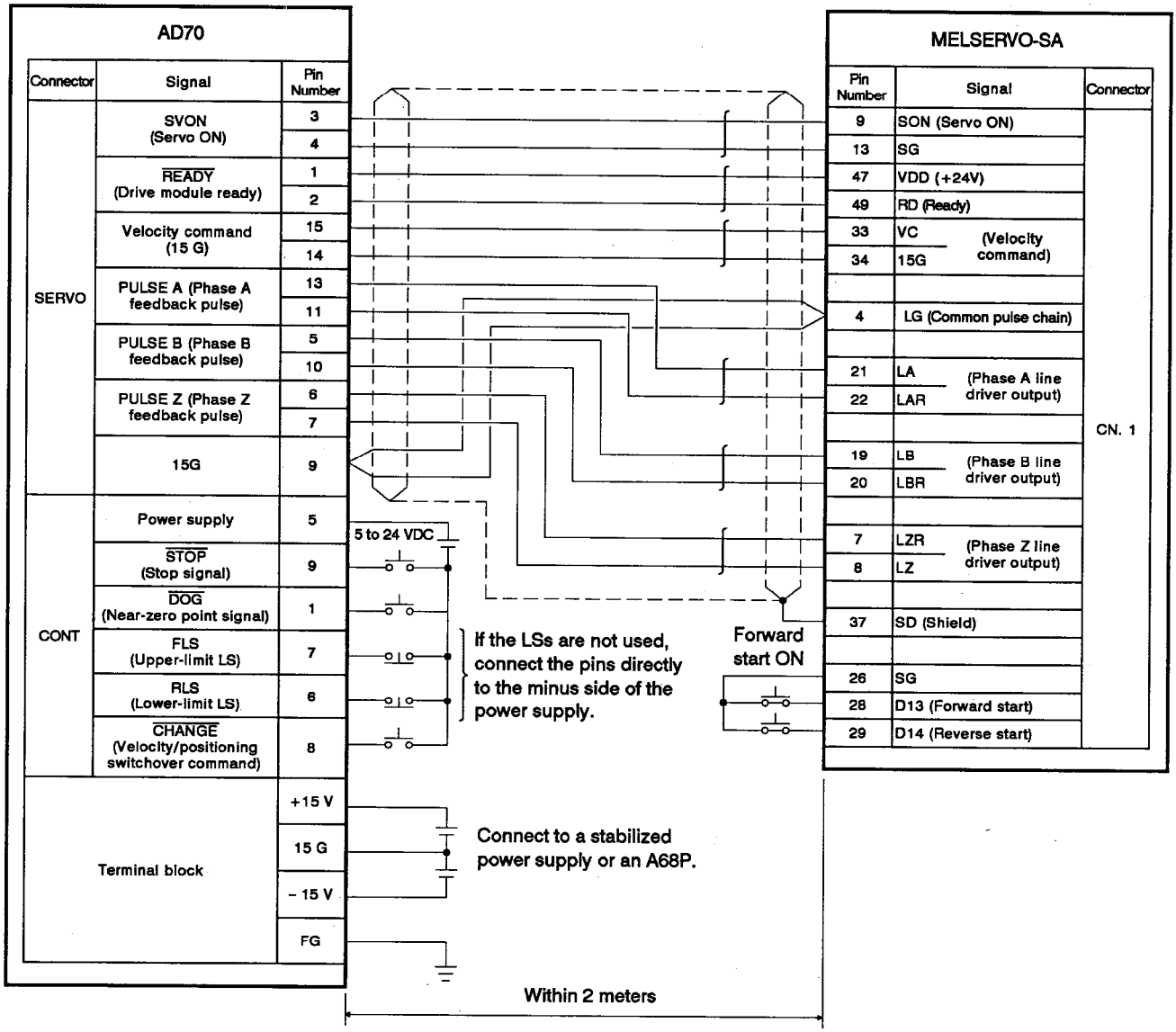
(1)  indicates a shielded twisted-pair cable.

(2) Set the encoder interface to differential output.

(3) The MELSERVO-SO User's Manual gives details on wiring which is different than the above example.

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2.2 Sample Connection Using a MELSERVO-SA



POINT

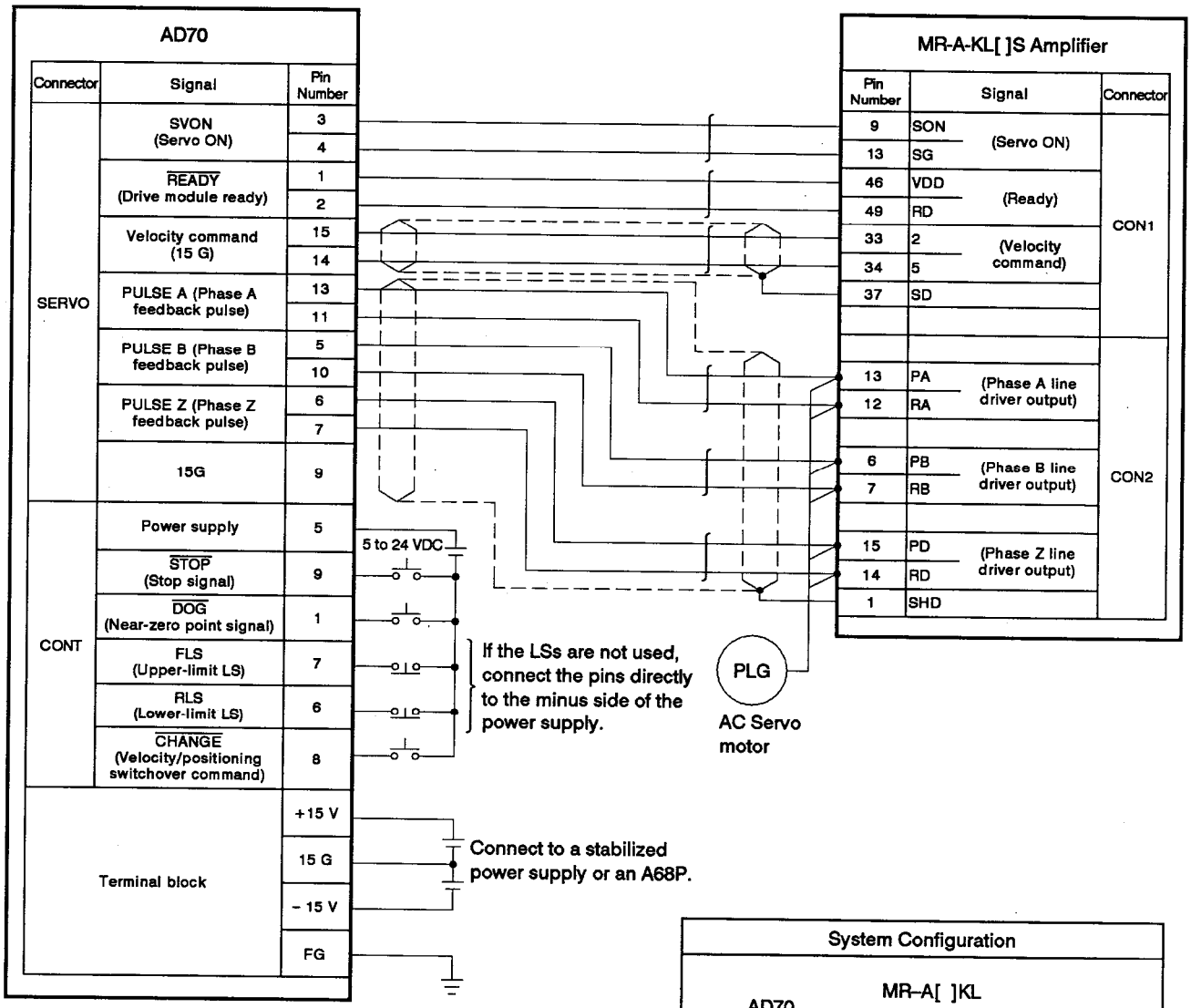
(1)  indicates a shielded twisted-pair cable.

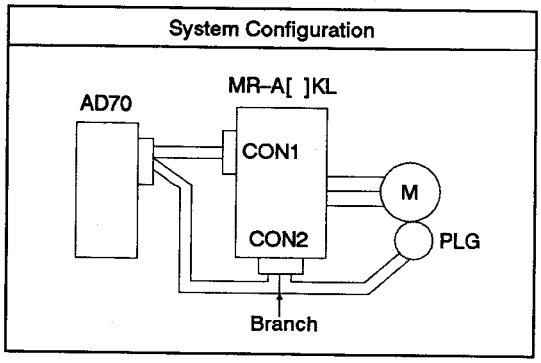
(2) Set Parameter 1 (servo loop mode) of the servo amplifier (MR-SA) to "2" (velocity control).

(3) The MELSERVO-SA User's Manual gives details on wiring which is different than the above example.

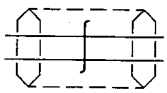
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2.3 Sample Connection Using a MELSERVO-A[ ]KLS





POINT

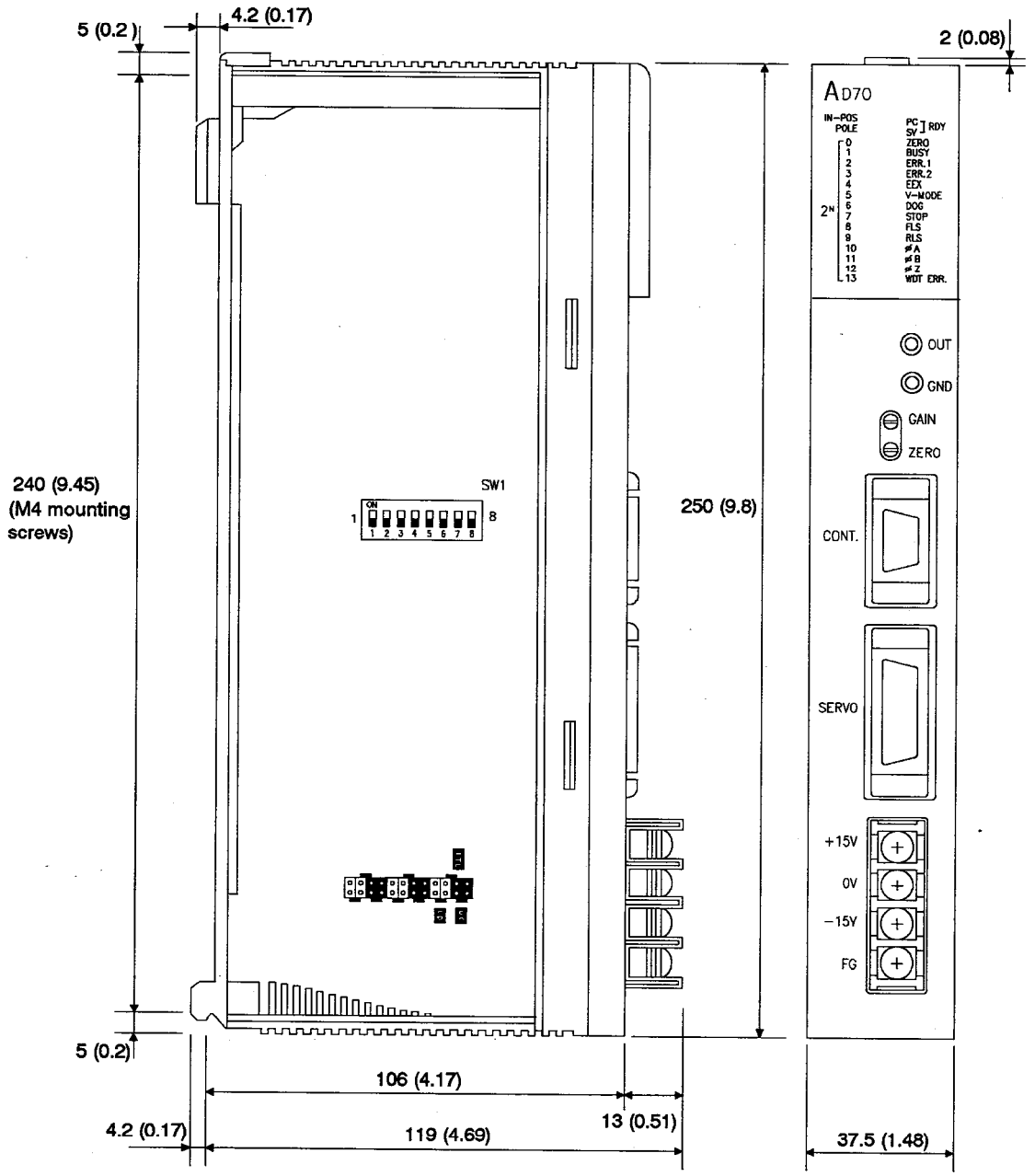
(1)  indicates a shielded twisted-pair cable.

(2) Set the encoder interface to differential output.

(3) The MELSERVO-A[ ]KLS User's Manual gives details on wiring which is different than the above example and also explains how to shield each signal wire.

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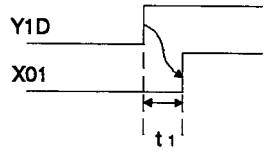
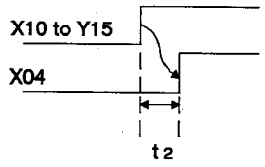
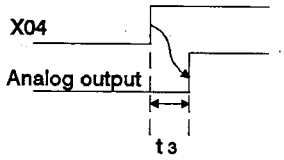
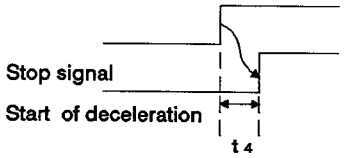
Appendix 3 AD70D Dimensions



Unit: mm (inch)

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Appendix 4 Processing Time

Item	Type of Signal		Processing Time (msec)
1. PC ready → AD70 ready completed (Y1D) (X0D)  			1
2. Start ON → BUSY ON (Y10 to Y15) (X04)  	Start signal		
	Y10	Near-zero point dog mode	0.9
		Count mode	1.6
	Y11	Absolute one-phase	0.9
		Absolute two-phase	1.1
	Y12	Incremental one-phase	1.0
	Y13	Incremental two-phase	1.2
	Y14 Y15	JOG	0.8
3. BUSY ON → analog output (X04)  			3.5
4. STOP ON → start of deceleration  	Stop signal		
	Y17		5.0
	External signal STOP		4.3
	External signal FLS		4.5
	External signal RLS		4.6
	External signal SERVO READY		4.4
5. Control switchover time in V/P control switchover mode			1

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Appendix 5 A68P Power Module (hereafter called the A68P)

5.1 Specifications

Table 5.1 A68P Specifications

Item		Specifications
		A68P
Base loading position		Power supply module loading slot
Number of occupied I/O points		32 points
Input voltage		100–120 VAC $^{+10\%}_{-15\%}$ (85 to 132 VAC)
		200–240 VAC $^{+10\%}_{-15\%}$ (170 to 264 VAC)
Input frequency		50/60Hz ±5%
Max. input apparent power		95 VA
Inrush current		20 A, within 8 msec
Rated output current	+ 15 VDC	1.2 A
	– 15 VDC	0.7 A
*1Current overload protection	+ 15 VDC	1.64 A or higher
	– 15 VDC	0.94 A or higher
Rated output voltage		+ 15 VDC ± 3%
		– 15 VDC ± 3%
Ripple voltage		50m Vp-p or lower
Spike voltage		100m Vp-p or lower
Excessive ouput variation		1 V or lower
Efficiency		±65 % or more
Power indicator		Power LED display
Output at power ON		Contact output
		Goes ON either when the +15 VDC output goes up to +14.25 V or higher, or when the –15 VDC output goes down to –14.25 V or lower.
		Min. contact load: 5 VDC, 10 mA Max. contact load: 264 VAC, 2A (R load)
Terminal screw size		M8 x 0.5 x 6
Applicable wire size		0.7 to 2mm^2
Applicable solderless terminal		V1.25 – 4, V1.25 – YS4A, V2 – S4, V2 – YS4A
Applicable tightening torque		7 kg•cm (ft-lb)
External dimensions (mm) (in)		250 x 75.5 x 121 (9.84 x 2.97 x 4.76)
Weight kg (lb)		0.9 (0.198)

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POINT

*1: Current overload protection

If a current larger than the sepcified value runs in the circuit, the current overload protection shuts the circuit OFF and functions in each case as follows:

(a) Both +15 VDC and –15 VDC will go OFF if there is current overload on the +15 V side;

(b) –15 VDC will be turned OFF and +15 VDC will be delivered if there is current overload on the –15 V side;

(c) The LED indicator on the power supply unit goes OFF or gets dim due to reduced voltage supply.

When this device is activated, the power supply module LED is either switched OFF or dimly lit. When this happens, remove the cause of the overload and start up the system.

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5.2 Handling

This section gives handling instructions and parts identification for the AD70.

5.2.1 Handling instructions

Precautions when handling of the power supply module between unpacking and installation are given below.

(1) The power supply module case, terminal, and pin connectors are made of plastic. Do not subject the power supply module to impact or shock.

(2) Do not remove the printed circuit boards from the housing. There are no user-serviceable parts on the boards.

(3) Make sure that no conductive debris can enter the module. If any does, make sure to remove it.

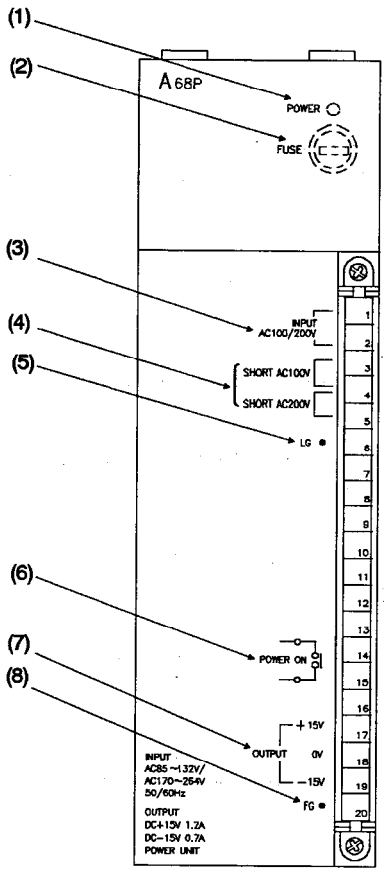
(4) Tighten the module mounting screws (if required) and terminal screws as specified below:

Screw	Tightening Torque (kg•cm)
Module terminal block installation screws (M3)	5 to 8
Module mounting screws (optional) (M4)	8 to 12

(5) To load the module onto the base, make sure that the hook is securely attached onto the base and gently swing the module into place. Make sure that the top catch engages. To remove, press the top catch down and swing the module out before unhooking.

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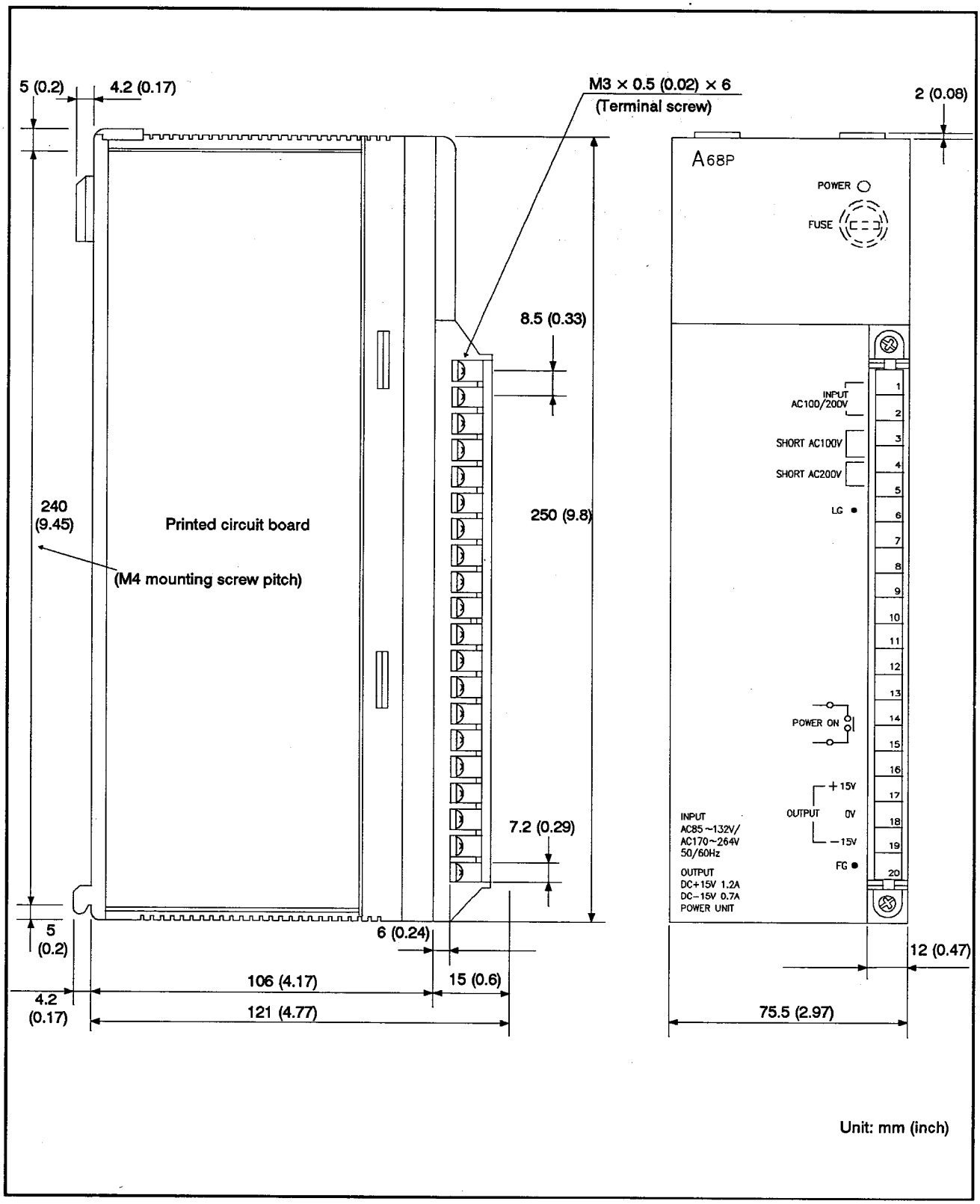
5.2.2 Parts identification



Number	Name	Description
(1)	"POWER" LED	• LED for indicating ±15 VDC power
(2)	Power fuse and fuse holder	• A 4A cartridge fuse for AC input power is held in place by the fuse holder.
(3)	Power input terminals	• Power input terminals for connecting AC power of 100 or 200 VAC.
(4)	Applied voltage select voltage	• Terminals for selecting applied voltage. • When 100 VAC is input, connect the "SHORT AC 100 V" terminals using the attached short chip. • When 200 VAC is input, connect the "SHORT AC 200 V" terminals using the attached short chip.
(5)	LG terminal	• Grounds the power filter. • Has half the input potential.
(6)	Power ON terminal	• Contact terminal which normally conducts at ±15 VDC output when the power input is turned ON.
(7)	+15 V, 0 V, and -15 V terminals	• For supplying ±15 VDC to a unit requiring this voltage (via external wiring).
(8)	FG terminal	• Connection terminal joined to the shielding pattern on the printed circuit board.

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5.3 Dimensions



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IMPORTANT

The components on the printed circuit boards will be damaged by static electricity, so avoid handling them directly. If it is necessary to handle them, take the following precautions.

(1) Ground human body and work bench.

(2) Do not touch the conductive areas of the printed circuit board and its electrical parts with any non-grounded tools, etc.

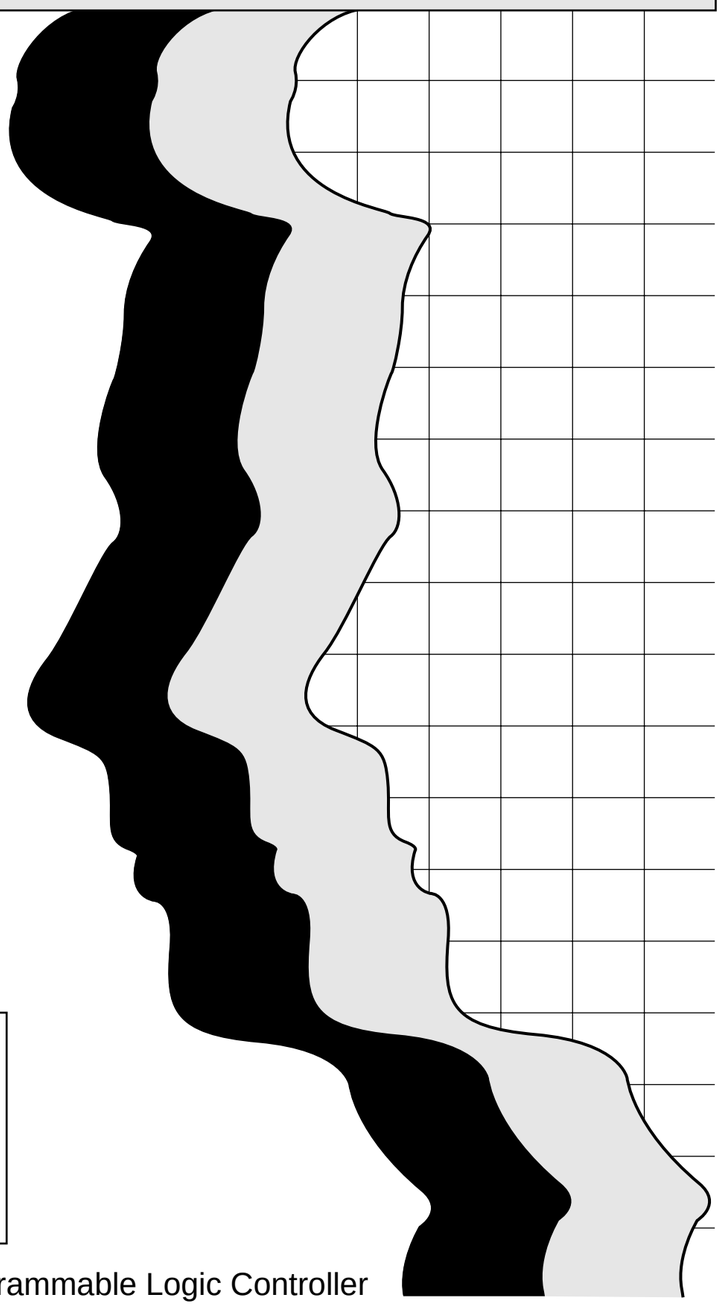
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MITSUBISHI

Positioning module type AD70
User’s Manual

Positioning module type AD70
User’s Manual

Positioning module type AD70



MODEL	AD70-USERS-E
MODEL CODE	13J663
IB(NA)66309-A(9104)MEE	

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A
MELSEC

Mitsubishi Programmable Logic Controller

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