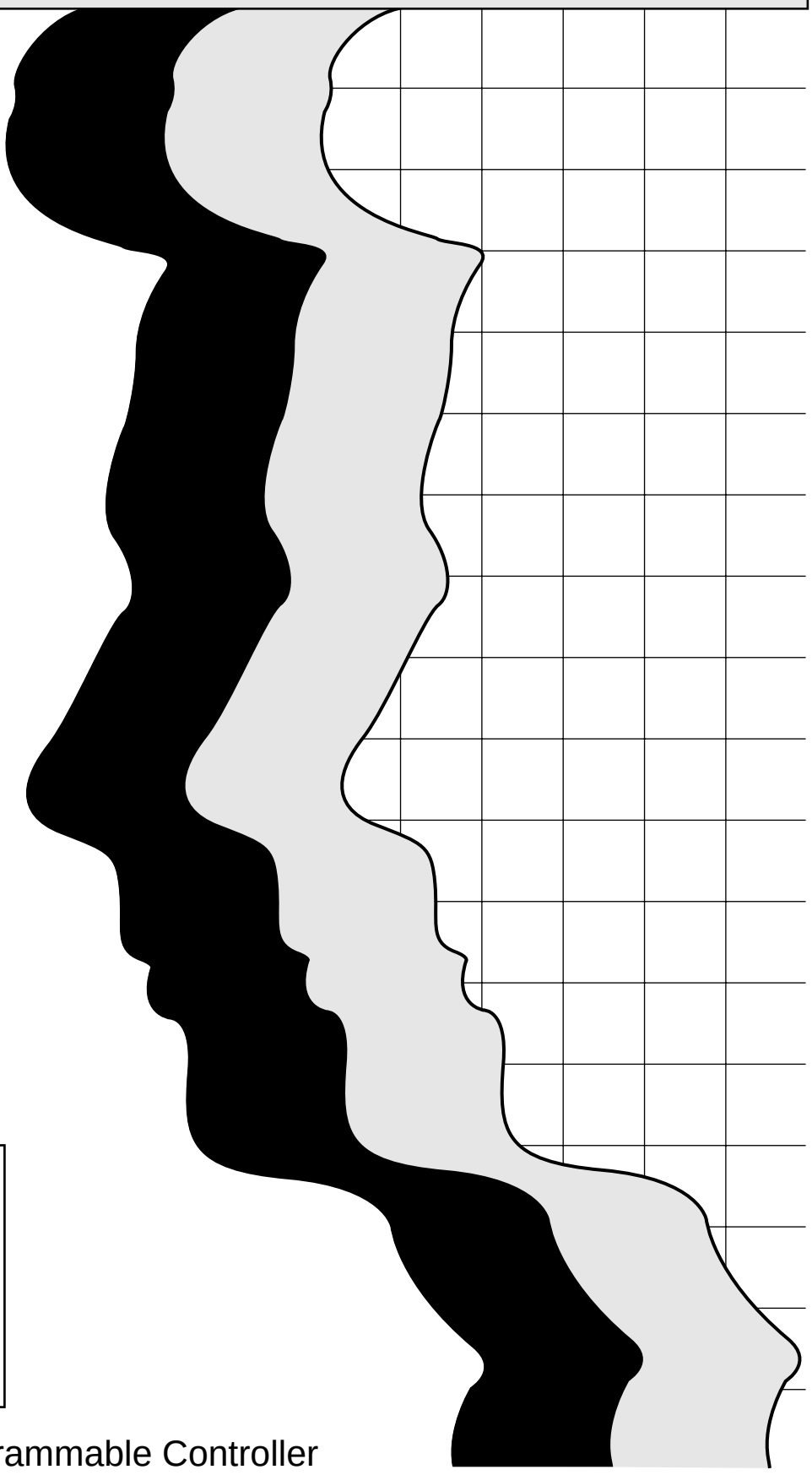
MITSUBISHI

Positioning Module Type A1SD70

User's Manual



MELSEC

Mitsubishi Programmable Controller

● SAFETY PRECAUTIONS ●

(Read these precautions before using.)

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

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

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

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

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

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

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

[System Design Precautions]

DANGER

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

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

[System Design Precautions]

CAUTION

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

[Cautions on Mounting]

CAUTION

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

[Cautions on Wiring]

DANGER

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

[Cautions on Wiring]

CAUTION

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

[Cautions on Startup and Maintenance]

DANGER

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

CAUTION

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

[Cautions on Disposal]

CAUTION

- Dispose of this product as industrial waste.

REVISIONS

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

Print Date	*Manual Number	Revision
Apr.,1994	IB (NA) 66367-A	First edition
May.,1997	IB (NA) 66367-B	Correction Section 1.1, 2.2, 4.4, 4.5.2, 5.1, 5.2.3, 5.6.6, 5.7.4, 5.9, 5.9.1, APP 1.2 Addition SAFETY PRECAUTIONS Chapter 1, Section 3.5.1, 4.5.1, 5.3.4, 5.9.3, APP 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10
Dec.,2003	IB (NA) 66367-C	Addition Conformation to the EMC Directive and Low Voltage Instruction, Section 4.7.5, WARRANTY Partial Correction SAFETY PRECAUTIONS, CONTENTS, Chapter 1, Section 1.1, 1.2, 2.1, 2.2, 3.5.2, 5.3.4, 5.5.3, 5.9.1, APP 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8 Partial Addition CONTENTS, Section 3.7, 4.5.3, 4.7.1, 4.7.4, 5.3, Chapter 6, Section 6.1.1, 6.1.5
Jul., 2007	IB (NA) 66367-D	Partial Correction Section 4.3, APP 2

Japanese Manual Version SH-3520-D

INTRODUCTION

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

CONTENTS

Conformation to the EMC Directive and Low Voltage Instruction

For details on making Mitsubishi PLC conform to the EMC directive and low voltage instruction when installing it in your product, please see Chapter 3, "EMC Directive and Low Voltage Instruction" of the User's Manual (Hardware) of the PLC CPU to use.

The CE logo is printed on the rating plate on the main body of the PLC that conforms to the EMC directive and low voltage instruction.

Refer to Section 4.7.5 to make this product conform to the EMC directive and low voltage instruction.

1. INTRODUCTION

The A1SD70 (hereafter called the A1SD70) is a single positioning control module for use with a MELSEC A series A1SCPU(S1), A1SJCPU(S3), A2S-CPU(S1), A2ASCPU(S1), and A52GCPU(T21B) (hereafter called the PC CPU unless the specific model name is required). This manual gives the specifications, handling, and programming information for the A1SD70.

The A1SD70 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.

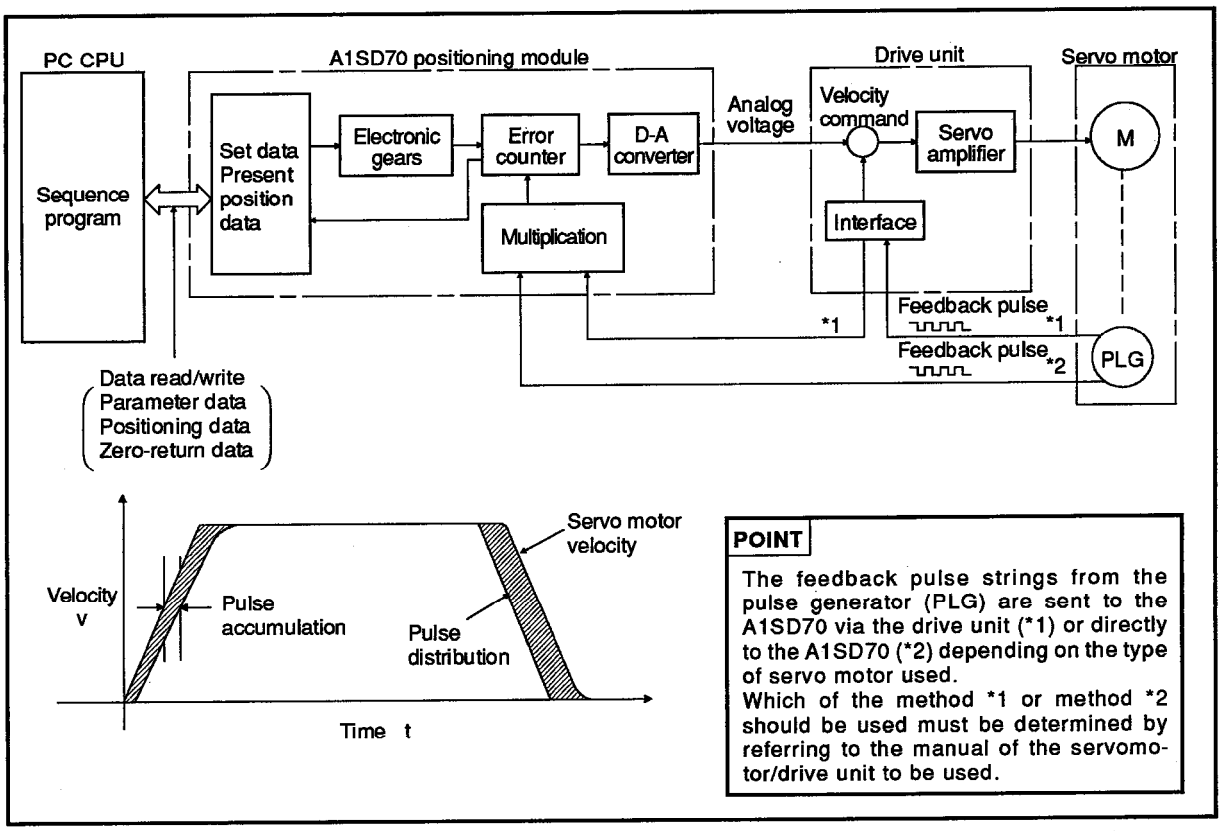
As shown below, the A1SD70 incorporates an error counter and a digital to analog (hereafter D-A) converter. The error counter accumulates the error pulses when a chain of positioning command pulses comes out. The accumulated pulses are then converted to DC analog voltage to be treated as a speed command.

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 A1SD70 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.



REMARK

Peripheral devices (A6GPP, A6PHP, and A6HGP) are collectively called GPP in this manual.

When using the A1SD70, see the following manuals as required:

User's Manual of the PC CPU

The appropriate driving module manual

Make sure that you have the following items:

Item	Quantity
A1SD70 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, A1SD70 I/O numbers assigned by the PC CPU assume that the A1SD70 is installed in slot 0 and 1.

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 A1SD70 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 A1SD70.

(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.

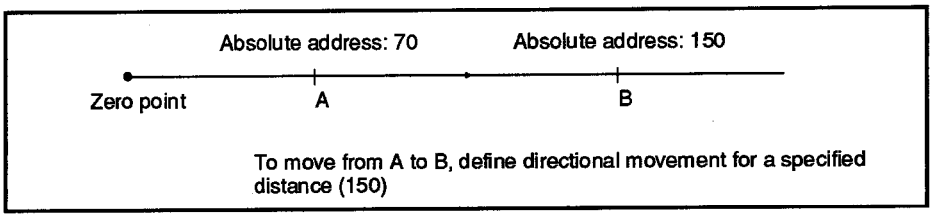
(5) Built-in electronic gear function

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.

1.2 Glossary of Terms

(1) Absolute mode (Absolute address designation)

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



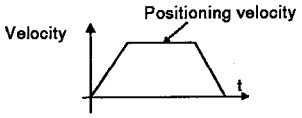
(2) Positioning mode

There are two positioning control modes:

Positioning modes

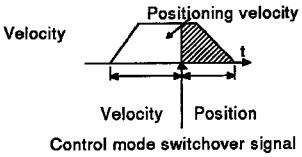
- Position control mode:

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



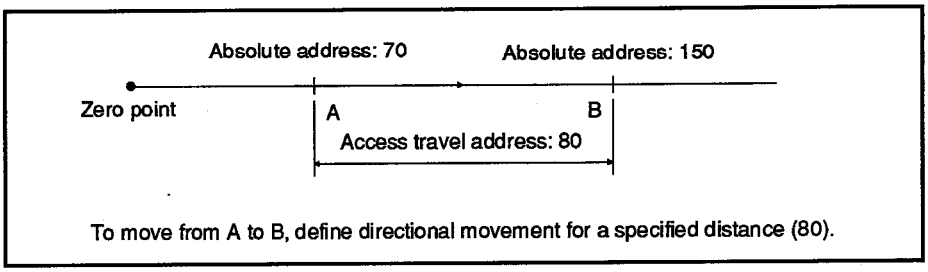
- Velocity/position control switchover mode:

  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 (Travel distance designation)

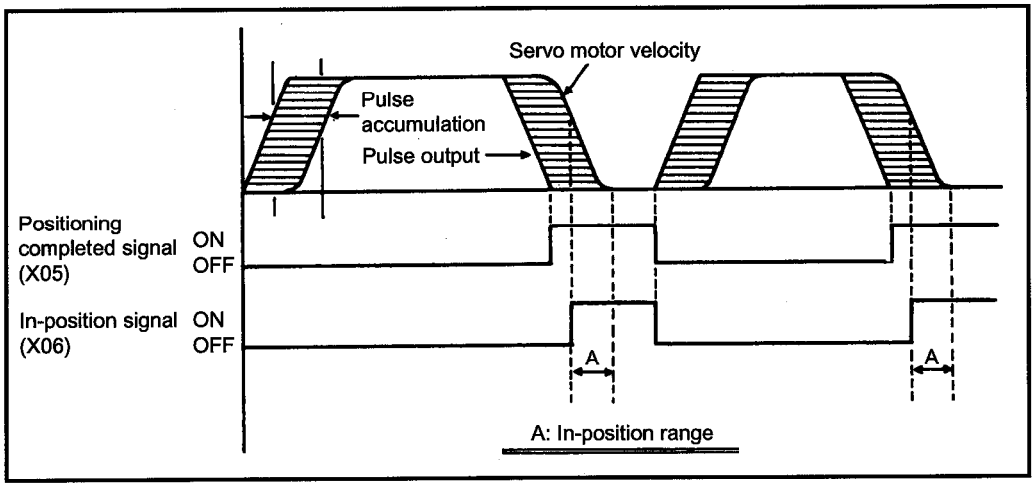
In incremental mode positioning, positions are reached by referencing the previous position.



(4) Positioning completed signal/in-position signal

The positioning completed signal switches ON when pulse output to the deviation counter is completed. The pulses input to the deviation counter are converted by the D/A converter into an analog voltage proportional to the number of pulses, and the analog voltage is output to the drive unit as a velocity command voltage.

The in-position signal switches ON when the deviation counter pulse value is within the setting range.
Any number of pulses can be set within the range 1 to 2047 pulses.

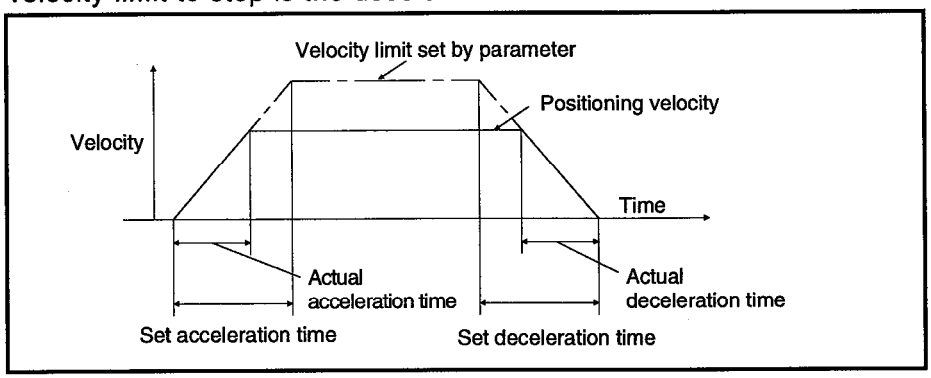


(5) Rotating direction setting

This function determines the motor rotating direction according to the polarity of the output voltage from the A1SD70. 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 A1SD70 can be set independently.

If the set positioning velocity value is faster than the velocity limit set by a parameter, the acceleration/deceleration time becomes comparatively shorter.

Therefore, set the maximum value of the positioning velocity equal to or approximating the velocity limit set by a parameter.

This velocity is valid for zero return, positioning, JOG, and STOP operations.

(7) Creep velocity

This is the low velocity used 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 A1SD70 can select any of the following four ranges to determine the counter's upper limit:

1) 0 to 3700
2) 0 to 7400
3) 0 to 11100
4) 0 to 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.

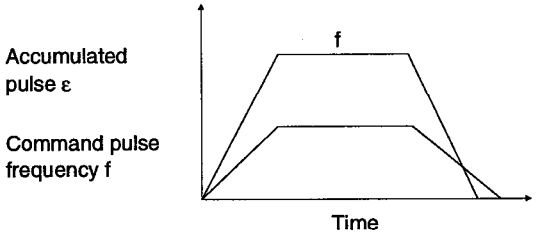
Even if the positioning velocity, zero return velocity, and JOG velocity are set at a value greater than the velocity limit, the operation will still be executed at the velocity limit.

(12) Accumulated pulses

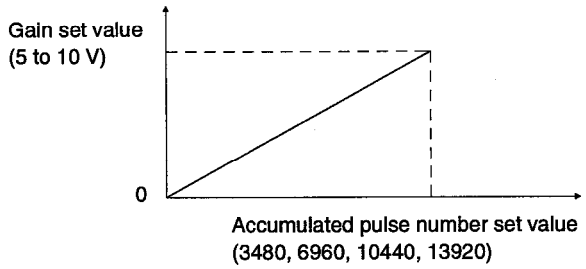
These are produced by subtracting the number of field back pulses from the command pulses. They are accumulated in the error counter.

While the A1SD70 is operating, accumulated pulses occur in proportion to the frequency of command pulses.

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



The A1SD70 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 A1SD70 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 A1SD70.

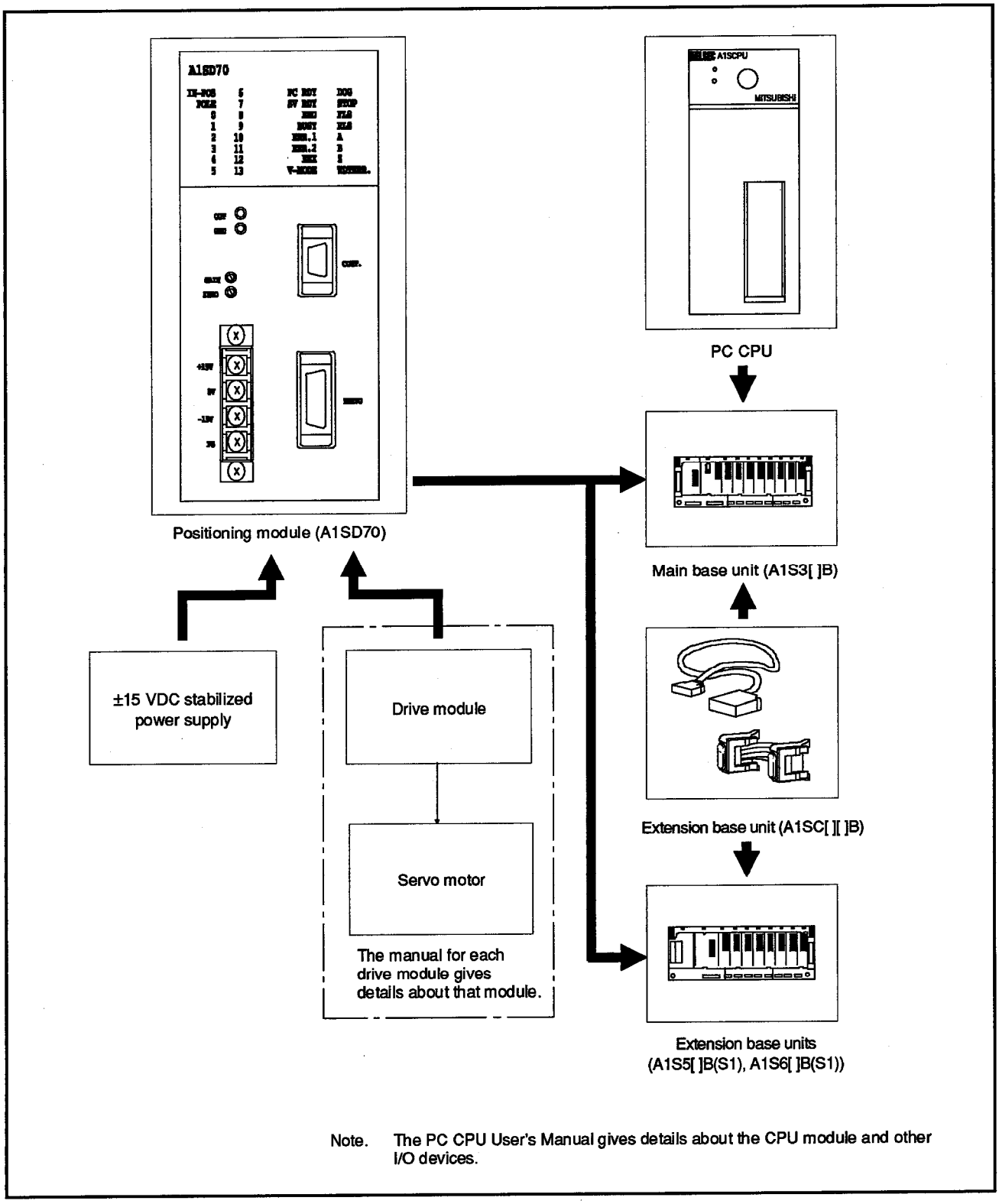
(16) Error counter

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.

2. SYSTEM CONFIGURATIONS

2.1 Overall Configurations



Note. The PC CPU User's Manual gives details about the CPU module and other I/O devices.

Fig. 2.1 System Configuration

2.2 Applicable Systems

(1) Applicable CPU
- A1SJ(H)CPU(S3)
- A1S(H)CPU(S1)
- A2S(H)CPU(S1)
- A2ASCPU(S1)
- A2USHCPU(S1)
- A52GCPU(T21B)
- Q2AS(H)CPU(S1)

(2) Number of modules
There are no restrictions on the number of modules that can be used as long as the number of I/O points is within the allowable range of I/O points of the PC CPU to be used with.

(3) Module installation slots
Positioning modules can be installed at any slots in the base unit. However, the following items must be carefully observed when installing the positioning modules to the base unit.
If a positioning module is installed to the extension base unit (A1S52B(S1), A1S55B(S1), A1S58B(S1)) that does not have the power supply module, there will be cases the power capacity will be insufficient. When installing the A1SD70 to the extension base unit that does not have the power supply module, select the power supply module, main base unit, extension base unit, and extension cable, taking into consideration the following factors.

1) Current capacity of the power supply module on the main base unit
2) Voltage drop at the main base unit
3) Voltage drop at the extension base unit
4) Voltage drop at the extension cable

(4) Data link system
In the data link system, the module can be installed in any of a master station, local station, and remote I/O station. For example programs when the module is installed at the remote I/O station, refer to MELSECNET, MELSECNET/B Data Link System Reference manual.

REMARK

For the range of I/O points and the calculation of voltage drop, refer to the following manuals.

- A1SJCPU(S3) User's manual IB-66446
- A1S/A1SC24-R2/A2SCPU(S1) User's manual IB-66320
- A1SJHCPU/A1SHCPU/A2SHCPU(S1) User's manual IB-66779
- A2ASCPU(S1) User's manual IB-66455
- A2USHCPU-S1 User's manual IB-66789
- Q2AS(H)CPU(S1) User's manual SH-3599
- A52GCPU(T21B) Reference manual IB-66420

3. SPECIFICATIONS

This chapter describes the general specifications performance specifications, and I/O conversion characteristics of the A1SD70.

3.1 General Specifications

Table 3.1 shows the general specifications of the A1SD70.

Table 3.1 General Specifications

Item	Specifications				
Operating ambient temperature	0 to 55°C				
Storage ambient temperature	–20 to 75°C				
Operating ambient humidity	10 to 90%RH, non-condensing				
Storage ambient humidity	10 to 90%RH, non-condensing				
Vibration resistance	Conforms to *JIS C 0911	Frequency	Acceleration	Amplitude	Sweep Count
		10 to 55 Hz	—	0.075 mm (0.003 in)	10 times **(1 octave/minute)
		55 to 150 Hz	9.8 m/s^2 (1g)	—	
Shock resistance	Conforms to *JIS C 0912 [98m/s^2 (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 1500 VAC for 1 minute across AC external terminals and ground				
Insulation resistance	5 MΩ or larger by 500 VDC insulation resistance tester across AC external terminals and ground				
Grounding	Class 3 grounding : If appropriate grounding is not available, connect the grounding wire to the electric panel.				
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.

3.2 Performances and Spcifications

Table 3.2 Performances and Specifications

Item		Performances and Specifications
Number of I/O points		48 points* (number of occupied slots: 2)
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/s)
	Acceleration and deceleration	Automatic trapezoidal acceleration and deceleration
	Acceleration and deceleration times	Acceleration ····· 2 to 9999 (ms) Deceleration ····· 2 to 9999 (ms)
	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)		130(H) x 69.5(W) x 93.6(D) (5.12 x 2.74 x 3.69)
Weight (kg) (lb)		0.4 (0.88)

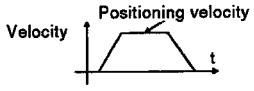
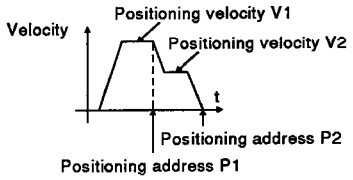
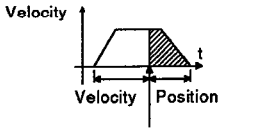
REMARK

* The I/O allocation of the two-slot area must be done as follows: (see also Section 5.1)

First-half slot: 16 vacant points
Second-half slot: 32 special-function module points

3.3 Functions

Table 3.3 A1SD70 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 A1SD70 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 A1SD70 positioning.	1.2

3.4 A1SD70 Interfaces

Communications between the PC CPU and an A1SD70

- 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 A1SD70 buffer memory using PC CPU application instructions.

- Communications between the drive unit and an A1SD70

  The A1SD70 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.

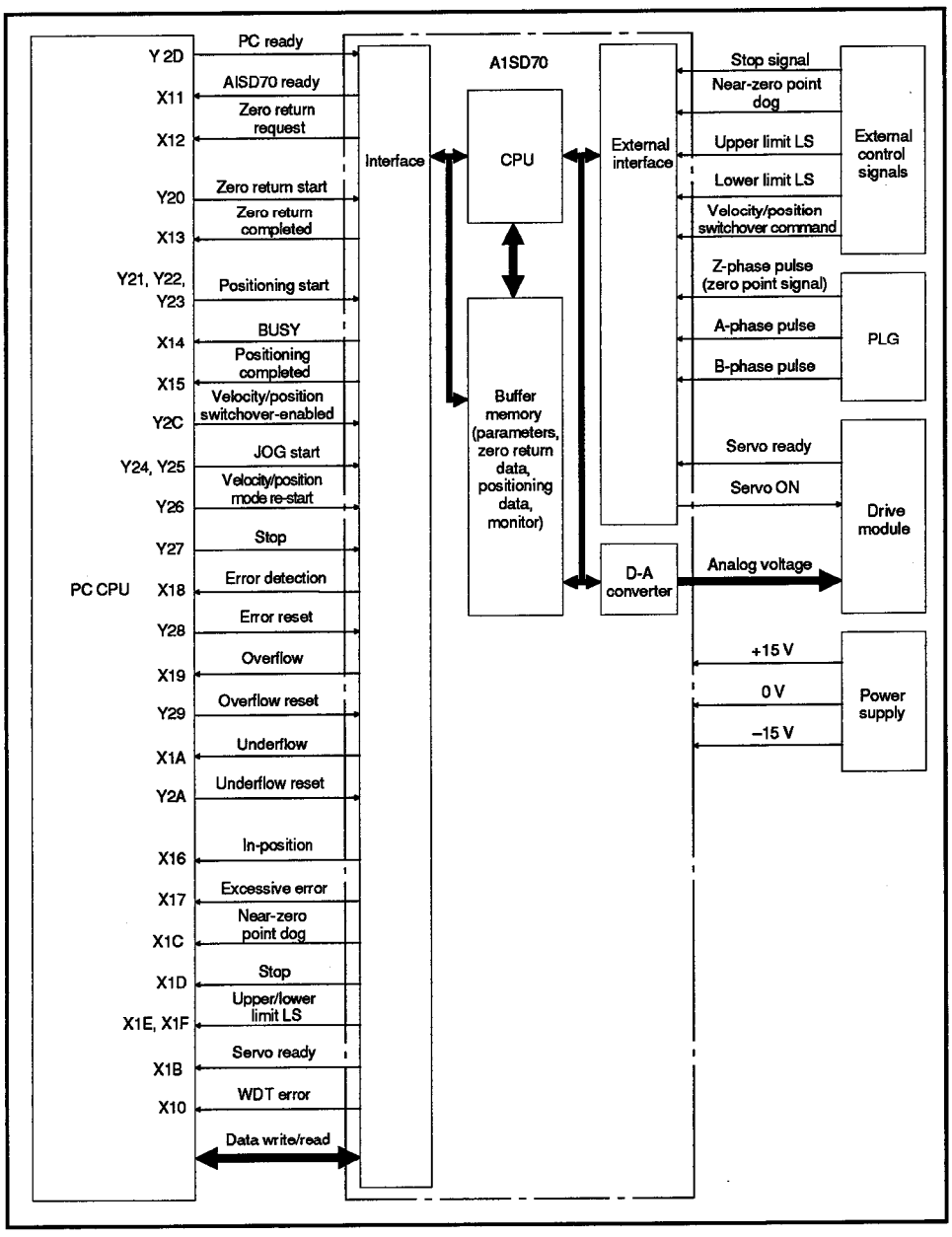


Fig. 3.1 A1SD70 Functions Block Diagram

3.5 Interface with External Device

3.5.1 A1SD70 electrical specifications

Table 3.4 gives the electrical specifications for A1SD70 I/O signals.

Table 3.4 A1SD70 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 mA x 6 per point)
		Terminal block	±15 VDC (±14.55 to 15.45 V) Ripple voltage : 50 mVp-p or less Spike voltage : 100 mVp-p or less Current consumption:+ 15 V 200 mA – 15 V 200 mA
	Servo ready ($\overline{\text{READY}}$) Stop signal ($\overline{\text{STOP}}$) Near-zero point signal ($\overline{\text{DOG}}$) Upper limit ($\overline{\text{FLS}}$) Lower limit ($\overline{\text{RLS}}$) Velocity/position switchover command ($\overline{\text{CHANGE}}$)		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 ($\overline{\text{PULSE A}}$) B-phase feedback pulse ($\overline{\text{PULSE B}}$) Z-phase feedback pulse ($\overline{\text{PULSE Z}}$)		Pulse frequency: 100k PPS or less Pulse rise time: 1 μs or less Pulse fall time: 1 μs or less HIGH: 4 V or more LOW: 1 V or less
	(TTL method) A-phase feedback pulse ($\overline{\text{PULSE A}}$) B-phase feedback pulse ($\overline{\text{PULSE B}}$) Z-phase feedback pulse ($\overline{\text{PULSE Z}}$)		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 ($\overline{\text{PULSE A}}$) B-phase feedback pulse ($\overline{\text{PULSE B}}$) Z-phase feedback pulse ($\overline{\text{PULSE Z}}$)		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.

3.5.2 I/O Interface between an external device and an A1SD70

Table 3.5 Specifications of the I/O Interface with External Device and A1SD70

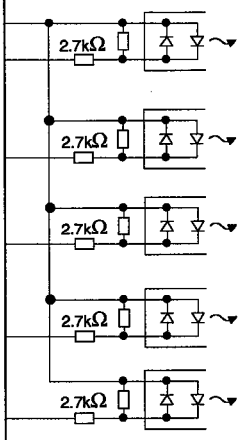
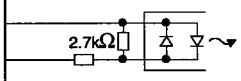
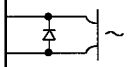
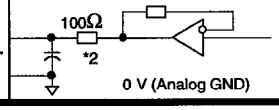
Con-nector	I/O	Pin No.	Internal Circuit	Signal	Description
CONT	Input	5 1 9 7 6 8		Power supply	5 VDC to 24 VDC
				Near-zero point signal/ $\overline{\text{DOG}}$	Used to detect the "near-zero point" during zero return operation. The signal is turned on when near-zero point dog is detected.
				Stop signal/ $\overline{\text{STOP}}$	Low to stop positioning. Signal duration should be longer than 20 ms.
				Upper limit LS/FLS	Upper stroke limit switch. Positioning stops when OFF.*1
				Lower limit LS/RLS	Lower stroke limit switch. Positioning stops when OFF.*1
				Velocity/position switchover command/$\overline{\text{CHANGE}}$	Used as the control switchover command in the velocity/position control switchover mode.
SERVO	Input	1 2		Servo ready/ $\overline{\text{READY}}$	Turns ON when the servo drive unit is normal and ready to receive feed pulse signals.
	Output	3 4		Servo ON/ SVON	Turns ON automatically at power-on of the system if there is no hardware fault. Turned OFF if an error excessive error occurs or if an error is detected by the self-diagnostics of the A1SD70 hardware. When external 15V power is OFF, the servo signal turns OFF. (Be sure to wire this signal to prevent servo malfunction.)
		15 14		Velocity command	The amount of accumulated pulses is converted into analog voltage output.

Table 3.5 Specifications of the I/O Interface with External Device and A1SD70 (continued)

Connector	I/O		Pin No.	Internal Circuit	Signal	Description
SERVO	Input	Near-zero point signal	13	5V, 1k Ω, 1k Ω, Equivalent to SN75115	Phase A feedback pulse	Connect to the encoder pulse output.
			11			
			5	1k Ω, 1k Ω	Phase B feedback pulse	
			10			
			6	1k Ω, 1k Ω	Phase Z feedback pulse	
			7			
			9	0 V	Analog GND	
		Open collector input	13	12V, 1.2k Ω	Phase A feedback pulse	The input voltage is raised to 12 V inside the module. Connect to the encoder pulse output.
			11			
			5	12V, 1.2k Ω	Phase B feedback pulse	
			10			
			6	12V, 1.2k Ω	Phase Z feedback pulse	
			7			
			9	0 V	Analog GND	
		TTL input	13	5V, 900 Ω	Phase A feedback pulse	Connect to the encoder pulse output.
			11			
			5	5V, 900 Ω	Phase B feedback pulse	
			10			
			6	5V, 900 Ω	Phase Z feedback pulse	
			7			
			9	0V	Analog GND	
Terminal block	Input		+15V		External power supply	Connect to ±15V power supply.
			0V	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.

3.6 Set Data

When using the A1SD70, the following three blocks of data are required for positioning. They are set from the sequence program.

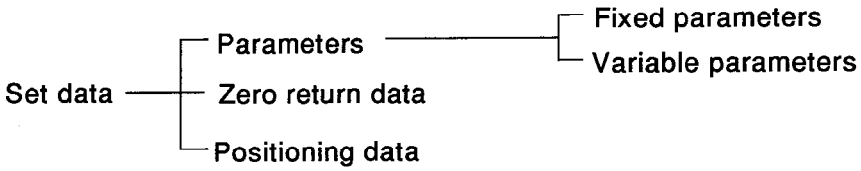


Table 3.6 Set Data

Data No. / Item					Setting Range	Default	Reference
Parameters	Fixed parameters	1	Upper stroke limit		–2147483648 to 2147483647 PLS (signed 32-bit data)	2147483647 PLS	5.2
		2	Lower stroke limit		–2147483648 to 2147483647 PLS (signed 32-bit data)	0 PLS	
		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/s (Set in units of 10 PLS/s)	200,000 PLS/s	
		6	Acceleration time		2 to 9999 ms	300 ms	
		7	Deceleration time		2 to 9999 ms	300 ms	
		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/s	10,000PLS/s	
		12	Creep velocity		1 to 400,000 PLS/s	1,000PLS/s	
		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/s	0	

MEMO

3.7 Buffer Memory

The A1SD70 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 A1SD70 to execute positioning.

Buffer memory data read

Buffer memory addresses are specified by access commands (FROM/DFRO) 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 A1SD70.

General conditions for writing are given in Figure 3.2. Sections 5.2 to 5.11 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	Y2D 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	Y2D 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

		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)

POINT

Among the special function module processings, access from the PLC CPU is processed with priority.

Therefore, frequent access from the PLC CPU to the special function module buffer memory will not only increase the scan time of the PLC CPU but will also cause a delay in the special function module processings.

Access from the PLC CPU to the buffer memory using the FROM/TO instructions, etc. should be made only when necessary.

3.8 I/O Signals To and From the PC CPU

The A1SD70 uses 16 inputs and 14 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 A1SD70 is installed in slot 0 and 1of the main base unit.

Device X indicates an input signal from the A1SD70 to the PC CPU. Device Y indicates an output signal from the PC CPU to the A1SD70.

Table 3.7 I/O Signals

Signal Direction: A1SD70 to PC CPU		Signal Direction: PC CPU to A1SD70	
Device No.	Signal	Device No.	Signal
X0 to XF	Reserved	Y0 to YF	Reserved
X10	WDT error, H/W error	Y10 to Y1F	Reserved for use by the OS
X11	A1SD70 ready complete		
X12	Zero return request		
X13	Zero return completion		
X14	BUSY		
X15	Positioning completion		
X16	In-position		
X17	Servo error excessive		
X18	Error detection		
X19	Overflow		
X1A	Underflow		
X1B	Servo ready		
X1C	Near-zero point dog		
X1D	Stop (external stop signal)		
X1E	Upper limit LS		
X1F	Lower limit LS		
X20 to X2F	Reserved (ON when X20 to X2F are monitored.)	Y20	Zero return start
		Y21	Absolute positioning start
		Y22	Forward start (in the incremental mode and velocity/position control switchover mode)
		Y23	Reverse start (in the incremental mode and velocity/position control switchover mode)
		Y24	Forward JOG start
		Y25	Reverse JOG start
		Y26	Velocity/position mode re-start
		Y27	Stop
		Y28	Error reset
		Y29	Overflow reset
		Y2A	Underflow reset
		Y2B	Servo OFF
		Y2C	Velocity/position switchover enabled
		Y2D	PC READY

Table 3.7 I/O Signals (continued)

Signal Direction: A1SD70 to PC CPU		Signal Direction: PC CPU to A1SD70	
Device No.	Signal	Device No.	Signal
X20 to X2F	Reserved (ON when X20 to X2F are monitored)	Y2E, Y2F	Reserved for use by the OS

IMPORTANT

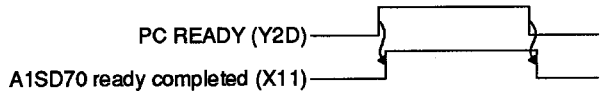
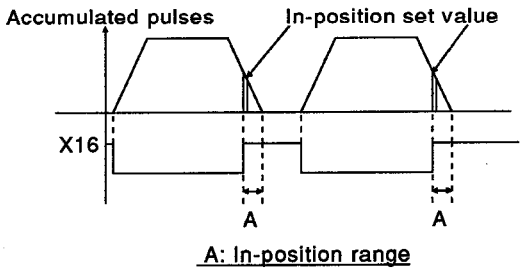
X20 to X2F and Y10 to Y1F, Y2E, and Y2F are reserved for OS use.

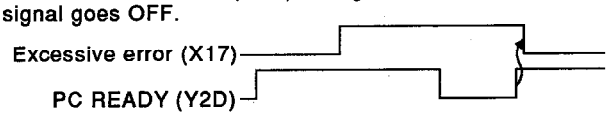
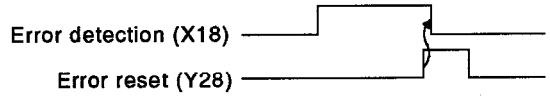
If the above devices are switched ON/OFF from the sequence program, normal functions of the A1SD70 cannot be guaranteed.

I/O signal details

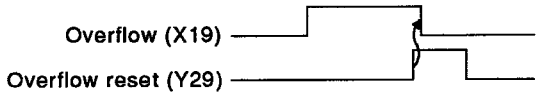
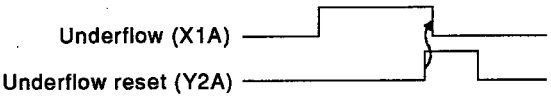
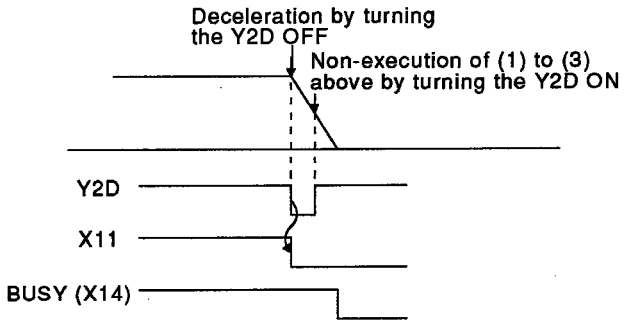
I/O signals, ON/OFF timing, and operating conditions are explained below.

Sections 5.3.4, 5.4.4, and 5.8.4 give timing details.

Device No.	Signal	Description
X10	WDT error	Turns ON when the A1SD70 self-diagnosis detects a WDT error. The servo motor immediately stops.
X11	A1SD70 ready completed	Checks the fixed parameters and servo parameters. It turns ON the A1SD70 ready complete signal (X11) when the PC READY (Y2D) is switched ON from the sequence program. X11 goes OFF when the Y2D is switched OFF. It is used for interlocking, etc., in the sequence program. 
X12	Zero return request	Turns ON in the following cases and OFF when zero return operations are completed: 1)At re-start of the A1SD70 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 (Y2D) changes from OFF to ON, the X12 cannot be turned ON.
X13	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.
X14	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.
X15	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.
X16	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

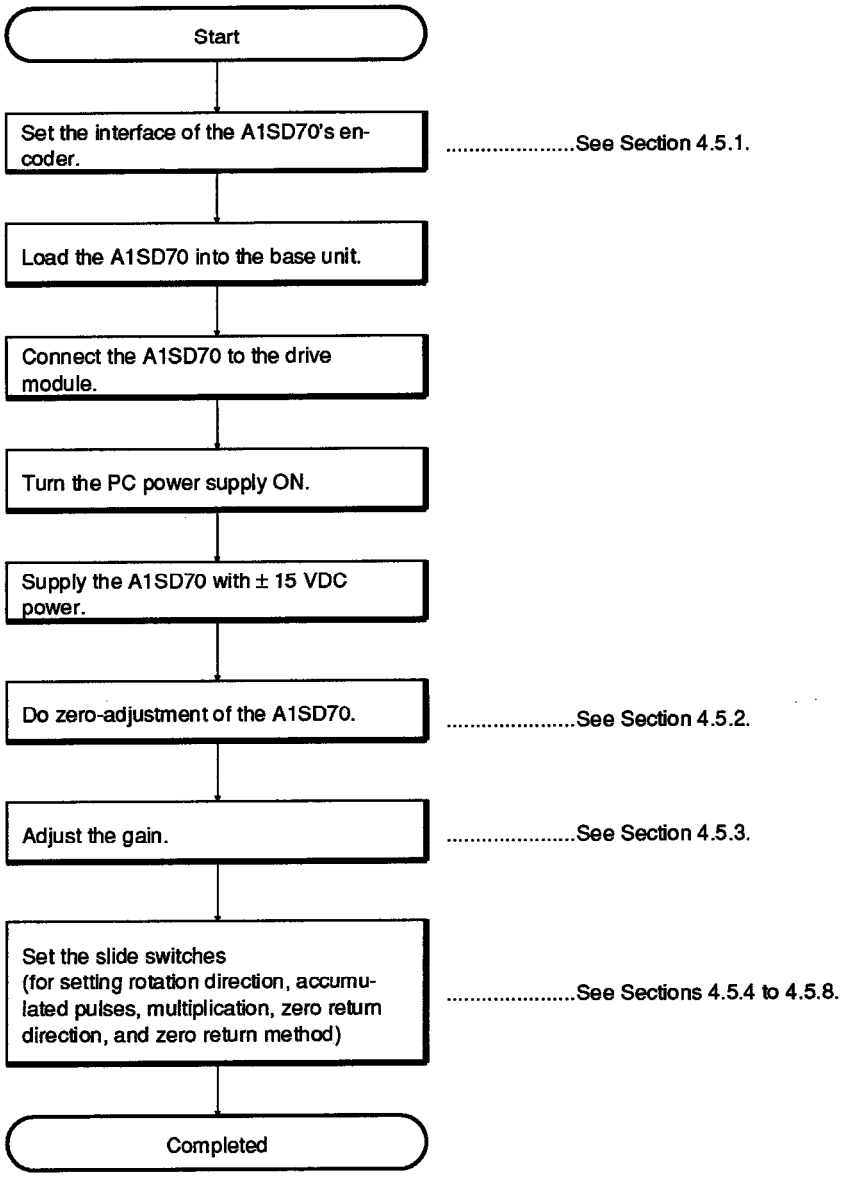
Device No.	Signal	Description
X17	Excessive error	Goes ON when the accumulated pulses exceed the set range (See Section 4.5.5). The A1SD70 shows the following in that state: 1) 0 volts output voltage 2) Accumulated pulses reset to zero 3) Servo ON signal (SVON) goes OFF 4) "EEX" LED turned ON 5) Actual current data equals feed position data When the PC READY (Y2D) changes from OFF to ON, this signal goes OFF.  The error detection signal is not turned ON.
X18	Error detection	Sets the corresponding error code. A major, minor, or servo error turns X18 ON. Goes OFF when the error reset signal (Y28) is turned ON. 
X19	Overflow	Goes ON when the present value exceeds 2147483647 using the JOG operation (velocity control operation). Goes OFF when the overflow reset signal (Y29) is turned ON. The present value 2147483647 becomes –2147483648 to 0.
X1A	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 signal (Y2A) is turned ON. The present value –214748368 becomes 2147483647 to 0.
X1B	Servo ready	Indicates the connected servo's ready state.
X1C	Near-zero point dog	Indicates the ON/OFF status of the external near-zero point dog signal (DOG).
X1D	Stop	Indicates the ON/OFF status of the external stop signal (STOP).
X1E	Upper limit LS	Indicates the ON/OFF status of the external upper limit LS signal (FLS).
X1F	Lower limit LS	Indicates the ON/OFF status of the external lower limit LS signal (RLS).

<table>
<tr><th>Device No.</th><th>Signal</th><th>Description</th></tr>
<tr><td>Y20</td><td>Zero return start</td><td>Valid at startup. The zero return request (X12) and the BUSY (X14) signals are switched ON by the zero return start.</td></tr>
<tr><td>Y21</td><td>Absolute positioning start</td><td>Valid at startup. The BUSY signal (X14) is turned ON by the positioning start.</td></tr>
<tr><td>Y22</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 (X14) is turned ON by the forward start.</td></tr>
<tr><td>Y23</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 (X14) is turned ON by the reverse start.</td></tr>
<tr><td>Y24</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 (X14) is turned ON by the forward JOG start.</td></tr>
<tr><td>Y25</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 (X14) is turned ON by the reverse JOG start.</td></tr>
<tr><td>Y26</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 (X14) is turned ON by the velocity/position mode re-start.</td></tr>
<tr><td>Y27</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 (Y27) is turned ON during zero return operations, the error detection signal (X18) goes ON.</td></tr>
</table>

Device No.	Signal	Description
Y28	Error reset	Clears the buffer memory error codes (addresses 104 and 105) to 0. The error detection signal (X18) goes OFF. Valid when ON.
Y29	Overflow reset	Resets the overflow signal (X19). Valid when ON. 
Y2A	Underflow reset	Resets the under flow signal (X1A). Valid when ON. 
Y2B	—	Unavailable
Y2C	Velocity/position switchover enabled	Enables/disables the control switchover signal in the velocity/position control switchover mode. Enabled when ON; disabled when OFF.
Y2D	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) A1SD70 ready complete signal (X11) ON (3) Initial servo communications (servo parameter transmission) Turning the Y2D OFF while the A1SD70 BUSY signal is ON causes the positioning to decelerate and stop. If the Y2D is turned ON while the BUSY signal is ON, the control actions above will not be executed. 

4. PRE-OPERATION SETTINGS AND PROCEDURES

4.1 Pre-Operation Settings and Procedures



4.2 Handling Instructions

(1) Protect the A1SD70 from vibrations and mechanical shocks.

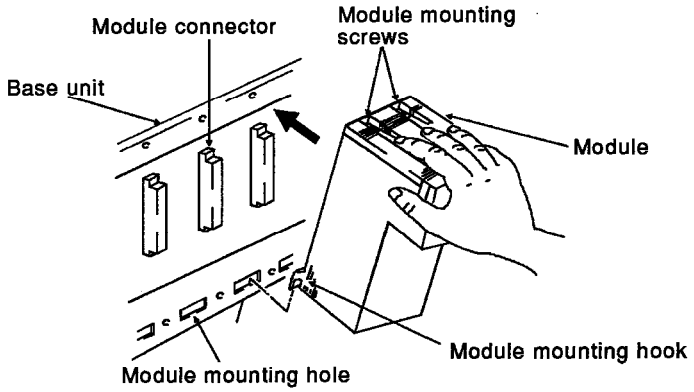
(2) Keep conductive debris out of the unit.

(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.

(5) To install the module to a base unit, first put the module mounting hook in the module mounting hole, and then tighten the two module mounting screws to secure the module.

To remove the module, loosen and remove the two module mounting screws first, and then disengage the module mounting hook from the module mounting hole.



IMPORTANT

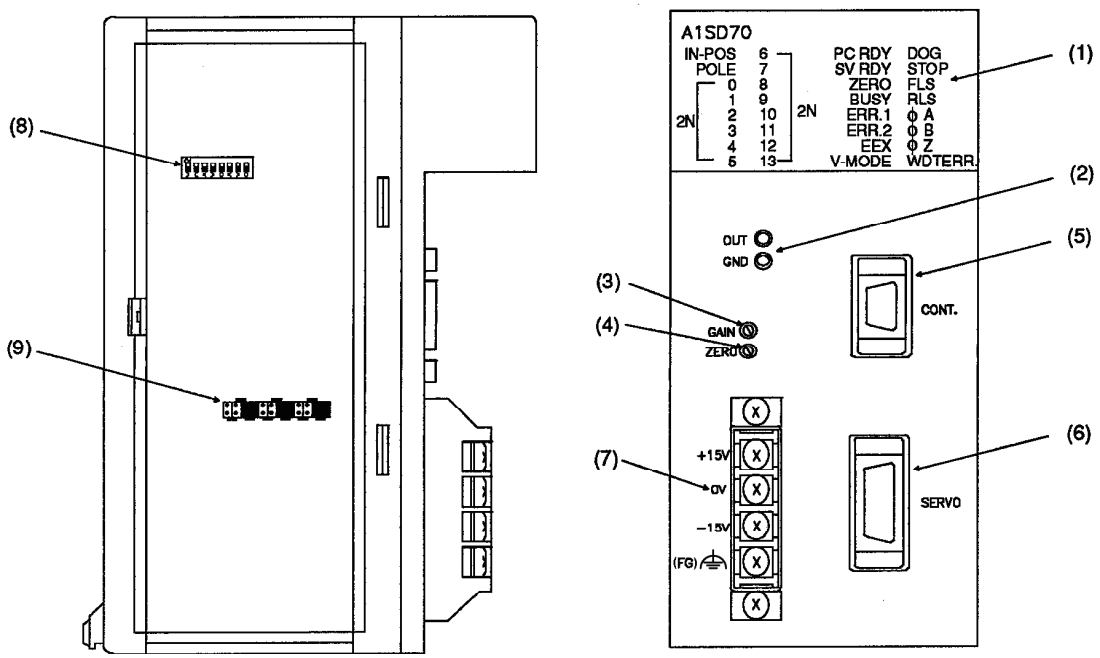
The analog voltage (velocity command) continues to be outputted at PC power OFF until the A1SD70's block power supply is turned OFF (The analog voltage is outputted at the same level as before the PC power went OFF). This should be taken into consideration during use.

However, the A1SD70'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 A1SD70 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.

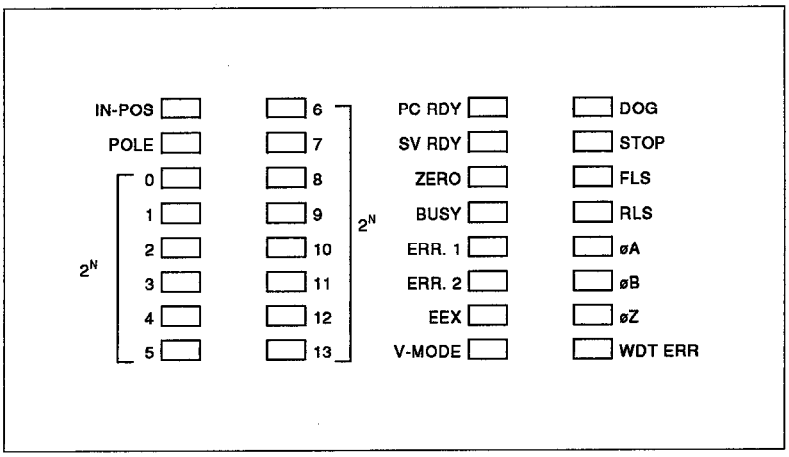
4.3 Nomenclature



No.	Name	Description
(1)	LED	Indicates the operation and error states of the A1SD70 (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 A1SD70. Grounded terminal FG.
(8)	Slide switches	Set the rotation direction, accumulated pulse, multiplication, zero-return direction, and adjustment mode. Section 4.5 explains setting procedures.
(9)	Encoder interface setting pin	Sets output types for phases A, B, and Z. Section 4.5.1 explains setting procedures.

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 −16384 to +16383)	See table below		All OFF
PC RDY	PC READY	Indicates the A1SD70 operation ready state	PC READY (Y2D) ON	PC READY (Y2D) 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.

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 (X12) ON	Zero return request signal (X12) OFF	ON
BUSY	BUSY	Indicates the ON/OFF state of the BUSY signal	BUSY signal (X14) ON	BUSY signal (X14) OFF	OFF
ERR. 1	Minor error	A1SD70 minor error state *2	ON at minor error	No minor error, or OFF after error reset	OFF
ERR. 2	Major error	A1SD70 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 A1SD70 WDT state	WDT error (X10) ON hardware error	WDT error (X10) OFF H/W error	OFF

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

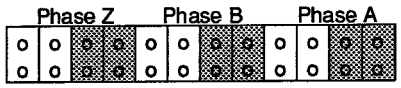
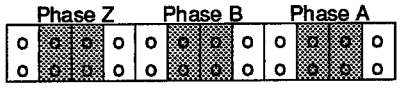
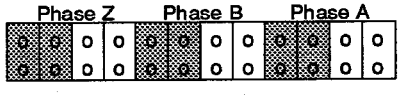
* 2 Section 6 gives error details.

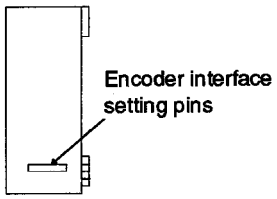
4.5 Settings

4.5.1 Encoder interface setting

Set the encoder interface setting pins on the side of the A1SD70 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	



A1SD70 side view

* ▒▒ indicates the positions of the setting pins.

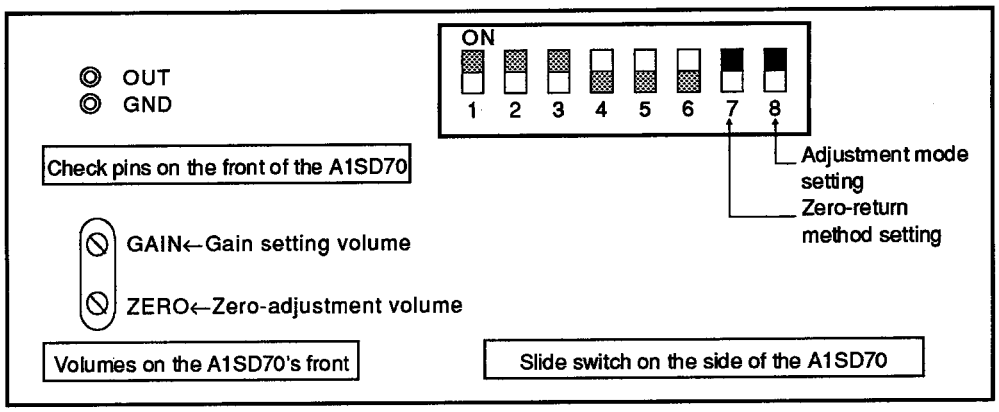
4.5.2 Zero adjustment

Execute zero adjustment using the slide switch and the zero-adjustment volume at the side of the A1SD70.

The analog output is factory-adjusted to zero.

Since there are cases that the adjusted zero point is offset, however, after the connection of the servomotor, carry out zero adjustment again.

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



Zero adjustment is done as follows:

(1) Set the servomotor in the servo lock state.

(2) Turn ON the slide switches (SW7 and SW8) on the side of the A1SD70;

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

(4) 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.

Setting		1	2	3	4
SW2		OFF	ON	OFF	ON
SW3		OFF	OFF	ON	ON
Accumulated pulses	Setting range (5V)	± 2000 to ± 2500 PLS	± 4000 to ± 5000 PLS	± 6000 to ± 7500 PLS	± 8000 to ± 10000 PLS
	Setting range (10V)	± 3250 to ± 3700 PLS	±6000 to ±7400 PLS	± 9750 to ± 11100 PLS	± 13000 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 A1SD70 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.

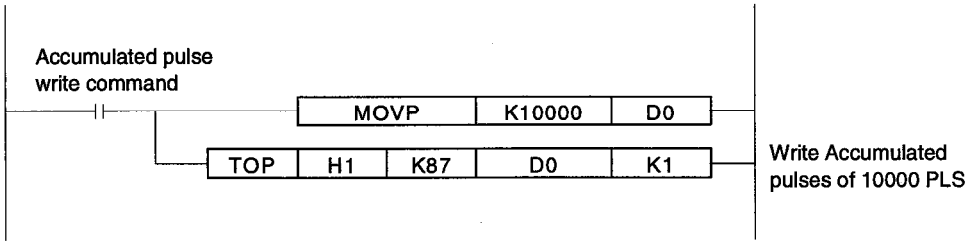
(2) Gain adjustment by setting the number of accumulated pulses

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.



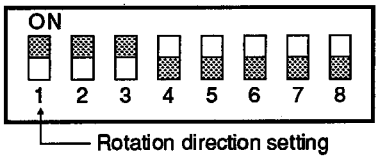
4) Turn the gain setting volume on the front of the A1SD70 so that both ends of the check pins are receiving enough voltage.

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).

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:

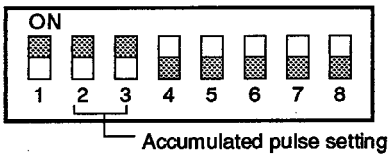
[SW1]	OFF	Negative voltage is output when the positioning addresses increase.
	ON	Positive voltage is output when the positioning addresses increase.

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 A1SD70 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:

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

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 s^{-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

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 A1SD70 is controlled by the accumulated pulses.

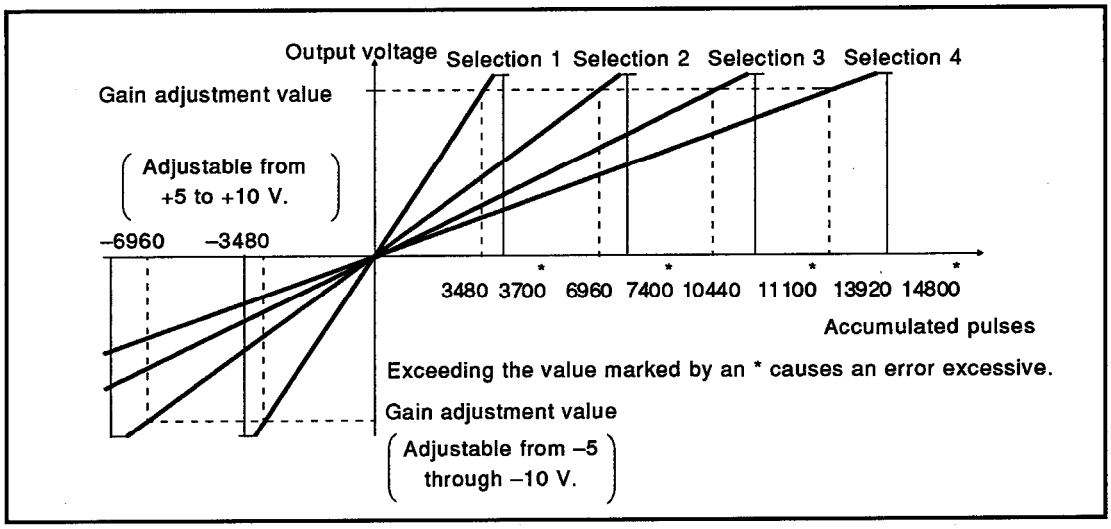


Fig. 4.1 Relationship Between Accumulated Pulses and Analog Voltage Output.

Select a slide switch as shown below:

Example : Maximum speed.....400 kPPS,

Position loop gain.....30 s^{-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

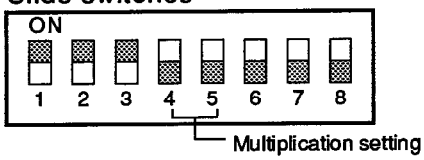
Servo ON signal : OFF

EEX LED (on front) : ON

When resetting the error excessive, change the PC READY signal (Y2D) from OFF to ON.

4.5.6 Multiplication setting

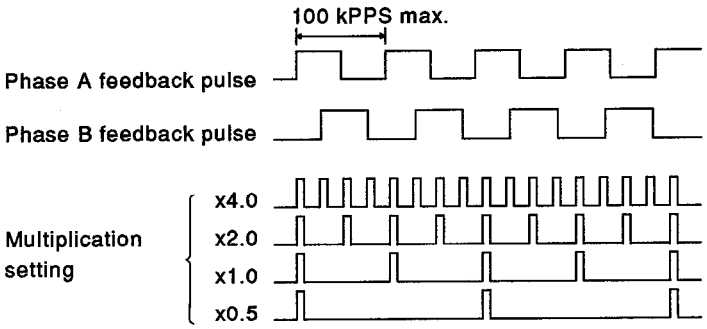
Slide switches



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.

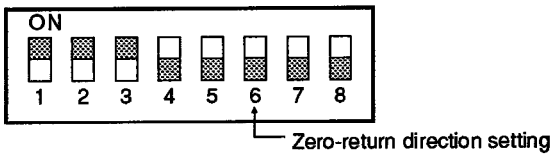
In other words, This function can change the axis travel distance by 1/4, 1/2, 1, and 2.

Slide switches \ Multiplication ratio	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.

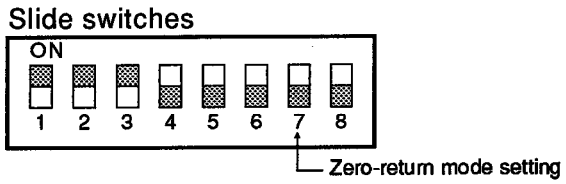
Set the zero-return direction.

[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.

4.5.8 Zero-return mode setting



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

The A1SD70 can be installed in any given slot of the main base or extension unit. However, the A1SD70 should not installed in a extension base (A1S5[ ]B(S1) type extension base) without a power supply module. Doing so could cause a power shortage.

4.7 Wiring

This section describes (a) precautions when doing wiring between the A1SD70 and external devices, and (b) how to use the external wiring connector.

4.7.1 Wiring precautions

Precautions when doing wiring between the A1SD70 and external devices (including a drive unit) are described below. (A connection example is given in Appendix 1.)

(1) Length of connection cable between A1SD70 and drive module

The length of the connection cable between the A1SD70 and the drive module is generally 1 to 3 meters (3 to 10 ft.). 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.

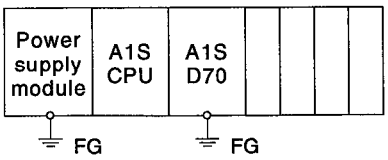
(3) The general lengths of the connection cable between the A1SD70 and an encoder is shown below. However, the distance depends on the encoder specifications. Make sure to confirm the correct specifications

Connect the A1SD70 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.

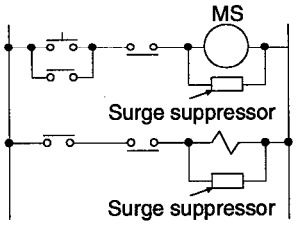
(4) Since the A1SD70 is completely noise proof, it usually does not need special grounding. However, if the A1SD70 is put in (a) noisy surroundings, or (b) in an unstable place, ground it as show below:



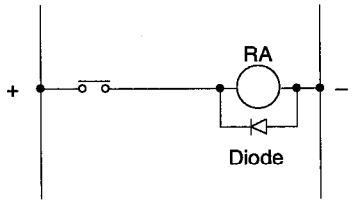
1) The FG terminals of the power supply module and the A1SD70 must be grounded separately and individually. Grounding should conform to JIS Class 3 grounding.

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.

(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) Be sure to connect the A1SD70 to the servo ON signal of the drive unit. In addition, do not turn that signal ON/OFF externally. If the servo ON signal is not connected, the motor may start running when a CPU error occurs or external 15V power switches off.

4.7.2 Precautions when connecting the encoder

Encoder connecting is described in this section.

The A1SD70'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.

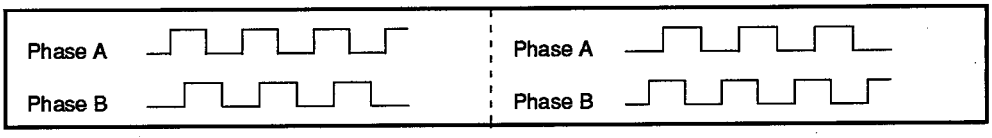


Fig.4.2 Phase A leading B by 90° Feedback Pulse **Fig.4.3 Phase B leading A by 90° Feedback Pulse**

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 A1SD70 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:

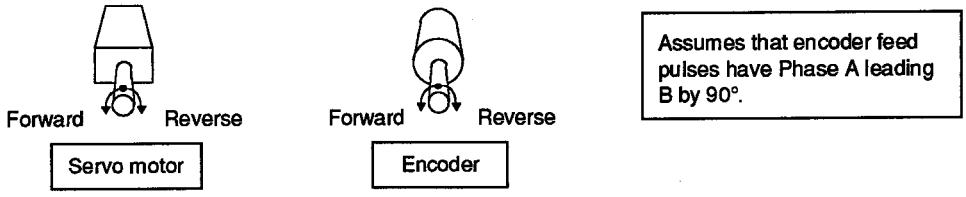
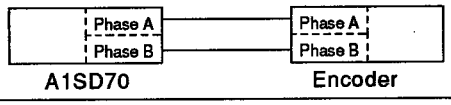
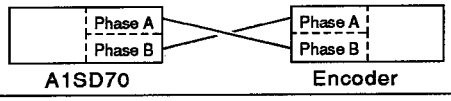
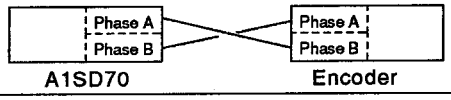
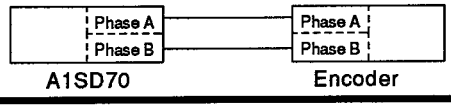


Table 4.1 Connections

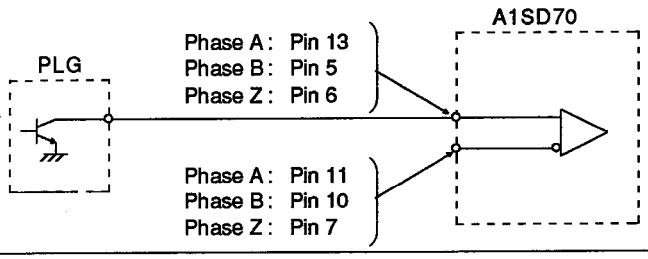
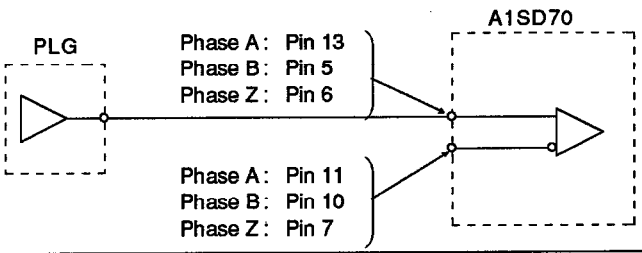
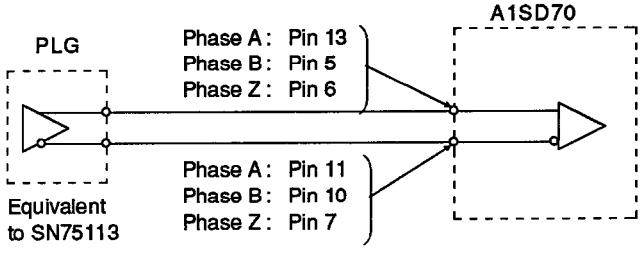
Motor Direction	Slide Switch Direction Setting	Connection	Description
Forward	[SW1] ON		When the rotations of the motor and the encoder are the same.
			When the rotations of the motor and the encoder are different.
Reverse	[SW1] OFF		When the rotations of the motor and the encoder are the same.
			When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

POINT

If the encoder is incorrectly connected to the A1SD70, the motor rotations at power start-up cause an error excessive (EEX).

Table 4.2 shows the connections between the encoder and the A1SD70.

Table 4.2 Connections between the Encoder and the A1SD70.

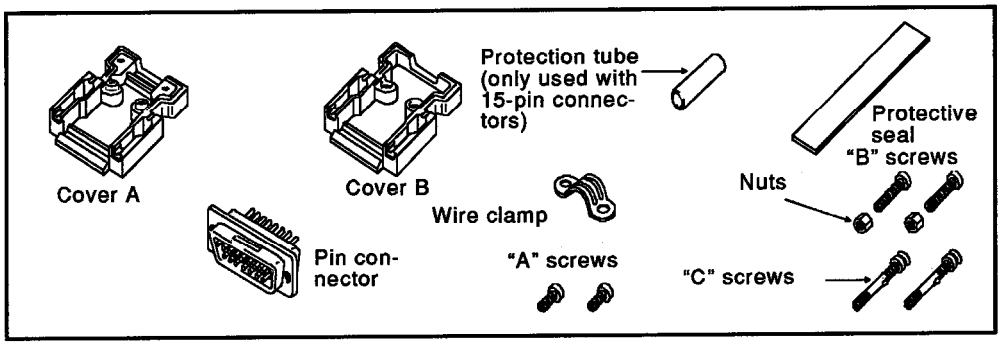
Encoder Type	Connection
Open collector output	
TTL output	
Differential output	

4.7.3 External wiring connectors

The A1SD70 has the following connectors:

9-pin connector (plug) for CONT connections

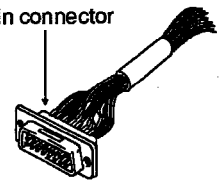
15-pin connector (plug) for SERVO connections



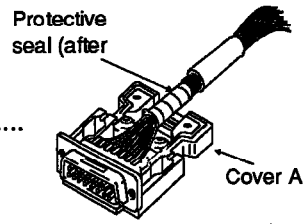
Assemble the connectors as follows:

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).....

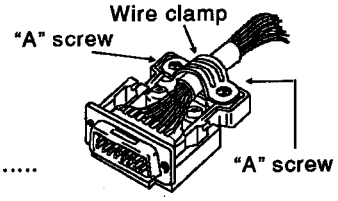


3) Attach the pin connector to cover A, and wrap protective seal around the part of the wires where the wire clamp is fitted.....

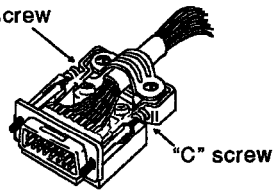


4) Slide the protection tube over the protective seal. (Only used with 15-pin connectors)

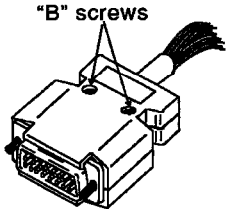
5) Wind protective seal around the cables to protect the insulation.....



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.....

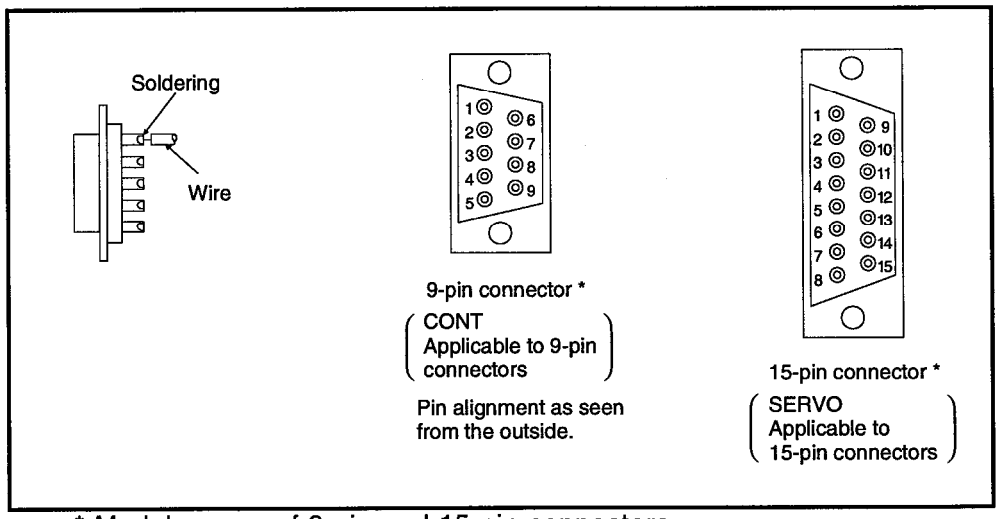


4.7.4 Connectors

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.)



* Model names of 9-pin and 15-pin connectors

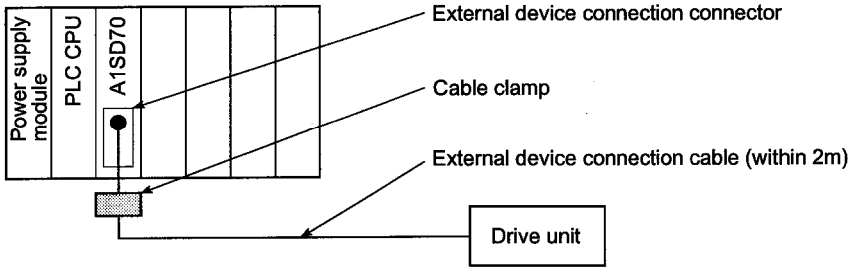
Connector Type	Model Name
External wiring 9-pin connector (pin type)	17JE-23090-02-D8A (DDK, Ltd.)
External wiring 15-pin connector (pin type)	17JE-23150-02-D8A (DDK, Ltd.)

4.7.5 Compliance with EMC and low-voltage directives

To comply with EMC and low-voltage directives, use shielded cables and AD75CK cable clamp (made by Mitsubishi Electric) to ground to the panel.

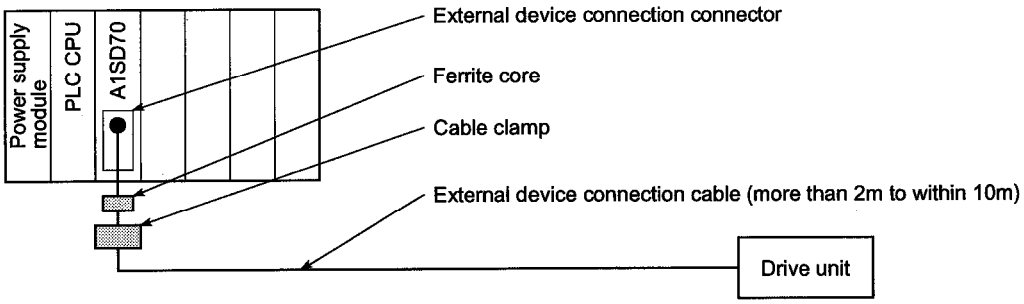
(1) When using cable of within 2m for wiring

- Ground the shield part of the external device connection cable with a cable clamp. (Ground the shield part at the point nearest to the external device connection connector of the A1SD70.)
- Wire the external device connection cable with the drive unit and external device at the shortest distance.
- Install the drive unit within the same enclosure.



(2) When using cable of more than 2m to within 10m for wiring

- Ground the shield part of the external device connection cable with a cable clamp. (Ground the shield part at the point nearest to the external device connection connector of the A1SD70.)
- Wire the external device connection cable with the drive unit and external device at the shortest distance.
- Fit a ferrite core.

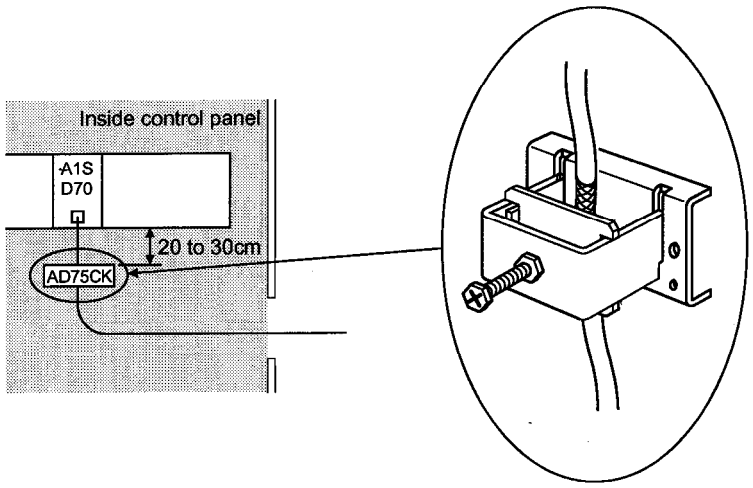


(3) Ferrite core, cable clamp model names

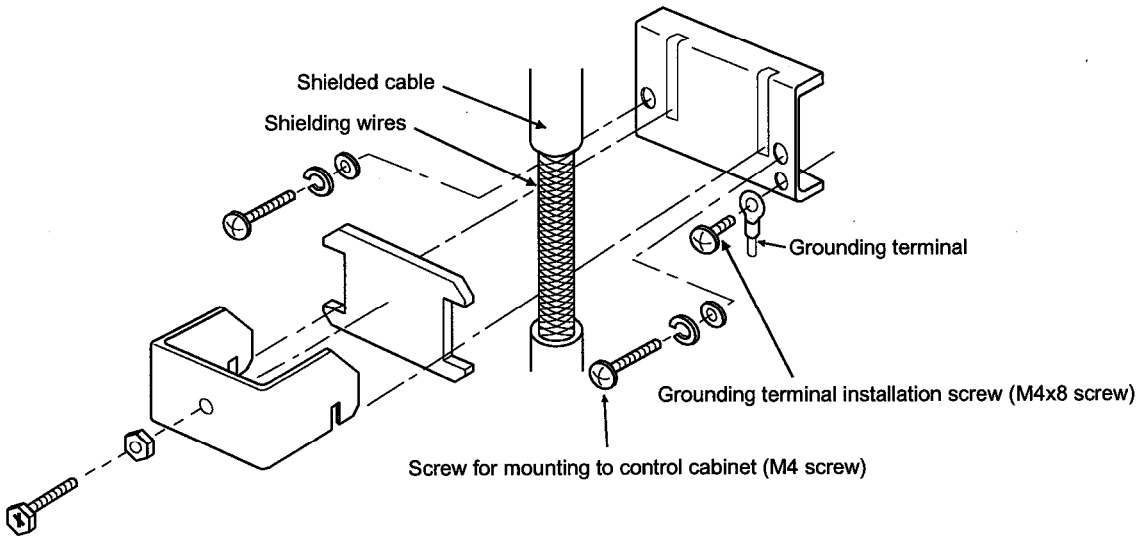
- Cable clamp
  Model name: AD75CK (Mitsubishi Electric make)
- Ferrite core
  Model name: ZCAT3035-1330 (TDK make ferrite core)

Cable length	Product to be arranged	Required quantity
Within 2m	AD75CK	1
More than 2m to within 10m	AD75CK	1
	ZCAT3035-1330	1

(4) Cable clamp fitting position and shielded cable grounding method



[How to ground shilded cable using AD75CK]



AD75CK can ground up to four shielded cables having about 7 mm or smaller outside diameters. (For details, refer to AD75CK cable clamp operation manual <IB-68682>.)

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 A1SD70 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

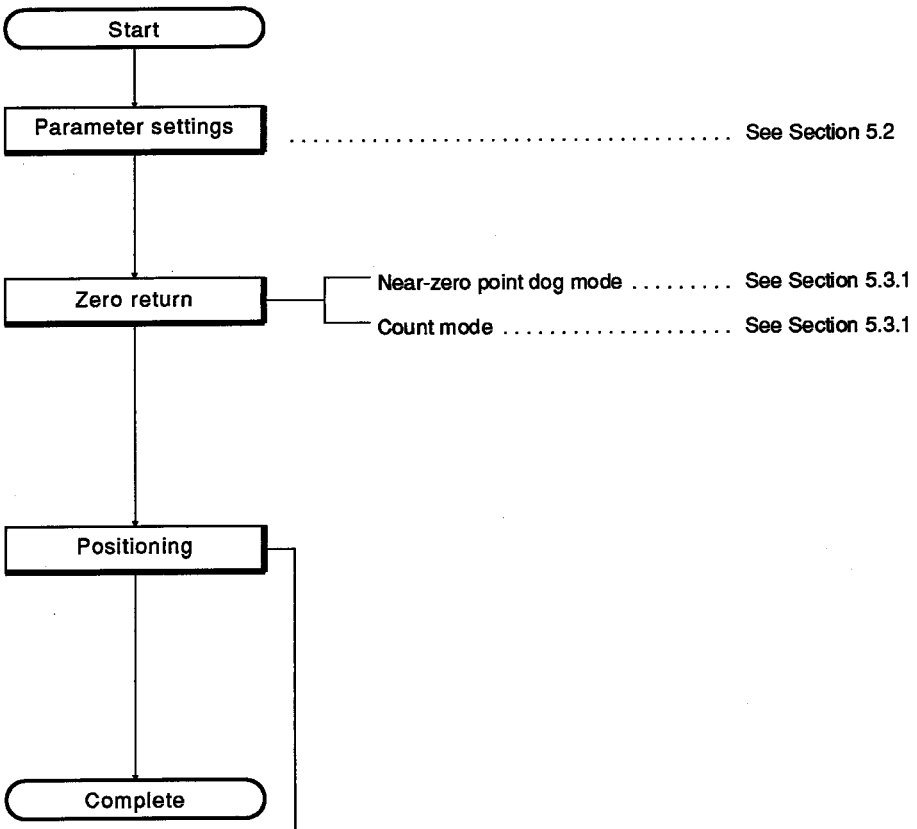
(3) No condensation (due to sudden temperature changes)

(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 A1SD70 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.)

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

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 A1SD70.

(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 A1SD70 is functioning normally. Upper and lower limit switches should be hard-wired 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

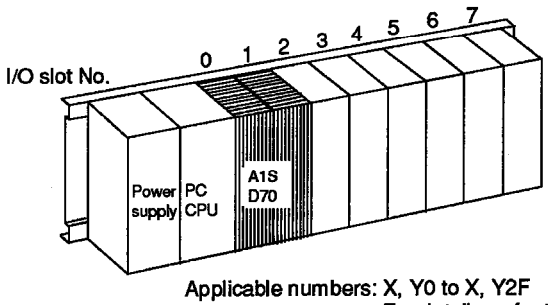
The velocity limit parameter should be checked before operation.

(8) Jog velocity

Set the jog velocity low when initially setting up the system.

REMARK

Unless otherwise specified, I/O numbers used in this manual assume that the A1SD70 is installed in slot 0 of the main base.



Applicable numbers: X, Y0 to X, Y2F
For details, refer to Table 3. 7 (item 3.8).

Fig. 5.1 Example of A1SD70 Installation in a Base Unit

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

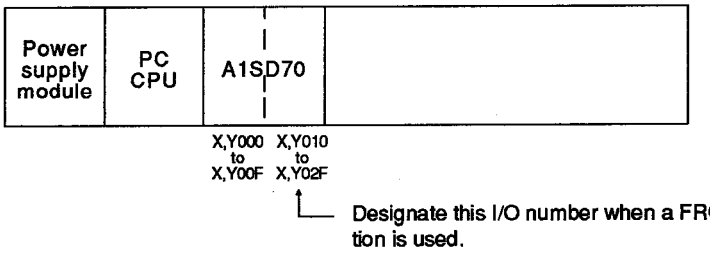
POINTS

(1) The A1SD70 module occupies a two-slot area which comprises 48 I/O points. The I/O allocation using a GPP must be done as follows;

First-half slot : 16 vacant points

Second-half slot : 32 special-function points

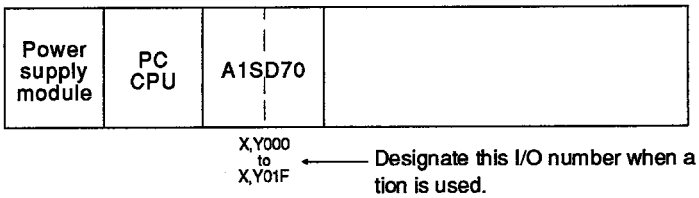
(2) To execute a FROM/TO instruction to an A1SD70, designate the head I/O number allocated to the second-half slot area of the A1SD70.



Therefore, the I/O number used with a FROM/TO instruction is the head I/O number allocated to the A1SD70 plus 010H.

(3) By allocating the first-half slot area of the A1SD70 by using a GPP as "0 vacant points", the 16 points of the first-half slot can be saved.

In this case, the I/O number used with a FROM/TO instruction is same as the head I/O number allocated to the A1SD70.



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 (Y2D) must be OFF.	When the PC READY signal (Y2D) is turned ON
		2	Lower stroke limit		-2147483648 to 2147483647 PLS (32-bit signed data)	0 PLS		
		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 (Y21 to Y23) is turned ON 2. When the JOG start signal (Y24, Y25) is turned ON 3. When the zero return start signal (Y20) is turned ON
		6	Acceleration time		2 to 9999 ms	300 ms		
		7	Deceleration time		2 to 9999 ms	300 ms		
		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.

(3) Electronic gear functions

By multiplying the A1SD70 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.

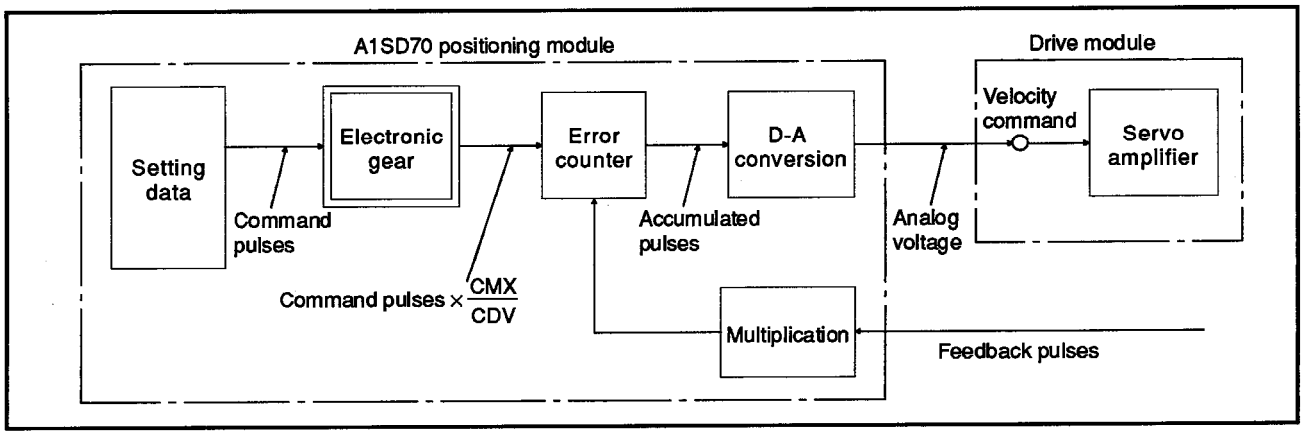


Fig. 5.2 Electronic Gear

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 kPPS

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 kPPS	105 kPPS	110 kPPS ↓ 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 kPPS.

POINTS

(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

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

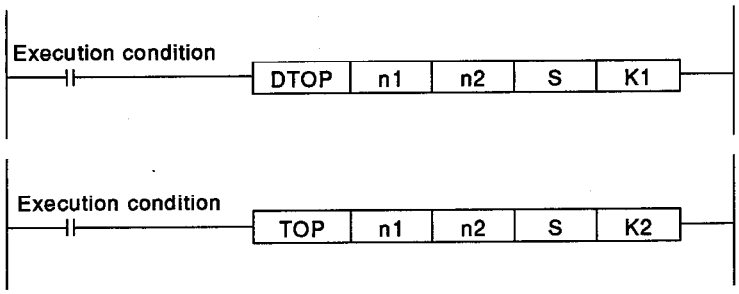
In this way any value for axis travel distance per pulse can be obtained using the electronic gear. This means that no fraction is generated in feed per pulse, regardless of the ball screw load.

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

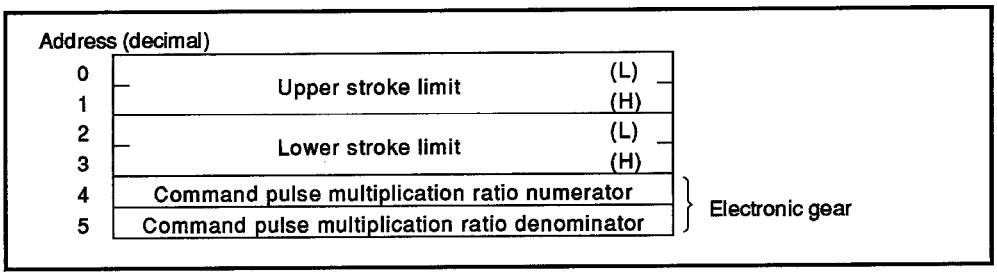


Fig. 5.3 Fixed Parameter Areas

(2) Variable parameters

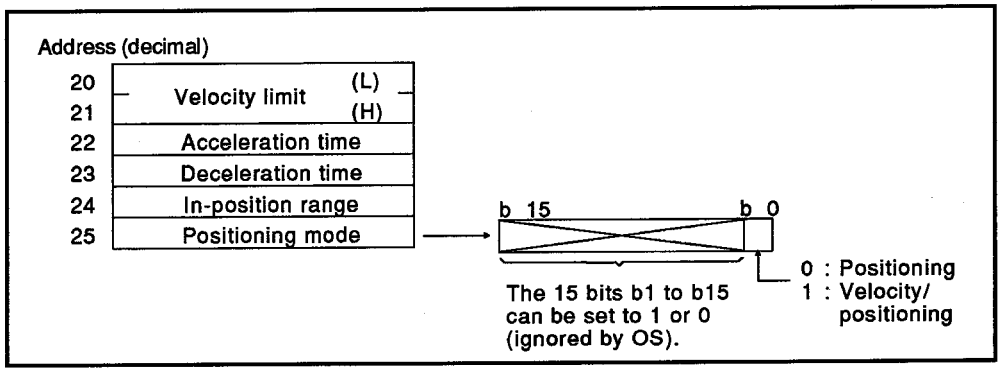


Fig. 5.4 Variable Parameter Areas

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 CPU reset, use the sequence program to change the default value.

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 (Y2D) is turned OFF.

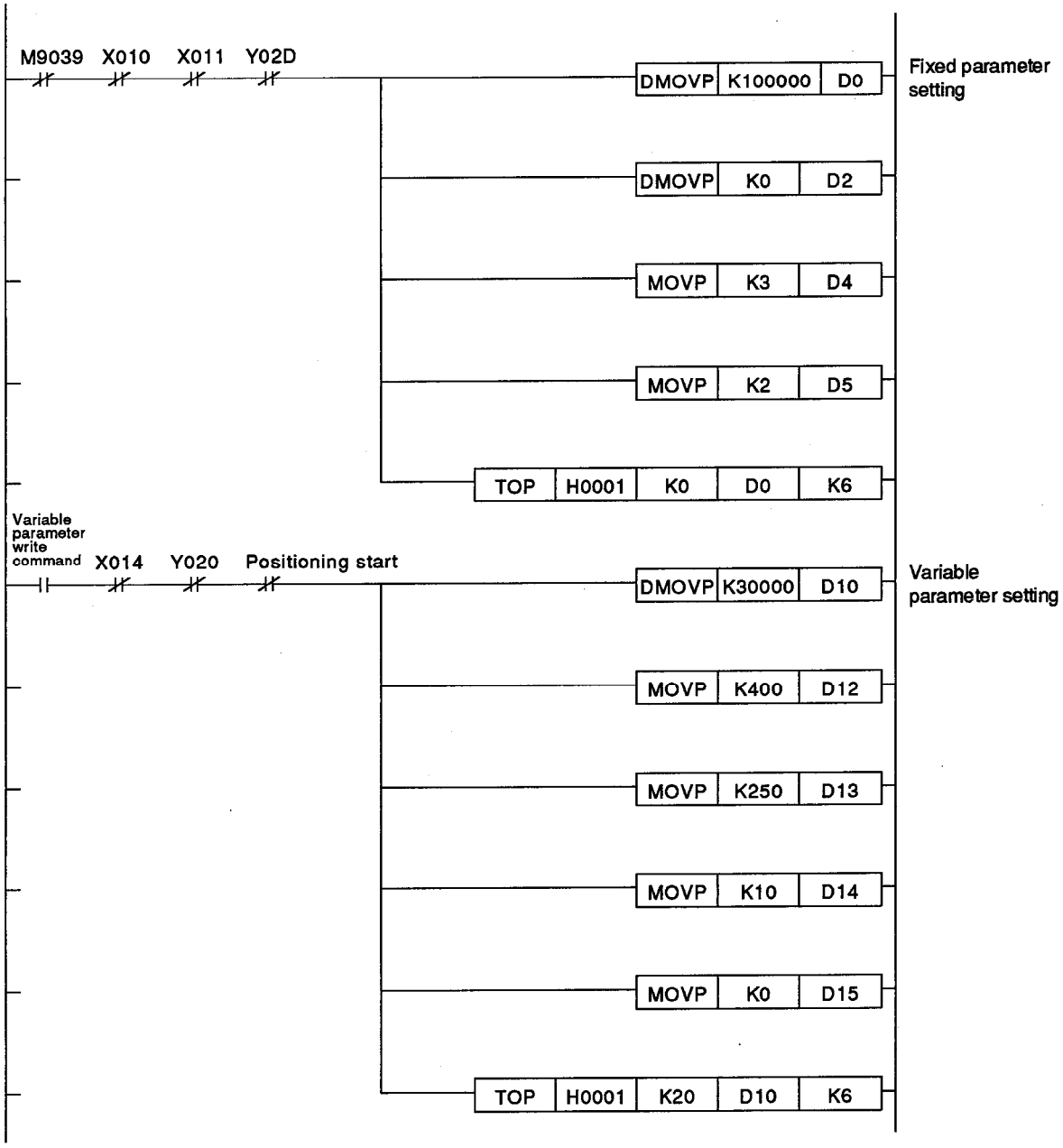
(3) Data below is set as fixed parameters.

Variable parameter settings

(1) Writes using the write command when BUSY (X14) 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 ms	D12	22
	Deceleration time		250 ms	D13	23
	In-position mode		10 PLS	D14	24
	Positioning mode		0	D15	25



REMARK

Variable parameters can be written whether or not the PC READY (Y2D) is ON.

5.3 Zero Return

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

5.3.1 Zero-return operation

When applying power to the A1SD70 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 (X12) 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.

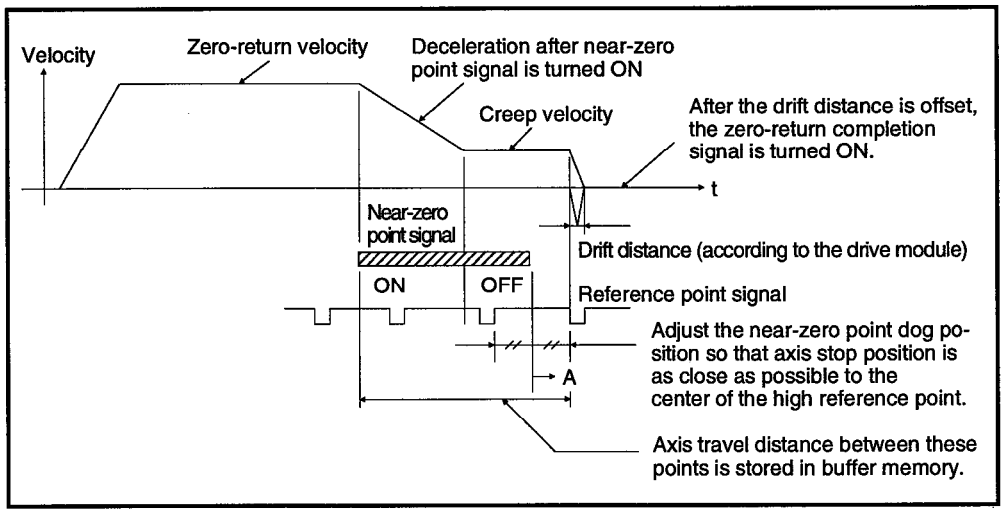


Fig. 5.5 Zero-Return Operation by the Near-Zero Point Dog

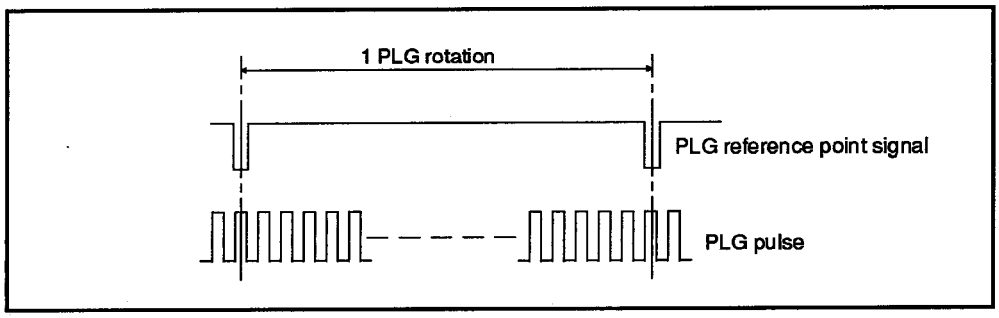


Fig. 5.6 Feedback Pulses

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 A1SD70.

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.

POINTS

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.

(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.

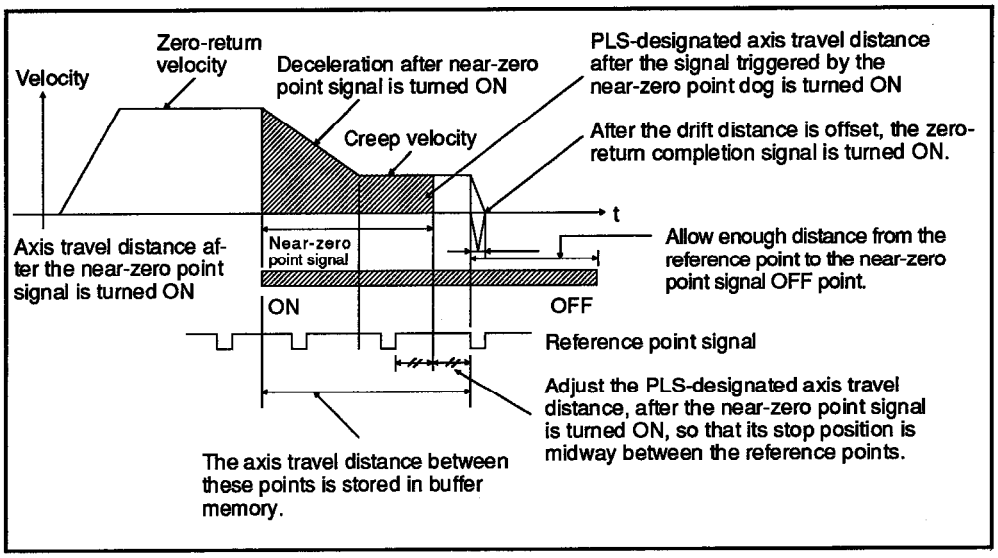


Fig. 5.7 Zero-Return Operation Sequence in the Count Mode

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.

(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.

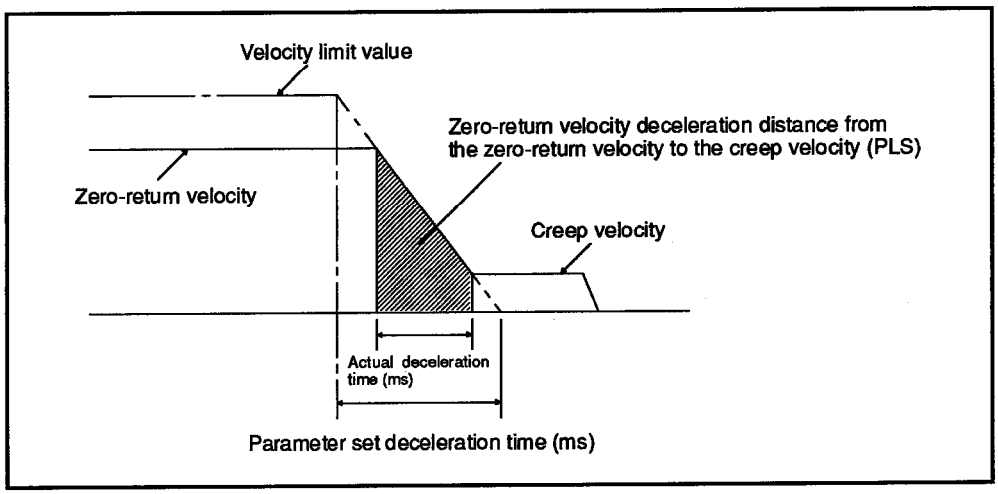


Fig. 5.8 Deceleration Distance from Zero-Return Velocity to Creep Velocity

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

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

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

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

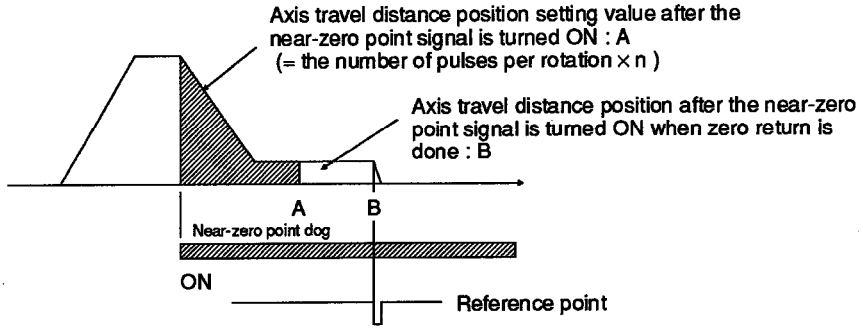
After the near-zero point signal is turned ON, the axis travel distance position must be set so that it is not close to the reference point signal.

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 $\times \frac{1}{2}$

5.3.2 Zero-return data settings

For the A1SD70 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 (Y2D) must be turned OFF.	When the zero-return start signal (Y20) 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.

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

Example:

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

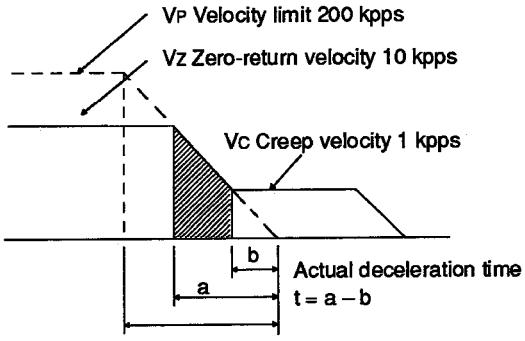
$$= \frac{Vz + Vc}{1000} \times \frac{t}{2}$$

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

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

$= 74.25$

= 75 (Round off below the decimal point) PLS



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

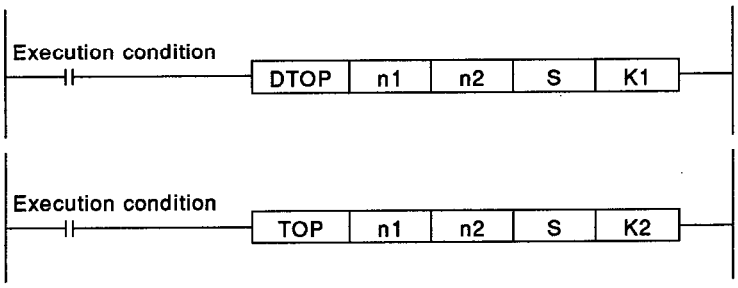
The following is applicable when setting the near-zero point dog position near the center of the reference point signal high range. If the axis travel distance after the near-zero point signal is turned ON is a multiple of the number of output pulses in one rotation of the servo motor, the axis travel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

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.



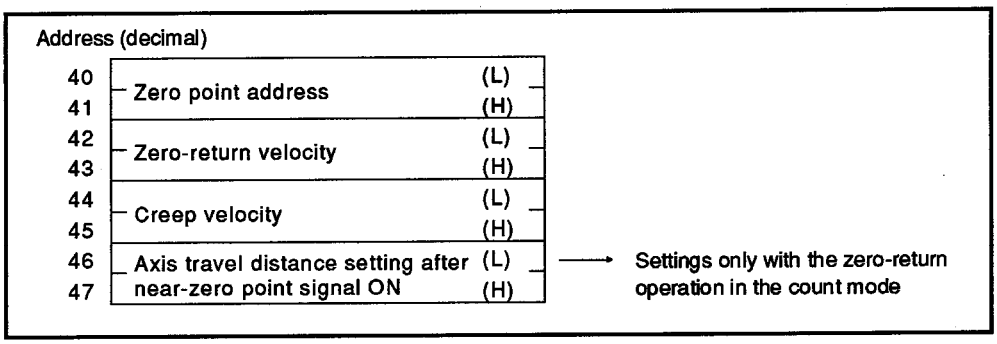


Fig. 5.9 Zero-Return Data Area

5.3.4 Zero-return program

(1) Sample flowchart (2) Start conditions

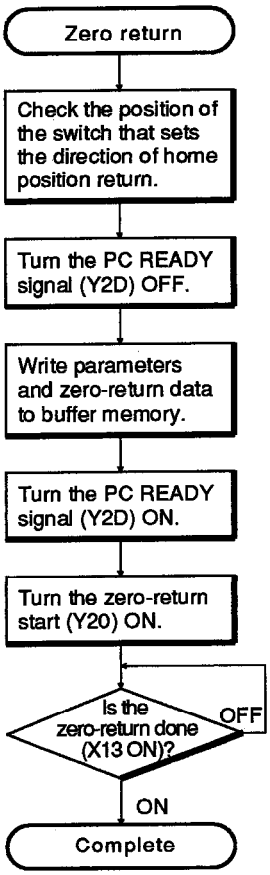


Table 5.3 Zero-Return Start Conditions

	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	X11	A1SD70 ready completed	ON	
	X13	Zero-return completed	OFF	Only in near-zero point dog mode
	X14	BUSY	OFF	
	Y20	Zero-return start	OFF	
	Y27	Stop signal	OFF	
	Y2D	PC ready	ON	
Data	Zero-return data		No error	No start at an error.

(3) Related signal timing

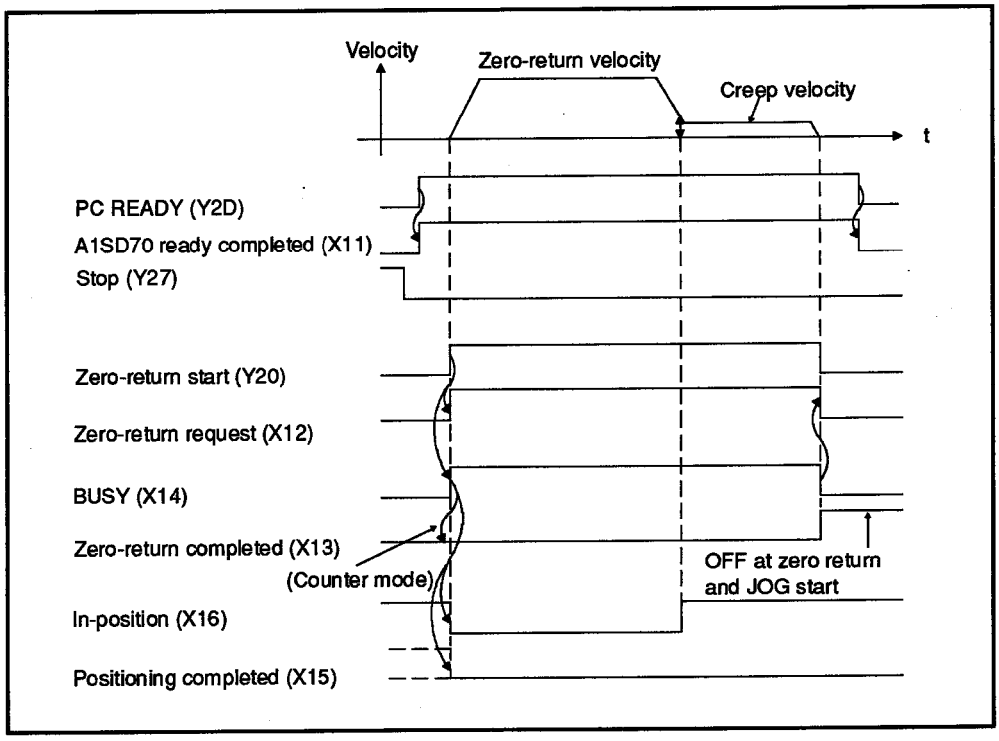


Fig. 5.10 Zero-Return Timing

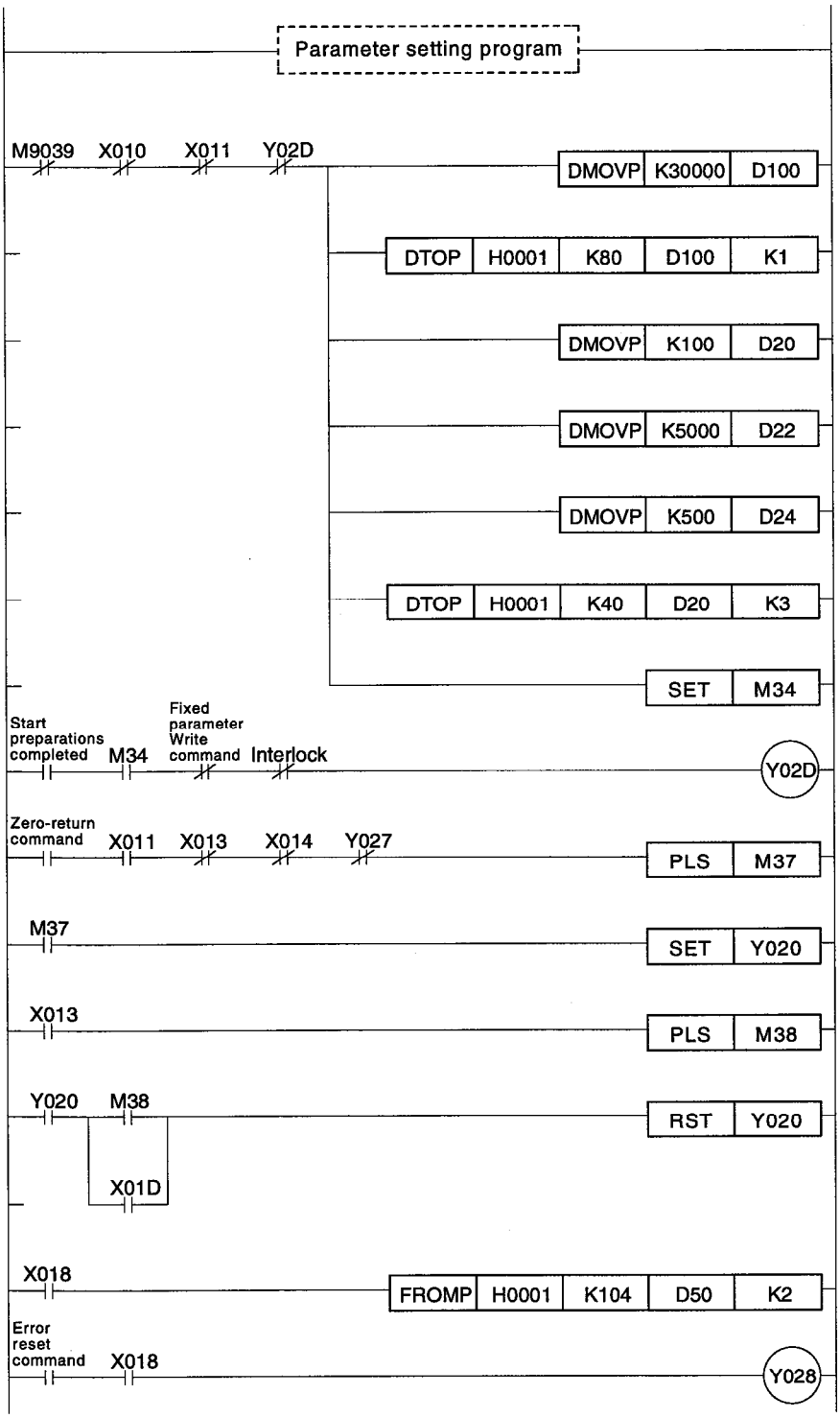
Section 3.8 gives I/O signal details.

(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 Table 5.3.
5) Slide switch setting for SW7 is OFF (near-zero point dog mode).
6) Turn the PC READY (Y2D) 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/s	D22, D23	42, 43
Creep velocity	500 PLS/s	D24, D25	44, 45
Present value	30000 PLS	D100, D101	80, 81

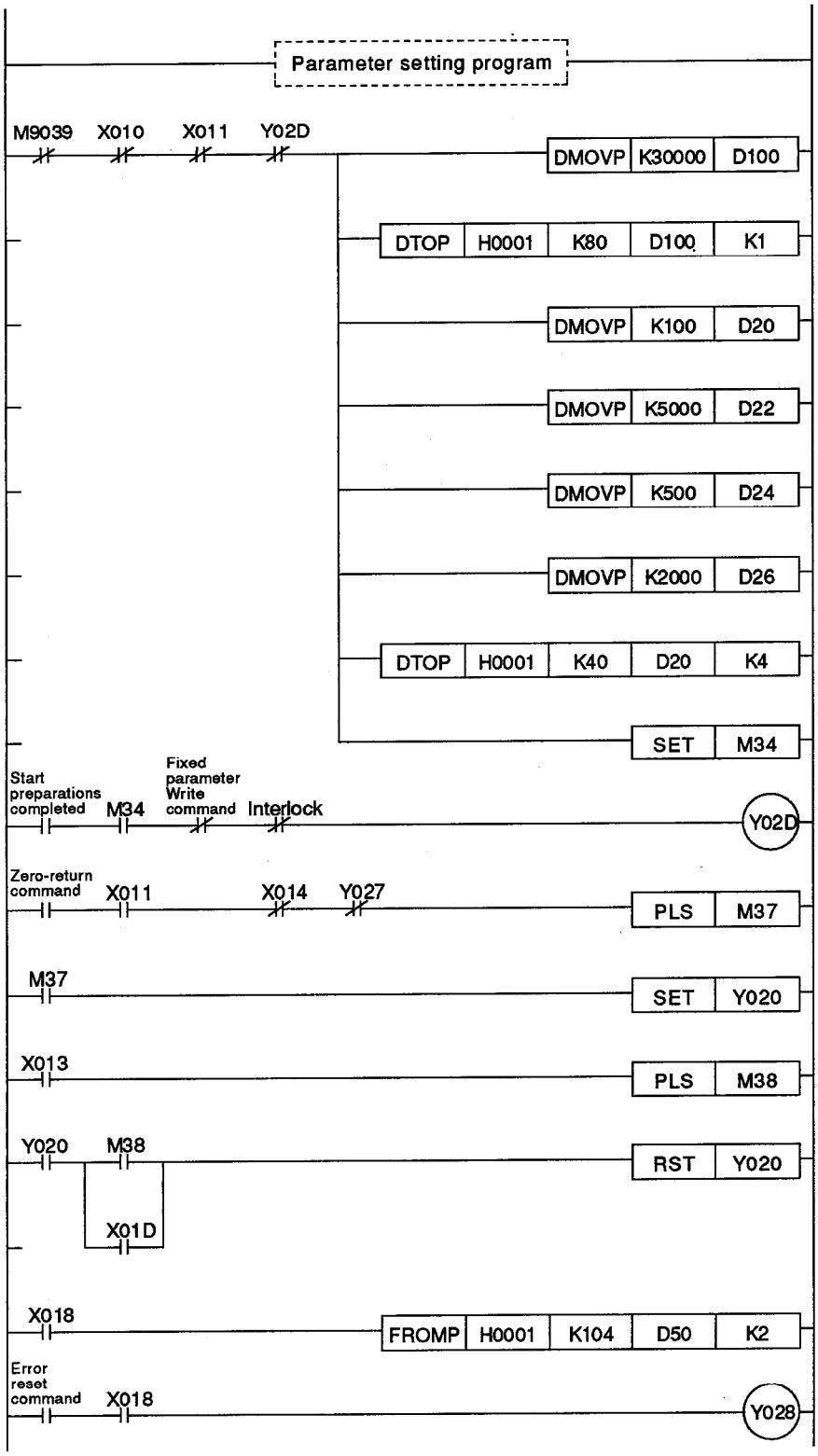

Parameter setting program
M9039 X010 X011 Y02D
DMOVP K30000 D100
Since the default value can cause error 100, the present value is changed to 30000 PLS.
DTOP H0001 K80 D100 K1
DMOVP K100 D20
Zero-return data setting
DMOVP K5000 D22
DMOVP K500 D24
DTOP H0001 K40 D20 K3
SET M34
Start preparations completed M34
Fixed parameter Write command Interlock
Y02D
PC ready ON
Zero-return command X011 X013 X014 Y027
PLS M37
M37
SET Y020
Zero-return start
X013
PLS M38
Y020 M38
RST Y020
X01D
X018
FROMP H0001 K104 D50 K2
At error detection, read the error code from the buffer memory to D50 and D51.
Reference program
Error reset command X018
Y028
Error reset

(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 Table 5.3.
5) Slide switch setting for SW7 is ON (count mode).
6) Turn PC READY (Y2D) 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/s	D22, D23	42, 43
Creep velocity	500 PLS/s	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


Parameter setting program
M9039
X010
X011
Y02D
DMOVP K30000 D100
Since the default value can cause error 100, the present value is changed to 30000 PLS.
DTOP H0001 K80 D100 K1
DMOVP K100 D20
Zero-return data setting
DMOVP K5000 D22
DMOVP K500 D24
DMOVP K2000 D26
DTOP H0001 K40 D20 K4
SET M34
Start preparations completed
M34
Fixed parameter Write command
Interlock
Y02D
PC READY ON
Zero-return command
X011
X014
Y027
PLS M37
M37
SET Y020
Zero-return start
X013
PLS M38
Y020
M38
RST Y020
X01D
X018
FROMP H0001 K104 D50 K2
At error detection, read the error code from the buffer memory to D50 and D51.
Reference program
Error reset command
X018
Y028
Error reset

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 (X18)	Error Code	Stop Mode
1	External stop signal is turned ON.	X18 ON	Error code reset	* Deceleration processing, with Nos. 4 and 7 at free run.
2	Stop signal (Y27) is turned ON.			
3	PC READY signal (Y2D) is turned OFF.			
4	Servo READY signal (X1B) 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.

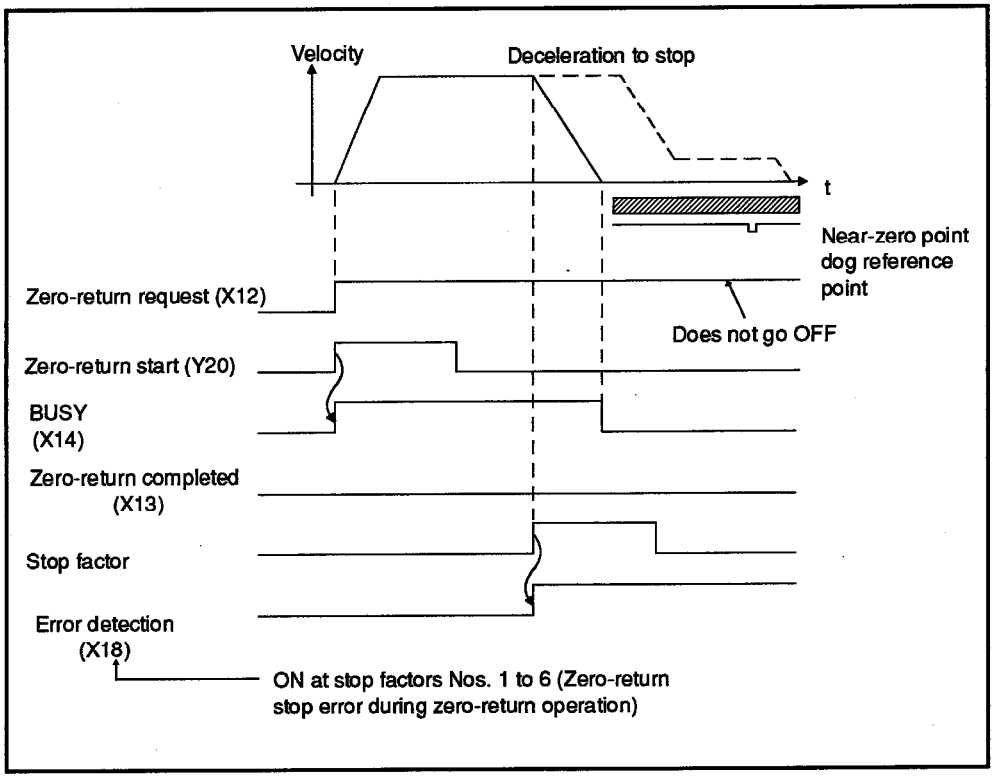


Fig. 5.11 Stop Timing During Zero-Return Operations

(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 sequence program.

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

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
Y21	Absolute mode positioning start
Y22	Incremental mode forward start (addresses increasing)
Y23	Incremental mode reverse start (addresses decreasing)

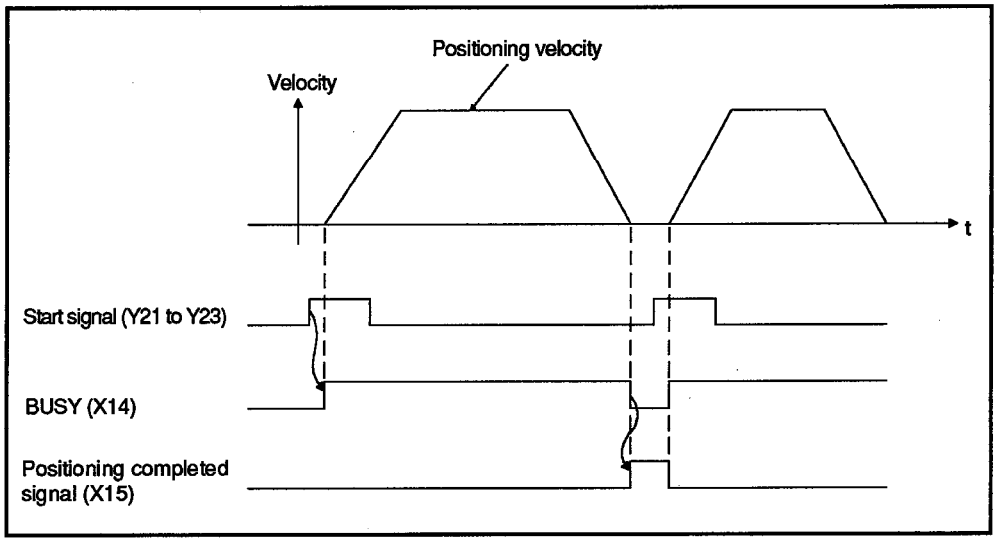


Fig. 5.12 Positioning

(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 sequence 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 sequence program. If a dwell is required, use the positioning completed signal (X15).

5.4.2 Positioning data settings

Table 5.5 Positioning Data

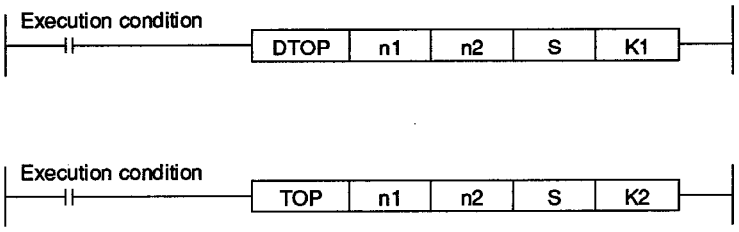
No.	Item	Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0 : One-phase trapezoidal positioning 1 : Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by the data set when the start signal is turned ON, 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 (Y21 to Y23) 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:



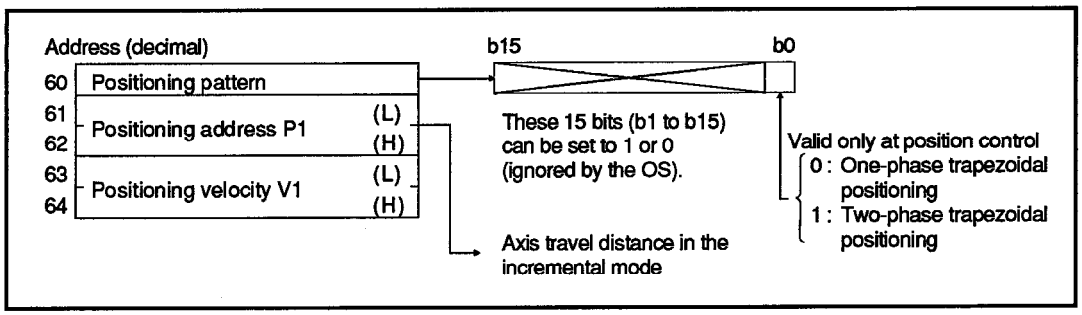


Fig. 5.13 Positioning Data Area

5.4.4 Sample positioning start program

(1) Sample flowchart (2) Start conditions

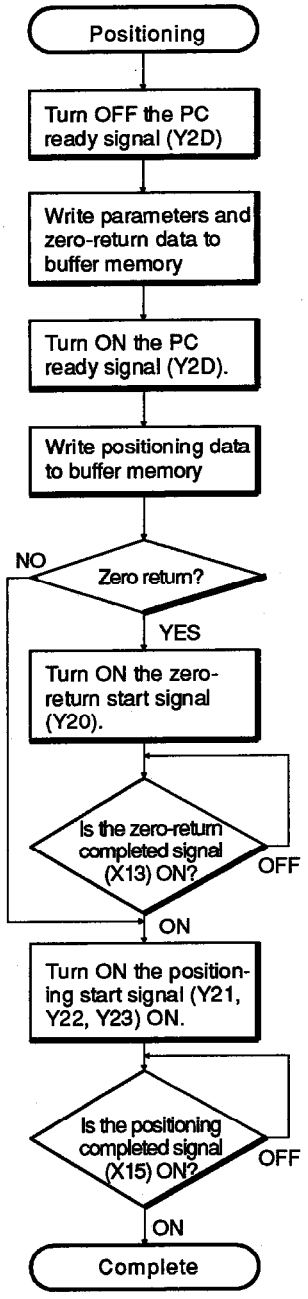


Table 5.6 Positioning Start Conditions

	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	X11	A1SD70 ready completed	ON	
	X14	BUSY	OFF	
	Y21 to Y23	Positioning start	OFF	
	Y27	Stop signal	OFF	
	Y2D	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

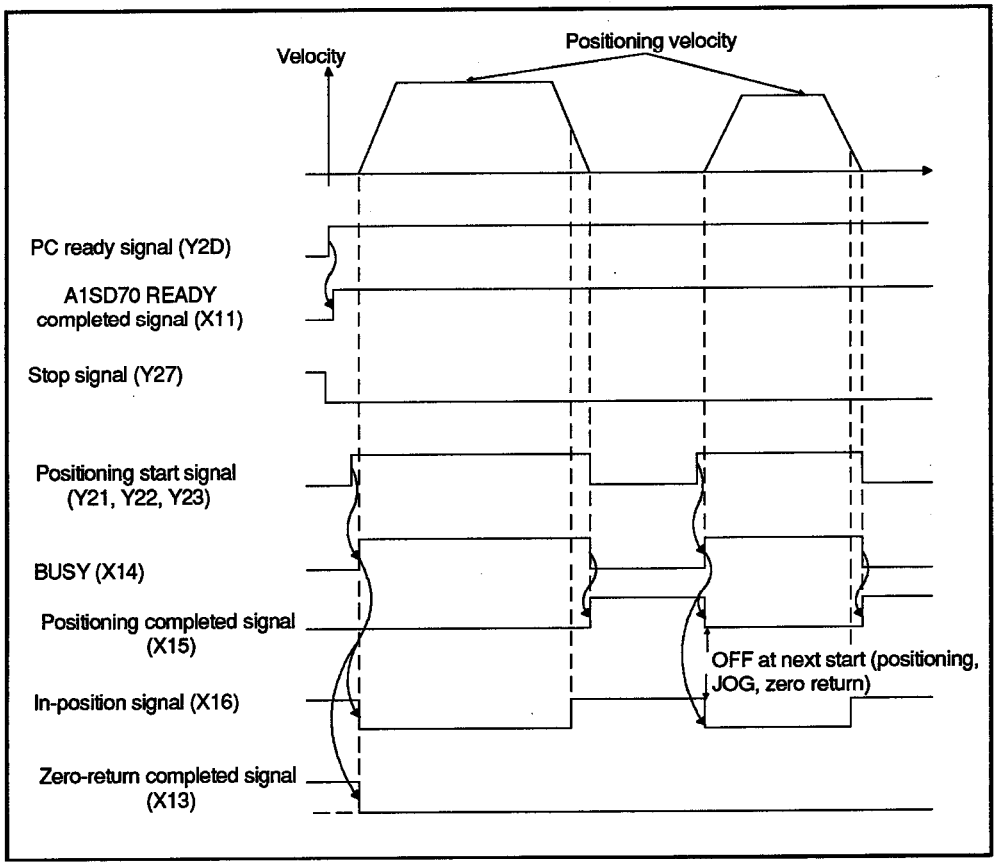


Fig. 5.14 Positioning Timing

(4) Sample positioning program

(Conditions)

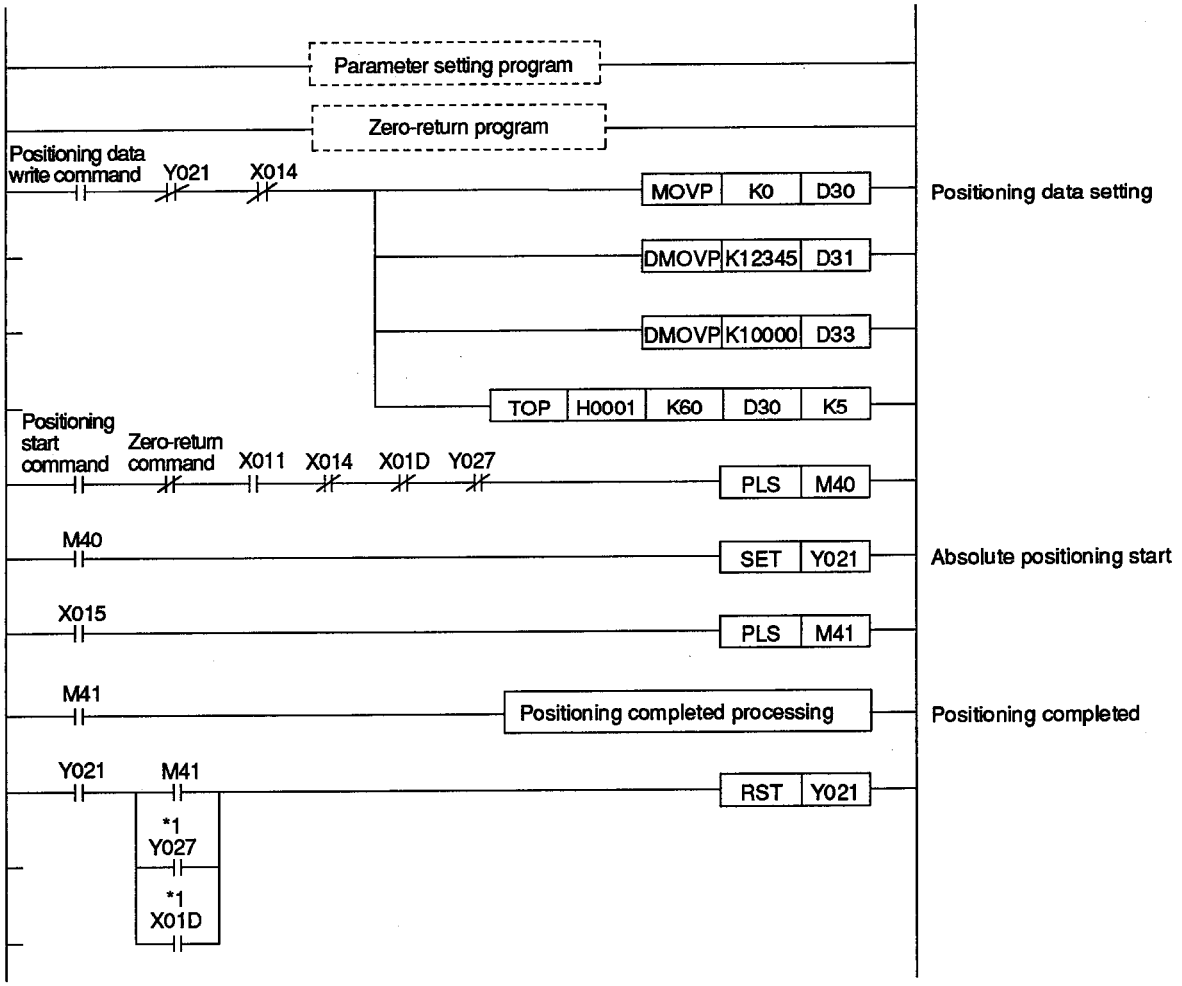
1) Execute absolute positioning using the positioning start command.

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.

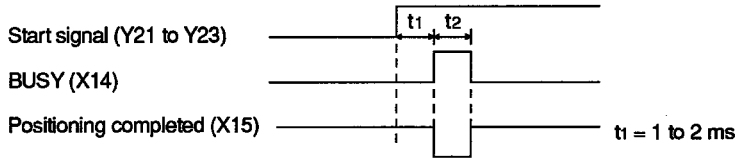
	Setting Value	Device Used	Buffer Memory Address
Positioning pattern	0	D30	60
Positioning address	12345 PLS	D31, D32	61, 62
Positioning velocity	10000 PLS/s	D33, D34	63, 64

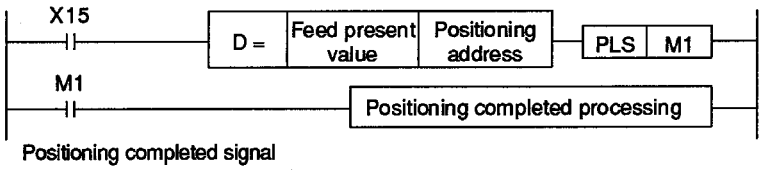


* 1 If the stop command is used during positioning, reset the start signal so that positioning can be restarted.

REMARK

If, after the second positioning in repeated positioning operations, the positioning operation time (t_2) is shorter than the scan time, the sequence program cannot detect the ON/OFF status change (ON → OFF → ON) positioning signal (X15). To detect this change, set the positioning completed timing using the following program.





Positioning completed signal

Section 5.11 explains how to read the feed present value.

5.5 Two-Phase Trapezoidal Positioning

5.5.1 Positioning

(1) Set the positioning pattern, address (P1 and P2), and velocity (V1 and V2) 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
Y21	Absolute mode positioning start
Y22	Incremental mode forward start (addresses increasing)
Y23	Incremental mode reverse start (addresses decreasing)

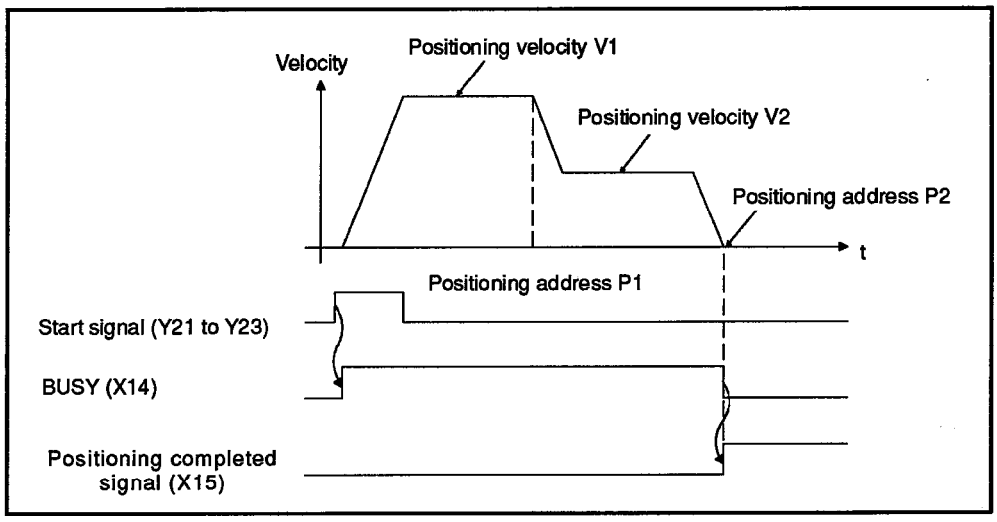
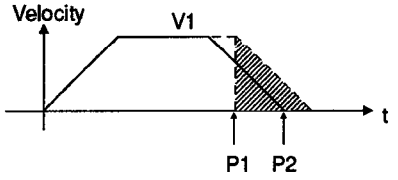


Fig. 5.15 Two-Phase Trapezoidal Positioning

(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

(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 sequence 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 (X15).

5.5.2 Positioning data setting

Table 5.7 shows the data to be used in positioning.

Table 5.7 Positioning Data

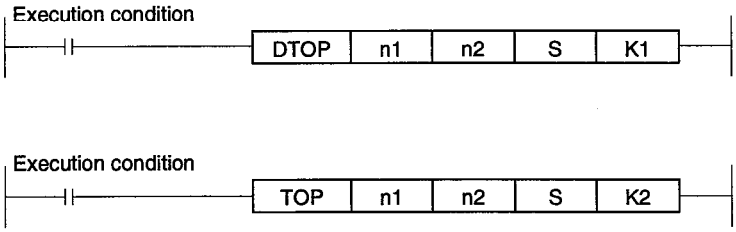
No.	Item	Setting Range	Default Value	Setting Enable Conditions	Set Data Check Timing
1	Positioning pattern	0 : Positioning 1 : Two-phase trapezoidal positioning	0	Setting enabled. However, since these parameters are controlled by the data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON (if they are written while the BUSY signal is ON).	1. When the positioning start signal (Y21 to Y23) 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		

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.



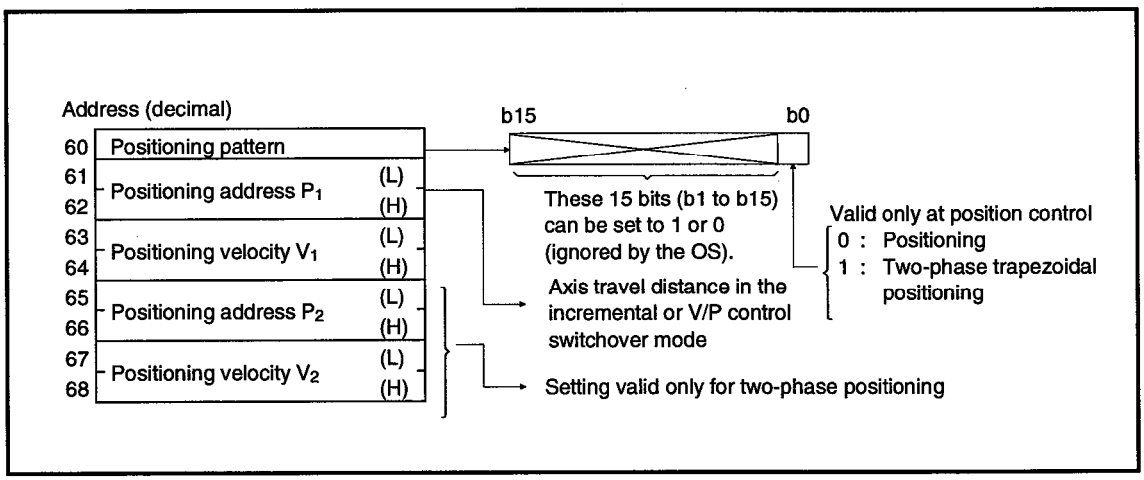


Fig. 5.16 Positioning Data Area

5.5.4 Sample two-phase positioning program

(1) Sample flowchart (2) Start conditions

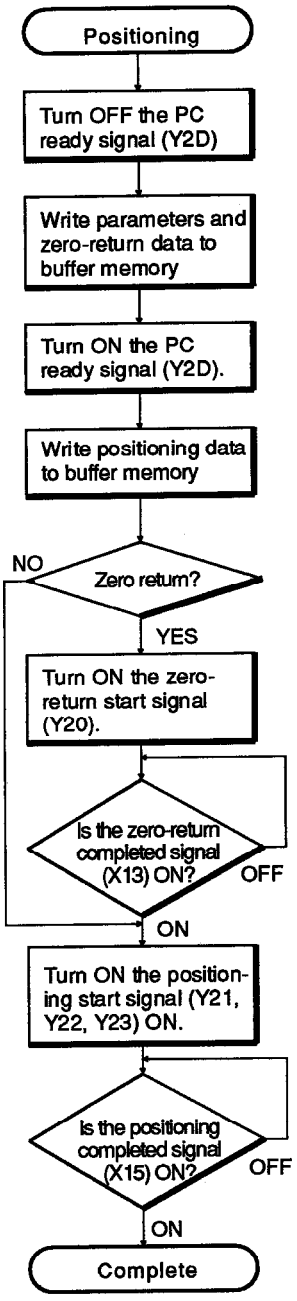


Table 5.8 Positioning Start Conditions

	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	X11	A1SD70 ready completed	ON	
	X14	BUSY	OFF	
	Y21 to Y23	Positioning start	OFF	
	Y27	Stop signal	OFF	
	Y2D	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

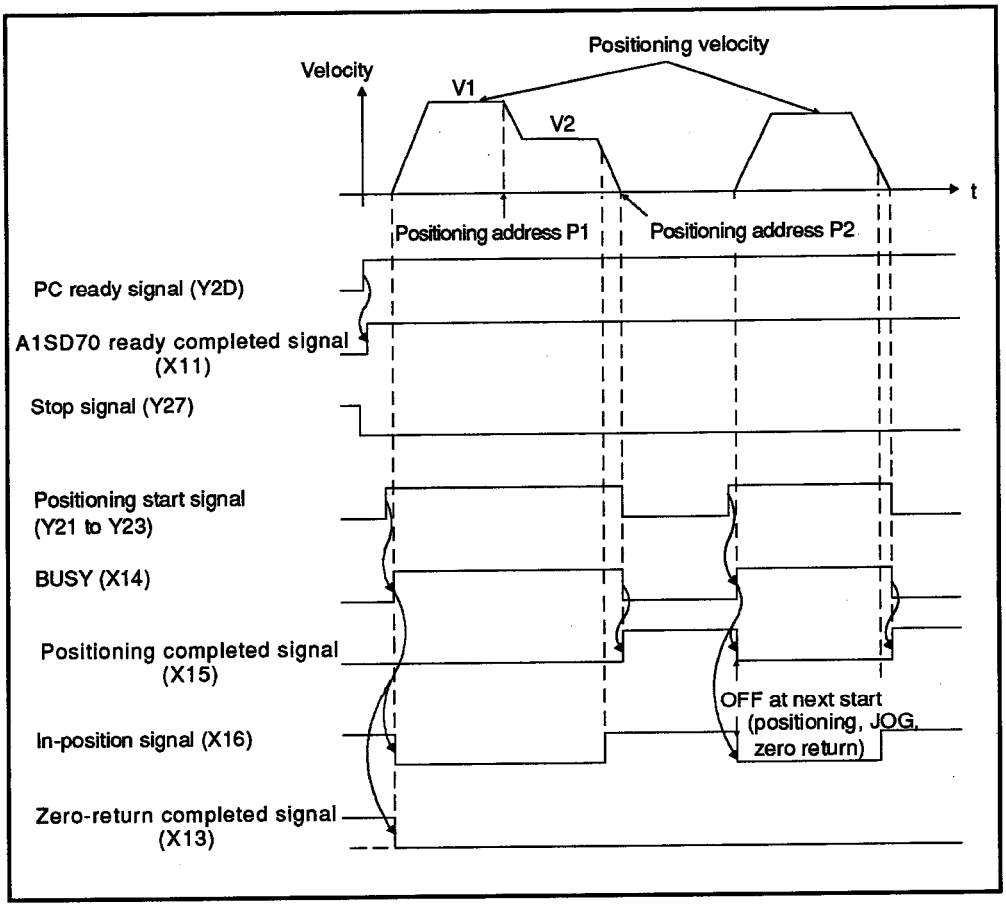


Fig. 5.17 Positioning Timing

(4) Sample positioning program

(Conditions)

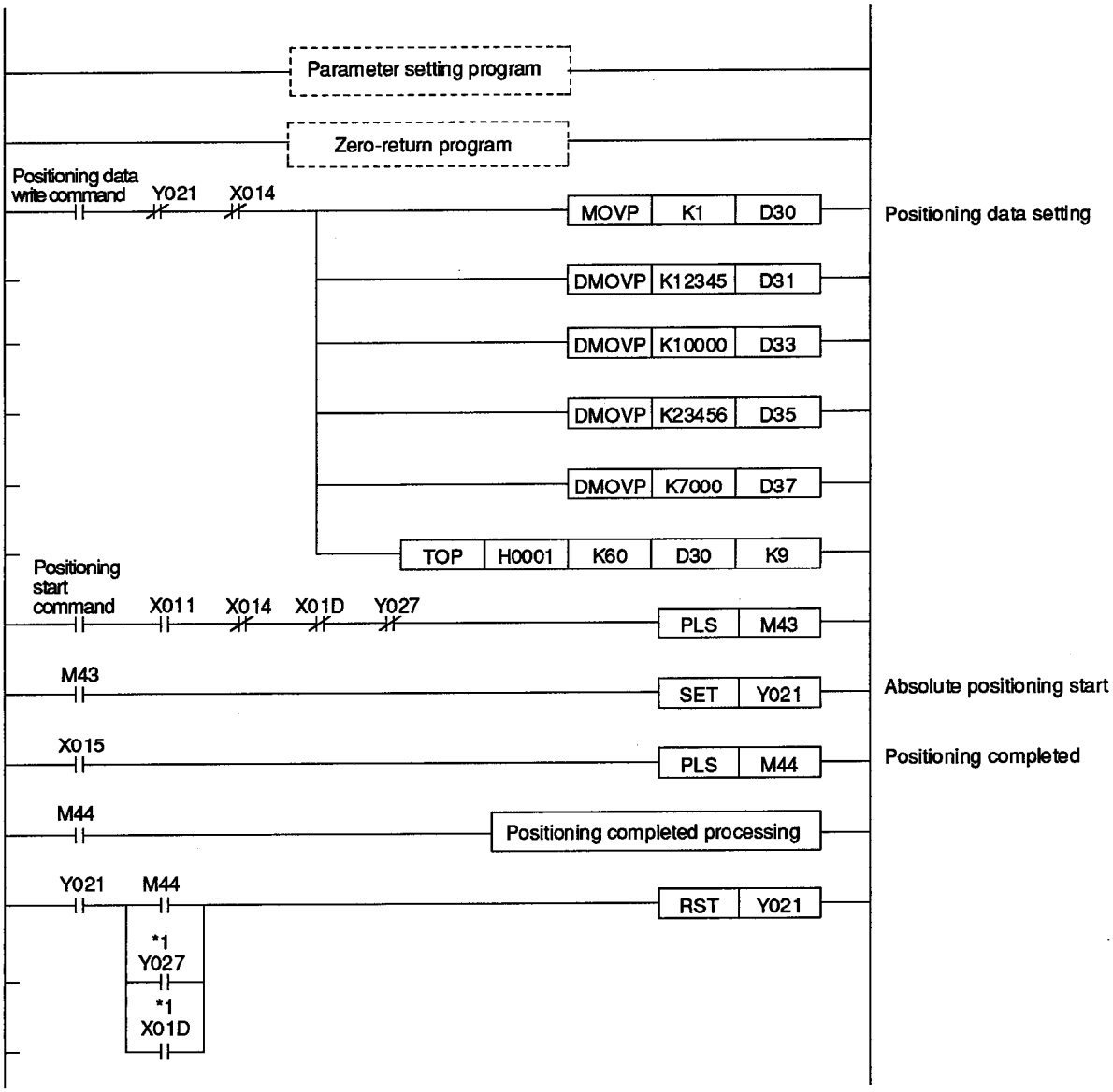
1) Execute positioning in the absolute mode for a two-phase positioning pattern using the positioning start command

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/s	D33, D34	63, 64
Positioning address P_2	23456 PLS	D35, D36	65, 66
Positioning velocity V_2	7000 PLS/s	D37, D38	67, 68



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

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
Y22	Forward start (addresses increasing)
Y23	Reverse start (addresses decreasing)

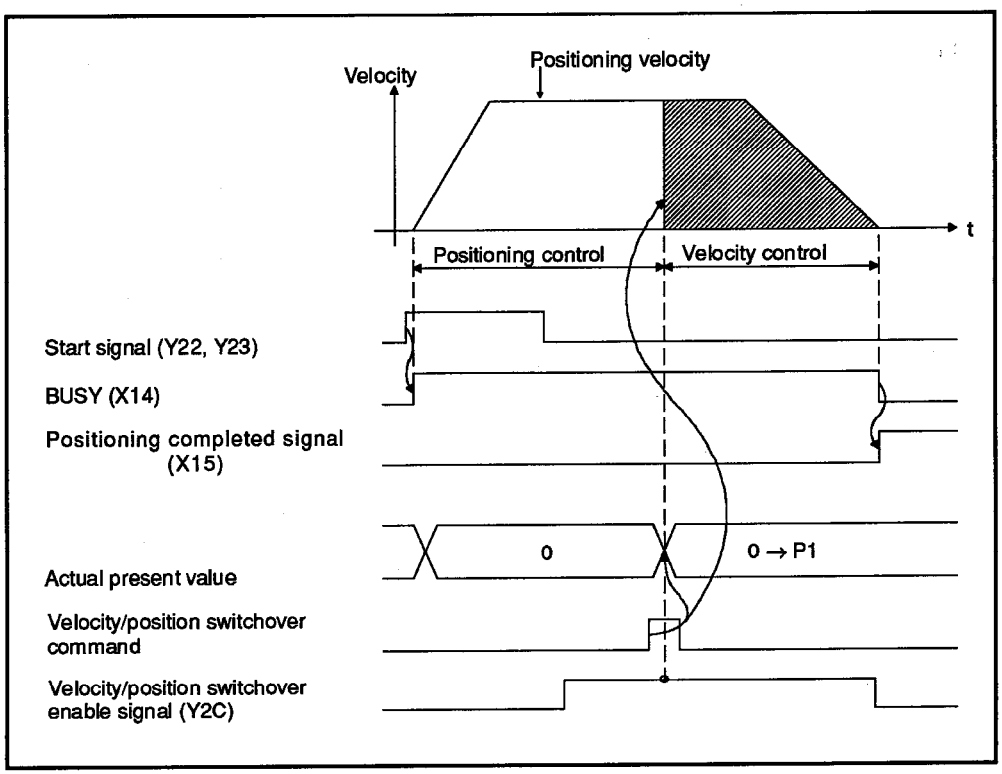


Fig. 5.18 V/P Control Switchover

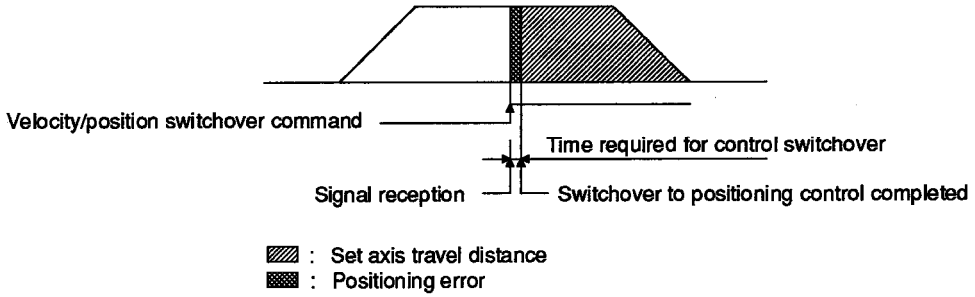
(2) The present value is set to "0" at the start of the operation and is continuously updated after control is switched to velocity control.

(3) If the velocity/position control switchover enable signal (Y2C) and the velocity switchover command are turned ON at the start of the operation, positioning is only executed in positioning control.

(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 μs, a positioning error is calculated as follows:

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

Appendix 3 gives the time t required for control switchover.

(6) Since there is no dwell-time function in the A1SD70, set the timer from the user program. If a dwell is required, use the positioning completed signal (X15).

(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 sequence program (see Section 5.9).

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

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 (Y22, Y23) 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/s	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.

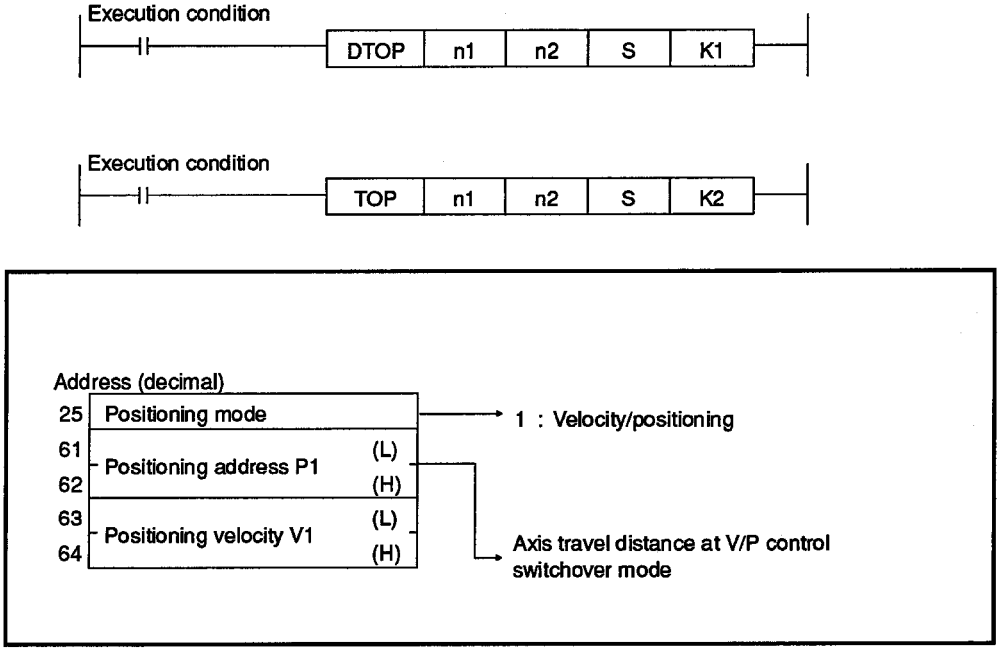


Fig. 5.19 Positioning Data Areas

5.6.4 Sample V/P control switchover program

(1) Program flowchart (2) Start conditions

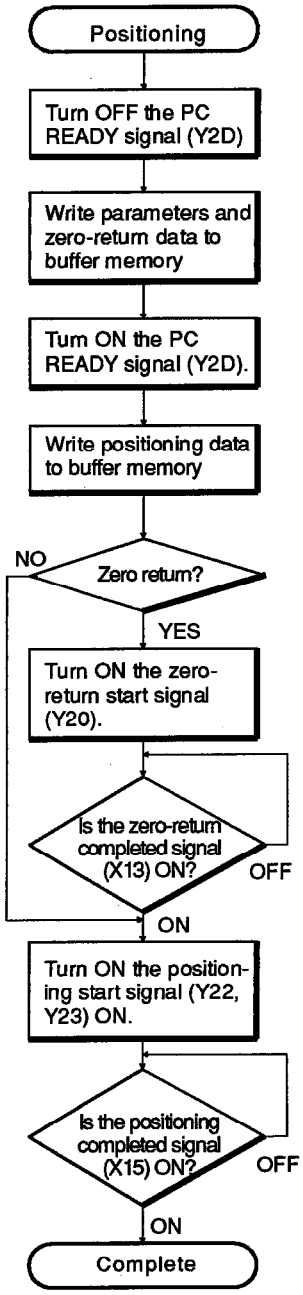


Table 5.10 Positioning Start Conditions

	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	X11	A1SD70 ready completed	ON	
	X14	BUSY	OFF	
	Y22, Y23	Positioning start	OFF	
	Y27	Stop signal	OFF	
	Y2D	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

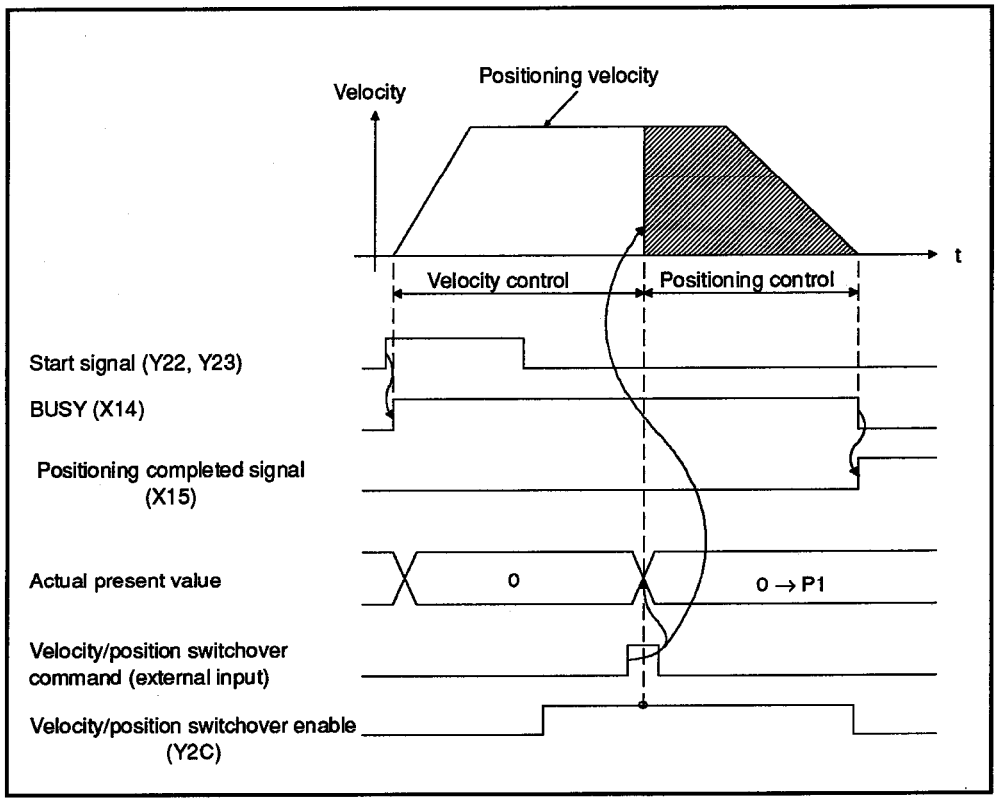


Fig. 5.20 V/P Control Switchover Timing

(4) Sample V/P control switchover program

(Conditions)

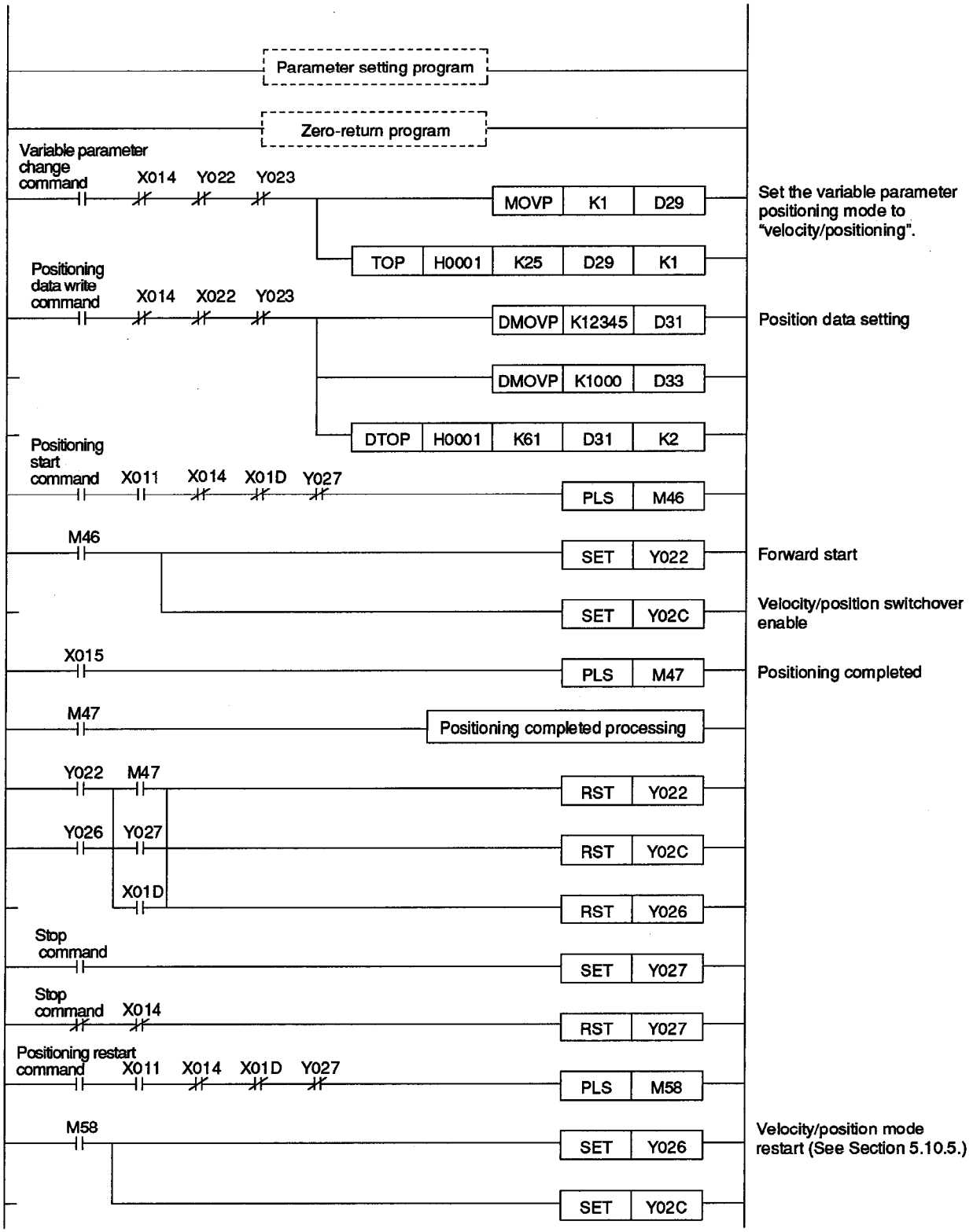
1) Start operation in velocity control using the positioning start command. Execute positioning by switching to positioning control using the control switchover signal from an external device.

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/s	D33, D34	63, 64

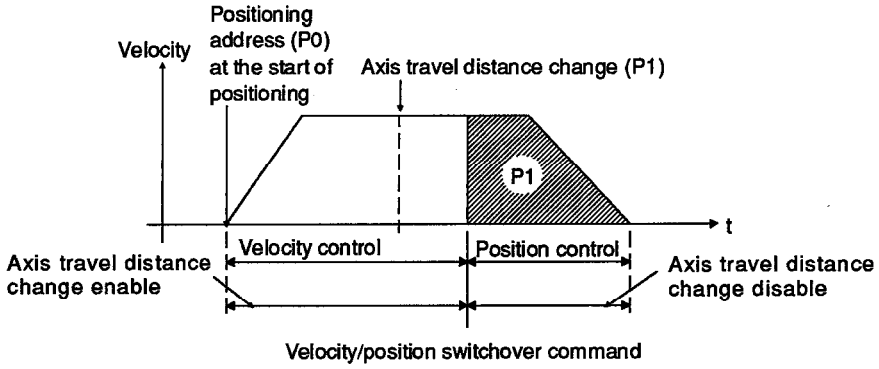

Parameter setting program
Zero-return program
Variable parameter change command
X014
Y022
Y023
MOVP K1 D29
Set the variable parameter positioning mode to "velocity/positioning".
TOP H0001 K25 D29 K1
Positioning data write command
X014
X022
Y023
DMOVP K12345 D31
Position data setting
DMOVP K1000 D33
DTOP H0001 K61 D31 K2
Positioning start command
X011
X014
X01D
Y027
PLS M46
M46
SET Y022
Forward start
SET Y02C
Velocity/position switchover enable
X015
PLS M47
Positioning completed
M47
Positioning completed processing
Y022
M47
RST Y022
Y026
Y027
RST Y02C
X01D
RST Y026
Stop command
SET Y027
Stop command
X014
RST Y027
Positioning restart command
X011
X014
X01D
Y027
PLS M58
M58
SET Y026
Velocity/position mode restart (See Section 5.10.5.)
SET Y02C

5.6.5 Velocity/position axis travel distance change

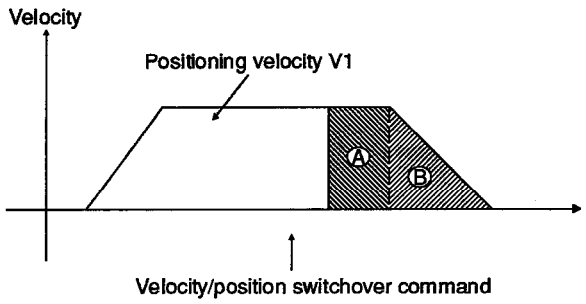
This mode is used to change the positioning address (axis travel distance) during operations in the V/P control switchover mode.

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)



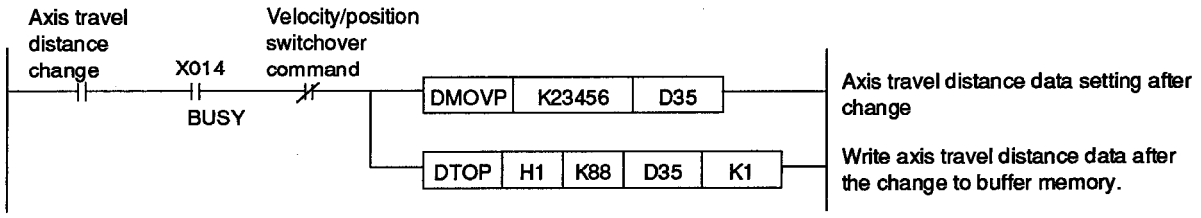
Set positioning address (axis travel distance) P1 so that it is greater than the distance shown below. If the set distance is less than the specified distance, the axis will exceed the required distance.



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

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

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.

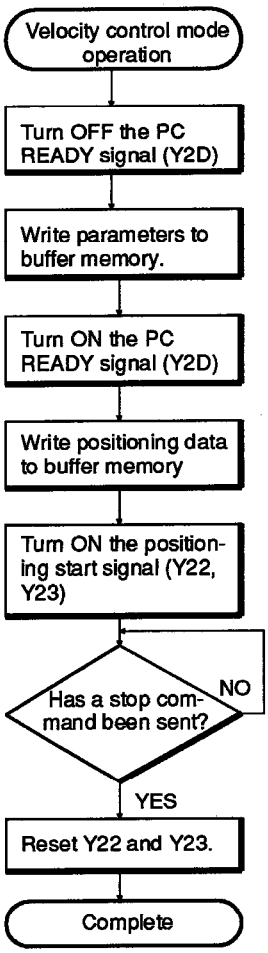
Set the positioning velocity in the V/P control switchover mode from the user program and execute the velocity mode operation using the start signal from the PC CPU. Use the stop command to stop the operation. Use the start signal to specify forward and reverse positioning directions.

Start Signal	Positioning Mode
Y22	Forward (addresses increasing)
Y23	Reverse (addresses decreasing)

(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.

(4) Sample flowchart



(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	X11	A1SD70 ready completed	ON	
	X14	BUSY	OFF	
	Y22, Y23	Positioning start	OFF	
	Y27	Stop signal	OFF	
	Y2D	PC READY	ON	
Data	Positioning data		No error	If the positioning velocity exceeds the velocity limit, control will be executed at the velocity limit.

(6) Related Signal Timing

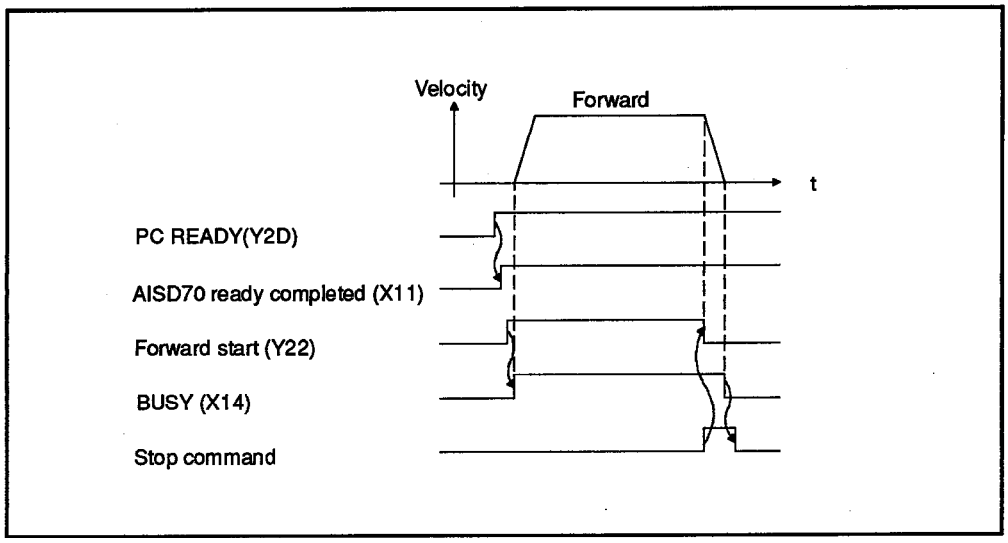


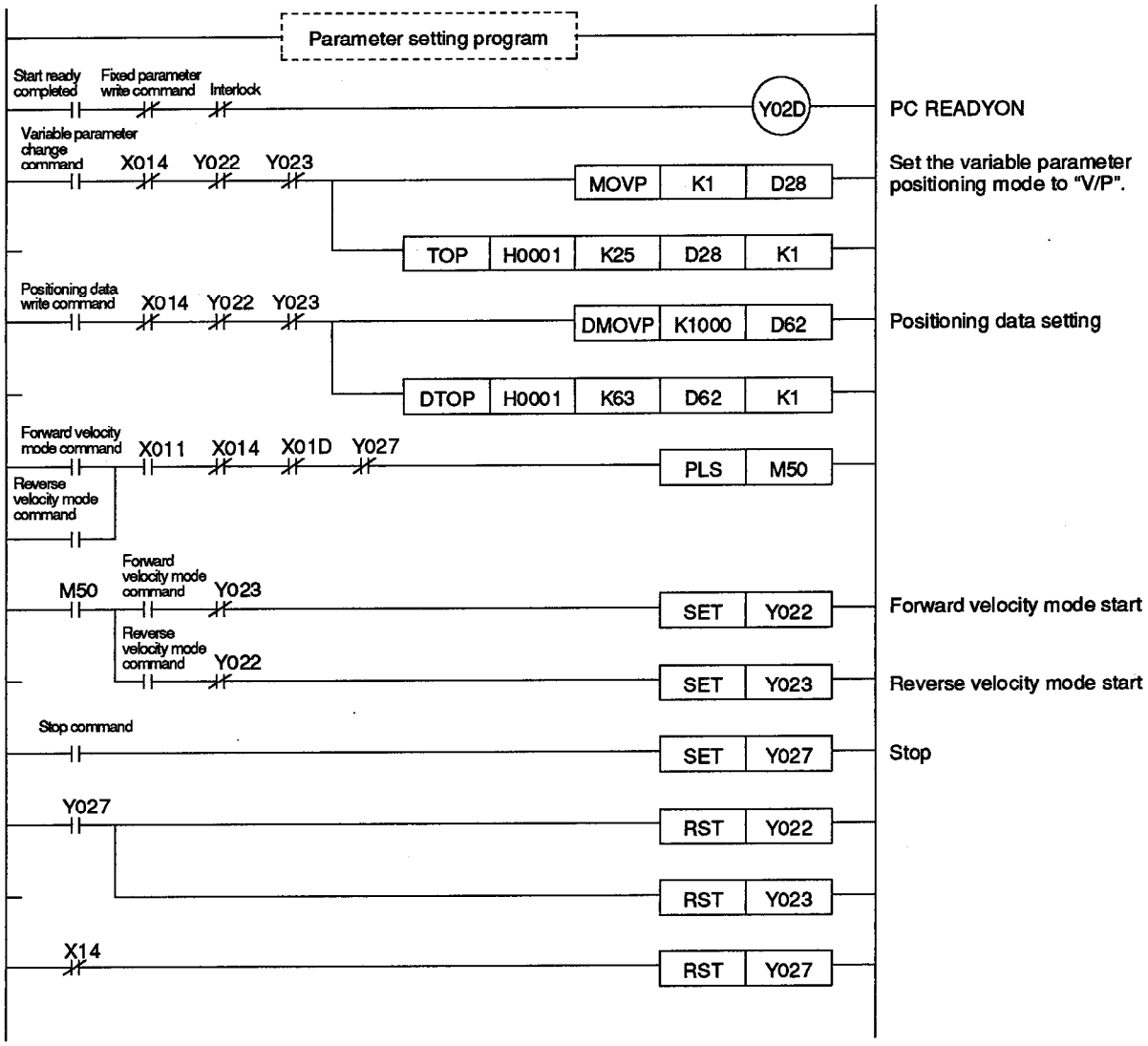
Fig. 5.21 Velocity Control Mode Operation

(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 5.17 gives the start conditions.
4) Turn ON the PC ready signal (Y2D) 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/s	D62, D63	63, 64


Parameter setting program
Start ready completed
Fixed parameter write command
Interlock
Y02D
PC READYON
Variable parameter change command
X014
Y022
Y023
MOVP K1 D28
Set the variable parameter positioning mode to "V/P".
TOP H0001 K25 D28 K1
Positioning data write command
X014
Y022
Y023
DMOVP K1000 D62
Positioning data setting
DTOP H0001 K63 D62 K1
Forward velocity mode command
X011
X014
X01D
Y027
PLS M50
Reverse velocity mode command
M50
Forward velocity mode command
Y023
SET Y022
Forward velocity mode start
Reverse velocity mode command
Y022
SET Y023
Reverse velocity mode start
Stop command
SET Y027
Stop
Y027
RST Y022
RST Y023
X14
RST Y027

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
Y21	Absolute mode positioning start
Y22	Incremental mode forward start (addresses increasing)
Y23	Incremental mode reverse start (addresses decreasing)

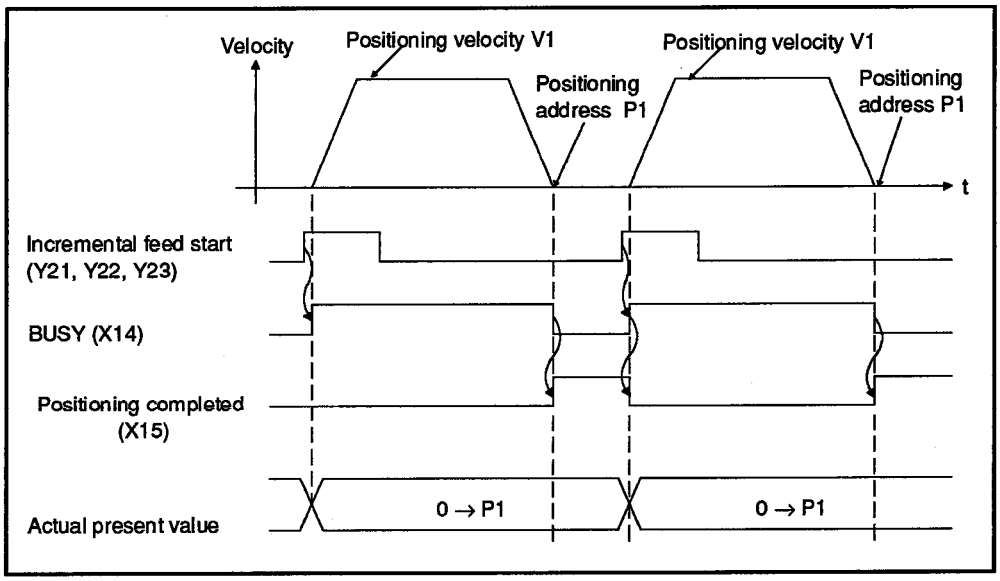


Fig. 5.22 Incremental Feed

(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 sequence 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 sequence program. If a dwell is required, use the positioning completed signal (X15).

5.7.2 Positioning data settings

Positioning data settings are shown in Table 5.13 below.

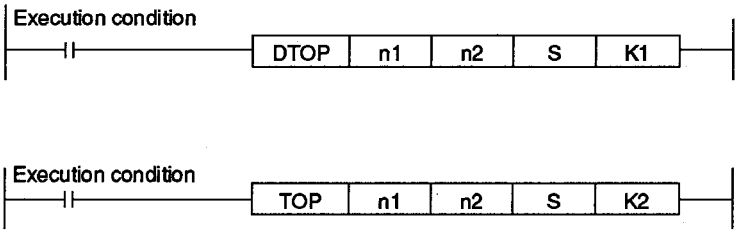
Table 5.13 Positioning Data

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 (Y21 to Y23) 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		

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.



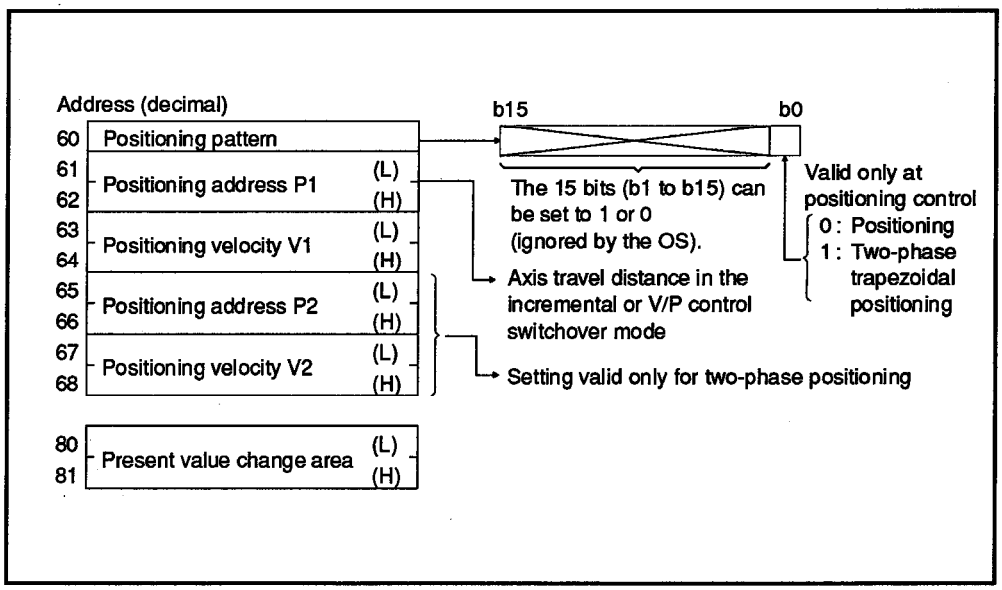


Fig 5.23 Positioning Data Present Value Change Area

5.7.4 Incremental feed program

(1) Program flowchart (2) Start conditions

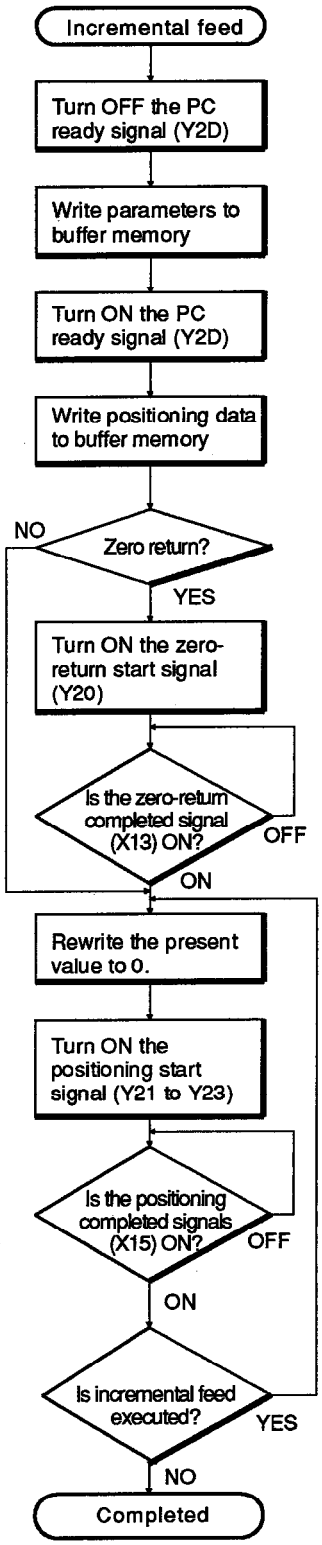


Table 5.14 Positioning Start Conditions

	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	X11	A1SD70 ready completed	ON	
	X14	BUSY	OFF	
	Y21 to Y23	Positioning start	OFF	
	Y27	Stop signal	OFF	
	Y2D	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

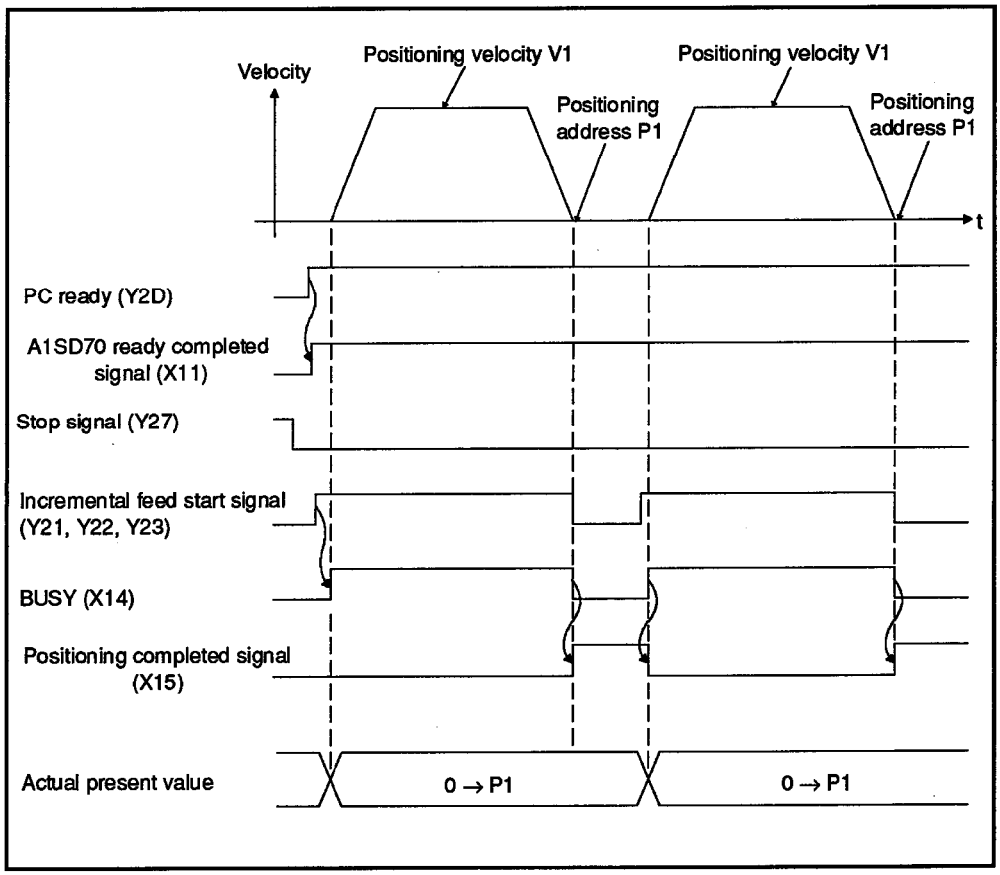


Fig. 5.24 Incremental Feed Timing

(4) Sample positioning program

(Conditions)

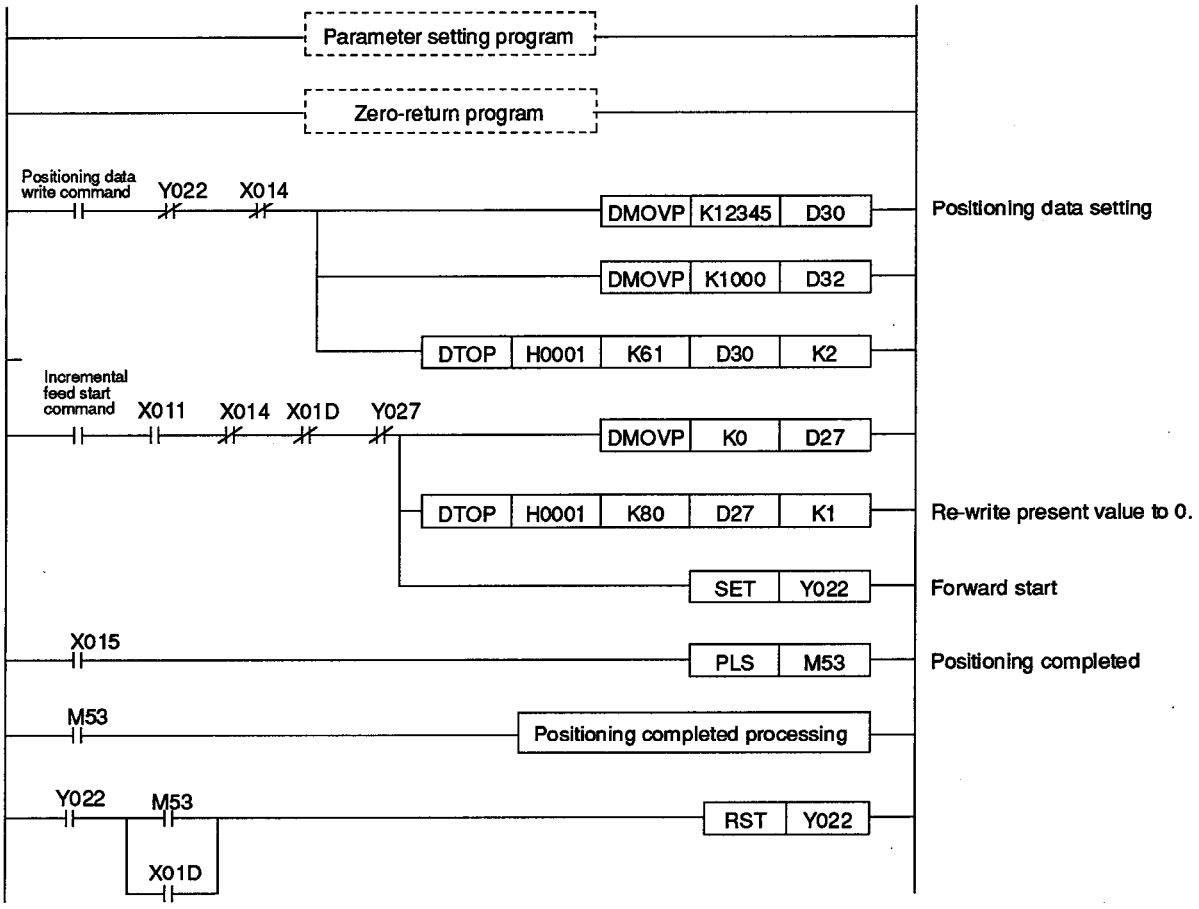
1) Using the incremental feed start command, execute incremental feed operation by restarting the incremental feed start command which executes positioning of the set axis travel distance at the set positioning velocity.

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



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
Y24	Forward JOG start (addresses increasing)
Y25	Reverse JOG start (addresses decreasing)

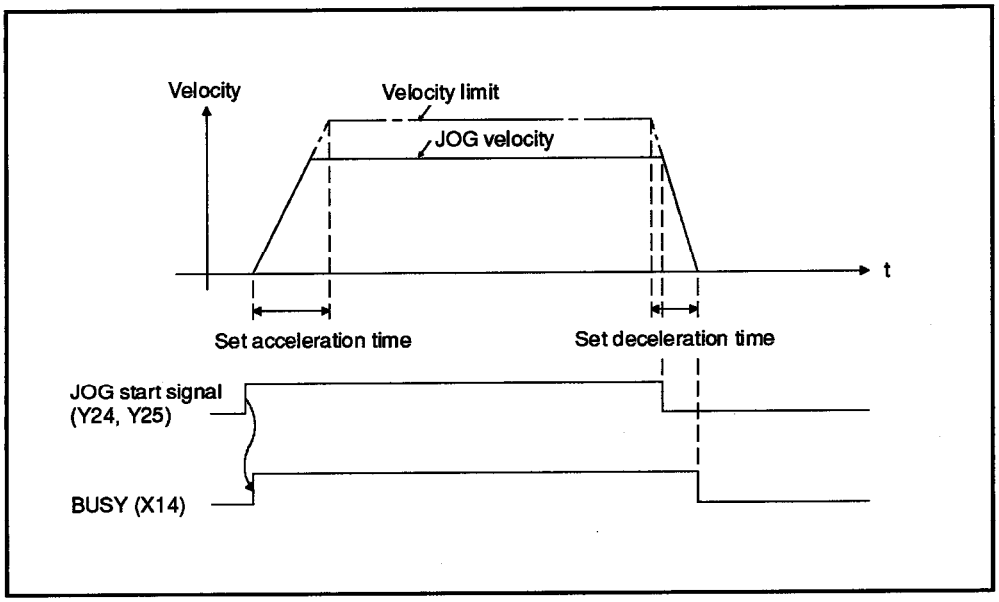


Fig. 5.25 JOG Operation

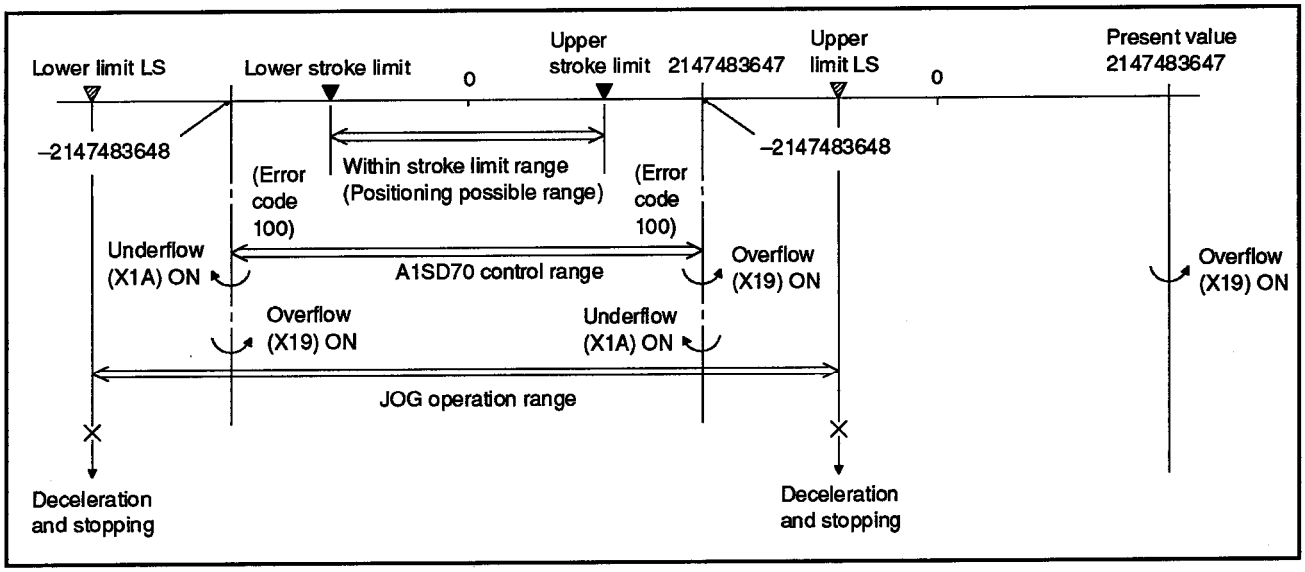
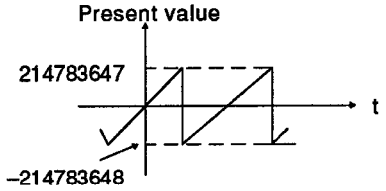


Fig. 5.26 JOG Operation Range

(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 A1SD70 control range (-2147483648 to 2147483647) during a JOG operation, either the overflow (X19) or the underflow (X1A) signal goes ON, and the present value changes as follows:



Reset the overflow or underflow signals by turning ON the overflow reset (Y29) or underflow reset (Y2A).

(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.

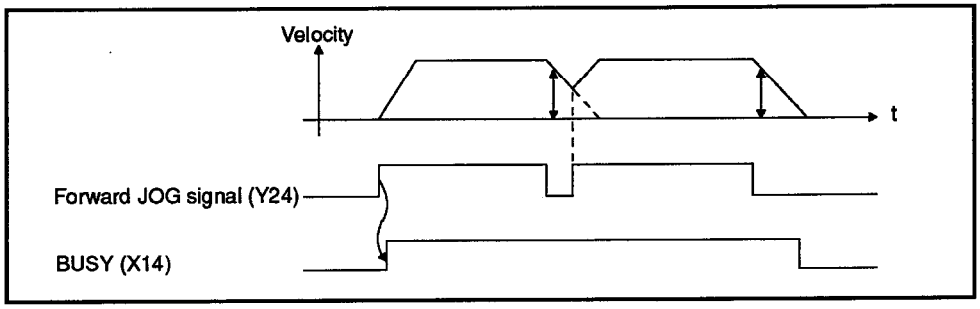


Fig. 5.27 Restarting During a JOG Operation Deceleration and Stopping (1)

(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.

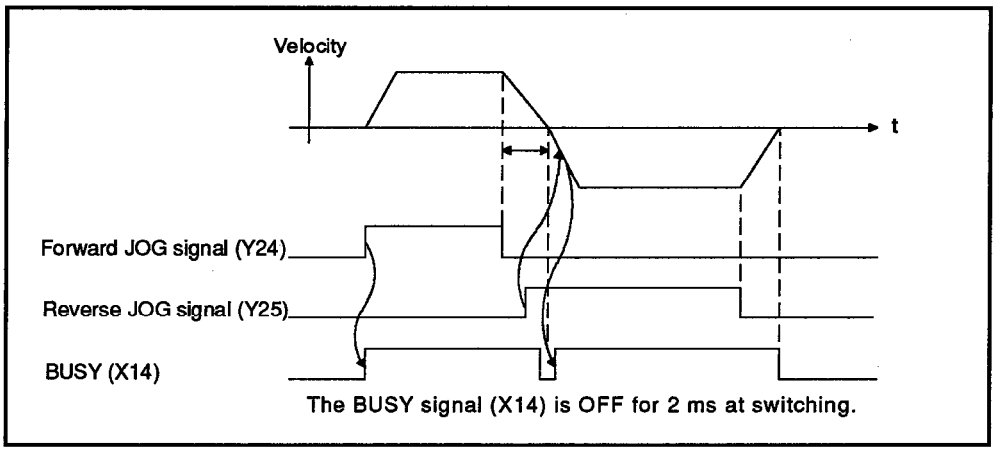


Fig. 5.28 Restarting During a JOG Operation Deceleration and Stopping (2)

(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.

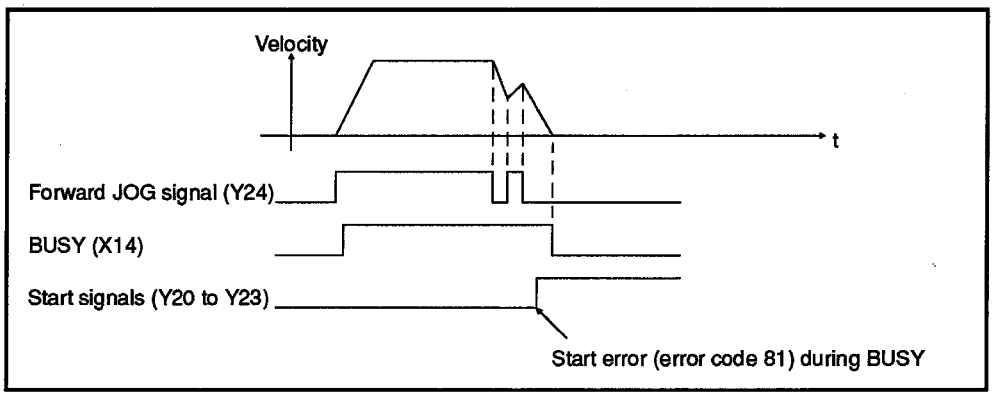


Fig. 5.29 Zero Return/Positioning Restart During Deceleration and Stopping After a JOG Operation

(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.

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

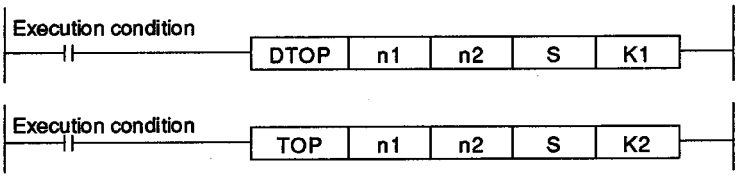
Item	Setting range	Default Value	Setting Enable Conditions	Set Data Check Timing
JOG velocity	1 to 400.000 PLS/s	—	Setting enabled. However, since these parameters are controlled by data set when the start signal is turned ON, they will be fetched when the next start signal is turned ON (if they are written while the BUSY signal is ON).	When the JOG start signal (Y24 or Y25) 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:



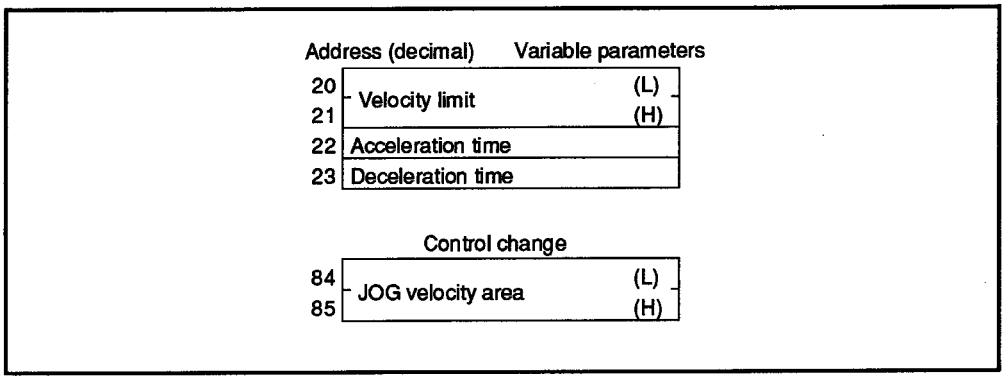


Fig. 5.30 Jog Data Area

5.8.4 Sample jog operation program

(1) Sample flowchart (2) Start conditions

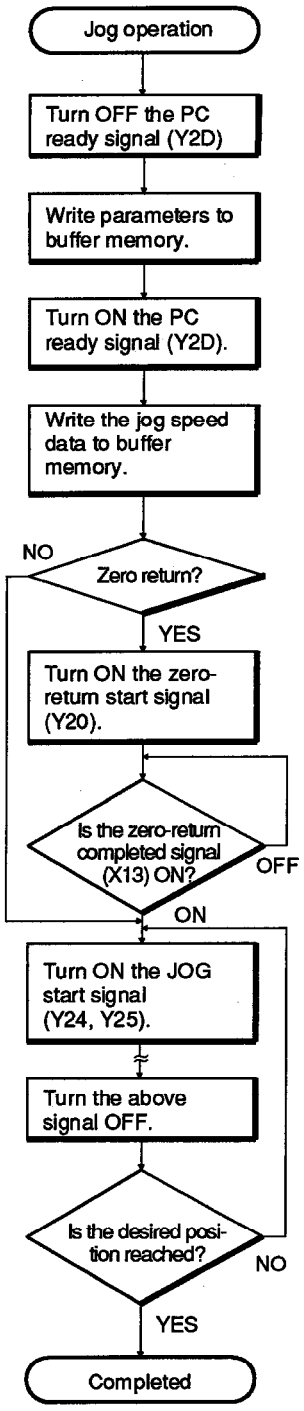


Table 5.16 Jog Operation Start Conditions

	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	X11	A1SD70 ready completed	ON	
	X14	BUSY	OFF	
	Y27	Stop signal	OFF	
	Y2D	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

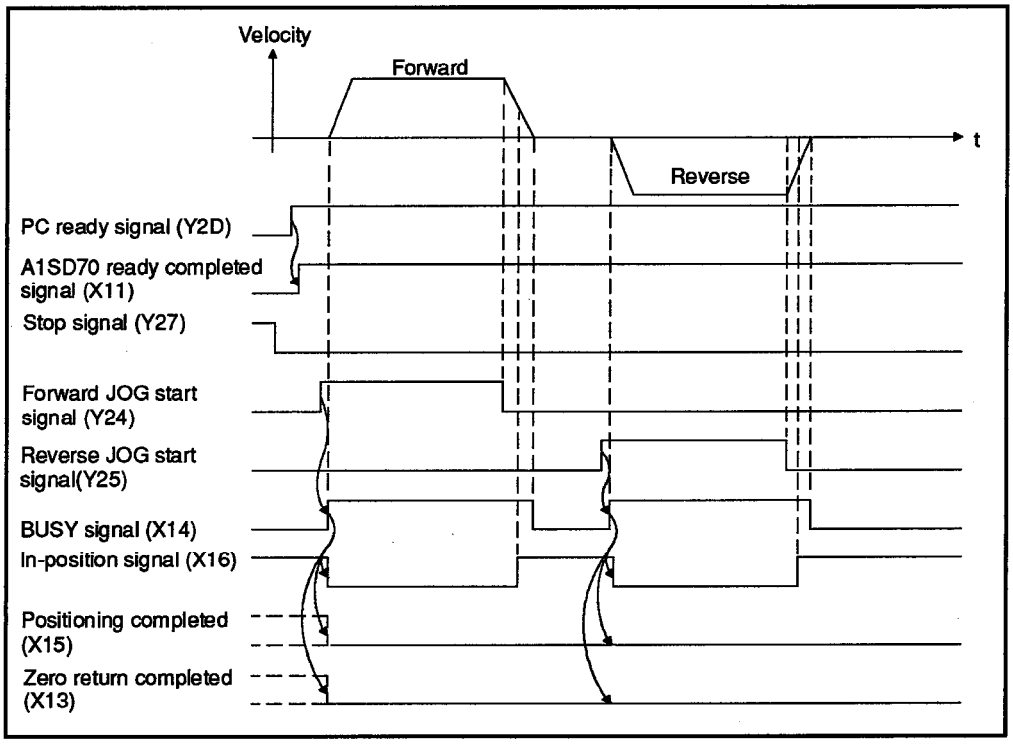


Fig. 5.31 JOG Operation Timing

(4) Sample JOG operation program

(Conditions)

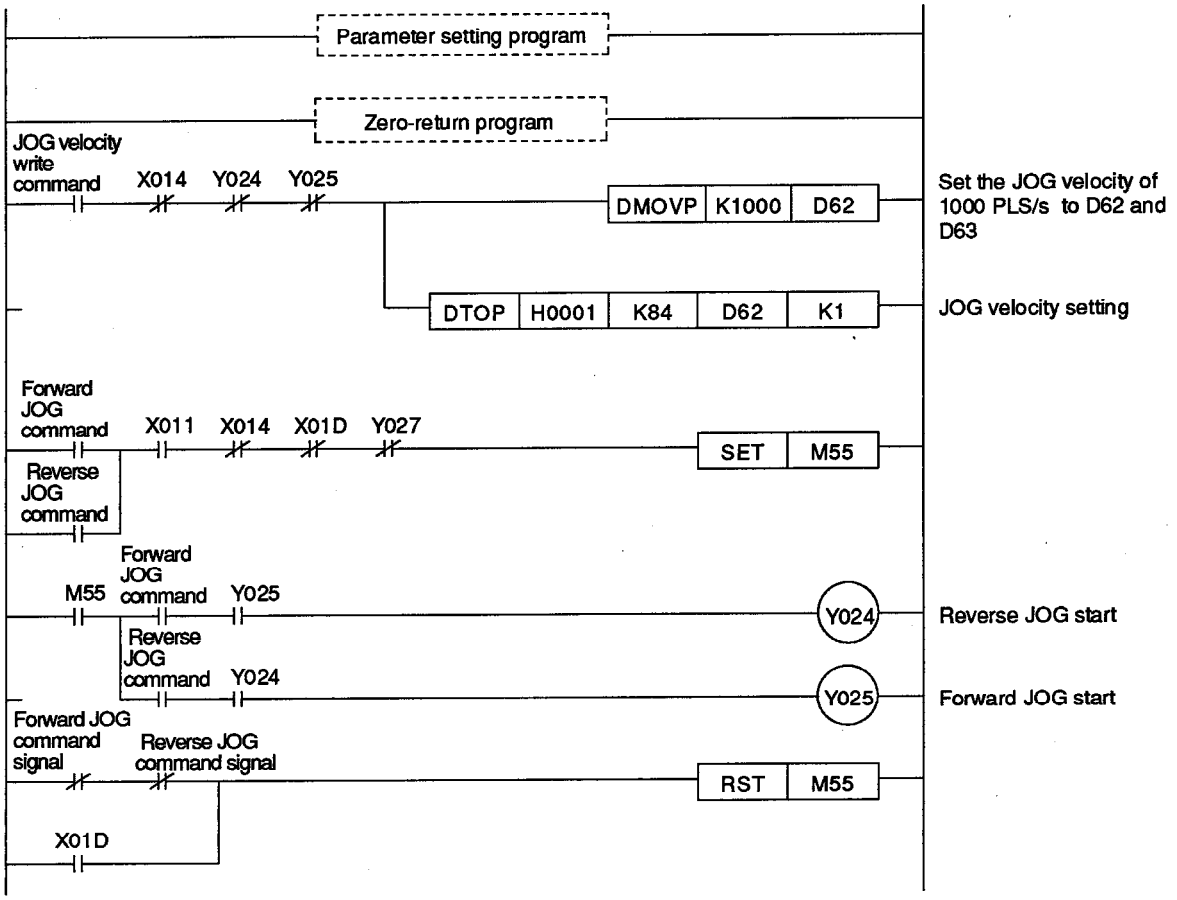
1) JOG operation can be executed while the JOG start command signal is ON.

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



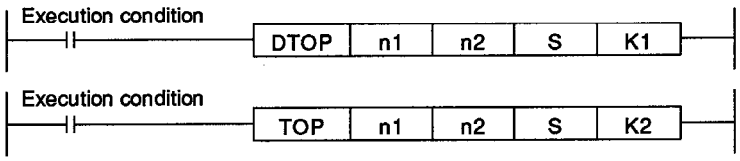
5.9 Control Changes

Control can be changed by writing data from the sequence 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 sequence 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:



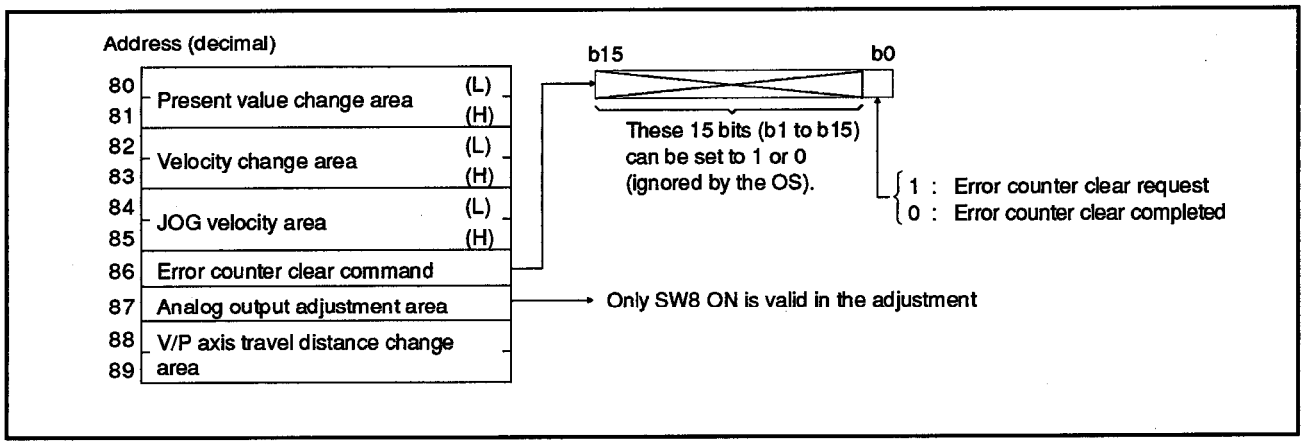
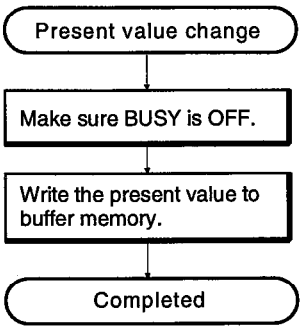


Fig. 5.32 Control Change Area

5.9.1 Present value changes

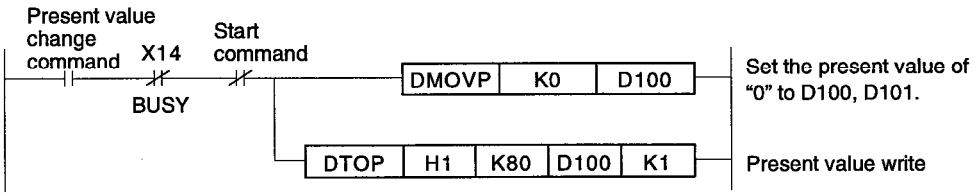


Change the present value when (a) the A1SD70 present value data is to be changed, (b) the present value is outside the stroke range, or (c) a start error occurs.

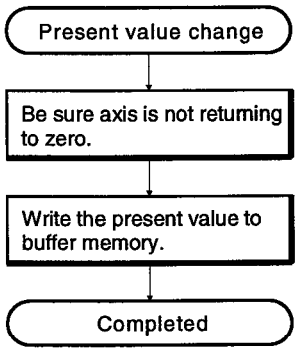
Table 5.17 Present Value Change Data

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)

Writing data to the present value change area changes the present feed value to that value.
The actual present value is the (present feed value - deviation counter pulse value).
When the deviation counter pulse value is 0, the present feed value is equal to the actual present value.
The following shows the program to change the present value to "0".



5.9.2 Velocity changes

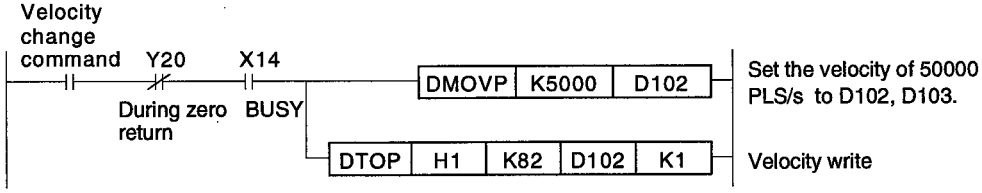


The velocity can be changed by force during positioning or a JOG operation.

Table 5.18 Velocity Change Data

Item	Setting Range	Execution Enable Conditions	Buffer Memory
Velocity change	1 to velocity limit PLS/s (Max. 400,000 PLS/s)	1. Valid during BUSY 2. Velocity change is disabled in the following cases: After automatic deceleration starting point After input of stop command signal (Y27, 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.



5.9.3 Error counter clear

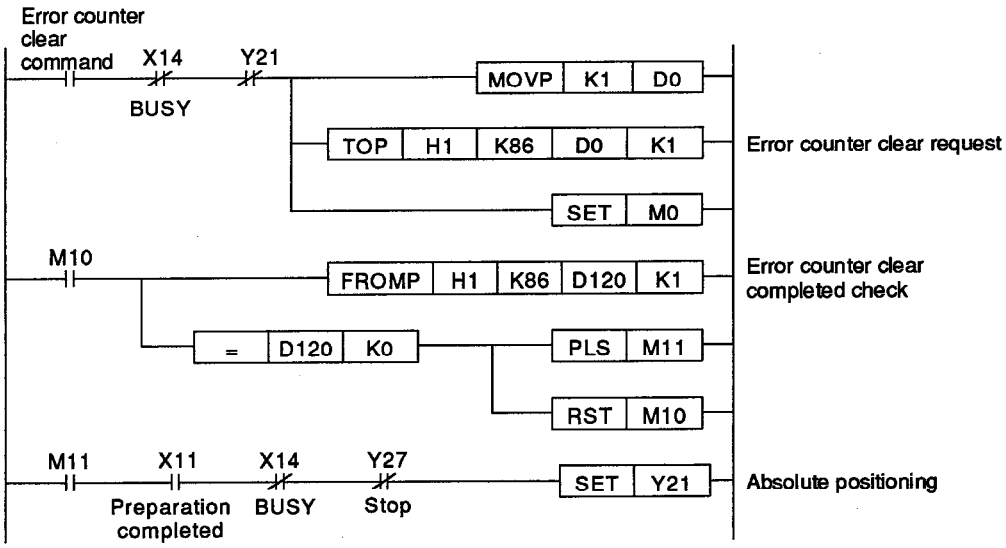
This function clears feedback pulses that were manually inputted from the encoder and restarts the positioning.

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 86 is "0" and no error has occurred.

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



REMARK

To change the feed present value after clearing the error counter to the actual value before clearing the counter, carry out the error counter clear operation in the following order.

(1) Read out the actual present value.

(2) Write the read-out value to the present value change area.

(3) Clear the error counter.

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 (X18)	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 (Y27) is turned ON.			
3	PC ready signal (Y2D) is turned OFF.	ON	Error code reset	
4	Servo ready signal (X1B) 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.	—	—	

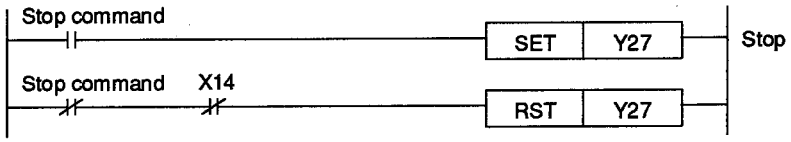
POINT

Hardware emergency stop circuits into the system.

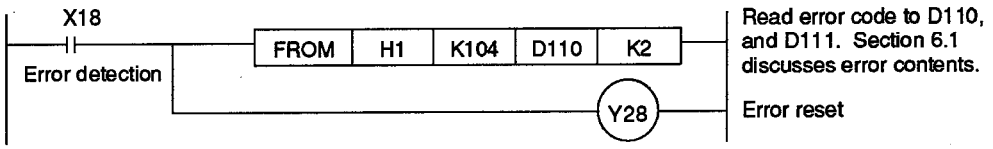
5.10.2 Program for stopping during positioning

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



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.

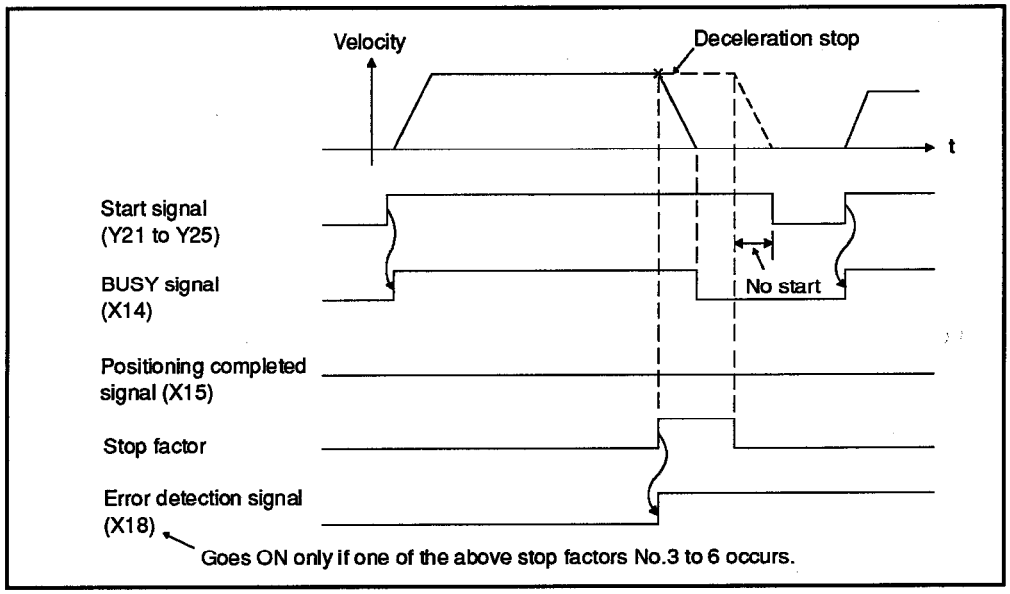


Fig. 5.33 Positioning During a Stop

(2) Stop during a positioning/JOG operation deceleration

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

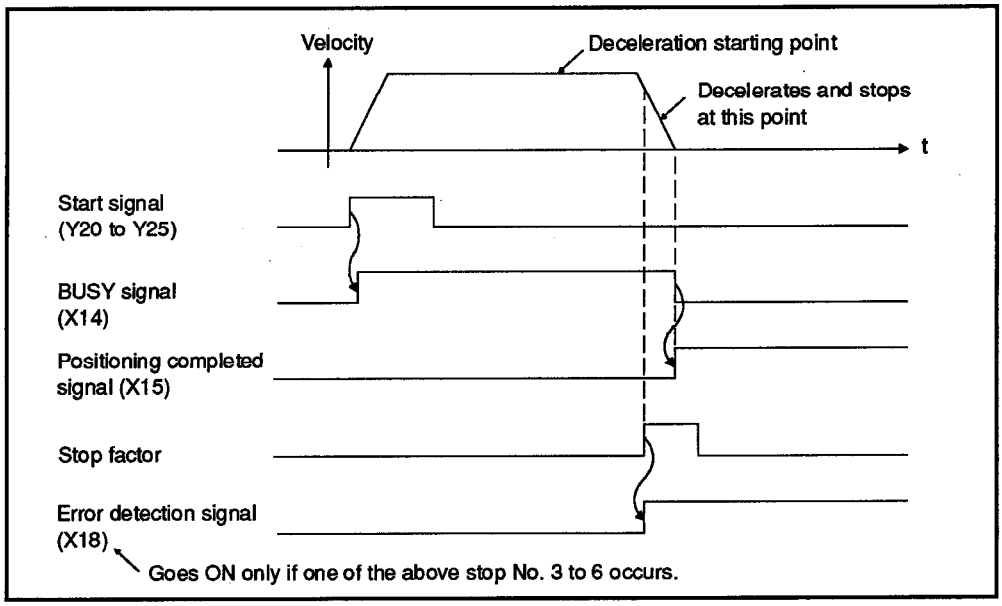


Fig. 5.34 Positioning Deceleration During a Stop

(3) Stop during JOG operation 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.

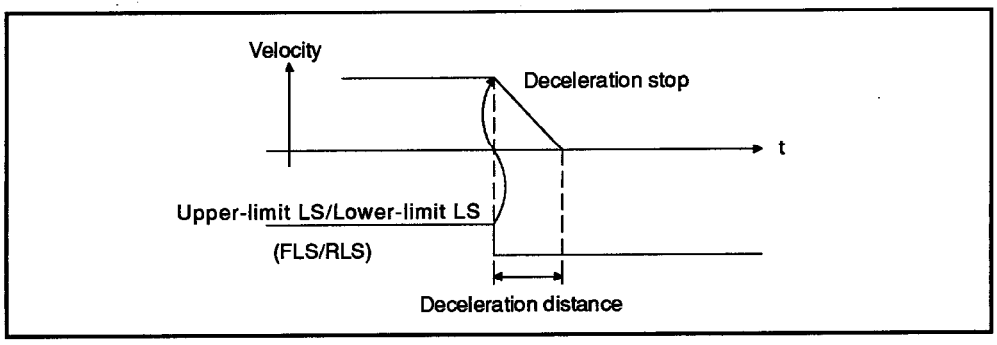


Fig. 5.35 Stop During a JOG Operation by Using Upper-Limit LS or Lower-Limit LS

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 (Y26) 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 (Y26).

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 (Y26). If the Y22 or Y23 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:

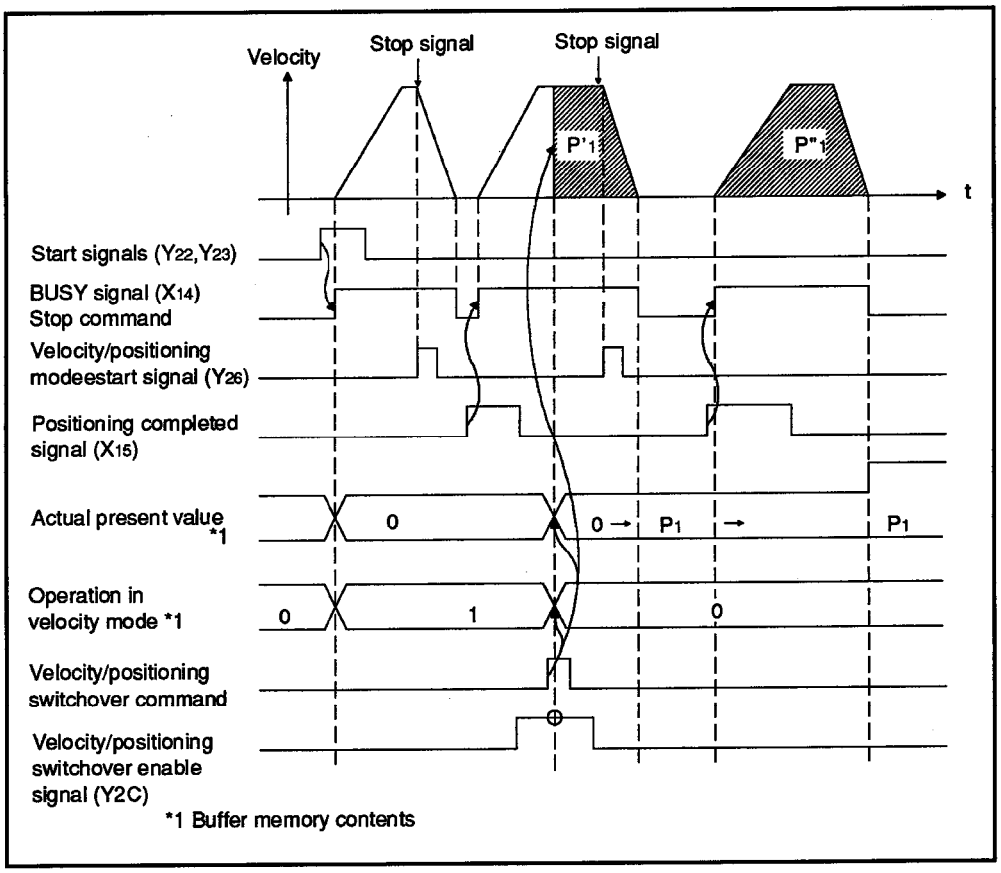


Fig. 5.36 Restarting After Stopping in the Velocity/Positioning Switchover Mode

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.

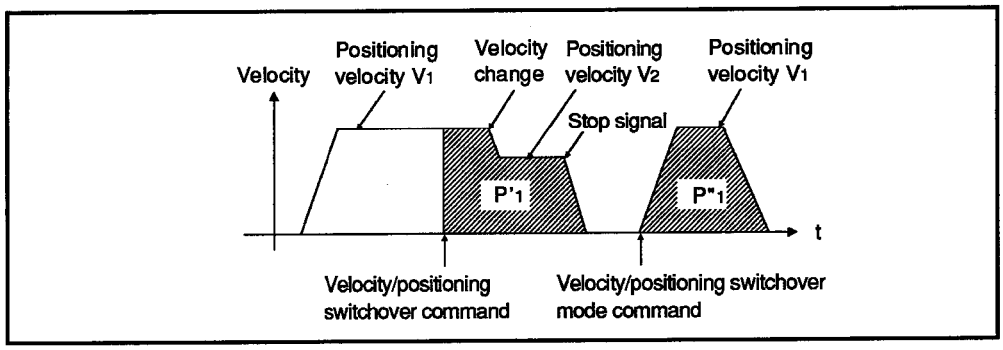


Fig. 5.37 Restarting After a Velocity Change in the Velocity/Positioning Switchover Mode

5.11 Monitoring Buffer Memory

Data (such as A1SD70 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.

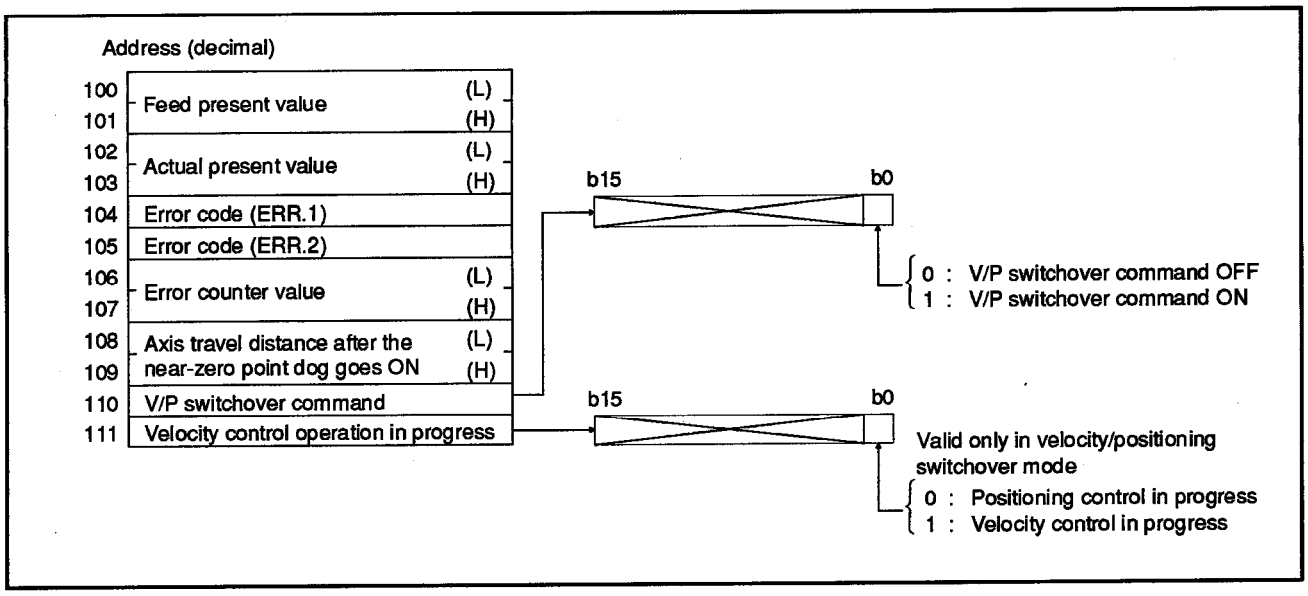


Fig. 5.38 Monitoring Buffer Memory

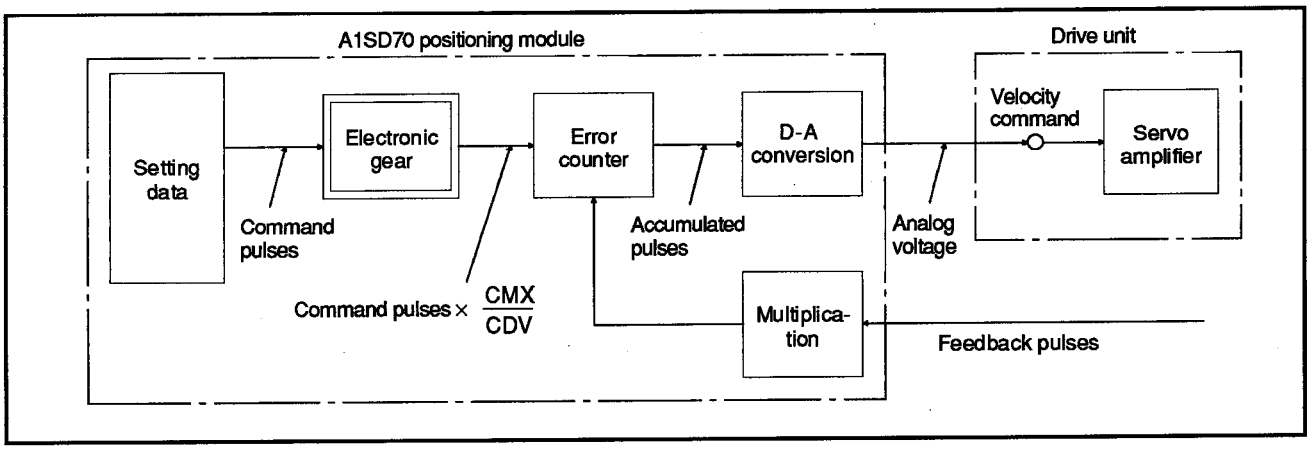


Fig. 5.39 Positioning Control

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

(1) Feed present value

The A1SD70 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.

(3) Error code (ERR.1)

If an ERR.1 error occurs in an A1SD70, 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 A1SD70, 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 A1SD70 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)

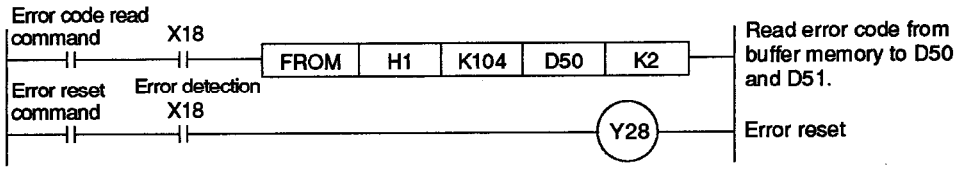
(7) V/P switchover command

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



6. TROUBLESHOOTING

This chapter explains the definitions of various errors that may occur during use of the A1SD70 and their corrective actions.

6.1 Errors Detected by A1SD70

The A1SD70 has various error check functions. When an error occurs, the LED on the front panel of the A1SD70 goes ON and an error code is written to addresses 104, 105 in buffer memory and the error detection signal X18 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 Y28 ON.

The error detection signal (X18) 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	A1SD70 start error		ERR. 2 lights	See Section 6.1.3
80 to 87			ERR. 1 lights	
90 to 93	A1SD70 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

When any of the conditions in Table 6.2 occurs in the A1SD70, the setting data ranges are checked, and if any data is found to be outside the setting range, the corresponding error code is set.

Table 6.2 Data Range Check

Data	Check Conditions
Fixed parameters	• At power ON • When the PC ready signal (Y2D) goes ON
Variable parameters	• When the positioning start signal (Y21 to Y23) goes ON • When the JOG start signal (Y24, Y25) goes ON • When the zero-return start signal (Y20) goes ON
Zero-return data	• When the zero-return start signal (Y20) goes ON
Positioning data	• When the positioning start signal (Y21 to Y23) goes ON
Control change area	• Before control change processing execution

When an error occurs, check the data corresponding to the error code, change the data to within the setting range, and then set it again.

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 $\frac{1}{50} \leq \frac{CMX}{CDV}$		
10	Variable parameters		Velocity control		10 to 400,000 PLS/s	Error parameters are replaced with default values.	
11			Acceleration time		2 to 9999 ms		
12			Deceleration time		2 to 9999 ms		
13			In-position range		1 to 2047 PLS		
14			Positioning mode		A value other than 0 or 1 causes error		
20	Zero-return data		Zero-return velocity		1 to velocity limit PLS/s	No data start at error.	
21			Creep velocity		1 to velocity limit PLS/s		
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				

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 Y2D 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.	

6.1.3 A1SD70 start errors

Table 6.5 A1SD70 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	A1SD70 ready completion signal(X11) and PC ready signal (Y2D) are OFF at the start.	Turn the PC ready signal (Y2D) ON.	104
81			The start signal does not go ON because the BUSY signal (X14) 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 (Y27) is ON at the start.	Turn the STOP signal (Y27) 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 (X13) 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 (Y22) or reverse start signal (Y23). (2) Start by an absolute positioning start signal (Y21), forward start signal (Y22), or reverse start signal(Y23).	
86			Positioning start signal (Y21) attempted in the V/P control switchover mode.	Start by a forward start signal (Y22) or reverse start signal (Y23).	
87			Axis travel distance changed to outside the stroke limit range.	Change the axis travel distance to within the stroke limit range.	

6.1.4 A1SD70 operation errors

Table 6.6 A1SD70 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 (Y27) 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 (Y2D) 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 (Y2D) is OFF during BUSY (positioning, JOG).	Decelerates to a stop	Turn the PC ready signal (Y2D) ON.	

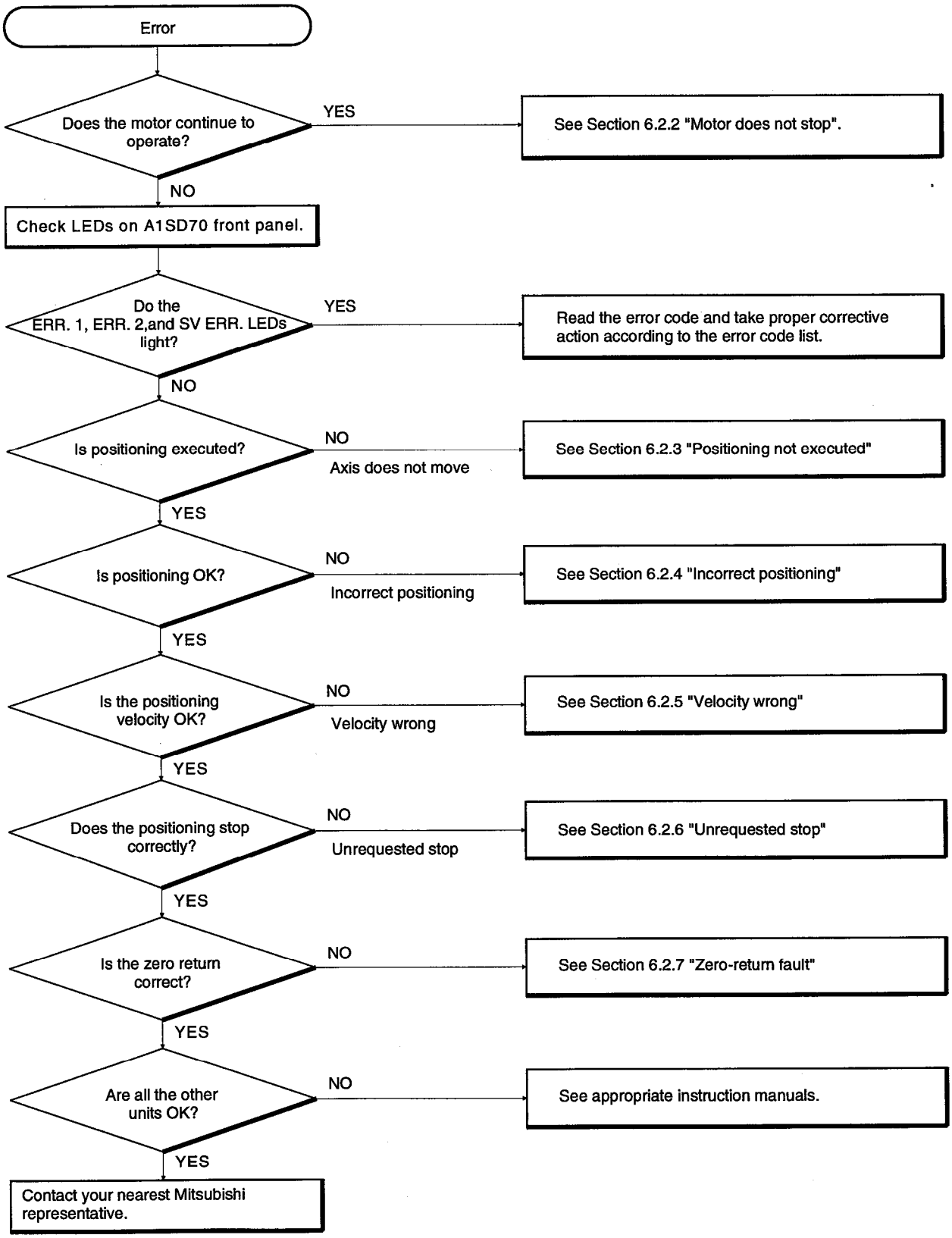
6.1.5 Control change errors during an A1SD70 operation

Table 6.7 Control Change Error Codes During an A1SD70 Operation

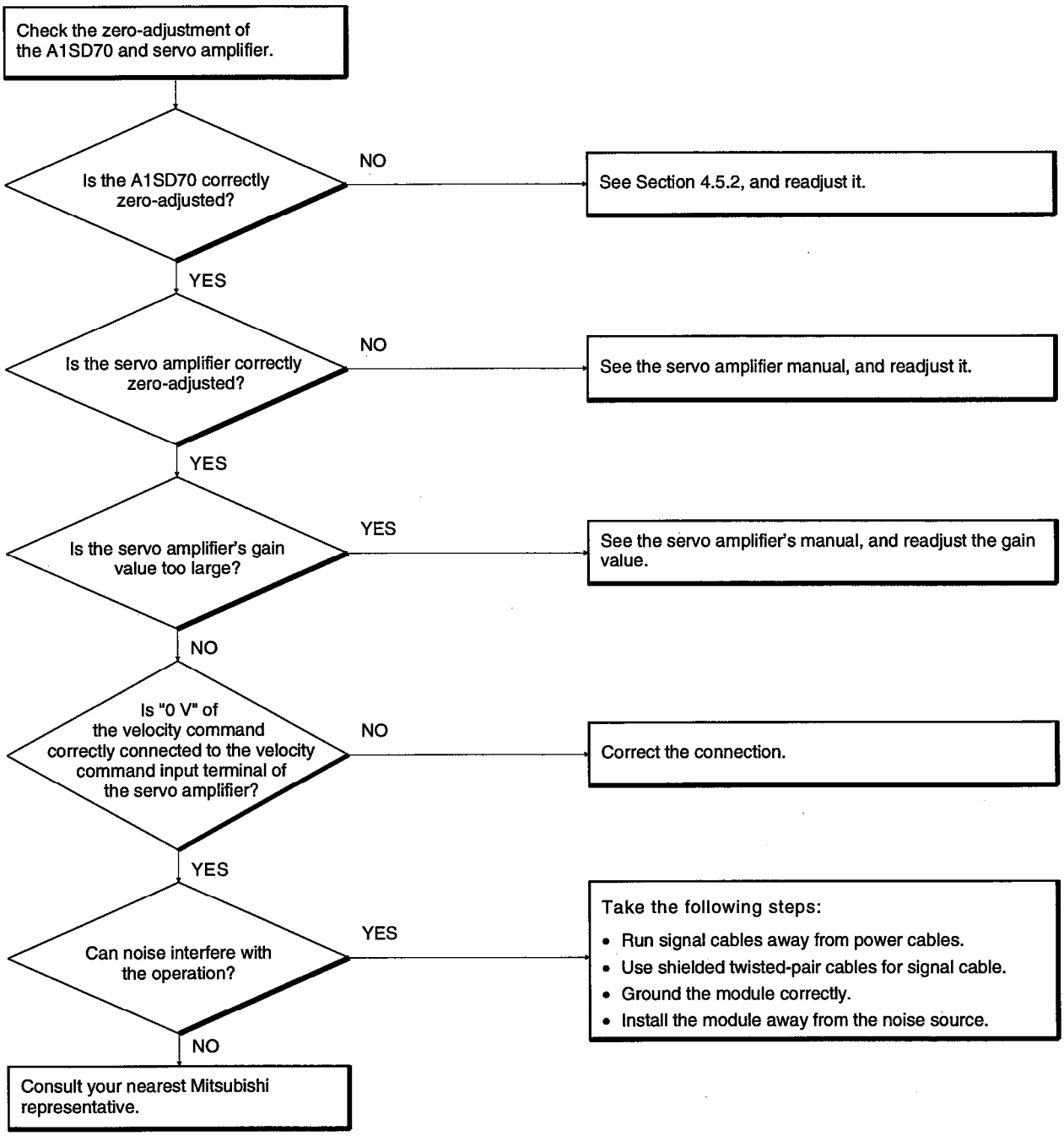
Error Code	When Error Occurs	LED Indicator	Error Description	Corrective Action	Error Code Set Address
110	At control change during operation	ERR. 1 lights	Attempted to change the present value (buffer memory addresses 80 and 81) during BUSY.	Provide interlock using the sequence program.	104
111			Attempted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

6.2 Troubleshooting

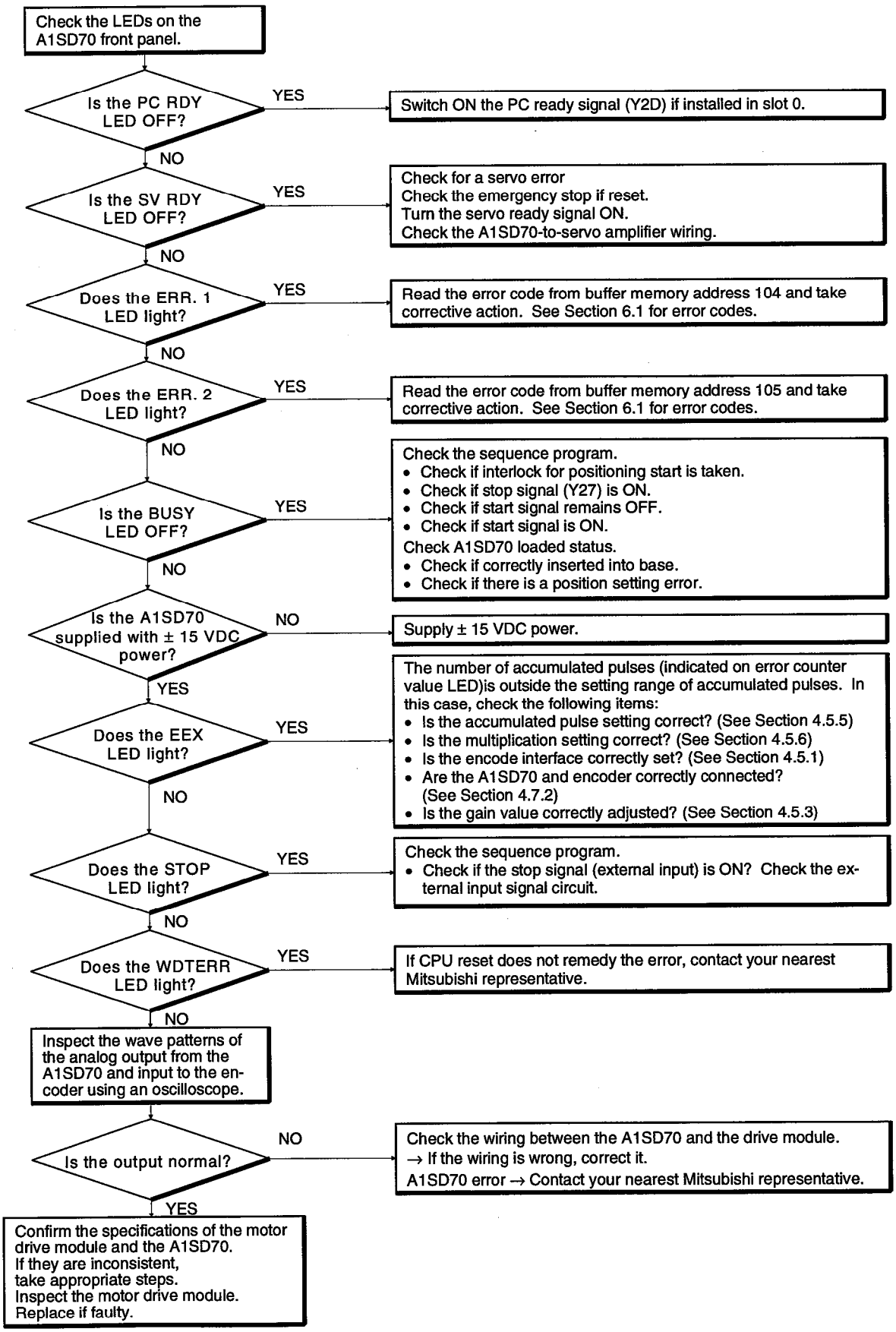
6.2.1 General troubleshooting



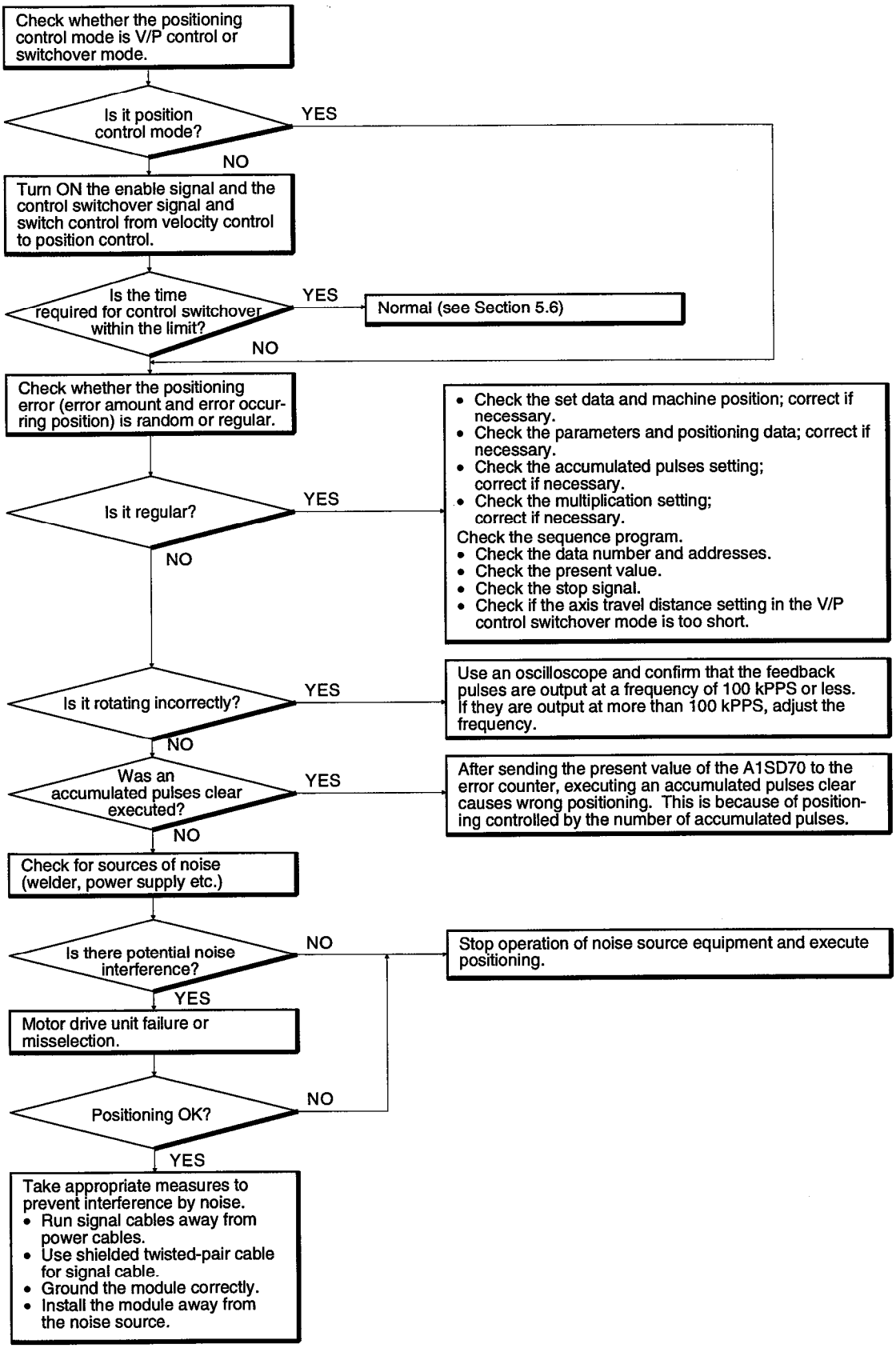
6.2.2 Motor does not stop



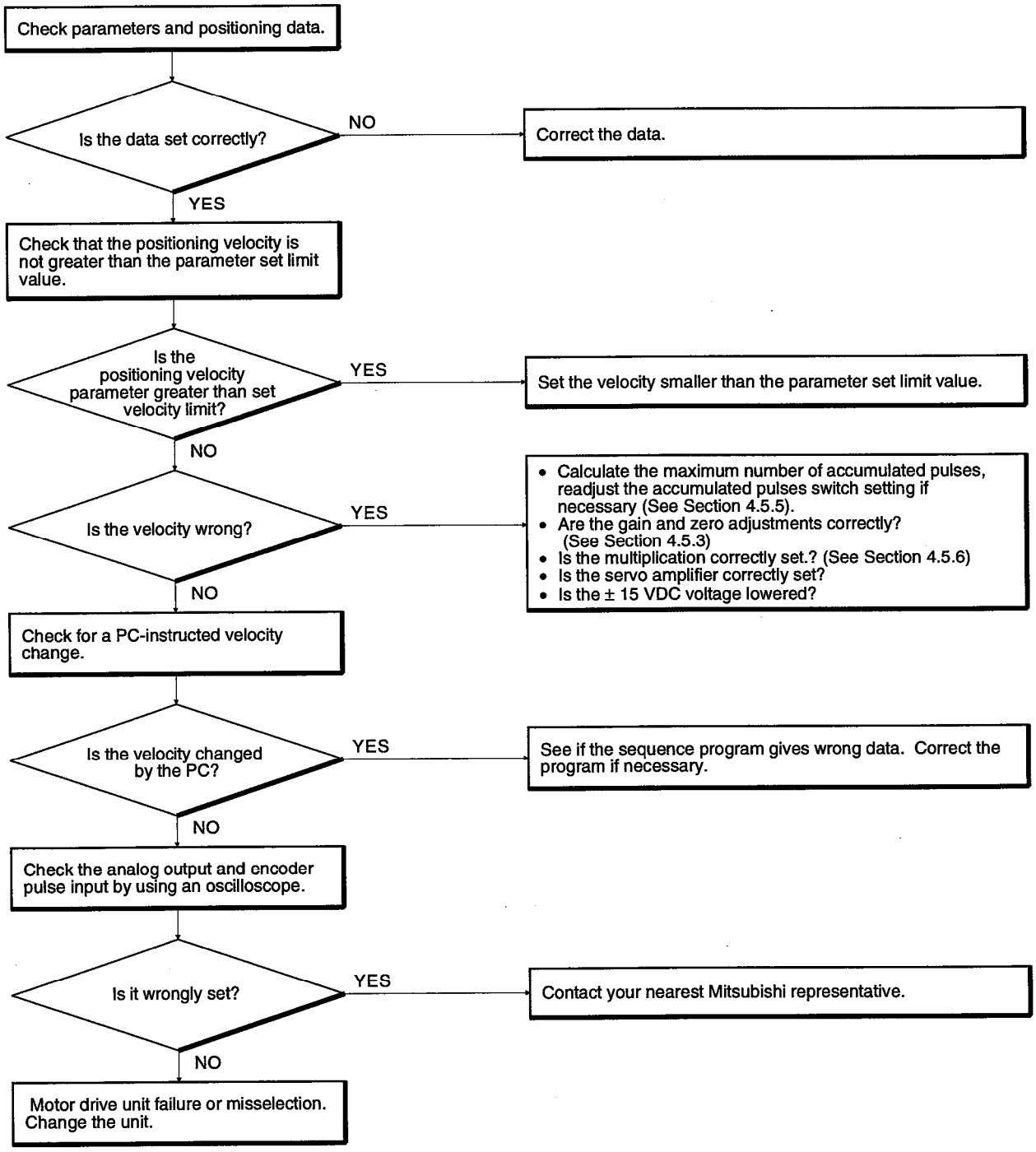
6.2.3 Positionings not executed



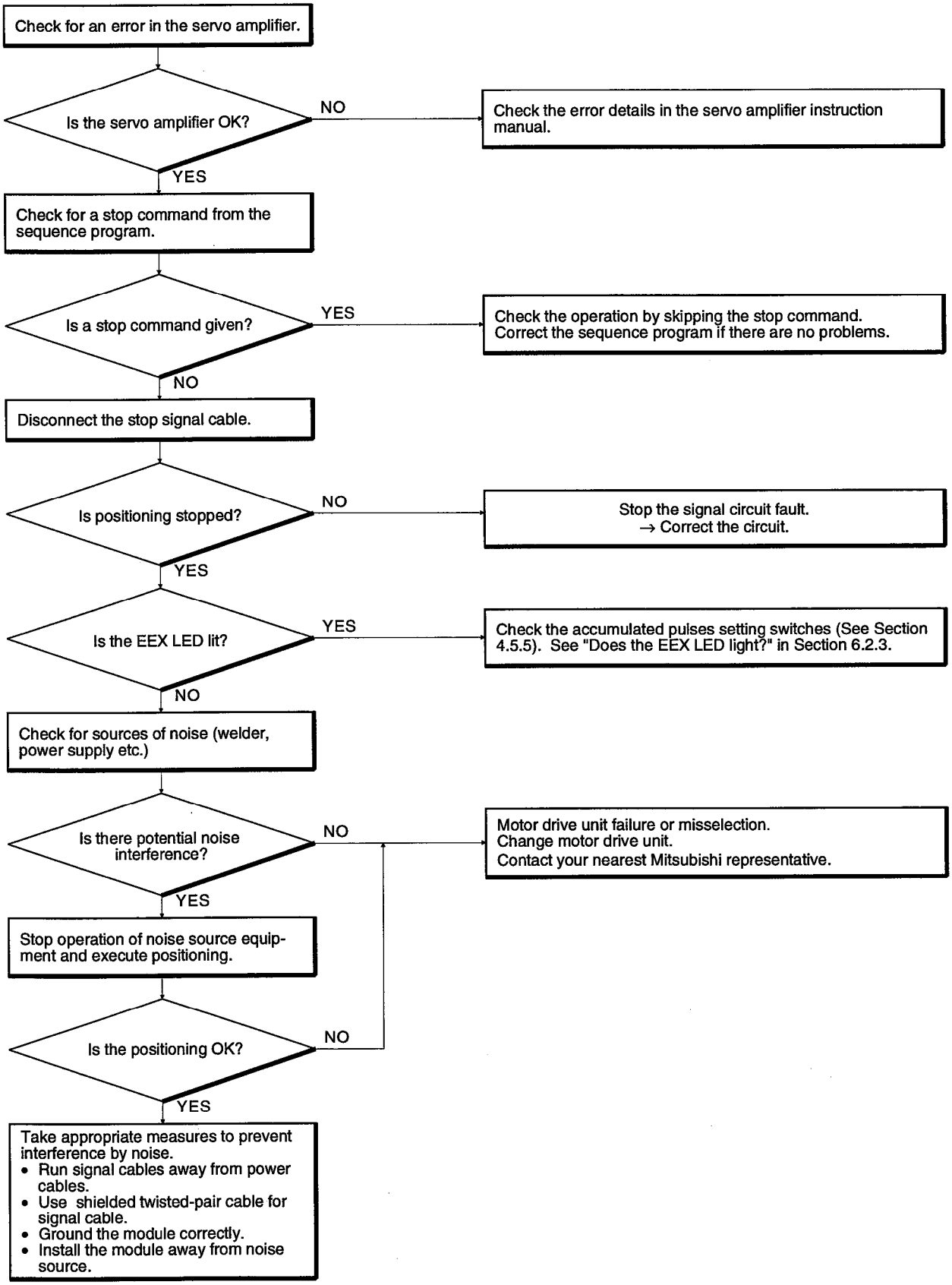
6.2.4 Incorrect positioning



6.2.5 Velocity wrong

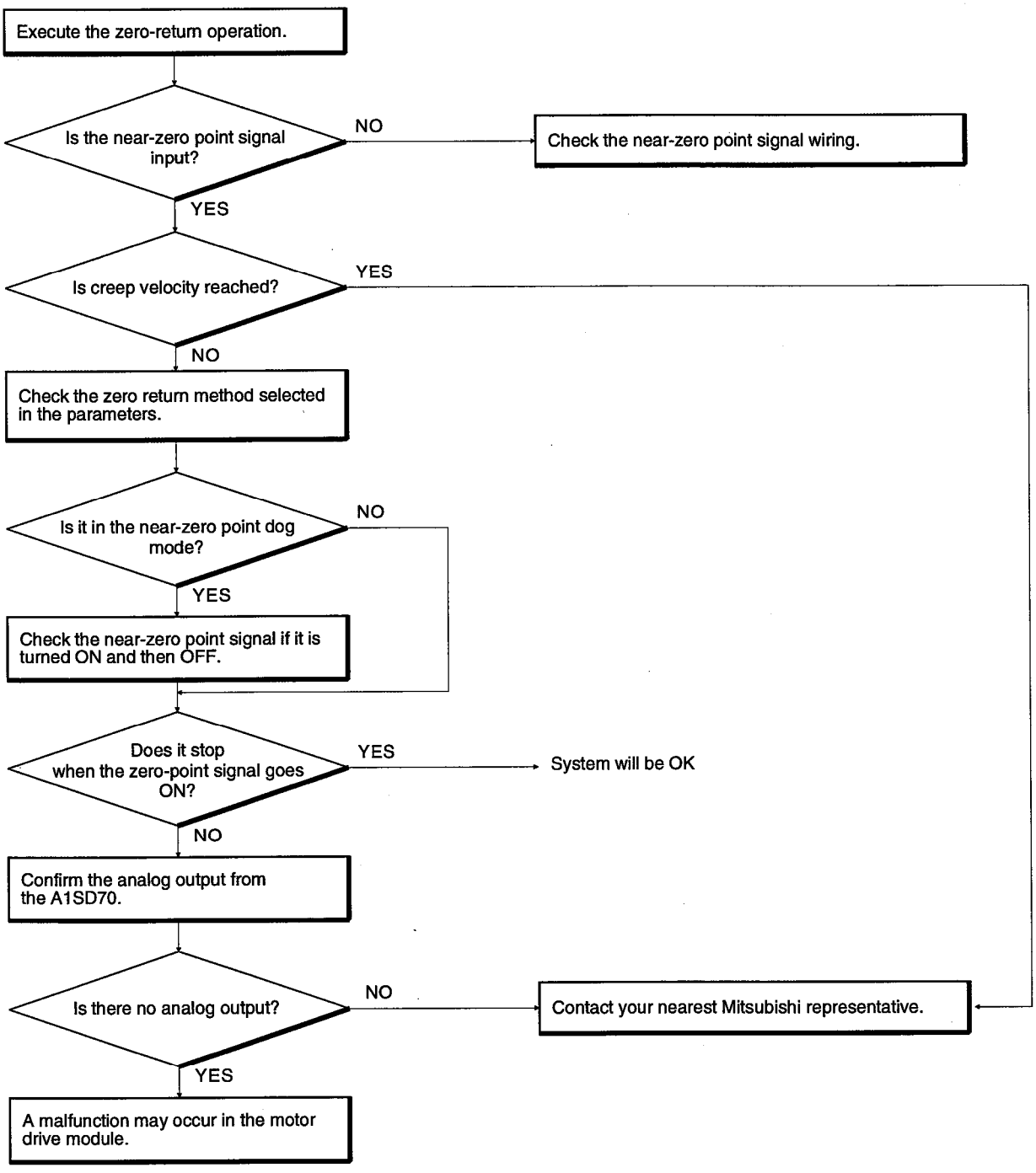


6.2.6 Unrequested stop

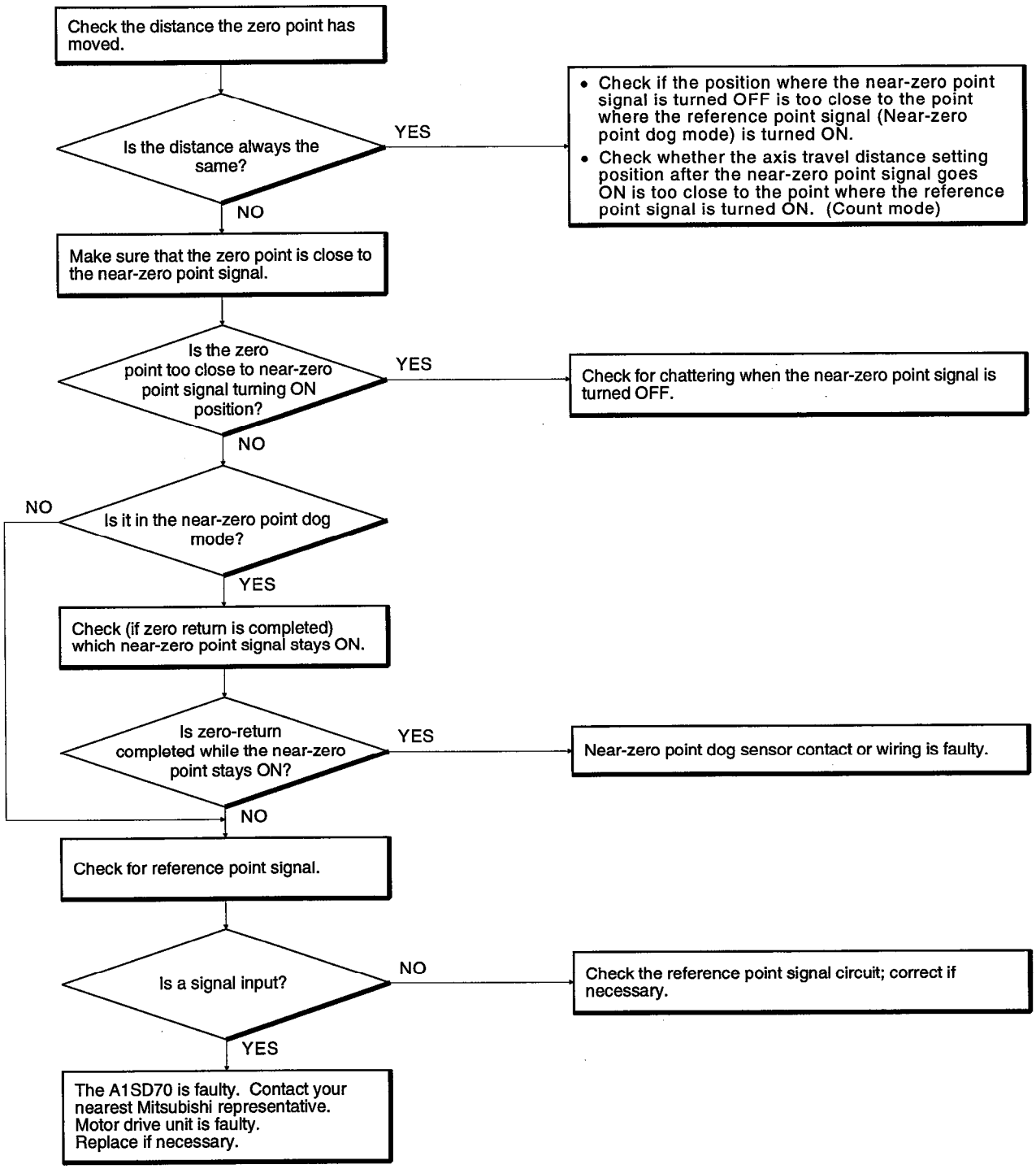


6.2.7 Zero-return fault

(1) Zero-return incomplete



(2) Zero point position has shifted



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

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

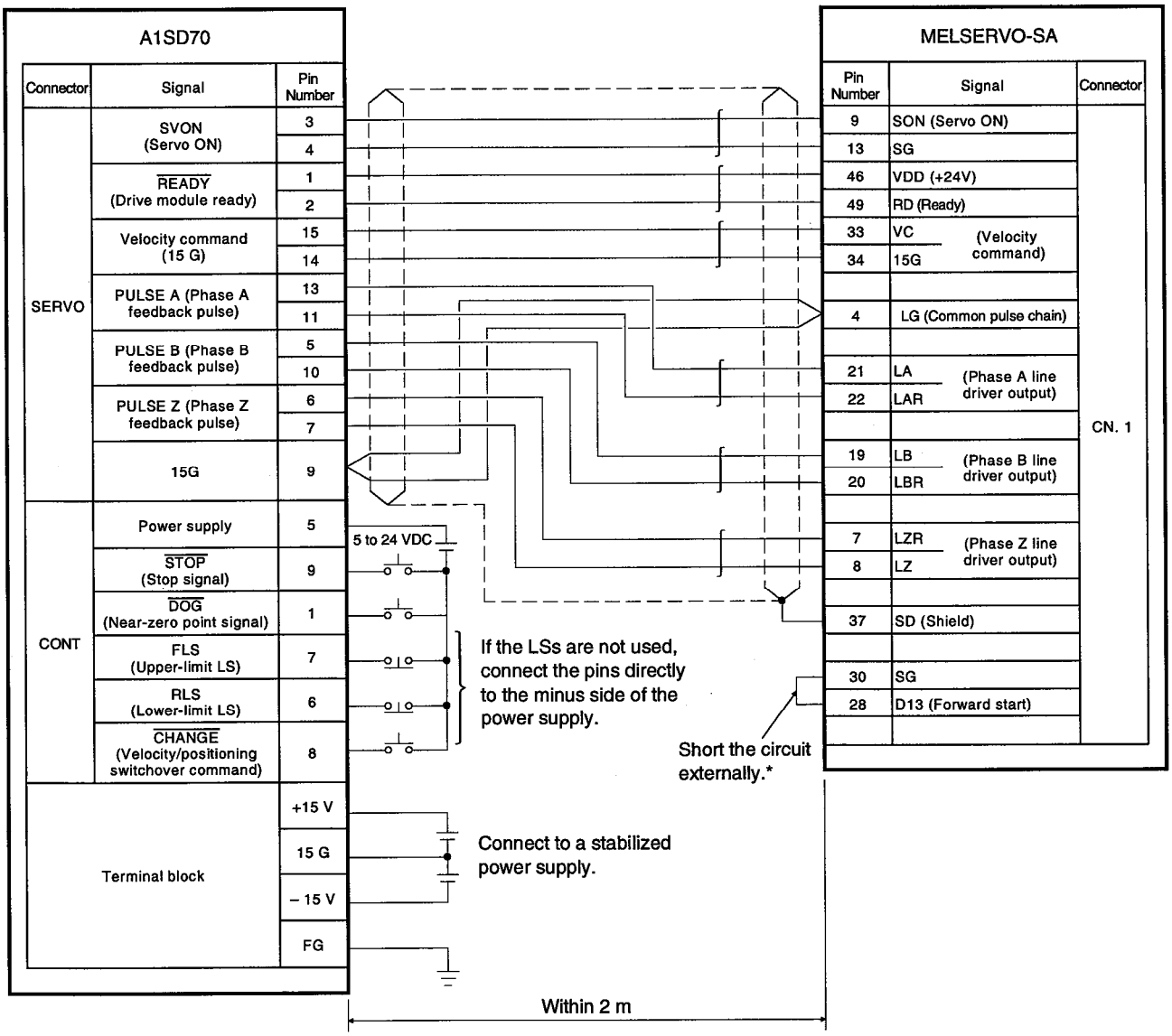
APPENDICES

APPENDIX 1 SAMPLE SERVO AMPLIFIER CONNECTION

Several types of amplifiers can be connected to the A1SD70.

A sample connection (using a 1992 servo amplifier) is given below.

1.1 Sample Connection Using a MELSERVO-SA



* : For the forward/reverse control of the servo, use either of the following two methods.
(1) To set the direction of rotation by the slide switch (refer to 4.5.4 and 4.7.2.).
(2) To use the sequence program (Y21: Starting absolute positioning, Y22: Starting forward rotation, Y23: Starting reverse rotation) (refer to 5.4.).

POINTS

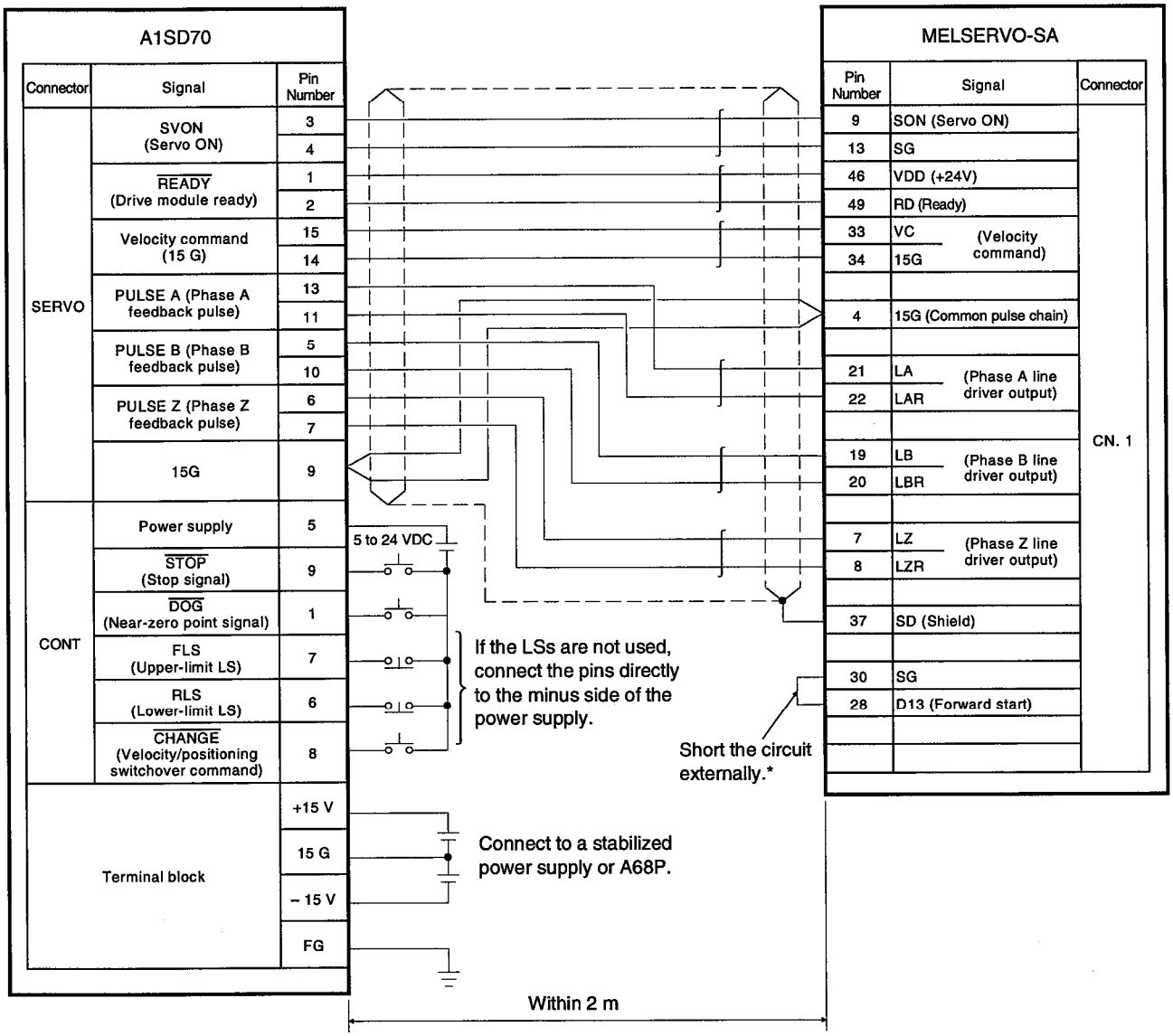
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "differential output type".

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

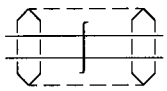
(4) The MELSERVO-SA User's Manual gives details on wiring which is different than the above example.

1.2 Sample Connection Using MELSERVO-SA-KL



* : For the forward/reverse control of the servo, use either of the following two methods.
(1) To set the direction of rotation by the slide switch (refer to 4.5.4 and 4.7.2.).
(2) To use the sequence program (Y21: Starting absolute positioning, Y22: Starting forward rotation, Y23: Starting reverse rotation) (refer to 5.4.).

POINTS

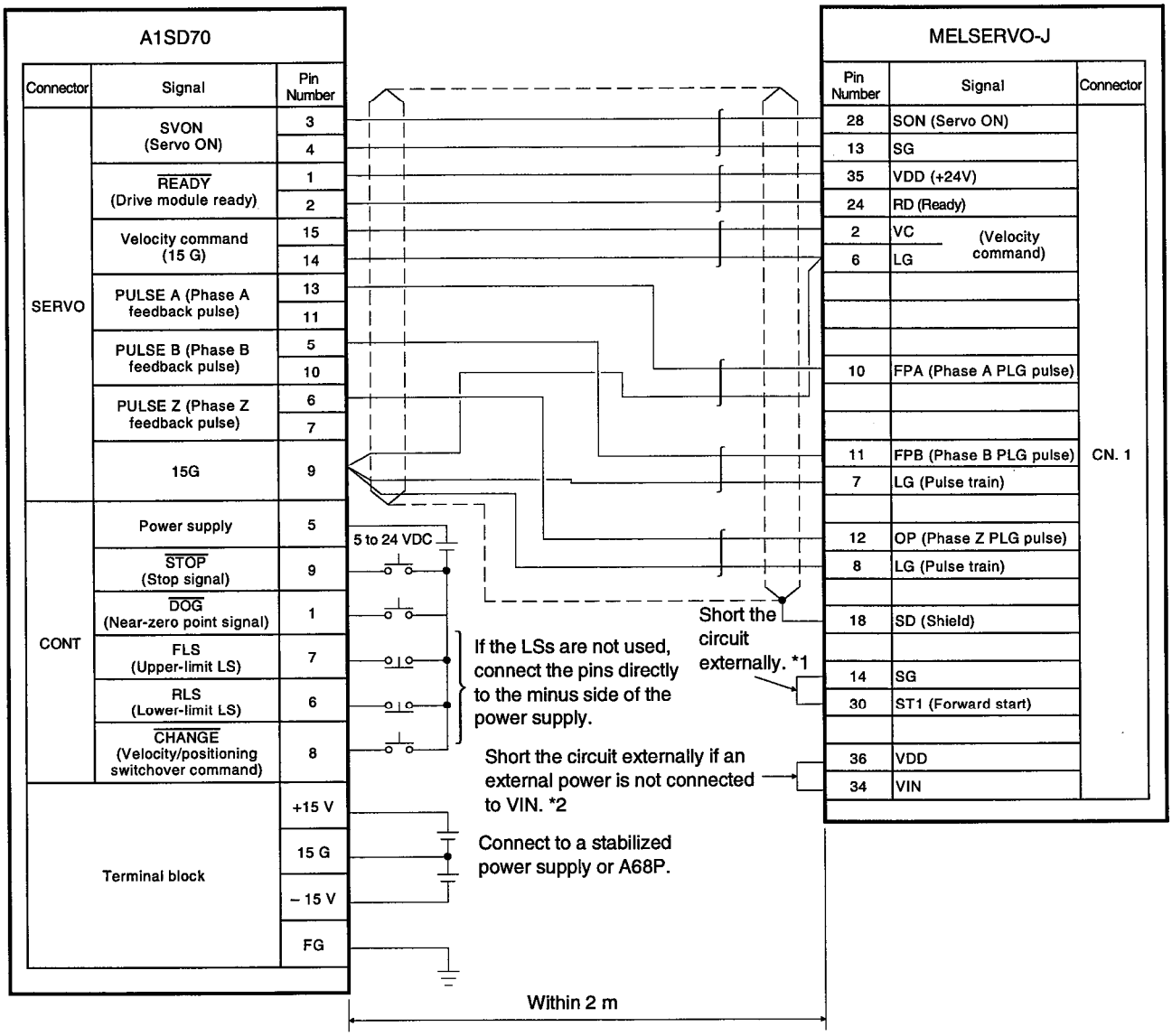
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "differential output type".

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

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

1.3 Sample Connection Using MELSERVO-J



*1 : For the forward/reverse control of the servo, use either of the following two methods.
(1) To set the direction of rotation by the slide switch (refer to 4.5.4 and 4.7.2.).
(2) To use the sequence program (Y21: Starting absolute positioning, Y22: Starting forward rotation, Y23: Starting reverse rotation) (refer to 5.4.).

*2 : If the total of the current flowing to the external relays connected to the MR-J and the current flowing to the digital I/O interface of the MR-J exceeds 80 mA, always follow the instructions indicated below:
(1) Open the external wiring connecting VDD (pin 36) and VIN (pin 34).
(2) Connect an external power supply to VIN (pin 34).

POINTS

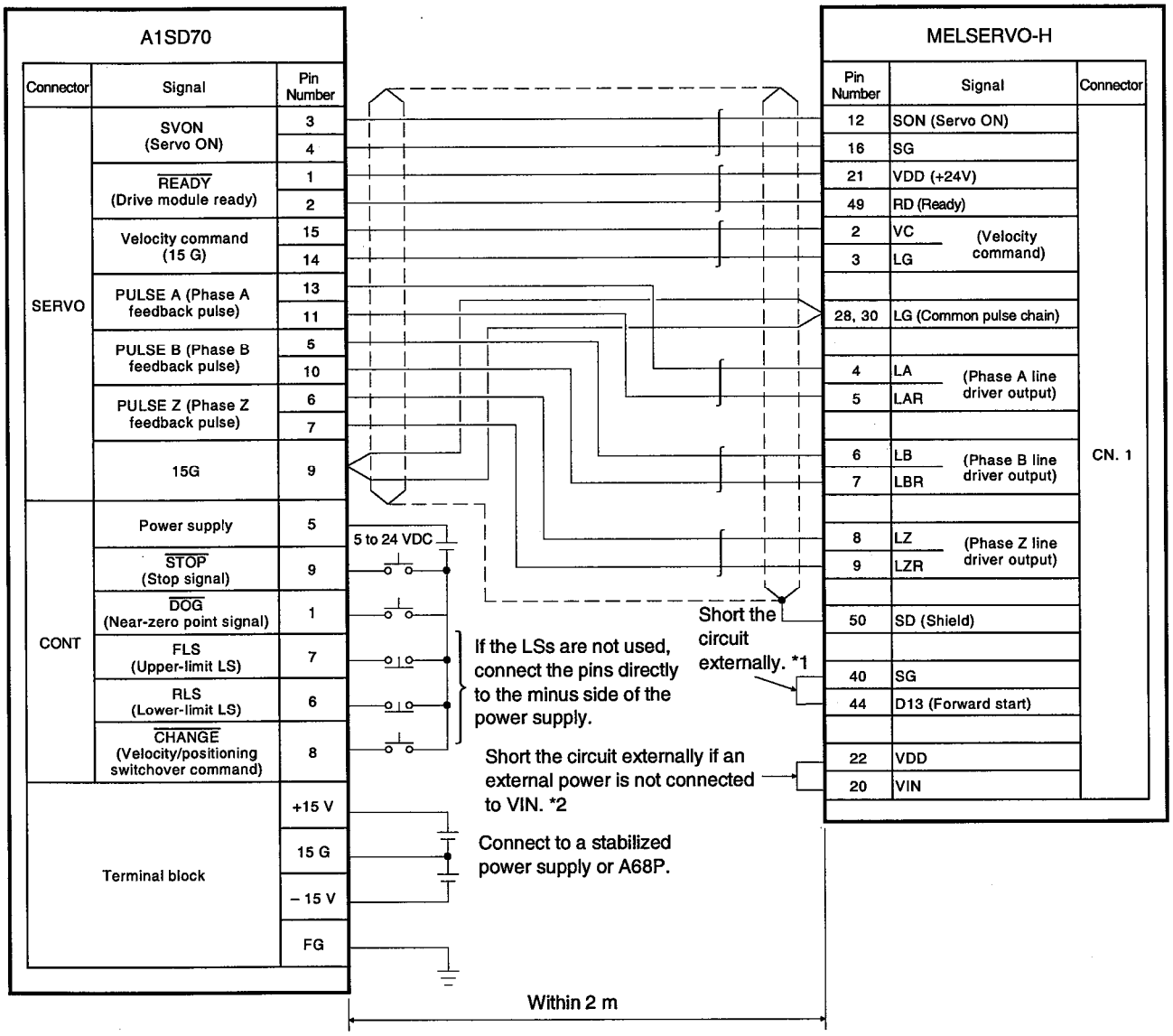
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "open collector output type".

(3) Set parameter 1 (servo loop mode) of the servo amplifier (MR-J) to "2" (velocity control).

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

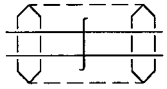
1.4 Sample Connection Using MELSERVO-H



*1 : For the forward/reverse control of the servo, use either of the following two methods.
(1) To set the direction of rotation by the slide switch (refer to 4.5.4 and 4.7.2.).
(2) To use the sequence program (Y21: Starting absolute positioning, Y22: Starting forward rotation, Y23: Starting reverse rotation) (refer to 5.4.).

*2 : If the total of the current flowing to the external relays connected to the MR-H and the current flowing to the digital I/O interface of the MR-H exceeds 200 mA, always follow the instructions indicated below:
(1) Open the external wiring connecting VDD (pin 22) and VIN (pin 20).
(2) Connect an external power supply to VIN (pin 20).

POINTS

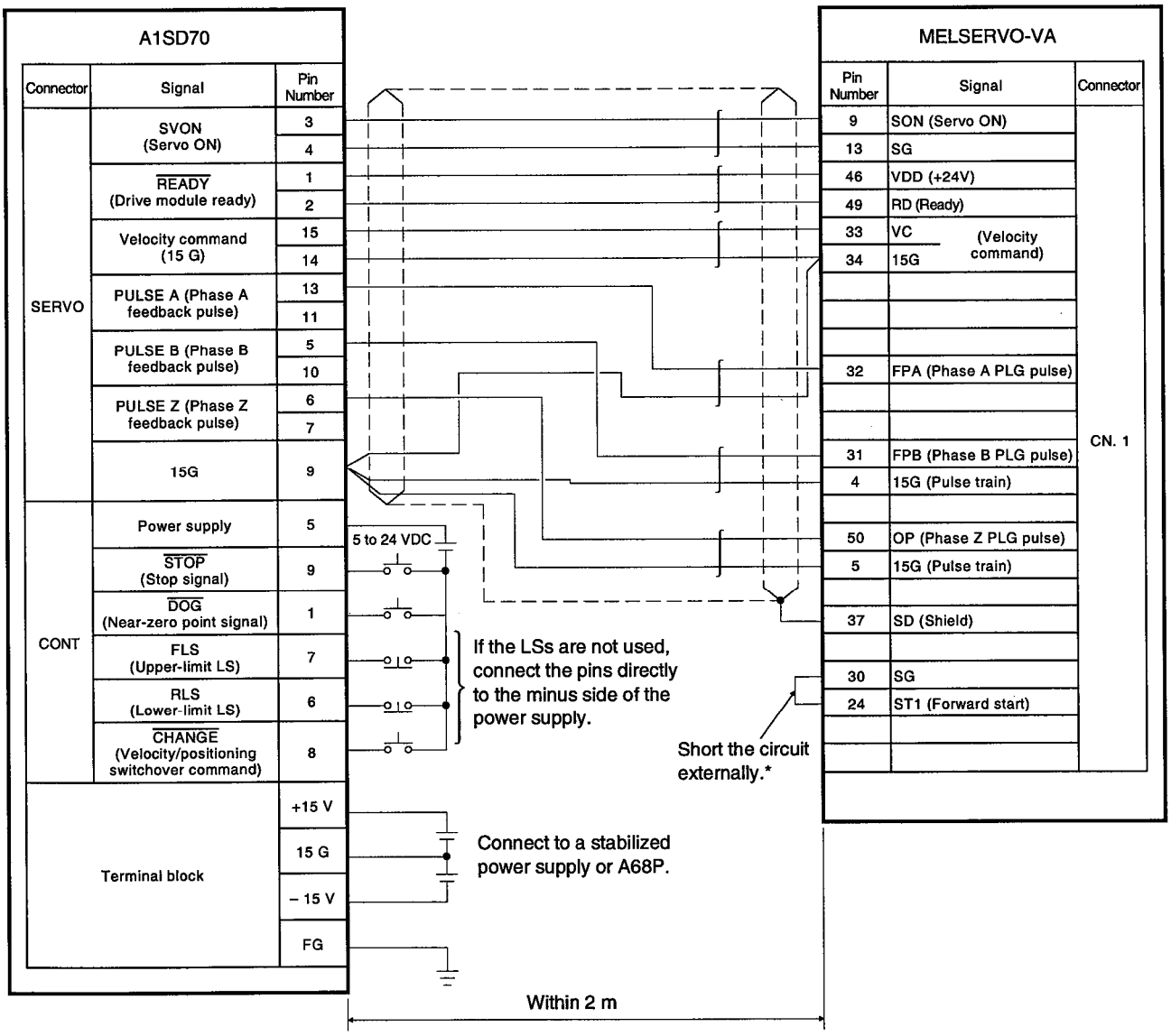
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "open collector output type".

(3) Set parameter 1 (servo loop mode) of the servo amplifier (MR-H) to "2" (velocity control).

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

1.5 Sample Connection Using MELSERVO-VA



* : For the forward/reverse control of the servo, use either of the following two methods.
(1) To set the direction of rotation by the slide switch (refer to 4.5.4 and 4.7.2.).
(2) To use the sequence program (Y21: Starting absolute positioning, Y22: Starting forward rotation, Y23: Starting reverse rotation) (refer to 5.4.).

POINTS

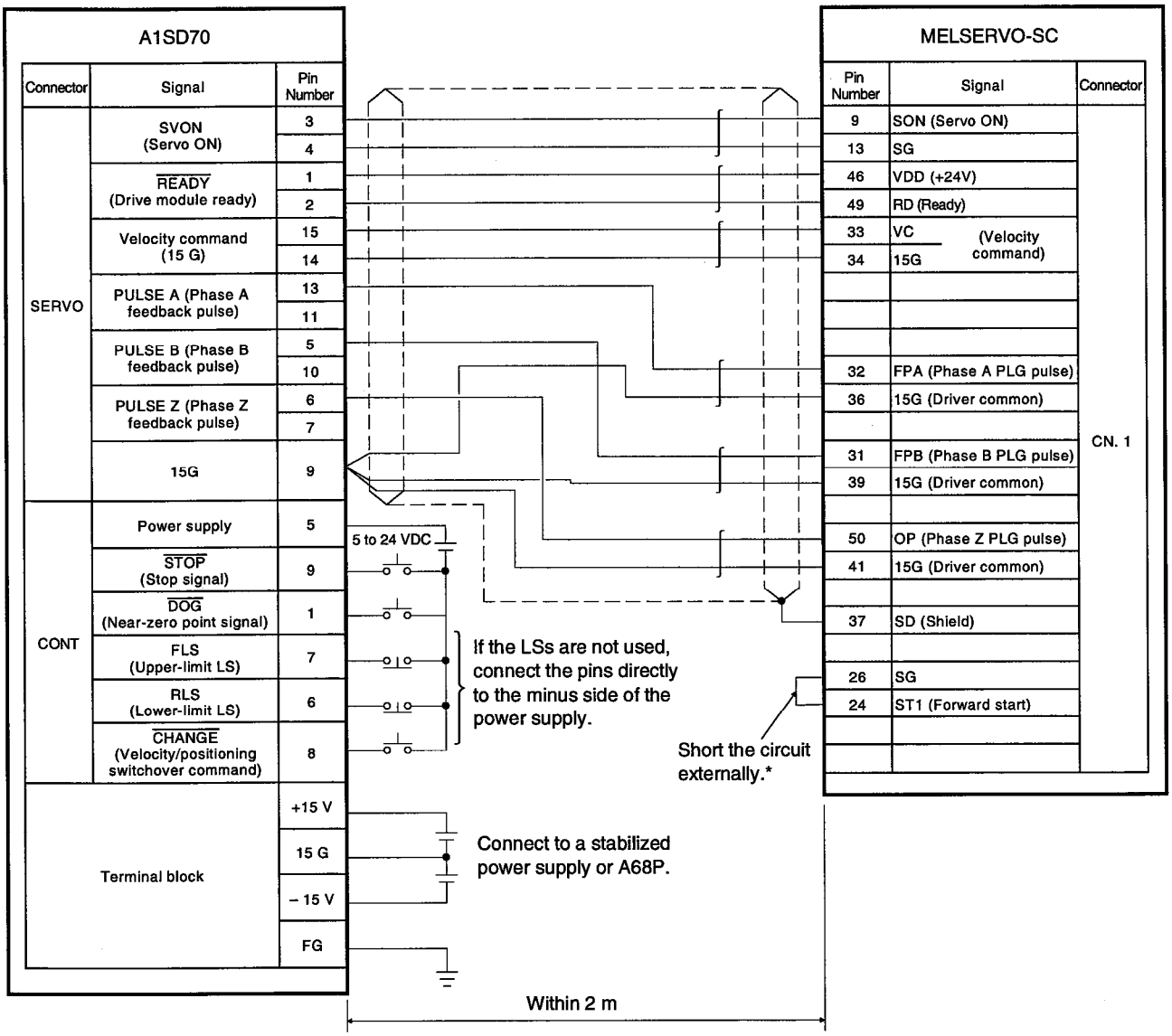
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "differential output type

(3) Set parameter 1 (servo loop mode) of the servo amplifier (MR-VA) to "2" (velocity control).

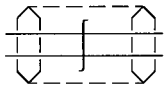
(4) MELSERVO-VA User's Manual gives details on wiring which is different than the above example.

1.6 Sample Connection Using MELSERVO-SC



* : For the forward/reverse control of the servo, use either of the following two methods.
(1) To set the direction of rotation by the slide switch (refer to 4.5.4 and 4.7.2.).
(2) To use the sequence program (Y21: Starting absolute positioning, Y22: Starting forward rotation, Y23: Starting reverse rotation) (refer to 5.4.).

POINTS

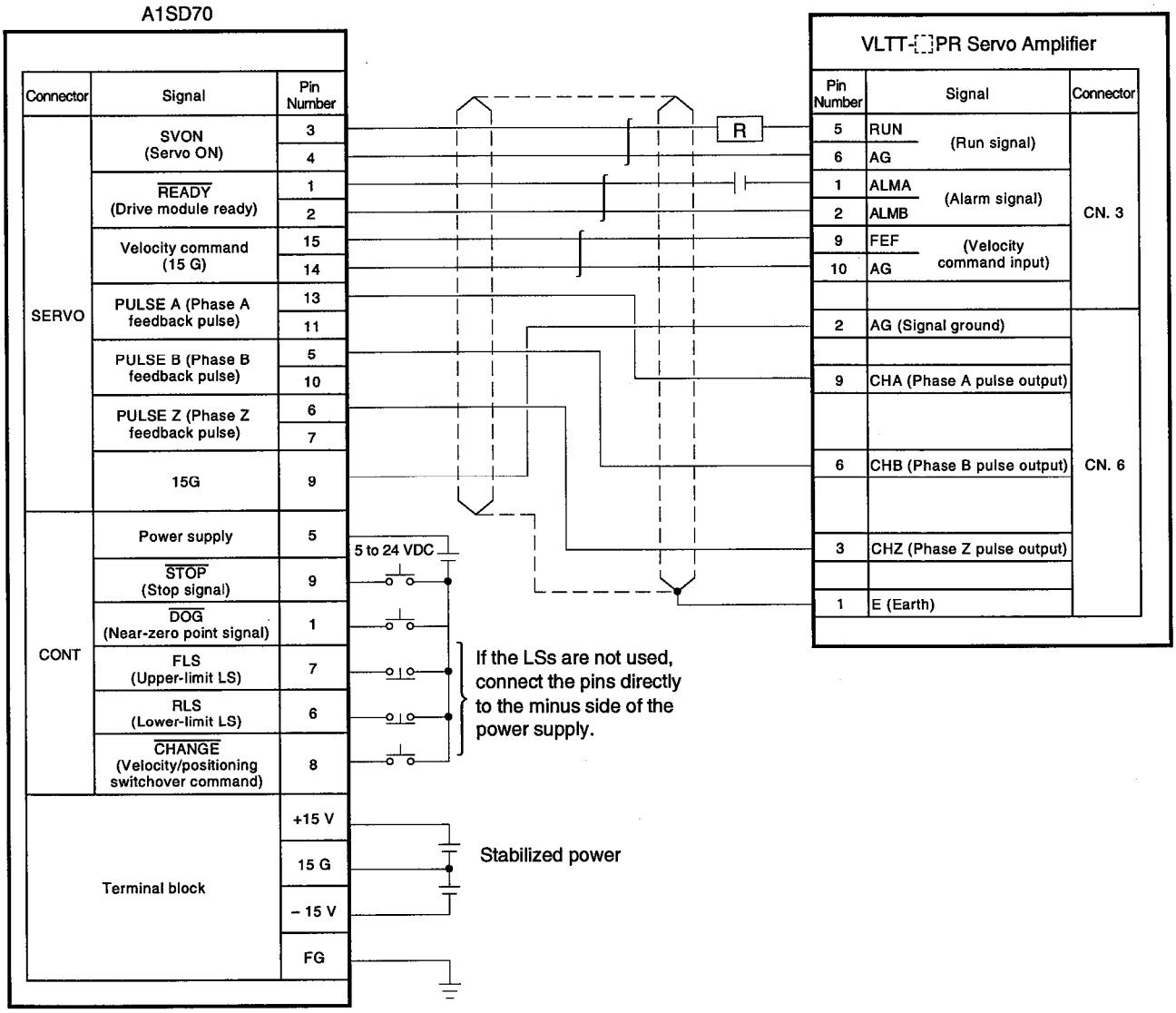
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "differential output type".

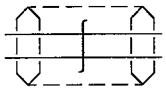
(3) Set parameter 1 (servo loop mode) of the servo amplifier (MR-SC) to "2" (velocity control).

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

1.7 Sample Connection Using Servo Amplifier of Toei Denki



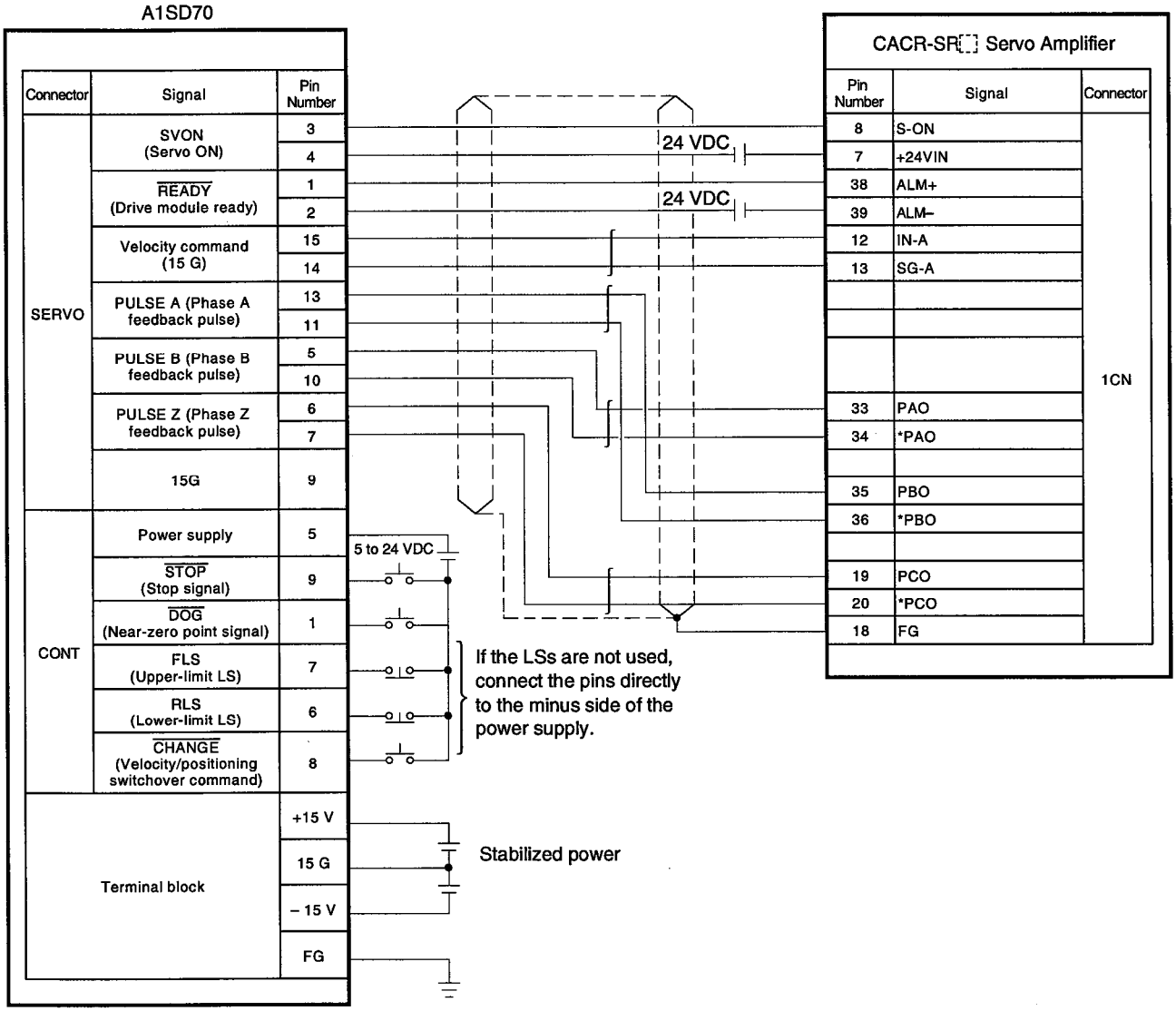
POINTS

(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "open collector output type".

(3) VLTT-☐PR User's Manual gives details on wiring which is different than the above example.

1.8 Sample Connection Using Servo Amplifier of Yaskawa



POINTS

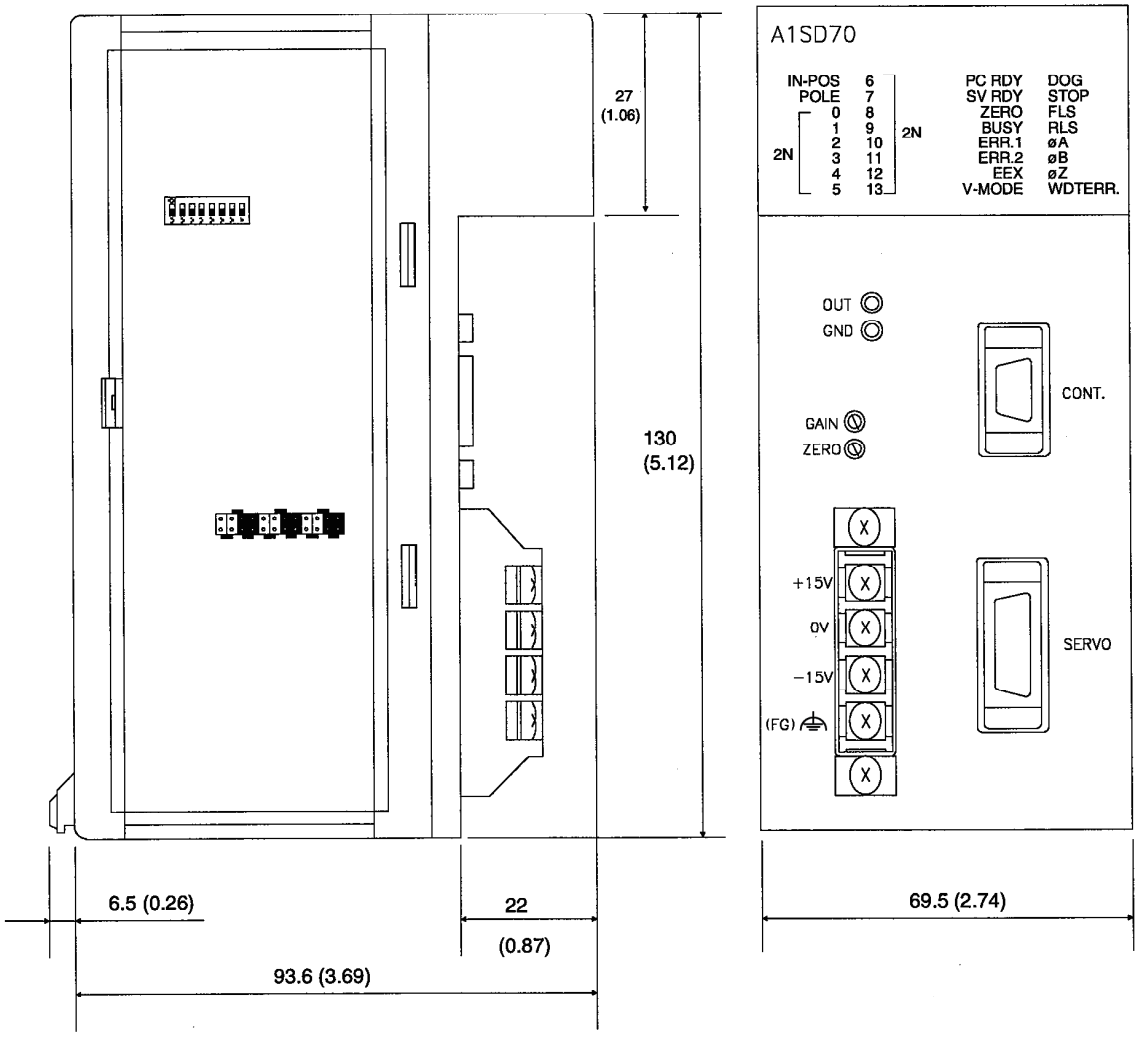
(1)  indicates a shielded twisted-pair cable.

(2) For the encoder interface setting, set to "differential output type".

(3) CACR-SR⬚ User's Manual gives details on wiring which is different than the above example.

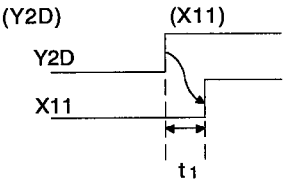
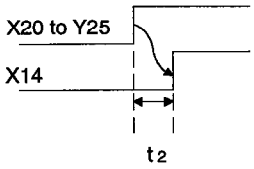
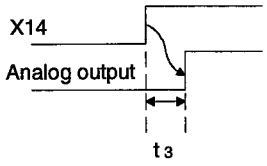
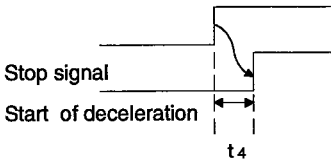
(4) Connection to Phase A and Phase B must be reversed as shown above since the phase of Phase B is 90° forward to the phase of Phase A of the feedback pulses from CACR-SR⬚ servo amplifier.

APPENDIX 2 A1SD70 DIMENSIONS



Unit: mm (inch)

APPENDIX 3 PROCESSING TIME

Item	Type of Signal		Processing Time (ms)
1. PC ready → A1SD70 ready completed (Y2D) (X11)  			1
2. Start ON → BUSY ON (Y20 to Y25) (X14)  	Start signal		
	Y20	Near-zero point dog mode	0.9
		Count mode	1.6
	Y21	Absolute one-phase	0.9
		Absolute two-phase	1.1
	Y22	Incremental one-phase	1.0
	Y23	Incremental two-phase	1.2
	Y24 Y25	JOG	0.8
3. BUSY ON → analog output (X14)  			3.5
4. STOP ON → start of deceleration  	Stop signal		
	Y27		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

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.
However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place.
Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.
(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.
1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.
(2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

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

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation of damages caused by any cause found not to be the responsibility of Mitsubishi, loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products, special damages and secondary damages whether foreseeable or not , compensation for accidents, and compensation for damages to products other than Mitsubishi products, replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

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

6. Product application

(1) In using the Mitsubishi MELSEC programmable controller, the usage conditions shall be that the application will not lead to a major accident even if any problem or fault should occur in the programmable controller device, and that backup and fail-safe functions are systematically provided outside of the device for any problem or fault.
(2) The Mitsubishi programmable controller has been designed and manufactured for applications in general industries, etc. Thus, applications in which the public could be affected such as in nuclear power plants and other power plants operated by respective power companies, and applications in which a special quality assurance system is required, such as for Railway companies or Public service purposes shall be excluded from the programmable controller applications.
In addition, applications in which human life or property that could be greatly affected, such as in aircraft, medical applications, incineration and fuel devices, manned transportation, equipment for recreation and amusement, and safety devices, shall also be excluded from the programmable controller range of applications.
However, in certain cases, some applications may be possible, providing the user consults their local Mitsubishi representative outlining the special requirements of the project, and providing that all parties concerned agree to the special circumstances, solely at the users discretion.

Positioning Module Type A1SD70

User's Manual

MODEL	A1SD70-USERS-E
MODEL CODE	13JE04
IB(NA)-66367-D(0707)MEE	

MITSUBISHI ELECTRIC CORPORATION

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