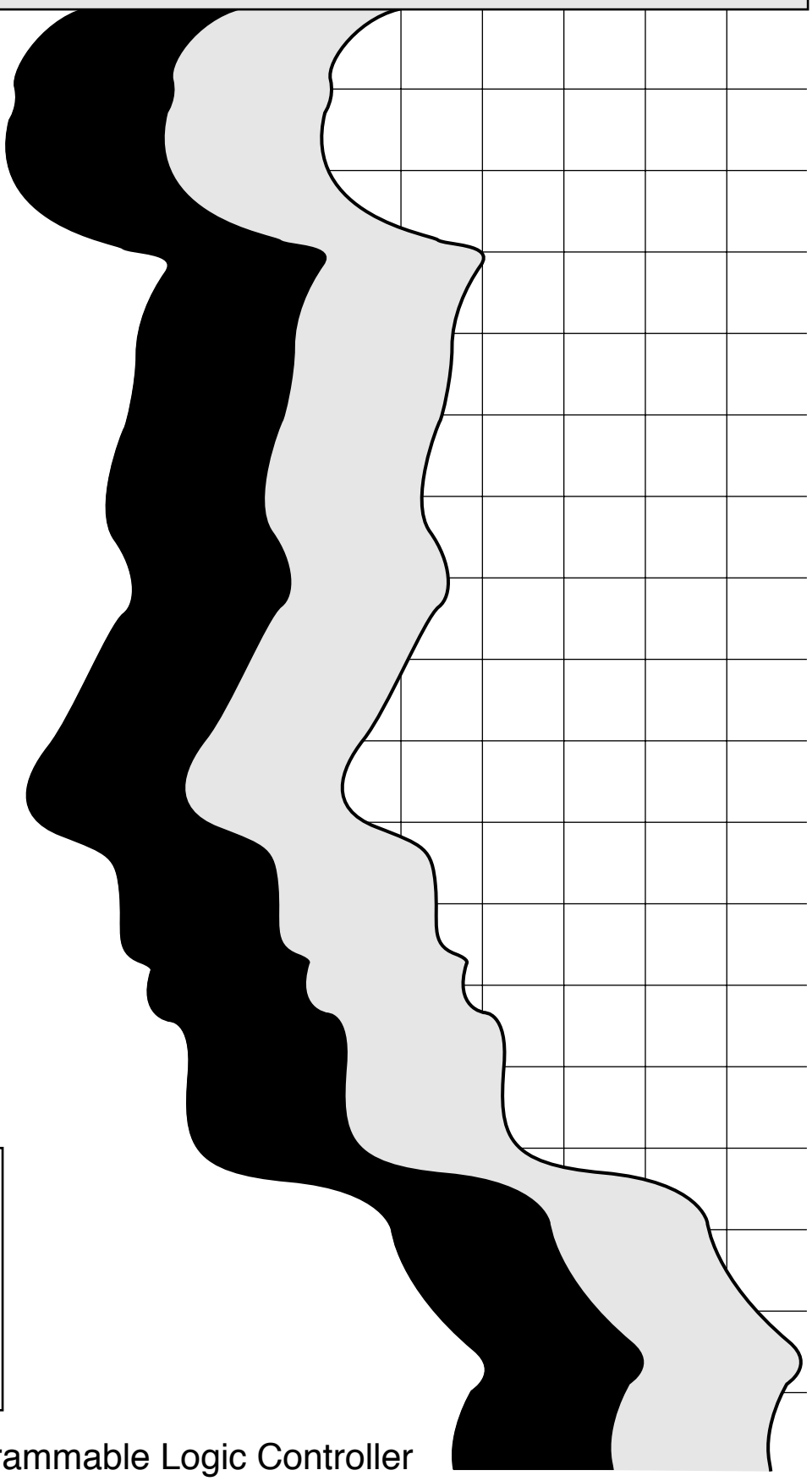
MITSUBISHI

Positioning Module Type AD72

User's Manual



A

MELSEC

Mitsubishi Programmable Logic Controller

● SAFETY PRECAUTIONS ●

(Read these precautions before using.)

When using Mitsubishi equipment, thoroughly read this manual and the associated manuals introduced in this manual.

Also pay careful attention to safety and handle the module properly. These precautions apply only to Mitsubishi equipment. Refer to the CPU module user's manual for a description of the PC system safety precautions.

These ● SAFETY PRECAUTIONS ● classify the safety precautions into two categories: "DANGER" and "CAUTION".

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

Depending on circumstances, procedures indicated by ⚠ CAUTION may also be linked to serious results.

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

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

[DESIGN PRECAUTIONS]

⚠ DANGER

- Install a safety circuit external to the PC that keeps the entire system safe even when there are problems with the external power supply or the PC module. Otherwise, trouble could result from erroneous output or erroneous operation.
  (1) Outside the PC, construct mechanical damage preventing interlock circuits such as emergency stop, protective circuits, positioning upper and lower limits switches and interlocking forward /reverse operations.
  (2) Zeroing operation is controlled by two pieces of data, zeroing direction and zeroing speed, and deceleration starts when the actuator (zeroing dog) signal turns on. Therefore, since incorrect setting of the zeroing direction may keep the axis running without deceleration, configure interlock circuits for machine damage prevention, etc. outside the PLC.
  (3) Set the parameters to meet the positioning system specifications.
  Also set the zeroing parameters and positioning data to within the parameter set values.
- When overcurrent which exceeds the rating or caused by short-circuited load flows in the output module for a long time, it may cause smoke or fire. To prevent this, configure an external safety circuit, such as fuse.
- Build a circuit that turns on the external power supply when the PC main module power is turned on. If the external power supply is turned on first, it could result in erroneous output or erroneous operation.
- When there are communication problems with the data link, the communication problem station will enter the following condition.
  Build an interlock circuit into the PC program that will make sure the system operates safely by using the communication state information. Not doing so could result in erroneous output or erroneous operation.
  (1) For the data link data, the data prior to the communication error will be held.
  (2) The MELSECNET (II,/B,/10) remote I/O station will turn all output off.
  (3) The MELSECNET/MINI-S3 remote I/O station will hold the output or turn all output off depending on the E.C. remote setting.
  Refer to the data link manuals regarding the method for setting the communication problem station and the operation status when there are communication problem.
- When configuring a system, do not leave any slots vacant on the base. Should there be any vacant slots, always use a blank cover (A1SG60) or dummy module (A1SG62).
  When the extension base A1S52B, A1S55B or A1S58B is used, attach the dustproof cover supplied with the product to the module installed in slot 0.
  If the cover is not attached, the module's internal parts may be dispersed when a short-circuit test is performed or overcurrent/overvoltage is accidentally applied to the external I/O area.

⚠ CAUTION

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

[DESIGN PRECAUTIONS]

⚠ CAUTION

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

[INSTALLATION PRECAUTIONS]

⚠ DANGER

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

[WIRING PRECAUTIONS]

⚠ DANGER

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

⚠ CAUTION

- Be sure to ground the FG terminals and LG terminals to the protective ground conductor. Not doing so could result in electric shock or erroneous operation.
- Use applicable solderless terminals and tighten them with the specifiedtorque.
  If any solderless spade terminal is used, it may be disconnected when the terminal screw comes loose, resulting in failure.
- When wiring in the PC, be sure that it is done correctly by checking the product's rated voltage and the terminal layout. Connecting a power supply that is different from the rating or incorrectly wiring the product could result in fire or damage.

[WIRING PRECAUTIONS]

⚠ CAUTION

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

[STARTUP AND MAINTENANCE PRECAUTIONS]

⚠ DANGER

- Do not touch the terminals while power is on. Doing so could cause shock or erroneous operation.
- Correctly connect the battery. Also, do not charge, disassemble, heat, place in fire, short circuit, or solder the battery. Mishandling of battery can cause overheating or cracks which could result in injury and fires.
- Switch all phases of the external power supply off when cleaning the module or tightening the terminal screws. Not doing so could result in electric shock. If the screws are too tight, it may cause falling, short circuit or erroneous operation due to damage of the screws or modules.
- Tightening the screws too far may cause damages to the screws and/or the module, resulting in fallout, short circuits, or malfunction.
- When performing test operation, set the speed limit value of the parameter to a low speed so that the operation can be stopped immediately if a hazardous condition occurs, and then check operation.
- Connect the battery correctly. Do not charge, disassemble, heat, throw into fire, short, or solder it. Incorrectly handling the battery may cause injury or fire due to heat buildup, burst, ignition, etc.

⚠ CAUTION

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

[STARTUP AND MAINTENANCE PRECAUTIONS]

⚠ CAUTION

- Do not drop or impact the battery fitted to the module.
  To do so may damage the battery, causing the battery liquid to leak inside the battery.
- Before touching the module, be sure to touch grounded metal or similar object to discharge the static electricity from the human body, etc.
  Failure to do so can cause the module to fail or malfunction.

[USAGE PRECAUTIONS]

⚠ CAUTION

- When the reference axis speed is specified for interpolation operation, note that the speed of the other axis (axis 2) may become higher than the set speed (speed limit value).
- When no parameters have been set or any one parameter has an error (outside the setting range), all parameter data are controlled as default values.

[DISPOSAL PRECAUTIONS]

⚠ CAUTION

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

[TRANSPORTATION PRECAUTIONS]

⚠ CAUTION

- When a lithium-containing battery is to be transported, it must be handled in conformance to the transportation restrictions.

REVISIONS

※The manual number is given on the bottom right of the top cover.

Print Date	*Manual Number	Revision
Apr., 1987	IB (NA) 66095-A	First edition
Dec., 1988	IB (NA) 66095-B	Correction CONTENTS, Page 1-5, 2-4, 2-5, 2-6, 2-7, 3-1, 3-2, 3-47, 3-48, 3-49, 3-50, 3-52, 3-57, 3-58, 4-5, 4-8, 5-1, 6-9, 6-16, 8-6, 9-1 Addition Page 3-9, 3-33, 3-46, 6-1, 6-45, 6-46, 7-1, 8-12 "Instructions for Strategic Materials" added
Oct., 2003	IB (NA) 66095-C	Addition Conformation to the EMC Directive and Low Voltage Instruction, About Manual, Section 5.2.4, 5.2.5, 6.5, 6.5.1 Appendix 3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 4, 4.1, 4.2, 4.3, 6, 6.1, 6.2, WARRANTY Partial Addition CONTENTS, Chapter 1, Section 2.1, 2.2, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.3.3, 3.4.1, 3.4.2, 3.4.3, 3.5.1, 3.5.4, 3.5.5, 3.5.6, 3.5.7, 3.6, 4.3, 4.4, 4.4.1, 5.1, 5.2, 5.2.1, 5.2.2, 5.2.4, 6.1.1, 6.1.2, 6.2, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.6, 6.3.7, 6.3.9, 6.4.1, 6.4.2, 6.4.3, 8.1.1, 8.2.2, 8.2.4, 8.2.7, 8.2.8, Appendix 3.1, 3.2, 3.3, 3.5, 4.1, 4.2, 4.3 Partial Correction Safety Precaution, Chapter 1, Section 1.1, 2.1, 2.1.1, 2.1.2, 2.2, 2.3, 3.2.3, 3.3, 3.4, 3.4.1, 3.4.2, 3.5, 3.5.1, 3.5.3, 3.5.5, 3.5.7, 3.6, 3.7.1, 3.7.2, 3.8, 4.2, 4.4.1, 4.4.2, 4.4.3, 5.1, 5.2.1, 5.2.2, 6.1.1, 6.1.2, 6.3.3, 6.3.5, 6.3.6, 6.3.8, 6.3.9, 6.3.10, 6.4.1, 6.4.2, 6.4.3, 7.2.1, 7.2.2, 8.1, 8.1.1, 8.1.2, 8.2.4, 8.2.5, 8.2.8, 9.2.2, Appendix 3.4 Partial Deletion Chapter 1, Section 2.3, 6.3.2, Appendix 5.18
Mar., 2006	IB (NA) 66095-D	Partial Correction Safety Precaution, Section2.1

INTRODUCTION

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

CONTENTS

About Manuals

The following manuals are also related to this product.

Related Manuals

Manual Name	Manual No. (Model Name Code)
Teaching unit for positioning module type AD71TU Operating Manual This manual explains the system configuration, performance specifications, handling, functions, parameter/zeroing data/positioning data write/read operation, monitor operation, test operation, etc. (Packed with the AD71TU teaching unit)	IB-66067 (13J706)
Positioning module type AD71(SW0-AD71PE) Operating Manual This manual explains the system configuration, functions, system startup procedure, function operation procedures, and error messages of SW0-AD71PE. (Packed with SW0-AD71PE)	IB-66099 (13J707)
Positioning module type AD71(SW0IX-AD71PE) Operating Manual This manual explains the system configuration, functions, system startup procedure, function operation procedures, and error messages of SW0IX-AD71PE. (Packed with SW0IX-AD71PE)	IB-66508 (13JE75)

Compliance with EMC Directive and Low Voltage Directive

When incorporating a Mitsubishi PLC that is compliant with the EMC and low voltage directives into any other product and ensuring compliance with these directives, refer to Chapter 3 "EMC and Low Voltage Directives" of the User s Manual (Hardware) for the PLC CPU included with the CPU module or base unit.

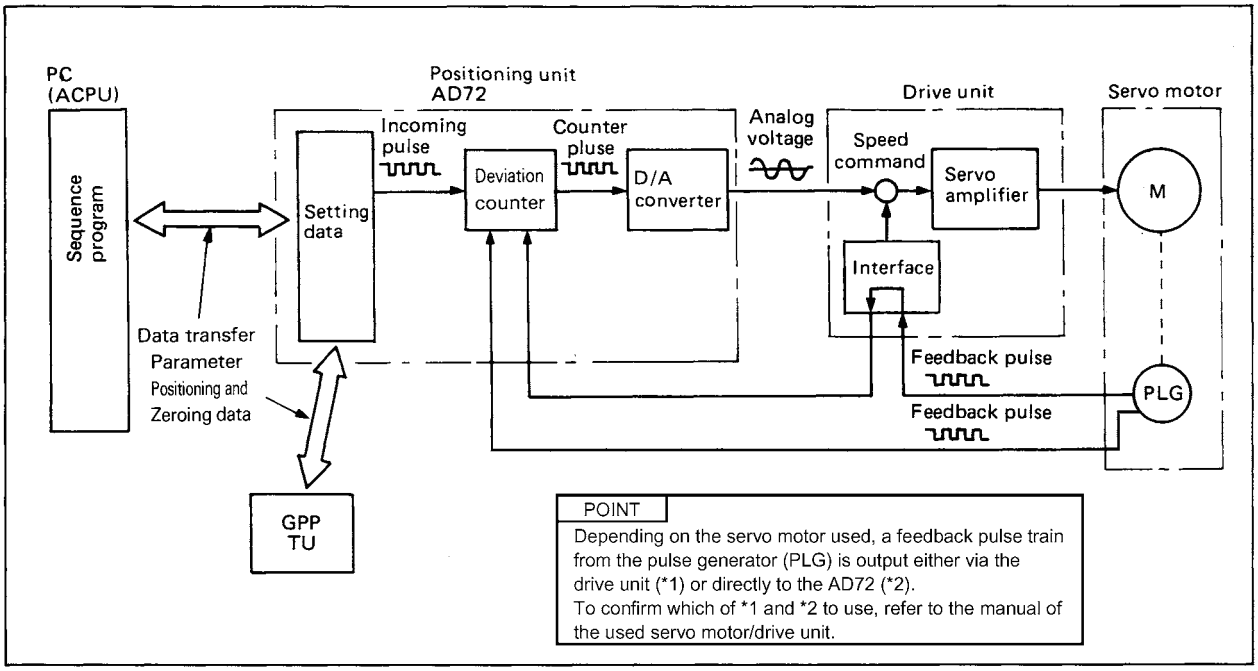
The CE logo is printed on the rating plate on the main body of the PLC that conforms to the EMC Directive and Low Voltage Directive.

Refer to Section 5.2.5 to conform this product to the EMC Directive and Low Voltage Directive.

1. INTRODUCTION

The AD72 is a positioning control module for use with the MELSEC-A series of programmable controllers. This manual gives specifications, handling and programming, information for the AD72.

- The AD72 controls the positioning of a servo motor by specifying positioning distance and motor speed.
  As illustrated below, the AD72 includes a built-in deviation counter and D/A converter to convert pulses into an analog voltage for the servo amplifier speed signal.



In this positioning control system, an analog voltage input type servo amplifier may be connected directly to the AD72.

This user's manual explains the A6GPP/A6PHP and AD71TU as the peripheral devices of the AD72.
When using a DOS/V personal computer as a peripheral device of the AD72, read as described below.

A6GPP → DOS/V personal computer
SW0GP-AD71P → SW0IX-AD71PE

POINT

The SW0-AD71P, SW0IX-AD71PE system disk and AD71TU teaching unit may be used with both the AD71 and AD72.

IB (NA) 66095-A

Packing list:

Description	Quantity
AD72 positioning unit	1
9-pin connector for external wiring (pin type)	2
9-pin connector for external wiring (socket type)	2
15-pin connector for external wiring (pin type)	2

POINT

(1) In this manual, AD72 I/O numbers assigned from the PC CPU assume that the AD72 is loaded in slot 0 and 1 of the main base.

(2) The A6GPP will be referred to as "GPP" and the AD71TU as "TU".

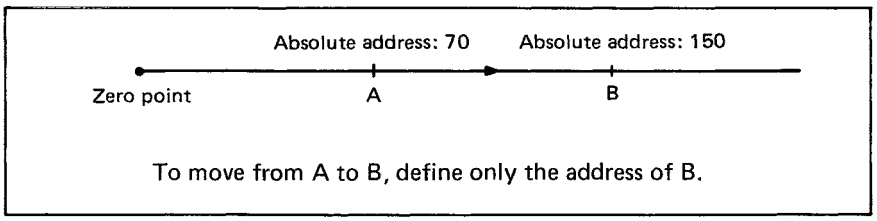
1.1 Comparison between AD72, AD71(S1) and AD71S2

Item	AD72	AD71(S1)	AD71S2
Output to servo amplifier	Analog voltage	Pulse chain	
Positioning control	Yes	Yes	
Speed control	No	No	Yes
In-position function	Yes (range specified as between 0 and ±2047 counts)	Change depending on the used servo amplifier. (Servo amplifier side functions)	
Multiplication rate setting	4, 2, 1 or 1/2 time		
Pulse value setting	Maximum pulse value switched between 2047, 4095, 8191 and 16383 pulses		
Inching using a manual pulser	Yes	Yes	No
Jog operation	Yes	Yes	
Use of stepping motor	No	Available when combined with the AD76 stepping motor drive unit.	
Acceleration/deceleration time	64 to 4999msec	64 to 4999msec	64 to 5000msec
Deceleration time setting for emergency stop	No	No	Yes
Phripheral	A6GPP (SW0-AD71PE) or TU		
Number of I/O points	48	32	32
Internal current consumption (A)	0.9	1.5	1.5
Size (mm)	250(H) x 75.5(W) x 121(D)	250(H) x 37.5(W) x 121(D)	250(H) x 37.5(W) x 121(D)
Weight (kg)	1.5	0.63	0.63

1.2 Glossary of Terms

(1) Absolute mode

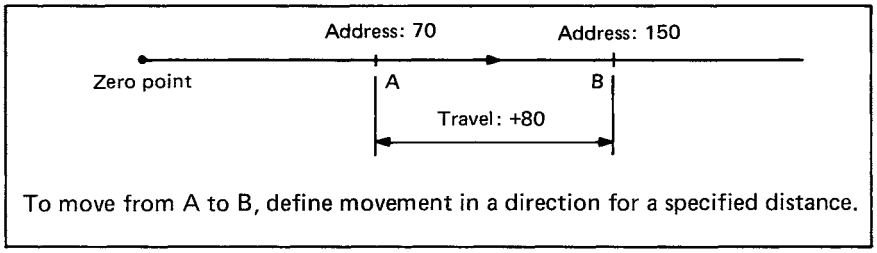
In absolute mode positioning, each position has its own address and is reached with reference to a zero point address.



To move from A to B, define only the address of B.

(2) Incremental mode

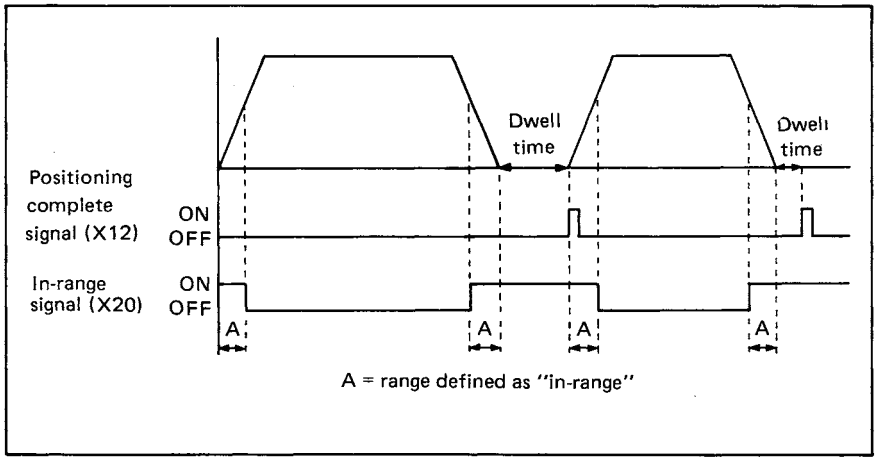
In incremental mode positioning, positions are reached with reference to the previous position.



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

(3) In-position signal

Switches on when the deviation counter pulse value is within the specified range from the target position. The range may be specified from 0 to ±2047.



A = range defined as "in-range"

(4) M code

M codes are code numbers (1 to 255) assigned by the user to control auxiliary functions at defined points in the positioning cycle. These are used by the PC CPU to coordinate the operation of external equipment and processes. (See Section 3.5.1 (16).)

(5) Direction setting

Selects the motor direction for increasing positioning addresses (i.e. defines the motor direction for +ve –ve analog voltages).

(6) Creep speed

This is the low speed used to approach the home position. (See Section 3.2.2.)

(7) Excessive error

The deviation counter pulse value has exceeded the allowed range. This range may be changed as follows by the pulse value switch (See Section 4.4.1)

1) 0 to 2047
2) 0 to 4095
3) 0 to 8191
4) 0 to 16383

(8) Manual pulser inching

The drive for the given axis is advanced by a pre-defined number of pulses when a manual pulse train is received from a manual pulser hard wired to the AD72.

(9) Jog operation

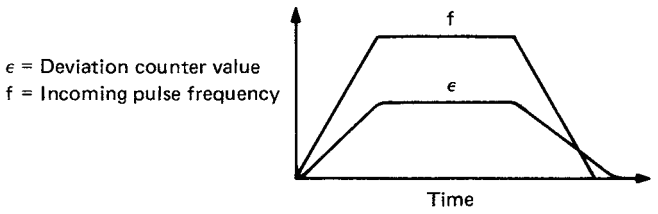
The drive for the given axis is operated for as long as the jog input is on.

(10) Upper and lower stroke limits

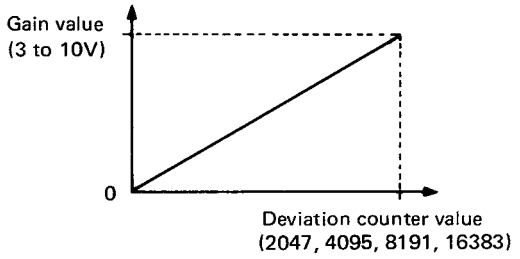
Define the limit values of machine travel.
The upper and lower limits are set independently.

(11) Deviation counter pulses

Integrated in the deviation counter, i.e. the difference between the internally generated control pulses and the feedback pulses from the encoder.
During operation, the deviation counter value is proportional to the incoming pulse frequency. When positioning is complete, the deviation counter value is zero.



The output voltage from the AD72 is proportional to the deviation counter value.



(12) Multiplication rate

Multiplies the feedback pulse frequency from the encoder by 4, 2, 1 or 0.5. (See Section 4.4.1 (2).)

(13) Dwell time

This is the period of time starting from when the motor stops until the next positioning operation is started.

- Zeroing dwell time . . . . . .Starting from when the actuator is turned on to when positioning is complete. (Valid for stop and dwell timer time-out only)

- Positioning dwell time. . . .Starting from when the required position is reached to when positioning is complete. Completion of one positioning cycle enables the next.

(14) Backlash compensation

Compensates for any positioning error caused by machine backlash. (See Section 3.5.1 (6).)

(15) Feedback pulse

Pulse chain proportional to the angular increments of the motor generated by an encoder and fed to the AD72.

(16) Deviation counter

An up/down counter that counts a difference between the number of command pulses and number of feedback pulses, which is added up in the deviation counter as pulses. When positioning is completed, pulses in the deviation counter are "0".

MEMO

2. SYSTEM CONFIGURATION

2.1 AD72 Overall Configuration

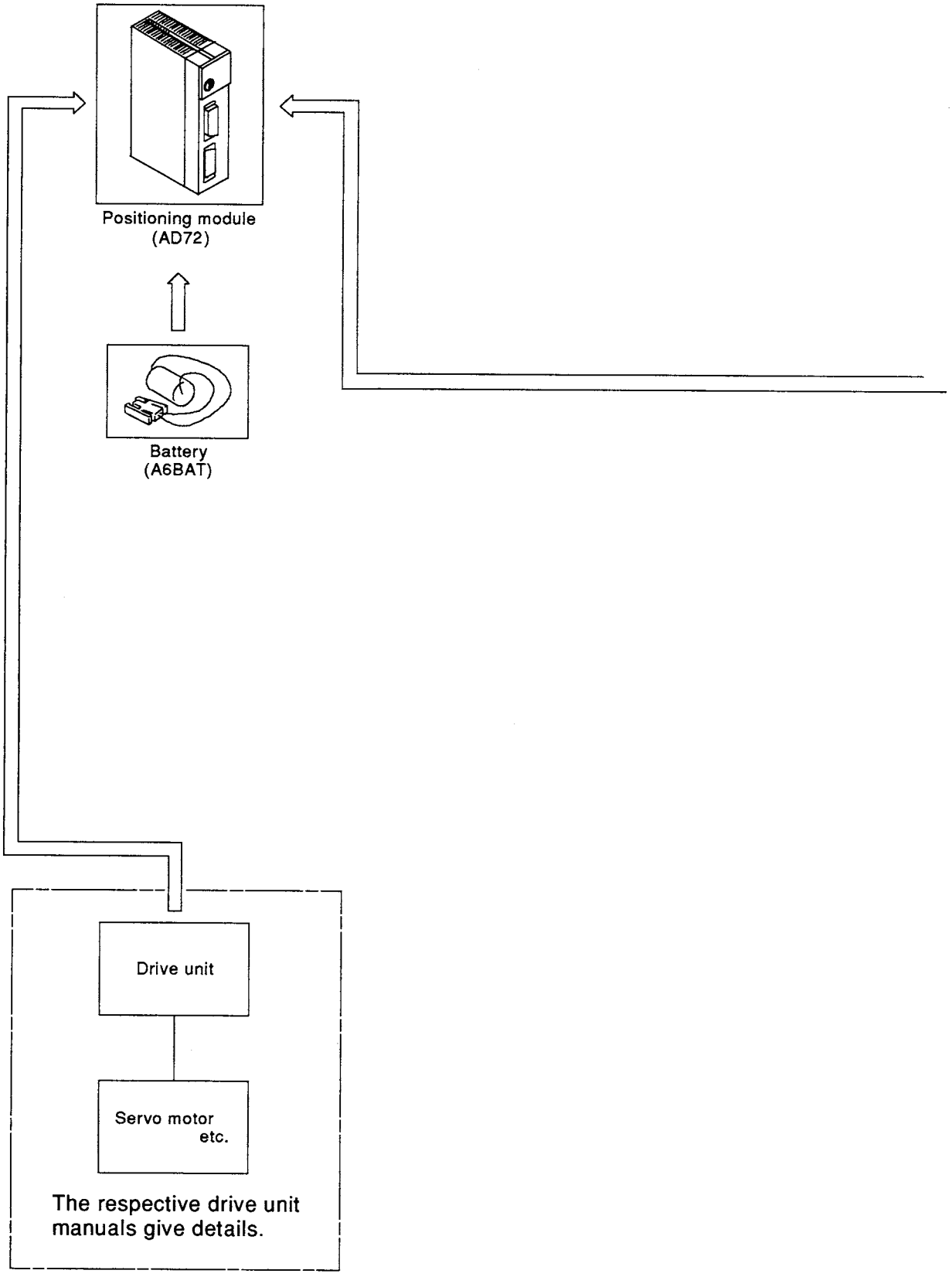
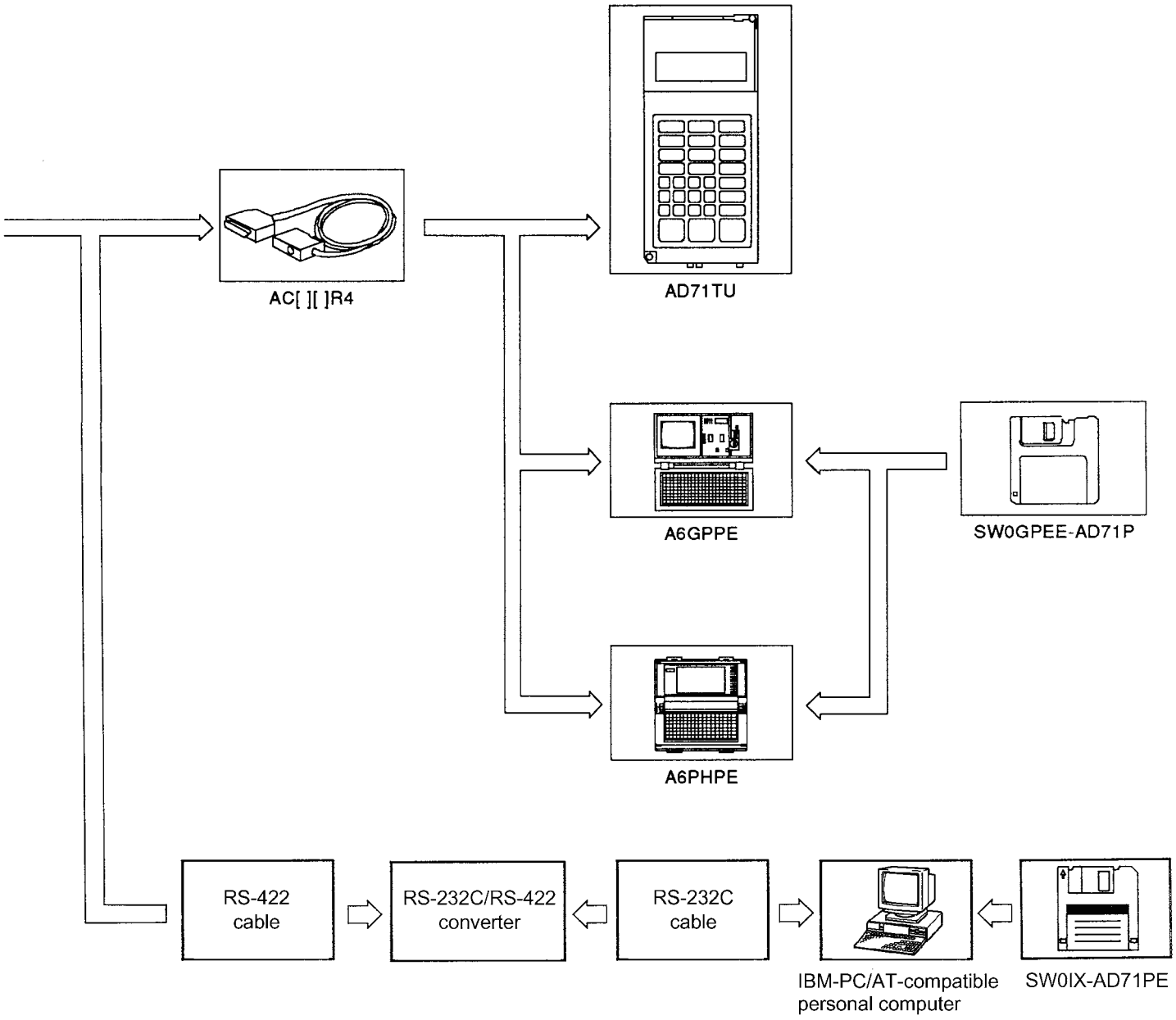


Fig. 2.1 Overall Configuration



POINT

For the applicable printer, CRT, etc. for each peripheral device, refer to the GPP Function Software Package Operating Manual for the module.

2.2 Applicable Systems

This section indicates the applicable CPUs and gives cautions on configuring a system.

2.2.1 Applicable CPUs

Listed below are the CPUs with which each type of positioning module is compatible.

(1) AD72

The AD72 type positioning module is compatible with the following CPUs (including those equipped with a link function).

• A0J2(H)CPU	• A3MCPU	• Q2ACPU	• A1S(H)CPU
• A1CPU	• A3HCPU	• Q3ACPU	• A1SJ(H)CPU
• A2CPU(S1)	• A2ACPU(S1)	• Q4ACPU	• A2S(H)CPU
• A3CPU	• A3ACPU	• A73CPU(S3)	• A2ASCPU(S1)
• A1NCPU	• A2UCPU(S1)	• A373CPU	• A2USHCPU(S1)
• A2NCPU(S1)	• A3UCPU	• A81CPU	• A52GCPU(T21B)
• A3NCPU	• A4UCPU		• Q2AS(H)CPU

2.2.2 Precautions on system configuration

The positioning module can be loaded in any slot of the main base unit or an extension base unit. However, note the following points.

(1) Since the positioning module has a large 5 VDC consumption, do not use it with any extension base unit (A5[ ]B, A1S5[ ]B) that does not have a power supply module if it can be avoided.

If it cannot be avoided, consider the power supply capacity, voltage drop, and other factors, when loading the module in such an extension base unit.

(2) The module can be mounted in any master, local or remote I/O station in a data link system.

(3) To load the positioning module in a CPU or base unit, follow the instructions in the CPU User's Manual.

POINT

(1) The A0J2P25/R25 (remote I/O station) cannot be used with any positioning module installed on it.

(2) The positioning module cannot be loaded in the main base unit of the A73CPU/A373CPU.
The positioning module cannot start operation simultaneously with a PCPU control axis of an A73CPU/A373CPU, or interpolate with it.

(3) The positioning module cannot be loaded in the last slot of the 7th extension stage of an A3CPU.

2.3 Programming Equipment

The following table indicates the equipment available for programming the AD71.

<table>
<tr><th>Unit Division</th><th>Type</th><th>Remarks</th></tr>
<tr><td>Software package</td><td>SW0GP-AD71P</td><td>Software package for A6GPPE/A6PHPE</td></tr>
<tr><td></td><td>SW0IX-AD71PE</td><td>Software package for IBM-PC/AT-compatible personal computer</td></tr>
<tr><td>Intelligent GPP</td><td>A6GPPE-SET</td><td>• Consists of the following:
<table>
<tr><th>Type</th><th>Remarks</th></tr>
<tr><td>A6GPPE</td><td>• Programming unit with CRT
• Equipped with ROM writer, FDD and printer interface functions.</td></tr>
<tr><td>SW[ ]GP-GPPA</td><td>A series system disk</td></tr>
<tr><td>SW[ ]GP-GPPK</td><td>K series system disk</td></tr>
<tr><td>SW0-GPPU</td><td>User disk (3.5 inch, formatted)</td></tr>
<tr><td>AC30R4</td><td>Cable for connecting A1SD71 and A6GPPE.</td></tr>
</table></td></tr>
<tr><td>Plasma handy programmer</td><td>A6PHPE-SET</td><td>• Consists of the following:
<table>
<tr><th>Type</th><th>Remarks</th></tr>
<tr><td>A6PHPE</td><td>• Programming unit with plasma display
• Equipped with FDD, printer interface and memory cassette functions.</td></tr>
<tr><td>SW[ ]GP-GPPA</td><td>A series system disk</td></tr>
<tr><td>SW[ ]GP-GPPK</td><td>K series system disk</td></tr>
<tr><td>SW0-GPPU</td><td>User disk (3.5 inch, formatted)</td></tr>
<tr><td>AC30R4</td><td>Cable for connecting A1SD71 and A6PHPE. 3 m (9.84 ft) length.</td></tr>
</table></td></tr>
<tr><td>User disk</td><td>SW0-GPPU</td><td>Floppy disk for storing user programs (3.5 inch, formatted)</td></tr>
<tr><td>RS-422 cable</td><td>AC30R4</td><td>Cable for connecting CPU and A6GPPE. 3 m (9.84 ft) length.</td></tr>
<tr><td></td><td>AC300R4</td><td>Cable for connecting CPU and A6GPPE. 30 m (98.4 ft) length.</td></tr>
<tr><td>Composite video cable</td><td>AC10MD</td><td>Cable for connecting GPP screen monitor display. 1 m (3.28 ft) length.</td></tr>
<tr><td>Cleaning disk</td><td>SW0-FDC</td><td>Floppy disk for cleaning floppy disk drive.</td></tr>
<tr><td>Printer</td><td>A7NPR-S1</td><td>For print out of program ladder diagrams and lists.</td></tr>
<tr><td>RS-232C cable</td><td>AC30R2</td><td>Cable for connecting A6GPPE and printer K6PR-K. A7NPR-S1, general-purpose printer with RS-232C interface). 3 m (9.84 ft) length.</td></tr>
<tr><td>Printer paper</td><td>K6PR-Y</td><td>Paper for K6PR-K printer. 9 inch. Available in units of 2000 pcs.</td></tr>
<tr><td>K6PR ink ribbon</td><td>K6PR-R</td><td>Replacement ink ribbon for K6PR and K6PR-K.</td></tr>
<tr><td>Teaching unit</td><td>AD71TU</td><td>AD71(S1)/AD72/A1SD71 teach box.</td></tr>
<tr><td>Manual pulse generator</td><td>(OSM-01-2(C))</td><td>(Manufactured by Nemicon)
• Prepare beforehand.
• The generator requires a 12 VDC external power supply.
• Refer to the outline drawing shown in APPENDIX 4 (3).</td></tr>
</table>

3. SPECIFICATIONS

3.1 General Specifications

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

Table 3.1 General Specifications

REMARKS

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 Performance Specifications and Functions

3.2.1 AD72 performance specifications

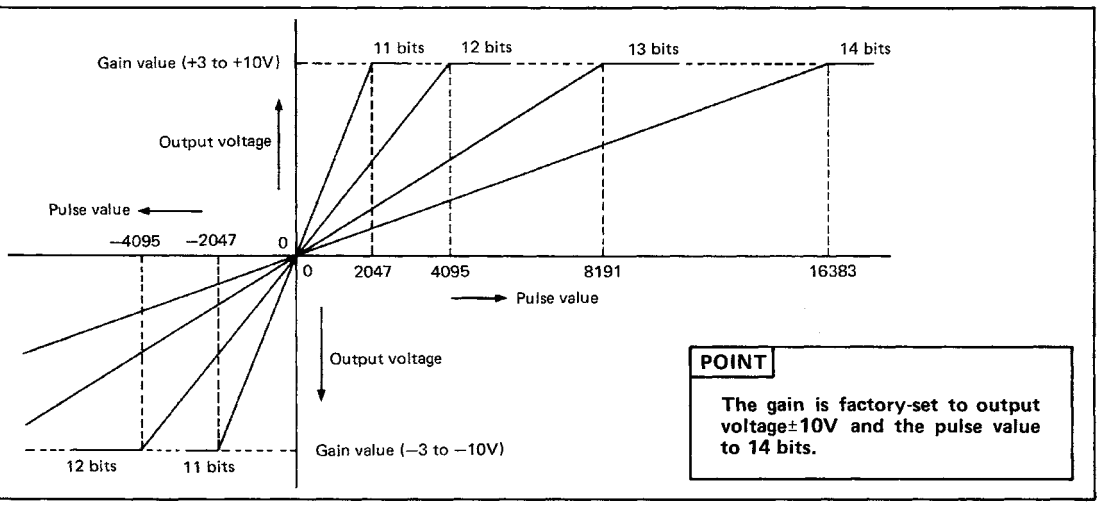
Item			Performances and Specifications
Number of I/O points			48 points (the first 16 points are not used) *
Number of control axes			2 (simultaneous or independent)
Interpolation			Linear interpolation (for 2 axes)
Positioning data		Capacity	400 points per axis
		Setting method	Input from A6GPP or sequence program
RAM memory backup			15 minutes without battery (25°C) Lithium battery guarantees power failure backup for a total of 300 days. Battery guaranteed for five years.
Positioning		Method	Absolute and/or incremental method.
		Positioning units	1 to 16,252,928 (PULSE) Max. 162 (m) (command unit: 0.1 to 10μm/PLS) Max. 16200 (inch) (command unit: 1 x 10^{-5} to 0.001 inch/PLS) Max. 16200 (degree) (command unit: 1 x 10^{-5} to 0.001 degree/PLS)
		Positioning speed	10 to 200000 (PLS/sec) (command unit: 10 PLS/sec) 10 to 120000 (mm/min) (command unit: 10 mm/min) 1 to 12000 (inch/min) (command unit: 1 inch/min) 1 to 12000 (degree/min) (command unit: 1 degree/min)
		Acceleration and deceleration	Automatic trapezoidal acceleration and deceleration
		Acceleration and deceleration times	64 to 4999 (msec)
		Backlash compensation	0 to 65535 x position command unit (0 to 255 pulses if unit is PULSE)
		Error compensation	The AD72 may be "calibrated" to allow for mechanical errors.
Positioning speed output			Analog signal 0 to ±10Vmax (Vmax adjustable between 3 and 10V).
Positioning feedback pulse input			Pulse frequency . .50 KPPS Encoder type . . .Open collector, TTL, differential output. Multiplication . . .The multiplication factor for the feedback pulse inputs may be set to 4, 2, 1, or 1/2.
Zeroing			With zero address change function. Zeroing direction and speed depend on setting.
Jog operation function			Jog operation by jog start signal input.
Inching function			Operation using manual pulse generator.
M function			M code output
Internal current comsumption			(From base unit) 5V DC, 0.9A
External supply			(Applied to terminal block. Supplies D to A converters and encoder) 4.75 to 5.25V, 1.0A + encoder current consumption
Size mm (inch)			250 (9.84) (H) x 75.5 (2.97) (W) x 121 (4.76) (D)
Weight kg (lb)			1.5 (3.3)

Table 3.2 Performance Specifications

* The I/O assignment of two slots is as follows. (Refer to Section 6.1.2 for details.)
First half slot ..... Empty slot, 16 points
Second half slot ... Special function module, 32 points

3.2.2 Output voltage characteristics

The output voltage from the AD72 is controlled as shown below by the deviation counter pulse value.



POINT

The gain is factory-set to output voltage±10V and the pulse value to 14 bits.

The maximum output voltage can be adjusted within the range ±3 to ±10V by the variable resistor on the AD72 front. (See Section 4.4.3.)
The corresponding maximum pulse count is set by DIP switches. (See Section 4.4.1.)
The maximum pulse count is specified in terms of bits as indicated below. The maximum voltage is output for the maximum pulse count.

- 11 bits. . . . . .0 to 2047 pulses
- 12 bits. . . . . .0 to 4095 pulses
- 13 bits. . . . . .0 to 8191 pulses
- 14 bits. . . . . .0 to 16383 pulses

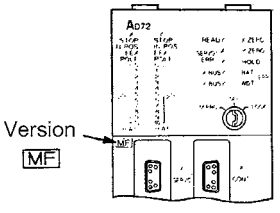
If the count value exceeds the specified maximum:

- The output voltage changes to 0V.
- The pulse value is reset to 0.
- The "servo on" signal is switched off.
- The EEX LED is lit.
- The I/O signals X22, X23 of the AD72 turn ON.*1

This error must be reset by switching the PC ready signal (Y2D) off then on.

POINT

***1: The AD72 that can detect an error excessive error using X22, X23 is the one whose version on the module front is MF or later, or whose date of manufacture in the DATE section of the rating plate is October, 1988 or later. Any other AD72 cannot detect an error excessive error using X22, X23.**



Date of manufacture October, 1988

3.2.3 Functions

The AD72 can drive two axes independently or with linear interpolation, either:

- **Using GPP or TU ..... Connect the GPP or TU to the AD72 and operate it to execute positioning. This method is used to check a program or perform test operation.**
- **From sequence program ... Execute positioning from the PLC CPU sequence program.**

For use of the GPP, refer to the SW0-AD71P and SW0IX-AD71PE Operating Manual. For use of the TU, refer to the AD71TU Operating Manual.
Positioning control functions are shown below.

Function	Sequence Program or GPP	
	Two-axis independent operation	Two-axis interpolation operation
Error detection	An error code is provided by the AD72 if a data setting or positioning control error occurs. (For details of the error codes, refer to Chapter 8.)	
Pulse clear	Available for a sequence program only. Pulses in the AD72 deviation counter can be forcibly cleared to "0". As the AD72 controls the output voltage according to the pulse value in the deviation counter, the servo motor will start immediately after power-on if there are pulses in the deviation counter. This function clears the pulses in the deviation counter to prevent the servo motor from starting at power recovery when the servo motor was powered off due to an emergency stop or similar cause during positioning. The AD72 that can clear pulses is the one whose version in the DATE section of the rating plate is "LE" or later as shown on the right. Any other AD72 cannot clear pulses.  Date of manufacture January, 1988 Version	
Set data read and write	AD72 set data (parameters, zeroing data, positioning data) can be read and written.	
Present value and speed read	Present value data and speed data can be read from the AD72. (Present value can be read and monitored during positioning.)	
Teaching (positioning data write)	After manual positioning, present value can be written as position data.	
Inching operation	The drive for the given axis is advanced by a predefined number of pulses when a manual signal is given.	Unavailable
Jog operation	The drive for the given axis is operated for as long as the jog input is on.	Unavailable
Zeroing	Returns the drive to a defined start position and refers the zero address to that position.	Unavailable

Table 3.3 Positioning Control Functions (Continue)

Function		Sequence Program or GPP	
		Two-axis independent operation	Two-axis interpolation operation
Positioning	Individual point positioning	Moves from the current position to the set position at set speed.	Moves from the current position to the set position at interpolated speed.
	Continuous positioning	Moves consecutively to a series of positions after receiving a single start signal.	As for two-axis independent operation but with interpolation.
	Continuous positioning with speed change (Pattern change)	Moves consecutively to a series of positions at different speeds after receiving a single start signal.	Unavailable

Table 3.3 Positioning Control Functions

Note 1: Error compensation and backlash compensation functions are valid for all the functions shown in Table 3.3.

2: An indexed code may be used as a digital signal for the control of associated processes during positioning. This is known as an "M" code.

3: The AD72 present value can be re-written before positioning is started using the sequence program or GPP.

4: Positioning may be executed continuously for up to 20 points by writing positioning start data to the buffer memory (X axis: 0 to 39, Y axis: 300 to 339).

3.3 Positioning System Operation

3.3.1 Positioning system using AD72

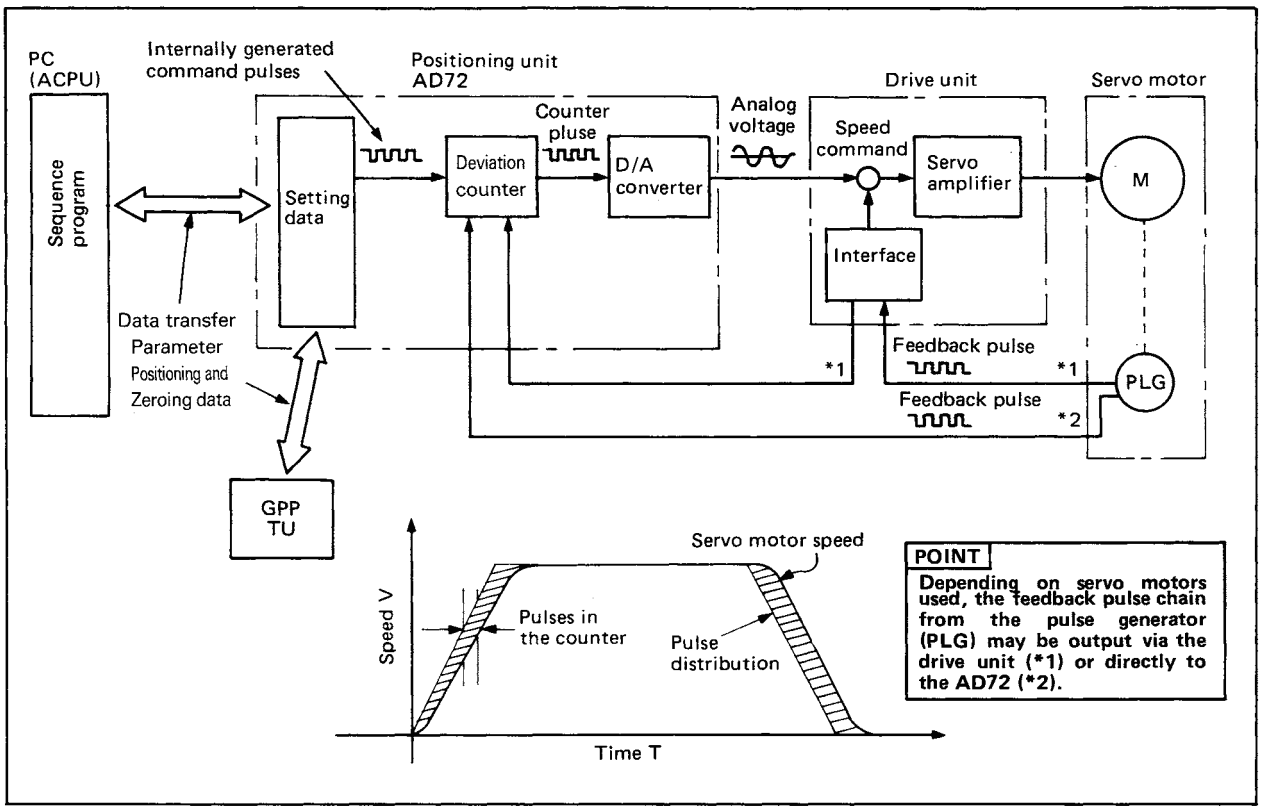
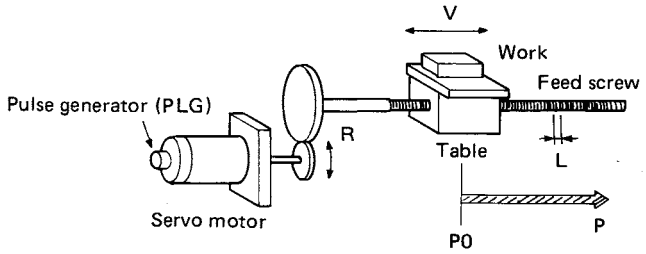


Fig. 3.1 Positioning System Operation Block Diagram

The output of the AD72 is an analog voltage.
When a pulse train is output, pulses are added up in the deviation counter, and the pulse value is converted into a DC analog voltage by the D/A converter for use as a speed command.
This causes the motor to start running and the pulse generator (PLG) to generate feedback pulses in proportion to the speed, decrementing the deviation counter.
The deviation counter retains a predetermined amount of pulses to keep the motor running.
When the AD72 stops outputting command pulses, the deviation counter is decremented to reduce the speed, and the motor stops when pulses decrease to zero.
In other words, the motor speed is proportional to the command pulse frequency, and the rotary angle of the motor is proportional to the number of output command pluses.
Therefore, when the feed value per pulse has been specified in advance, the analog voltage proportional to the number of pulses in a pulse train is output to feed the system to the set position. The pulse frequency is the motor speed (feed rate).

General design of positioning system



A : Position detection increment (mm/p)
Vs : Command pulse frequency (p/s)
n : Number of pulse generator slits (slits/Rev.)
L : Feed screw lead (mm/rev)
R : Reduction ratio
V : Work speed (mm/s)
N : Motor speed (rpm)
K : Position loop gain (sec^{-1})
ϵ : Deviation counter pulse value
P0 : Zero point (pulse)
P : Address (pulse)

(1) Position detection increment

$$A = \frac{L}{R \times n} \text{ (mm/p)}$$

(2) Command pulse frequency

$$Vs = \frac{V}{A} \text{ (p/s)}$$

(3) Deviation counter pulse amount

$$\epsilon = \frac{Vs}{K} \text{ (pulse)}$$

Expression (1) indicates the travel per pulse, i.e. the number of output pulses x A. Using expression (2), calculate the command pulse frequency from the work speed and position detection increment. Expression (3) indicates the relation between the command pulse frequency and deviation counter pulse value.

Any of the four positioning units, (mm), (inch), (degree), and (PULSE), may be selected individually for the X and Y axes.

Therefore, by setting the travel per pulse, acceleration/deceleration time, positioning speed, positioning address and other data that meet the positioning command unit, pulses are calculated in the AD72 and an analog voltage is output to execute positioning to reach the target positioning address.

3.3.2 AD72 interfaces

Fig. 3.2 indicates the signal communications between the AD72 and external devices.

○ Communication between PC CPU and AD72

Control signals and data communications via base unit, they consist of:

Control signals. . . .I/O signals given in Section 3.6 (page 3-50).
Data . . . . . .Written to and read from the buffer memory by the PC CPU.

○ Communication between GPP (or TU) and AD72

Data write, AD72 test, AD72 monitor, etc. via the AD72's RS422 connector.

○ Communications between drive unit and AD72

Control signal communications and speed command (analog voltage) output from the AD72. (For the I/O interface, refer to Section 3.7 (page 3-56.)

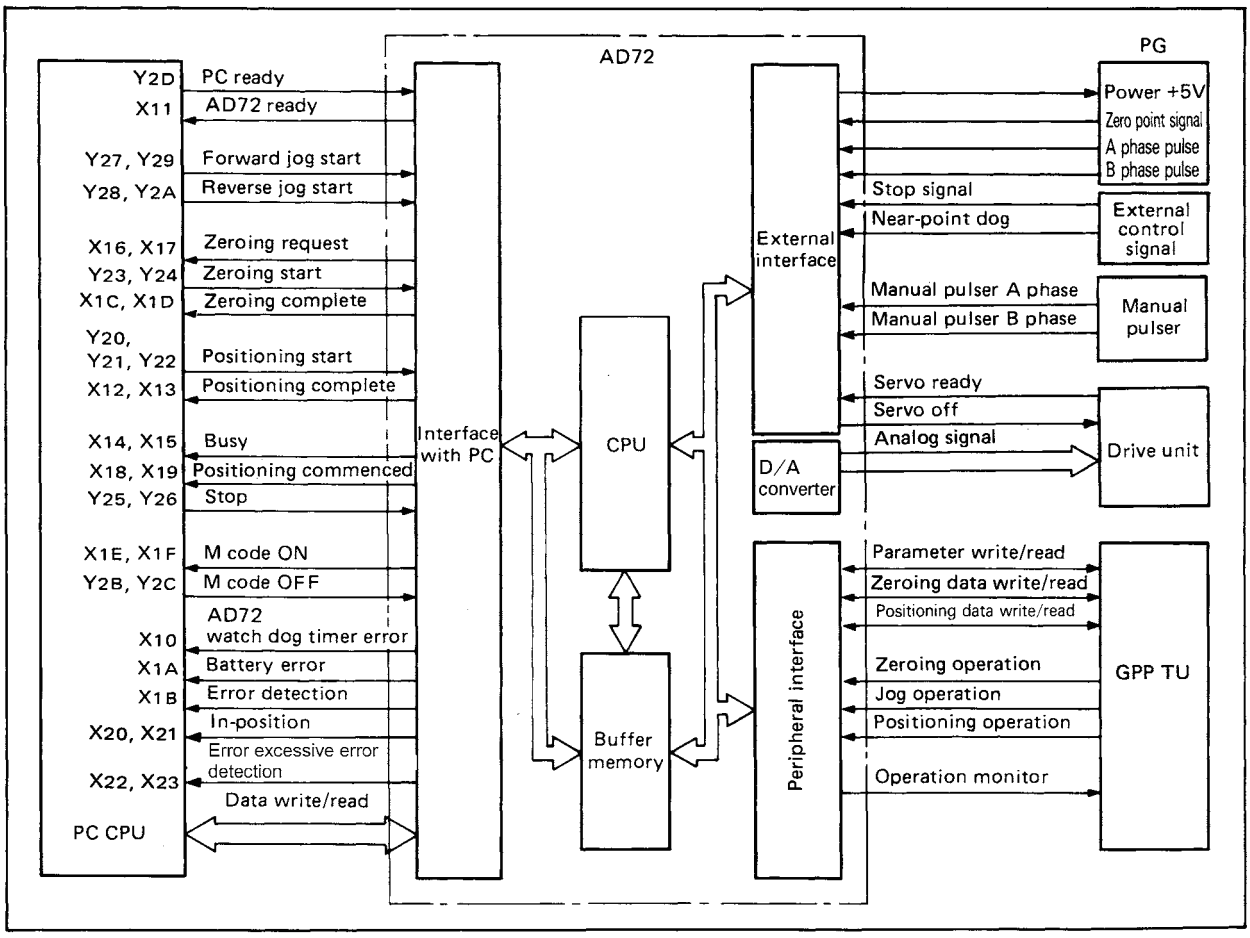
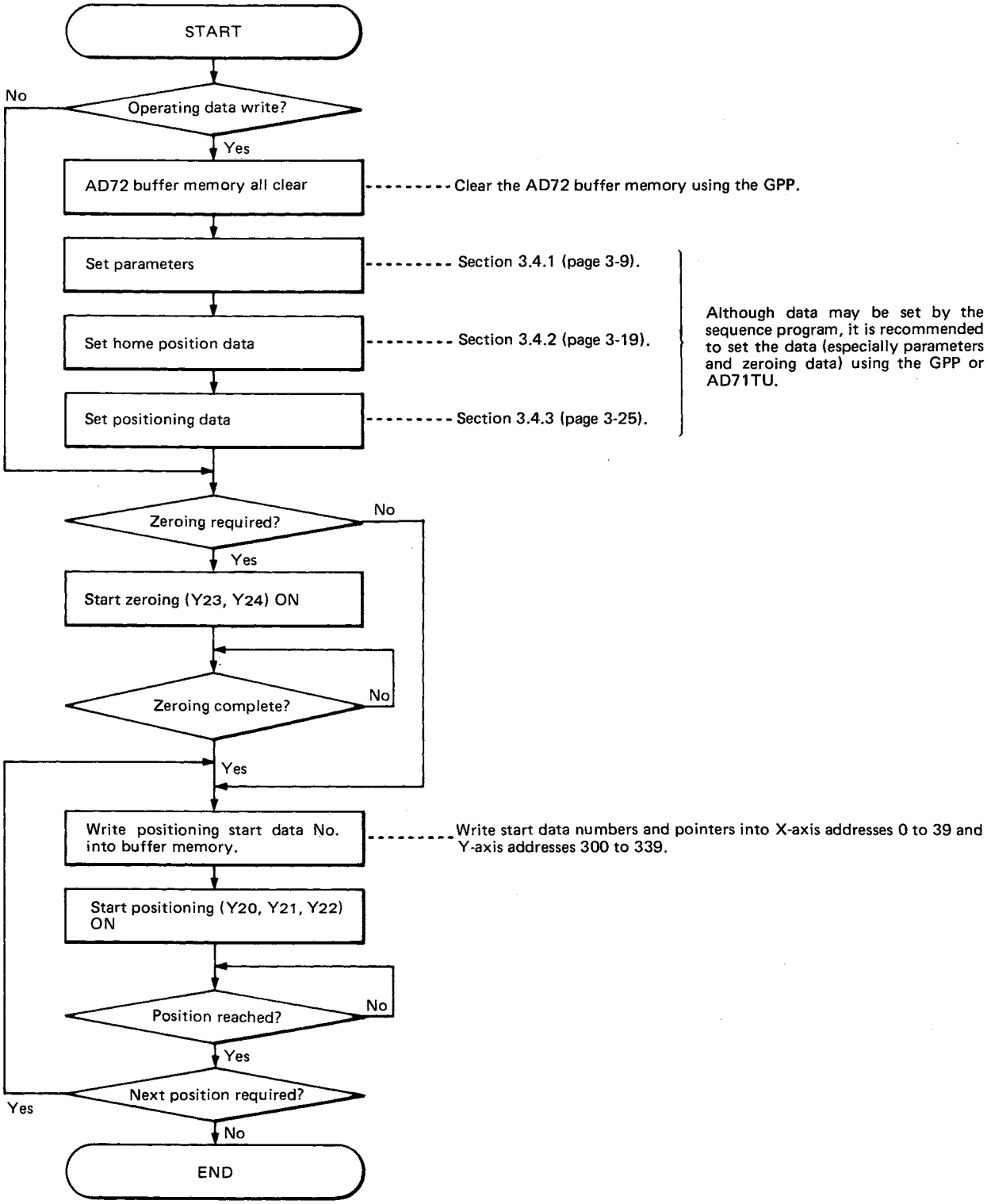


Fig. 3.2 AD72 Function Block Diagram

3.3.3 AD72 operation

Fig. 3.2 PC initiated positioning procedure



Note 1: For home position and positioning start conditions, refer to Chapter 6.

Note 2: Data related to the control signals (positioning functions) from the PLC CPU are as given in Table 3.4.

Data \ Function		Inching Operation	Jog Operation	Zeroing	Positioning
Parameter	Unit setting	O	O	O	O
	Travel per pulse	O	O	O	O
	Speed limit value		O	O	O
	Jog speed limit value		O		
	Starting bias speed		O	O	O
	Backlash compensation	O	O		O
	Upper stroke limit				O
	Lower stroke limit				O
	Error compensation	O	O		O
	Travel per manual pulse during inching	O			
	Acceleration and deceleration times		O	O	O
	Positioning complete signal output time				O
	Pulse output mode	O	O	O	O
	Rotation direction setting	O	O	O	O
	Positioning method				O
	M code ON/OFF timing				O
Zeroing data	Zeroing direction	O	O	O	O
	Zeroing method			O	
	Zeroing address	O	O	O	O
	Zeroing speed			O	
	Zeroing creep speed			O	
	Zeroing dwell time			O	
	Torque limit			O	
Positioning data	Positioning information				O
	Positioning speed				O
	Positioning address				O
	Dwell time				O
Other	Start data area				O
	Speed change data		O*	O*	O*
	Jog speed		O		
	Inching operation enable	O			

Table 3.4 Relation between Data and Positioning Functions

* Indicates functions used to change the speed when the AD72 is busy.

3.4 Format and Functions of Operating Data

The following three blocks of data are required for positioning using the AD72. This data is written to the buffer memory which will be explained in Section 3.5 (page 3-32).

- Parameters
- Zeroing data
- Positioning data

Operating data is written using:

1) GPP or TU. . . . . .For details, refer to the SW0-AD71E and SW0IX-AD71PE or AD71TU Operating Manual.

2) Sequence program. . . . .For details, refer to Chapter 6.

It is necessary to set data for the two axes (X and Y).

POINT

(1) Data clear
Before writing the operating data, the memory must be cleared from the peripheral device.

(2) Operating data for use of only one axis
If only one axis (X or Y axis) is used, parameters and zeroing data must be written to the unused axis. Otherwise zeroing will result in error and switch on the X1B (error detection) signal.
(Data written must be within the range given in the User's Manual. Parameters may be default values.)

3.4.1 Parameters

This is the general information required for positioning. Table 3.5 gives a list of all the parameters which must be set for the AD72.

Initial parameter values

If parameters are not set or an error is found (for example parameter is outside the allowed setting range), all data defaults to the values shown in Table 3.5 and the faulty set of parameters will remain in the buffer memory.

Parameters are checked when:

1) the power is switched on;
2) parameters are transferred from the GPP to the AD72;
3) "PC ready signal" from the PC CPU to the AD72 switches from "off" to "on"; or
4) (1) zeroing, (2) positioning, (3) jog operation, or (4) inching has been selected in GPP test mode.

Error code and error detection signal are not given for the "power on" parameter check.

No.	Item	mm		Inch		degree		PULSE(PLS)		Default Value	
		Setting range	Unit	Setting range	Unit	Setting range	Unit	Setting range	Unit		Unit
1	Units	0	—	1	—	2	—	3	—	3	—
2	Travel per pulse	1 to 100	$\times 10^{-1}$ μm/PLS	1 to 100	$\times 10^{-5}$ inch/PLS	1 to 100	$\times 10^{-5}$ degree/PLS	—	—	—	—
3	Speed limit value	1 to 12000	$\times 10^{1}$ mm/min	1 to 12000	$\times 1$ inch/min	1 to 12000	$\times 1$ degree/min	1 to 20000	$\times 10^{1}$ PLS/sec	20000	$\times 10^{1}$ PLS/sec
4	Jog speed limit value	1 to 12000	$\times 10^{1}$ mm/min	1 to 12000	$\times 1$ inch/min	1 to 12000	$\times 1$ degree/min	1 to 20000	$\times 10^{1}$ PLS/sec	2000	$\times 10^{1}$ PLS/sec
5	Starting bias speed	Set to "0"								0	$\times 10^{1}$ PLS/sec
6	Backlash compensation	0 to 65535	$\times 10^{-1}$ μm	0 to 65535	$\times 10^{-5}$ inch	0 to 65535	$\times 10^{-5}$ degree	0 to 255	PLS	0	PLS
7	Upper stroke limit	0 to 162000	mm	0 to 16200	inch	0 to 16200	degree	0 to 16252928	PLS	16252928	PLS
8	Lower stroke limit	0 to 162000	mm	0 to 16200	inch	0 to 16200	degree	0 to 16252928	PLS	0	PLS
9	Error compensation	±0 to 100000 (per 1m)	$\times 10^{-1}$ μm	±0 to 100000 (per 100inch)	$\times 10^{-5}$ inch	±0 to 100000 (per 100deg)	$\times 10^{-5}$ degree	—	—	0	—
10	Travel per manual pulse during inching	1 to 100000	$\times 10^{-1}$ μm	1 to 100000	$\times 10^{-5}$ inch	1 to 100000	$\times 10^{-5}$ degree	1 to 100	PLS	1	PLS
11	Acceleration and deceleration times	64 to 4999(msec)								1000	msec
12	Positioning complete signal output time	0 to 20000(msec)								300	msec
13	Pulse output mode	Set to "0"								0	—
14	Direction setting	0 : Plus voltage output when positioning address increases 1 : Minus voltage output when positioning address increases								As previous setting *	—
15	Positioning method	0 : Absolute 1 : Incremental 2 : Incremental/absolute combined								0= absolute	—
16	M code ON/OFF timing	0 : M code not used 1 : M code used { 0 : WITH mode 1 : AFTER mode								As previous setting *	—

* Unfixed when shipped from factory. All clear sets to 0.

Table 3.5 Parameter List

POINT

(1) No. 2 to No. 12 are set from the sequence program. The AD72 automatically multiplies any numerical data received from the sequence program by the relevant factor. For example, if the AD72 receives the constant K = 200 from the sequence program and the units have been defined as PLS/sec, the speed output to the drive is 2000 PLS/sec (i.e. 200 x 10^1 PLS/sec.)

(2) When setting No. 1 and No. 13 to No. 16 from the sequence program, refer to Section 3.5.5 (page 3-48).

IMPORTANT

The speed limit value and jog speed limit value among the above parameters are actually integral multiples of 6.1 (PLS/sec).
For example, if the speed limit value is set to 200 (PLS/sec), it is an integral multiple of 6.1 (PLS/sec) closest to 200 (PLS/sec).

$$\frac{200}{6.1} = 32.78688.....$$

The AD72 can only deal with whole number multiples of 6.1, so the actual speed will be 32 x 6.1 = 195.2 pulses per second.

Parameter data is explained as follows.

(1) Unit

Selects the units (mm, inch, degree, or pulse) for positioning control. Can be set independently for X and Y axes (e.g. X axis = mm, Y axis = degree).

(2) Travel per pulse

- Specifies the distance travelled per internal command pulse.
- The input pulses to the deviation counter from the pulse generator will be at the same frequency as the internally generated control pulses. (Note that a magnification factor may be applied to the feedback pulse chain before it is input to the deviation counter).

(3) Speed limit value

- Specifies the maximum speed for positioning (or zeroing).
- If the positioning speed called at a given time is greater than the speed limit value, the speed is limited to the value set by the parameter.
- If a new speed is called during positioning by the sequence program and this is greater than the speed limit value, the speed is limited to the value set by the parameter.

(4) Jog speed limit value

- Specifies the maximum speed for jog operation.
- The jog speed limit value must be within the range shown in Table 3.5 and must not exceed the speed limit value.
- If the jog speed set using the A6GPP or sequence program is greater than the jog speed limit value, the jog speed is kept to the limit value.

*For jog operation, refer to Section 6.3.4 (page 6-23).

(5) Starting bias speed

Must always be "0" for the AD72.

(6) Backlash compensation

- Allows a backlash compensation (see Fig. 3.4) to be programmed in for accurate positioning.
  Note that there is also an error compensation facility to allow for tolerances within the mechanical drive, see note (9).
- The backlash compensation facility allows extra feed pulses to be generated every time the direction of movement changes during positioning.
  During manual pulser inching, pulse output begins as soon as the distance equivilant of the number of input pulses exceeds the backlash compensation amount each time the direction of movement changes. (If the inched distance is less than the backlash compensation, feed pulses are not generated but the AD72 calculates subsequent positions according to the updated data.)
- During jog operation, backlash compensation is made for the first movement after a change of direction only and minimum Jog distance is equal to the backlash compensation value.
- Backlash compensation is valid after zeroing. After redefining the backlash compensation, always zero the system.

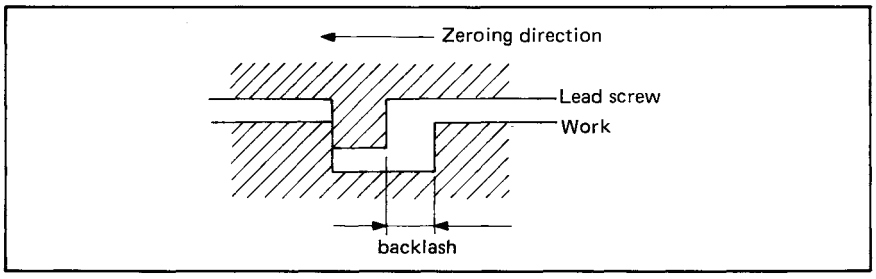


Fig. 3.4 Backlash Compensation

- For the backlash compensation amount, the range of the number of output pulses differs in accordance with the unit to be set in the parameter.

Setting Units	Number of Output Pulses
PLS	0 to 255
mm	*0 to 65535
inch	
degree	

The * symbol indicates the value when the travel distance per pulse is set to 1.

(7) Upper stroke limit

- Defines the upper limit value of machine travel.
- The stroke limit is checked before each positioning operation and if outside the allowed range, positioning is halted.
  During jog operation and manual pulser inching, the stroke limit is ignored.

(8) Lower stroke limit

- Defines the lower limit value of machine travel.
- The stroke limit is checked before each positioning operation and if outside the allowed range, positioning is halted.
  During jog operation and manual pulser inching, the stroke limit is ignored.

(9) Error compensation

When the set value and an actual feedrate differ is called error compensation.
When the unit is mm, an error compensation per m (per 100 inches if the unit is inches and per 100 degrees if the unit is degrees) is set to 0, and the feedrate of any set value is transmitted. (Automatic start) Then, the actual feedrate (A) is measured, and the error compensation amount and backlash compensation amount are calculated as indicated below.
Errors are compensated during JOG operation or positioning.

- When the unit is mm

$$\text{Error compensation amount } (10^{-1}\mu\text{m}) = \left(\frac{\text{Set value(mm)}}{\text{A (mm)}} - 1\right) \times 10^7$$

- When the unit is inches

$$\text{Error compensation amount } (10^{-5}\ \text{inch}) = \left(\frac{\text{Set value(inch)}}{\text{A (inch)}} - 1\right) \times 10^7$$

- When a unit is degrees

$$\text{Error compensation amount } (10^{-5}\ \text{degree}) = \left(\frac{\text{Set value(degree)}}{\text{A (degree)}} - 1\right) \times 10^7$$

- Set the numerical value calculated in the following expression as the backlash compensation amount when there is a machine error.

$$\text{Backlash compensation} = \text{Backlash compensation actual value} \times \frac{\text{Set value}}{\text{A}}$$

(10) Manual pulser inching travel increment

- Defines the distance travelled each time a manual pulser inching command is given.
- The AD72 counts the number of manual pulser inching commands input and provides a preset analog output voltage (equivalent to 20000 PLS/sec.)
- During manual pulser inching there is no automatic acceleration/deceleration.

(11) Acceleration and deceleration times

- Defines the period of time from the start of positioning to when the speed limit value specified in the parameter is reached. (Refer to Fig. 3.5.)

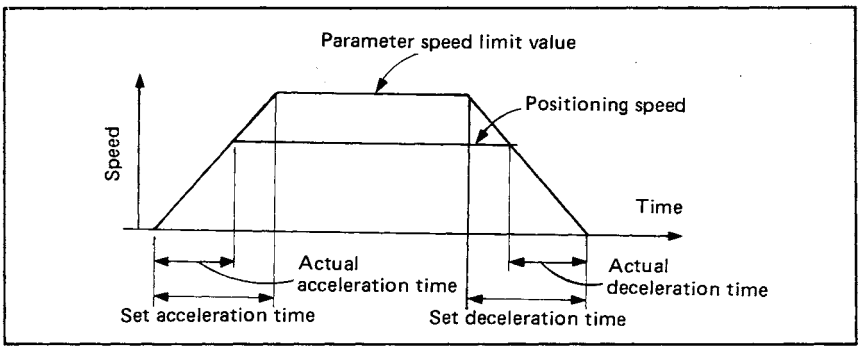


Fig. 3.5 Acceleration and Deceleration Times

- The acceleration and deceleration times cannot be set independently.
- Acceleration and deceleration are controlled at a constant value.
- If the positioning speed is very much lower than the parameter speed limit, the acceleration/deceleration time is comparatively short.
- Acceleration/deceleration time is valid for zeroing, positioning, and jog operations.
- For interpolation positioning, the acceleration/deceleration time for the axis with the longer travel is valid. (The acceleration/deceleration time for the other axis is ignored.)

(12) Positioning complete signal duration

Sets the duration of the "positioning complete signal" from the AD72.
Positioning is considered to be complete after the AD72 terminates pulse output and the predetermined dwell time has elapsed.

(13) Pulse output mode

Set to "0" for the AD72.

(14) Direction setting

Selects the direction for which the positioning address increases. (0 for positive output voltage and 1 for negative.)
Connection of the AD72 and pulse generator differs between "0" and "1" settings. (See Section 5.2.2.)

(15) Positioning mode

- Specifies incremental, absolute, or incremental/absolute combination modes for positioning.
- In incremental mode positioning, positions are reached with reference to the previous position. (See Fig. 3.6.)

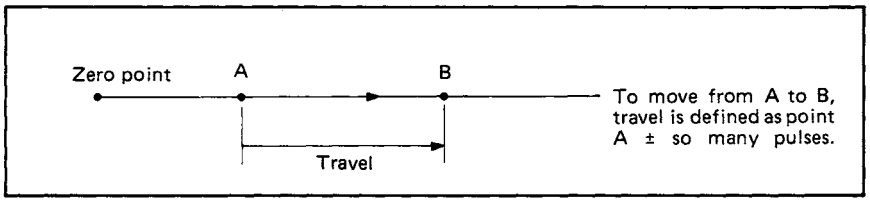


Fig. 3.6 Incremental Method

- In absolute mode positioning, positions are reached with reference to a zero point address. (See Fig. 3.7.)

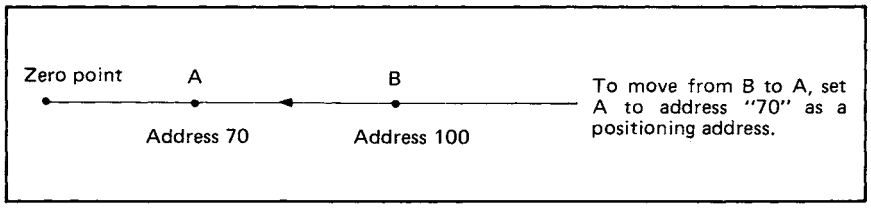


Fig. 3.7 Absolute Method

- To use both incremental and absolute modes in the same axis (e.g. X axis), set 2. In this case, the mode is controlled by the individual piece of positioning data. (Refer to Section 3.4.3 (page 3-25).)

(16) M code ON/OFF timing

M codes are code numbers (1 to 255) assigned by the user to control auxiliary functions at defined points in the positioning cycle. These are used by the PC CPU to co-ordinate the operation of external equipment and processes.

- M code use/non-use must be specified as well as where in the positioning sequence they are to be used.
  When M code non-use is specified or GPP, TU test mode is in operation, M code data in the buffer memory is cleared and the "M code ON" signal is not output.
- "M code ON" signal output is available in two timing modes, WITH and AFTER.
- WITH mode
  The "M code ON" signal is given at approximately the same time as the positioning operation starts.

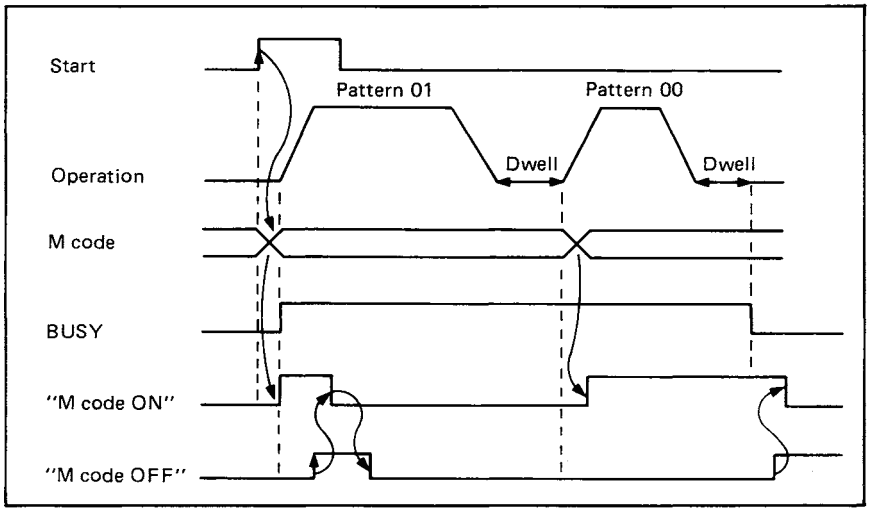


Fig. 3.8 WITH Mode Timing

- AFTER mode

The "M code ON" signal is given after the positioning operation has finished. In this mode, if the operation is stopped before it is complete the "M code ON" signal is not given.

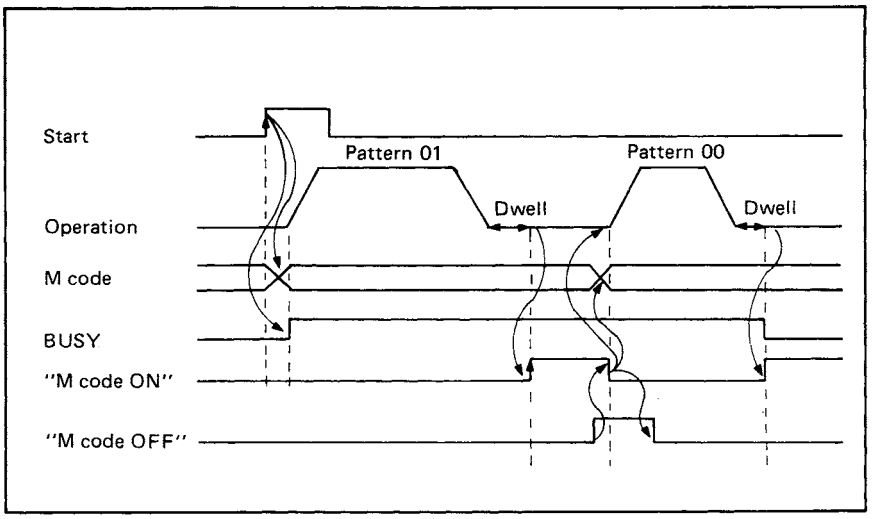


Fig. 3.9 AFTER Mode Timing

POINT

- The "M code ON" signal is not given if the M code data in the positioning data is set at 0.
- The M code is ignored if the positioning pattern is "11" and the "M code ON" signal is not given. (For details of the positioning pattern, refer to Section 3.4.3 (page 3-25).)
  The next positioning operation is not started until the "M code ON" signal is switched off.
  An error condition arises if the "M code ON" signal is on at the rise of the start signal and positioning is not started. The "M code ON" signal is turned off when:

  1. "M code OFF" signal changes from OFF to ON;
  2. PC ready signal (Y2D) is off; or
  3. Zeroing, positioning, jog operation, or manual pulser inching is selected in GPP/TU test mode.

For a sequence of positions, the first of which are defined as pattern "11", the "M code ON" signal is not given until the first "00" or "01" pattern data is reached. In this case the M code itself is given at the first position. This is illustrated below.

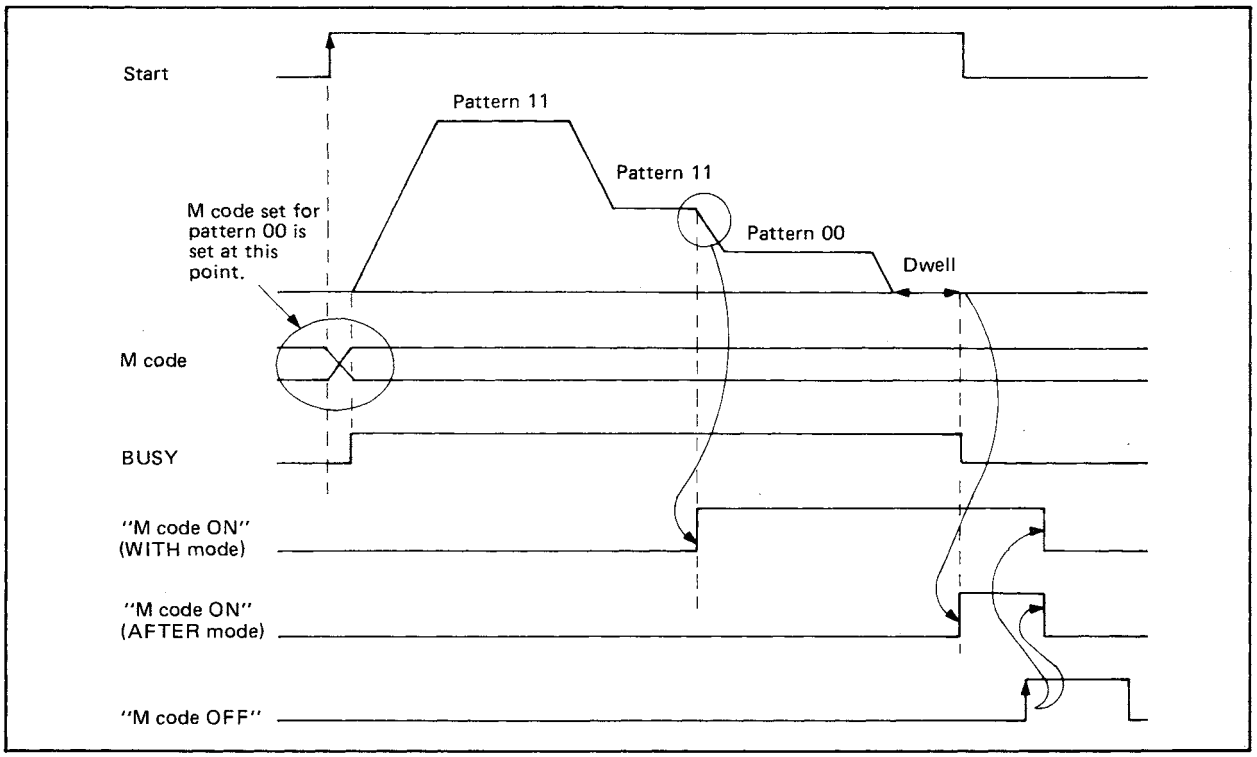


Fig. 3.10 "M Code ON" Signal Timing for Positioning Pattern "11"

REMARKS

Fig. 3.10 shows the timings of the M code ON signal in both the WITH mode and AFTER mode. However, they are shown to explain the M code ON signal timing, and only one of the two modes (WITH mode or AFTER mode) applies to actual operation.

3.4.2 Zeroing data

This defines a home position or zero point for the AD72. Refer to Table 3.6.
Zeroing data is checked when:

1) parameters or zeroing data is transferred from the GPP to the AD72;
2) "PC ready signal" output from the PC CPU to the AD72 changes from OFF to ON; or
3) zeroing, positioning, jog operation, or manual pulser inching is selected in GPP/TU test mode.

No.	Item	mm		inch		degree		PULSE	
		Setting range	Unit	Setting range	Unit	Setting range	Unit	Setting range	Unit
1	Zeroing direction	0 : Forward direction(address increases) 1 : Reverse direction(address decreases)							
2	Zeroing method	0 : Pulse generator(PLG)zero-point signal 1 : Stop and dwell timer time-out 2 : Stop and signal from drive unit							
3	Zeroing address	0 to 162×10^7	$\times10^{-1}\mu$m	0 to 162×10^7	$\times10^{-5}$inch	0 to 162×10^7	$\times10^{-5}$deg	0 to 16252928	PLS
4	Zeroing speed	1 to 12000	$\times10^1$ mm/min	1 to 12000	$\times1$ inch/min	1 to 12000	$\times1$ deg/min	1 to 20000	$\times10^1$ PLS/sec
5	Creep speed	1 to 12000	$\times10^1$ mm/min	1 to 12000	$\times1$ inch/min	1 to 12000	$\times1$ deg/min	1 to 20000	$\times10^1$ PLS/sec
6	Zeroing dwell time	0 to 499($\times10^1$msec)							
7	Torque limit	10 to 250(%)							

Table 3.6 Zeroing Data

POINT

(1) No. 3 to No. 7 can be set by the sequence program.

(2) The numbers "0, 1" for setting the zeroing direction and the numbers "0, 1, 2" for setting the zeroing method are set from the peripheral device (GPP, TU).
When setting No. 1 and No. 2 from the sequence program, refer to Section 3.5.6 (page 3-49).

REMARKS

The zeroing speed and creep speed in Table 3.6 are actually integral multiples of 6.1 (PLS/sec).
For example, if the zeroing speed is set to 200 (PLS/sec), it is an integral multiple of 6.1 (PLS/sec) closest to 200 (PLS/sec).
200 / 6.1 = 32.78688 ..... (fractional portion dropped)
∴Namely, the actual speed is 6.1 × 32 = 195.2 (PLS/sec).

Zeroing data is explained below:

(1) Zeroing direction

- Specifies the direction for zeroing.

IMPORTANT

Zeroing is controlled according to the zeroing direction and speed. Deceleration is started when an actuator is operated. Always ensure that the zeroing direction is correct for the drive system used.

(2) Zeroing methods

Zero the system using one of the following methods, all methods require a "zeroing dog" or actuator to reduce the speed to the creep speed.

a) Zero-phase signal from pulse generator (PG)
b) Stop and dwell timer time-out
c) Stop and signal from drive unit

(a) Zero-phase signal from PG

A zero-phase signal from the PLG is used to stop the axis as shown in Fig. 3.11.
The PLG used must have a zero-phase signal. (Refer to Fig. 3.11, 12.)

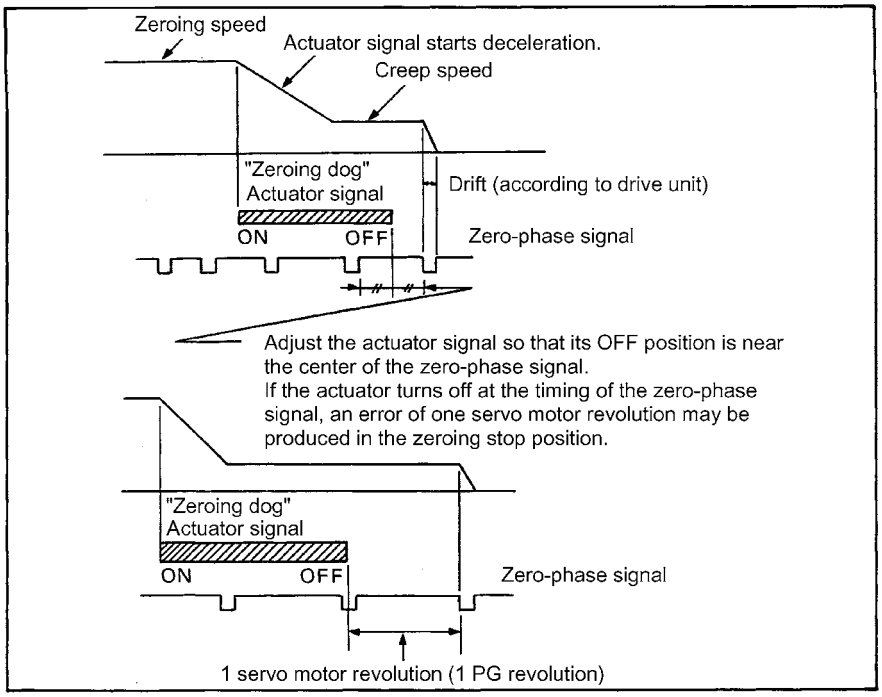


Fig. 3.11 Zeroing Using a Zero-Phase Signal from PG

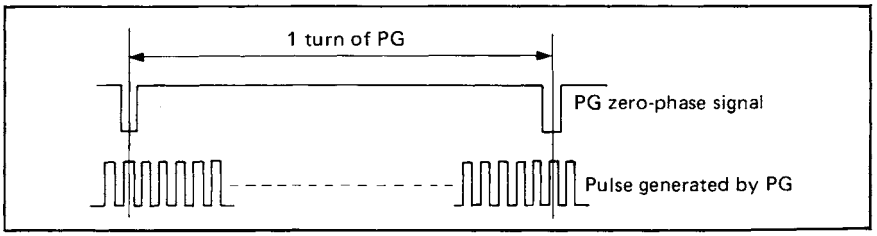


Fig. 3.12 Pulse Generator (PG) Output

(b) Stop and dwell timer time-out

Zeroing is completed when the dwell timer times out after the actuator signal turns on. (Refer to Fig. 3.13.)

In this case, if the actuator signal turns off midway, zeroing is not completed after the dwell timer has timed out.

After the creep speed is reached, be sure to impose torque limit on the servo motor. (Refer to Section 3.4.2 (7) for details.)

If torque limit is not imposed on the servo motor, the servo motor may fail when the system makes contact with the stopper.

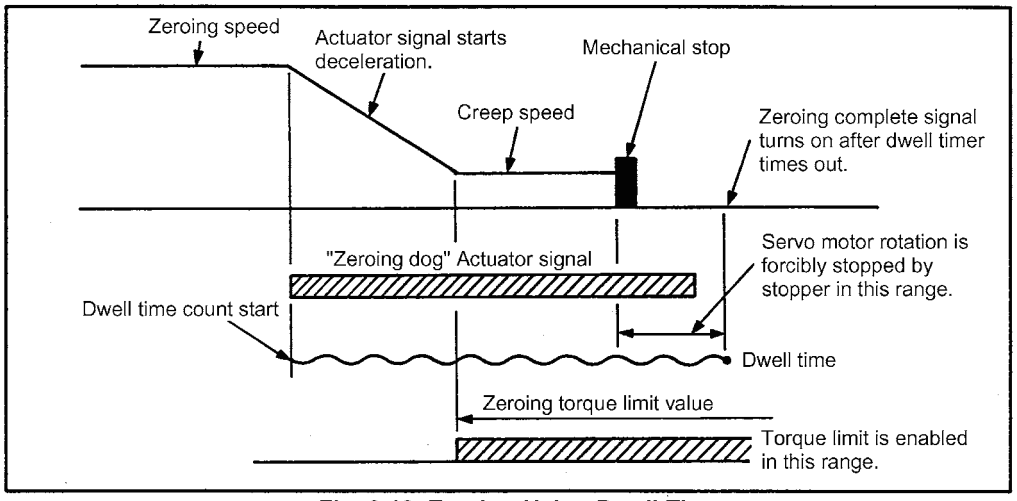


Fig. 3.13 Zeroing Using Dwell Timer

(c) Stop and signal from drive unit

When the system makes contact with the stopper, an external stop command is input to stop the system. (Refer to Fig. 3.14-1.)

After the actuator signal turns on, a zero-phase signal (stop command) is input forcibly to the Z phase by an external switch or similar device. At this point, the actuator signal may either be on or off.

In this method, the axis can also be stopped by only a stop signal input without making contact with the stopper. (Refer to Fig. 3.14-2.)

When the system is stopped by the stopper, be sure to impose torque limit on the servo motor after the creep speed is reached. (Refer to Section 3.4.2 (7).)

If torque limit is not imposed on the servo motor, the servo motor may fail when the system makes contact with the stopper.

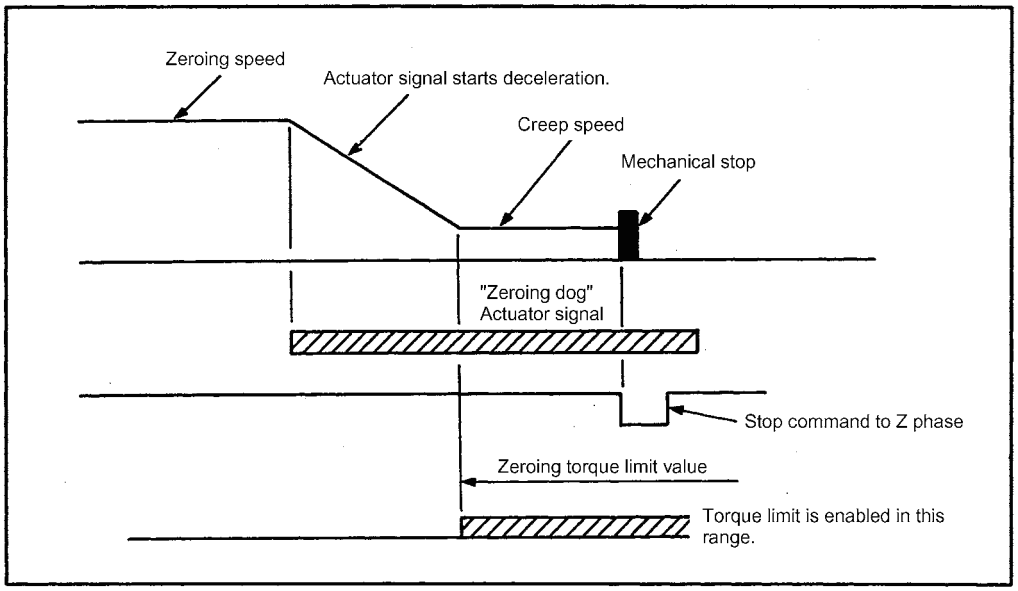


Fig. 3.14-1 Zeroing Using Stopper

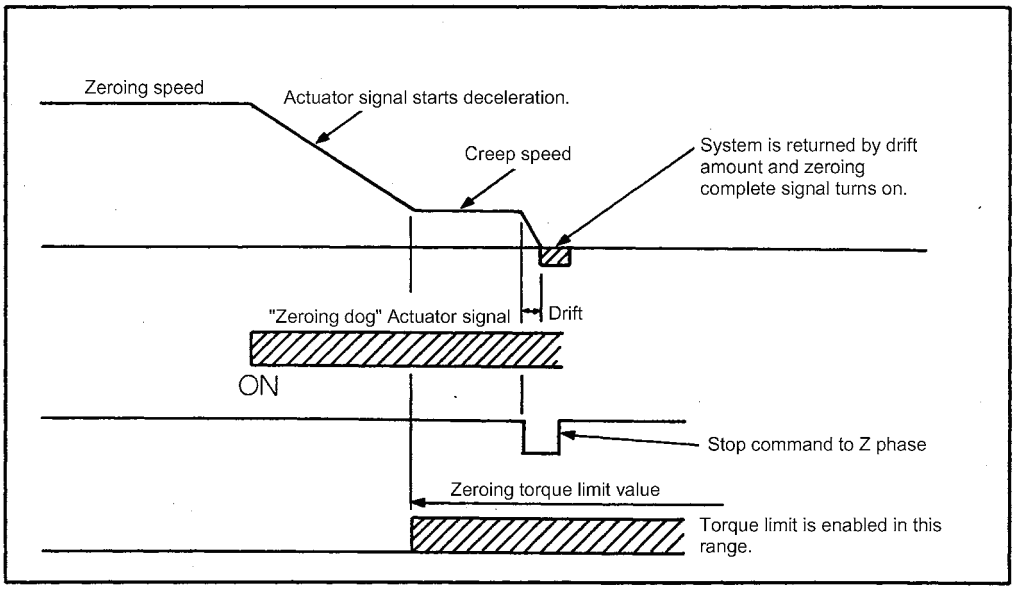


Fig. 3.14-2 Zeroing without Using Stopper

REMARKS

(1) Connect a pulse generator (PLG) to only Phase A and Phase B, and connect a limit switch or similar device to the Z phase. When connecting a limit switch to the Z phase, connect it across the pin No. "10" and "9 (ground)" of the connector "ENCO". (Refer to Section 3.7.2.)

(2) If a stop signal is input before the speed decreases to the creep speed, note that the servo motor and mechanical system will be stained, causing a failure.

(3) Zeroing address

- This address is set as the present value of the home position upon completion of zeroing.
- Set the zeroing address to either the upper or lower stroke limit set in the parameters.

(4) Zeroing speed

- Sets the zeroing speed. (Refer to Fig. 3.15.)

(5) Creep speed

- This is the low speed used to approach the home position. (See Fig. 3.15.)
- This speed should be set with consideration for errors in zeroing as well as the impact with the end stop.

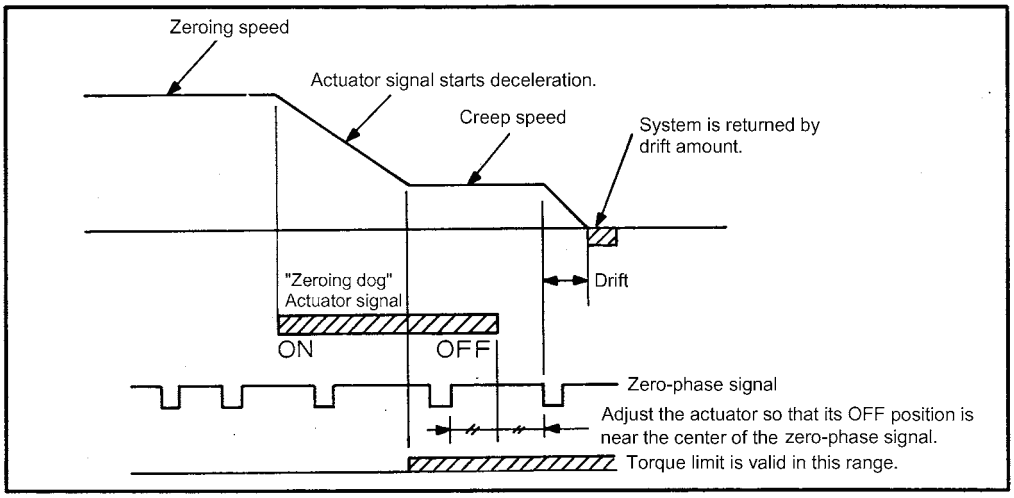


Fig. 3.15 Zeroing and Creep Speeds

(6) Zeroing dwell time

- This is the period of time starting from when the actuator is turned on to when home positioning is complete.
- Set the time interval to allow the creep speed to stabilize and the drive to hit the mechanical stopper.
- When the zero-phase signal is used for zeroing, dwell time refers to the period of time from when the zero-phase signal is input to when the analog voltage output is switched off.

(7) Torque limit

- The torque limit may be defined and stored in the AD72.

POINT

- **The D/A converter module is required to impose torque limit.**
- **Be sure to set the torque limit when performing zeroing operation by "stop and dwell timer time-out" or "stop and signal from drive unit".**
- **When torque limit is not imposed, any value (within the setting range) may be specified.**

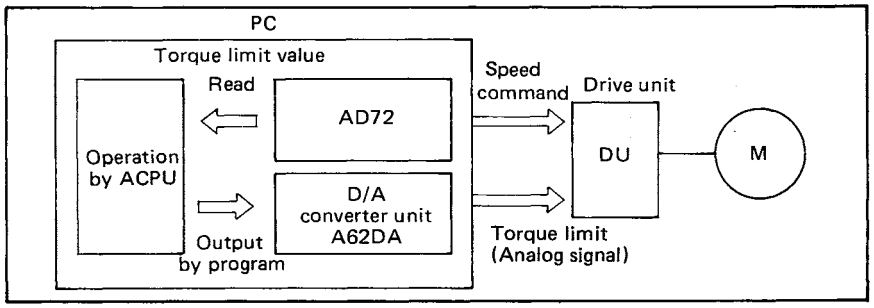


Fig. 3.15 Torque Limit Block Diagram

3.4.3 Positioning data

Positioning data is used in the AD72 to execute positioning control (i.e. control other than home positioning, inching and jog operation). Refer to Table 3.7.
Table 3.7 shows one block of positioning data. 400 blocks can be set for the X and Y axes, respectively.
The block of data used for positioning is dictated by the number set in the positioning start area of the buffer memory.
Positioning data is checked when positioning is started.

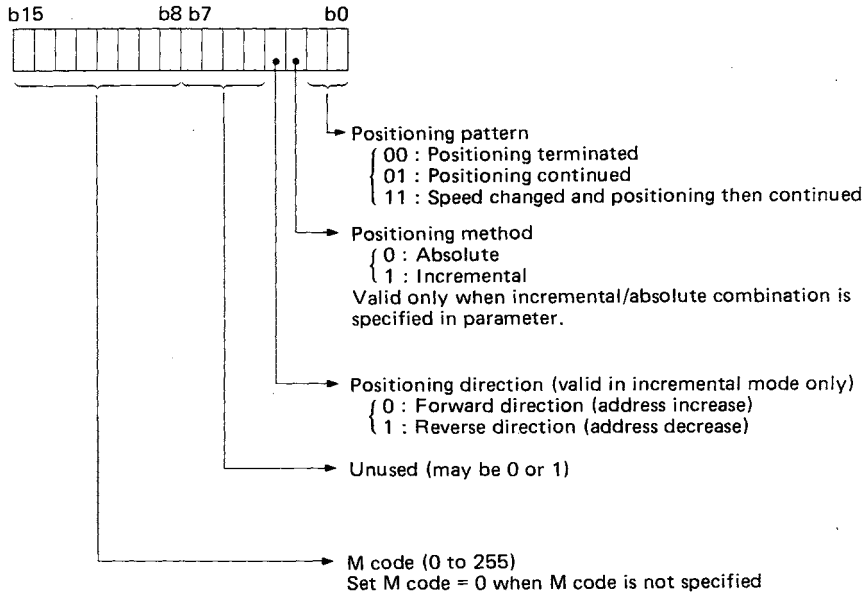
<table>
<tr><th colspan="2" rowspan="2">No. \ Item</th><th colspan="8">Setting Data</th></tr>
<tr><td colspan="8"> 
</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Positioning information</td><td colspan="2">mm</td><td colspan="2">inch</td><td colspan="2">degree</td><td colspan="2">PULSE</td></tr>
<tr><td>Setting range</td><td>Unit</td><td>Setting range</td><td>Unit</td><td>Setting range</td><td>Unit</td><td>Setting range</td><td>Unit</td></tr>
<tr><td>2</td><td>Positioning speed</td><td>1 to 12000</td><td>$\times 10^{1}$ mm/min</td><td>1 to 12000</td><td>$\times 1$ inch/min</td><td>1 to 12000</td><td>$\times 1$ deg/min</td><td>1 to 20000</td><td>$\times 10^{1}$ PLS/sec</td></tr>
<tr><td>3</td><td>Positioning address</td><td>0 to 162×10^{7}</td><td>$\times 10^{-1}\mu$m</td><td>0 to 162×10^{7}</td><td>$\times 10^{-5}$inch</td><td>0 to 162×10^{7}</td><td>$\times 10^{-5}$deg</td><td>0 to 16252928</td><td>PLS</td></tr>
<tr><td>4</td><td>Dwell time</td><td colspan="8">0 to 499 ($\times 10^{1}$ msec)</td></tr>
</table>

Table 3.7 Positioning Data List

POINT

No. 2 to No. 4 can be set from the sequence program.

REMARKS

The positioning speed is an integral multiple of 6.1 (PLS/sec).
For example, if the positioning speed is set to 200 (PLS/sec), the maximum speed output from the AD72 is

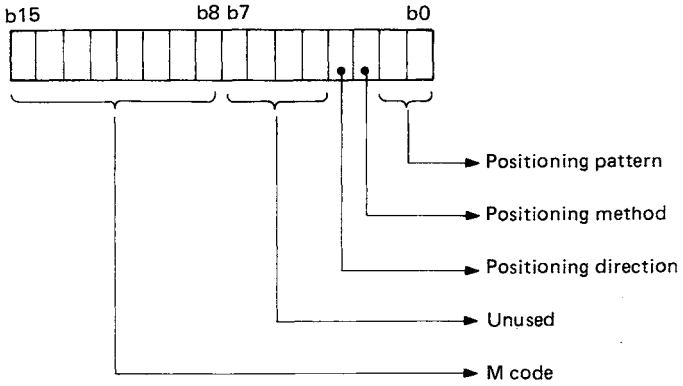
$200 = 6.1 \times n = 32.7868.....$

Therefore, the actual speed is $6.1 \times 32 = 195.2$ (PLS/sec).

Positioning data is explained below.

(1) Positioning information

- Separate the information for the X and Y axes.
- Positioning information consists of 16 bits and includes the following.



(a) Positioning pattern

This specifies whether the operation is to be continued to the next position, or if operation is to be halted after the current position has been reached.
Continued operation is further divided as follows:

1) Consecutive positions are reached using the same speed.

2) The speed is changed at the specified address and positioning then proceeds in the same direction.

This pattern data is specified by the first two bits of the positioning information.

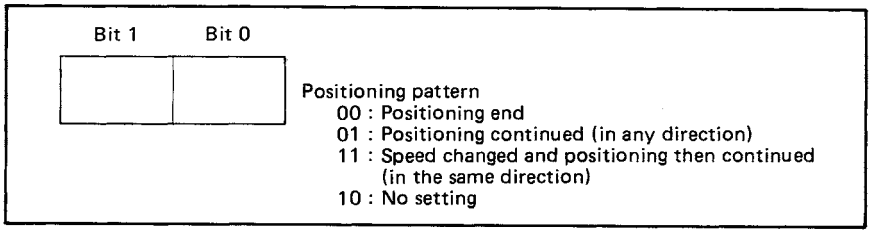


Fig. 3.16 Positioning Pattern

- Positioning end (00)

  Drives to the specified address, positioning is complete after the dwell time has elapsed. The drive remains stopped until the next start signal is provided.

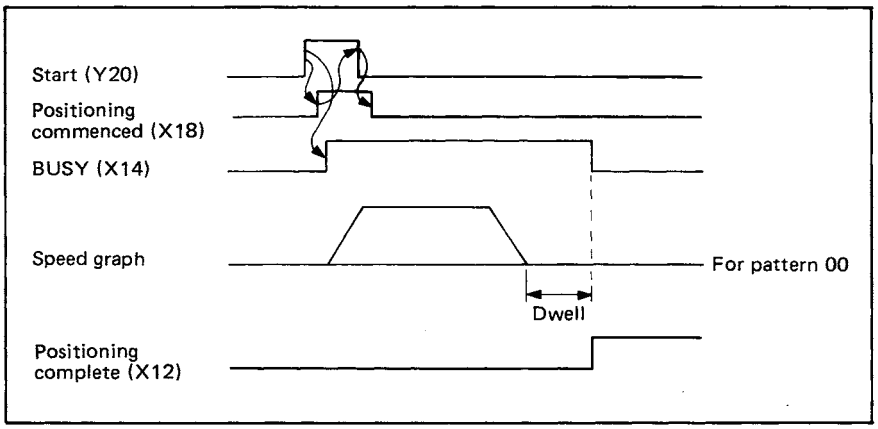


Fig. 3.17 Pattern 00

- Positioning continued (01)

  The positions are reached consecutively in the order specified by their data numbers by a single start signal. A pause separates each consecutive position. (The BUSY signal remains on during positioning.)

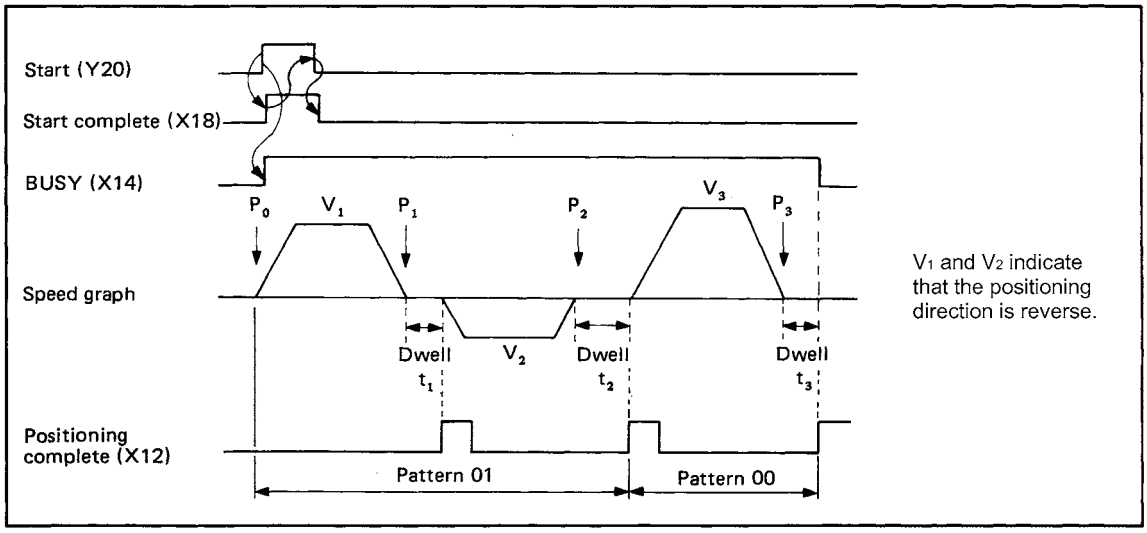


Fig. 3.18 Pattern 01

POINT

Pattern 00 should be set for the last position in a series of continuous operations.
Pattern 01 may be set for interpolation positioning. In this case, the patterns for the X and Y axes should be the same. The X and Y axis patterns are checked before operation and any error will stop positioning.

- Positioning continues with speed change (11)

The positions are reached consecutively without a pause in the order specified by their data numbers by a single start signal. During positioning, the speed may be changed but the direction remains the same. (Refer to Fig. 3.19.)

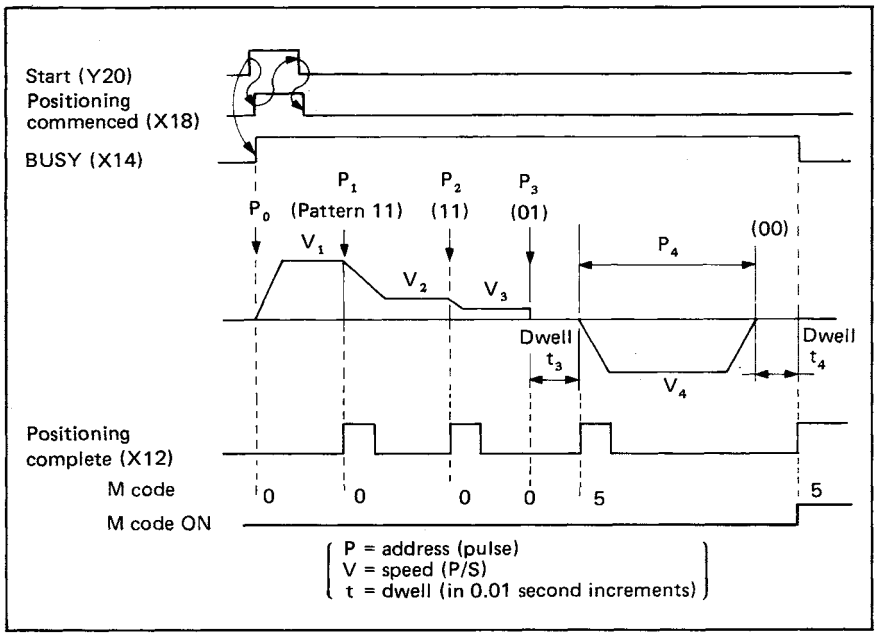


Fig. 3.19 Pattern 11

Table 3.8 shows the positioning data for Fig. 3.19. The following conditions apply:

M code ON/OFF timing : AFTER mode
Incremental/absolute method: Incremental and absolute combined

	Data No.	Pattern	Speed	Address	Dwell	Method	M Code
X axis	100	11	V_1	P_1	—	Abs.	0
	101	11	V_2	P_2	—	Abs.	0
	102	01	V_3	P_3	t_3	Abs.	0
	103	00	V_4	P_4	t_4	Inc.	5
	104						
	105						
	106						
	107						
	108						

In the method column, Abs. indicates absolute method and Inc. incremental method.

Table 3.8 Positioning Data

POINT

For continuous positioning, pattern 11 should not be used more than nine times consecutively. Where a large number of consecutive 11 patterns are being used, they must be broken down by placing 01 pattern data every nine 11 patterns. (e.g. pattern 11 = 9 times, pattern 01 = 1 time, pattern 11 = 9 times, pattern 00 = 1 time).

Always set pattern 00 in the final data block.

While pattern 11 is continuing, the direction of movement and the positioning method should remain unchanged, only after pattern 01 or 00 may these be changed. If the speed is changed after deceleration has started, the new speed is ignored and, if the M code has been set in WITH mode, the "M code ON" signal is not given.

During positioning using pattern 11, dwell time data and M code will be ignored.

Interpolation positioning cannot be specified when pattern 11 is being used.

(b) Positioning method

Incremental or absolute positioning must be specified assuming that it has not been set in the parameters (item 15, page 3-10). Parameter data takes precedence over this data.

POINT

The positioning method cannot be changed if pattern 11 has been specified.
The positioning method can be changed after patterns 00 or 01 have been executed.

(c) Positioning direction

For incremental mode positioning, the direction of travel relative to the previous address must be specified. (0 specifies forward, increasing address numbers and 1 specifies reverse, decreasing address numbers.)
In absolute mode, the positioning direction is ignored.

(d) M code

Specifies an "M" code relevant to that position address. (range: 0 to 255)
The code should be set to 0 if it is not required.
During interpolation positioning, M codes are given individually for the X and Y axes. (X-axis M code, buffer address = 46. Y-axis M code, buffer address = 346.)

(2) Positioning speed

Specifies the speed at which the next position is to be approached.

POINT

Before operation, the parameter speed limit is checked and if the positioning speed exceeds the speed limit value, the parameter speed limit value is used.

Positioning speed for linear interpolation

During linear interpolation positioning, the speed set for the axis with the furthest to travel takes precedence and the speed of the other axis is derived as follows.

(Short travel axis speed)

$$= (\text{long travel axis speed}) \times \frac{(\text{short travel distance})}{(\text{long travel distance})}$$

An example of this is given in Fig. 3.20 which uses the following data:

	X Axis	Y Axis
Parameter set value : speed limit value	20KPLS/sec	50KPLS/sec
Positioning data set value : positioning speed	20KPLS/sec	50KPLS/sec

To move from point A (address 0, 0) to point B (100kp, 200kp), X-axis travel is less than Y-axis travel so Vy = 50kp/s has precedence.

$$\text{X-axis positioning speed} = 50 \times \frac{100}{200} = 25\text{KPLS/sec}$$

(This speed exceeds the speed limit value which is ignored in this case.)

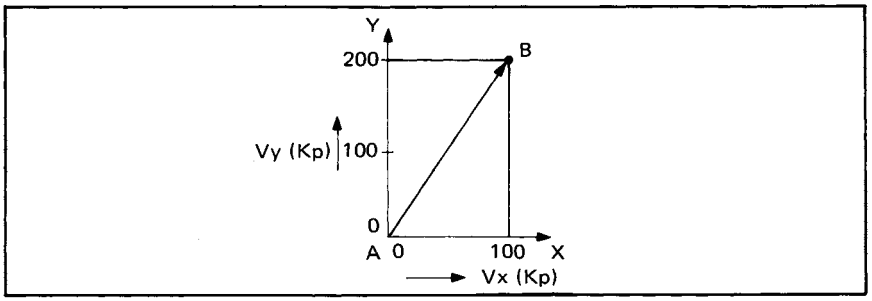


Fig. 3.20 Linear Interpolation

Note: For interpolation positioning, the actual positioning speed is approximately 5% lower than the set speed. (If the set speed is extremely low, the error will be larger, e.g. about 10% at 100P/S.)

POINT

During linear interpolation positioning it is possible for the speed of a given axis to exceed the set speed and the speed limit value if the travel distance for the two axes varies greatly.
For linear interpolation, it is suggested that the positioning speeds and speed limits for the X and Y axes are set to the same value.

(3) Positioning address

The positioning address is set either as an absolute value or an incremental value.

(4) Dwell time

The dwell time is the period of time indicated in Fig. 3.21 below.

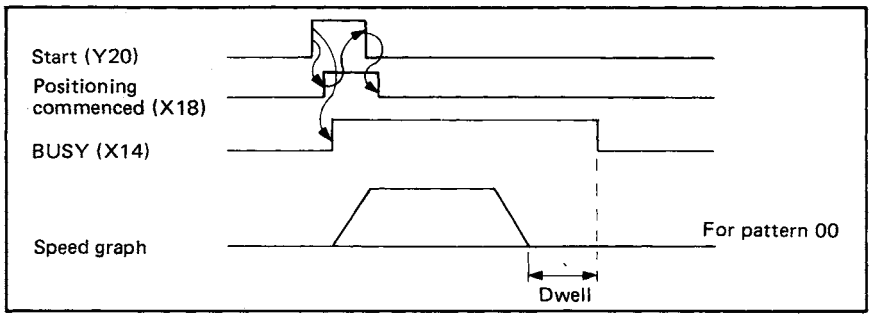


Fig. 3.21 Pattern 00

During interpolation positioning, the longer dwell time value is valid irrespective of the distance travelled (e.g. if X axis = 1 sec and Y axis = 1.5 sec, 1.5 sec is valid.)

3.5 Buffer Memory

The AD72 has a battery backed buffer memory for communication of data with the PLC CPU.
This memory stores various data as shown in Fig. 3.22 and the AD72 uses these data to perform positioning control.
The data shown in Fig. 3.22 can be read and written by the following methods.

Read of data from buffer memory

- From the sequence program ... Using the buffer memory access instruction, data at the specified buffer memory address can be read directly at any time in 1-word (16-bit) or 2-word unit.
- Using the GPP ... Data can be read in various GPP modes. Refer to the SW0-AD71P Operating Manual for operation details.

Write of data to buffer memory

Data write may be restricted depending on the AD72 status.
General write conditions are shown in Fig. 3.22. Refer to Section 3.5.1 to 3.5.6 for details.

- From the sequence program ... Using the buffer memory access instruction, data can be written directly to the specified buffer memory address in 1-word (16-bit) or 2-word unit.
- Using the GPP ... Data stored beforehand in the GPP memory area can be written from the GPP to the AD72 buffer memory by block transfer.
  The write conditions from the GPP shown in Fig. 3.22 apply to the above method.

An additional function allows individual pieces of positioning data to be written to the AD72 if the AD72 is busy. Refer to the SW0-AD71P or SW0IX-AD71PE Operating Manual for operation details.

REMARKS

Refer to Chapter 6 Programming for the buffer memory access instructions.

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.

Address (Decimal)		Description	Source of Data		Ref. Page
			Program	GPP or TU	
0 to 200	X axis positioning start data	Area for positioning start data numbers, speed change data, present value change data, error code, M code and status data	*1	*2	Section 3.5.1
201	Error reset	Area for error reset	Yes	Yes	Section 3.5.2
202	X axis counter pulse clear	Area for setting counter pulse clear	Yes	No	Section 3.5.3
203	Y axis counter pulse clear				
	(Reserved)		No	No	–
300 to 500	Y axis positioning start data	Area for positioning start data numbers, speed change data, present value change data, error code, M code and status data	*1	*2	Section 3.5.1
	(Reserved)		No	No	–
600 to 607	Monitoring data	Area for output speed, present value address and zeroing torque limit value	No	No	Section 3.5.4
	(Reserved)		No	No	–
3872 to 5871	X axis positioning data	Area for positioning data in Section 3.4.3, i.e. positioning information, positioning speed, dwell time and positioning address (Maximum 400 positions for each axis)	Yes	*3	Section 3.5.5
5872 to 7871	Y axis positioning data				
7872 to 7891	X axis parameters	Area for parameter data in Section 3.4.1	*3	*3	Section 3.5.6
7892 to 7911	Y axis parameters				
7912 to 7921	X axis zeroing data	Area for zeroing data in Section 3.4.2	*3	*3	Section 3.5.7
7922 to 7931	Y axis zeroing data				

*1: Depends on data.
*2: Write enabled when both X and Y axis BUSY signals are off.
*3: Write only enabled when PC ready signal is off.

REMARKS

The above data may be read at any time.

Fig. 3.22 Buffer Memory map

3.5.1 Positioning start data

The positioning start data area is shown in Fig. 3.23. The arrangement of the data is the same for both X and Y axes, only addresses are different.

POINT

Both the X-axis and Y-axis BUSY signals must be off to write this data into the AD72 from the A6GPP.

The conditions of writing the positioning start data from the sequence program will be described in the text as they change depending on the data type.

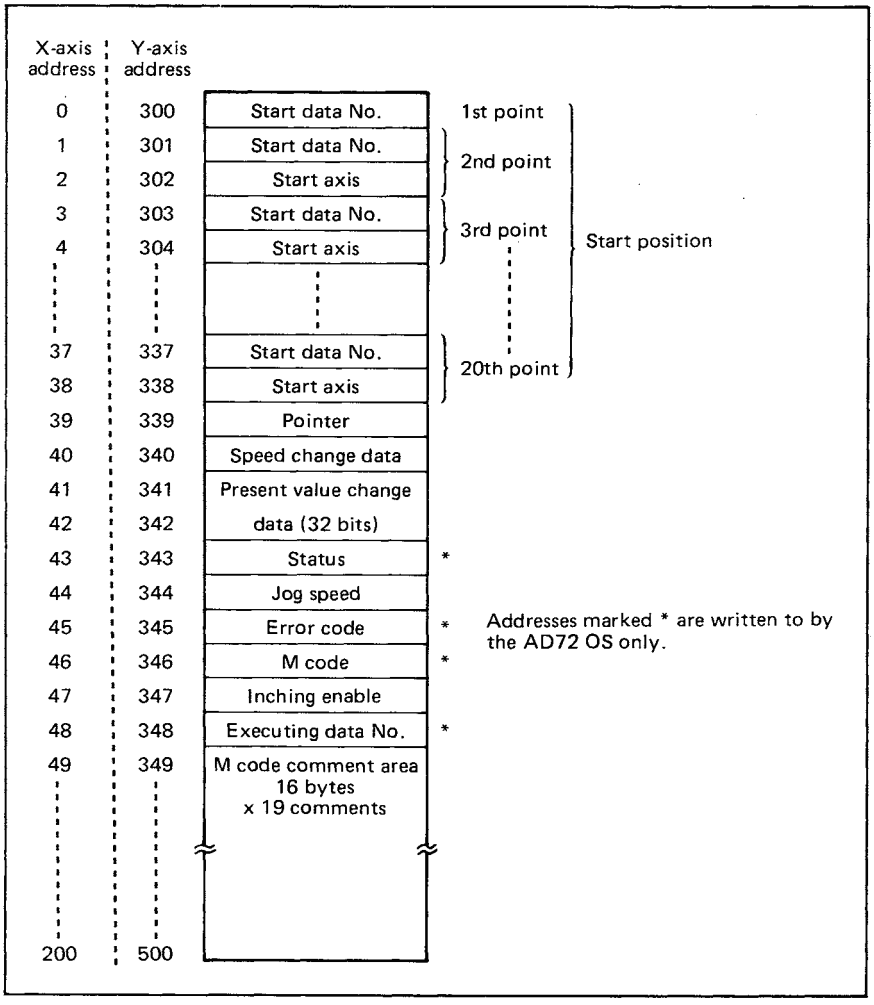


Fig. 3.23 Positioning Start Data

(1) Start data number area

For continuous positioning, the AD72 uses consecutive position data numbers starting at the data number indicated in these addresses. A maximum of 20 start numbers can be specified for each axis, providing a maximum of 20 positioning sequences from the total of 400 positions. These sequences can be called in turn by using the pointer to specify how many start numbers (and hence, how many sequences) are to be processed.

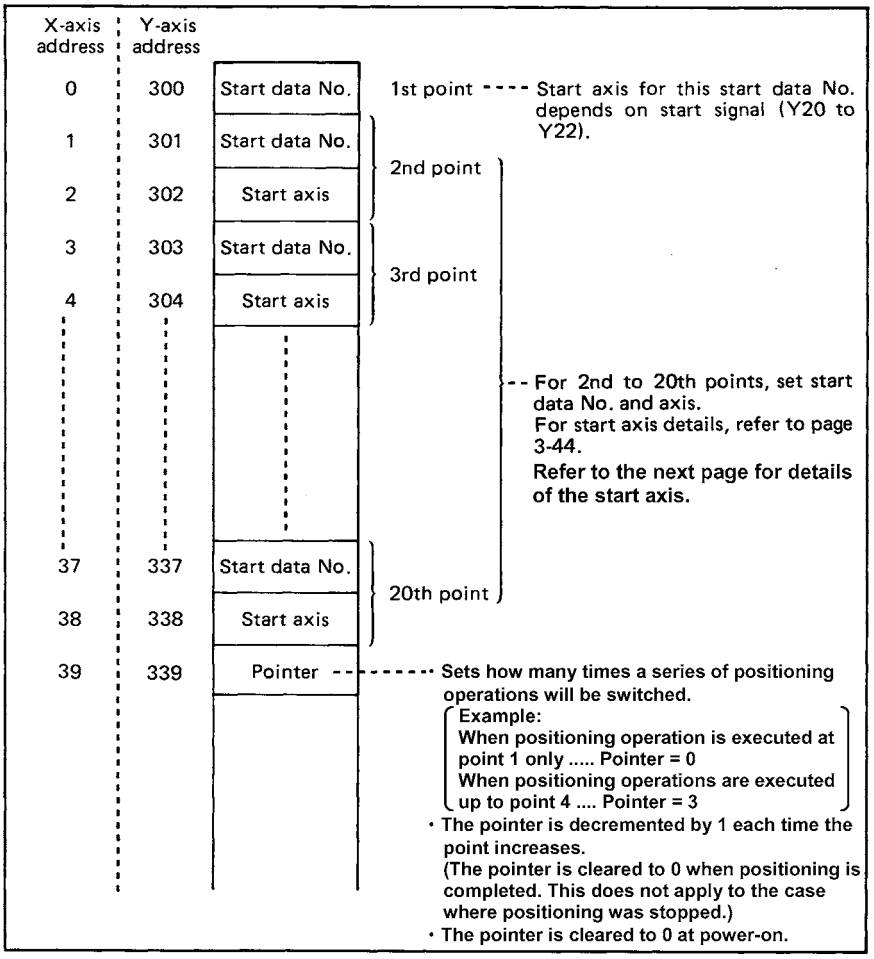


Fig. 3.24 Start Data Number Area

POINT

- **When positioning of the start data No. at point 20 ends, positioning is completed if the pointer value is not 0. (However, the error code is set.)**
- **The BUSY signal remains on between consecutive positions.**

(a) Start axis area details

Use the two least significant bits of these addresses to define the start axis. (See Fig. 3.25.)

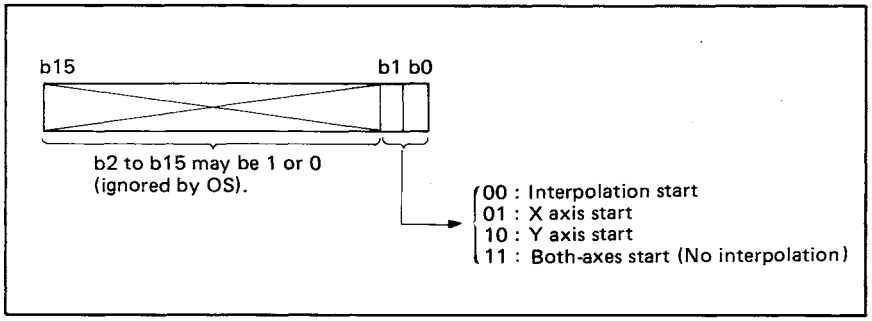


Fig. 3.25 Start Axis Area

The following occurs if both axes are started and an error is found in one:

1) both axes stop if the error has occurred between consecutive positions.
2) only the axis with the error stops if the error occurred after both axes have started.

(b) Data setting precautions

1) When both axes are to be started together (i.e. interpolation setting 00 or independent setting 11) ensure that the start axis data matches for both X and Y axes at that point. Processing will stop if the data does not match. Refer to Fig. 3.26.

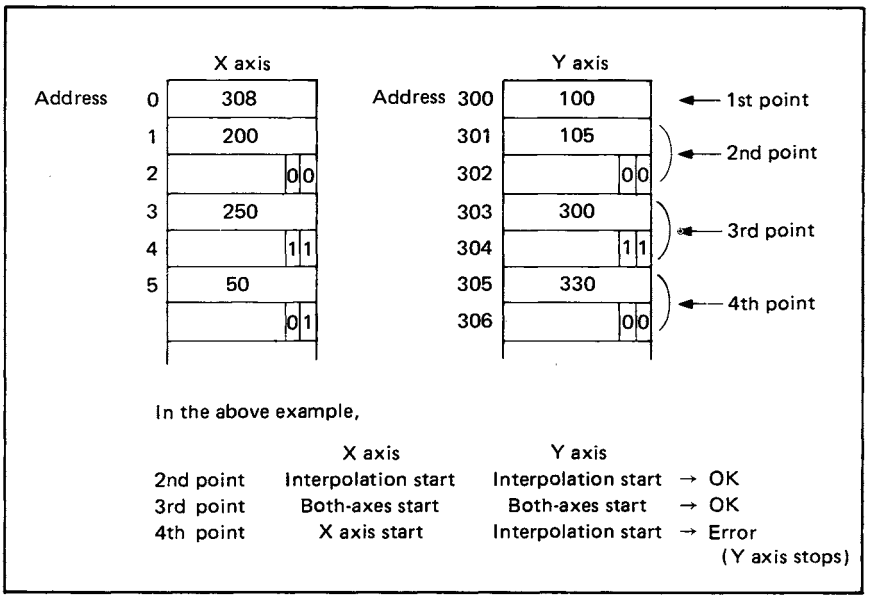
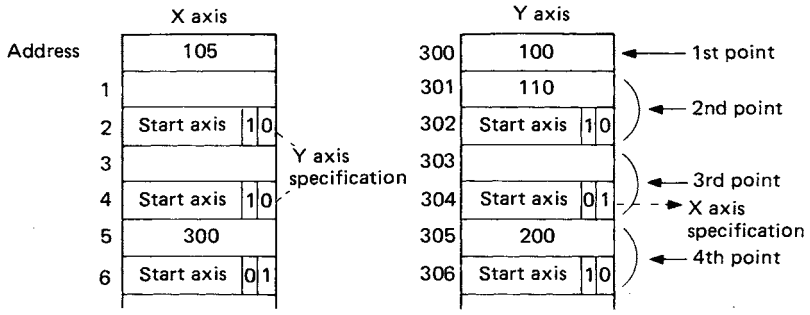


Fig. 3.26 Start Data Example 1

2) If the start axis setting in the X axis start data No. area is a Y-axis start (10), that point data is ignored (positioning is not executed) and the processing proceeds to the next point. (Refer to Fig. 3.27.)
This also applies to the case where the start axis setting in the Y axis start data No. area is an X-axis start (01).

[Example]



If point 2 or point 3 of the X axis is set to the Y axis (10) as in the above example, the processing skips point 2 and point 3 and immediately starts the positioning processing at point 4.
Also, point 3 of the Y axis is set to the X axis (01). Hence, the processing skips point 3 and switches to point 4.

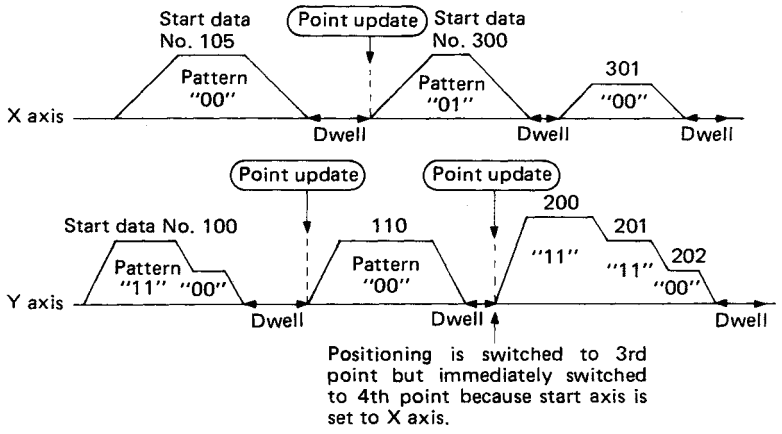
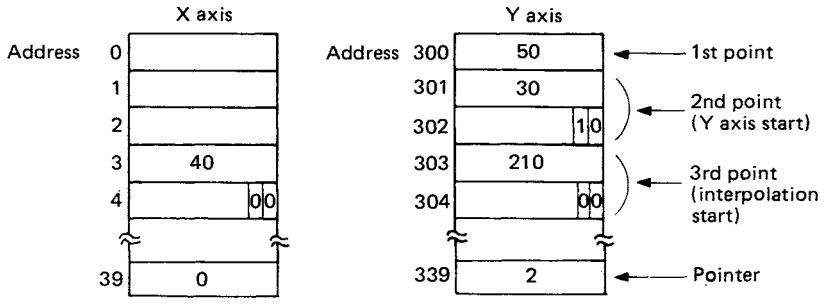


Fig. 3.27 Start Data Example 2

3) If the start axis is set to an interpolation start (00) or dual start (11) and the other axis is not busy, the other axis is automatically started from the start data No. corresponding to the point value of the original axis. (Refer to Fig. 3.28.)
At this time, an error will occur if the "M code ON" signal of the other axis is on.

Start data No. area setting example



First, assume that the Y axis is started.
When the Y axis ends positioning at point 1 and point 2, the setting of point 3 is an interpolation start. At this point, therefore, the X axis starts automatically from point 3.

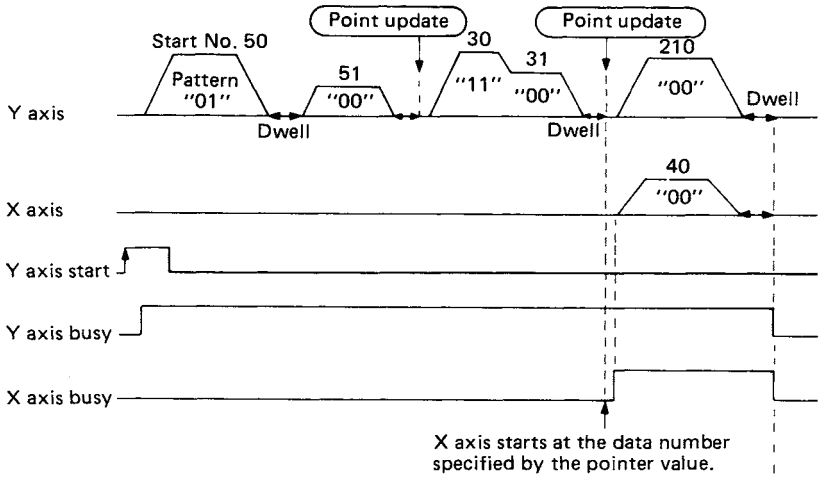
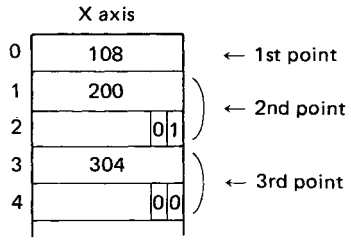


Fig. 3.28 Start Data Example 3

4) If the start axis is set to an interpolation start (00) or dual start (11) and the other axis is busy with other than positioning, an error occurs and the positioning process of the original axis is stopped. (Refer to Fig. 3.29.)

Start data No. area setting example



Assume that the X axis start signal was turned on and the X axis is being positioned.
If the Y axis is zeroing, is jogging or is busy under control of the manual pulse generator when the positioning of the X axis switches to point 3, the X axis does not start interpolation positioning, registers an error, and stops positioning.

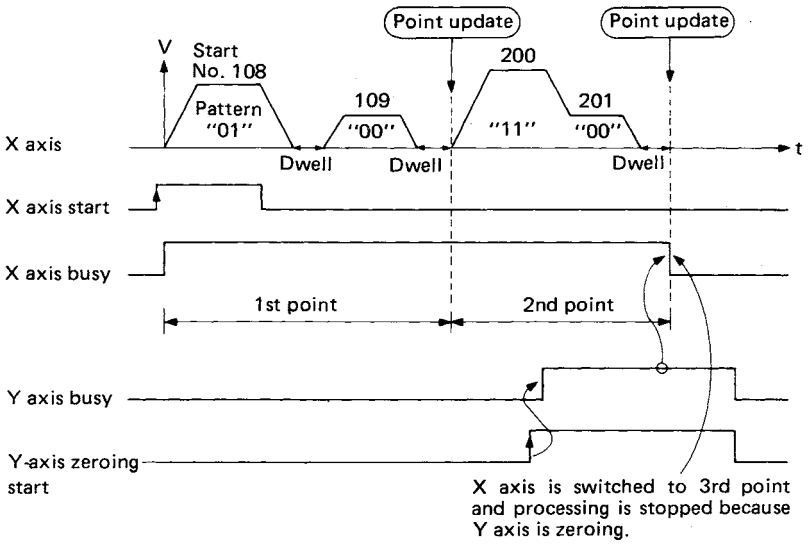
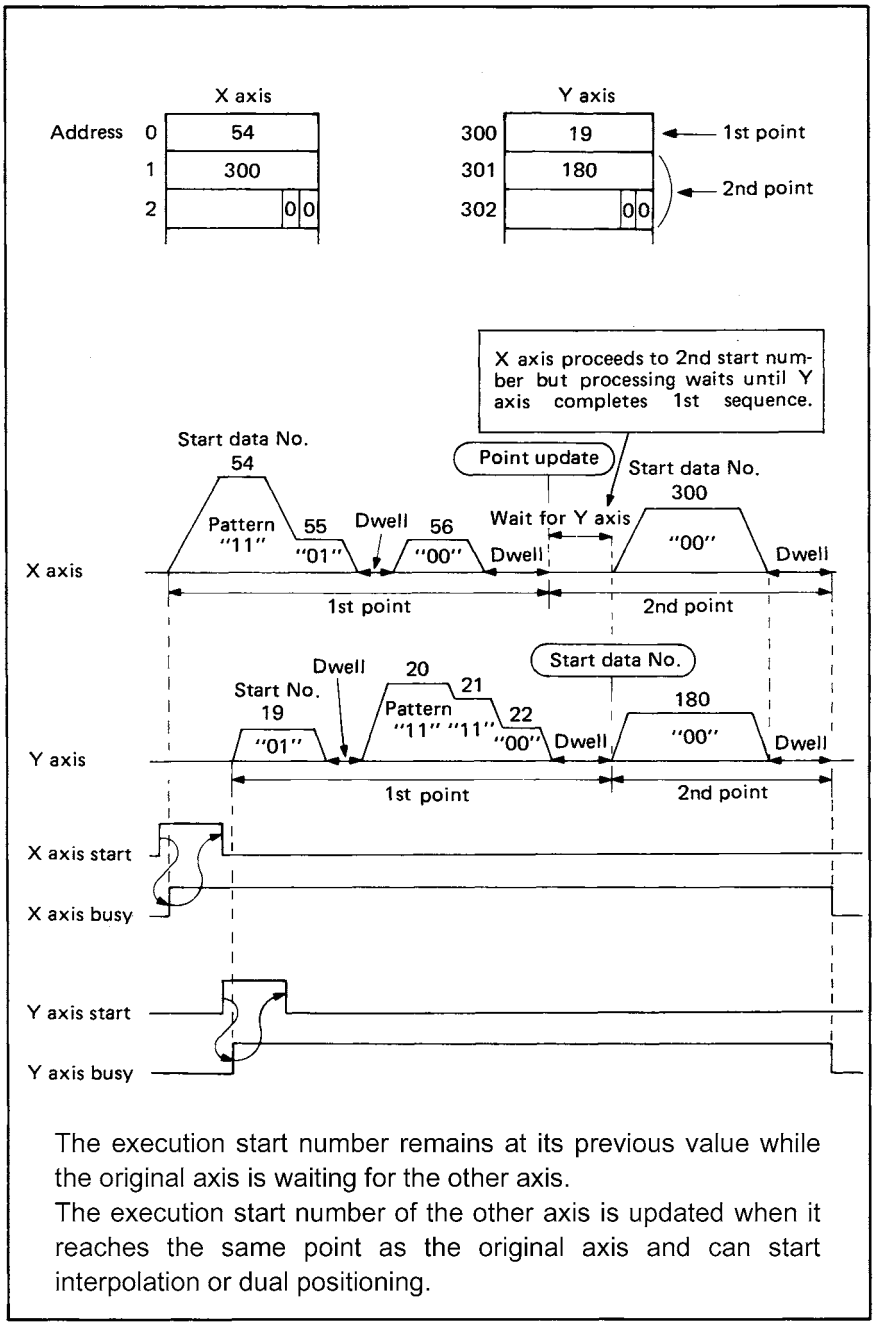


Fig. 3.29 Start Data Example 4

5) In a situation where interpolation (00) or independent (11) start has been defined at one axis and the other axis is still positioning, processing will vary as described below.

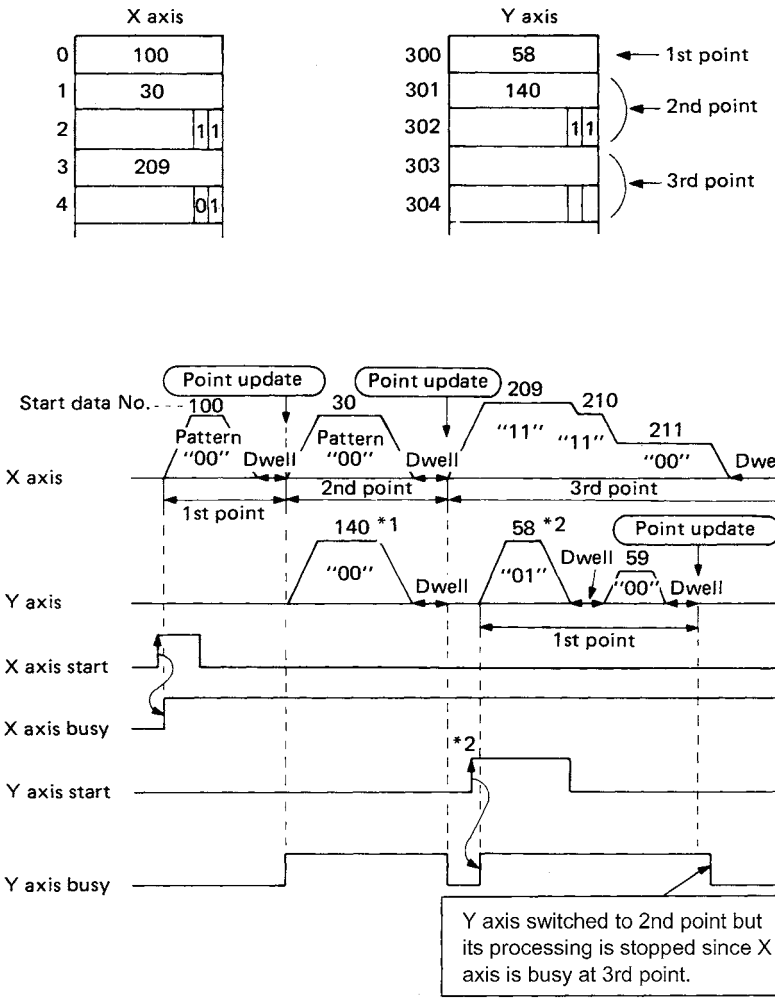
- An axis will wait for the other to finish its current process or for its busy signal to turn off. This is illustrated in Fig. 3.30 below.



The execution start number remains at its previous value while the original axis is waiting for the other axis.
The execution start number of the other axis is updated when it reaches the same point as the original axis and can start interpolation or dual positioning.

Fig. 3.30 Start Data Example 5

- Processing will stop if one axis proceeds ahead of the other and dual axis processing is called. See Fig. 3.31.



*1: As a dual axis start was specified for point 2 of the X axis, the Y axis starts at point 2 with data No. 140.

*2: After the X and Y axes have been dually started and positioned, the Y axis starts with data No. 58 under its start command during positioning of the X axis at point 3.

Fig. 3.31 Start Data Example 6

(2) Speed change area (X axis: address 40, Y axis: address 340)

To change the speed of traverse during positioning, jog operation or home positioning, write the new speeds to these addresses. (To be within the range shown in Table 3.7 page 3-25) This data overrides the speed set in the positioning data. Speed change is illustrated in Fig. 3.32 below.

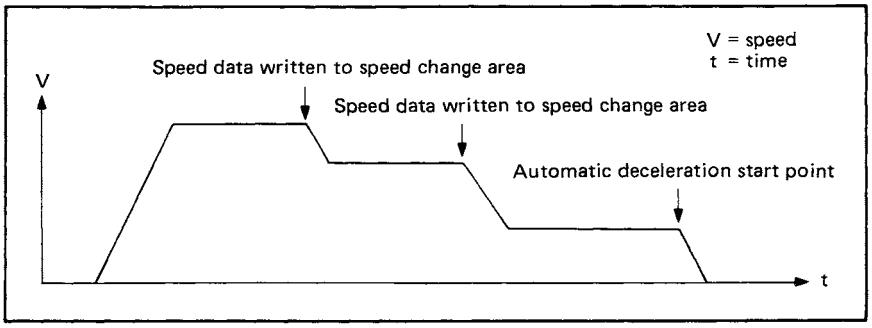


Fig. 3.32 Speed Change Example

POINT

Acceleration and deceleration cycles use the positioning data speed regardless of any forced speed change.
The speed cannot be force changed under the following circumstances:

- **after a deceleration start point;**
- **in inching mode;**
- **after a stop command or after the jog signal is turned off; or**
- **during interpolation positioning.**

(3) Present value change area (X axis: address 41, 42, Y axis: address 341, 342)

To change the present value data in the AD72, write the new value to these addresses.

POINT

The present value cannot be changed while the AD72 is BUSY.
Present value data is two words long, one word data cannot be written.

(4) Status area (X axis: address 43, Y axis: address 343)

Is reserved for the information shown in Fig. 3.33 and is set by the AD72 OS.

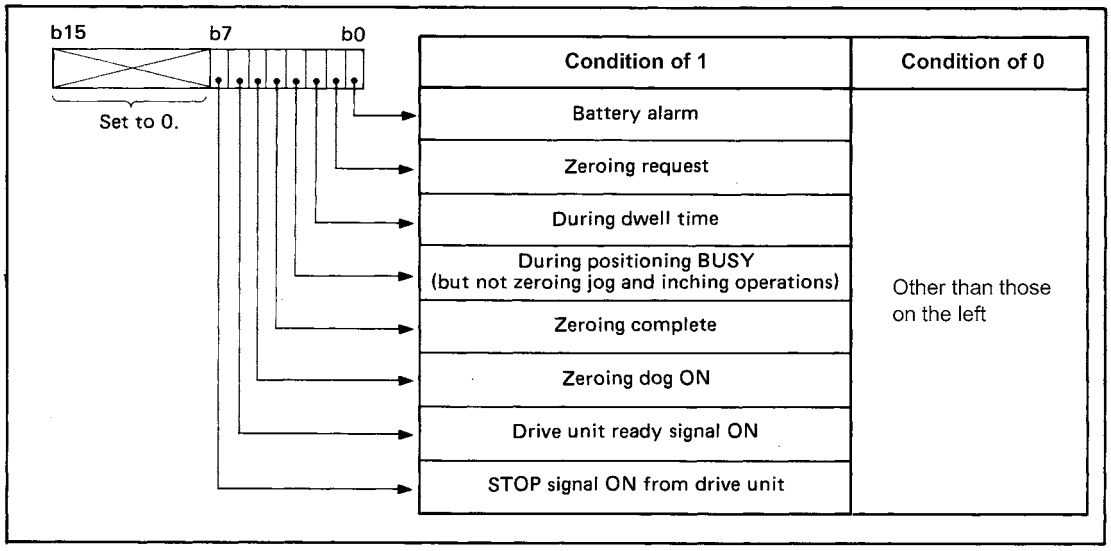


Fig. 3.33 Status Area

POINT

The status area is used by the AD72 OS and data must not be written here.

(5) Jog speed area (X axis: address 44, Y axis: address 344)

Specify the jog speed by writing speed data to these addresses. This data may be written at any time.
The jog speed data set at a jog start are valid.

(6) Error code area (X axis: address 45, Y axis: address 345)

The code number of any error detected by the AD72 is written to these addresses by the OS. Use in conjunction with the error detection signal (X1B).

POINT

- **The error code area is used by the AD72 OS and data must not be written here.**
- **The most recent error code is written to this area. The absence of any error is indicated by a "0" in this address.**
- **For error codes, refer to Chapter 8.**

(7) M code area (X axis: address 46, Y axis: address 346)

The "M code" specified in the positioning data being executed is set as shown in Fig. 3.34. The M code number can be used to coordinate external equipment and processes.

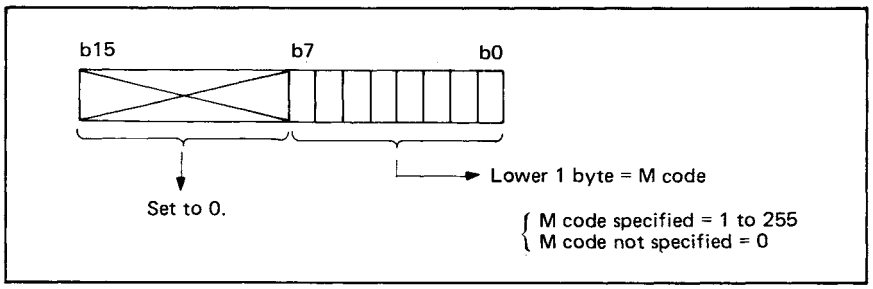


Fig. 3.34 M Code Area

POINT

- **The M code area is used by the AD72 OS and data must not be written here.**
- **For M code data timing details, refer to Section 3.4.1 (16).**

(8) Inching enable area (X axis: address 47, Y axis: address 347)

Enable the inching function by writing a 1 to the least significant bit in this address. This data may be written at any time.

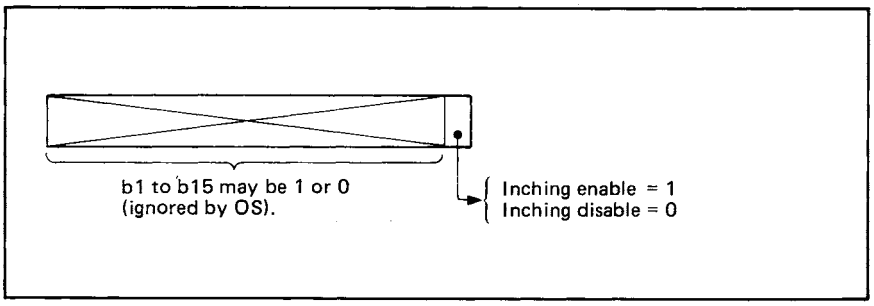


Fig. 3.35 Inching Enable

IB (NA) 66095-A

(9) Current data number (X axis: address 48, Y axis: address 348)

The number of the positioning data block currently being processed is written to these addresses by the OS. This number is retained until the next positioning operation begins. (Refer to Fig. 3.36.)

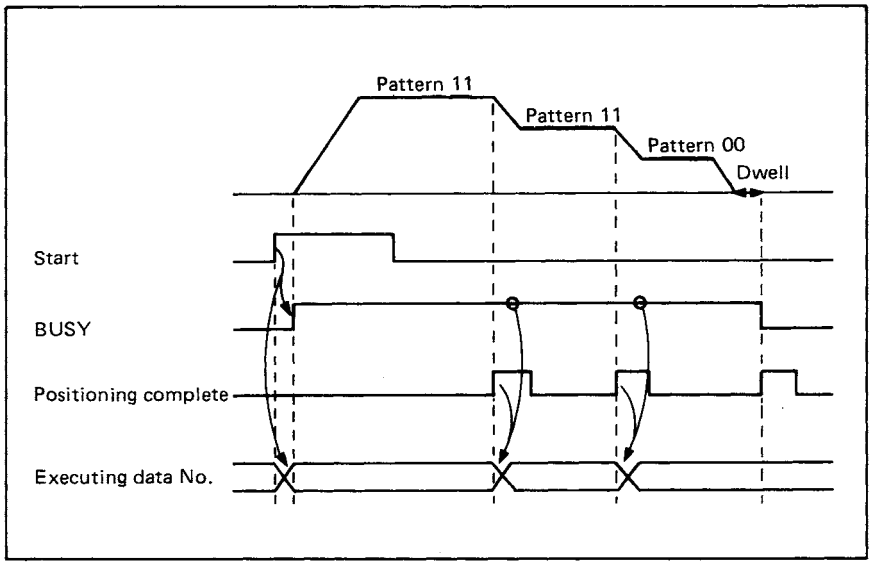


Fig. 3.36 Current Data No. Update Timing

POINT

The current data number area is used by the AD72 OS and data must not be written here.

(10) M code comment area (X axis: address 49 to 200, Y axis: 349 to 500)

Up to 16 ASCII characters may be entered as M code comment data (using the GPP or sequence program).
Comments may be written to M code numbers 1 to 19 for both X and Y axes.
For example, they can be used as described below.

1) Monitored on the GPP.
2) Read and displayed externally using the sequence program.

3.5.2 Error reset (Address 201)

The error codes for both axes can be reset by writing a 1 to the least significant bit of this address. This also resets the error detection signal X1B.
The OS then acknowledges that error signals have been reset by writing a 0 to this bit.

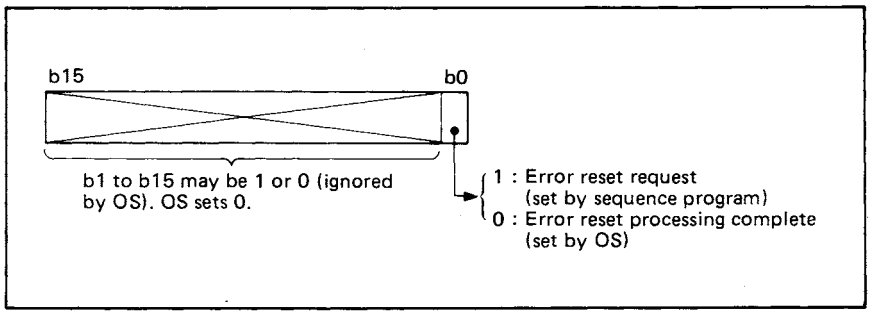
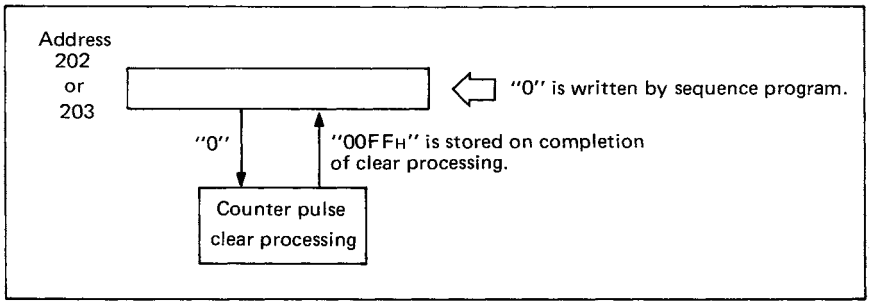


Fig. 3.37 Error Reset Area Details

3.5.3 Counter pulse clear (X axis: address 202, Y axis: address 203)

If the servo motor power is switched off during positioning due to an emergency stop, etc., counter pulses are cleared to stop the servo motor from rotating when the power is restored.

To clear pulses, write "0" to address 202 (for X axis) or 203 (for Y axis) with the sequence program. (Any value other than "0" is ignored.)
When pulses have been cleared, "00FFH" is automatically written to address 202 or 203.



POINT

(1) Zeroing must be performed after counter pulse clear.

The present value of the AD72 is controlled in accordance with the pulses transmitted to the deviation counter. Clearing counter pulses resets the deviation counter pulses to "0" and causes a position shift by the pulses cleared.

(2) The AD72 allowed for pulse clear is given in Section 3.2.3.

3.5.4 OS data (Address 600 to 607)

This data area is used by the OS.
The user cannot write data to this area.
The data shown in Fig. 3.38 can be read and used from the sequence program. (Refer to Section 6.3.2 for the reading method.)
The stored data are all binary values.

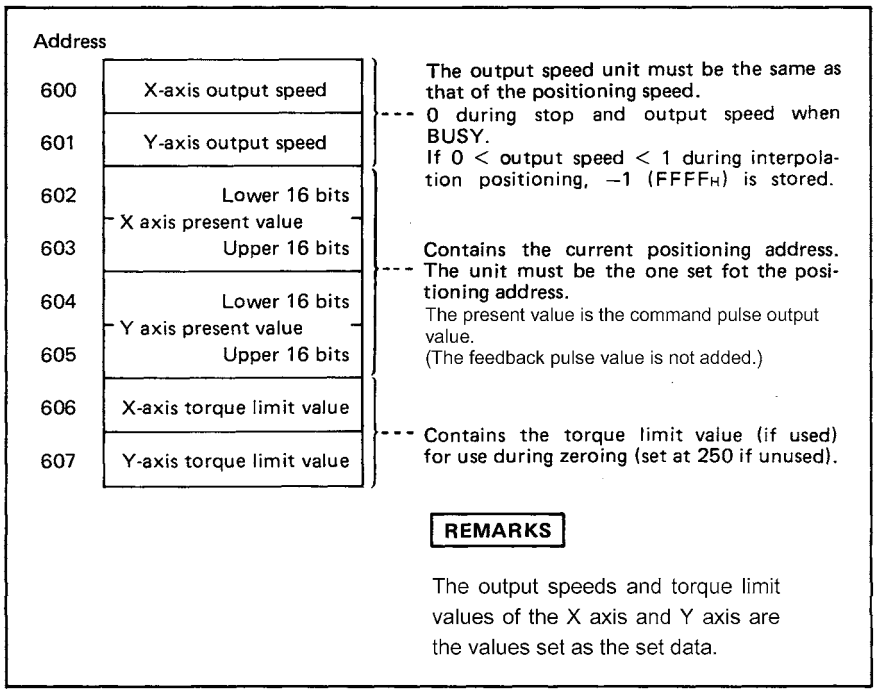


Fig. 3.38 Monitoring Data Area

3.5.5 Positioning data area (X axis: address 3872 to 5871, Y axis: address 5872 to 7871)

This area stores the positioning data explained in Section 3.4.3. The positioning data consists of positioning information, positioning speed, dwell time, and positioning address as shown in Fig. 3.39. For the conversion of expressions from a data number to a buffer memory address, refer to the next page.
As an example, for X axis data number = 2, data is stored in the following areas:

Positioning information : Address = 3873
Positioning speed : Address = 4273
Dwell time : Address = 4673
Positioning address : Address = 5074 (lower 16 bits), 5075 (upper 16 bits)

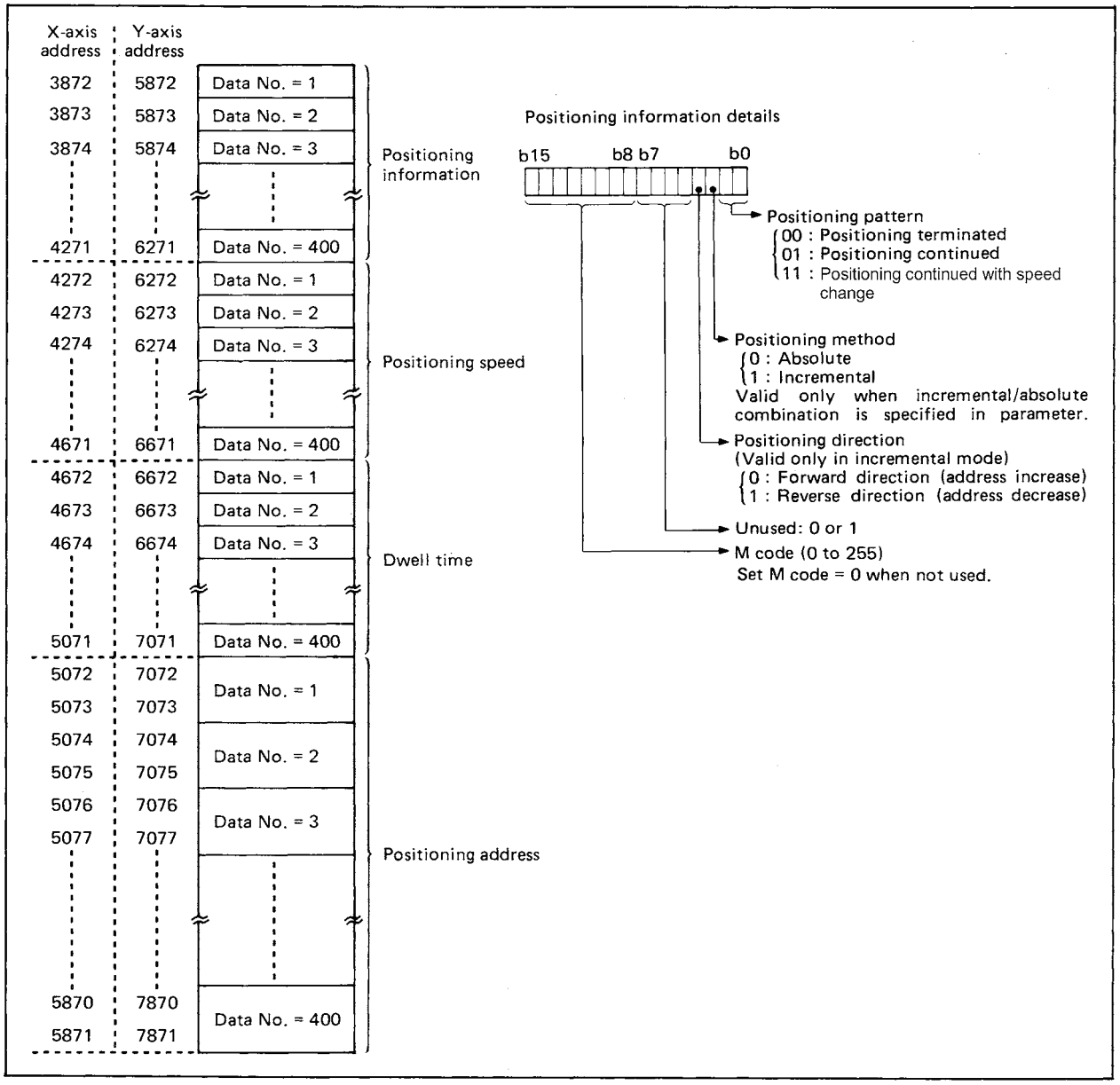


Fig. 3.39 Positioning Data Area

Conversion from data number to buffer memory address

When setting the data number-based positioning data from the sequence program, convert the data number into the buffer memory address with the following expression.

Conversion from data number to buffer memory address

	X Axis	Y Axis
Positioning information	A=3872+(data No.−1) or A=3871+(data No.	A=5872+(data No.−1) or A=5871+(data No.)
Positioning speed	A=4272+(data No.−1) or A=4271+(data No.	A=6272+(data No.−1) or A=6271+(data No.)
Dwell time	A=4672+(data No.−1) or A=4671+(data No.	A=6672+(data No.−1) or A=6671+(data No.)
Positioning address	Lower 16 bits A_2=5072+(data No.−1)x2 or A_2=5070+(data No.)x2	Lower 16 bits A_2=7072+(data No.−1)x2 or A_2=7070+(data No.)x2
	Upper 16 bits $A_1=A_2+1$	Upper 16 bits $A_1=A_2+1$

REMARKS

A conversion table is given in Appendix 2.

3.5.6 Parameter area (X axis: address 7872 to 7887, Y axis: address 7892 to 7907)

Stores the parameters described in Section 3.4.1.
Refer to Fig. 3.40 for details of the parameter area.

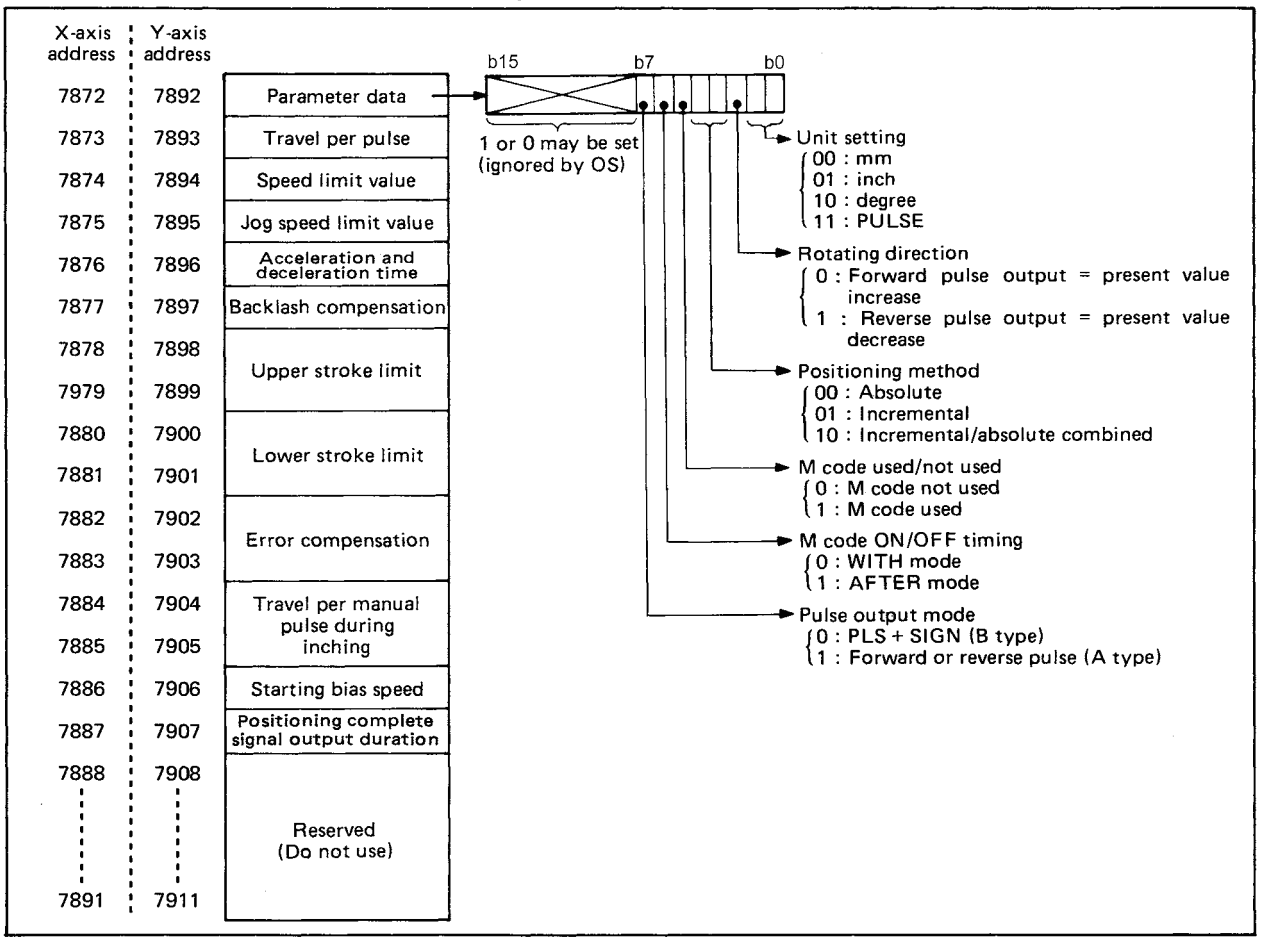


Fig. 3.40 Parameter Area

3.5.7 Zeroing data area (X axis: address 7912 to 7918, Y axis: address 7922 to 7928)

Stores zeroing data described in Section 3.4.2.
Refer to Fig. 3.41 for details of the zeroing data area.

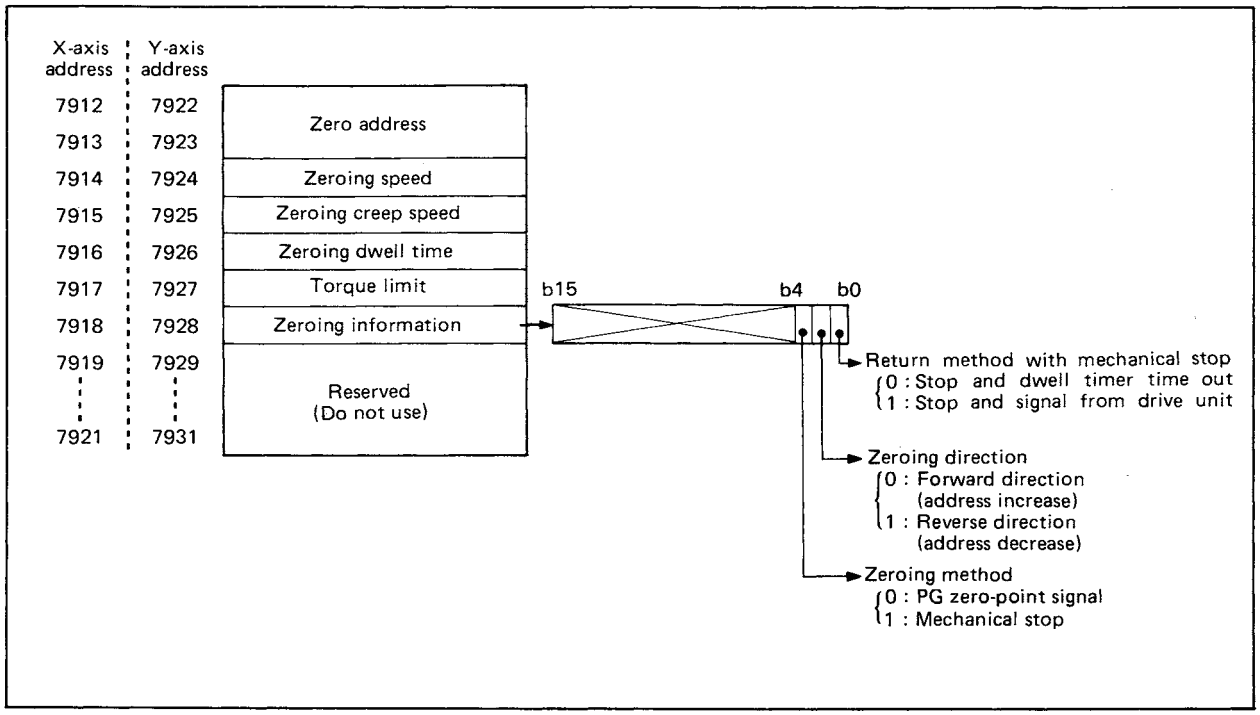


Fig. 3.41 Zeroing Data Area

3.6 I/O Signals To and From PC CPU

The AD72 uses 18 inputs and 16 outputs for non-numerical communications with the PC CPU. I/O signal assignment and functions are given below.
Table 3.9 shows I/O signals with the AD72 in slots 0 and 1 of the main base unit.
Device X indicates an input signal from the AD72 to the PC CPU.
Device Y indicates an output signal from the PC CPU to the AD72.

Signal Direction: AD72 to PC CPU			Signal Direction: PC CPU to AD72		
Device No.	Signal		Device No.	Signal	
X0 to XF	Reserved		Y0 to YF	Not used (may be used as internal relays (M).)	
			Y10 to Y1F	Reserved	
X10	Watch dog timer error (detected by AD72)		Y20	X axis	Positioning start
X11	AD72 ready		Y21	Y axis	
X12	X axis	Positioning complete	Y22	Inter-polation	
X13	Y axis		Y23	X axis	Zeroing start
X14	X axis	BUSY	Y24	Y axis	
X15	Y axis		Y25	X axis	Stop
X16	X axis	Zeroing request	Y26	Y axis	
X17	Y axis		Y27	X axis	Forward jog start
X18	X axis	Positioning commenced	Y28	X axis	Reverse jog start
X19	Y axis		Y29	Y axis	Forward jog start
X1A	Battery error		Y2A	Y axis	Reverse jog start
X1B	Error detection		Y2B	X axis	M code OFF
X1C	X axis	Zeroing complete	Y2C	Y axis	
X1D	Y axis		Y2D	PC ready	
X1E	X axis	M code ON	Y2E	} Reserved.	
X1F	Y axis		Y2F		
X20	X axis in-position				
X21	Y axis in-position				
X22	X axis error excessive error detection				
X23	Y axis error excessive error detection				
X24 to X2F	Reserved				

Table 3.9 I/O Signal List

IMPORTANT

Y2E, Y2F, and Y10 to Y1F are reserved for use by the OS or for special applications which are detailed later.
If the above devices are used (turned on/off) from the sequence program, we cannot guarantee the normal functions of the AD72. (However, only when the AD72 is mounted on a remote I/O station, Y1D to Y1F must be turned off in the user program. Refer to Section 6.4 for details.)

POINT

When the AD72 is mounted on a remote I/O station, the in-position signals X20, X21 and error excessive error detection signals X22, X23 are unavailable.

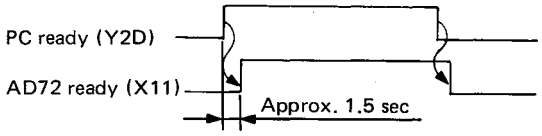
Details of I/O signals
The on/off timings, conditions and others of the I/O signals will be explained. The device numbers in the parentheses correspond to those in Table 3.9.
I/O signal details (See Fig. 3.42 to 3.45.)

(1) Watch dog timer error (X10)

Switches on when the AD72 self-diagnostics detect a watch dog timer error.

(2) AD72 ready (X11)

Changes state according to the PC ready signal (Y2D). Used for interlocking, etc. in the sequence program.



(3) Positioning complete (X12, X13)

Switches on for a period set in the parameters (Table 3.5, page 3-10, item 12) after each position is reached. (Ignored if the positioning complete signal output time = 0.)
Switched off at positioning start, zeroing start, inching start, jog start, and power on.
If positioning is stopped midway, the positioning complete signal does not switch on.

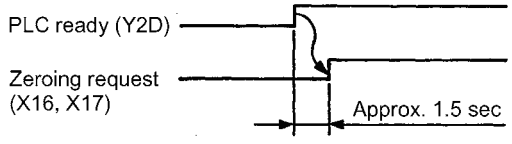
(4) BUSY (X14, X15)

Switches on at positioning start, zeroing start, inching start, and jog start. Switches off after pulse output and dwell time have elapsed. (Refer to Fig. 3.42 to 3.45.) (Remains on during positioning.)
Switches on while the test function is being used on the GPP.

(5) Zeroing request (X16, X17)

Switches on under the following conditions. Switches off upon completion of zeroing.

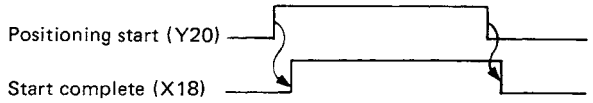
AD72 power is switched on;
Drive unit ready signal (READY) has turned off in BUSY state;
PC ready signal (Y2D) has turned on;



Parameters and/or zeroing data has been written from the GPP;
Zeroing is started; or
1) zeroing, 2) positioning, 3) jog operation, or 4) inching has been selected in GPP or TU test mode.

(6) Positioning commenced (X18, X19)

Switches on to confirm that the AD72 has started the specified operation. Switches off when the start signal turns off.



Does not switch on in GPP or TU test mode.

(7) Battery error (X1A)

Switches on when battery voltage drops.

(8) Error detection (X1B)

Switched on by any of the errors in Chapter 8. Switched off when the error is reset. For resetting, refer to Section 3.6.2 (page 3-45).

(9) Zeroing complete (X1C, X1D)

Switches on to indicate the completion of zeroing. Switched off at the start of the next process.

(10) M code ON (X1E, X1F)

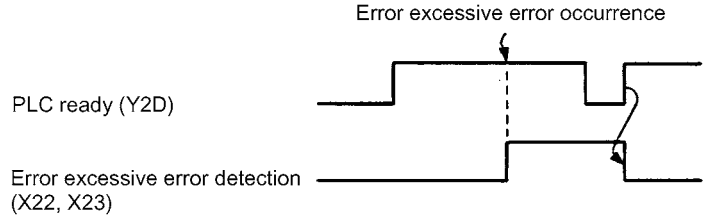
The ON timing for this signal depends on the parameter setting (see Table 3.5, page 3-10, item 16). If set in WITH mode, the "M code ON" signal is given at the start of positioning, if set in AFTER mode it is given after positioning is complete. Switched off by the "M code OFF" signal. Remains off when the M code is not used (M code = 0) or in test mode using the GPP or TU.
For further details, refer to Section 3.5.1 (16) (page 3-16).

(11) In-position (X20, X21)

Indicates that the work is within a defined range from the target position. For further details refer to Section 4.4.1.

(12) Error excessive error detection (X22, X23)

Switches on when the pulse value exceeds the set value, resulting in an error excessive error (EEX. error).
Switch Y2D off and then on to reset the error excessive error and turn off X22, X23.



Refer to Section 3.2.2 for the AD72 that can detect an error excessive error using X22, X23.

(13) Positioning start (Y20, Y21, Y22)

The leading edges of the pulses cause the operations to start as shown in Table 3.9.

(14) Zeroing start (Y23, Y24)

The leading edges of the pulses cause the operations to start as shown in Table 3.9.

(15) Stop (Y25, Y26)

Terminates the current operation. (If the BUSY signal is on, the "M code ON" signal turns off.)
For restarting the operation see Section 6.3.9.
When this signal is switched on with the BUSY signal on, X14 and X15 switch off after the motor is brought to a stop, X1B switches on (during zeroing only), X1E and X1F switch off, and any other signals remain unchanged.

(16) Jog start (Y27 to Y2A)

The motor is driven for as long as the jog start signal is on. When it is switched off the motor is ramped down to a halt.

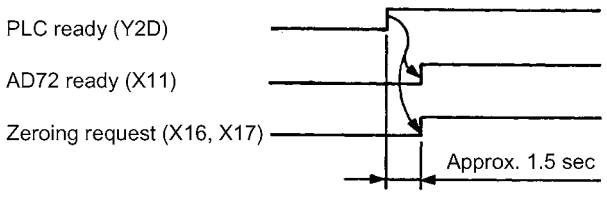
(17) M code OFF (Y2B, Y2C)

The leading edge of this signal switches the "M code ON" signal off.

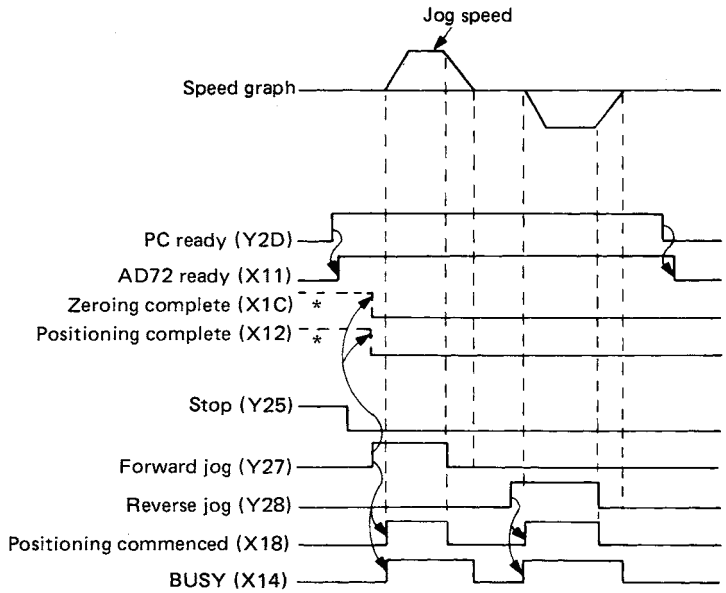
(18) PC ready (Y2D)

Indicates correct PC CPU operation. At the start of all positioning operations (other than those carried out in GPP or TU test mode) this signal must be on.
To write parameters and zeroing data, this signal must be off.(For details, see Fig. 3.22 (Section 3.5).)
The following control actions occur when the PC ready signal switches from off to on. (Also applies for GPP or TU test mode when neither axis is BUSY.)

1) Parameter check and initialization;
2) Zeroing data check; and
3) Zeroing request ON, AD72 ready signal ON
4) Error excessive error clear



Switching the PC ready signal off while the AD72 is BUSY causes positioning to stop, and the "M code ON" signal to be disabled as well as the M code to be cleared. (Not for GPP or TU test mode)



*: If the signal marked * is already on before the forward/reverse jog signal turns on, the signal marked * turns off when the forward/reverse jog signal turns on.

Fig. 3.42 I/O Signal ON/OFF Timing during Jog Operation

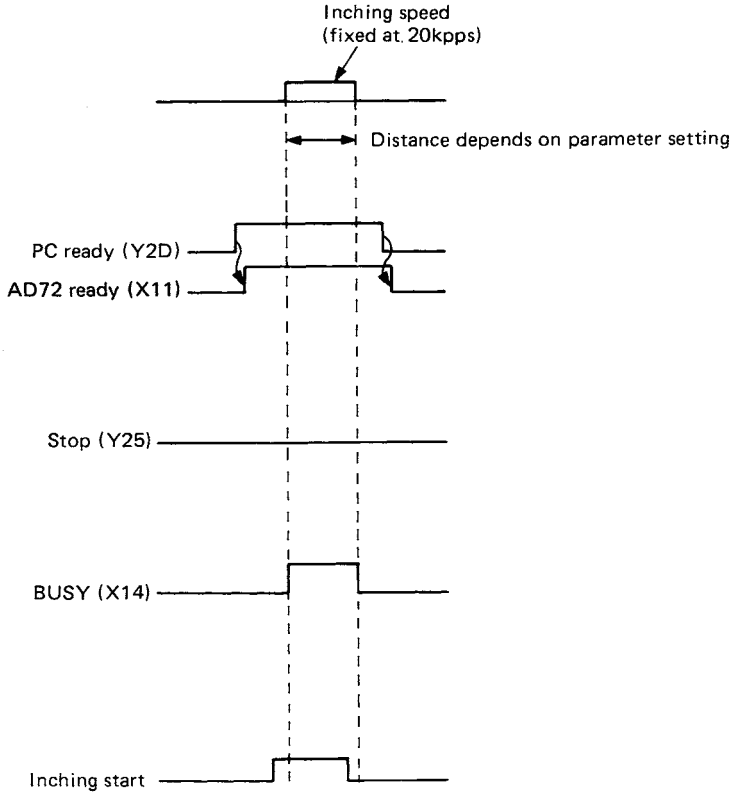


Fig. 3.43 I/O Signal ON/OFF Timing during Inching Operation

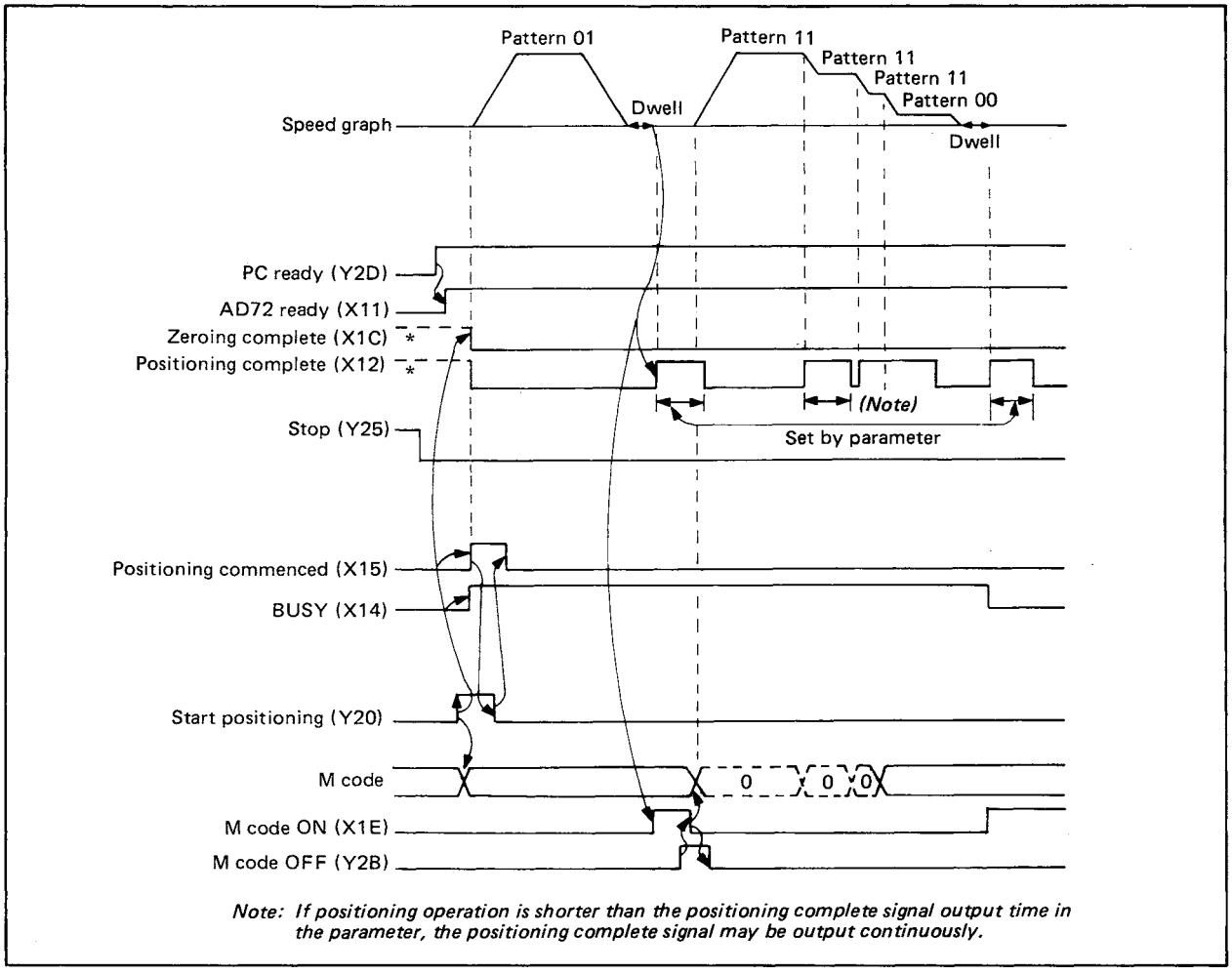


Fig. 3.44 I/O Signal ON/OFF Timing during Positioning Operation

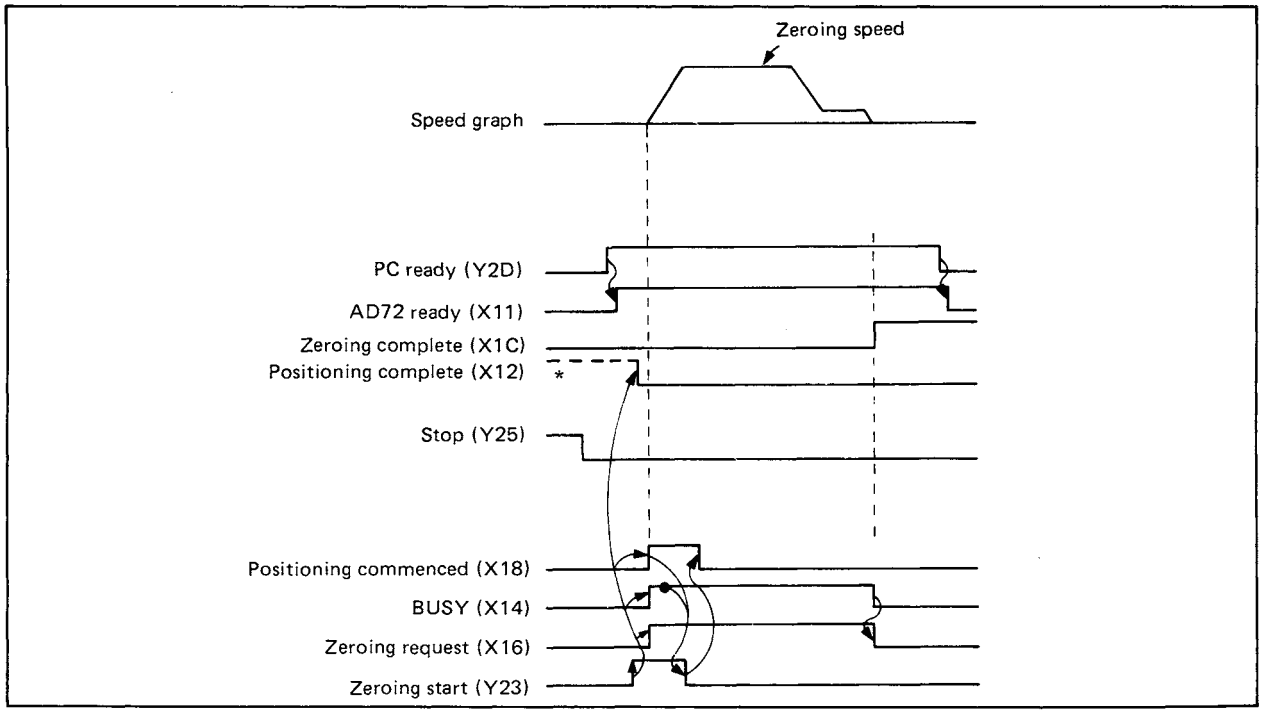


Fig. 3.45 I/O Signal ON/OFF Timing during Zeroing Operation

*: If the signal marked * is already on before the positioning start signal turns on, the signal marked * turns off when the positioning start signal turns on.

3.7 I/O Interface with External Equipment

3.7.1 AD72 electrical specifications

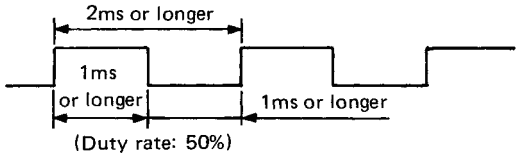
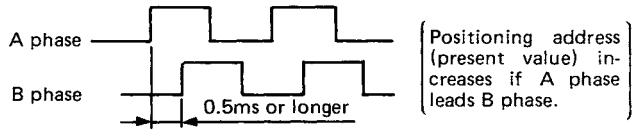
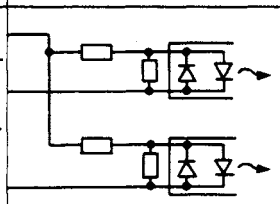
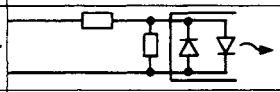
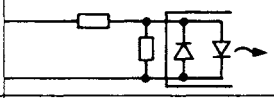
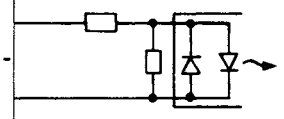
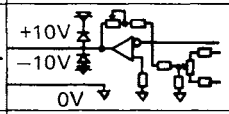
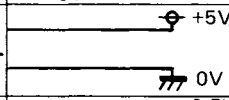
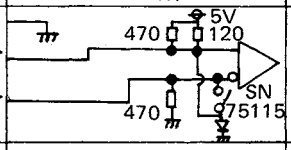
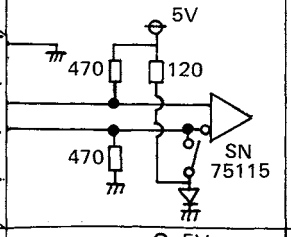
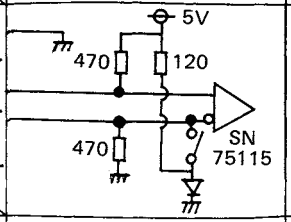
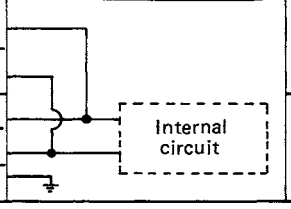
I/O	Signal		Description
Input	Supply	CONT. connector (Pin 1)	5 to 24V DC (Use a 4.75 to 26.4V stabilized power supply.) Current consumption: 10mA maximum Used for AD72 control signals
		Terminal block	5V DC (Use a 4.75 to 5.25V stabilized power supply.) Current consumption: 1.0A maximum + encoder current consumption (Max. 0.6A as a total of X axis and Y axis) Used for D to A converters and encoder
	Drive unit ready ($\overline{\text{READY}}$) Stop signal ($\overline{\text{STOP}}$) Zeroing dog signal ($\overline{\text{DOG}}$)		High : (Supply power voltage − 1V) min. (Input current: 0.3mA max.) Low : (Supply power voltage − 3V) max. (Input current: 2.5mA min.)
	Inching A phase ($\overline{\text{PULSER A}}$) Inching B phase ($\overline{\text{PULSER B}}$)		Input voltage : 5V DC $^{+20\%}_{-10\%}$ High : 4.5V or more, 3mA or more Low : 1.0V or less, 0mA Pulse width :  (Duty rate: 50%) Phase difference:  Inuput pulse rise, fall time : 500μs max.
	(Open collector, TTL) Phase A feedback pulse ($\overline{\text{PULSE A}}$) Phase B feedback pulse ($\overline{\text{PULSE B}}$) Phase Z feedback pulse ($\overline{\text{PULSE Z}}$)		Pulse frequency : 50KPPS max. (pulse width: 20μs min.) Pulse rise time : 0.5μs max. Pulse fall time : 0.5μs max. High : 2.7V min. Low : 0.8V max.
	(Differential output) Phase A feedback pulse (PULSE A) Phase B feedback pulse (PULSE B) Phase Z feedback pulse (PULSE Z)		Pulse frequency : 50KPPS max. (pulse width: 20μs min.) Pulse rise time : 0.5μs max. Pulse fall time : 0.5μs max. (Use the liner driver SN75113 or equivalent as the connection target.)
Output	Servo ON (SVON)		Output form : Open collector Load voltage : 4.75 to 26.4V DC Load current : 10mA max. Maximum voltage drop when ON : 1.0V max. Leakage current when OFF : 0.1mA max.
	Speed command (analog signal)		Output voltage : 0 to ±10V DC (10mA)
	Encoder power supply		Output voltage : 5V DC (Supplied from terminal block)

Table 3.10 AD72 Electrical Specifications

3.7.2 I/O interface electrical details

Connector	I/O	Pin Number X axis	Pin Number Y axis	Internal Circuit	Signal	Description
CONT	Input	1	1		Power supply	5V to 24V DC
		2	2		Stop signal $\overline{\text{STOP}}$	(1) Low to stop positioning. Signal duration ≧ 20ms. (2) This signal causes the AD72 to stop positioning and turn off the start signal (START).
		3	3		Near-point signal $\overline{\text{DOG}}$	(1) Used to detect the actuator or "zeroing dog" during zeroing. Low when zeroing dog signal is on. (2) During zeroing using the zero-point signal, the zero point leaves the near-point dog after the dog is detected, and changes into the first grid point. The grid point is at resolver phase angle 0.
		4	4		Manual pulser A phase $\overline{\text{PULSER A}}$	Signal described in Table 3.10
		5	5			
		6	6		Manual pulser B phase $\overline{\text{PULSER B}}$	Signal described in Table 3.10
		7	7			
SERVO	Input	3	3		Drive unit ready $\overline{\text{READY}}$	(1) Turns on when the servo drive unit is normal and can accept feed pulses. (2) When started, the AD72 checks the drive unit ready signal, and outputs a zeroing request when the drive unit is not ready. (3) Turn this signal off when the drive unit becomes inoperative, for example when the control power supply or similar device becomes faulty. (4) Positioning stops when this signal is turned off during positioning. If it is turned on again, positioning will not start unless restarted.
		4	4			
	Output	1	1		Servo on $\overline{\text{SVON}}$	Any self-check error or excess pulse count error will cause this signal to switch OFF.
		2	2			
		5	5		Speed command	Analog output.
		6	6			
ENCO	Output	1	1		Encoder power supply	5V DC, max. 600mA.
		2	2			
	Input	3	3		A phase feedback pulse PULSE A	Connect to encoder A phase pulse output.
		4	4			
		5	5			
		6	6		B phase feedback pulse PULSE B	Connect to encoder B phase pulse output.
		7	7			
		8	8			
		9	9		Z phase feedback pulse PULSE Z	Connect to encoder 2-phase pulse output. Used as a zero-point signal during zeroing.
		10	10			
		11	11			
	Output	1	1		Encoder power supply	Used as the encoder power.
		2	2			
Terminal block	Input	5V DC				±10V power for speed command and +5V power for encoder. 5V ± 5%
		5G DC				
		FG2				

3.8 Battery Specifications

Table 3.11 provides the specifications of the battery used in the AD72.

Item \ Type	A6BAT
Classification	Thionyl chloride lithium battery
Nominal voltage	3.6V DC
Guarantee period	5 years
Total power failure time	300 days (7200 hours)
Application	Power failure back-up for buffer memory
Size (mm)	16 diameter x 30 length

Table 3.11 Battery Specifications

MEMO

4. HANDLING

4.1 Handling Instructions

This chapter explains the part names of the AD72 and how to handle it (especially before installing it)

(1) The module casing is made of plastic. Protect it from mechanical shock and vibration.

(2) Keep conductive debris, such as wiring off-cuts and drill chips, out of the module.

(3) Power off the PLC before mounting or dismounting the module to or from the base. Refer to Section 5.3 for the mounting or dismounting of the module.

(4) Power off the PLC and drive unit before connecting or disconnecting the drive unit connector.
As the connector has a specific orientation, confirm it and insert the connector straight from the front.
After connecting it, completely tighten the two fixing screws.
When the drive unit is not connected, be sure to cover the connector.

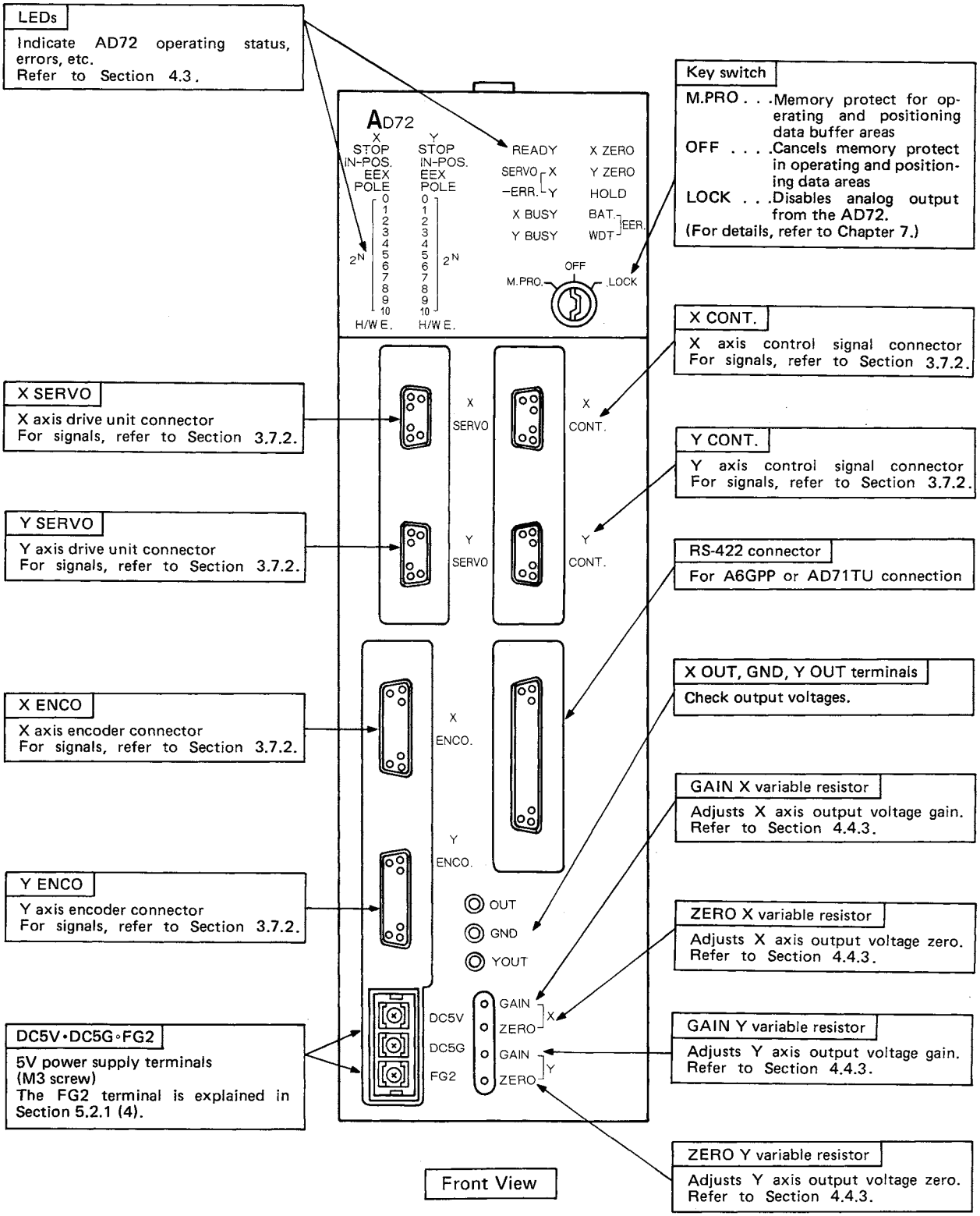
(5) Do not connect the GPP or TU to the AD72 when the AD72 is busy.
As the connector has a specific orientation, confirm it and insert the connector straight from the front.
After connecting it, completely tighten the two fixing screws.
When the GPP or TU is not connected, be sure to cover the connector.

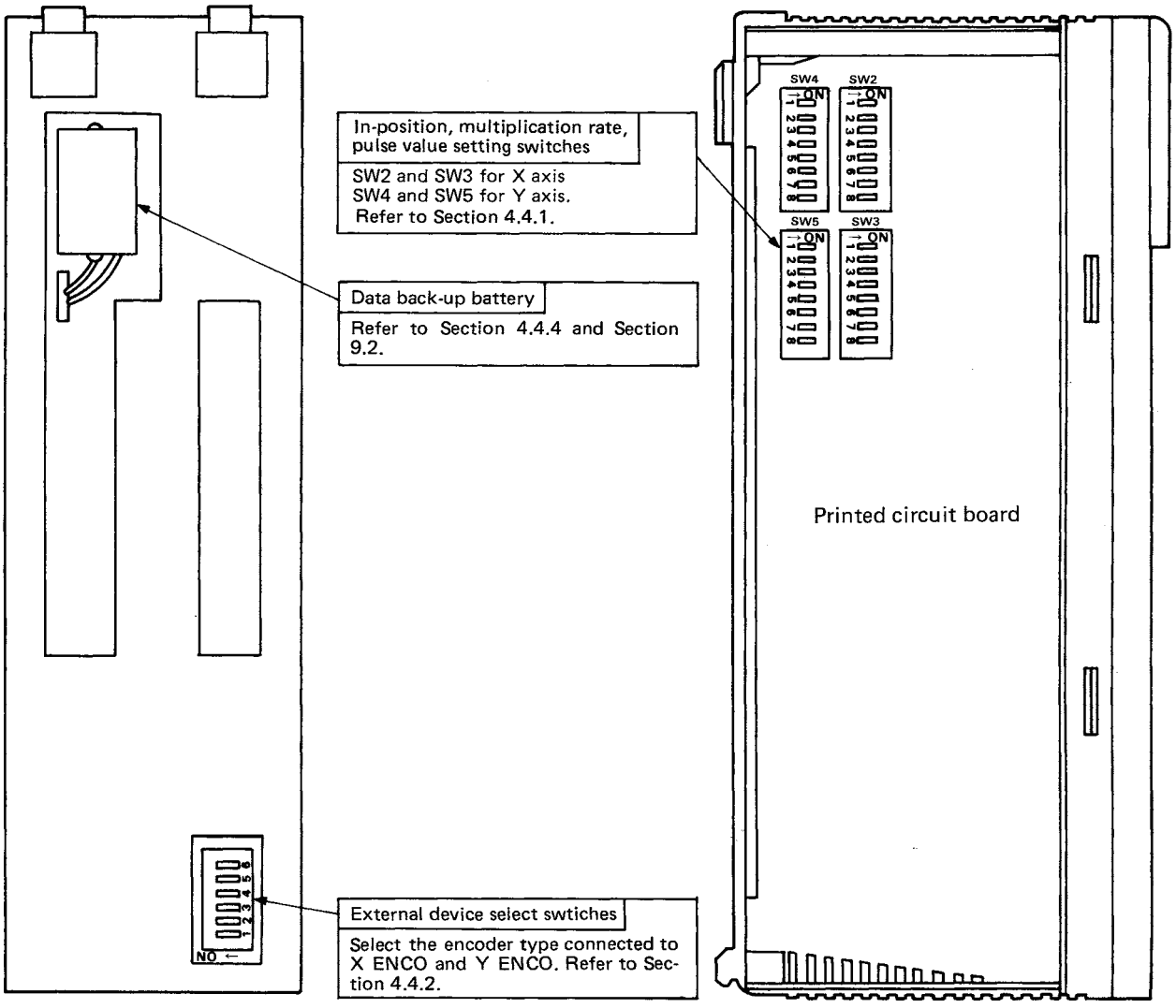
IMPORTANT

While 5VDC is supplied to the AD72 terminal block, the analog voltage (speed command) to the servo amplifier is output if the PLC is powered off. The analog voltage will be maintained at the level provided when the PLC was powered off.
When the PLC is powered off, the servo-on signal of the AD72 is also turned off.
Therefore, when the servo amplifier can use the servo-on signal to stop control, be sure to connect the servo-on signals of the AD72 and servo amplifier.
When the servo amplifier cannot use the servo-on signal to stop control, take either of the following actions.

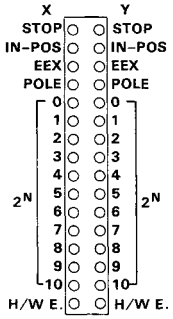
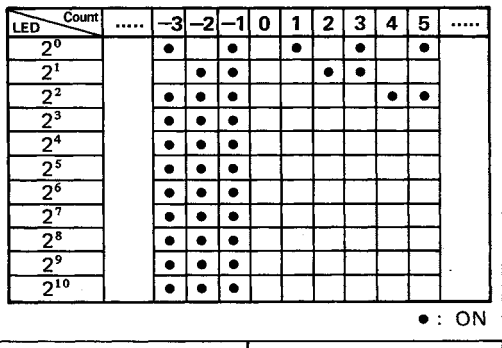
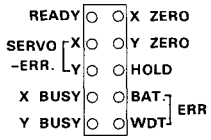
- **Be sure to power off the PLC when the analog voltage is 0V (when the motor is at a stop).**
- **Create an external circuit that will switch off 5VDC when the PLC is switched off.**

4.2 Nomenclature




In-position, multiplication rate, pulse value setting switches
SW2 and SW3 for X axis
SW4 and SW5 for Y axis.
Refer to Section 4.4.1.
Data back-up battery
Refer to Section 4.4.4 and Section 9.2.
External device select swtiches
Select the encoder type connected to X ENCO and Y ENCO. Refer to Section 4.4.2.
SW4
SW2
SW5
SW3
ON
NO
Printed circuit board
Rear View
Side View

4.3 LED Indications

LEDs	Name	Indication	ON Condition	OFF Condition	Initial State
	STOP	Indicates stop signal state.	Stop signal ON	Stop signal OFF	OFF
	IN-POS.	Indicates in-position state.	In in-position range	Out of in-position range	ON
	EEX	Indicates counter pulse state (excessive error).	The number of pulses is larger than the gain value.	The number of pulses is smaller than the gain value.	OFF
	POLE	Indicates deviation counter polarity.	Positive	Negative	OFF
	2^0	Indicates deviation counter value. *			OFF
	2^1				
	2^2				
	2^3				
	2^4				
	2^5				
	2^6				
	2^7				
	2^8				
	2^9				
	2^{10}				
	H/WE.	Indicates AD72 hardware status.	Fault	Normal	OFF
	READY	Indicates AD72 ready state.	PC ready signal (Y2D) ON	PC ready signal (Y2D) OFF	OFF
	SERVO-ERR. X	Indicates READY signal state in the driver connected to the X SERVO connector.	READY signal OFF	READY signal ON	ON/ OFF
	SERVO-ERR. Y	Indicates READY signal state in the driver connected to the Y SERVO connector.	READY signal OFF	READY signal ON	ON/ OFF
	X BUSY	Indicates X axis busy state.	Busy	Not busy	OFF
	Y BUSY	Indicates Y axis busy state.	Busy	Not busy	OFF
	X ZERO	Indicates X axis zero point return request state.	Request ON	Request OFF	ON
	Y ZERO	Indicates Y axis zero point return request state.	Request ON	Request OFF	ON
	HOLD	Indicates AD72 hardware status. Refer to chapter 8 for HOLD error information.	Error	Normal	OFF
	BAT. ERR	Indicates battery voltage state.	Error	Normal	OFF
	WDT ERR	Indicates AD72 watch dog timer status. Refer to chapter 8 for WDT error information.	Error	Normal	OFF

* When 12 bits, 13 bits or 14 bits are selected in gain setting (refer to Section 4.4.1), only the upper 11 bits of each binary indication are displayed.

REMARKS

The EEX LED is lit when:

The pulse value exceeds the allowed range (see Section 4,4,1 (3)); or
The acceleration/deceleration time setting is too short for the parameters and drive unit used.

When the EEX LED turns on,

The output voltage changes to 0V;
The pulse value is reset to 0; and
The "servo on" signal switches off.
The input signals X22, X22 of the AD72 turn on.

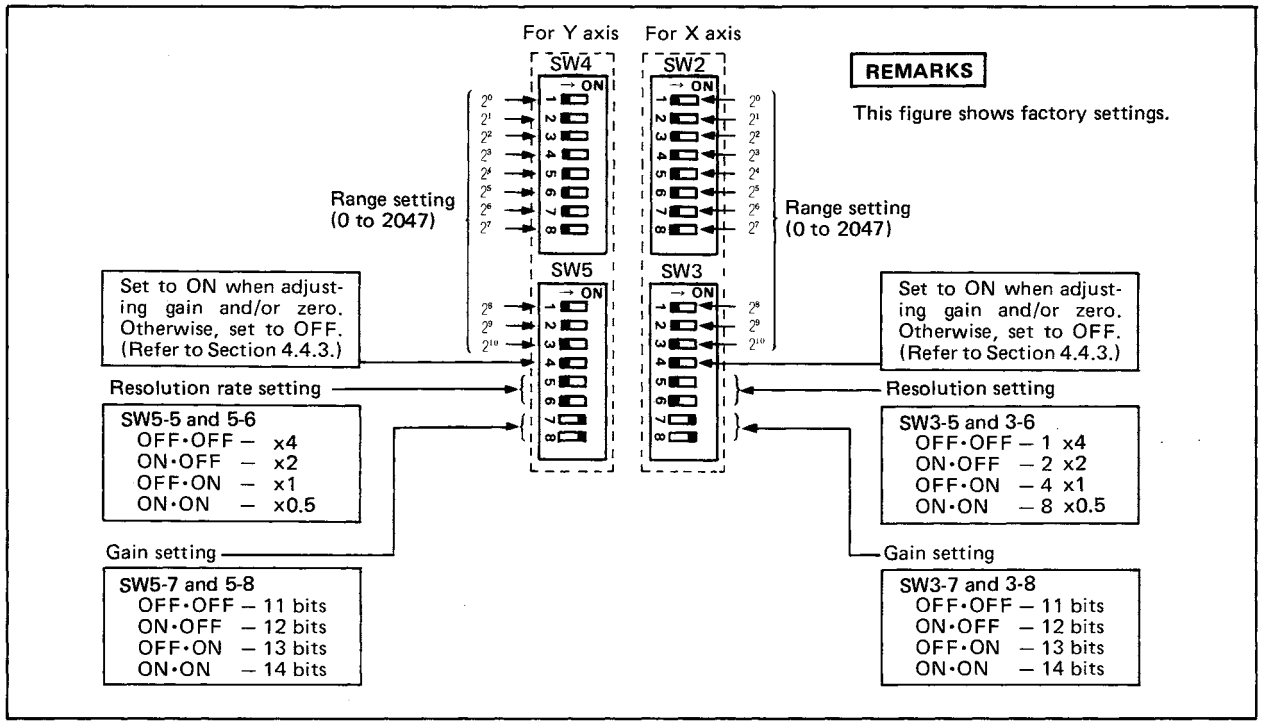
To turn off the EEX LED. switch Y2D off and then on.

4.4 Settings

This section explains the AD72 slide switches, potentiometers and battery connection method.

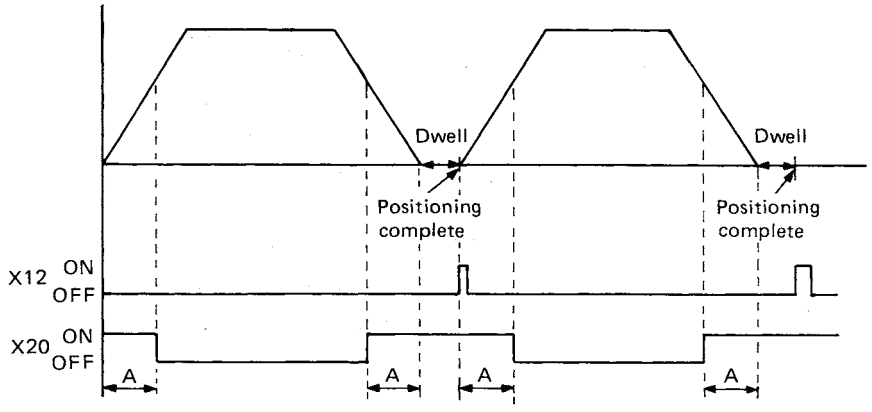
4.4.1 In-position, resolution and pulse value setting switches

This section explains how to set the in-position range setting, resolution and pulse value setting switches of the AD72.



(1) In-position range

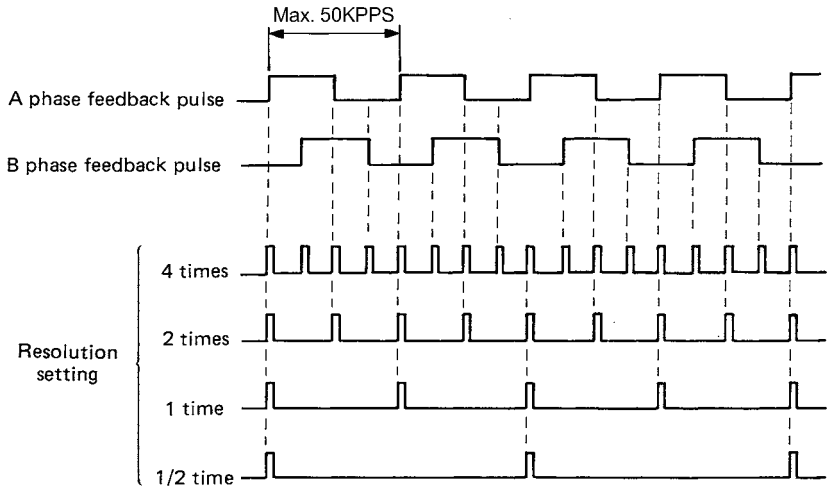
X20 and X21 are used as flags to indicate when the X and Y axes (respectively) count values are within a specified range on either side of the target position. The range may be set from 0 to ±2047 pulses on either side of each target position. The "in-position range" flag may be used as indicated below:



A: In-position setting range

(2) Resolution setting

The positioning resolution may be increased by providing a multiplication factor for the feedback pulse train. The multiplication factor may be set as 4, 2, 1 or 0.5 (reduced resolution). These settings will correspond to 1/4, 1/2, 1 or 2 times the distance travelled per feedback pulse as illustrated below:



(3) Counter pulse value

The pulse value switches specify the maximum pulse value which is expressed as follows:

The maximum pulse value represented by the following expression is generated during servo motor operation.

$$\text{Maximum pulse value} = \frac{\text{speed command [PPS]}}{\text{position loop gain [sec}^{-1}\text{]}}$$

Position loop gain is generally between 20 and 30.

If this maximum pulse value is exceeded, the appropriate (X or Y) EEX LED is lit.
Set the maximum pulse value within the following range:

- 0 to 2047 pulses with 11 bits selected
- 0 to 4000 pulses with 12 bits selected
- 0 to 8000 pulses with 13 bits selected
- 0 to 16000 pulses with 14 bits selected

Pulse value against analog output characteristics are illustrated in Fig. 4.1.

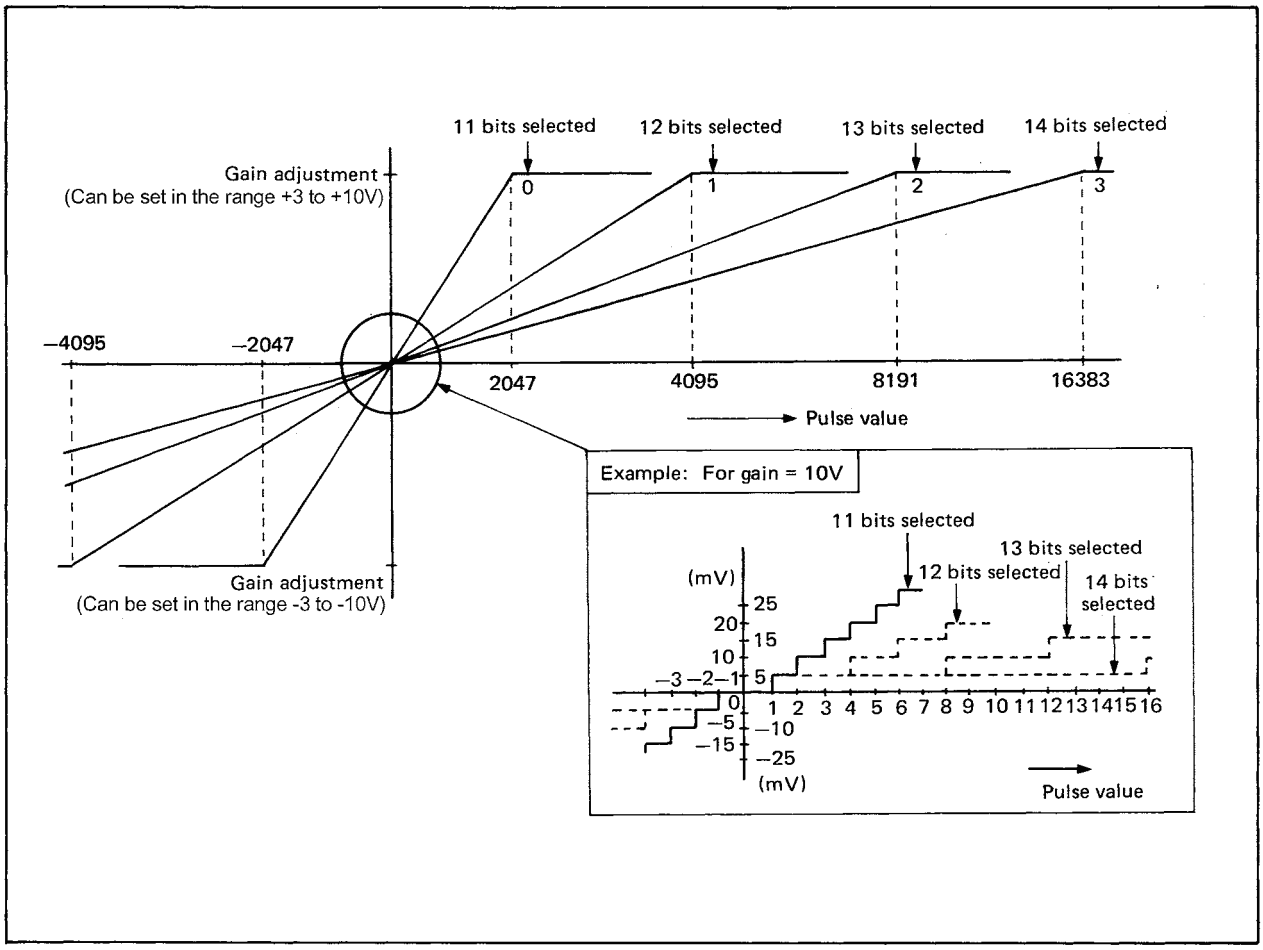


Fig. 4.1 Relation between Counter Pulse Value and Output Voltage

Therefore, select the slide switches as described below.

Example:

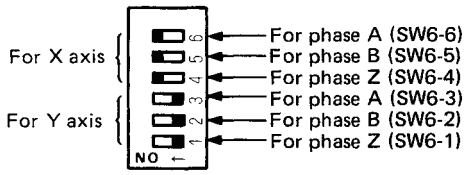
Consider a system in which the maximum speed is to be 200 KPPS and the position loop gain is 20 sec^{-1}. The maximum pulse value is given by:

$$\frac{\text{Speed (PPS)}}{\text{Position loop gain } (sec^{-1})} = \frac{200 \times 10^3}{20}$$

$$= 10{,}000 \text{ counts}$$

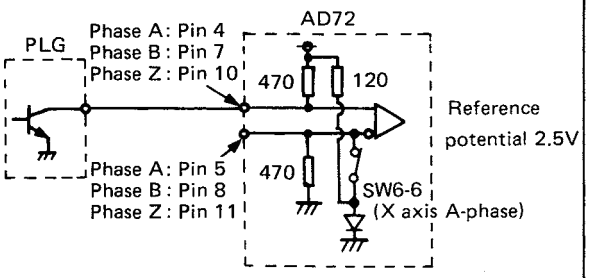
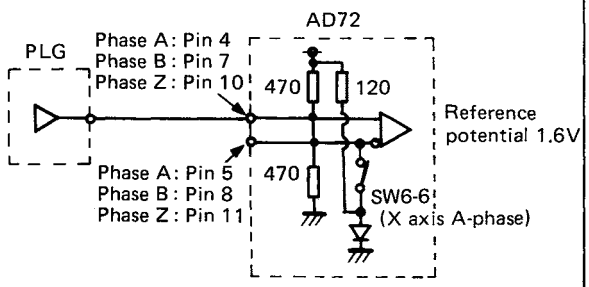
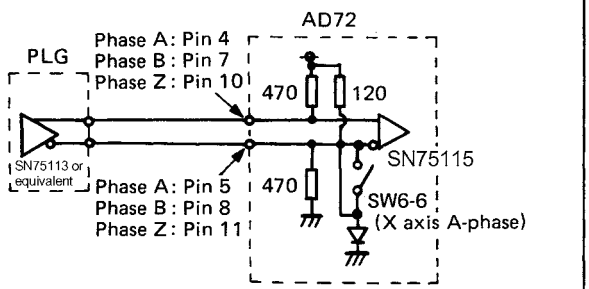
14 bits should therefore be specified.

4.4.2 External device select switches



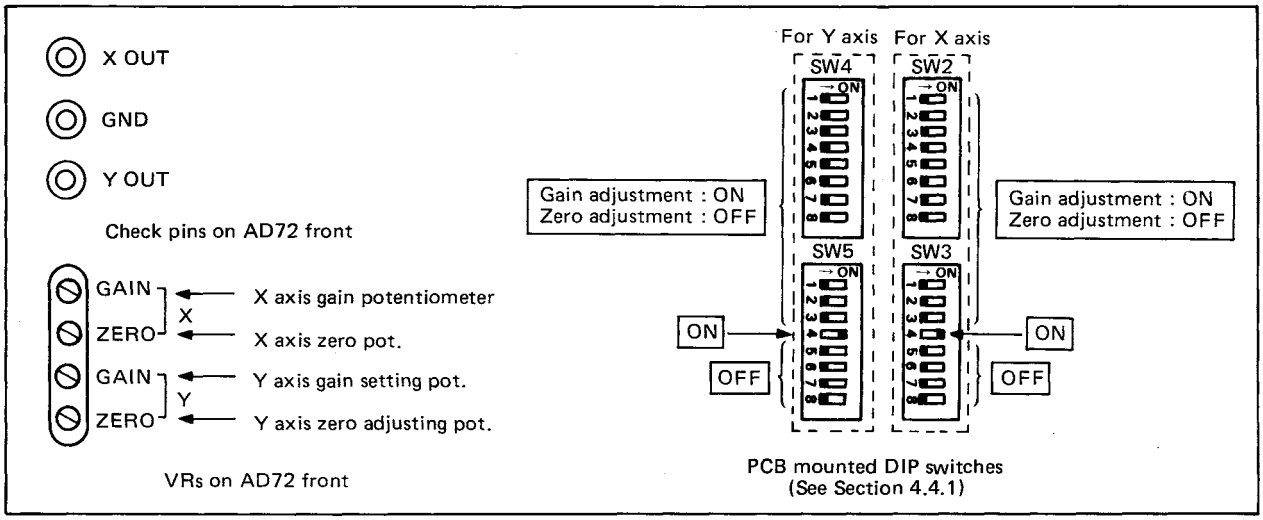
REMARKS

In this example, the TTL output type encoder is connected to the X axis and the differential type to the Y.
The switches (SW6-1 to 6) are all factory-set to OFF.

Encoder Type	SW1 Setting	Connection
Open collector output type	ON	
TTL output type	ON	
Differential output type	OFF	

4.4.3 Gain and zero adjustments

The analog output gain is factory set to 10V and may be adjusted between 3V and 10V as appropriate for the servo amplifier used.



The output voltage may be checked between the following pins:

X axis . . . . .X OUT, GND
Y axis . . . . .Y OUT, GND

(1) Gain adjustment

a) Set DIP switches as follows:
X axis . . . .SW2-1 to 2-8, SW3-1 to 3-3 → ON
SW3-4, SW5-4 → ON
SW3-5 to 3-8 → OFF
Y axis . . . .SW4-1 to 4-8, SW5-1 to 5-3 → ON
SW5-4, SW3-4 → ON
SW5-5 to 5-8 → OFF

b) Turn the GAIN X or GAIN Y variable resistor (VR) on the front of the AD72 until the required voltage is measured between the relevant test pins.

(2) Zero adjustment

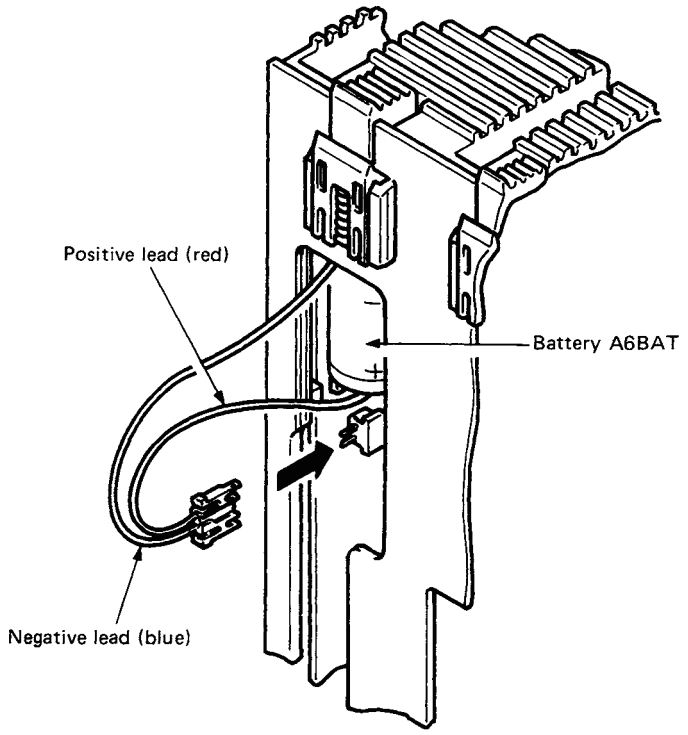
a) Set DIP switches as follows:
X axis . . . .SW2-1 to 2-8, SW3-1 to 3-3 → OFF
SW3-4, SW5-4 → ON
SW3-5 to 3-8 → OFF
Y axis . . . .SW4-1 to 4-8, SW5-1 to 5-3 → OFF
SW5-4, SW3-4 → ON
SW5-5 to 5-8 → OFF

b) Adjustment

Turn the ZERO X or ZERO Y VR on the front of the AD72 until 0V is measured between the relevant test pins.

4.4.4 Battery connection

The battery backs up the IC-RAM during power failure. The leads are disconnected before shipment to prevent battery consumption. Always connect the leads before using the AD72. (For battery life, etc., refer to Chapter 9.)



IMPORTANT

The components on the printed circuit board may be damaged by static electricity. When handling the printed circuit board:

1) ground all tools, work bench, etc.
2) do not touch conductive areas or electrical components.

5. LOADING AND INSTALLATION

This chapter explains the methods and precautions for loading and installation to enhance system reliability and exhibit its functions fully.

5.1 System Design Precautions

Take the following precautions when mounting the AD72 on the base (main or extension base).

(1) Do not use the AD72 on any extension base which does not include a power supply (i.e. A5□B).

(2) Where the temperature inside a panel is likely to exceed 55°C, forced ventilation or cooling must be provided.

(3) Do not install the AD72 adjacent to the AY22, AY23, AY42, AY51, AY60, AY60E and AY81 output modules, the AX42 input module, and the A61P, A62P and A65P power supply modules.

5.2 Wiring

This section explains the items to be noted for wiring of the AD72 and external device and the connection of the external wiring connector.

5.2.1 Wiring precautions

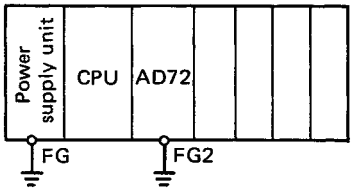
Examples of connecting the AD72 and drive unit are given in Appendix 3. This section explains the wiring precautions for the AD72 and external device (including the drive unit).

(1) Connection cable length
Generally the cable length should be less than 3m.

(2) I/O signal wiring
- Separate the I/O signal wires from the power and main circuit cables.
- Separate I/O signal wires from other cables and use separate conduit where applicable.
- In excessively noisy environments I/O signal wires should be screened and the PC grounded.
- When running I/O signal wires in metal piping, this should be grounded.

(3) The cable length between the AD72 and encoder depends on the encoder used:
Differential output type . . . . . .30m (98.4 ft) max.
TTL, open collector type . . . . . .3m (9.84 ft) max.
Use twisted pair shielded wires.

(4) The AD72 may be used without grounding. If grounding is required to avoid noise interference, etc., note the following:



a) Ground terminals FG (power supply module) and FG2 AD72) separately Class D grounding (Class 3 grounding).
b) Use 2mm² (minimum) wire for grounding and keep the wire run as short as possible.

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5.2.2 Notes on encoder connection

This section explains the precautions for connection of the encoder.

The AD72 deviation counter is an up/down counter.
Switching between up and down processings is performed depending on the feedback pulse phase.
When Phase A of the input feedback pulse leads Phase B by a phase angle of 90 degrees as shown in Fig. 5.1, the command pulses are counted down.
When Phase B of the input feedback pulse leads Phase A by 90 degrees as shown in Fig. 5.2, the command pulses are counted up.

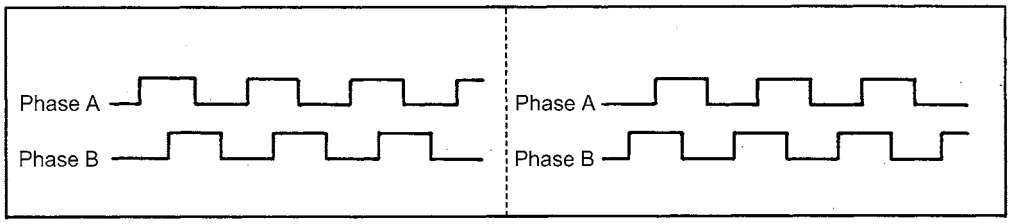


Fig. 5.1 When Phase A Leads 90° **Fig. 5.2 When Phase B Leads 90°**

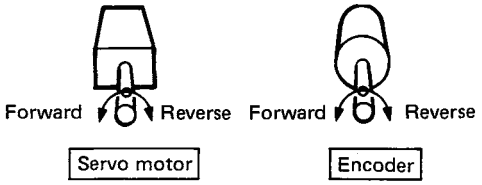
When command pulses are counted at the speed command of a positive voltage (when the motor rotates in the forward direction), the feedback pulses shown in Fig. 5.1 must be entered.
When command pulses are counted at the speed command of a negative voltage (when the motor rotates in the reverse direction), the feedback pulses shown in Fig. 5.2 must be entered.
Note that when Phase A and Phase B of the feedback pulses are inverted, the command pulses and feedback pulses are both counted and the counter pulse value will be excessive, stopping the control.
The counting of command pulses and feedback pulses changes in the following cases.

1) Rotation direction setting in parameter
   .....The rotation direction of the motor and the positive/negative counting of command pulses change.
2) When rotation direction of motor differs from that of encoder
   .....Since the encoder rotates in the reverse direction when the motor is rotating in the forward direction, their feedback pulse phases are reverse to each other.

Table 5.1 shows the connection depending on the rotation direction setting in the parameter and the rotation directions of the motor and encoder.

Co-ordinating motor and encoder directions

The relative directions of motor and encoder may be the same (i.e. both forward in a given direction) or they may be opposite (i.e. motor forward equivilant to encoder reverse).
The count direction may therefore need to be changed. This may be done either in the parameters or by changing the wiring as shown below:



For A phase lead of 90° on B phase during forward encoder rotation.

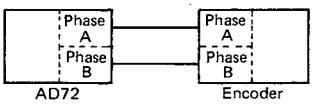
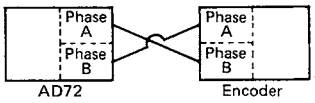
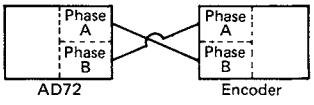
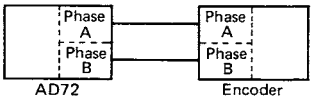
Motor and Encoder Directions	Direction Set in Parameter	Connection
Motor forward equivilant to encoder forward and vice versa	0	
	1	
Motor forward equivilant to encoder reverse and vice versa	0	
	1	

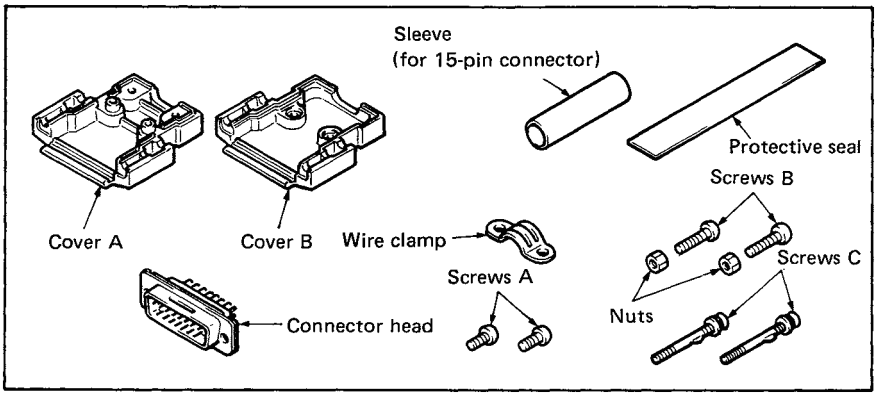
Table 5.1 Connection

Note that if the above connection is incorrect, the motor will also rotate at power-on, resulting in an error excessive (EEX.) error.

5.2.3 External wiring connectors

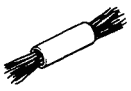
The AD72 is provided with the following connectors:

Two 9-pin connectors (plug) for X SERVO and Y SERVO connection
Two 9-pin connectors (socket) for X CONT and Y CONT connection
Two 15-pin connectors (plug) for X ENCO and Y ENCO connectors



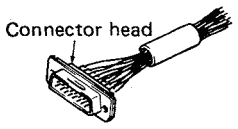
Assemble the connectors as follows:

1) Pass cable through sleeve.
(For the 15-pin connectors only)



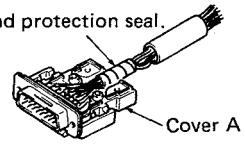
↓

2) Solder the wires to the connector head.



↓

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

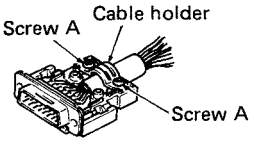


↓

4) Slide the sleeve over the protective seal.
(For the 15-pin connectors only)

↓

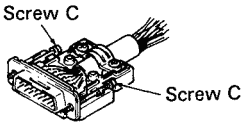
5) Fit the wire clamp using screws A.



↓

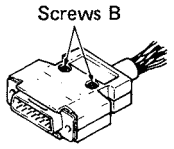
↓

6) Fit screws C.



↓

7) Fasten cover B onto cover A using screws B and the two nuts.



5.2.4 Wire connection

Fig. 5.2 shows the connector pin-outs. Connect the wires correctly according to the I/O numbers given in Section 3.7.

(1) Use up to 0.3mm^2 wires. A thicker wire will not pass through the cable clamp section.

(2) "Solder" the wires. Strip the wires properly to avoid a short circuit. Cover them with insulating tubing wherever possible.

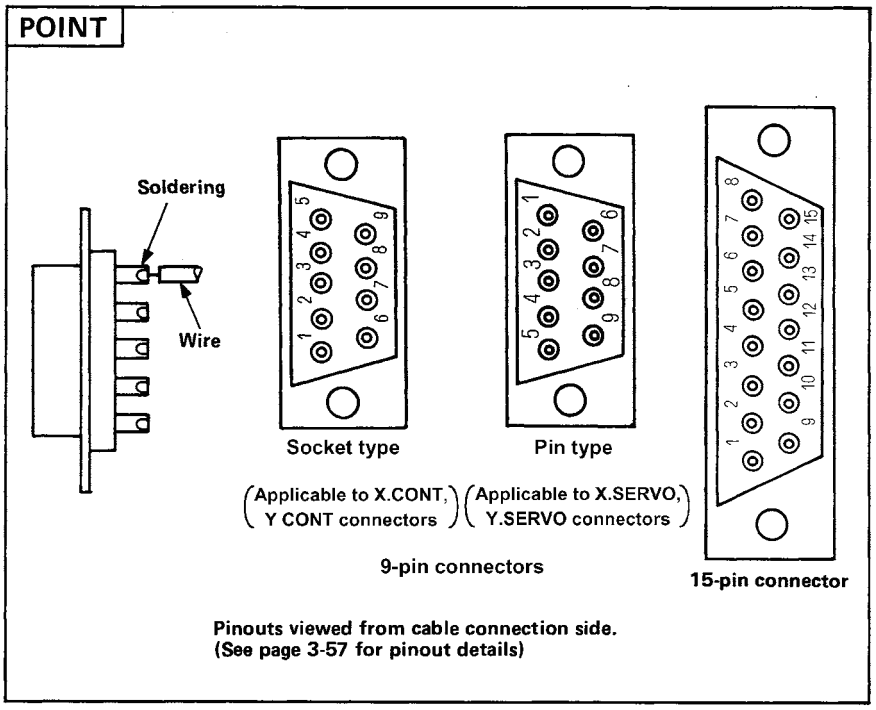
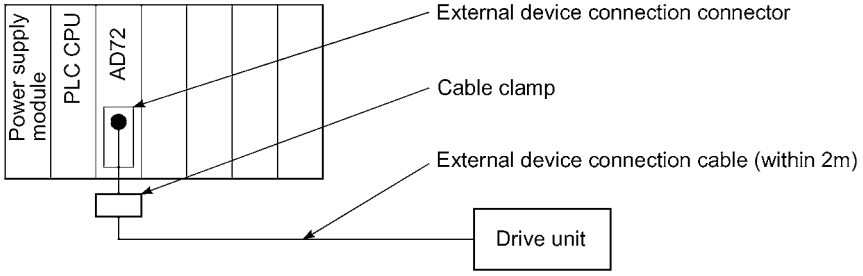


Fig. 5.2 Connecter

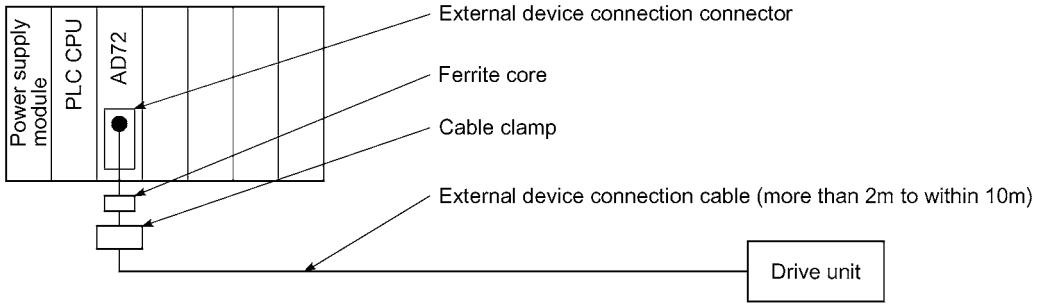
5.2.5 Compliance with EMC Directive and Low Voltage Directive

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 AD72.)
   - 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.



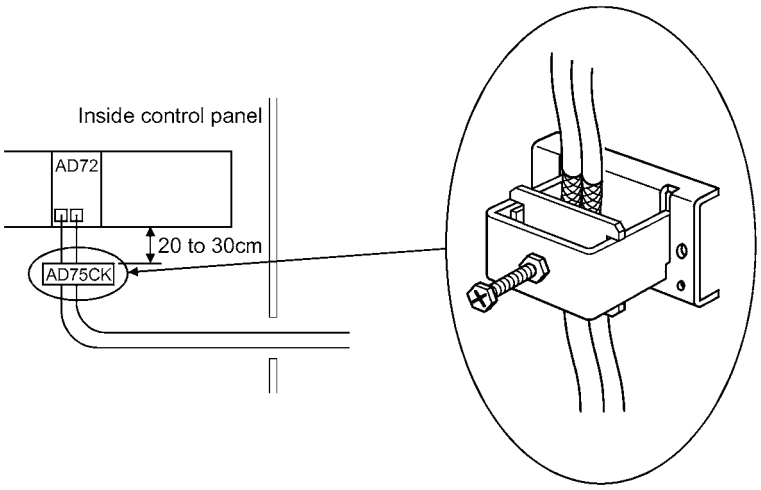
2) When using cable of more than 2m to within 10m for wiring
   - Ground the shield part of the external device connection cable with a cable clamp. (Ground the shield part at the point nearest to the external device connection connector of the AD72.)
   - Wire the external device connection cable with the drive unit and external device at the shortest distance.
   - Fit a ferrite core.



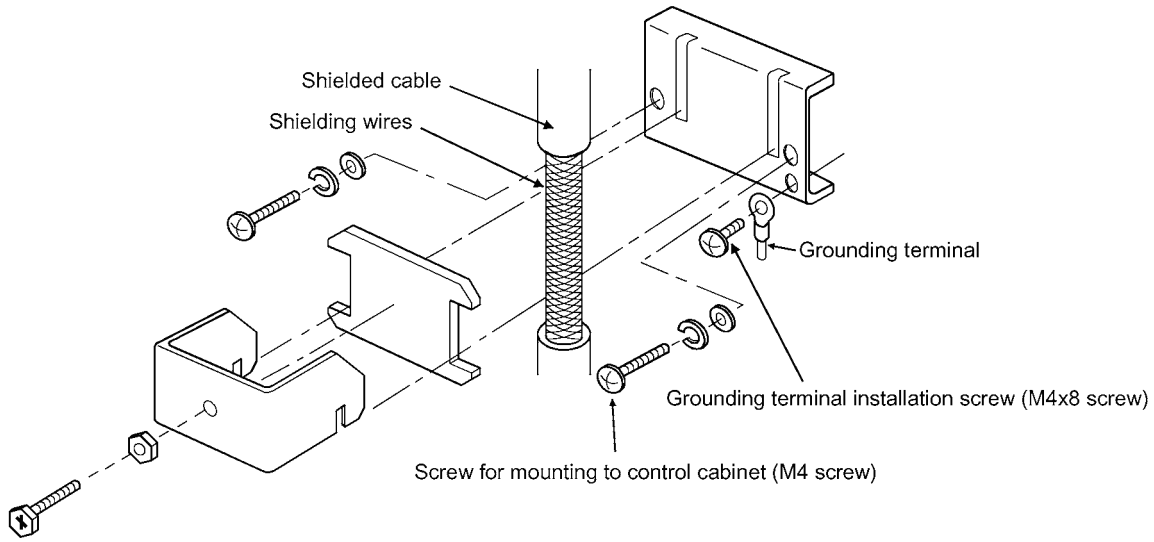
3) Ferrite core, cable clamp model names
   - Cable clamp
     Model name: AD75CK (Mitsubishi Electric make)
   - Ferrite core
     Model name: ZCAT3035-1330 (TDK make ferrite core)

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

4) Cable clamp fitting position and shielded cable grounding method



[How to ground shilded cable using AD75CK]



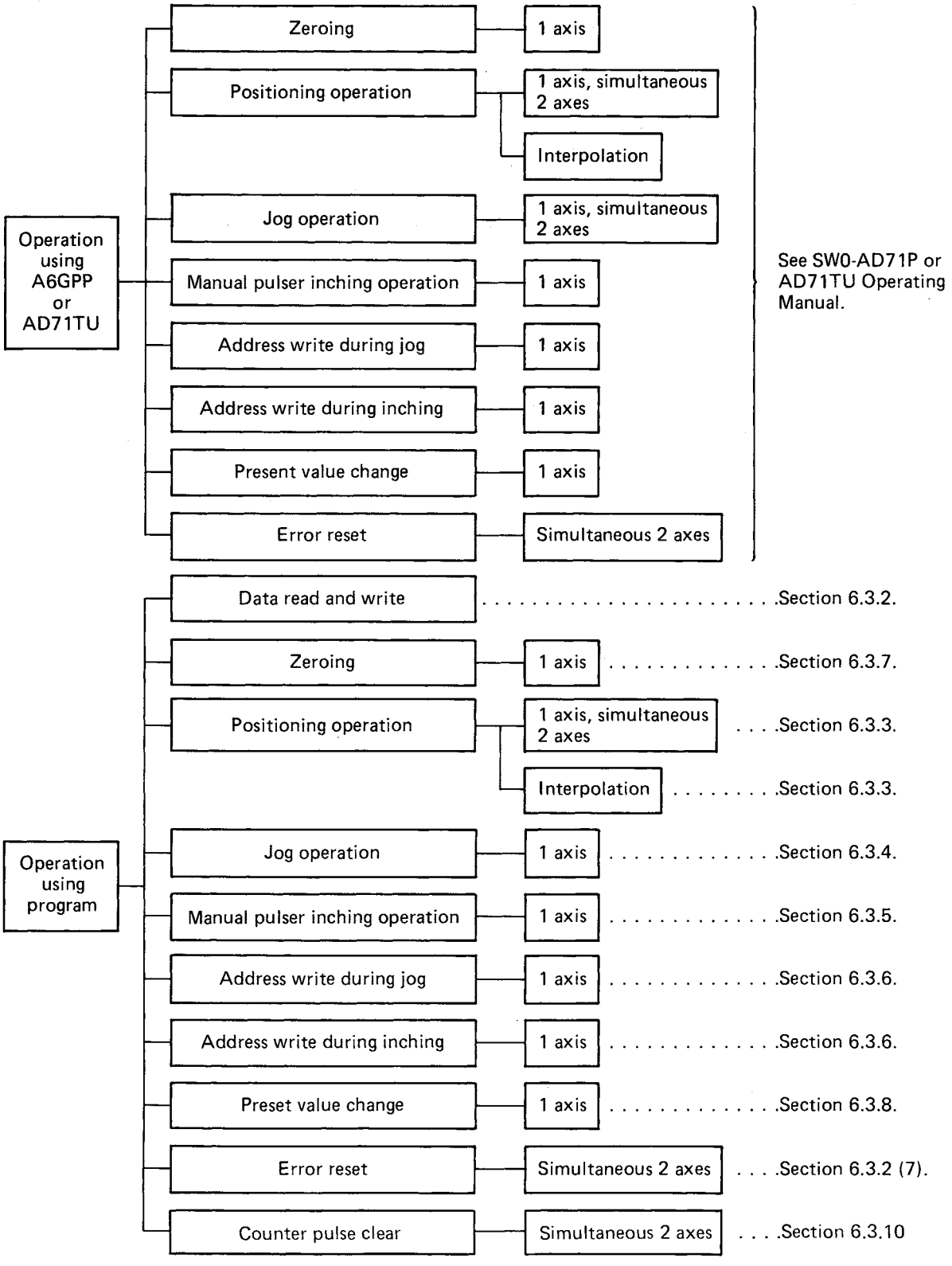
AD75CK can ground up to four shielded cables having about 7 mm or smaller outside diameters. (For details, refer to AD75CK cable clamp operation manual <IB-68682>.)

6. PROGRAMMING

6.1 Writing Programs

6.1.1 Program structure

The AD72 programs are generally included in a comprehensive program. Here, program examples are given according to the following classification.



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REMARKS

Unless otherwise specified, I/O numbers used in this manual assume that the AD72 is located at slot 0, 1 of the main base.

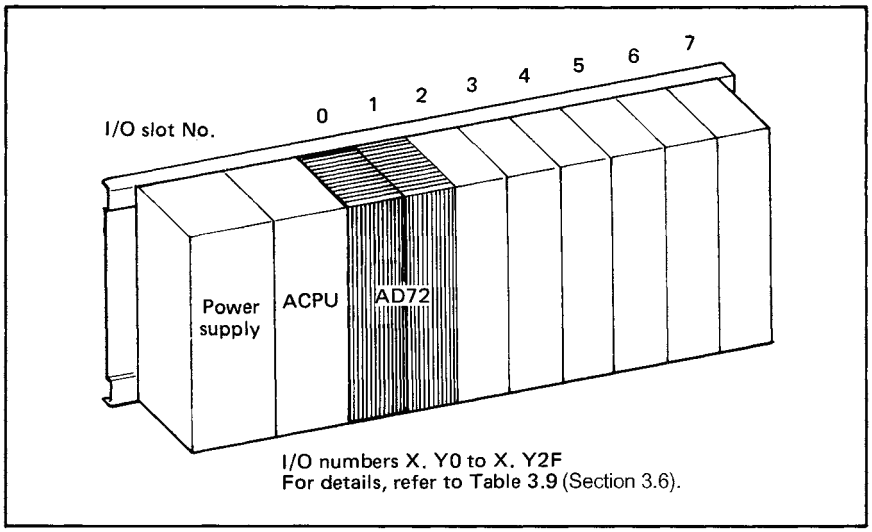


Fig. 6.1 AD72 Location for the Following Examples

All relevant A series processor units are referred to as "ACPU."

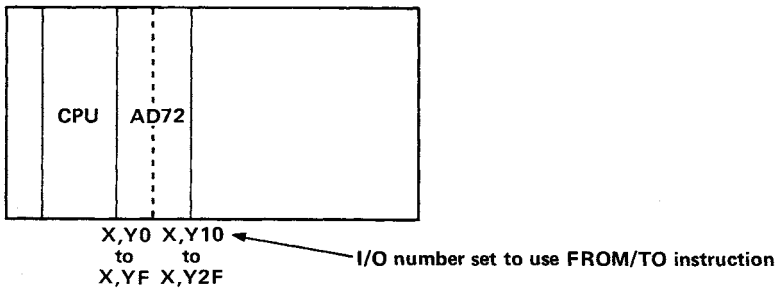
POINT

The AD72 occupies 48 I/O points (2 slots). When assigning I/O in the ACPU parameters specify 16 points to the first slot (vacant) and 32 to the second (special function unit).

6.1.2 Notes on programming

POINT

When the FROM and TO instructions are used, specify the head I/O number of the second slot, i.e. AD72 head I/O number plus 10H.



(1) Start-up program

The following program steps should be used to clear error messages from the AD72 when it is first start-up.

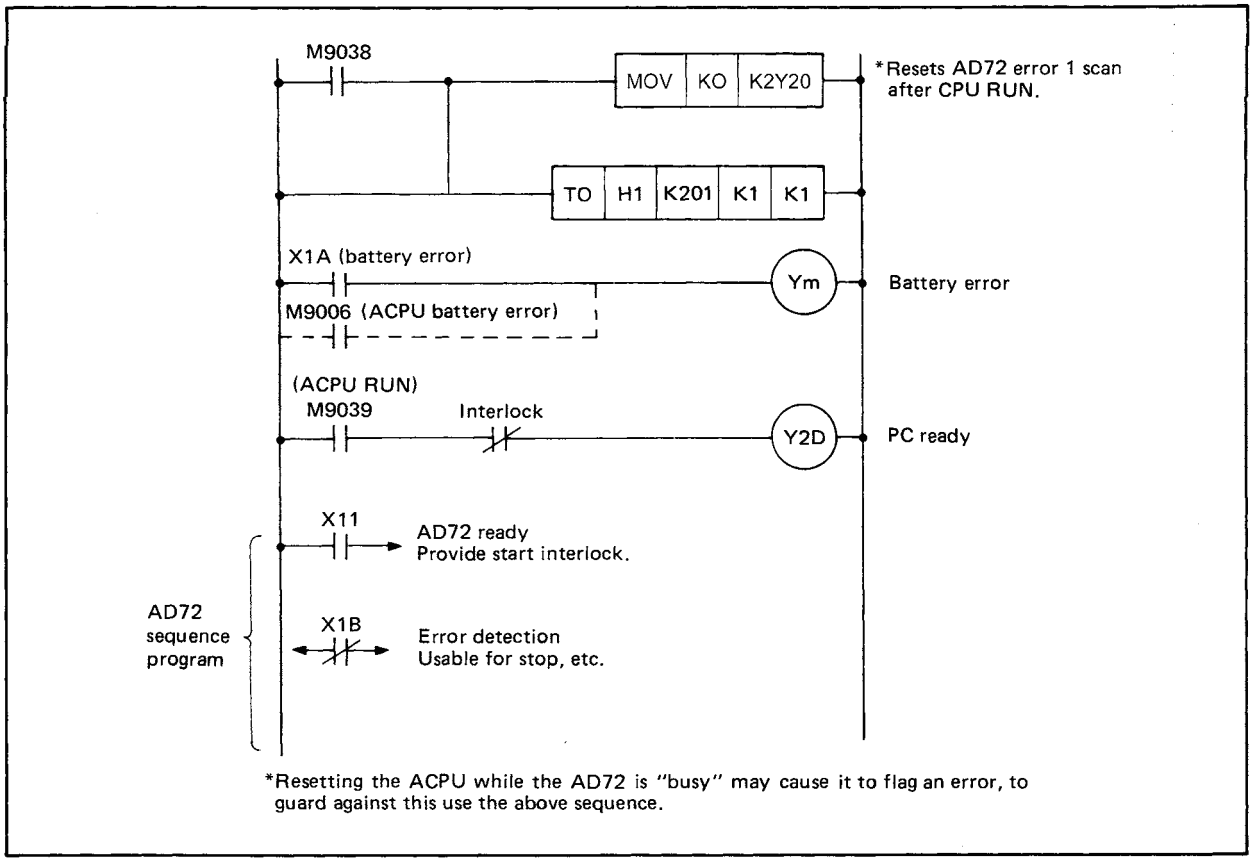


Fig. 6.2 Initial Program

(2) PC ready reset

When an error check is made by the sequence program, the PLC ready (Y2D) signal should be reset at error detection.

(3) Zeroing

The system must be zeroed at power-on.
(The present values in the positioning module cannot be guaranteed at power-on.)

(4) Zeroing actuator

Ensure that the zeroing actuator is serviceable and reliable. Failure to receive an input from this switch will allow the zeroing routine to maintain the drive signal.

(5) Overrun precautions

The upper and lower stroke limits will only be operable if the AD72 is functioning normally. Upper and lower limit switches should be hard wired into the system.

(6) Emergency stop signal

The STOP input signal is a deceleration-to-stop signal for positioning, and cannot be used to make an emergency stop.
Use the external contact to bring the drive unit into an emergency stop.

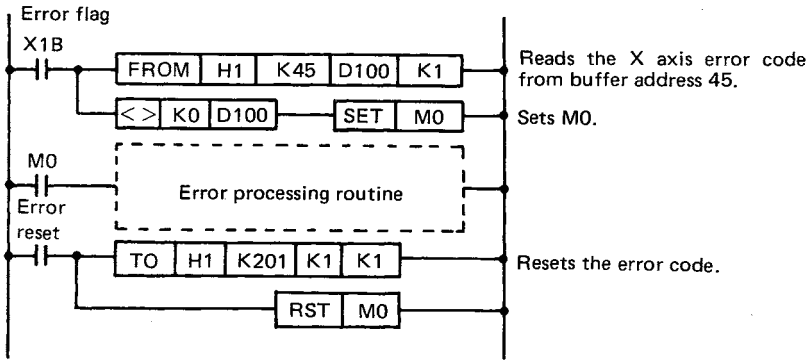
(7) Upper and lower stroke limit values should be checked before operation.

(8) The speed limit parameter should be checked before operation.

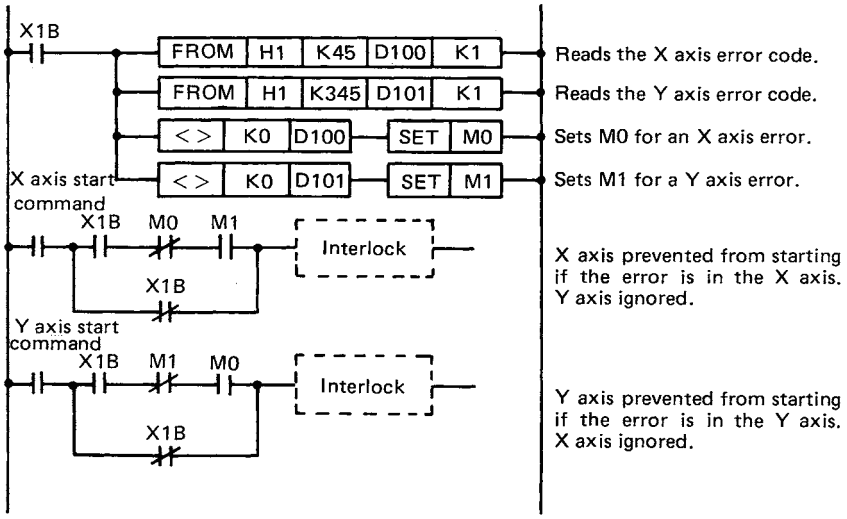
(9) Set the jog speed low when initially setting up the system.

(10) For interpolation positioning, set the X and Y axis speeds to the same value. This will represent the maximum speed that either axis can travel at.

(11) If only the X axis is used



Note that the error detection signal (X1B) is switched on in the event of an error in either axis. When error detection is determined by the state of X1B, both axes will be stopped by any error.
X1B may be used as an axis start interlock as follows:



(12) Refer to Section 5.1 for the precautions for module arrangement.

6.2 Notes on Use of the GPP and TU

1) Connect the GPP or TU to the AD72.

2) Operation can be performed with the PC ready signal (Y2D) or AD72 ready signal (X11) on or off.

3) Data cannot be transferred from or to the GPP when the AD72 is "busy" and the GPP is in test mode.

4) The M code is ignored. (Data in the M code area of the buffer memory (X axis: 46, Y axis: 346) is cleared.)

6.3 ACPU Programming

6.3.1 Data read and write precautions

(1) Data read from and written to the sequence program should be kept to a minimum for optimum program scan time. The majority of the AD72 data must therefore be written to the buffer memory by the GPP.

(2) The parameters and zeroing data is checked at power on and when the PC ready signal (Y2D) changes from OFF to ON.

(3) Positioning data is checked immediately before it is processed. Any error will cause the error signal (X1B) to switch on and, in most cases, positioning to stop.

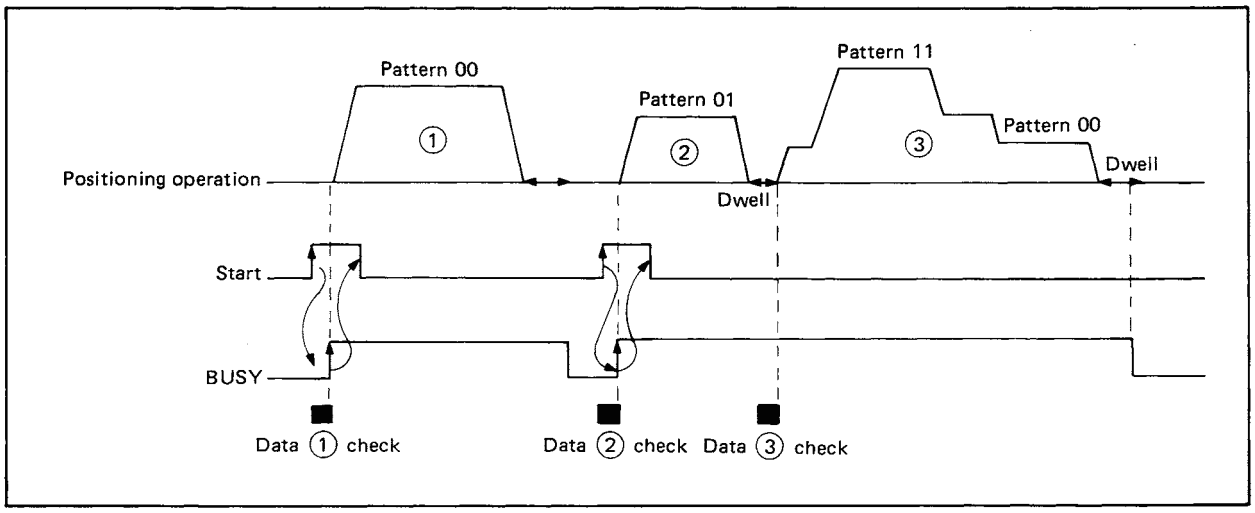


Fig. 6.3 Positioning Data Check

An error is flagged if the total distance requested exceeds the upper (or lower) stroke limit when incremental position addressing is used.

6.3.2 Data communication with PC program

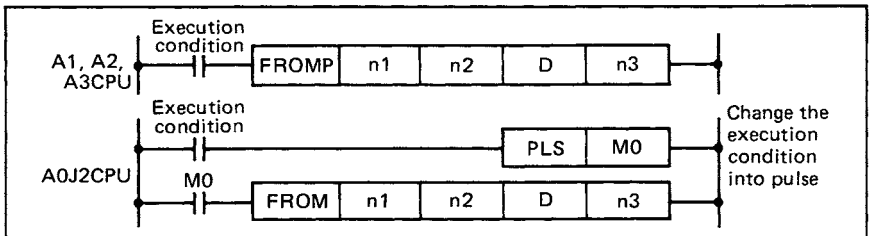
This section gives basic examples for writing set data to the buffer memory and reading data from the buffer memory using sequence programs in the ACPU. Refer to Section 6.5 for K2ACPU programs.

(1) Read and write instructions

(a) Read from AD72

FROM instruction: Also FROMP, DFRO, and DFROP.

[Format]



Symbol	Description	Device
n1	Upper 2 digits of the 3-digit head I/O number +10H to which the AD72 has been assigned (e.g. 5 when the head I/O number is X, Y040)	K, H
n2	Buffer head address of stored data	K, H
D	Head number of devices to which data will be written	T, C, D, W, R
n3	Number of words to be read	K, H

Fig. 6.4 Read Instruction FROM

Example: To read one word from buffer memory address 600 (X axis output speed) to D2 with the AD72 assigned to X, Y130 to X, Y15F.

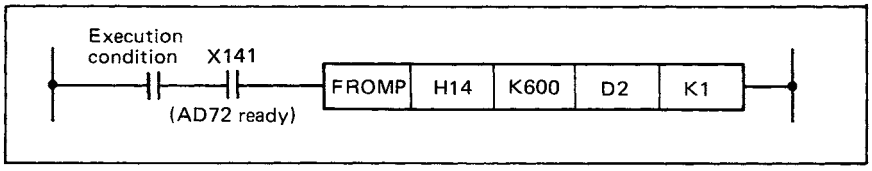
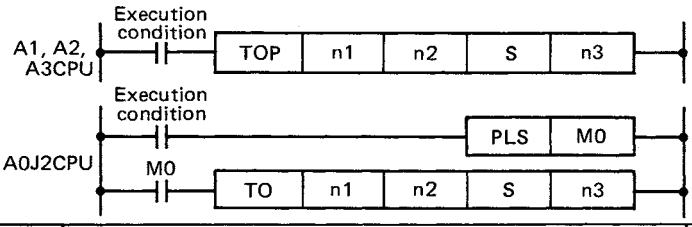


Fig. 6.5 Read Example

(b) Write to AD72

TO instruction: Also TOP, DTO, and DTOP.

[Format]



Symbol	Description	Available Device
n1	Upper 2 digits of the 3-digit head I/O number +10H to which the AD72 has been assigned (e.g. 5 when the head I/O number is X, Y040)	K, H
n2	Buffer head address for written data	K, H
S	Head number of devices from which data will be written (may also be a constant)	T, C, D, W, R, K, H
n3	Number of words to be written	K, H

Fig. 6.6 Write Instruction TO

Example: To write positioning information to buffer memory address 3872, with the AD72 assigned to X,Y10 to X,Y3F.

X-axis data No. 1 positioning information example

Item	Setting	Data
Positioning pattern	Continue with speed change	11
Positioning method	Incremental	1
Positioning direction	Forward	0
M code	13	13

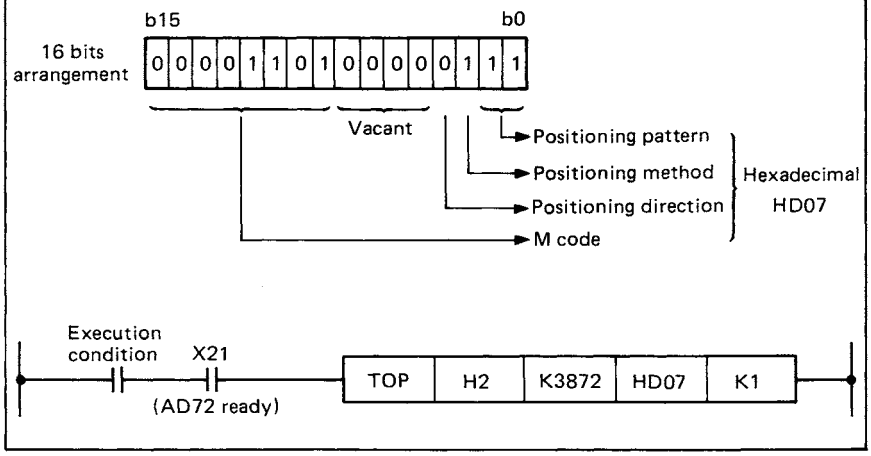


Fig. 6.7 Write Example

POINT

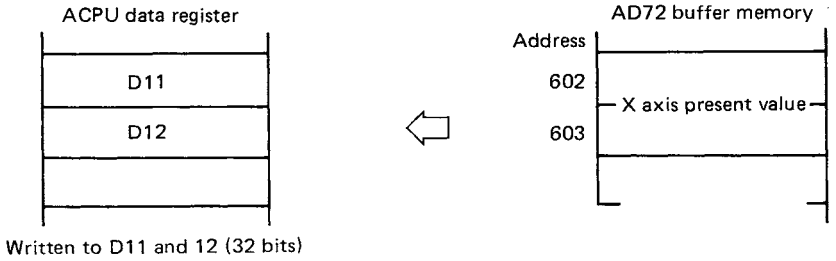
A maximum of 2,000 words may be read or written using one instruction.
Note however that in this case the watch dog timer (WDT) may need to be reset.

(2) Present value read program

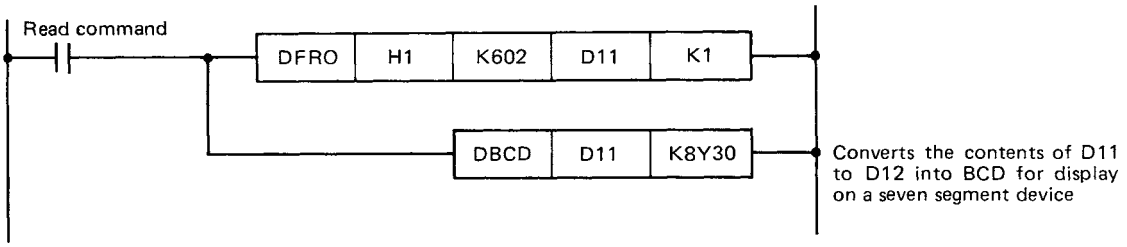
[Example] Indication of X axis present value

[Notes] (1) During positioning, the present value as stored in the AD72 buffer memory lags behind the actual value by about 0.1 seconds.
(2) The present value is two words long.

[Data transfer]



[Program]



Note: The "D" in the two instructions DFRO and DBCD specify 32 bit processing.

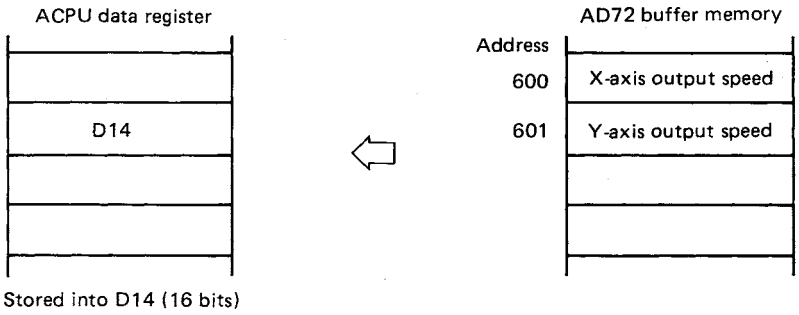
POINT

The present value is a command pulse output value (feedback pulse not included).

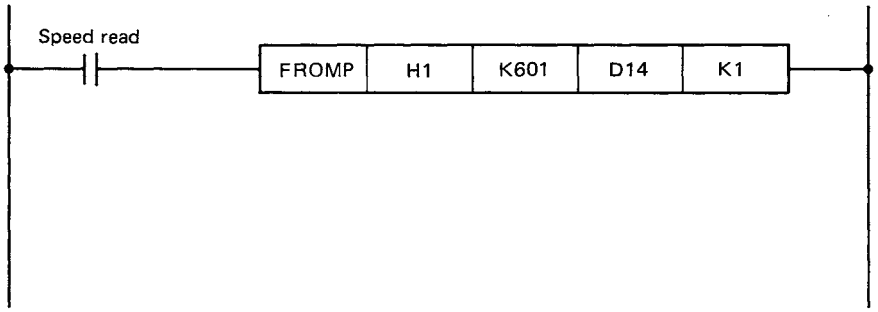
(3) Speed read while BUSY

[Example] Y axis speed read

[Data transfer]



[Program]

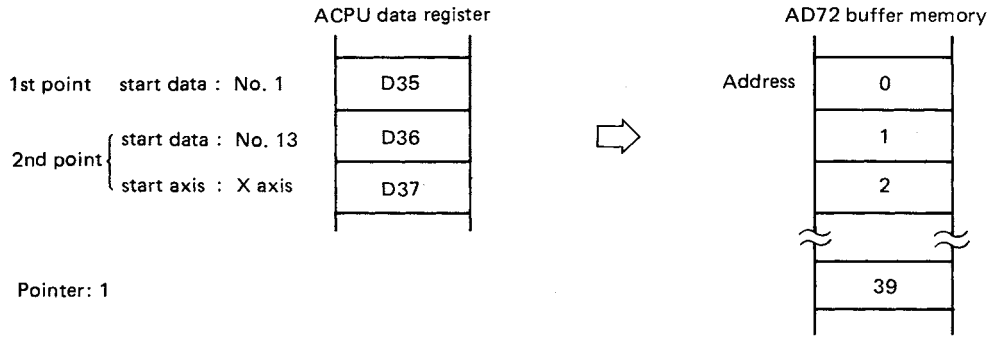


(4) Data number and pointer write

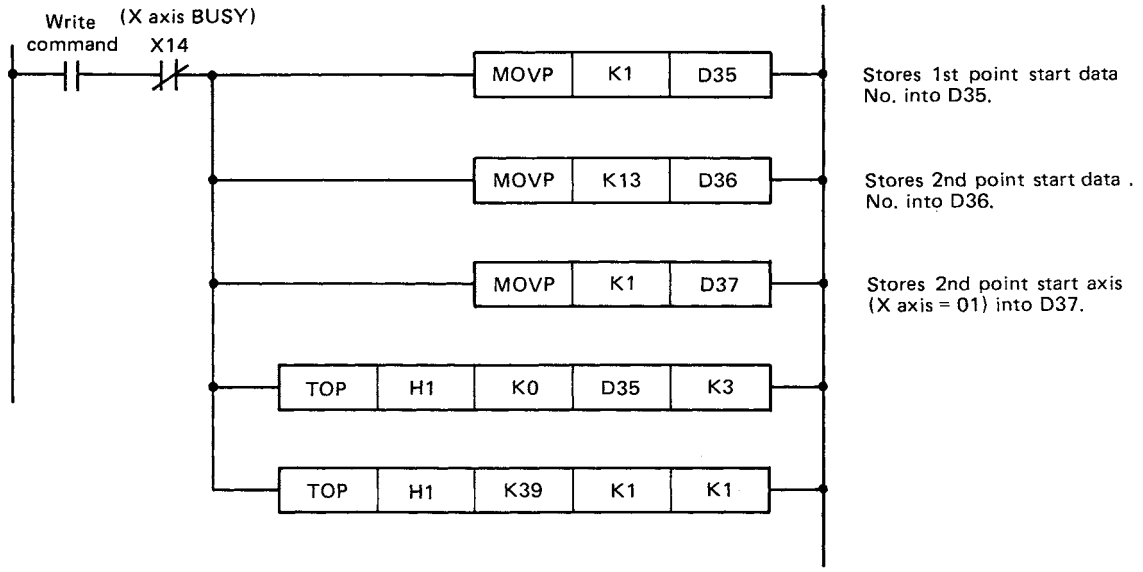
[Exmaple] X axis data number and pointer write

[Note] The relevant axis must not be busy.

[Data transfer]



[Program]



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(5) Parameter and zeroing data write

[Example] X axis parameter write – Assume that the parameters are already in D16 to 31

[Note] When writing parameters and zeroing data, the PC ready signal (Y2D) should be off.

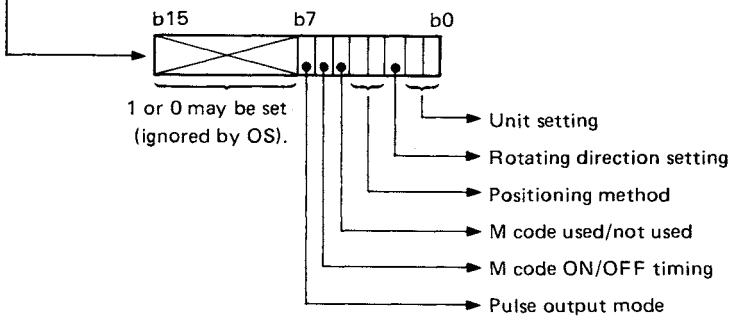
[Data transfer]

ACPU data register
(Data already written)

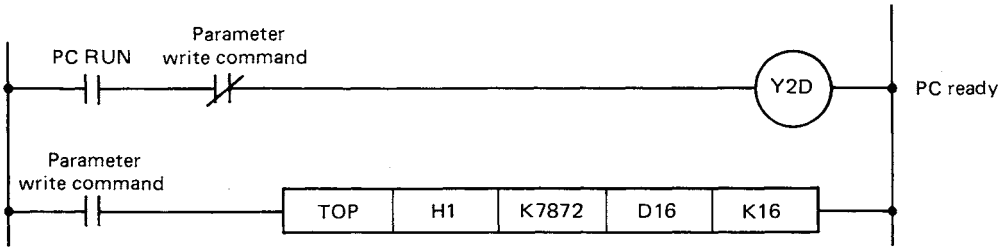
Parameter data	D16
Travel per pulse	D17
Speed limit value	D18
Jog speed limit value	D19
Acceleration and deceleration times	D20
Backlash compensation	D21
Upper stroke limit	D22
	D23
Lower stroke limit	D24
	D25
Error compensation	D26
	D27
Travel per manual pulse during inching	D28
	D29
Starting bias speed	D30
Positioning complete signal output duration	D31

AD72 buffer memory

Address	7872
	7873
	7874
	7875
	7876
	7877
	7878
	7879
	7880
	7881
	7882
	7883
	7884
	7885
	7886
	7887



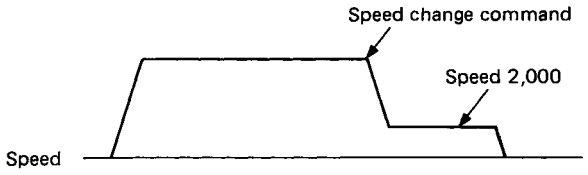
[Program]



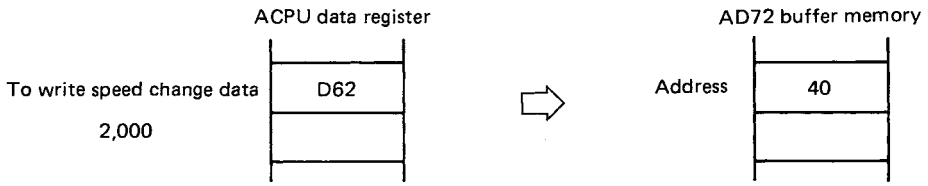
(6) Speed change when BUSY

[Example] To change X axis positioning speed to 2,000 (20,000 mm/min)

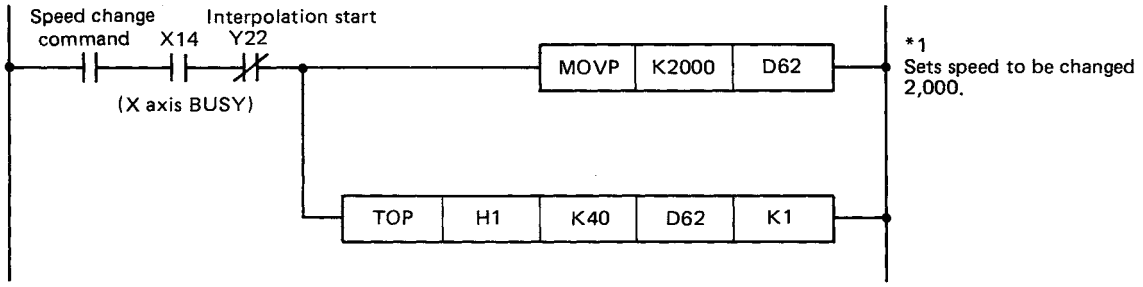
[Note] Speed cannot be changed during interpolation.



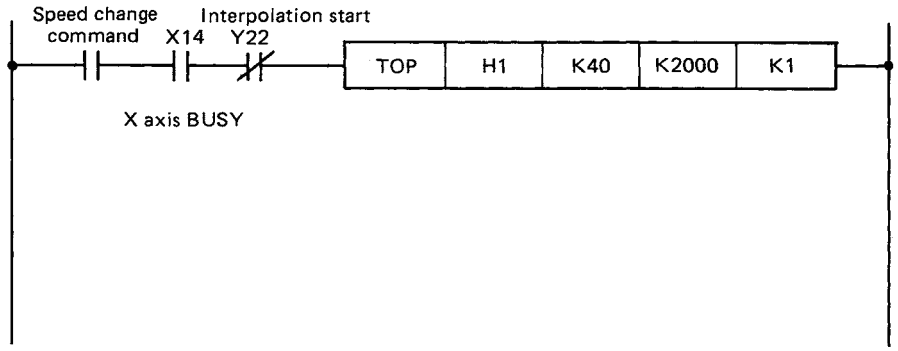
[Data transfer]



[Program] Example 1



Example 2



POINT

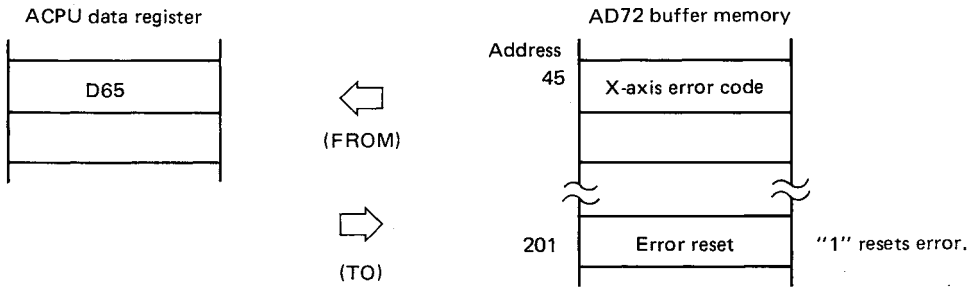
The speed to be changed to (*1) set in the program is automatically multiplied ten times by the AD72, e.g. when 2,000 is set, actual speed is 20,000mm/min (2,000 x 10^1).

(7) Error reset

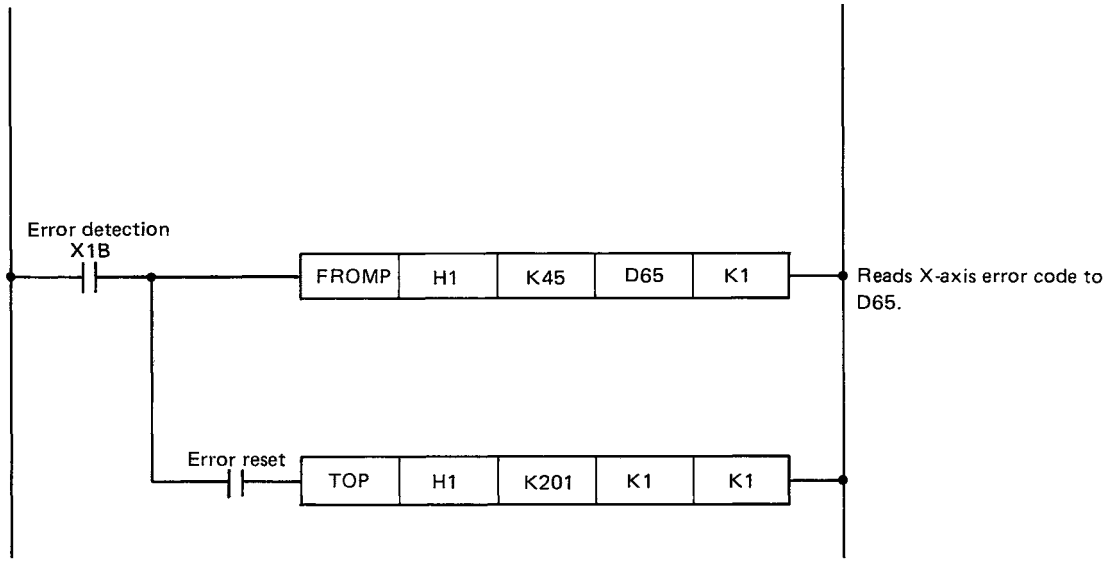
[Example] To read an error code and then reset it.

[Notes] (1) The error detection (X1B) signal should be used.
(2) The buffer memory error reset (address 201) is used for both the X and Y axes. Writing a 1 to this address clears the error.

[Data transfer]



[Program]



REMARKS

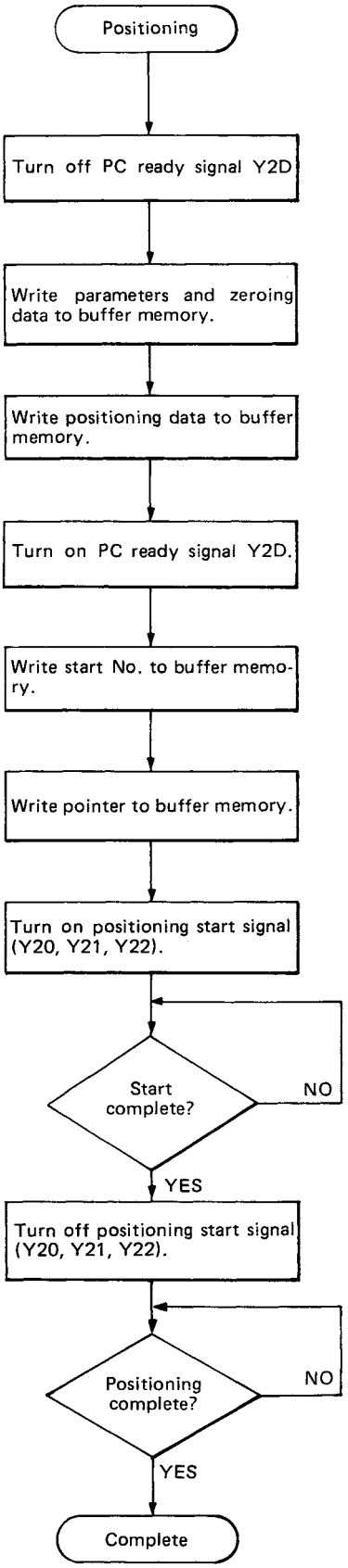
Writing "1" to the buffer memory error reset address resets the error code and X1B. The error reset address is then automatically changed to "0" to acknowledge that the error code and flag have been cleared.

6.3.3 Start positioning

(a) The start of a positioning operation will be greatly simplified if all the relevant data has already been written to the buffer memory. (e.g. from the A6GPP)
Complex programs with long scan times are required if all the operating data must be written from the sequence program.

(b) When set data are set externally
When there are many positioning data changes, programs are required to write or read data to or from the buffer memory by communication between the ACPU and AD72.
As complex programs with long scan times are required in this case, simplify programs without using unnecessary programs.

(1) Flow chart



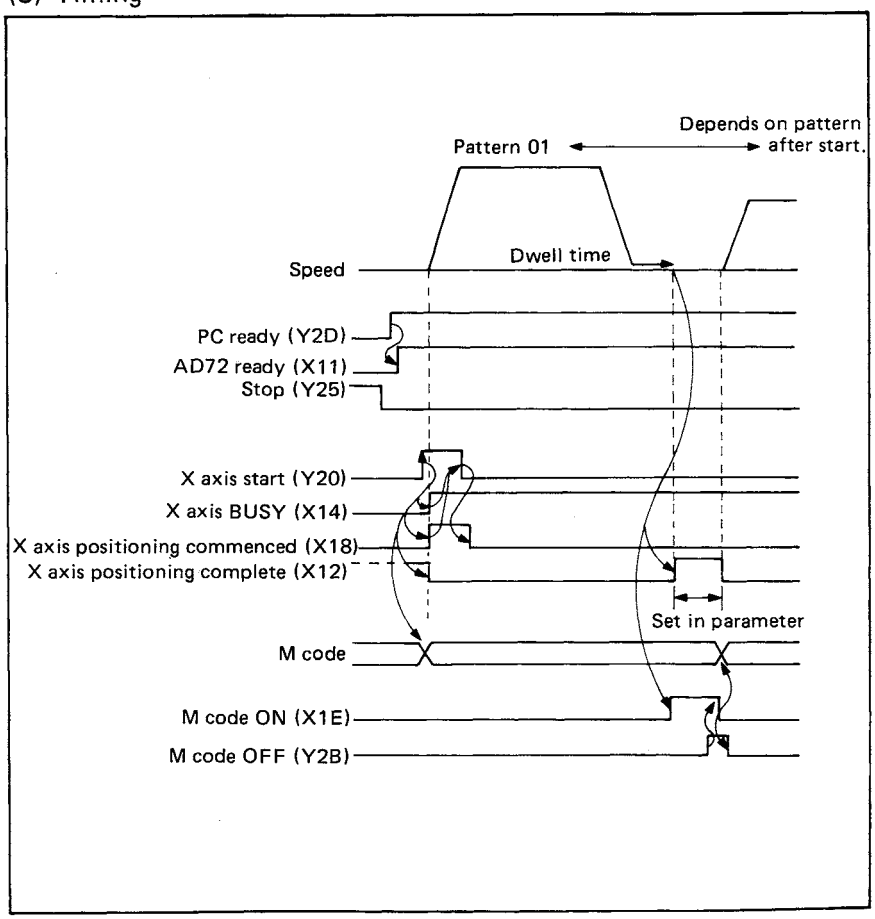
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	AD72 ready (X11)	ON	*
	Relevant axis busy (X14, X15)	OFF	
	Relevant axis positioning commenced (X18, X19)	OFF	
	Relevant axis M code ON (X1E, X1F)	OFF	
	Relevant axis stop (Y25, Y26)	OFF	
	PC ready (Y2D)	ON	*
Other	Positioning data	Within setting range	If positioning speed is higher than the speed limit value, positioning is executed at the speed limit value.
	Start data number		
	Start axis		
	Pointer		
	Zero address		
	Monitor present value	0 ≦ present value ≦ 16,252,928	
	After [BREAK] signal from the GPP or [STOP] signal from the AD71TU, neither axis should be busy.		

*In GPP or AD71TU test mode, X11 and Y2D may be off.

Table 6.1 Start Conditions

(3) Timing



(4) Program

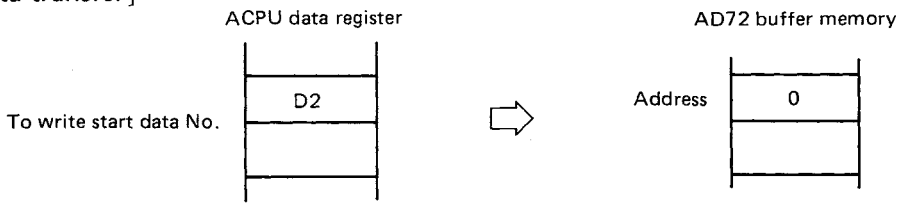
(a) Operating data already written from GPP

The following program assumes that parameters, zeroing data, and positioning data have already been written to the AD72 buffer memory using the GPP or AD71TU.

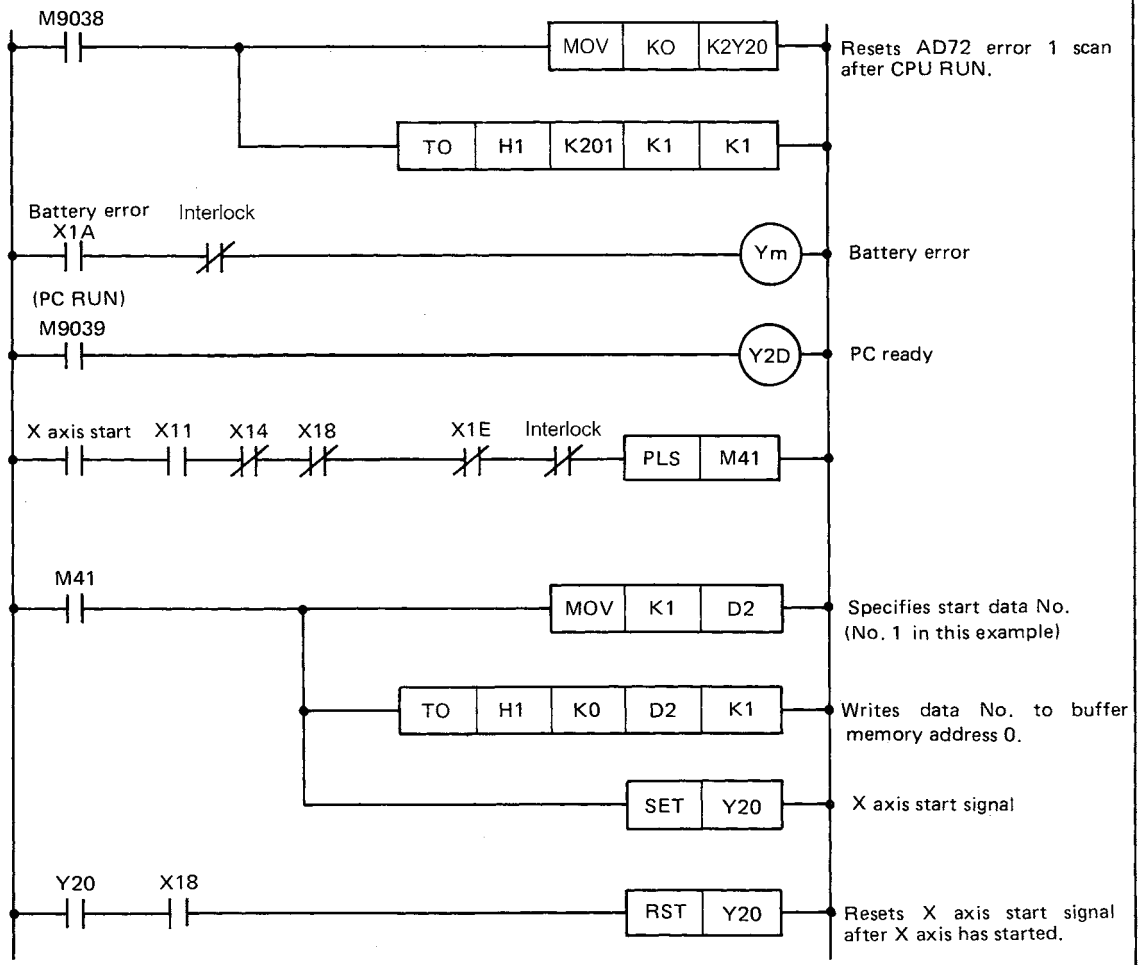
[Example] To start at X axis data number 1.

[Notes] (1) For start conditions, see Table 6.1.
(2) Actual positioning operation depends on data No. 1 pattern setting.
(3) For stop during positioning, refer to Section 6.3.9.

[Data transfer]



[Program]



(b) Setting data specified using sequence program

Assumes data is stored in registers as shown in Table 6.2, page 6-19.

[Notes] (1) For start conditions, see Table 6.1.
(2) For stop during positioning, refer to Section 6.3.9.
(3) To write parameters and zeroing data, turn off PC ready signal (Y2D).

[Data transfer]

		ACPU data register	AD72 buffer memory address
(X axis)			
1st point start data No.		D0	0
2nd point start data No.		D1	1
2nd point start axis		D2	2
3rd point start data No.		D3	3
3rd point start axis		D4	4
X axis pointer		D5	39
(Y axis)			
1st point start data No.		D10	300
2nd point start data No.		D11	301
2nd point start axis		D12	302
3rd point start data No.		D13	303
3rd point start axis		D14	304
Y axis pointer		D15	339
(X axis) Positioning information data	No. 1	D20	3872
	No. 2	D21	3873
	No. 3	D22	3874
	No. 4	D23	3875
	No. 5	D24	3876
	No. 6	D25	3877
	No. 7	D26	3878
	No. 8	D27	3879
	No. 9	D28	3880
	No. 10	D29	3881
(X axis) Positioning speed data	No. 1	D30	4272
	No. 2	D31	4273
	No. 3	D32	4274
	No. 4	D33	4275
	No. 5	D34	4276
	No. 6	D35	4277
	No. 7	D36	4278
	No. 8	D37	4279
	No. 9	D38	4280
	No. 10	D39	4281

(X axis) Dwell time data	No. 1	D40	4672
	No. 2	D41	4673
	No. 3	D42	4674
	No. 4	D43	4675
	No. 5	D44	4676
	No. 6	D45	4677
	No. 7	D46	4678
	No. 8	D47	4679
	No. 9	D48	4680
	No. 10	D49	4681
(X axis) Positioning address data	No. 1	D50	5072
		D51	5073
	No. 2	D52	5074
		D53	5075
	No. 3	D54	5076
		D55	5077
	No. 4	D56	5078
		D57	5079
	No. 5	D58	5080
		D59	5081
	No. 6	D60	5082
		D61	5083
	No. 7	D62	5084
		D63	5085
	No. 8	D64	5086
		D65	5087
	No. 9	D66	5088
		D67	5089
	No. 10	D68	5090
		D69	5091

(Y axis positioning data omitted)

(X axis parameters)		
Parameter information	D120	7872
Travel per pulse	D121	7873
Speed limit value	D122	7874
Jog speed limit value	D123	7875
Acceleration and deceleration times	D124	7876
Backlash compensation	D125	7877
Upper stroke limit	D126	7878
	D127	7879
Lower stroke limit	D128	7880
	D129	7881
Error compensation	D130	7882
	D131	7883
Travel per inching input	D132	7884
	D133	7885
Starting bias speed	D134	7886
Positioning complete signal output duration	D135	7887
(Y axis parameters)		
Parameter information	D140	7892
Travel per pulse	D141	7893
Speed limit value	D142	7894
Jog speed limit value	D143	7895
Acceleration and deceleration times	D144	7896
Backlash compensation	D145	7897
Upper stroke limit	D146	7898
	D147	7899
Lower stroke limit	D148	7900
	D149	7901
Error compensation	D150	7902
	D151	7903
Travel per inching input	D152	7904
	D153	7905
Starting bias speed	D154	7906
Positioning complete signal output duration	D155	7907
(X axis zeroing data)		
Zero address	D160	7912
	D161	7913
Zeroing speed	D162	7914
Zeroing creep speed	D163	7915
Zeroing dwell time	D164	7916
Torque limit	D165	7917
Zeroing information	D166	7918
(Y axis zeroing data)		
Zero address	D170	7922
	D171	7923
Zeroing speed	D172	7924
Zeroing creep speed	D173	7925
Zeroing dwell time	D174	7926
Torque limit	D175	7927
Zeroing information	D176	7928

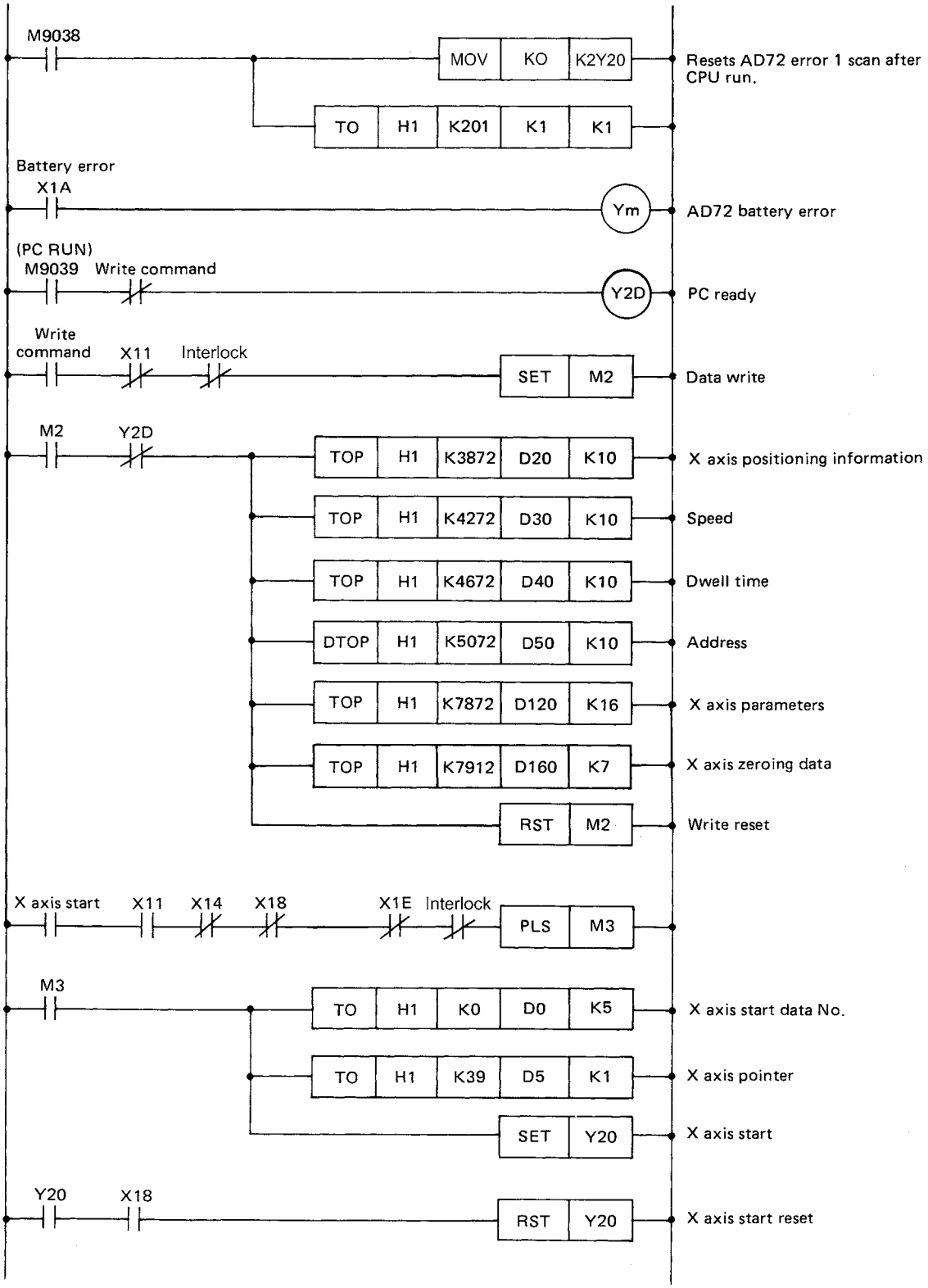
Item			Data Register
X axis start data number (3 points)			D0 to 4
X axis pointer (2)			D5
Y axis start data number (3 points)			D10 to 14
Y axis pointer (2)			D15
Positioning data	X axis	Positioning information (No. 1 to 10)	D20 to 29
		Positioning speed (No. 1 to 10)	D30 to 39
		Dwell time (No. 1 to 10)	D40 to 49
		Positioning address (No. 1 to 10)	D50 to 69
	Y axis	Positioning information (No. 1 to 10)	D70 to 79
		Positioning speed (No. 1 to 10)	D80 to 89
		Dwell time (No. 1 to 10)	D90 to 99
		Positioning address (No. 1 to 10)	D100 to 119
X axis parameters			D120 to 135
Y axis parameters			D140 to 155
X axis zeroing data			D160 to 166
Y axis zeroing data			D170 to 176

Table 6.2 Data Register Contents

REMARKS

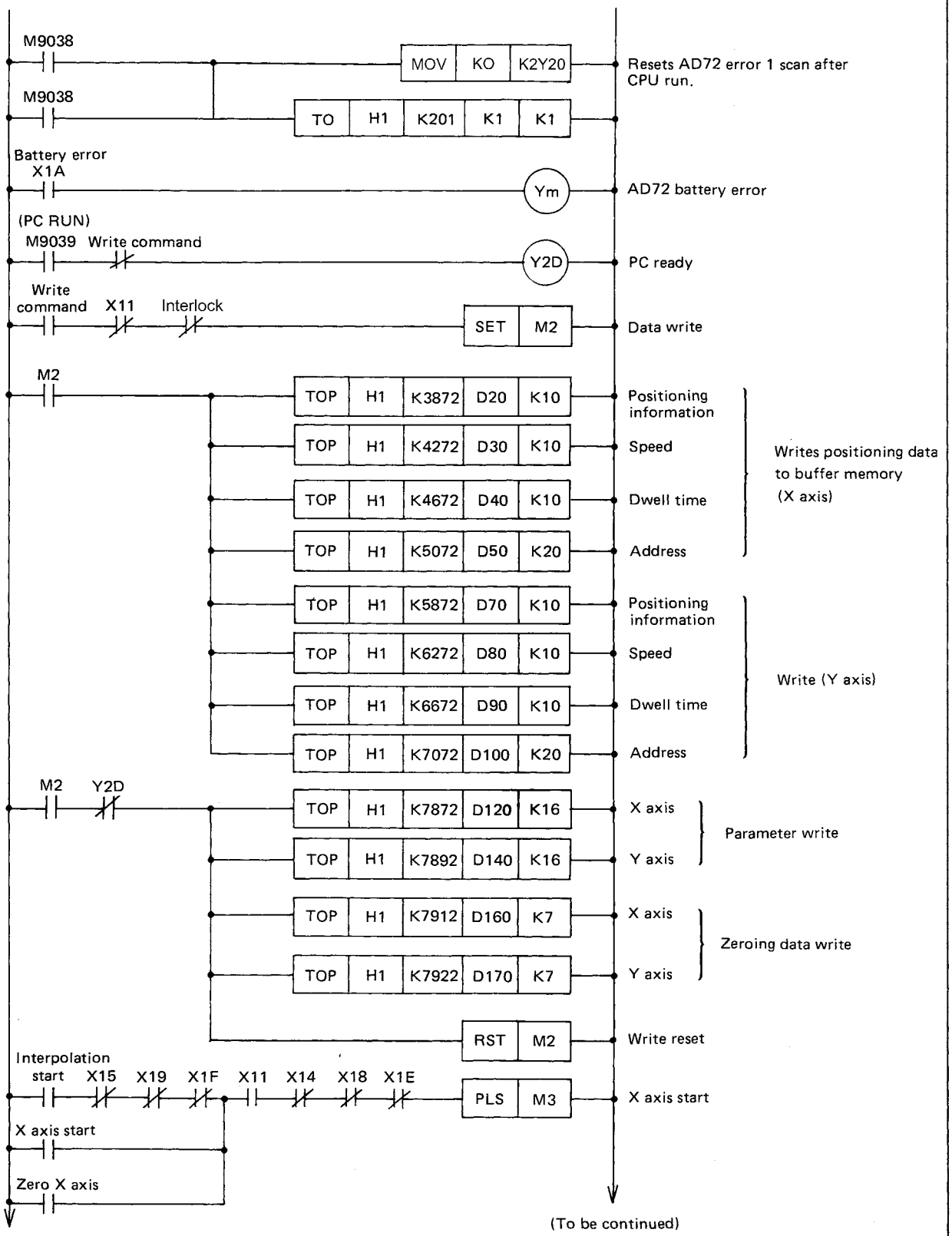
Number the data registers freely. The buffer memory addresses are fixed.

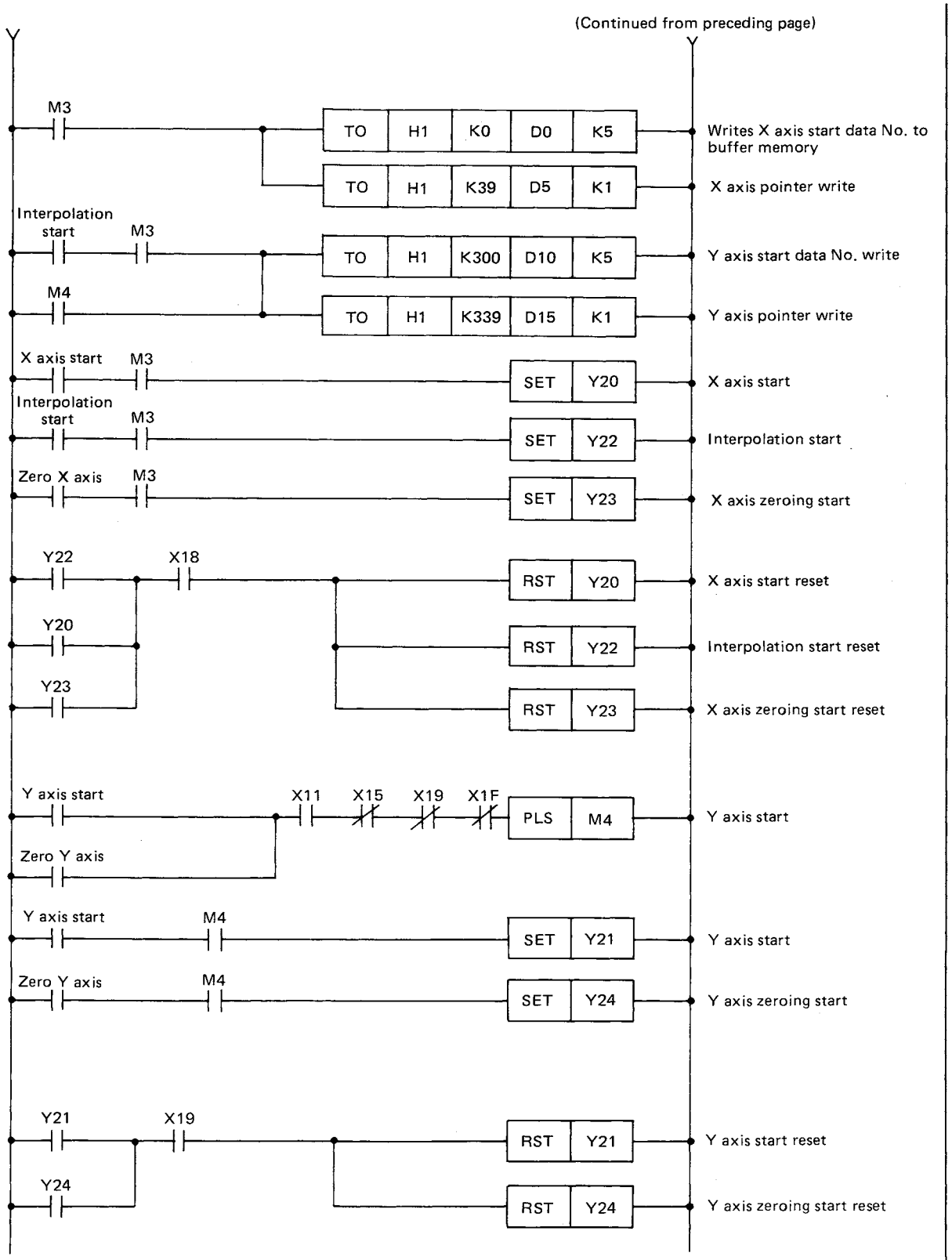
[Example 1] X axis start



Timing is same as on page 6-16.

[Example 2] XY interpolation start

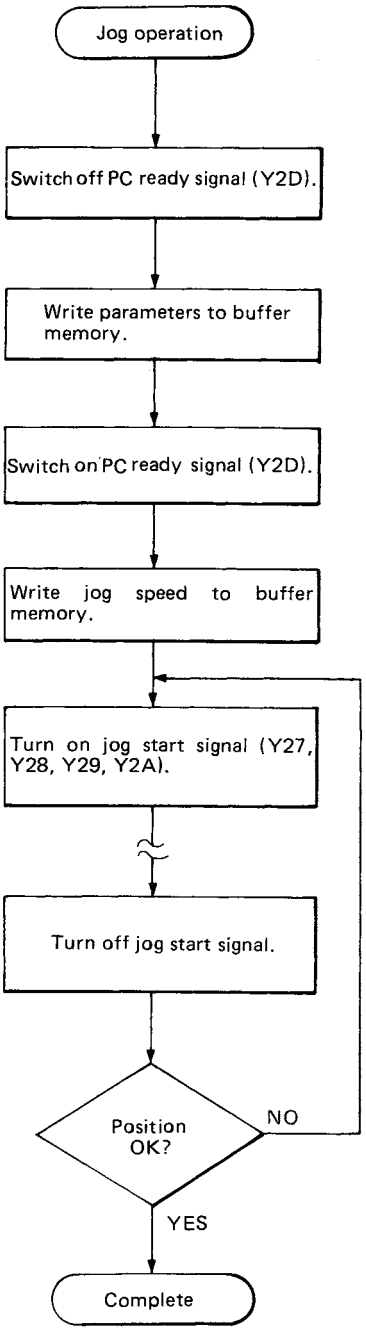




Note: For time shedule, refer to Fig. 3.44, 3.45 (Section 3.6 (17)).

6.3.4 Jog operation program

(1) Flow chart



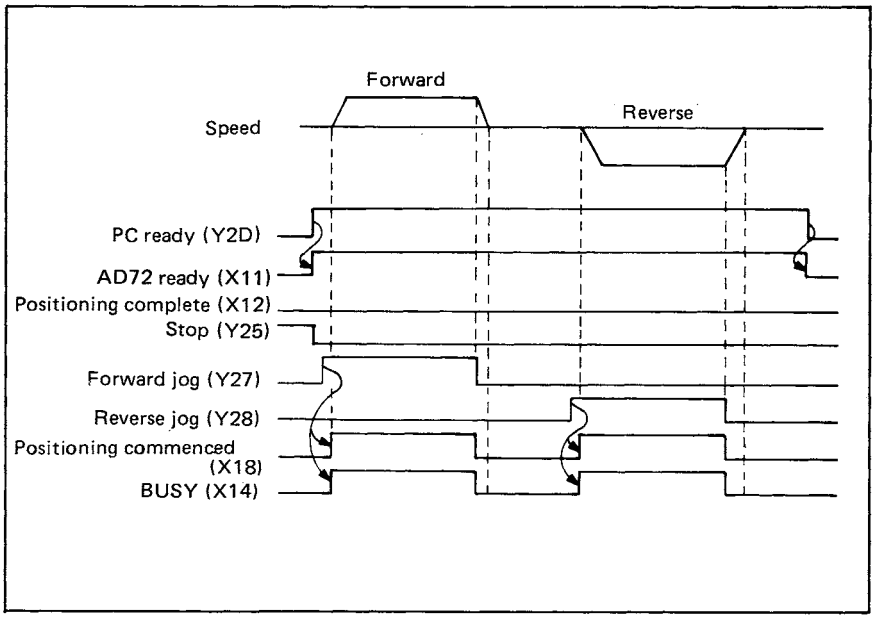
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	AD72 ready (X11)	ON	*
	Relevant axis busy (X14, X15)	OFF	
	Relevant axis positioning commenced (X18, X19)	OFF	
	Relevant axis M code ON (X1E, X1F)	OFF	
	Relevant axis stop (Y25, Y26)	OFF	
	PC ready (Y2D)	ON	*
Others	Jog speed	Starting bias speed or higher	If jog speed specified is higher than the jog speed limit value, operation is performed at the jog speed limit value.
	Parameters	Within setting range.	
	Neither axis should be busy after a BREAK signal has been received from the GPP and both axes have stopped.		
	Neither axis should be busy after a STOP signal has been received from the AD71TU and both axes have stopped.		

*In GPP or AD71TU test mode, X11 and Y2D may be off.

Table 6.3 Jog Operation Start Conditions

(3) Timing



POINT

(1) During jog operation the upper and lower stroke limits are ignored.

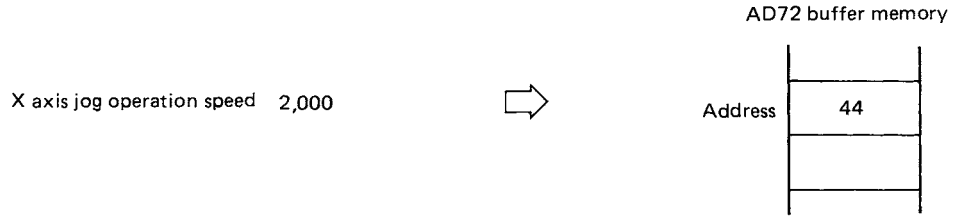
(2) When backlash compensation has been specified, the minimum movement allowed will be the backlash specified.

(4) Program

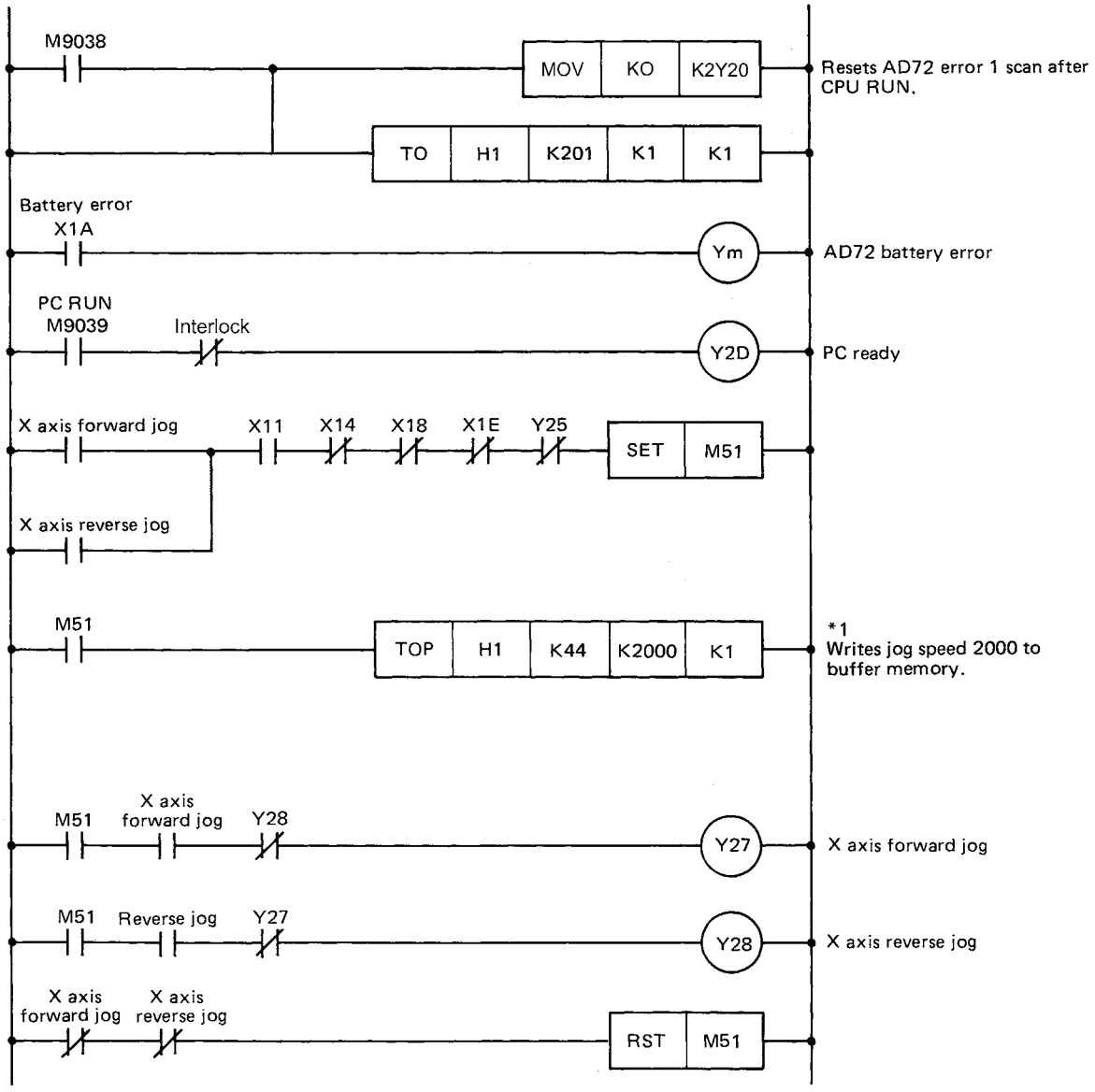
The drive is enabled for as long as the jog switch is pressed.

[Example]	X axis jog at speed 2,000 (20,000 mm/min)
[Note]	Start conditions are shown in Table 6.3. The jog speed must be written to the buffer memory.

[Data transfer]



[Program]



REMARKS

1. The AD72 will wait until the output speed is zero before giving a second jog output.

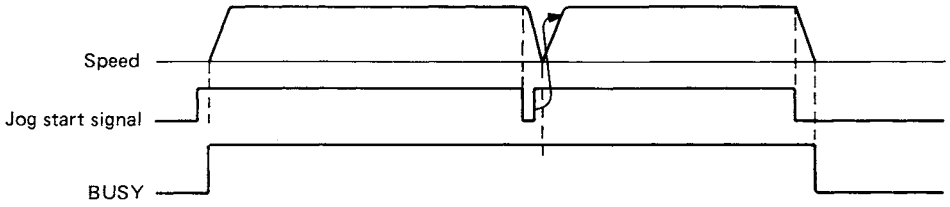


Fig. 6.8 Jog Repetition

2. Interpolation is not enabled during jog operation.

3. The AD72 defaults to forward jog if both forward and reverse jog commands are given simultaneously.

POINT

The jog speed (*1) set in the program is automatically multiplied ten times by the AD72, e.g. when 2,000 is set, actual speed is 20,000mm/min (2,000 x 10^1).

6.3.5 Manual pulser inching (inching)

The following principle underlies positioning by manual pulse operation:

(1) When the manual pulse is operated, the pulse is transmitted to the AD72.

(2) The AD72 converts the received pulse into an output pulse.

The AD72 requires several tens of milliseconds to perform internal processing, such as output pulse conversion.

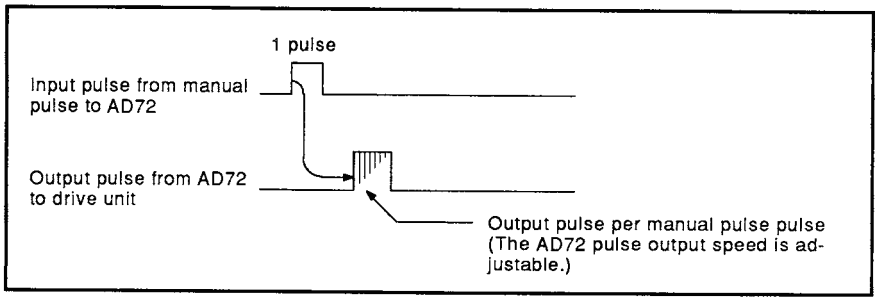
Conversion expression

$$\text{Number of AD72 output pulses} = \frac{R \times Q}{P} \quad \text{..... (Expression 1)}$$

P: "Travel distance per pulse" in the parameters (setting unnecessary when the set unit is "PLS")
Q: "Travel distance per manual puls" in the parameters
R: Number of input manual pulse pulses

(3) The AD72 transmits output pulses, calculated in accordance with Expression 1, to the drive unit. The AD72 transmits output pulses as shown below:

(a) In response to each input pulse from the manual pulse to the AD72, the AD72 transmits output pulses to the drive unit.



(b) The AD72 requires the time calculated from the following expression to complete pulse output in response to each manual pulse.

$$\text{AD72 pulse output time} = \underset{1)}{\text{(AD72 internal processing time)}} + \underset{2)}{\text{(Pulse output time) [ms]}} \quad \text{..... (Expression 2)}$$

1) AD72 internal processing time: Several tens of milliseconds

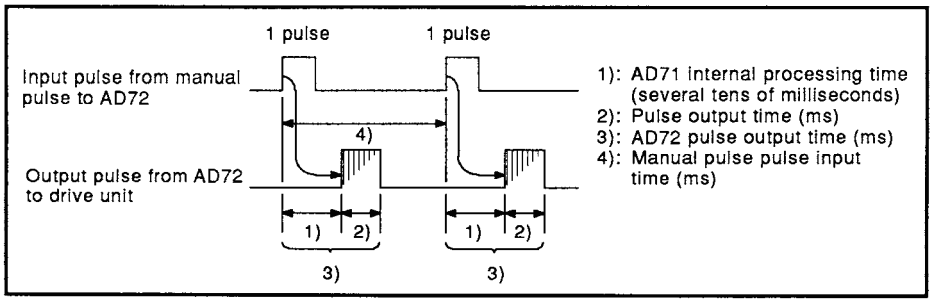
2) Pulse output time:

$$\frac{\text{(Travel distance per manual pulse) x (Number of pulses the AD72 counts)}}{\text{(AD72 pulse output speed)*}} \text{ [ms]}$$

..... (Expression 3)

* The pulse output speed of the AD72 is 20Kpps (fixed).

As soon as the AD72 completes pulse output, it receives the next input pulse from the manual pulse, and accordingly transmits output pulses to the drive unit within the time calculated in accordance with Expression 2.



Consequently, the AD72 transmits output pulses intermittently even if it receives continuous pulse input.

If the manual pulse input time (ms) is shorter than the value obtained in accordance with Expression 2, output pulses remain in the AD72. These pulses will be transmitted after the AD72 completes each internal processing (several tens of milliseconds).

(4) While the AD72 is transmitting pulses to the drive unit, the BUSY signal of the relevant axis is on.

POINT

(1) Always disable the inching operation when not in use (i.e. write "0" to buffer memory address 47 (X axis) or 347 (Y axis). See page 3-43.)

(2) The inching operation is allowed if:

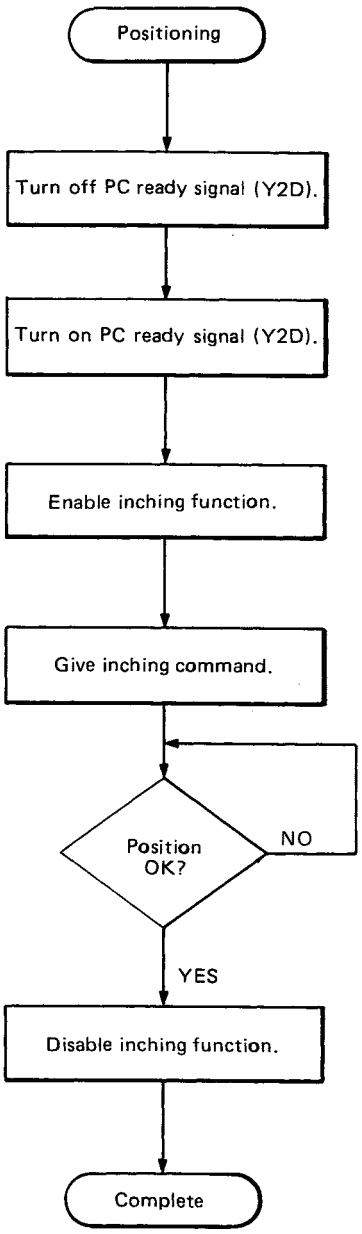
- **Inching is enabled in the buffer memory.**
- **The relevant axis is not busy, or is busy in inching mode.**

(3) The input and output counters which count the number of inching commands given, are cleared approx. 0.2 seconds after disabling the inching function or switching off the PC ready signal (Y2D).
When the stop signals (Y25, Y26) are switched on, the pulse input and output counters are cleared to 0.

(4) Travel requiring backlash compensation is not started if the number of output pulses is less than the backlash setting value.

(5) The inching command input counter is not cleared if there is an error preventing operation. In this case disable the inching function (which clears the counter), clear the error, and then re-enable the inching function.

(1) Flow chart



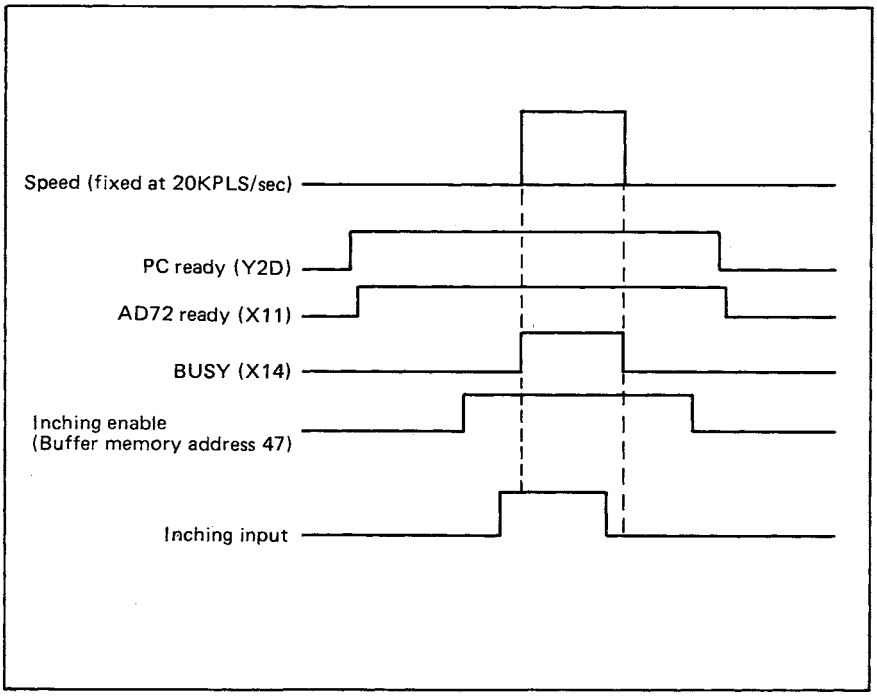
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	AD72 ready (X11)	ON	*
	Relevant axis busy (X14, X15)	OFF	On during manual pulser pulse generation
	Relevant axis positioning commenced (X18, X19)	OFF	
	Relevant axis M code ON (X1E, X1F)	OFF	
	Relevant axis stop (Y25, Y26)	OFF	
	PC ready (Y2D)	ON	*
Others	"Inching enable" in buffer memory (X axis 47 / Y axis 347)	Bit = 1	
	Parameters	Within setting range.	
	Neither axis should be busy if a [BREAK] (A6GPP) or [STOP] (AD71TU) signal has been received and positioning has stopped.		

*In GPP or AD71TU test mode, X11 and Y2D may be off.

Table 6.4 Start Conditions

(3) Timing



IMPORTANT

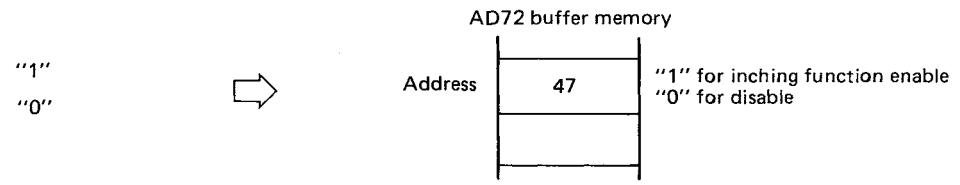
Error code 73 is given if the inching command is given while the AD72 is "BUSY" during positioning, zeroing or jog operation. For this reason, it is recommended that inching is disabled while not in use.

(4) Program

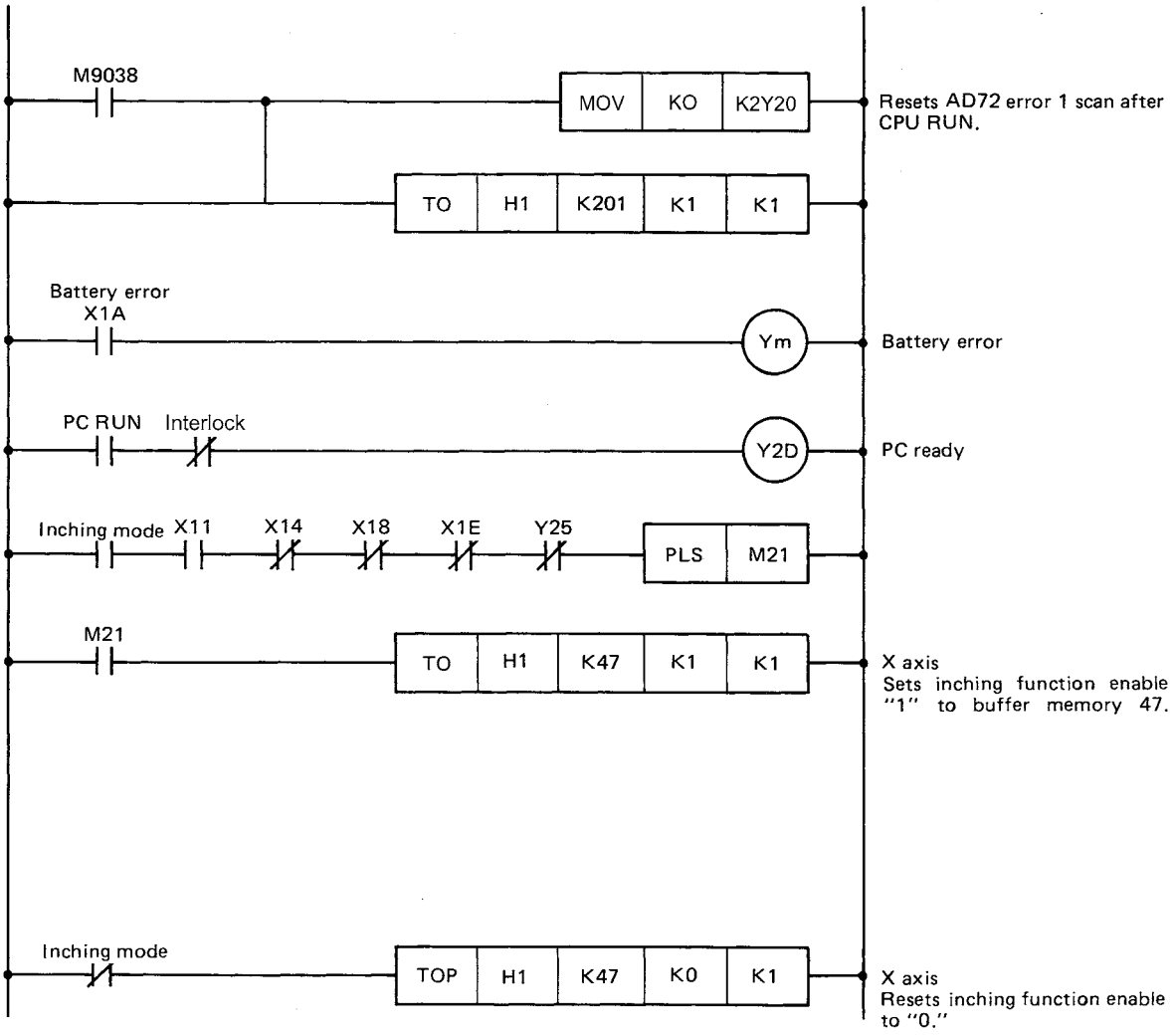
[Example] X axis inching

[Note] Start conditions are shown in Table 6.4.

[Data transfer]



[Program]



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6.3.6 Position address teaching

May be achieved as follows:

(1) Jog operation

Move the system to be required position and write that address into the buffer memory.

(2) Inching operation

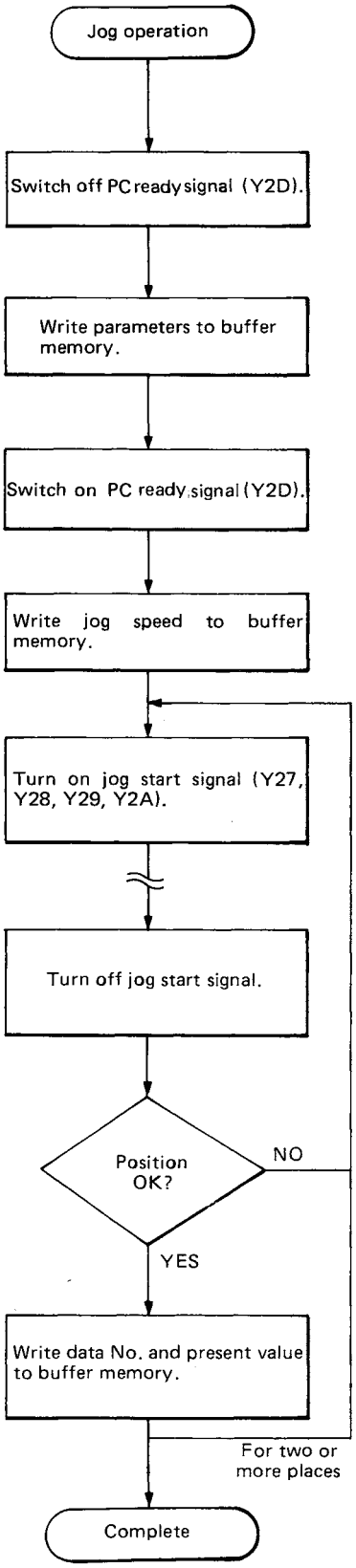
Inch the system to the required position and write that address into the buffer memory.

(3) Jog then inching combined

Course position using the jog operation then fine position with the inching function. Write the address to the buffer memory.

[1] Jog to position and teach

(1) Flow chart



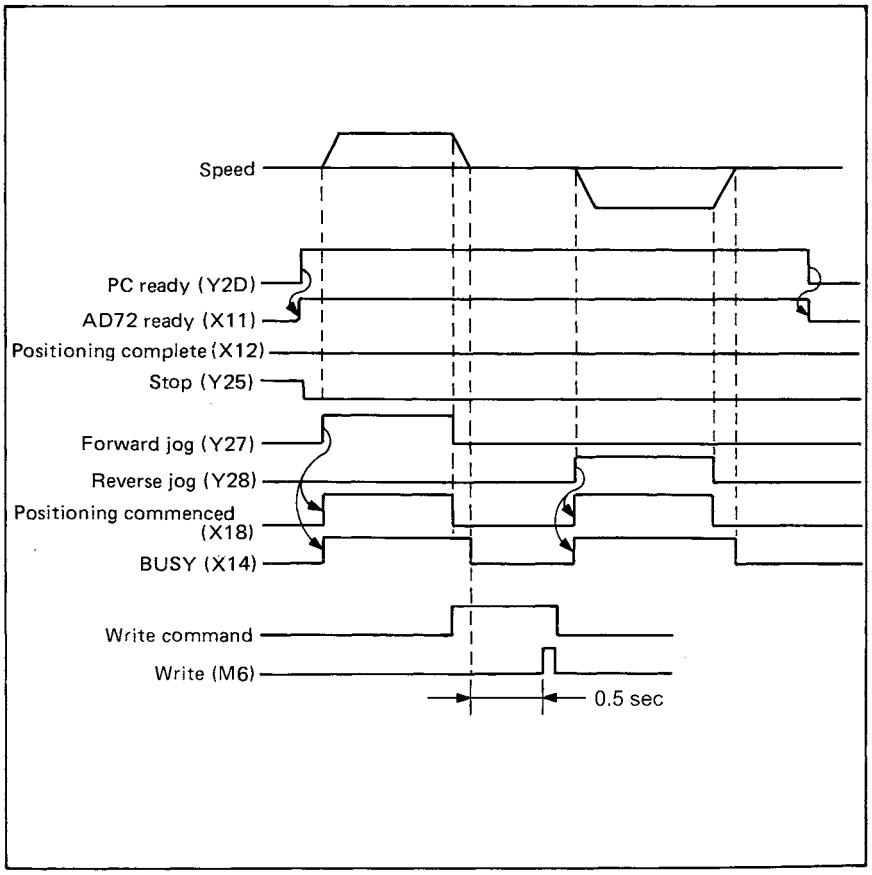
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	AD72 ready (X11)	ON	*
	Relevant axis busy (X14, X15)	OFF	
	Relevant axis positioning commenced (X18, X19)	OFF	
	Relevant axis M code ON (X1E, X1F)	OFF	
	Relevant axis stop (Y25, Y26)	OFF	
	PC ready (Y2D)	ON	*
Others	Jog speed	Starting bias speed or higher	If jog speed specified is higher than the jog speed limit value, operation is performed at the jog speed limit value.
	Parameters	Within setting range.	
	Neither axis should be busy after a BREAK signal has been received from the A6GPP and both axes have stopped.		
	Neither axis should be busy after a STOP signal has been received from the AD71TU and both axes have stopped.		

*In GPP or AD71TU test mode, X11 and Y2D may be off.

Table 6.5 Address Write Conditions Using Jog Operation

(3) Timing

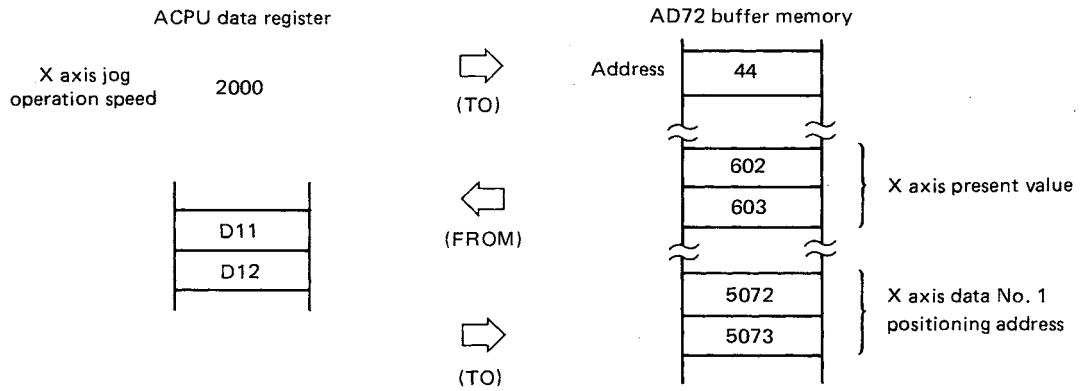


(4) Program

System is positioned in jog mode and resulting address written to buffer memory.

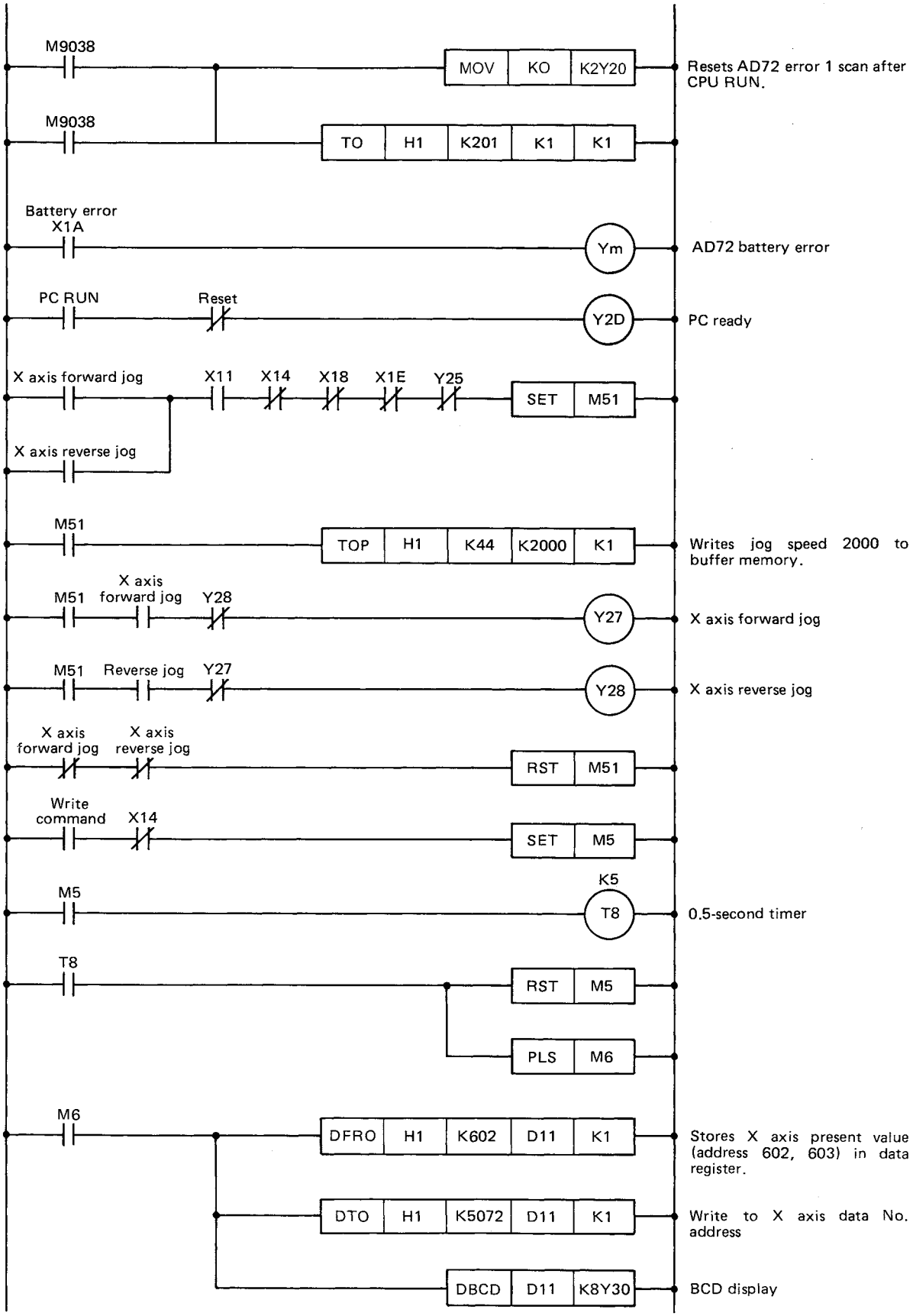
[Example]	X axis jog and address written as data No. 1 (jog speed = 2,000 (20,000 mm/min))
[Notes]	(1) Start conditions are shown in Table 6.5. (2) A delay of approx. 0.5 seconds occurs after positioning stops to allow the current value of the buffer memory to be updated.

[Data transfer]



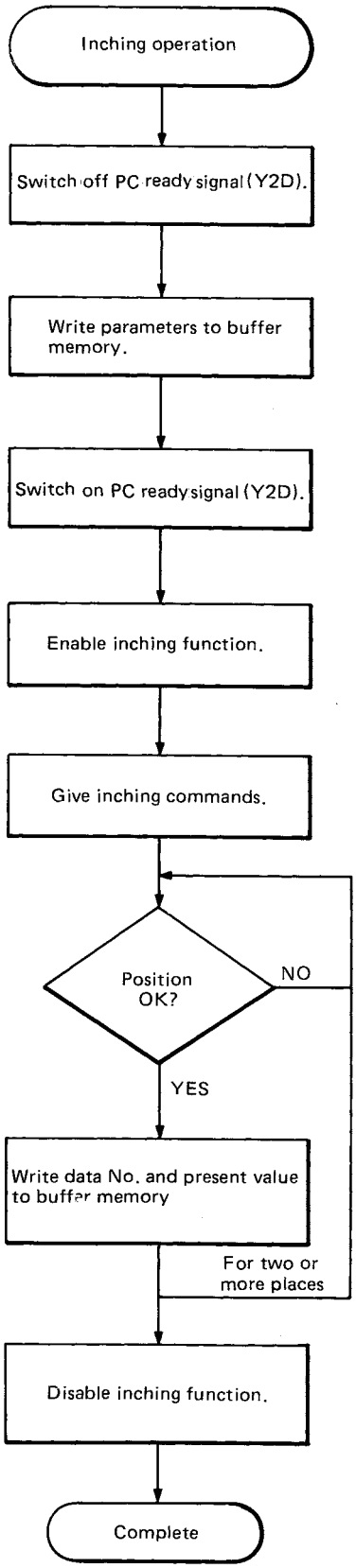
[Program]

To write address to data No. 1



[2] Inch to position and teach

(1) Flow chart



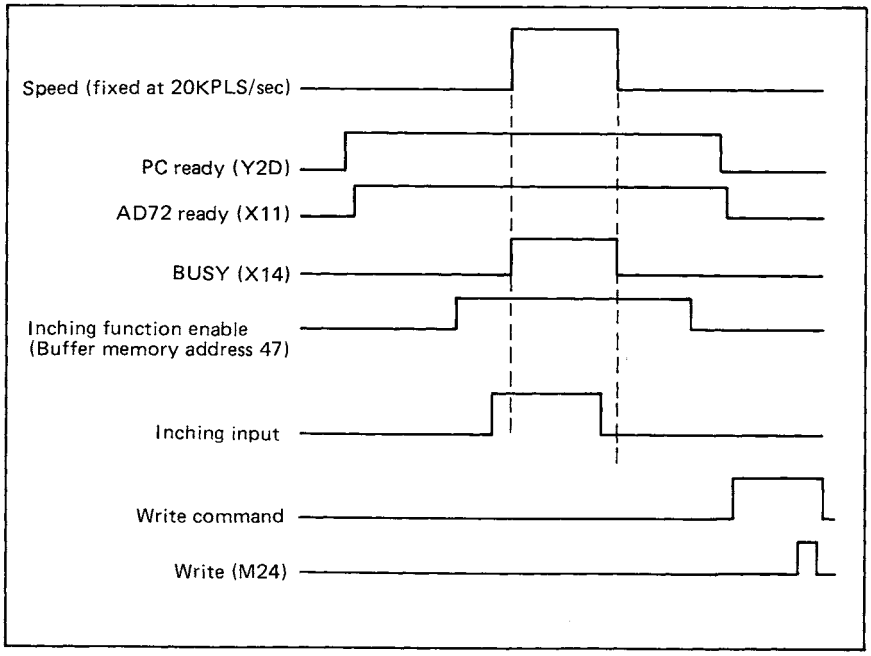
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	AD72 ready (X11)	ON	*
	Relevant axis busy (X14, X15)	OFF	
	Relevant axis positioning commenced (X18, X19)	OFF	
	Relevant axis M code ON (X1E, X1F)	OFF	
	Relevant axis stop (Y25, Y26)	OFF	
	PC ready (Y2D)	ON	*
Others	Inching function enable in buffer memory (X axis 47, Y axis 347)	Bit 0 = 1	
	Parameters	Within setting range.	
	Neither axis should be busy if a BREAK (A6GPP) or STOP (AD71TU) signal has been received and positioning has stopped.		

*In GPP or AD71 TU test mode, X11 and Y2D may be off.

Table 6.6 Address Write Conditions

(3) Timing



IMPORTANT

Error code 73 is given if the inching command is given while the AD72 is "BUSY" during positioning, zeroing or jog operations. For this reason it is recommended that inching is disabled when not in use.

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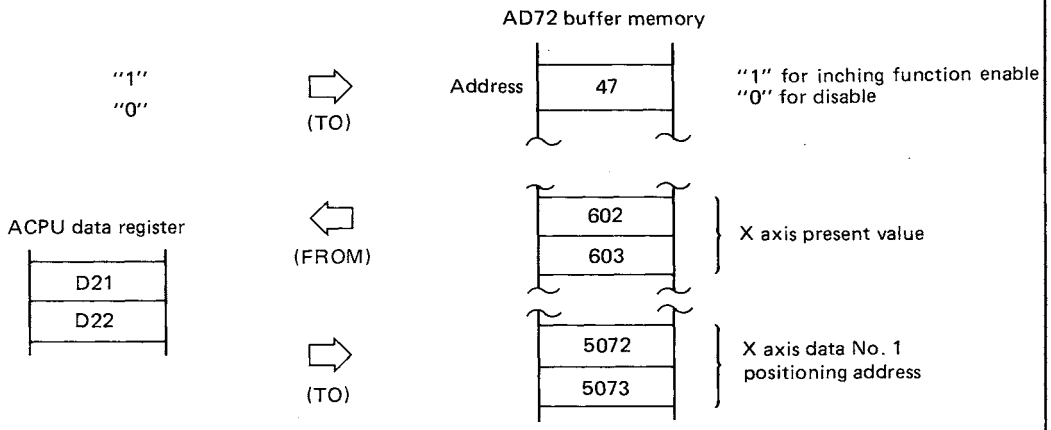
(4) Program

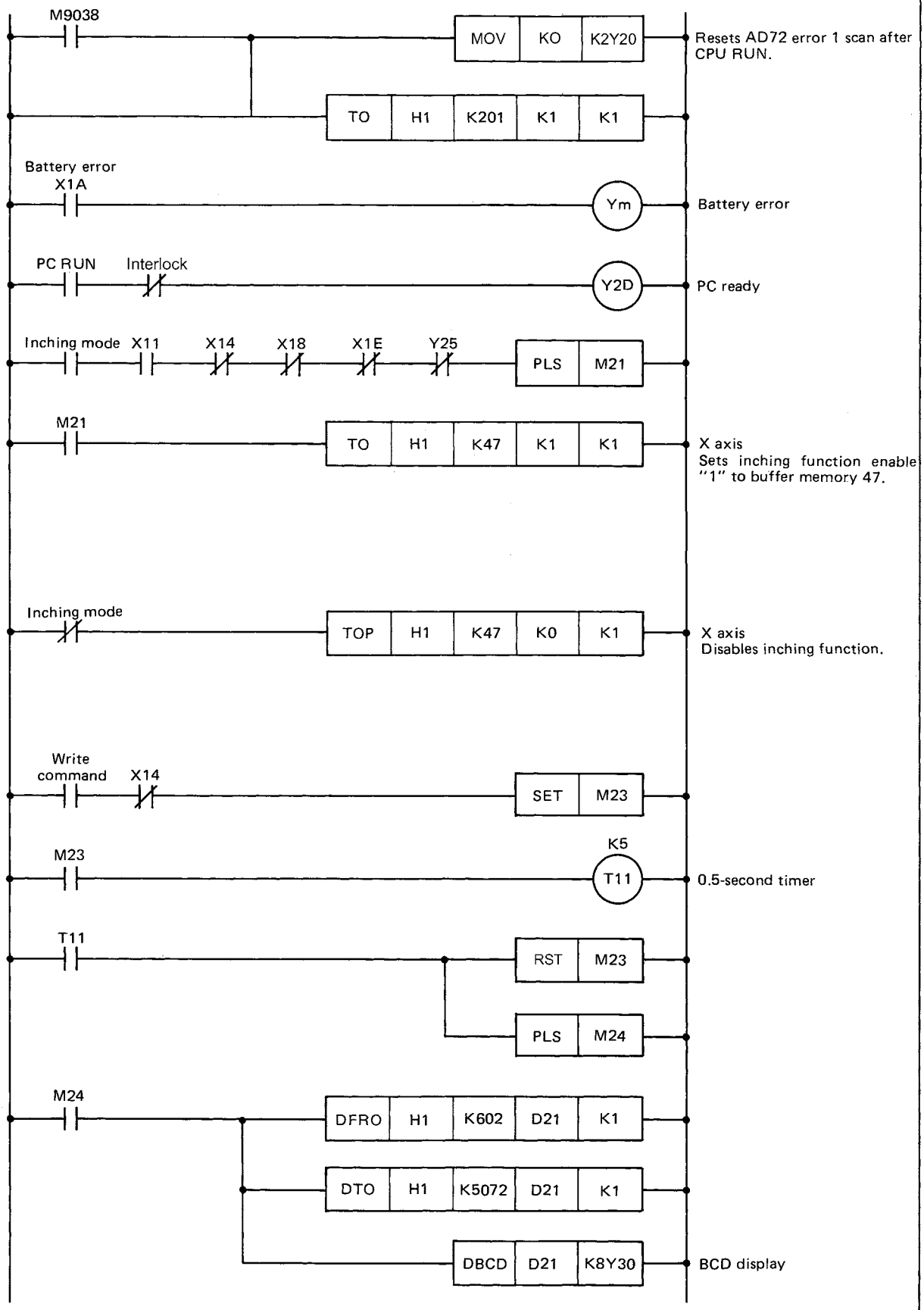
System is inched to required position and resulting address written to buffer memory.

[Example]	Inch X axis and address written as data No. 1.
[Notes]	(1) Start conditions are shown in Table 6.6. (2) A delay of approx. 0.5 seconds occurs after positioning stops to allow the current value of the buffer memory to be updated.

[Data transfer]



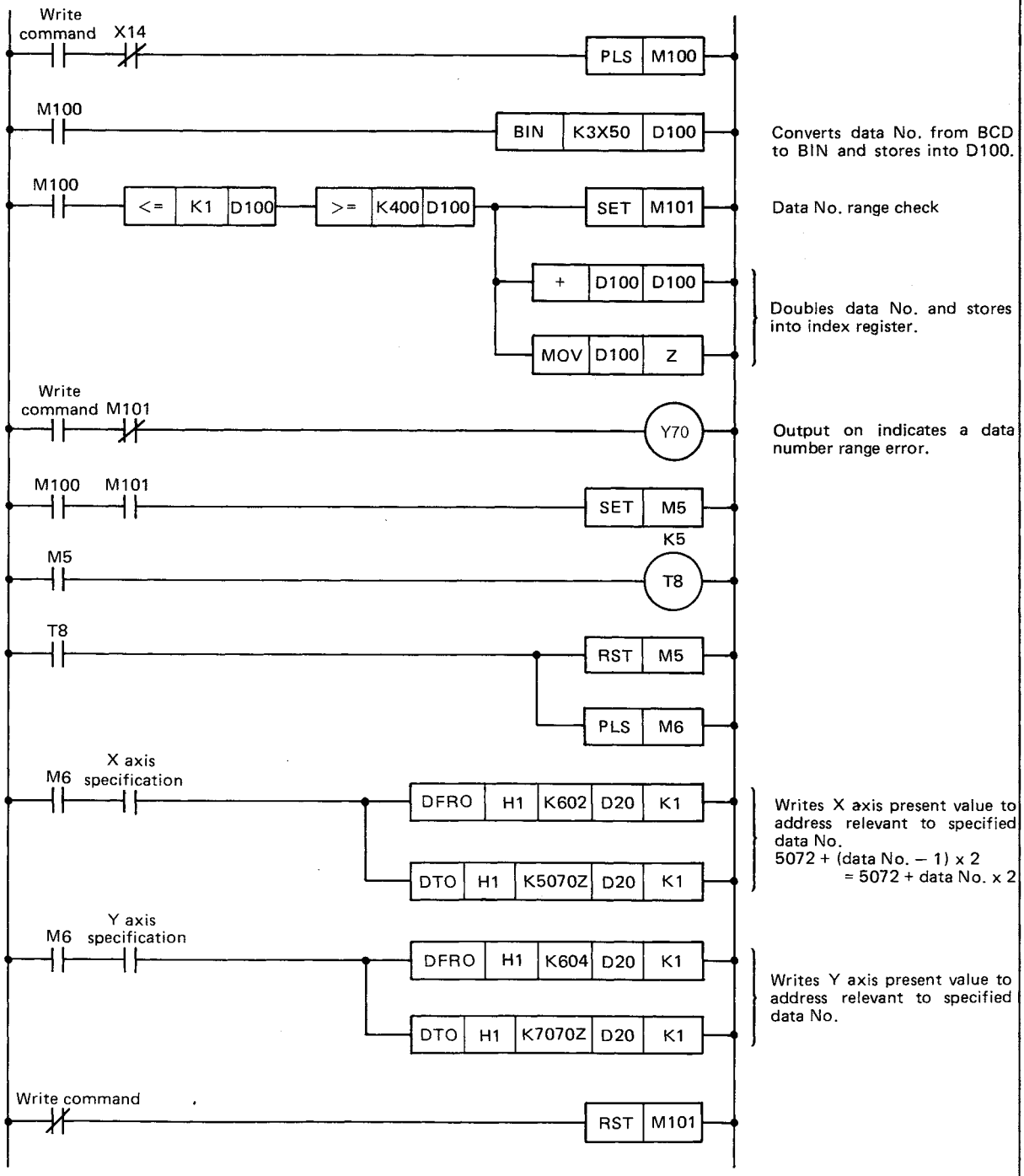
[Program]


M9038
MOV
KO
K2Y20
Resets AD72 error 1 scan after CPU RUN.
TO
H1
K201
K1
K1
Battery error
X1A
Ym
Battery error
PC RUN
Interlock
Y2D
PC ready
Inching mode
X11
X14
X18
X1E
Y25
PLS
M21
M21
TO
H1
K47
K1
K1
X axis
Sets inching function enable "1" to buffer memory 47.
Inching mode
TOP
H1
K47
K0
K1
X axis
Disables inching function.
Write command
X14
SET
M23
M23
K5
T11
0.5-second timer
T11
RST
M23
PLS
M24
M24
DFRO
H1
K602
D21
K1
DTO
H1
K5072
D21
K1
DBCD
D21
K8Y30
BCD display

[3] Teaching the position address and defining the data number using a thumbwheel switch

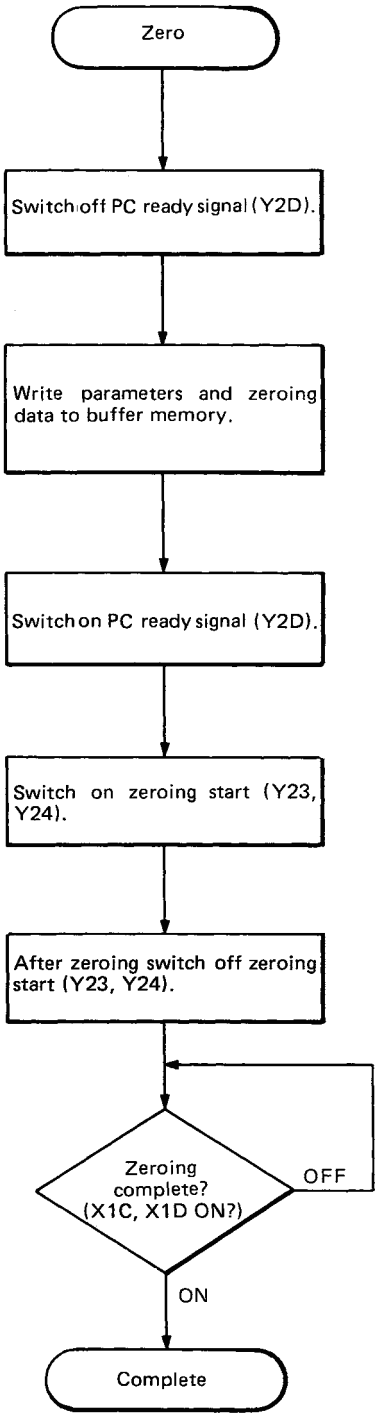
[Example] The data number for the address reached is input from a 3 digit BCD switch wired to inputs X50 to X5B.

[Program]



6.3.7 Zeroing

(1) Flow chart



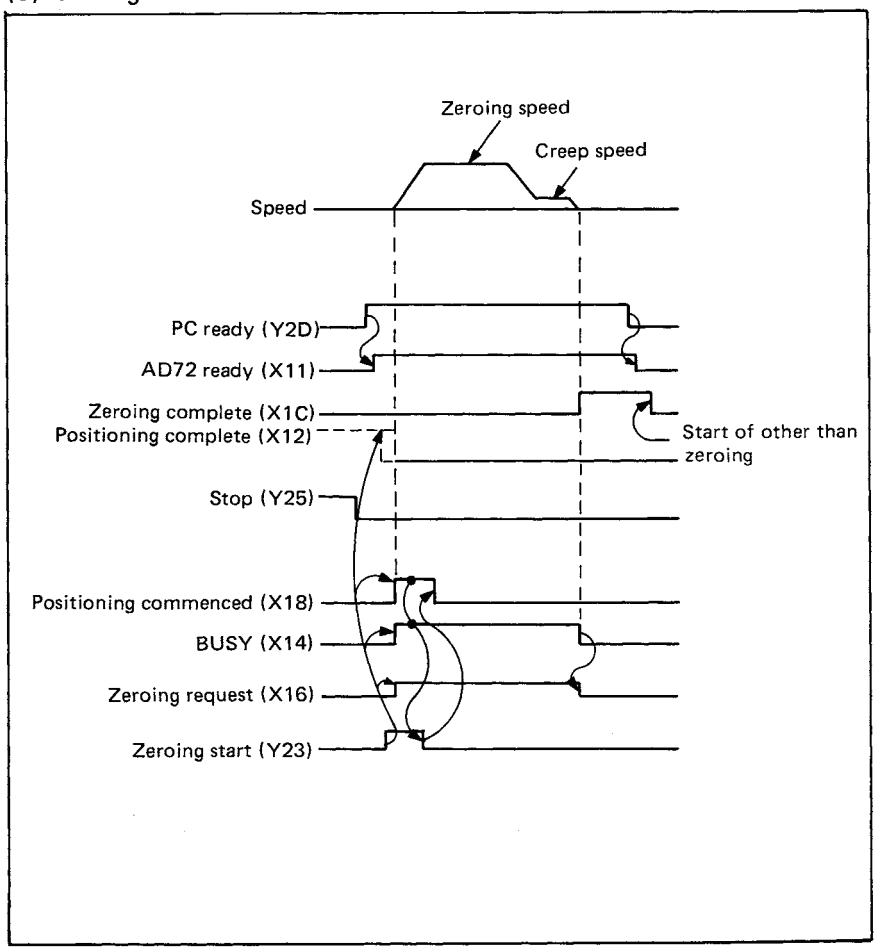
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	AD72 ready (X11)	ON	*
	Relevant axis busy (X14, X15)	OFF	
	Relevant axis positioning commenced (X18, X19)	OFF	
	Relevant axis zeroing complete (X1C, X1D)	OFF	
	Relevant axis M code ON (X1E, X1F)	OFF	
	Relevant axis stop (Y25, Y26)	OFF	
	PC ready (Y2D)	ON	*
Others	Zeroing data	No error	
	Repetition of zeroing start	Max. twice consecutively.	
	Neither axis should be busy after [BREAK] (A6GPP) or [STOP] (AD71TU) has been received and positioning has stopped.		

*In GPP or AD71TU test mode, X11 and Y2D may be off.

Table 6.7 Zeroing Conditions

(3) Timing

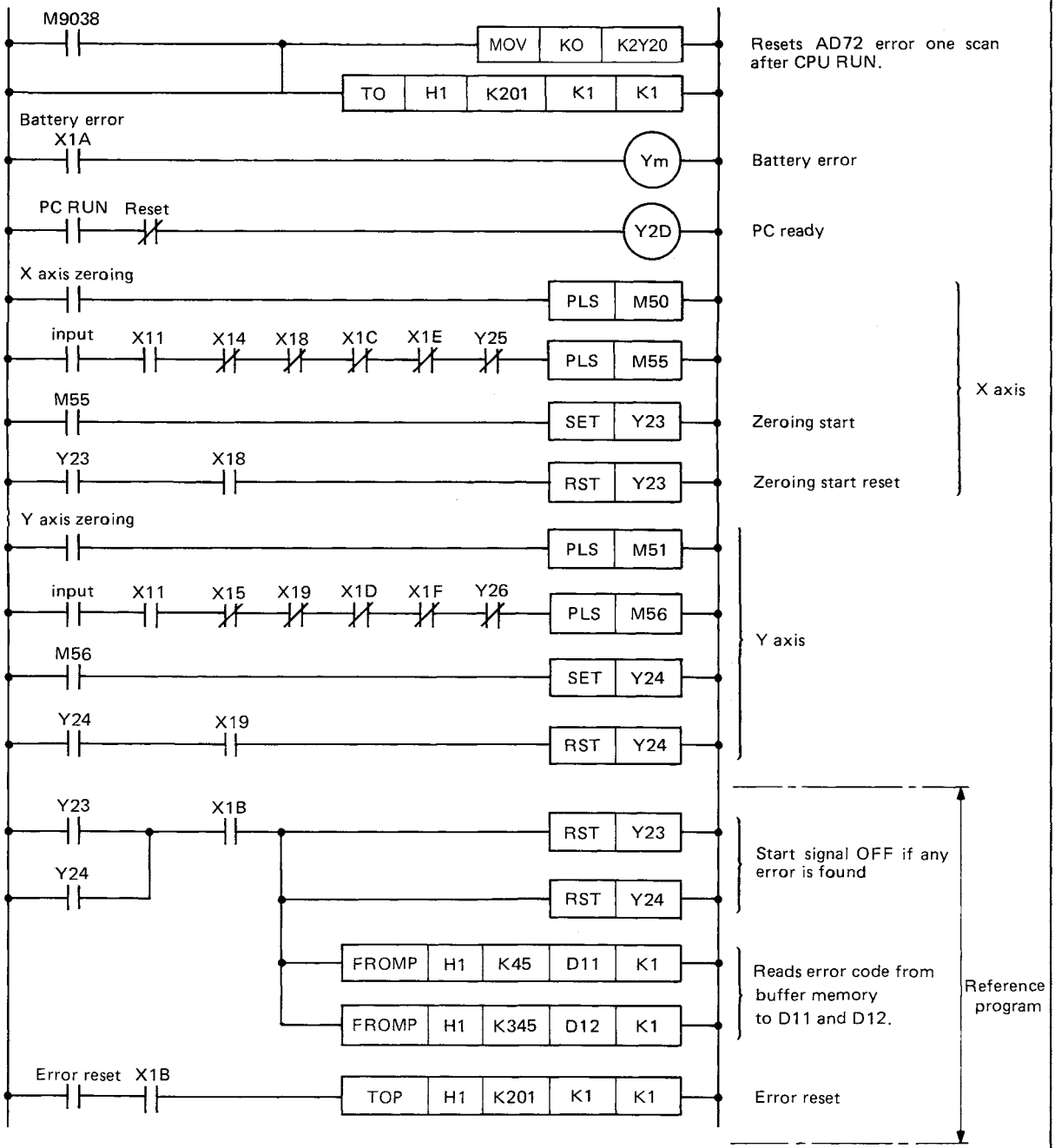


(4) Program

[Example] To zero the system, the X and Y axis zeroing inputs are pulsed. In the event of an error occurring during zeroing, the error number is read to data register.

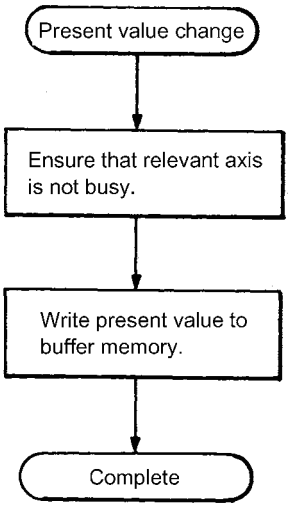
[Notes]
(1) Start conditions are shown in Table 6.7.
(2) Interpolation is not enabled during zeroing.
Giving a simultaneous zeroing command to both axes causes one axis to delay about 50ms before starting.
(3) The zeroing command may be used no more than twice consecutively. (i.e. with no intermediate operation)

[Program]



6.3.8 Present value change

(1) Flow chart



(2) Condition

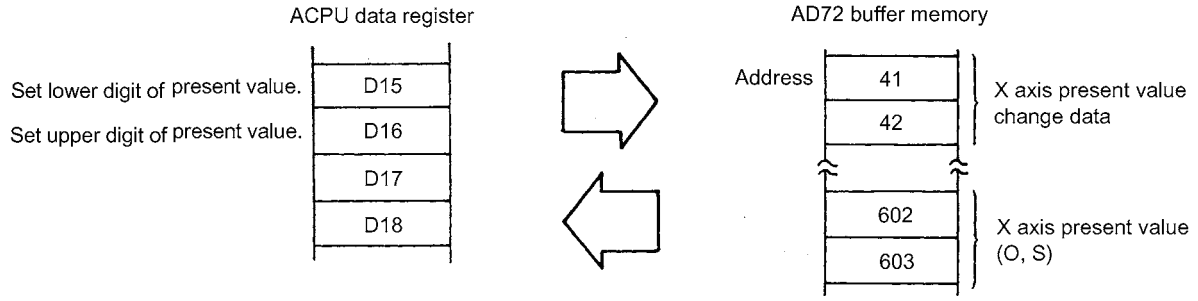
Table 6.8 Present Value Change Condition

Signal	State	Remarks
Relevant axis BUSY	OFF	

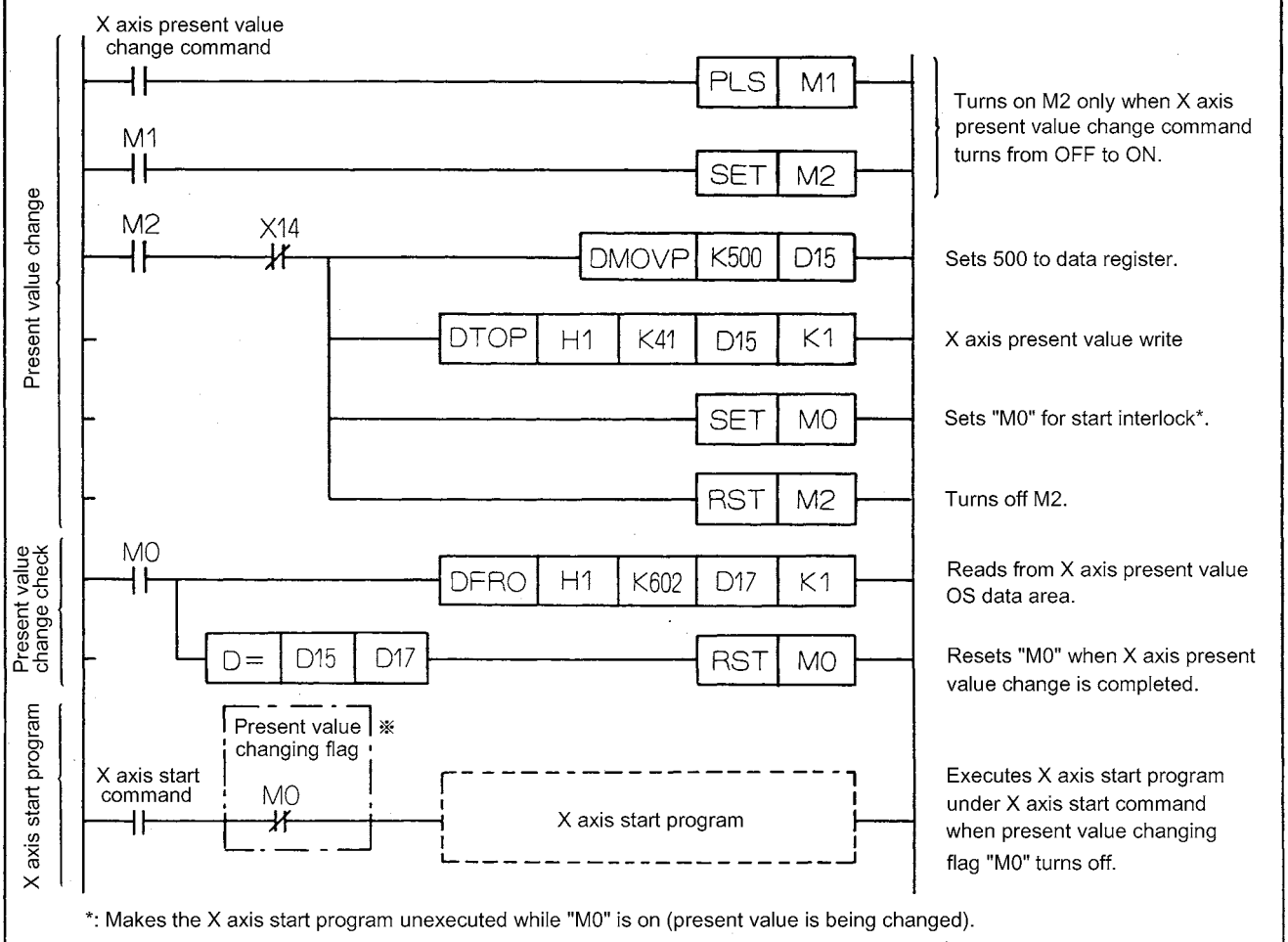
(3) Program

[Example] To change the present value to 500 only when the X axis present value change command turns from OFF to ON

[Data transfer]



[Program]



REMARKS

1. Always write the two (upper and lower) words to the present value change area simultaneously. Writing one word only will not change the present value and will cause an error to be flagged.

2. Zeroing will always set the present value back to the zero address. However, the zeroing data and parameters should be written to the buffer memory before zeroing.

6.3.9 Positioning stop

The positioning process may be stopped while the AD72 is busy as follows:

Item	Valid Signal	Independent Operation		Inter-polation Operation
		Relevant axis	Other axis	
STOP signal from drive unit ON	↑	○		○
PC ready signal (Y2D) OFF*	↓	○	○	○
Stop signal from PC (Y25, Y26) ON	↑	○		○
BREAK key input from GPP or STOP key input from AD71TU	↑	○	○	○

○ indicates that the signal is valid.
*In GPP or AD71TU test mode signals Y2D, Y25, and Y26 are ignored and cannot stop processing.

Table 6.9 Stop Signals

(1) Note on use of stop signal

(a) Deceleration is valid after stop signal is received

On receiving any of the stop commands given in Table 6.9, the system is decelerated to a stop.
All emergency stops and limits must be hard-wired.

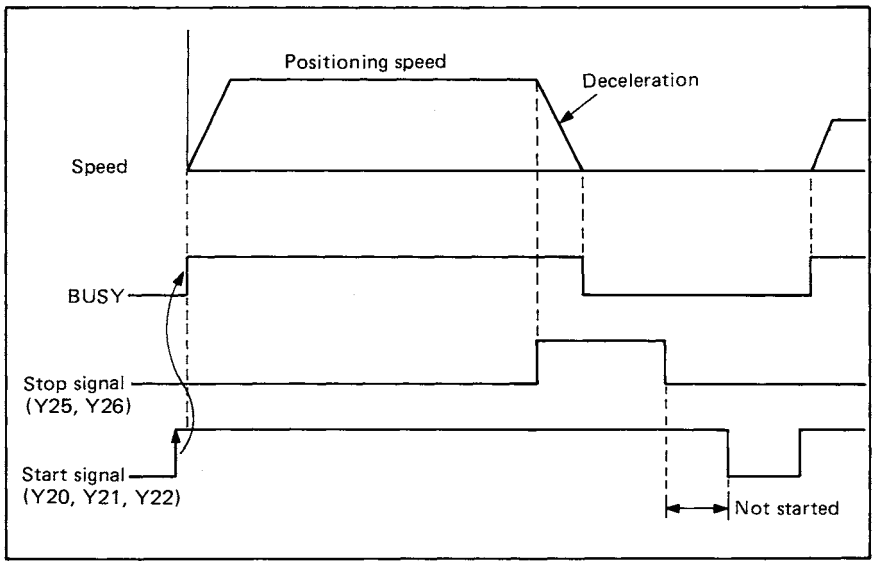


Fig. 6.9 Stop Signal

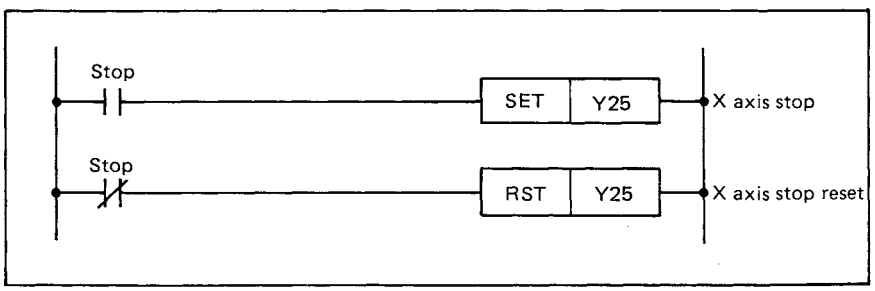


Fig. 6.10 Stop Program Example

(b) Stop signal during deceleration

When a stop signal is received during normal deceleration, this has no effect on the rate etc. However if the signal is received during zeroing, positioning stops immediately.

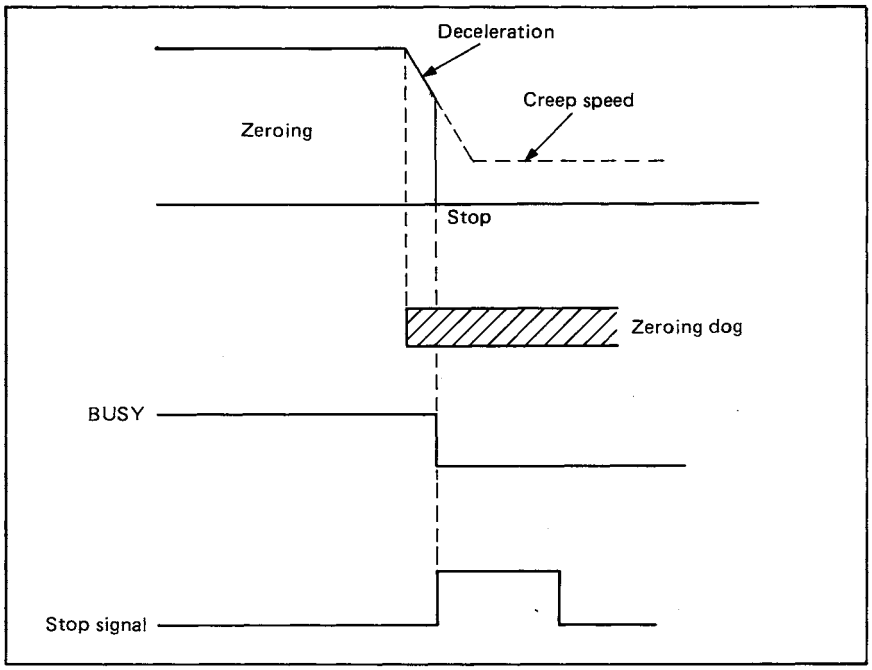


Fig. 6.11 Stop Command Received during Zeroing Deceleration

REMARKS

Giving the stop command at any point after the zeroing dog has been actuated will invalidate the zeroing process. In this case the system must be manually driven (jog or inch) to a point before the zeroing dog and the process repeated.

(c) Stop signal reset

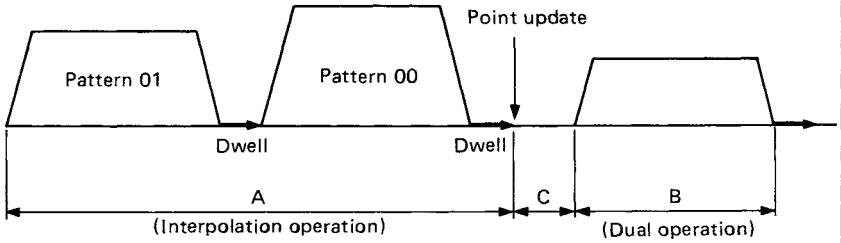
A start signal is only valid at its leading edge, therefore if it is already on when the stop signal is reset the process will not restart.

(d) M code

The conditions shown in Table 6.9 turn off the M code ON signal at the relevant axis. When the PC ready signal is turned off, the M code is set to "0".

(e) Stop during interpolation operation

During interpolation, both axes are stopped by either the X- or the Y-axis stop signal. Where interpolation and dual operation are combined the effect of the stop command will depend on where in the cycle the AD72 has reached (see below).



Condition	Stop signal turns on in area A	Stop signal turns on in area C
The relevant axis is not busy or is executing independent positioning in B.	Both axes stop.	Only the original axis stops.
The relevant axis has not yet executed positioning in B.		Both axes stop.

Fig. 6.12 Stop during Interpolation

(2) Other stop signals

In addition to the four stop signals in Table 6.9, the following also stop processing while the AD72 is BUSY. For all the following, positioning is decelerated to a stop and the GPP displays an error message.

Item	Valid Signal	Independent Operation		Interpolation Operation
		Relevant axis	Other axis	
Ready signal from drive unit OFF	↓	○		○
Operation error (8231 error)		○	○	○
AD72 bus error		○	○	○

Table 6.10 Stop Signals (Hardware)

(3) Restart after stop

(a) Proceed to next address

A restart changes as indicated in the following table depending on the positioning method and whether automatic data No. change is used or not.

	Absolute method	Incremental method
	2-axis independent operation/2-axis interpolation operation	2-axis independent operation/2-axis interpolation operation
When automatic data No. change is not used	Enabled	Disabled
When automatic data No. change is used	Disabled	Disabled

REMARKS

- When automatic data No. change is not used
  Indicates that the data No. is set to only the first point (X axis address: 0, Y axis address: 300) of the positioning start data No. area in the AD72.
- When automatic data No. change is used
  Indicates that multiple data Nos. are set to the positioning start data No. area (X axis address: 0 to 39, Y axis address: 300 to 339) in the AD72.

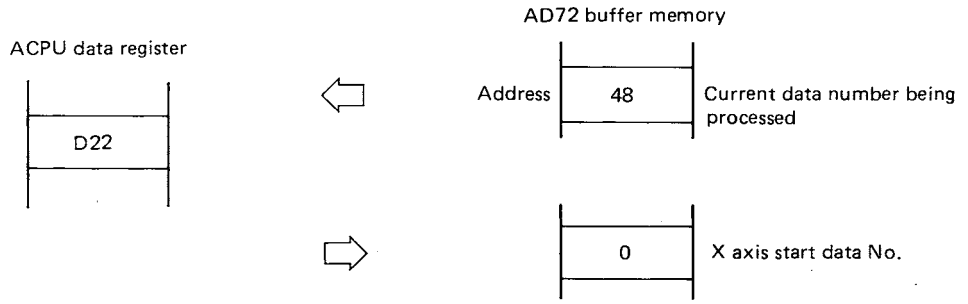
In the mode disabled in the above table, take either of the following actions.

- Perform zeroing and then restart positioning.
- Re-set the positioning data and then restart positioning.

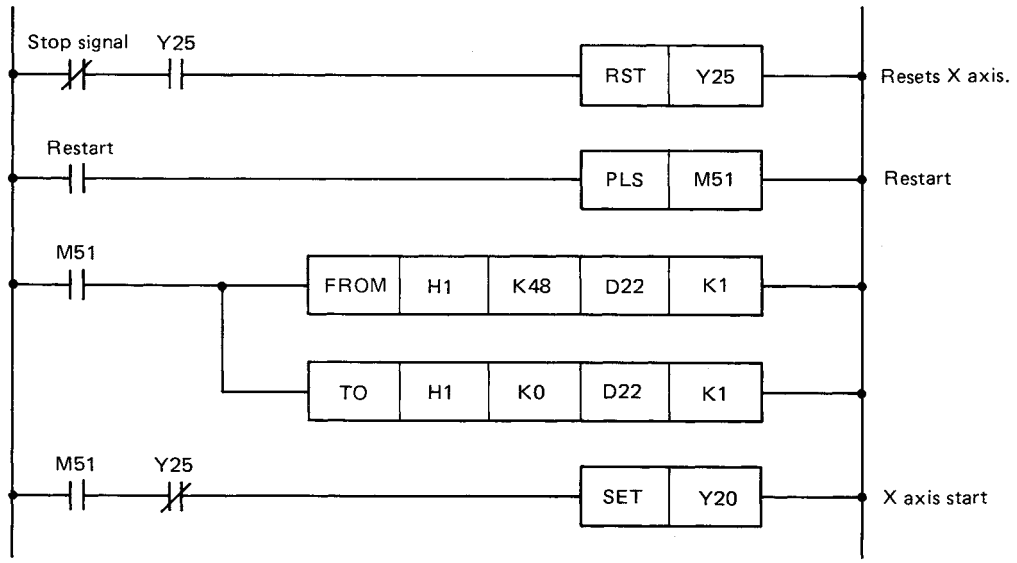
1) Absolute processing with one start data number

During positioning, the current data number is stored in buffer memory address 48 (X axis) and 348 (Y axis) and retained until the next positioning process is started. This data can be used to restart the process.

[Data transfer]



[Program]



(b) Zeroing method
Refer to Section 6.3.7.

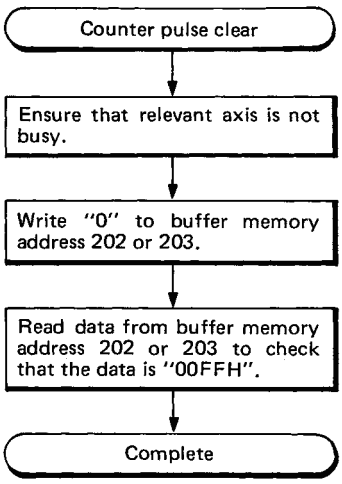
(c) Restart after stop during zeroing
A zeroing start cannot be repeated two or more times.
Start zeroing after performing the following operation.
1) Perform positioning once according to a proper data No.
2) Perform positioning properly by jog operation. When the system stops near the zero point, jog the system to before the zeroing dog.

(d) Positioning has been stopped using the "BREAK" key on the GPP

The "BREAK" key stops both the X and Y axes. Positioning can be restarted when both axes are not busy.

6.3.10 Counter pulse clear program

(1) Flow chart

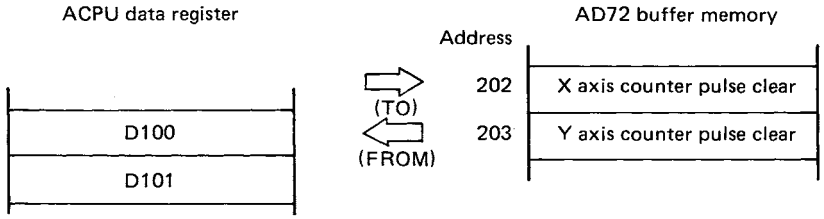


(2) Conditions

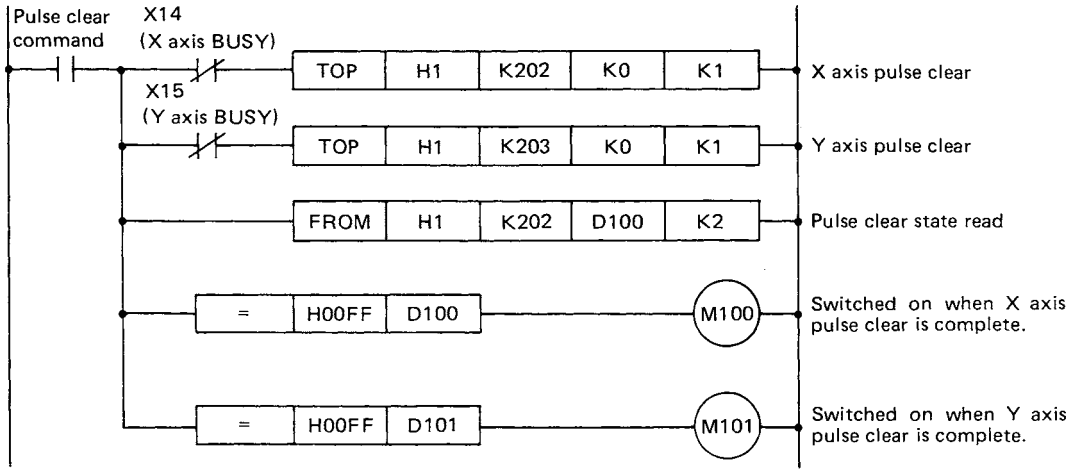
Signal	State	Remarks
Relevant axis BUSY	OFF	

[Example] To clear counter pulses of both X and Y axes and then switch on M100 and M101

[Data transfer]



[Program]

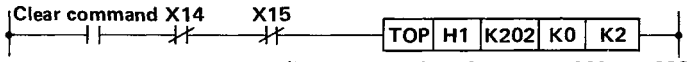


POINT

(1) As shown in the preceding example, the corresponding addresses must be directly specified for the X and Y axes in the counter pulse clear program.
Pulses are not cleared if batch processing is performed for several addresses as shown below:

Example 1: Batch processing of addresses 202 and 203

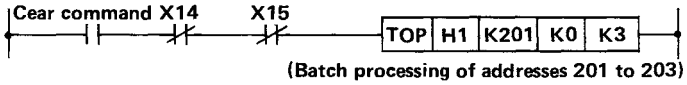
Pulses of X axis are only cleared and those of Y axis are not cleared.



(Batch processing of addresses 202 and 203)

Example 2: Batch processing of addresses 201 to 203

Pulses of X and Y axes are not cleared.



(Batch processing of addresses 201 to 203)

(2) Zeroing must be performed after counter pulse clear.

The present value of the AD72 is controlled in accordance with the pulses transmitted to the deviation counter. Clearing counter pulses resets the deviation counter pulses to "0" and causes a position shift by the pulses cleared.

(3) The AD72 allowed for pulse clear is given in Section 3.2.3.

6.4 ACPU Remote I/O Station Programming

6.4.1 Notes on programming

Data communication with a remote I/O station is on a batch refresh basis after the END (or FEND) instruction is executed in the master station program.
For detailed data link specifications, refer to the Data Link Unit User's Manual.

(1) There is a short time delay in the communication of control data between master and remote I/O stations which must be allowed for when specifying the system.

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

Data write from master to AD72 : RTOP instruction
Data read from AD72 to master : RFRP instruction

Note that link registers W, are used for data communication between master and remote stations.

(3) The RTOP and RFRP instructions cannot be executed in the same scan for one AD72 in a remote I/O station. (These may be used in the same scan if addressed to separate AD72 units.)

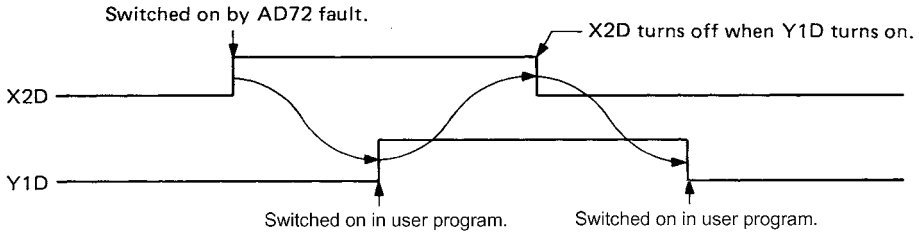
(4) Control signals between master and remote stations

- Due to the relationship between the master station scan time and link scan time, Y□□ to a remote I/O station may not be output by PLS Y□□.
- Since data are transferred between the master station and remote I/O station in a batch refresh method after the END (FEND) instruction is executed, the pulse output that executes the RST instruction after the SET instruction is executed cannot be used.

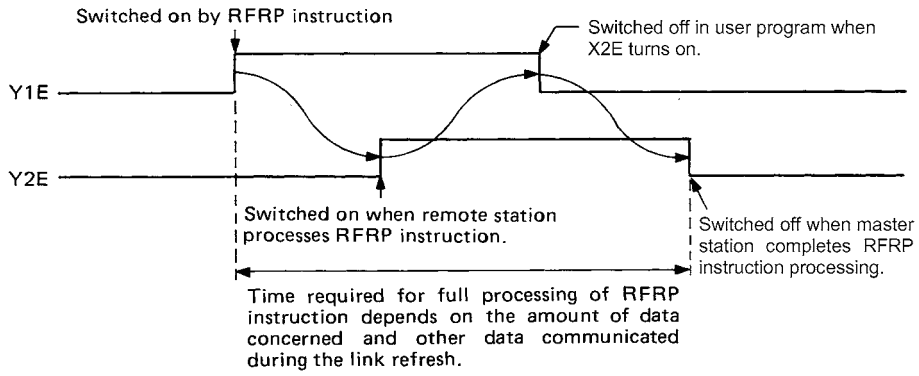
Signal Direction: PC CPU to AD72		Signal Direction: AD72 to PC CPU	
Device No.	Signal	Device No.	Signal
Y10 to Y1C	Reserved	X20 to X2C	Reserved
Y1D	Switches X2D off.	X2D	On indicates AD72 fault. RFRP and RTOP instructions cannot be used.
Y1E	Automatically switched on by master station CPU when RFRP instruction is executed. To be reset in user program after ensuring that X2E is on.	X2E	On while AD72 in remote station is processing RFRP instruction.
Y1F	Automatically switched on by master station CPU when RTOP instruction is executed. To be reset in user program after ensuring that X2F is on.	X2F	On while AD72 in remote station is processing RTOP instruction.

Timing

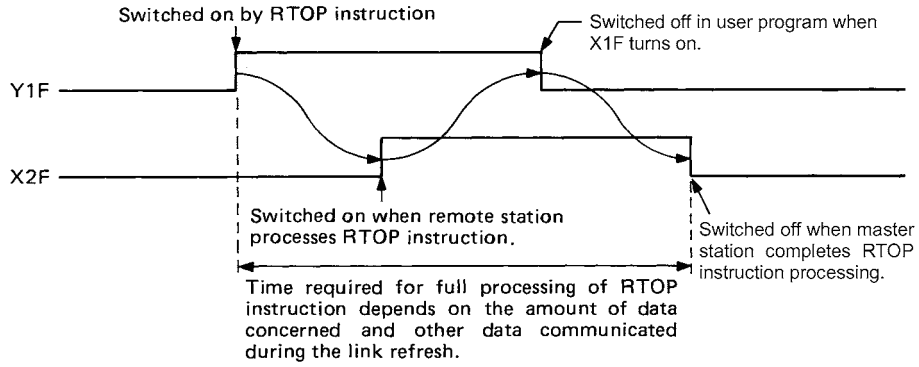
AD72 fault. RTOP and RFRP instructions cannot be used.



Execution of RFRP instruction



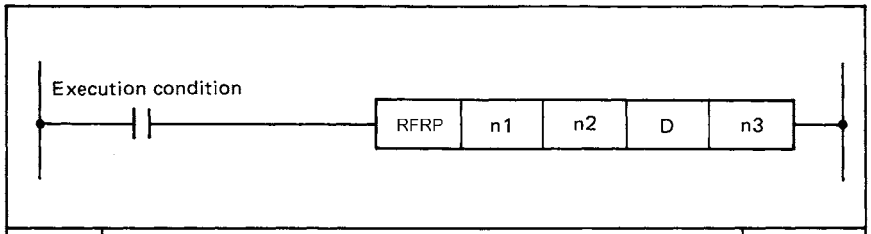
Execution of RTOP instruction



6.4.2 Reading and writing data

(1) Read from remote I/O station

[Format]



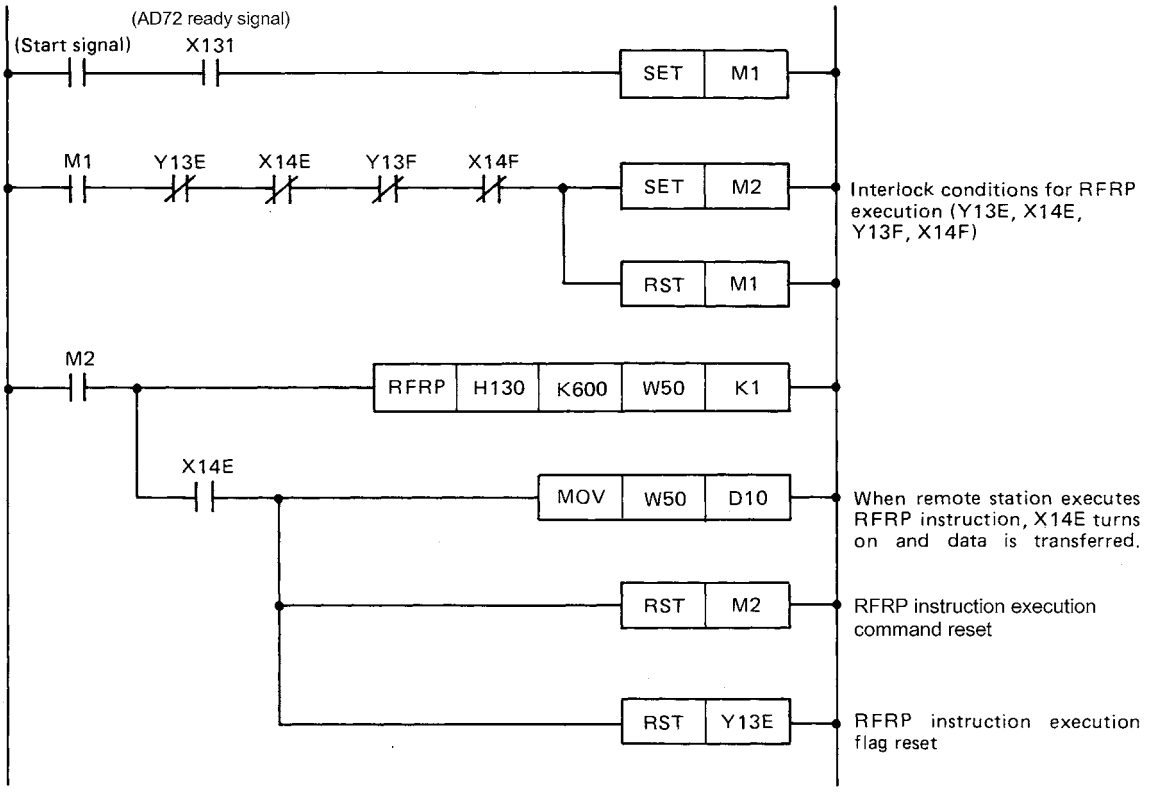
Symbol	Description	Available Device
n1	AD72 3 digit head I/O number assignment plus 10H from master station	K, H
n2	Head buffer address to be read	K, H
D	Head link register to which data will be written	W
n3	Number of data words to be read (1 to 16)	K, H

POINT

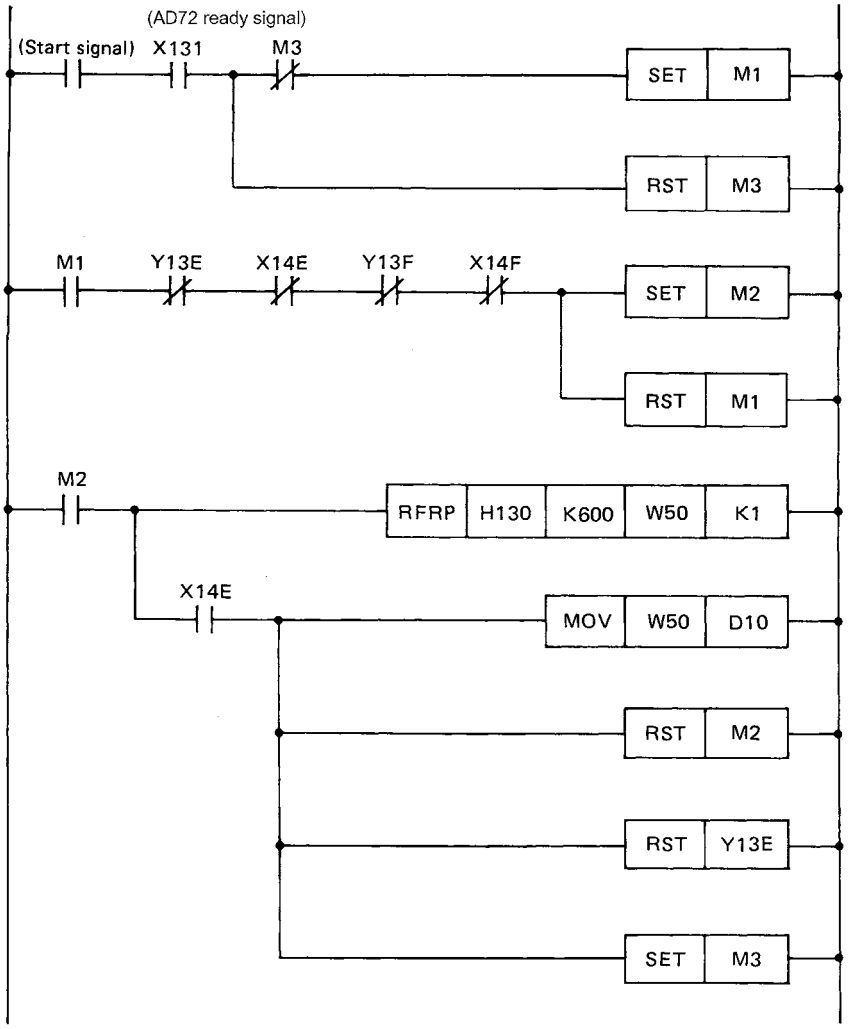
The head I/O number specified in n1 should be 3 digits in the RFRP and RTOP instructions.

Example: Reading one word from buffer address 600 of the AD72 located at I/O address X, Y120 to 14F in a remote I/O station.

To read once on receiving the start signal



To continually read while start signal is on.



Interlock conditions for RFRP execution (Y13E, X14E, Y13F, X14F)

When remote station executes RFRP instruction, X14E turns on and data is transferred.

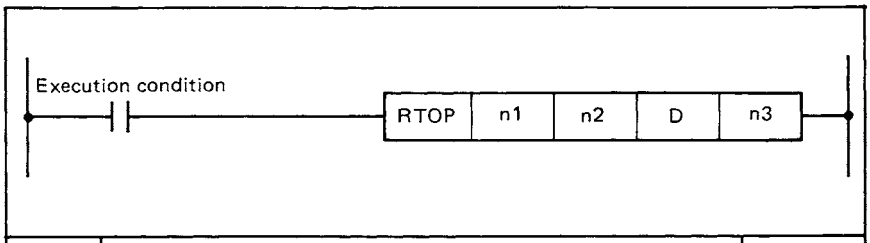
RFRP instruction execution command reset

RFRP instruction execution flag reset

Generates pulse for repetition

(2) Write to remote I/O station AD72

[Format]



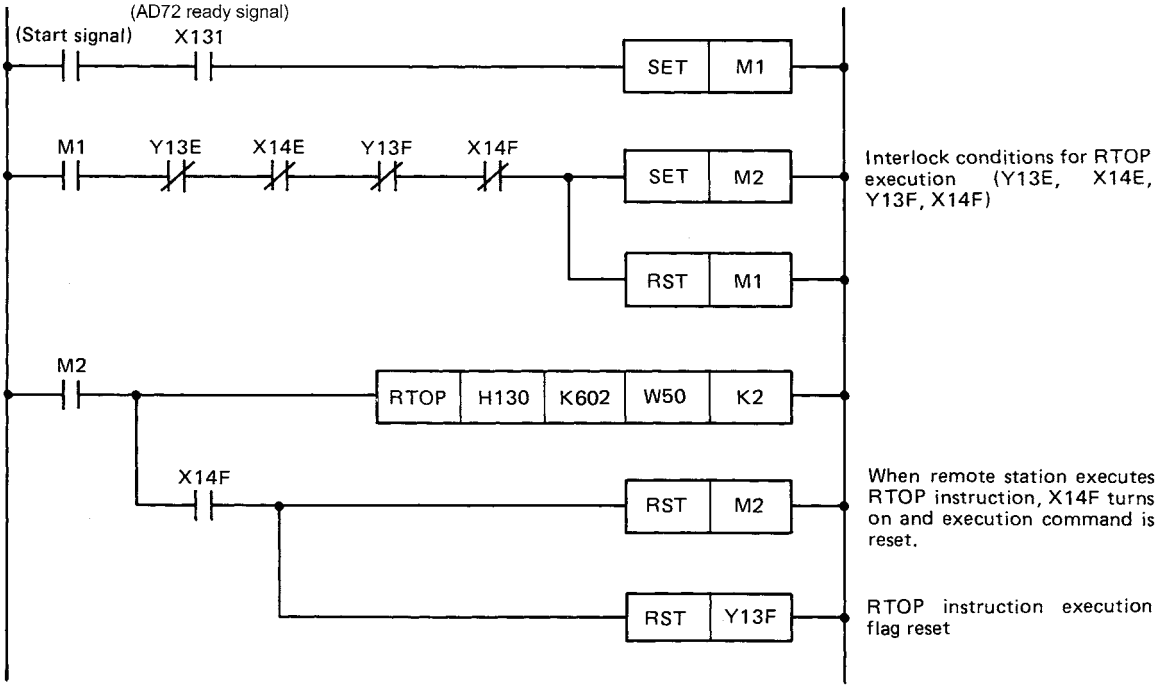
Symbol	Description	Available Device
n1	AD72 3 digit head I/O number assignment plus 10H from master station	K, H
n2	Head buffer address to which data will be written	K, H
D	Head link register from which data will be read	W
n3	Number of data words to be written (1 to 16)	K, H

POINT

The head I/O number specified in n1 should be 3 digits in the RFRP and RTOP instructions.

Example: Writing two words to buffer address 602 and 603 of the AD72 located at I/O address X, Y120 to 14F in a remote I/O station.

To write once on receiving the start signal



6.4.3 Program example

The following program enables X and Y axis starts, interpolation start, and zeroing. Preconditions are as follows:

1. Parameters, zeroing data, and positioning data should all have been written to the AD72 in the remote I/O station using the A6GPP (SW0-AD71P).
2. The AD72 should have been assigned from the master station to X, Y90 to 11F.
3. 64 link registers (W100 to 13F) for RTOP instruction and 64 (W200 to 23F) for RFRP.
4. Data numbers, pointers, etc. should have been written to the link registers.

(1) Rink parameters

* LINK *

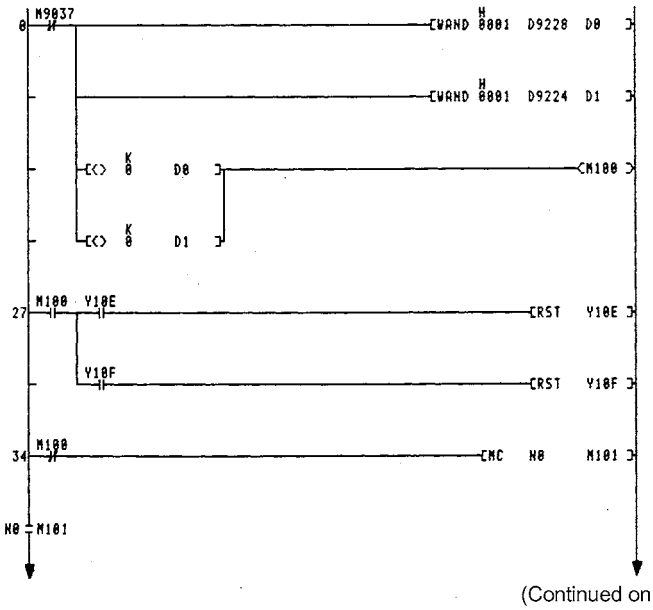
MASTER	SLAVE PC STATIONS	M → ALL L		W.D.T. FOR LINK	INTER-MITTENT
		B	W	10ms	10ms
M	1	-	-	20	XXXX

M:B ⟷ ALL L:B -
M:W ⟷ ALL L:W -
M:W ⟶ ALL R:W 100-13F
M:W ⟵ ALL R:W 200-23F
M:Y ⟶ ALL L:X -
M:Y ⟶ ALL R:Y 0F0-11F
M:X ⟵ ALL L:Y -
M:X ⟵ ALL R:X 0F0-11F

L/R NO.	M ← L		M → R	M ← R	M → L/R		M ← L/R	
	B	W	W	W	Y	X/Y	X	Y/X
R 1	--------	--------	100-13F	200-23F	0F0-11F	000-02F	0F0-11F	000-02F
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-

M: MASTER L: LOCAL R: REMOTE I/O

(2) Program example



Detects error of remote I/O station No. 1.
(Error is detected when b0 of D9228 is 1)

Detects parameter communication of remote I/O station No. 1.
(Parameter communication is being made when b0 of D9224 is 1)

M1 is on when remote I/O station No. 1 has an error or is making parameter communication.

Resets handshake signal Y0E (YnE) or Y0F (Yn) when a communication error occurs while RFRP or RTOP instruction is being executed in remote I/O station No. 1.

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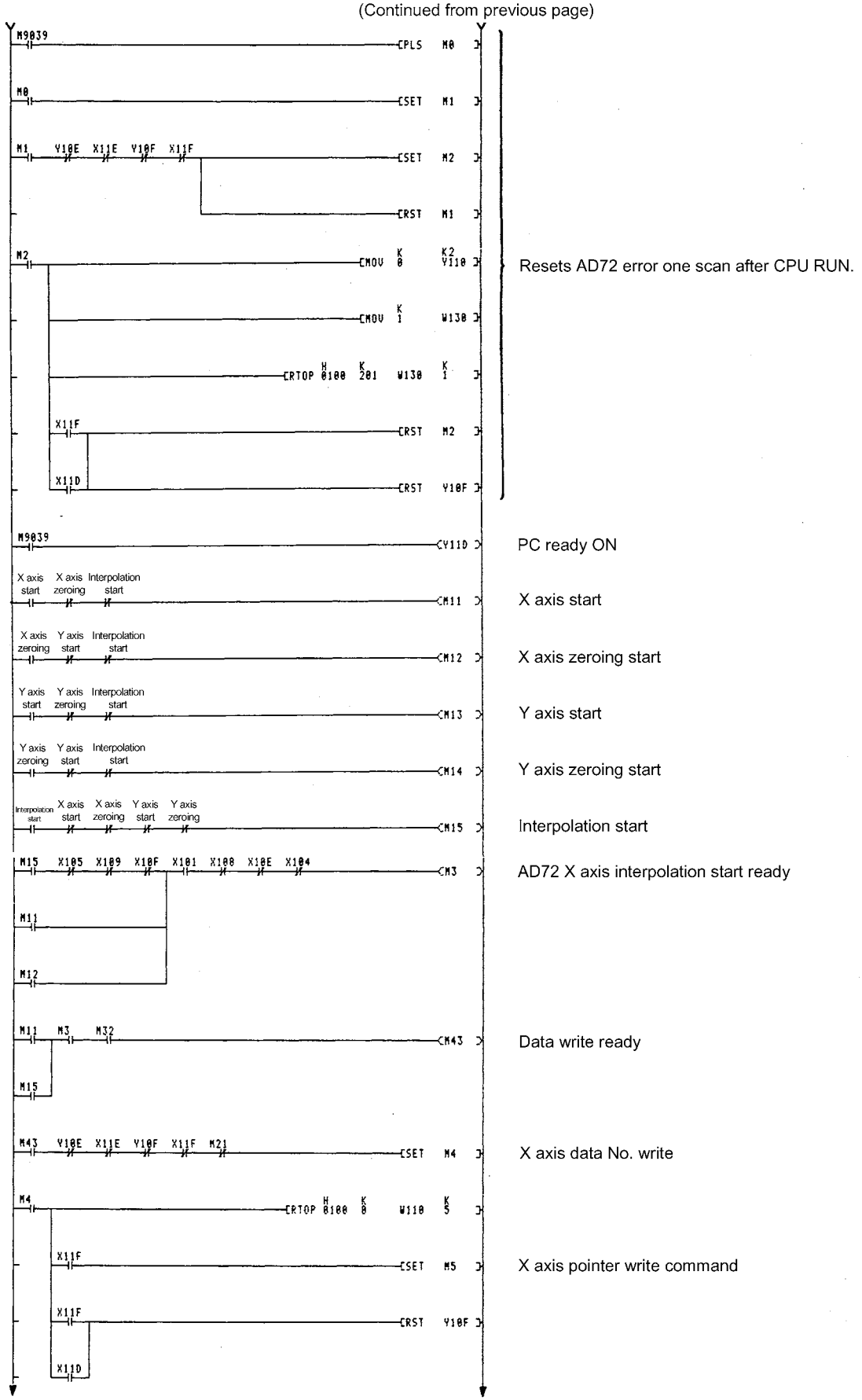
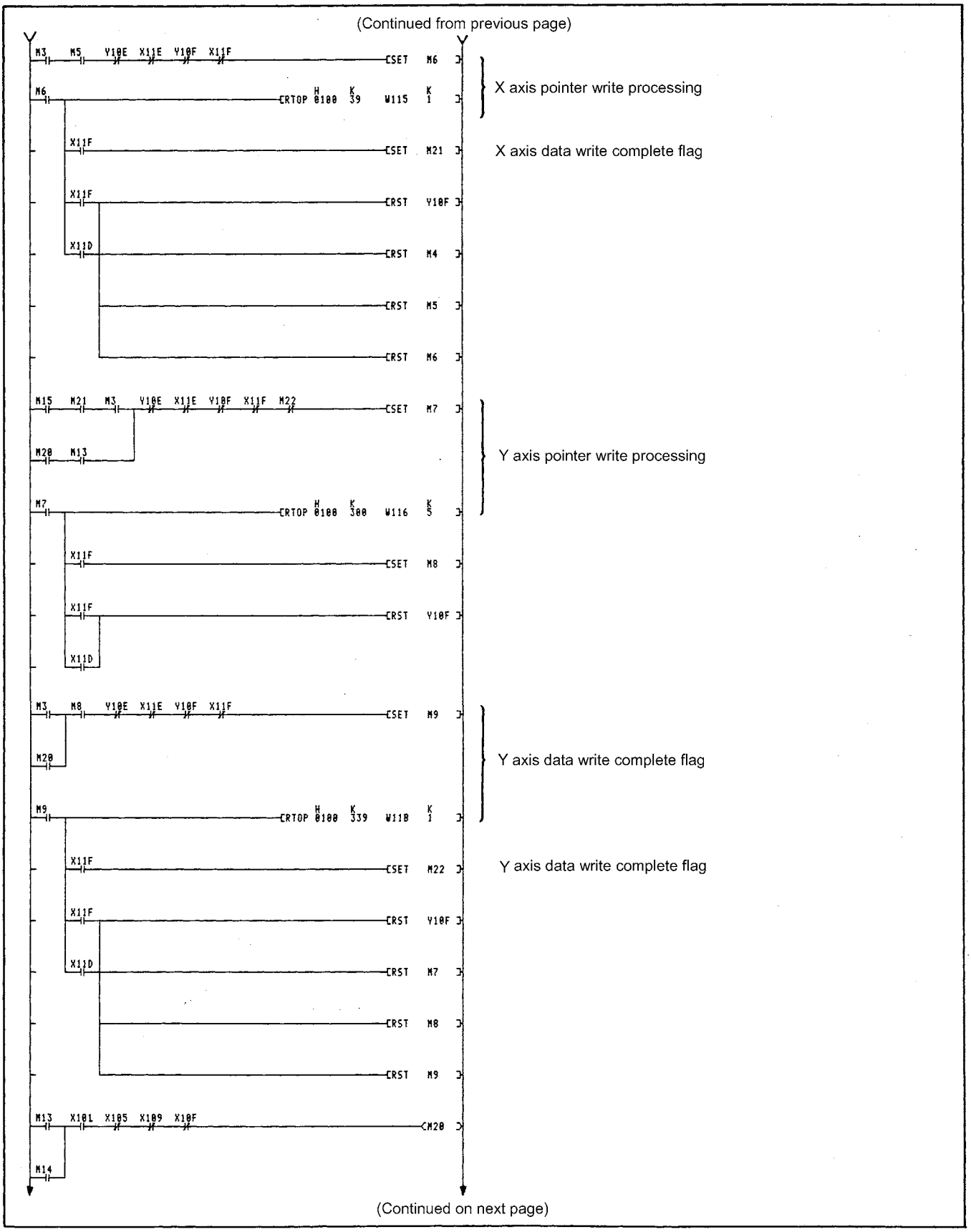
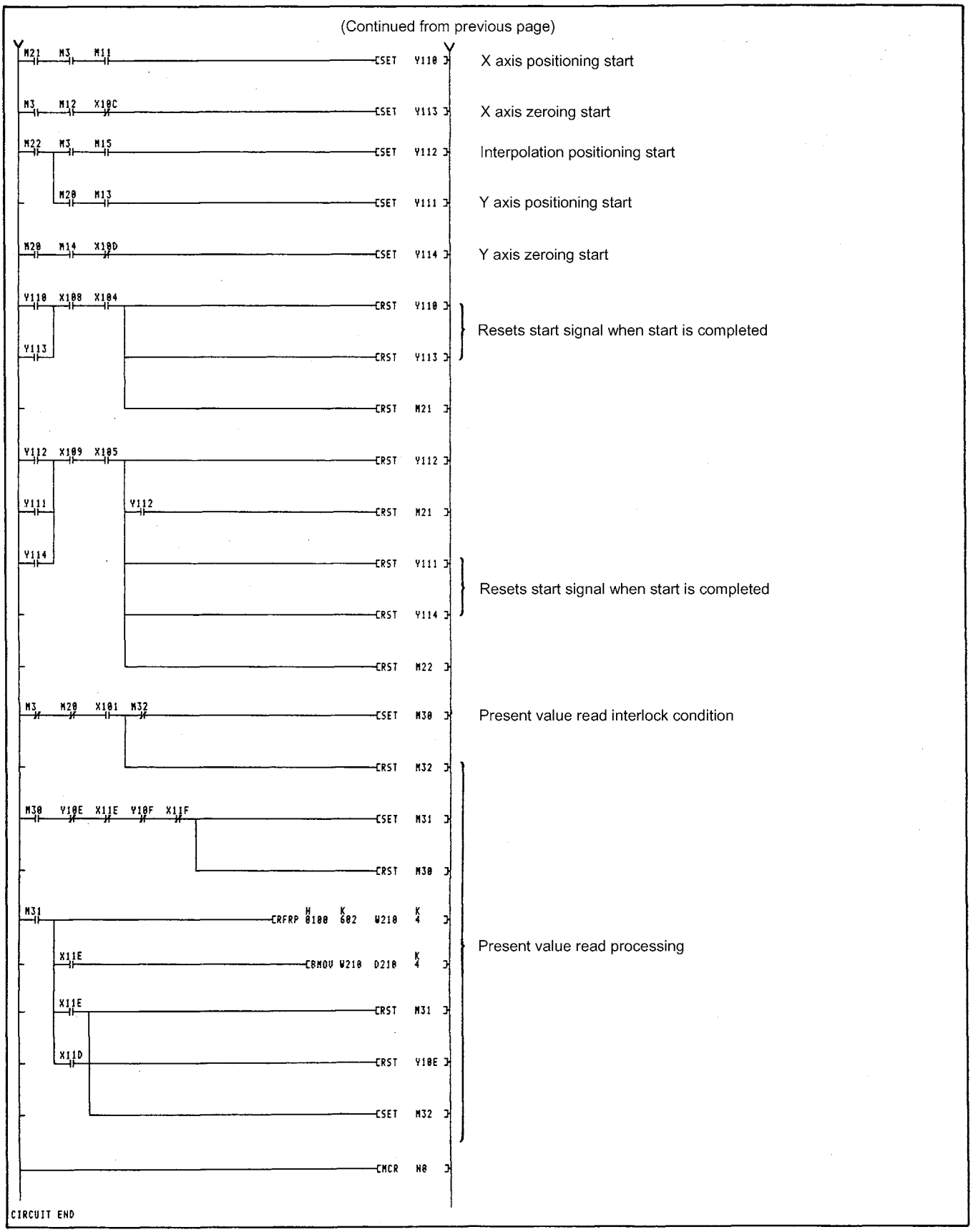


(Continued on next page)


(Continued from previous page)
M3 M5 V10E X11E V10F X11F
SET M6
M6
CRTOP H0100 K39 W115 K1
X axis pointer write processing
X11F
SET M21
X axis data write complete flag
X11F
RST V10F
X11D
RST M4
RST M5
RST M6
M15 M21 M3 V10E X11E V10F X11F M22
SET M7
M20 M13
M7
CRTOP H0100 K300 W116 K5
Y axis pointer write processing
X11F
SET M8
X11F
RST V10F
X11D
M3 M8 V10E X11E V10F X11F
SET M9
M20
M9
CRTOP H0100 K339 W11B K1
Y axis data write complete flag
X11F
SET M22
Y axis data write complete flag
X11F
RST V10F
X11D
RST M7
RST M8
RST M9
M13 X101 X105 X109 X10F
M20
M14
(Continued on next page)


(Continued from previous page)
M21 M3 M11 CSET Y110
X axis positioning start
M3 M12 X10C CSET Y113
X axis zeroing start
M22 M3 M15 CSET Y112
Interpolation positioning start
M20 M13 CSET Y111
Y axis positioning start
M20 M14 X10D CSET Y114
Y axis zeroing start
Y110 X108 X104 CRST Y110
Y113 CRST Y113
CRST M21
Resets start signal when start is completed
Y112 X109 X105 CRST Y112
Y111 Y112 CRST M21
Y114 CRST Y111
CRST Y114
CRST M22
Resets start signal when start is completed
M3 M20 X101 M32 CSET M30
Present value read interlock condition
CRST M32
M30 Y10E X11E Y10F X11F CSET M31
CRST M30
M31 CRFRP H 8100 K 602 W210 K 4
X11E CBMOV W210 D210 K 4
X11E CRST M31
X11D CRST Y10E
CSET M32
Present value read processing
CMCR H0
CIRCUIT END

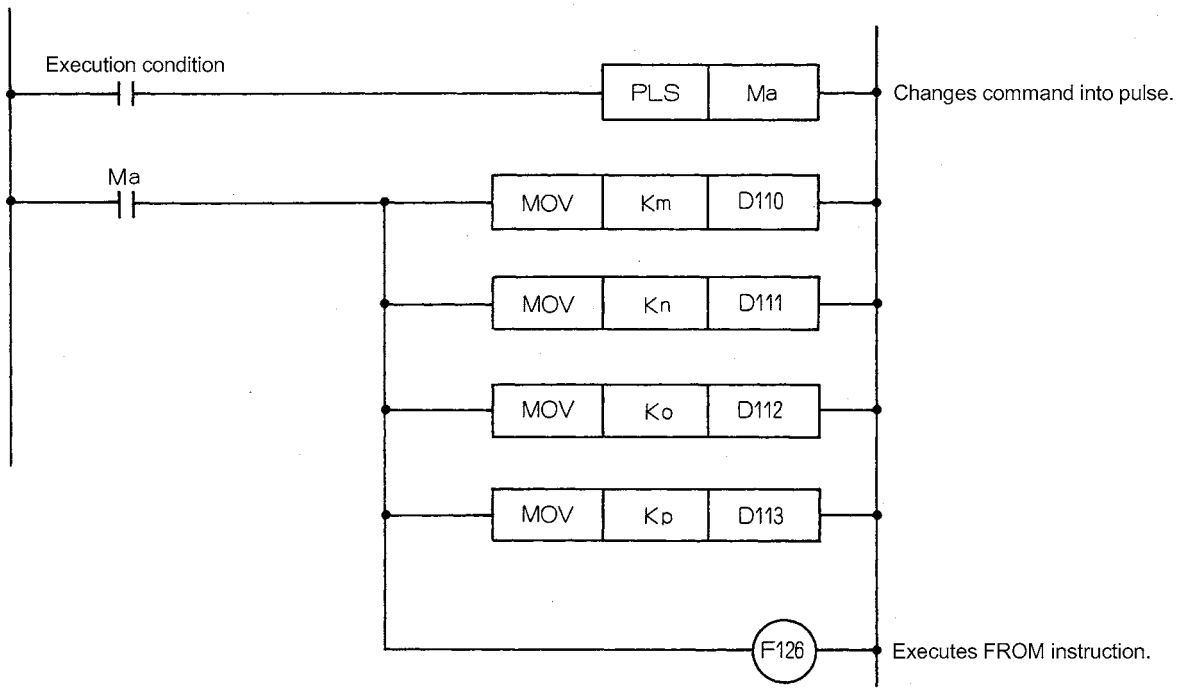
6.5 K2ACPU Programming

The K2ACPU does not have FROM and TO instructions. It cannot handle 8-digit BCD data, either. Instead, it has application instructions F126, F127, F100.
F126: Has a FROM function, i.e. reads data from AD72.
F127: Has a TO function, i.e. writes data to AD72.
F100: Converts between 8-digit BCD and 24-bit binary.
When using the K2ACPU and AD72 together, replace the FROM, TO and 8-digit BCD ↔ 24-bit binary conversion instructions in the program examples in Section 6.3 with the above F126, F127 and F100 application instructions, respectively.

6.5.1 Basic programs

(1) Read from AD72 ..... F126 (FROM instruction)

[Format]



Symbol	Description
D110	Upper 2 digits of the 3-digit head I/O number + 10H to which the AD72 has been assigned. Note that a hexadecimal number should be changed into a decimal number. (See Table 6.11)
D111	Buffer memory head address of stored data
D112	Head number of data registers that will store read data. Use D0 to 95.
D113	Number of words to be read. 1 word = 16 bits.

Fig. 6.13 Read Instruction F126

[Example] To read one word from buffer memory address 600 (X axis output speed) to D2 with the AD72 assigned to X, YB0 to DF (XC0 to XCF, YD0 to YDF).

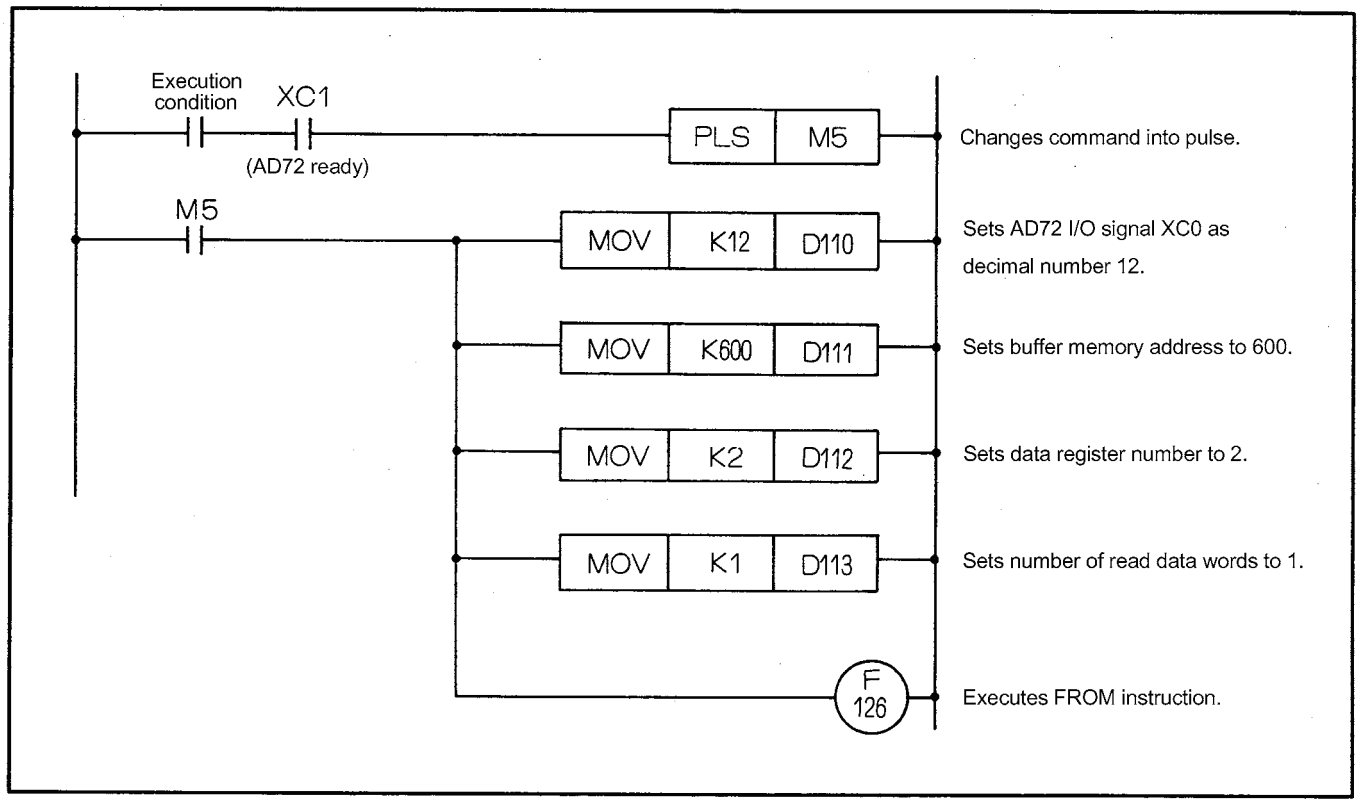


Fig. 6.14 Read Example

*The upper 2 digits of the I/O numbers stored into D110 are indicated below.

Table 6.11 D100 Contents

Head I/O Number of AD72	I/O Number Specified in Program	Number Stored in D110	Head I/O Number of AD72	I/O Number Specified in Program	Number Stored in D110
000	010	1	100	110	17
010	020	2	110	120	18
020	030	3	120	130	19
030	040	4	130	140	20
040	050	5	140	150	21
050	060	6	150	160	22
060	070	7	160	170	23
070	080	8	170	180	24
080	090	9	180	190	25
090	0A0	10	190	1A0	26
0A0	0B0	11	1A0	1B0	27
0B0	0C0	12	1B0	1C0	28
0C0	0D0	13	1C0	1D0	29
0D0	0E0	14	1D0	1E0	30
0E0	0F0	15			
0F0	100	16			

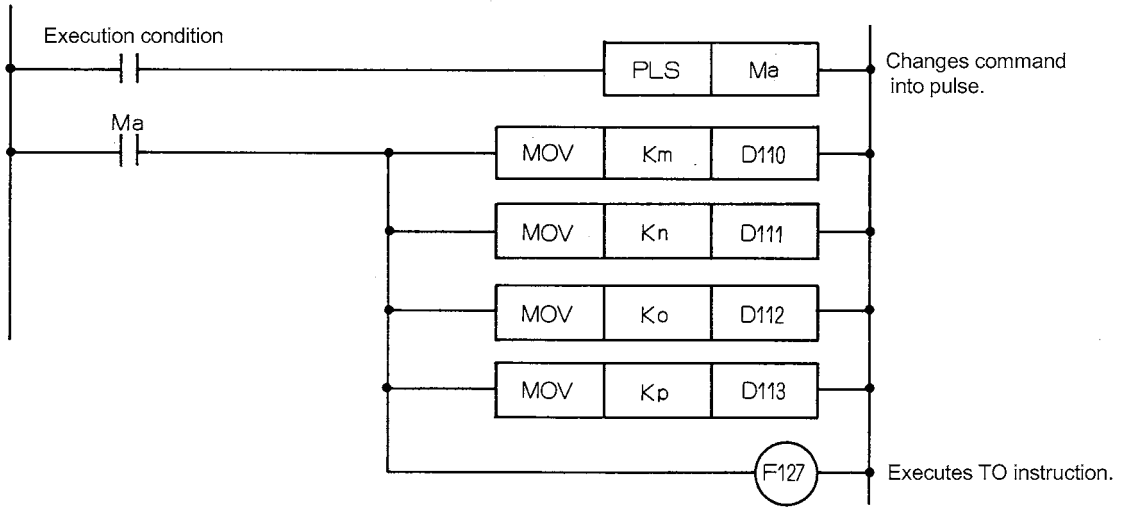
[Conditions]

(a) Errors
In any of the following cases, an error occurs and F126 is not executed. At this time, the operation flag M249 turns on and operation continues. Use M249 to stop operation.
1) Communication with the module is disabled.
2) The specified module is not a special function module.
3) D112 and D113 contents are larger than the capacity of data registers D0 to D95.
4) The buffer memory address specified in D111 and the number of words specified in D113 do not exist in the buffer memory.
5) D110 contains 31 or more.
6) D113 contains 0.

(b) 2-word data
Unlike the A1, A2 and A3CPU, the K2ACPU does not have the DFRO and DTO instructions. Specify D113 as K2 when accessing 2 words (32 bits) together.

(2) Write to AD72 ..... F127 (TO instruction)

[Format]



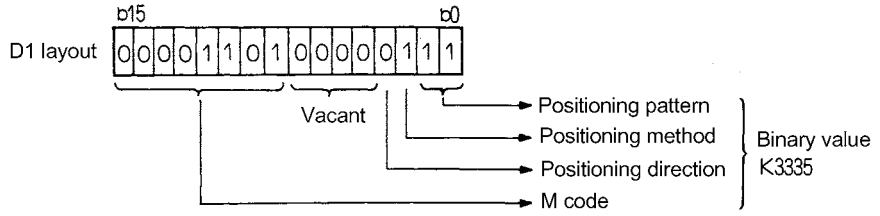
Symbol	Description
D110	Upper 2 digits of the 3-digit head I/O number + 10_H to which the AD72 has been assigned. Note that a hexadecimal number should be changed into a decimal number. (See Table 6.11)
D111	Buffer memory head address where data will be stored
D112	Head number of data registers that store data to be written.
D113	Number of words to be written. 1 word = 16 bits.

Fig. 6.15 Write Instruction F127

[Example] To write positioning information to buffer memory address 3872 via the data register D9 with the AD72 assigned to X, Y160 to 18F (X170 to 17F, Y180 to 18F).

X-axis data No. 1 positioning information example

Item	Setting	Data
Positioning pattern	Continue with speed change	11
Positioning method	Incremental	1
Positioning direction (Incremental only)	Forward	0
M code	13	13



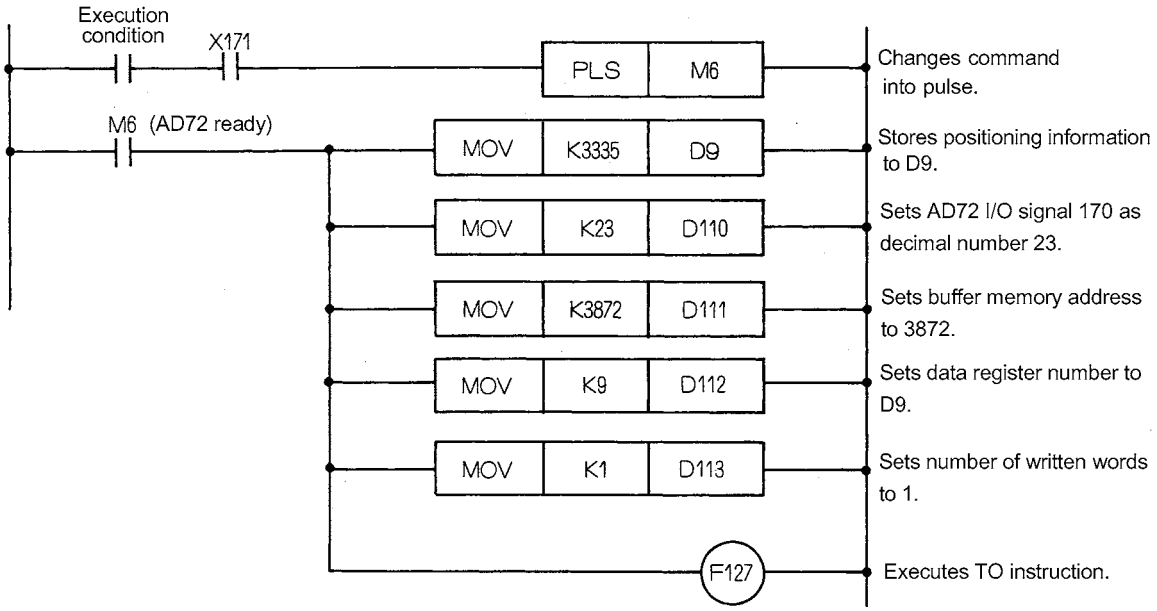


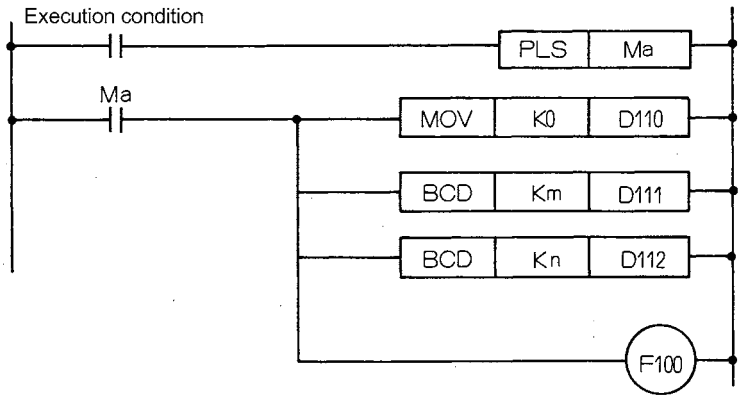
Fig. 6.16 Write Example

[Conditions]

Same as in F126.

(3) 8-digit BCD ↔ 24-bit binary conversion ... F100
Use D110, D111 to 114 and F100 to convert 8-digit BCD to 24-bit binary or 24-bit binary to 8-digit BCD.
(a) 8-digit BCD to 24-bit binary conversion

[Format]



Binary results are stored into D113 and D114.
Note: BCD instructions are used as Km and Kn are binary.

Symbol	Description
D110	"0" when BCD is converted into binary.
D111	BCD lower 4 digits
D112	BCD upper 4 digits. Stores "0" if result is 0.
D113	Stores binary lower 16 bits after conversion.
D114	Stores binary upper 8 bits after conversion. (Lower 8 bits are 0)

Fig. 6.17 Conversion Instruction F100

[Example] To convert BCD 16,777,215 into binary

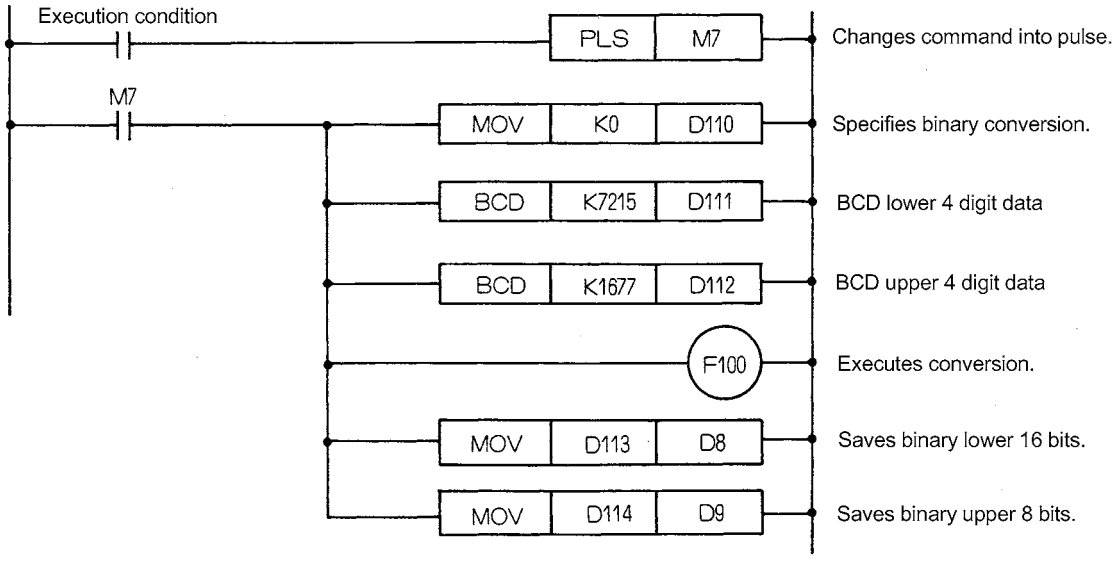
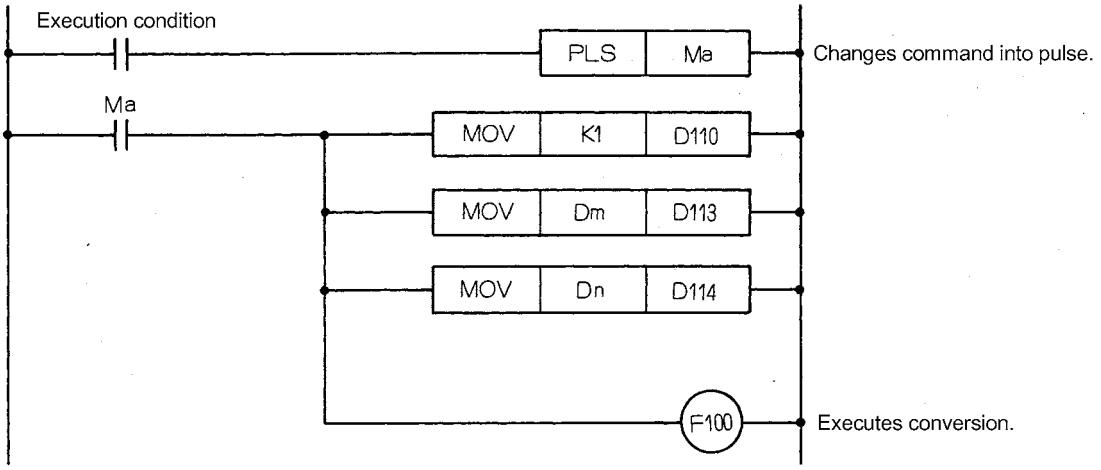


Fig. 6.18 Conversion Example

(b) 24-bit binary to 8-digit BCD conversion

[Format]



Results are stored into D111 and D112.

Symbol	Description
D110	"1" when binary is converted into BCD. *1
D111	Stores BCD lower 4 digits after conversion.
D112	Stores BCD upper 4 digits after conversion.
D113	Binary lower 16 bits
D114	Binary upper 8 bits (Lower 8 bits are ignored)

Fig. 6.19 Conversion Instruction F100

[Example] To convert data of binary lower 16 bits in D1 and upper 8 bits in D2 into BCD

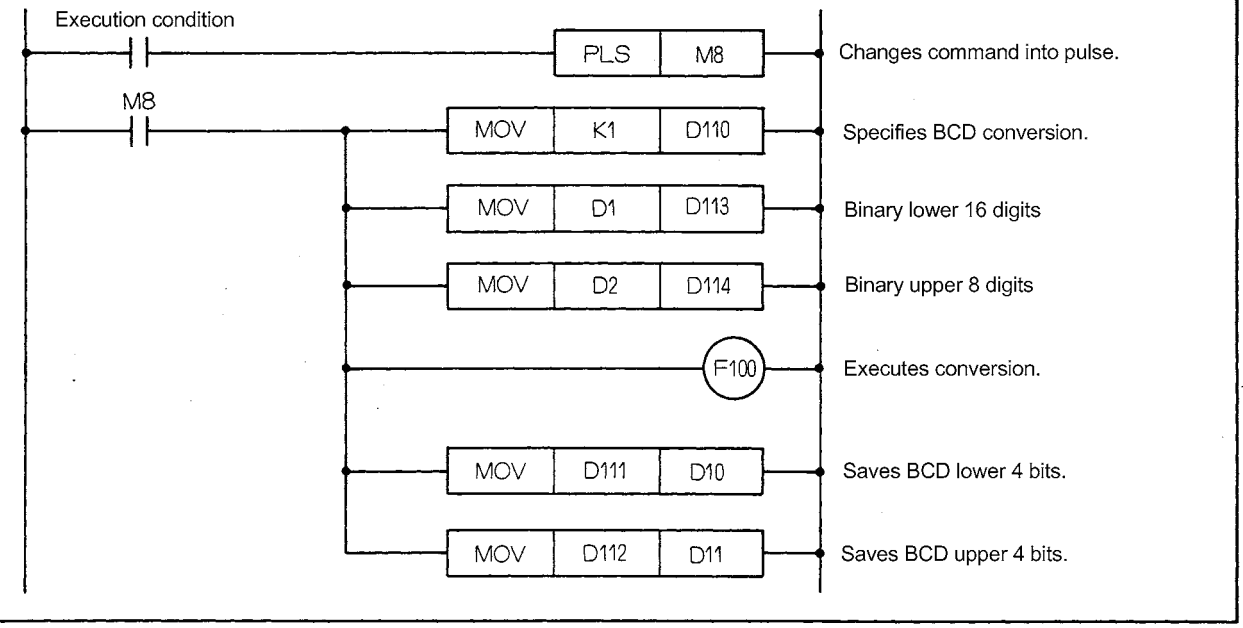


Fig. 6.20 Conversion Example

7. CHECK LISTS

The checklists given in associated equipment manuals should also be referred to.

7.1 General Check List

Before testing the AD72, check the following:

	Check Point	Description	Check
1	Battery	• Check that battery leads are connected to the printed circuit board.	
2	Slide switch setting	• Check that in-position, multiplication rate, and gain have been set. • Check that external devices have been set.	
3	VR setting	• Check that gain and zero have been set.	
4	Parameter setting	• Check that parameters have been set. • Check that values are correct.	
5	Zeroing data setting	• Check that zeroing data has been set. • Check that values are correct.	
6	Positioning data	• Check that positioning data has been set. • Check that values are correct.	

Table 7.1 General Check List

POINT

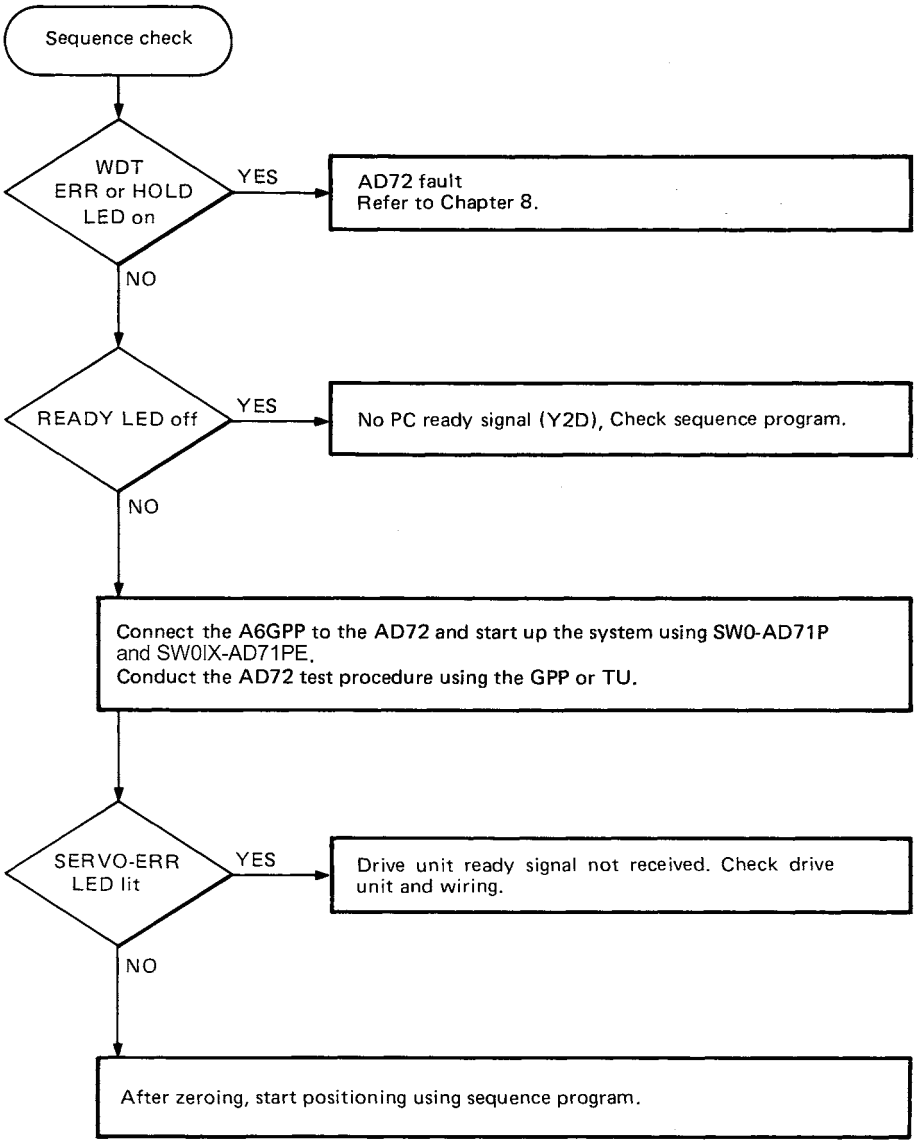
If only one axis (X or Y axis) is used, parameters and zeroing data must be written to the unused axis. Otherwise zeroing will result in error and switch on the X1B (error detection) signal.
(Data written must be within the range given in the User's Manual. Parameters may be default values.)

7.2 Tests and Adjustments

Refer also to the A series CPU User's Manual.

7.2.1 Sequence check

Use the following procedure to check the system.
Set the key switch on the AD72 front panel to "LOCK." This only changes the present value and allows checking of the positioning functions without providing an analog output.



7.2.2 Checking positioning operation

After completing the checks given in Section 7.2.1, move the key switch on the AD72 front panel to "OFF" or "M.PRO."
Set the speed limit parameter to a low value.
Zero the system and check positioning operation. Use the SW0-AD71P and SW0IX-AD71PE monitoring function to check for error codes etc.

8. TROUBLESHOOTING

Errors may be detected by:

1) the AD72 CPU; or
2) the GPP during program development and debugging.

This section describes errors detected by the AD72 CPU, for other errors see the SW0-AD71P Operating Manual.

8.1 Errors Detected by AD72

The AD72 has various error check functions. When an error occurs, an error code is written to address 45 (X axis) and 345 (Y axis) in the buffer memory.

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

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

(3) Error reset

Errors are reset by writing a "1" to buffer address 201. (See Section 6.3.2 (7))
For resetting of errors using the A6GPP, refer to the SW0-AD71P and SW0IX-AD71PE Operating Manual.

(4) Error detection

X1B is the error detection flag. Resetting the error also resets X1B.

Error codes are classified as shown in Table 8.1.

Error Code	Error Classification	Remarks
1 to 46	Data range error	Refer to Section 8.1.1.
50 to 51	AD72 HOLD error	Refer to Section 8.1.2.
60 to 64	Buffer memory write disable error	Refer to Section 8.1.3.
70 to 79	AD72 start and operation error	Refer to Section 8.1.4.
80 to 81	AD72 BUSY stop error	Refer to Section 8.1.5.

Table 8.1 Error Code Classification

8.1.1 Data range errors

Any of the operations shown in Table 8.2 will prompt a data range check by the AD72 as shown below.

Data	Operation
Parameters	• At power on* • When parameters have been transferred from the GPP to the AD72. • When PC ready signal (Y2D) changes from OFF to ON. • When positioning, zeroing, jog, or inching has been selected in GPP test mode.
Zeroing data	• When parameters or zeroing data has been transferred from the GPP to the AD72. • When PC ready signal (Y2D) changes from OFF to ON. • When positioning, zeroing, jog, or inching has been selected in A6GPP test mode.
Positioning data	• At the start of positioning (Refer to the figure in Section 6.3.)

*: The power on check will not give an error code or an error detection signal (X1B).

Table 8.2 Data Range Check

When an error occurs, the data corresponding to the error code must be checked, changed into within the setting range, and written again.

POINT

If the parameter settings not been made or if any one parameter is erroneous (outside the setting range), all data are controlled as the default values indicated in Table 3.5. However, the parameter area data remain as set by the user.

A list of error codes is shown in Table 8.3.

Error Code	Data Type	Check Point	Check Range	Re-marks
0	Parameter		Normal	
1		Travel per pulse	1 to 100	
2		Speed limit value	1 to 12,000 in mm, inch, or degree { If travel per pulse is "a" (unit/PLS), speed V range is restricted as given below: $\frac{V\ (unit/PLS)}{a\ (unit/PLS)} \leqq 200{,}000$ PLS/sec } 1 to 20,000 in PLS	
3		Jog speed limit value	1 to parameter speed limit value	
4		Starting bias speed	0 to parameter speed limit value	
5		Acceleration and deceleration times	64 to 4,999	
6		Backlash	0 to 255 in PLS 0 to 65535 in mm 0 to 65535 in inch 0 to 65535 in degree	*3
7		Upper stroke limit	0 to 162,000 in mm 0 to 16,200 in inch or degree 0 to 16,252,928 in PLS	*2
8		Lower stroke limit	0 to upper stroke limit	
9		Error compensation	0 to 100,000 in mm, inch, or degree	
10		Travel per inching signal	1 to 100,000 in mm, inch, or degree 1 to 100 in PLS	
11		Positioning method	00, 01, or 10 in bits b4 and b3	
12		Positioning complete signal duration	0 to 20,000	
20	Zeroing data	Zero address	0 to 1,620,000,000 in mm, inch, or degree 0 to 16,252,928 in PLS	*2
21		Zeroing speed	Starting bias speed to parameter speed limit. (Not 0)	*1
22		Creep speed	Starting bias speed to parameter zero point return. (Not 0)	
23		Dwell time	0 to 499	
24		Torque limit	10 to 250	
30	Positioning data	Positioning speed	Starting bias speed to parameter speed limit. (Not 0)	*1
31		Positioning address	Within stroke limits	
32		Dwell time	0 to 499	
33		Positioning pattern	00, 01, or 11 in bits 0 and 1 (00 only if start data No. is 400)	
34			Pattern 11 may be used a max. of 9 times consecutively.	
35			Travel for consecutive 11 patterns must be in the same direction.	
36			The addressing method must be the same for consecutive 11 patterns.	
37			Interpolation start setting for both axes must be the same (00 or 01).	

Table 8.3 Data Range Error Codes (Continue)

Error Code	Data Type	Check Point	Check Range	Re-marks
40	Positioning start data	Start number	1 to 400	
41		Pointer	0 to 19	
42		Speed change	Starting bias speed to parameter speed limit (Not 0)	*1
43		Present value change	0 to 1,620,000,000 in mm, inch, or degree 0 to 16,252,928 in PLS	*2
44		Jog speed	Starting bias speed to parameter jog speed limit (Not 0)	*1
45		Start axis	When two axes are to be started at the same time, both must be set for inter-polation start or for dual axis start.	
46		Start axis	The second axis must not be busy or must be behind the start point when an interpolation start or a dual axis start is called.	

*1: If the set speed exceeds the parameter speed limit value, positioning is controlled at the parameter speed limit value.

*2: If the units are mm, inch, or degree and travel per pulse is "a" (unit/PLS), the address S range is restricted as given below:

$$\frac{S\ (\text{unit})}{a\ (\text{unit/PLS})} \leqq 16{,}252{,}928\ (\text{PLS})$$

*3: When each travel per pulse is set to "1"

Table 8.3 Data Range Error Codes

8.1.2 "HOLD" LED

The errors shown in Table 8.4 are indicated by the AD72 "HOLD" LED. Errors 50 or 51 indicate a hardware failure.
A bus error may be due to a hardware failure or to the sequence program accessing too much of the buffer memory too frequently. In the case of the latter, the sequence program must be changed in order to allow sufficient time for the AD72 to access the buffer memory between buffer → PC transactions.

Error Code	Check Point	Error Definition
50	Operation element (8231)	Operation time-out error (hardware fault)
51		Operation error (overflow, underflow, etc.)
	AD72 bus error	The PC has priority for accessing the buffer memory. If accessing is too frequent the AD72 may not be able to access the data.

Table 8.4 AD72 Hold Error Codes

In the event of any of the above errors occurring 1) turn off the AD72 ready (X11) and 2) force BUSY processing to stop. The start signal is then not accepted.

8.1.3 Buffer memory write errors

Writing data from the sequence program to prohibited buffer addresses or writing when the buffer cannot accept the data prompts the error codes shown in Table 8.5.

Error Code	Shared Memory Address	Error Definition
60	39,339	Pointer value is not 0 though 20th point has been reached. Data has been written to pointer address while BUSY.
61	40,340	"Speed change" during interpolation.
62	41, 42, 341, 342	"Present value change" while BUSY.
63	7872 to 7928	Data written from PC while Y2D is on.
64	Monitoring present value area Speed area	Data written from PC to a write prohibit address.

Table 8.5 Buffer Memory Write Error Codes

8.1.4 AD72 start and operation errors

The error codes shown in Table 8.6 are given if the AD72 cannot start operation or if an error occurs during positioning.

Error Code	Error	Corrective Action
70	No READY signal	Set the drive unit ready.
71	External stop signal (CONT connector pin 2) received by AD72.	Switch off the stop signal (CONT connector pin 2).
72	AD72 ready (X11) and PC ready (Y2D) are off.	Switch on the PC power and set the ACPU to RUN. Check hardware.
73	Relevant axis is already BUSY.	Do not start when BUSY.
74	Relevant axis positioning commenced signal is on.	Restart after turning off the start signal.
75	"M code ON" signal is on.	Turn off the ON signal using the M code OFF signal.
76	STOP signal (Y25, Y26) or [BREAK] signal (from A6GPP, A6PHP, AD71TU) received by AD72.	• Switch off the STOP signal (Y25, Y26). • Reset the BREAK signal from the A6GPP, A6PHP, AD71TU.
77	Zeroing repeated more than twice consecutively.	Jog to safe position in front of zeroing dog and zero.
78	Zeroing attempted with zeroing complete signal on.	Zeroing already completed.
79	Present value (in pulses) is outside the range 0 to 16252928.	• Return the present value to within the stroke limit range using jog or inching operation. • Zero the system. • Change the present value.

Table 8.6 AD72 Start and Operation Error Codes

Note 1: Start includes:

- *Zeroing start*
- *Jog start*
- *Inching start*

2: For interpolation start, error codes are always given for both axes.

8.1.5 AD72 BUSY (positioning) stop errors

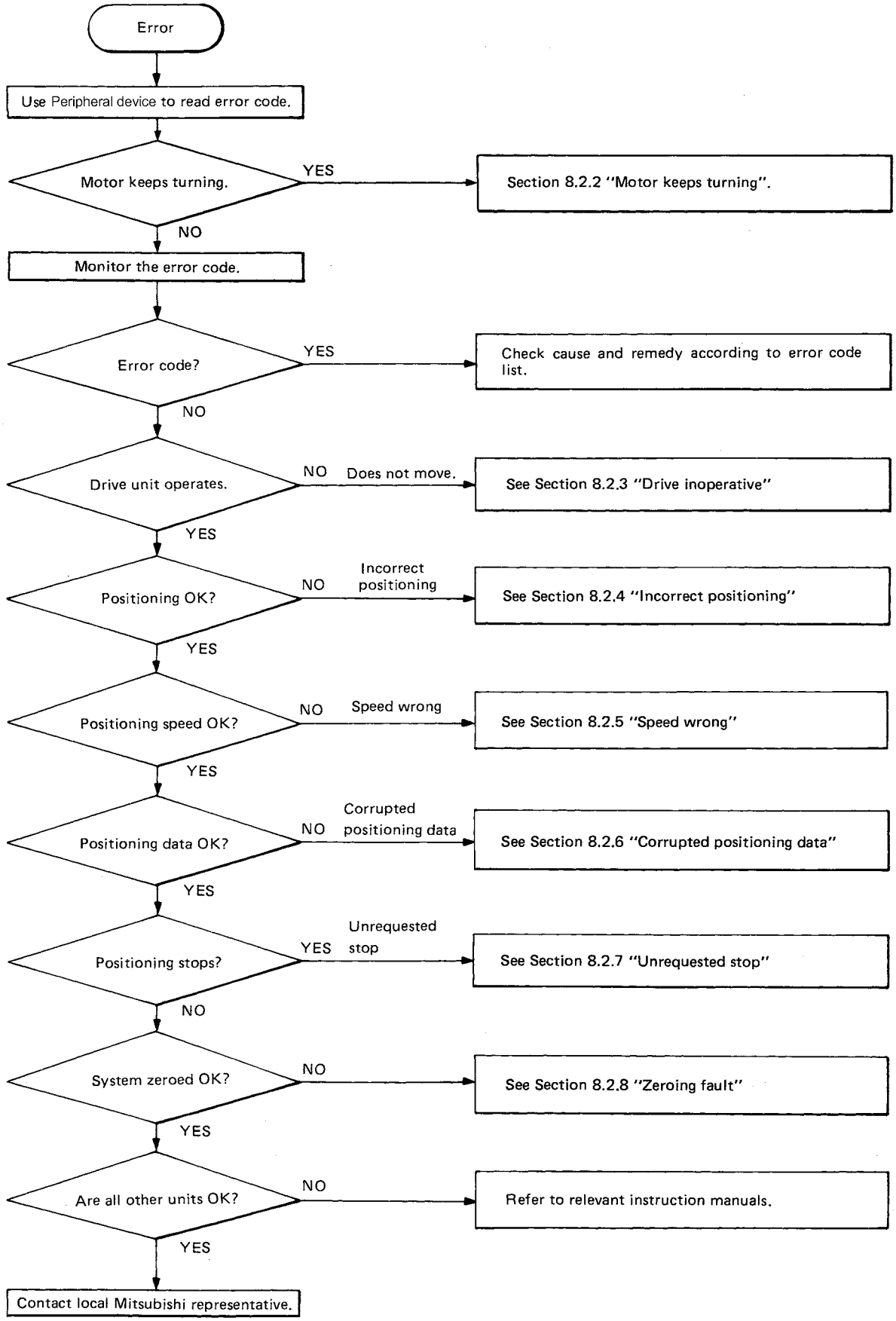
The following error codes result from the AD72 losing the READY signal while it is BUSY or zeroing is stopped.

Error Code	Factor	Corrective Action
80	READY lost while AD72 is BUSY.	Check drive unit and READY signal.
81	Zeroing stopped.	Zeroing is not allowed more than twice consecutively. If necessary jog to a safe position in front of zeroing dog and restart zeroing.

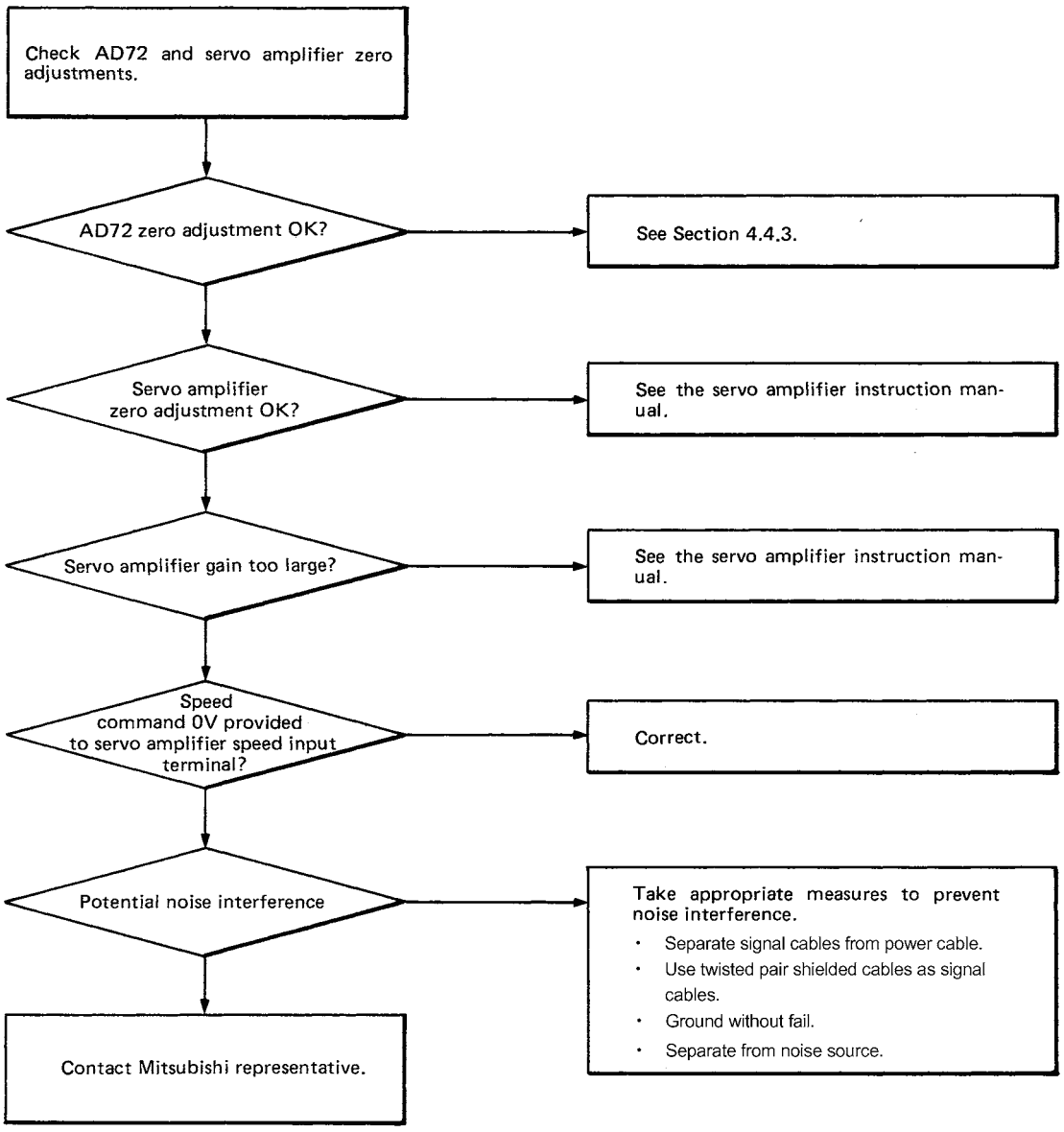
Table 8.7 BUSY Error Codes

8.2 Troubleshooting

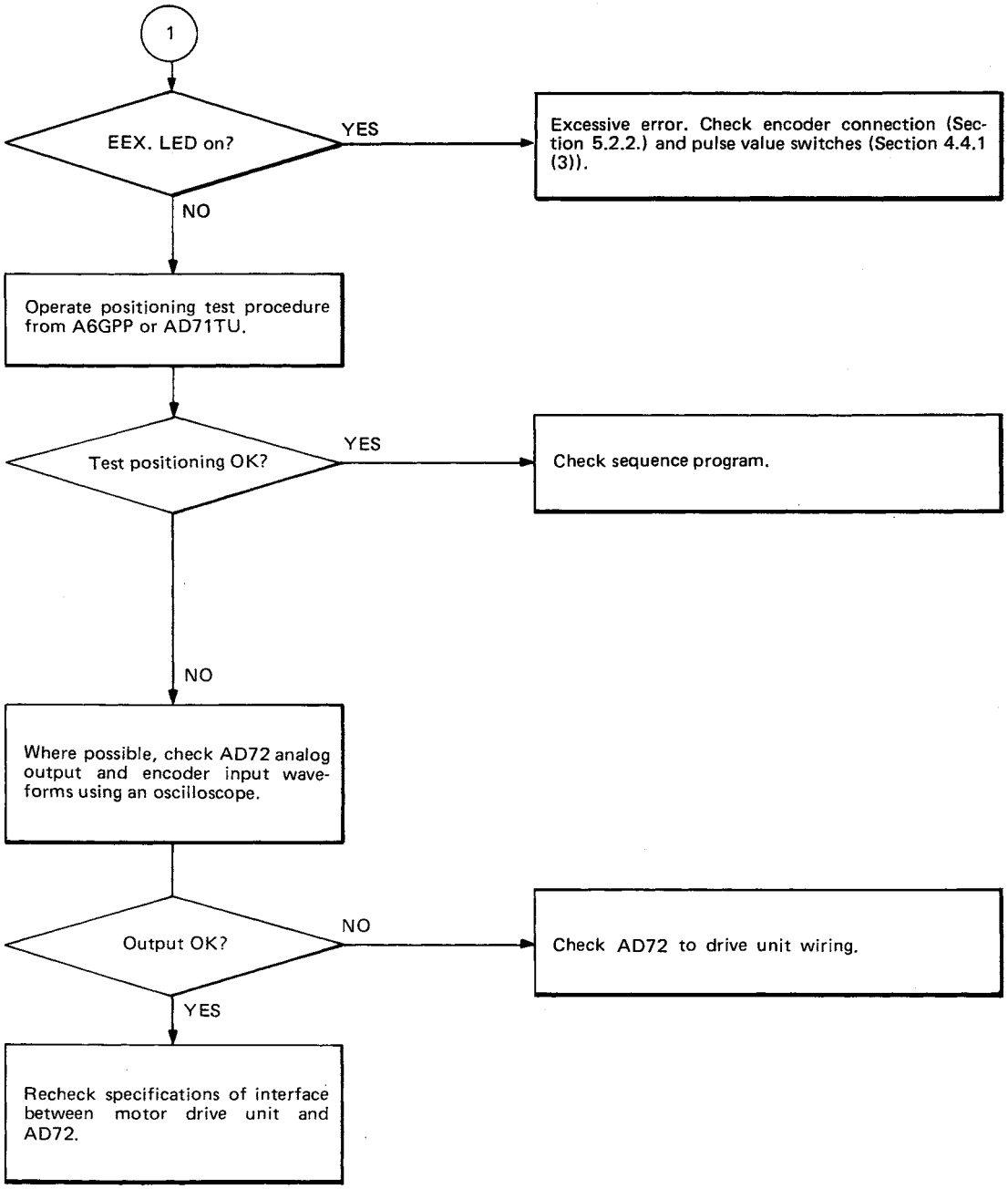
8.2.1 General troubleshooting



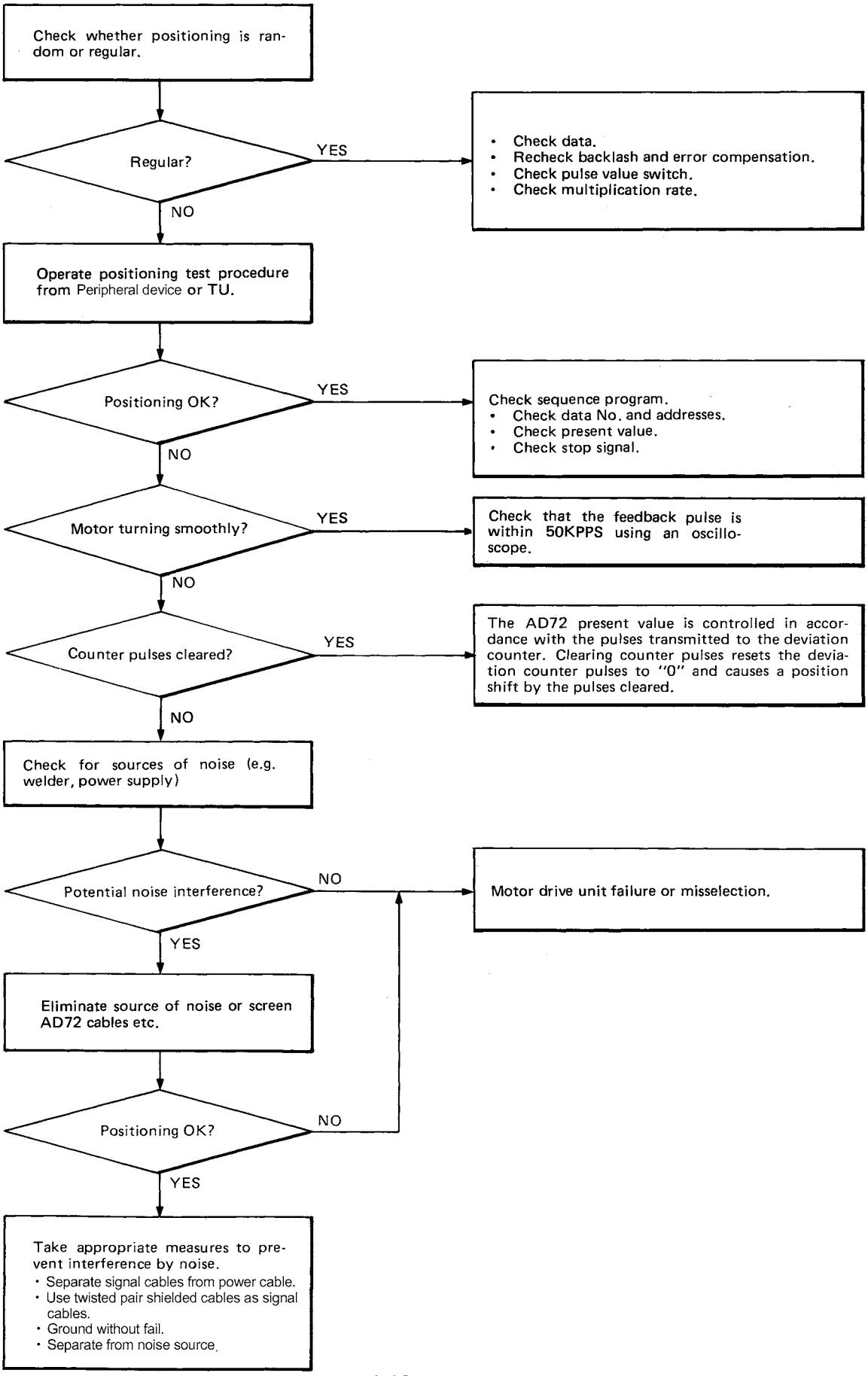
8.2.2 Motor keeps turning



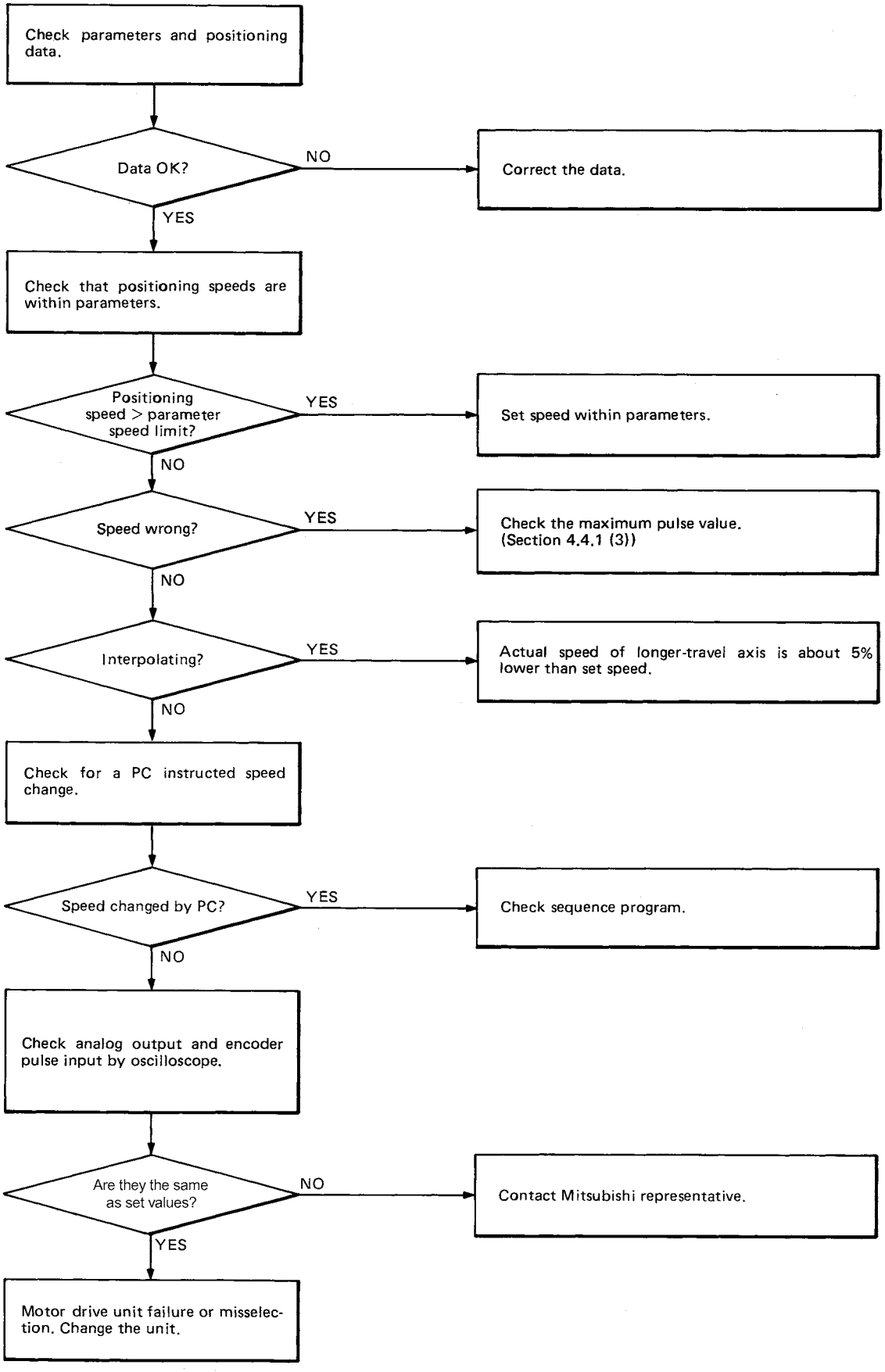
8.2.3 Drive inoperative


1
EEX. LED on?
YES
Excessive error. Check encoder connection (Section 5.2.2.) and pulse value switches (Section 4.4.1 (3)).
NO
Operate positioning test procedure from A6GPP or AD71TU.
Test positioning OK?
YES
Check sequence program.
NO
Where possible, check AD72 analog output and encoder input waveforms using an oscilloscope.
Output OK?
NO
Check AD72 to drive unit wiring.
YES
Recheck specifications of interface between motor drive unit and AD72.

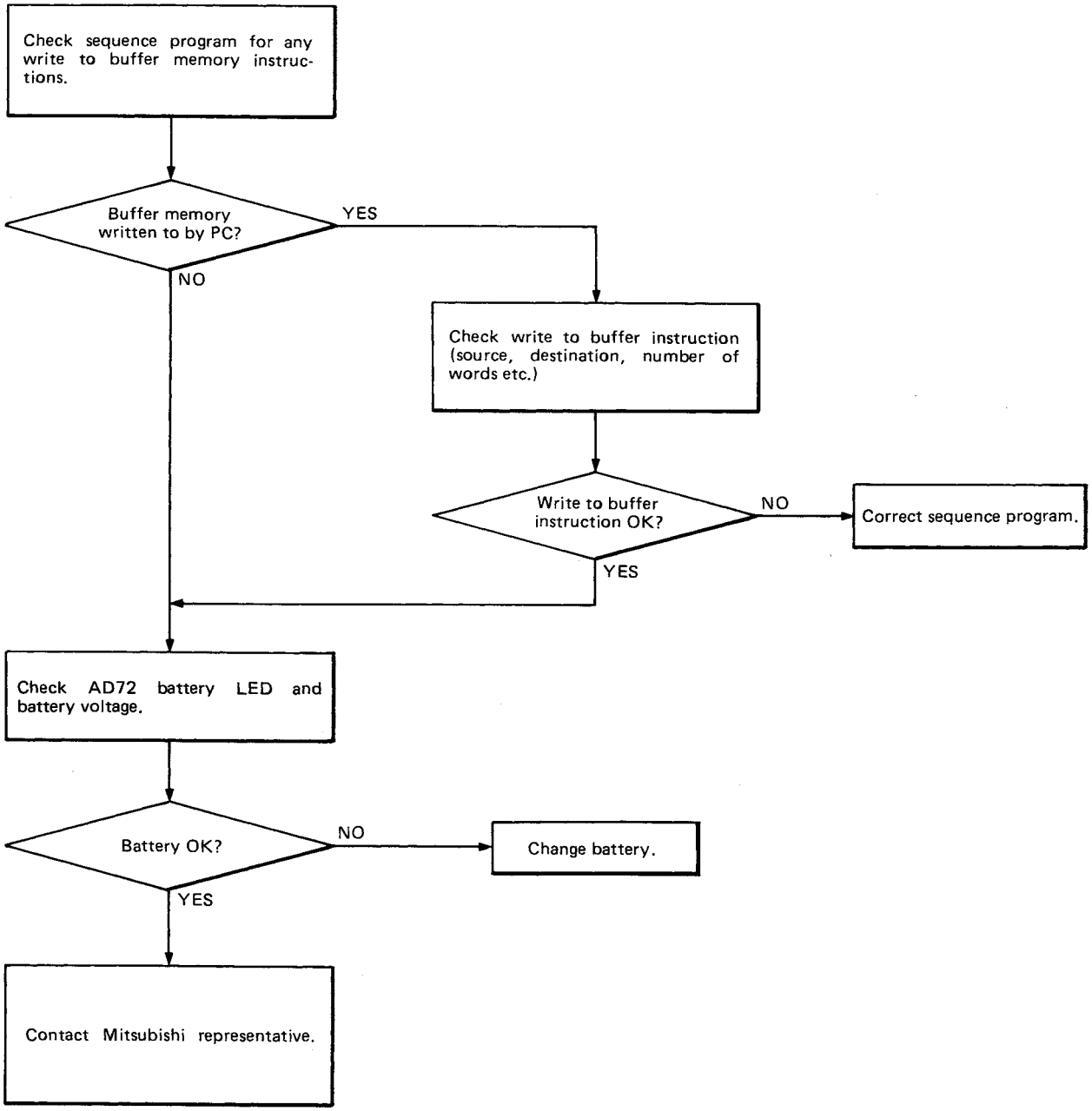
8.2.4 Incorrect positioning



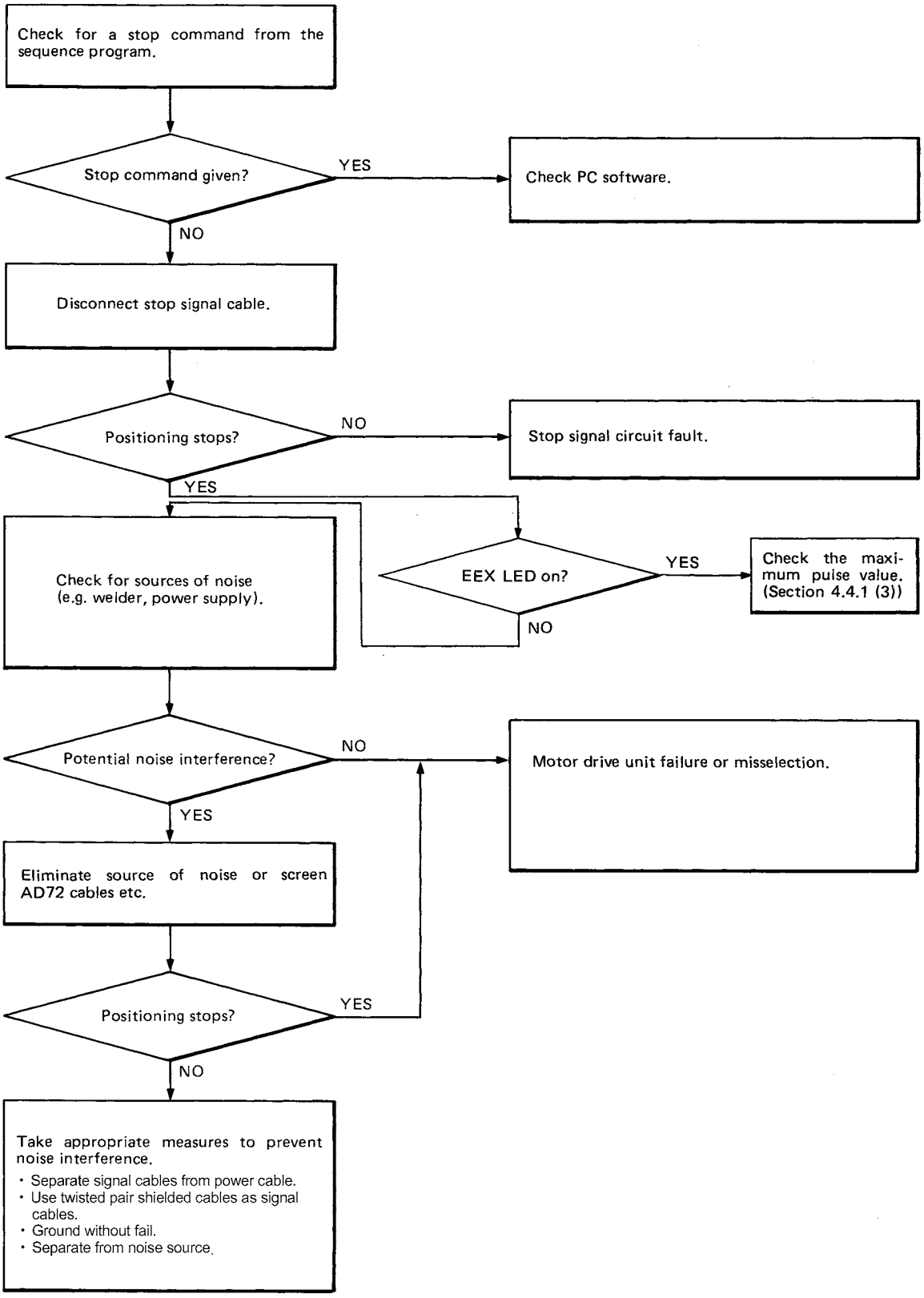
8.2.5 Speed wrong



8.2.6 Corrupted positioning data

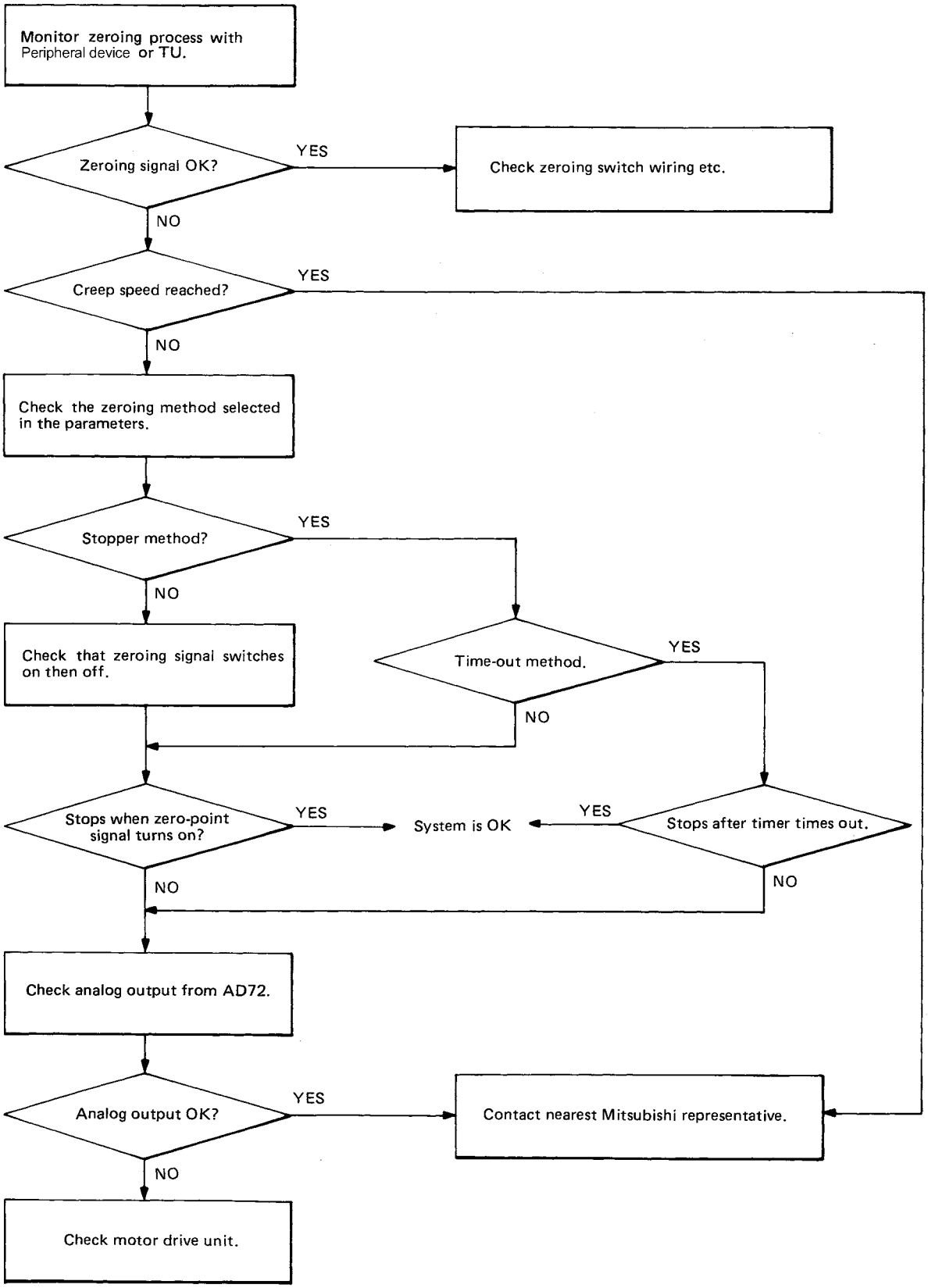


8.2.7 Unrequested stop

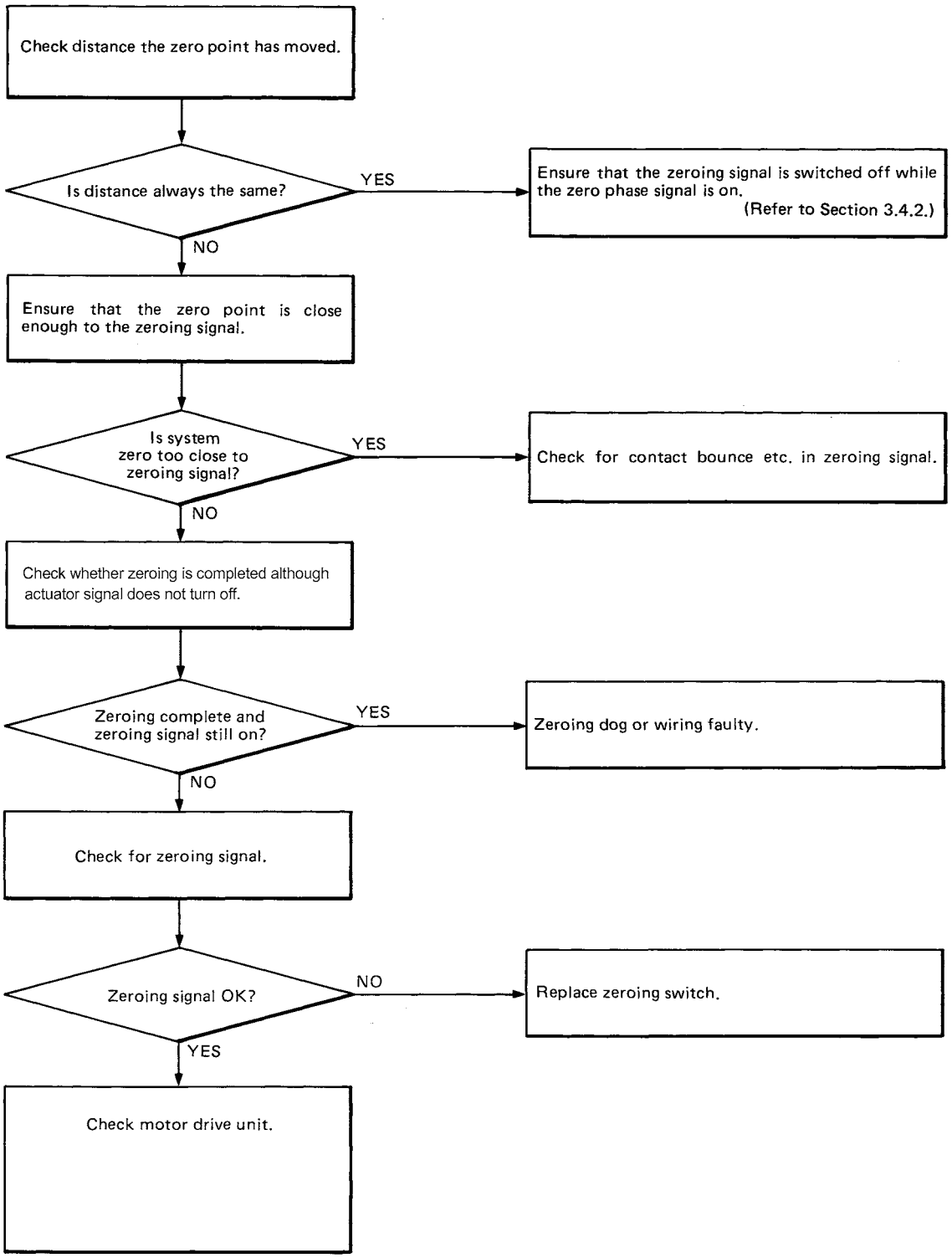


8.2.8 Zeroing fault

(1) Partial zeroing



(2) System zero has moved



Note: When the stopper method is used, recheck whether the stop signal is input without fail and the dwell timer setting is correct.
When there are no problems, change the AD72 or motor drive unit as it is faulty.

9. MAINTENANCE

9.1 Unit Storage

The AD72 should be stored in the following environments:

(1) Ambient temperature −20 to 75°C.

(2) Ambient humidity 10 to 90%RH.

(3) No condensation (e.g. due to sudden temperature changes).

(4) No direct exposure to sunlight.

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

A two hour "warming up" period should be allowed if the AD72 has not been powered up for over 12 months. (This is to allow the electrolyte in electrolytic capacitor to stabilize.) The battery should be replaced every 10 months if the unit is not powered up to maintain buffer memory data.

9.2 Battery Change

9.2.1 Battery change frequency

When the data backup battery voltage drops, the LED on the AD72 front panel is lit and an input signal (battery error) to the PC CPU is enabled. The battery is live for about one month more and, if it is not replaced, data will then be lost or corrupted.

Guide for preventive maintenance

1) The battery should be replaced every 4 to 5 years if it is only used for memory back up for a maximum of 300 days in that period.

2) Battery changing frequency for memory backup duty exceeding 300 days can be calculated as follows.

Example

Assume that there are five operation days (10-hour operation and 14-hour power-off during a day) and two power-off days in a week. Under these conditions, power-off period during one week is:

14 (hours) x 5 (days) = 70 hours
24 (hours) x 2 (days) = 48 hours

7200 (hours) / (70+48) (hours) = 61 (weeks)

61 (weeks) x 7 (days) = 427 (days)

Regarding one month as 30 days,

427 (days) / 30 (days) = 14.2 months

Hence,

it is necessary to change the battery every 14 months.

REMARKS

The battery is the same as that for the MELSEC-A series.
The battery may be stored for five years. The total power failure guarantee period is 300 days.
The following battery is used:

Description : Lithium battery
Type and rating : Type A6BAT (3.6V with leads and socket)

Handling:

(1) Do not short.
(2) Do not disassemble.
(3) Do not burn.
(4) Do not heat.
(5) Do not solder electrodes.
(6) Do not measure voltage with an analog voltmeter.

9.2.2 Changing the battery

Fig. 9.1 shows the battery changing procedure.

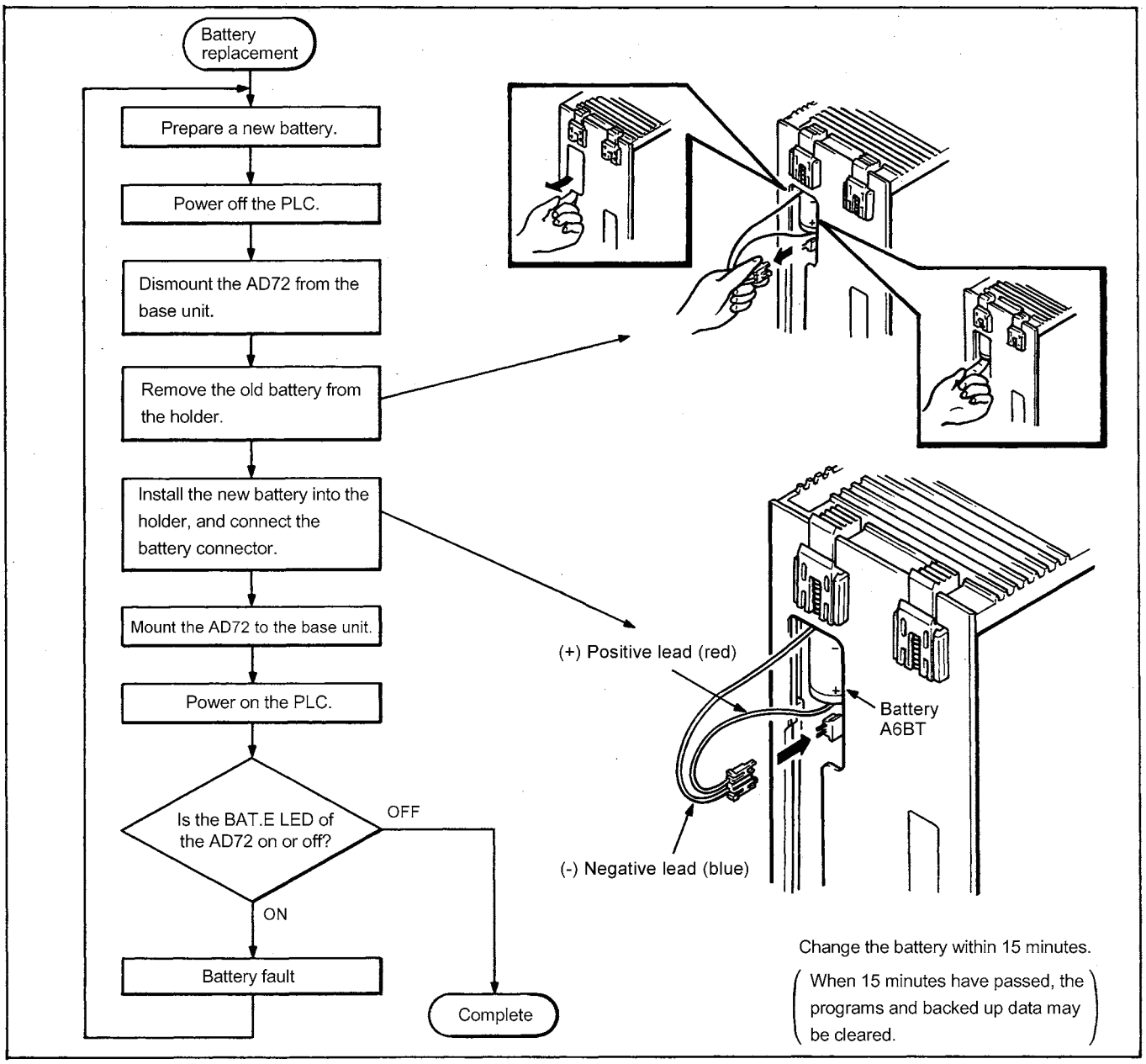


Fig. 9.1 Battery Changing

Buffer memory data is maintained for approx. 15 minutes by a capacitor without the battery.

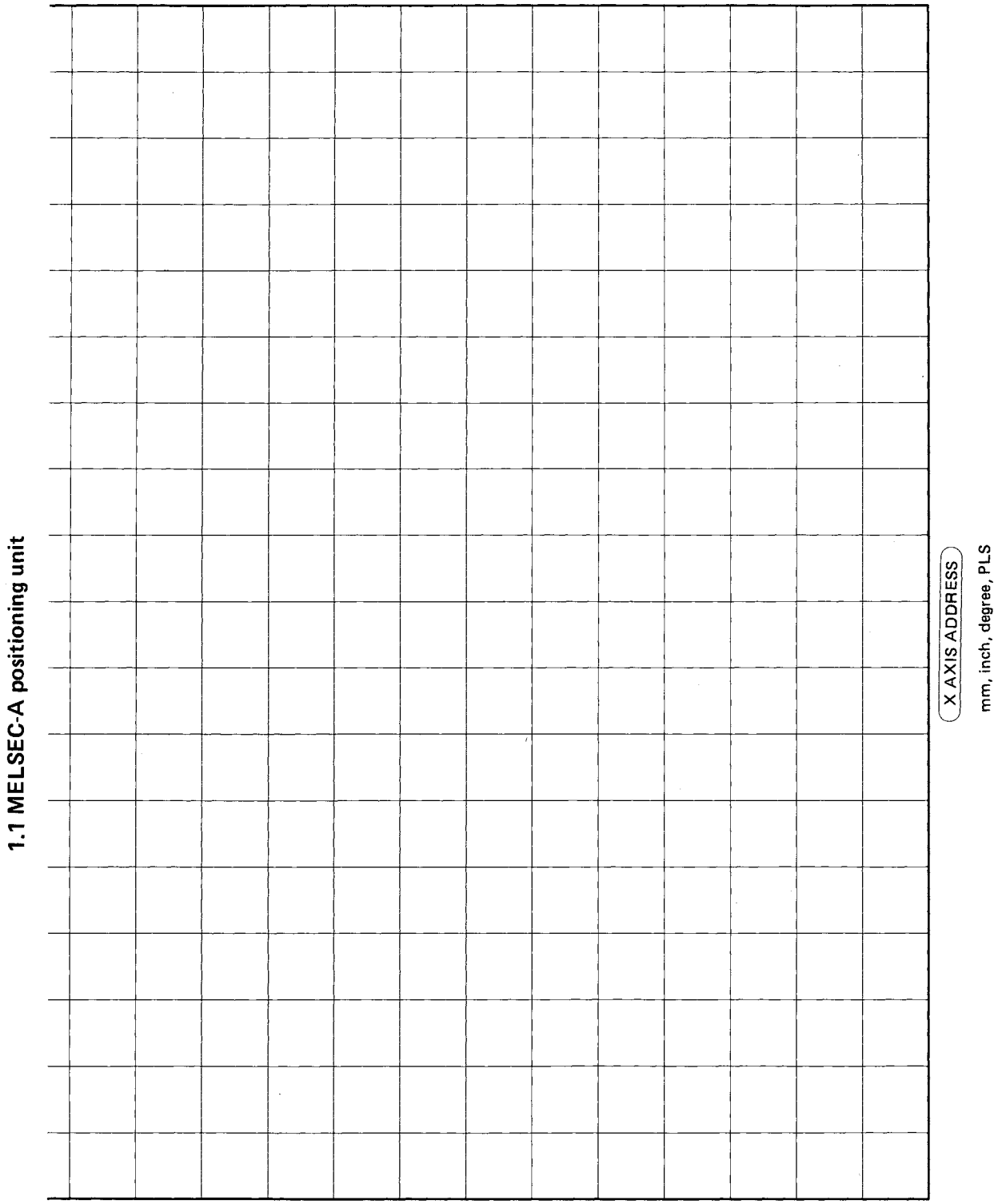
IMPORTANT

The components on the printed circuit board may be damaged by static electricity. When handling the printed circuit board:

1) **Ground all tools, work bench, etc.**
2) **Do not touch the conductive areas or electrical components.**

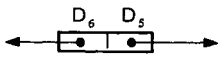
APPENDICES

APPENDIX 1 Format Sheets



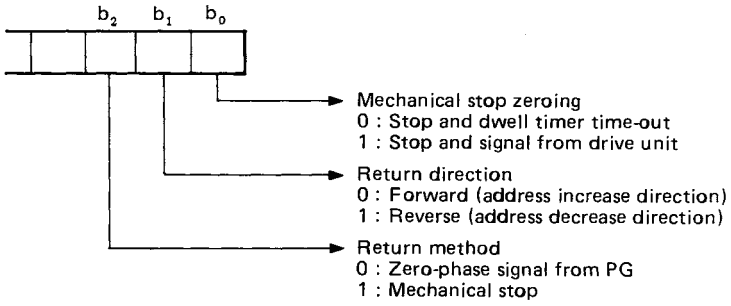
1.2 Format sheets

(1) Parameters

	Item	Initial Value	X Axis	Y Axis	mm		inch		degree		PULSE (PLS)	
					Setting range	Unit	Setting range	Unit	Setting range	Unit	Setting range	Unit
1	Unit setting	3			0	–	1	–	2	–	3	–
2	Travel per pulse	Set value			1 to 100	$X10^{-1}$ μm/ PLS	1 to 100	$X10^{-5}$ inch/ PLS	1 to 100	$X10^{-5}$ deg/ PLS	–	
3	Speed limit value	20,000			1 to 12,000	X10 mm/ min	1 to 12,000	X1 inch/ min	1 to 12,000	X1 deg/ min	1 to 20,000	X10 PLS/ sec
4	Jog speed limit value	2,000			1 to 12,000	X10 mm/ min	1 to 12,000	X1 inch/ min	1 to 12,000	X1 deg/ min	1 to 20,000	X10 PLS/ sec
5	Starting bias speed	0			1 to 12,000	X10 mm/ min	1 to 12,000	X1 inch/ min	1 to 12,000	X1 deg/ min	1 to 20,000	X10 PLS/ sec
6	Backlash	0			0 to 65, 35	$X10^{-1}$ μm	0 to 65,535	$X10^{-5}$ inch	0 to 65,535	$X10^{-5}$ deg	0 to 255	PLS
7	Upper stroke limit	16,252,928			0 to 162,000	mm	0 to 16,200	inch	0 to 16,200	deg	0 to 16,252,928	PLS
8	Lower stroke limit	0			0 to 162,000	mm	0 to 16,200	inch	0 to 16,200	deg	0 to 16,252,928	PLS
9	Error compensation	0			±0 to 100,000 (per 1m)	$X10^{-1}$ μm	±0 to 100,000 (per 100 inch)	$X10^{-5}$ inch	±0 to 100,000 (per 100 deg)	$X10^{-5}$ deg	–	
10	Travel per manual pulser pulse	1			0 to 100,000	$X10^{-1}$ μm	0 to 100,000	$X10^{-5}$ inch	0 to 100,000	$X10^{-5}$ deg	0 to 100	PLS
11	Acceleration and deceleration times	1,000			64 to 4,999 msec							
12	Positioning complete signal output time	300			0 to 20,000 msec							
13	Pulse output mode	Set value			0 : PLS + SIGN 1 : forward pulse, reverse pulse							
14	Rotating direction setting	Set value			0 : present value increase with forward pulse output 1 : present value increase with reverse pulse output							
15	Absolute/ incremental setting	0			0 : absolute 1 : incremental 2 : absolute/incremental combined							
16	M code ON/OFF timing	Set value			0 : WITH mode 1 : AFTER mode  0 : not used 1 : used							

(2) Zeroing data

	Item	X Axis	Y Axis	mm		inch		degree		PULSE (PLS)	
				Setting range	Unit	Setting range	Unit	Setting range	Unit	Setting range	Unit
1	Zeroing direction			0 : forward direction (address increase) 1 : reverse direction (address decrease)							
2	Zeroing method			See below.							
3	Zeroing address			0to 1,620,000,000	$X10^{-1}$ μm	0to 1,620,000,000	$X10^{-5}$ inch	0to 1,620,000,000	$X10^{-5}$ deg	0to 16,252,928	PLS
4	Zeroing speed			1to12,000	X10 mm/ min	1to12,000	X1 inch/ min	1to12,000	X1 deg/ min	1to20,000	X10 PLS/ sec
5	Creep speed			1to12,000	X10 mm/ min	1to12,000	X1 inch/ min	1to12,000	X1 deg/ min	1to20,000	X10 PLS/ sec
6	Dwell			0 to 499 x 10 msec							
7	Torque limit			1 to 25 x 10%							



1.3 Positioning data (Data No. to)

X AXIS							
Data No.	Pattern	Abs./ Inc.	Direc- tion	Speed	Address	Dwell	M Code
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							

00 : END
01 : Continue
11 : Change

0 : Abs.
1 : Inc.

For Inc.
0 : Address increase direction
1 : Address decrease direction

0 to 255

0 : Without M code
1 to 19 : With comment

Y AXIS							
Data No.	Pattern	Abs./ Inc.	Direc- tion	Speed	Address	Dwell	M Code
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							

00 : END
01 : Continue
11 : Change

0 : Abs.
1 : Inc.

For Inc.
0 : Address increase direction
1 : Address decrease direction

0 to 255

0 : Without M code
1 to 19 : With comment

1.4 M code comments

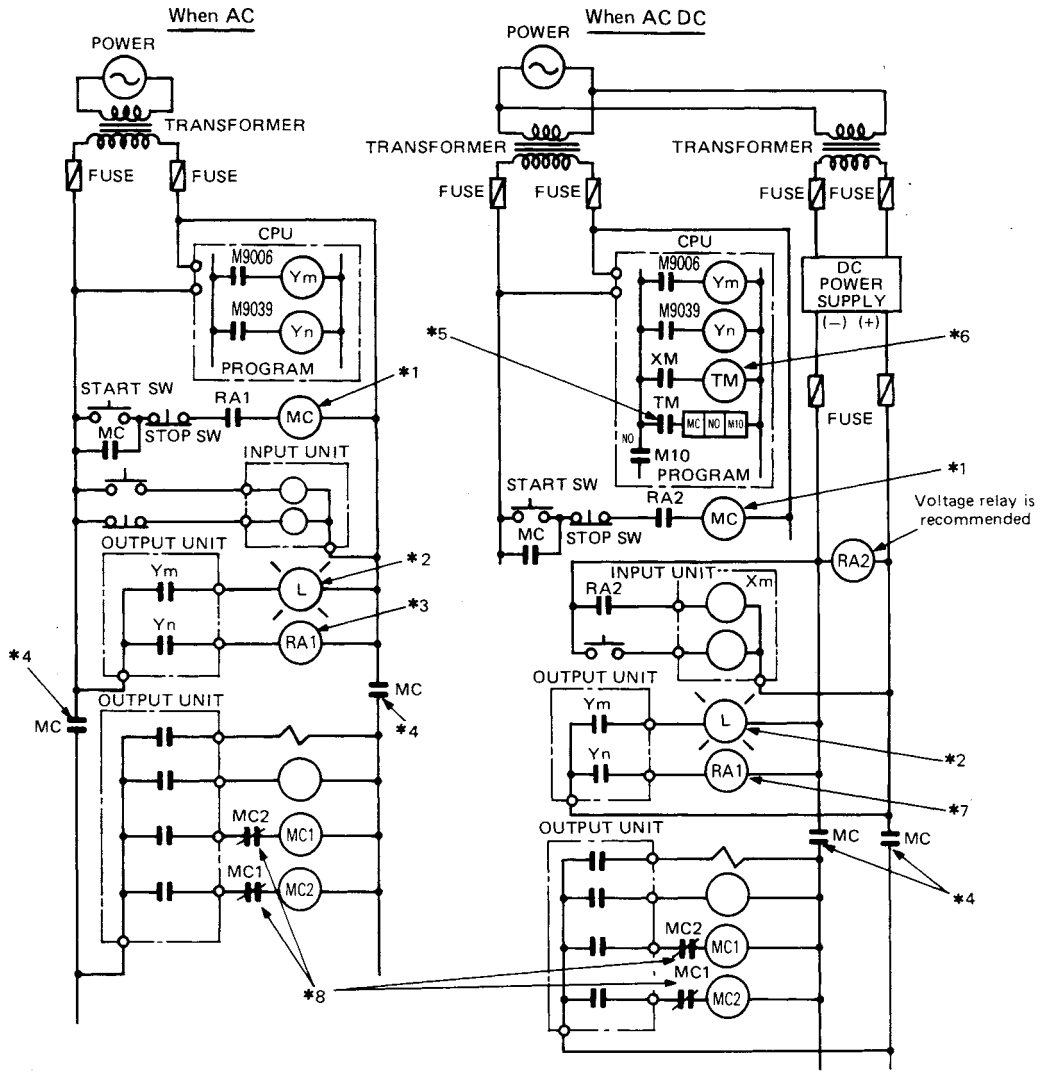
M CODE	X AXIS	M CODE	Y AXIS
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	
16		16	
17		17	
18		18	
19		19	

Maximum 16 characters per comment

APPENDIX 2 System Design Considerations

On switching on the PC power supply there is a short but finite time before the DC levels reach their operating values. During this period the unit will not operate normally. The same applies when the power is cut as the DC levels drop below their operating values.
The following circuit will overcome any problems which may arise in extreme circumstances due to this phenomenon.

System design circuit example



*1: Run/stop circuit interlocked with RA1 (run monitor relay)
*2: Battery low alarm
*3: RA1 turned on by M9039 (run monitor relay)
*4: Power to output equipment turned off when STOP signal given.
*5: Input switched when power supply established.
*6: Set time for DC power supply to be established (approx. 0.5 secs)
*7: On when run by M9039
*8: Interlock circuit as necessary.

Power on procedure:

(a) AC

1) Switch power on.

2) Set CPU to RUN.

3) Switch on the START switch.

4) When magnetic contactor (MC) comes in, output equipment is powered and may be driven by the program.

(b) AC·DC

1) Switch power on.

2) Set CPU to RUN.

3) When DC power is established, RA2 turns on.

4) When DC power reaches 100%, timer TM starts.
(Timer (TIM) should be set to the time required for the DC voltage to reach 100% of its value after RA2 turns on.)

5) Switch on the START switch.

6) When the magnetic contactor (MC) comes in, the output equipment is powered and may be driven by the program.

APPENDIX 3 Positioning Data Number and Buffer Memory Address Conversion Table

Positioning Data No. and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
1	3872	4272	4672	5072	5073	5872	6272	6672	7072	7073
2	3873	4273	4673	5074	5075	5873	6273	6673	7074	7075
3	3874	4274	4674	5076	5077	5874	6274	6674	7076	7077
4	3875	4275	4675	5078	5079	5875	6275	6675	7078	7079
5	3876	4276	4676	5080	5081	5876	6276	6676	7080	7081
6	3877	4277	4677	5082	5083	5877	6277	6677	7082	7083
7	3878	4278	4678	5084	5085	5878	6278	6678	7084	7085
8	3879	4279	4679	5086	5087	5879	6279	6679	7086	7087
9	3880	4280	4680	5088	5089	5880	6280	6680	7088	7089
10	3881	4281	4681	5090	5091	5881	6281	6681	7090	7091
11	3882	4282	4682	5092	5093	5882	6282	6682	7092	7093
12	3883	4283	4683	5094	5095	5883	6283	6683	7094	7095
13	3884	4284	4684	5096	5097	5884	6284	6684	7096	7097
14	3885	4285	4685	5098	5099	5885	6285	6685	7098	7099
15	3886	4286	4686	5100	5101	5886	6286	6686	7100	7101
16	3887	4287	4687	5102	5103	5887	6287	6687	7102	7103
17	3888	4288	4688	5104	5105	5888	6288	6688	7104	7105
18	3889	4289	4689	5106	5107	5889	6289	6689	7106	7107
19	3890	4290	4690	5108	5109	5890	6290	6690	7108	7109
20	3891	4291	4691	5110	5111	5891	6291	6691	7110	7111
21	3892	4292	4692	5112	5113	5892	6292	6692	7112	7113
22	3893	4293	4693	5114	5115	5893	6293	6693	7114	7115
23	3894	4294	4694	5116	5117	5894	6294	6694	7116	7117
24	3895	4295	4695	5118	5119	5895	6295	6695	7118	7119
25	3896	4296	4696	5120	5121	5896	6296	6696	7120	7121
26	3897	4297	4697	5122	5123	5897	6297	6697	7122	7123
27	3898	4298	4698	5124	5125	5898	6298	6698	7124	7125
28	3899	4299	4699	5126	5127	5899	6299	6699	7126	7127
29	3900	4300	4700	5128	5129	5900	6300	6700	7128	7129
30	3901	4301	4701	5130	5131	5901	6301	6701	7130	7131
31	3902	4302	4702	5132	5133	5902	6302	6702	7132	7133
32	3903	4303	4703	5134	5135	5903	6303	6703	7134	7135
33	3904	4304	4704	5136	5137	5904	6304	6704	7136	7137
34	3905	4305	4705	5138	5139	5905	6305	6705	7138	7139
35	3906	4306	4706	5140	5141	5906	6306	6706	7140	7141
36	3907	4307	4707	5142	5143	5907	6307	6707	7142	7143
37	3908	4308	4708	5144	5145	5908	6308	6708	7144	7145
38	3909	4309	4709	5146	5147	5909	6309	6709	7146	7147
39	3910	4310	4710	5148	5149	5910	6310	6710	7148	7149
40	3911	4311	4711	5150	5151	5911	6311	6711	7150	7151
41	3912	4312	4712	5152	5153	5912	6312	6712	7152	7153
42	3913	4313	4713	5154	5155	5913	6313	6713	7154	7155
43	3914	4314	4714	5156	5157	5914	6314	6714	7156	7157
44	3915	4315	4715	5158	5159	5915	6315	6715	7158	7159
45	3916	4316	4716	5160	5161	5916	6316	6716	7160	7161
46	3917	4317	4717	5162	5163	5917	6317	6717	7162	7163
47	3918	4318	4718	5164	5165	5918	6318	6718	7164	7165
48	3919	4319	4719	5166	5167	5919	6319	6719	7166	7167
49	3920	4320	4720	5168	5169	5920	6320	6720	7168	7169
50	3921	4321	4721	5170	5171	5921	6321	6721	7170	7171

Positioning Data No. and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
51	3922	4322	4722	5172	5173	5922	6322	6722	7172	7173
52	3923	4323	4723	5174	5175	5923	6323	6723	7174	7175
53	3924	4324	4724	5176	5177	5924	6324	6724	7176	7177
54	3925	4325	4725	5178	5179	5925	6325	6725	7178	7179
55	3926	4326	4726	5180	5181	5926	6326	6726	7180	7181
56	3927	4327	4727	5182	5183	5927	6327	6727	7182	7183
57	3928	4328	4728	5184	5185	5928	6328	6728	7184	7185
58	3929	4329	4729	5186	5187	5929	6329	6729	7186	7187
59	3930	4330	4730	5188	5189	5930	6330	6730	7188	7189
60	3931	4331	4731	5190	5191	5931	6331	6731	7190	7191
61	3932	4332	4732	5192	5193	5932	6332	6732	7192	7193
62	3933	4333	4733	5194	5195	5933	6333	6733	7194	7195
63	3934	4334	4734	5196	5197	5934	6334	6734	7196	7197
64	3935	4335	4735	5198	5199	5935	6335	6735	7198	7199
65	3936	4336	4736	5200	5201	5936	6336	6736	7200	7201
66	3937	4337	4737	5202	5203	5937	6337	6737	7202	7203
67	3938	4338	4738	5204	5205	5938	6338	6738	7204	7205
68	3939	4339	4739	5206	5207	5939	6339	6739	7206	7207
69	3940	4340	4740	5208	5209	5940	6340	6740	7208	7209
70	3941	4341	4741	5210	5211	5941	6341	6741	7210	7211
71	3942	4342	4742	5212	5213	5942	6342	6742	7212	7213
72	3943	4343	4743	5214	5215	5943	6343	6743	7214	7215
73	3944	4344	4744	5216	5217	5944	6344	6744	7216	7217
74	3945	4345	4745	5218	5219	5945	6345	6745	7218	7219
75	3946	4346	4746	5220	5221	5946	6346	6746	7220	7221
76	3947	4347	4747	5222	5223	5947	6347	6747	7222	7223
77	3948	4348	4748	5224	5225	5948	6348	6748	7224	7225
78	3949	4349	4749	5226	5227	5949	6349	6749	7226	7227
79	3950	4350	4750	5228	5229	5950	6350	6750	7228	7229
80	3951	4351	4751	5230	5231	5951	6351	6751	7230	7231
81	3952	4352	4752	5232	5233	5952	6352	6752	7232	7233
82	3953	4353	4753	5234	5235	5953	6353	6753	7234	7235
83	3954	4354	4754	5236	5237	5954	6354	6754	7236	7237
84	3955	4355	4755	5238	5239	5955	6355	6755	7238	7239
85	3956	4356	4756	5240	5241	5956	6356	6756	7240	7241
86	3957	4357	4757	5242	5243	5957	6357	6757	7242	7243
87	3958	4358	4758	5244	5245	5958	6358	6758	7244	7245
88	3959	4359	4759	5246	5247	5959	6359	6759	7246	7247
89	3960	4360	4760	5248	5249	5960	6360	6760	7248	7249
90	3961	4361	4761	5250	5251	5961	6361	6761	7250	7251
91	3962	4362	4762	5252	5253	5962	6362	6762	7252	7253
92	3963	4363	4763	5254	5255	5963	6363	6763	7254	7255
93	3964	4364	4764	5256	5257	5964	6364	6764	7256	7257
94	3965	4365	4765	5258	5259	5965	6365	6765	7258	7259
95	3966	4366	4766	5260	5261	5966	6366	6766	7260	7261
96	3967	4367	4767	5262	5263	5967	6367	6767	7262	7263
97	3968	4368	4768	5264	5265	5968	6368	6768	7264	7265
98	3969	4369	4769	5266	5267	5969	6369	6769	7266	7267
99	3970	4370	4770	5268	5269	5970	6370	6770	7268	7269
100	3971	4371	4771	5270	5271	5971	6371	6771	7270	7271

Positioning Data No.and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
101	3972	4372	4772	5272	5273	5972	6372	6772	7272	7273
102	3973	4373	4773	5274	5275	5973	6373	6773	7274	7275
103	3974	4374	4774	5276	5277	5974	6374	6774	7276	7277
104	3975	4375	4775	5278	5279	5975	6375	6775	7278	7279
105	3976	4376	4776	5280	5281	5976	6376	6776	7280	7281
106	3977	4377	4777	5282	5283	5977	6377	6777	7282	7283
107	3978	4378	4778	5284	5285	5978	6378	6778	7284	7285
108	3979	4379	4779	5286	5287	5979	6379	6779	7286	7287
109	3980	4380	4780	5288	5289	5980	6380	6780	7288	7289
110	3981	4381	4781	5290	5291	5981	6381	6781	7290	7291
111	3982	4382	4782	5292	5293	5982	6382	6782	7292	7293
112	3983	4383	4783	5294	5295	5983	6383	6783	7294	7295
113	3984	4384	4784	5296	5297	5984	6384	6784	7296	7297
114	3985	4385	4785	5298	5299	5985	6385	6785	7298	7299
115	3986	4386	4786	5300	5301	5986	6386	6786	7300	7301
116	3987	4387	4787	5302	5303	5987	6387	6787	7302	7303
117	3988	4388	4788	5304	5305	5988	6388	6788	7304	7305
118	3989	4389	4789	5306	5307	5989	6389	6789	7306	7307
119	3990	4390	4790	5308	5309	5990	6390	6790	7308	7309
120	3991	4391	4791	5310	5311	5991	6391	6791	7310	7311
121	3992	4392	4792	5312	5313	5992	6392	6792	7312	7313
122	3993	4393	4793	5314	5315	5993	6393	6793	7314	7315
123	3994	4394	4794	5316	5317	5994	6394	6794	7316	7317
124	3995	4395	4795	5318	5319	5995	6395	6795	7318	7319
125	3996	4396	4796	5320	5321	5996	6396	6796	7320	7321
126	3997	4397	4797	5322	5323	5997	6397	6797	7322	7323
127	3998	4398	4798	5324	5325	5998	6398	6798	7324	7325
128	3999	4399	4799	5326	5327	5999	6399	6799	7326	7327
129	4000	4400	4800	5328	5329	6000	6400	6800	7328	7329
130	4001	4401	4801	5330	5331	6001	6401	6801	7330	7331
131	4002	4402	4802	5332	5333	6002	6402	6802	7332	7333
132	4003	4403	4803	5334	5335	6003	6403	6803	7334	7335
133	4004	4404	4804	5336	5337	6004	6404	6804	7336	7337
134	4005	4405	4805	5338	5339	6005	6405	6805	7338	7339
135	4006	4406	4806	5340	5341	6006	6406	6806	7340	7341
136	4007	4407	4807	5342	5343	6007	6407	6807	7342	7343
137	4008	4408	4808	5344	5345	6008	6408	6808	7344	7345
138	4009	4409	4809	5346	5347	6009	6409	6809	7346	7347
139	4010	4410	4810	5348	5349	6010	6410	6810	7348	7349
140	4011	4411	4811	5350	5351	6011	6411	6811	7350	7351
141	4012	4412	4812	5352	5353	6012	6412	6812	7352	7353
142	4013	4413	4813	5354	5355	6013	6413	6813	7354	7355
143	4014	4414	4814	5356	5357	6014	6414	6814	7356	7357
144	4015	4415	4815	5358	5359	6015	6415	6815	7358	7359
145	4016	4416	4816	5360	5361	6016	6416	6816	7360	7361
146	4017	4417	4817	5362	5363	6017	6417	6817	7362	7363
147	4018	4418	4818	5364	5365	6018	6418	6818	7364	7365
148	4019	4419	4819	5366	5367	6019	6419	6819	7366	7367
149	4020	4420	4820	5368	5369	6020	6420	6820	7368	7369
150	4021	4421	4821	5370	5371	6021	6421	6821	7370	7371

Positioning Data No.and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
151	4022	4422	4822	5372	5373	6022	6422	6822	7372	7373
152	4023	4423	4823	5374	5375	6023	6423	6823	7374	7375
153	4024	4424	4824	5376	5377	6024	6424	6824	7376	7377
154	4025	4425	4825	5378	5379	6025	6425	6825	7378	7379
155	4026	4426	4826	5380	5381	6026	6426	6826	7380	7381
156	4027	4427	4827	5382	5383	6027	6427	6827	7382	7383
157	4028	4428	4828	5384	5385	6028	6428	6828	7384	7385
158	4029	4429	4829	5386	5387	6029	6429	6829	7386	7387
159	4030	4430	4830	5388	5389	6030	6430	6830	7388	7389
160	4031	4431	4831	5390	5391	6031	6431	6831	7390	7391
161	4032	4432	4832	5392	5393	6032	6432	6832	7392	7393
162	4033	4433	4833	5394	5395	6033	6433	6833	7394	7395
163	4034	4434	4834	5396	5397	6034	6434	6834	7396	7397
164	4035	4435	4835	5398	5399	6035	6435	6835	7398	7399
165	4036	4436	4836	5400	5401	6036	6436	6836	7400	7401
166	4037	4437	4837	5402	5403	6037	6437	6837	7402	7403
167	4038	4438	4838	5404	5405	6038	6438	6838	7404	7405
168	4039	4439	4839	5406	5407	6039	6439	6839	7406	7407
169	4040	4440	4840	5408	5409	6040	6440	6840	7408	7409
170	4041	4441	4841	5410	5411	6041	6441	6841	7410	7411
171	4042	4442	4842	5412	5413	6042	6442	6842	7412	7413
172	4043	4443	4843	5414	5415	6043	6443	6843	7414	7415
173	4044	4444	4844	5416	5417	6044	6444	6844	7416	7417
174	4045	4445	4845	5418	5419	6045	6445	6845	7418	7419
175	4046	4446	4846	5420	5421	6046	6446	6846	7420	7421
176	4047	4447	4847	5422	5423	6047	6447	6847	7422	7423
177	4048	4448	4848	5424	5425	6048	6448	6848	7424	7425
178	4049	4449	4849	5426	5427	6049	6449	6849	7426	7427
179	4050	4450	4850	5428	5429	6050	6450	6850	7428	7429
180	4051	4451	4851	5430	5431	6051	6451	6851	7430	7431
181	4052	4452	4852	5432	5433	6052	6452	6852	7432	7433
182	4053	4453	4853	5434	5435	6053	6453	6853	7434	7435
183	4054	4454	4854	5436	5437	6054	6454	6854	7436	7437
184	4055	4455	4855	5438	5439	6055	6455	6855	7438	7439
185	4056	4456	4856	5440	5441	6056	6456	6856	7440	7441
186	4057	4457	4857	5442	5443	6057	6457	6857	7442	7443
187	4058	4458	4858	5444	5445	6058	6458	6858	7444	7445
188	4059	4459	4859	5446	5447	6059	6459	6859	7446	7447
189	4060	4460	4860	5448	5449	6060	6460	6860	7448	7449
190	4061	4461	4861	5450	5451	6061	6461	6861	7450	7451
191	4062	4462	4862	5452	5453	6062	6462	6862	7452	7453
192	4063	4463	4863	5454	5455	6063	6463	6863	7454	7455
193	4064	4464	4864	5456	5457	6064	6464	6864	7456	7457
194	4065	4465	4865	5458	5459	6065	6465	6865	7458	7459
195	4066	4466	4866	5460	5461	6066	6466	6866	7460	7461
196	4067	4467	4867	5462	5463	6067	6467	6867	7462	7463
197	4068	4468	4868	5464	5465	6068	6468	6868	7464	7465
198	4069	4469	4869	5466	5467	6069	6469	6869	7466	7467
199	4070	4470	4870	5468	5469	6070	6470	6870	7468	7469
200	4071	4471	4871	5470	5471	6071	6471	6871	7470	7471

Positioning Data No.and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
201	4072	4472	4872	5472	5473	6072	6472	6872	7472	7473
202	4073	4473	4873	5474	5475	6073	6473	6873	7474	7475
203	4074	4474	4874	5476	5477	6074	6474	6874	7476	7477
204	4075	4475	4875	5478	5479	6075	6475	6875	7478	7479
205	4076	4476	4876	5480	5481	6076	6476	6876	7480	7481
206	4077	4477	4877	5482	5483	6077	6477	6877	7482	7483
207	4078	4478	4878	5484	5485	6078	6478	6878	7484	7485
208	4079	4479	4879	5486	5487	6079	6479	6879	7486	7487
209	4080	4480	4880	5488	5489	6080	6480	6880	7488	7489
210	4081	4481	4881	5490	5491	6081	6481	6881	7490	7491
211	4082	4482	4882	5492	5493	6082	6482	6882	7492	7493
212	4083	4483	4883	5494	5495	6083	6483	6883	7494	7495
213	4084	4484	4884	5496	5497	6084	6484	6884	7496	7497
214	4085	4485	4885	5498	5499	6085	6485	6885	7498	7499
215	4086	4486	4886	5500	5501	6086	6486	6886	7500	7501
216	4087	4487	4887	5502	5503	6087	6487	6887	7502	7503
217	4088	4488	4888	5504	5505	6088	6488	6888	7504	7505
218	4089	4489	4889	5506	5507	6089	6489	6889	7506	7507
219	4090	4490	4890	5508	5509	6090	6490	6890	7508	7509
220	4091	4491	4891	5510	5511	6091	6491	6891	7510	7511
221	4092	4492	4892	5512	5513	6092	6492	6892	7512	7513
222	4093	4493	4893	5514	5515	6093	6493	6893	7514	7515
223	4094	4494	4894	5516	5517	6094	6494	6894	7516	7517
224	4095	4495	4895	5518	5519	6095	6495	6895	7518	7519
225	4096	4496	4896	5520	5521	6096	6496	6896	7520	7521
226	4097	4497	4897	5522	5523	6097	6497	6897	7522	7523
227	4098	4498	4898	5524	5525	6098	6498	6898	7524	7525
228	4099	4499	4899	5526	5527	6099	6499	6899	7526	7527
229	4100	4500	4900	5528	5529	6100	6500	6900	7528	7529
230	4101	4501	4901	5530	5531	6101	6501	6901	7530	7531
231	4102	4502	4902	5532	5533	6102	6502	6902	7532	7533
232	4103	4503	4903	5534	5535	6103	6503	6903	7534	7535
233	4104	4504	4904	5536	5537	6104	6504	6904	7536	7537
234	4105	4505	4905	5538	5539	6105	6505	6905	7538	7539
235	4106	4506	4906	5540	5541	6106	6506	6906	7540	7541
236	4107	4507	4907	5542	5543	6107	6507	6907	7542	7543
237	4108	4508	4908	5544	5545	6108	6508	6908	7544	7545
238	4109	4509	4909	5546	5547	6109	6509	6909	7546	7547
239	4110	4510	4910	5548	5549	6110	6510	6910	7548	7549
240	4111	4511	4911	5550	5551	6111	6511	6911	7550	7551
241	4112	4512	4912	5552	5553	6112	6512	6912	7552	7553
242	4113	4513	4913	5554	5555	6113	6513	6913	7554	7555
243	4114	4514	4914	5556	5557	6114	6514	6914	7556	7557
244	4115	4515	4915	5558	5559	6115	6515	6915	7558	7559
245	4116	4516	4916	5560	5561	6116	6516	6916	7560	7561
246	4117	4517	4917	5562	5563	6117	6517	6917	7562	7563
247	4118	4518	4918	5564	5565	6118	6518	6918	7564	7565
248	4119	4519	4919	5566	5567	6119	6519	6919	7566	7567
249	4120	4520	4920	5568	5569	6120	6520	6920	7568	7569
250	4121	4521	4921	5570	5571	6121	6521	6921	7570	7571

Positioning Data No.and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
251	4122	4522	4922	5572	5573	6122	6522	6922	7572	7573
252	4123	4523	4923	5574	5575	6123	6523	6923	7574	7575
253	4124	4524	4924	5576	5577	6124	6524	6924	7576	7577
254	4125	4525	4925	5578	5579	6125	6525	6925	7578	7579
255	4126	4526	4926	5580	5581	6126	6526	6926	7580	7581
256	4127	4527	4927	5582	5583	6127	6527	6927	7582	7583
257	4128	4528	4928	5584	5585	6128	6528	6928	7584	7585
258	4129	4529	4929	5586	5587	6129	6529	6929	7586	7587
259	4130	4530	4930	5588	5589	6130	6530	6930	7588	7589
260	4131	4531	4931	5590	5591	6131	6531	6931	7590	7591
261	4132	4532	4932	5592	5593	6132	6532	6932	7592	7593
262	4133	4533	4933	5594	5595	6133	6533	6933	7594	7595
263	4134	4534	4934	5596	5597	6134	6534	6934	7596	7597
264	4135	4535	4935	5598	5599	6135	6535	6935	7598	7599
265	4136	4536	4936	5600	5601	6136	6536	6936	7600	7601
266	4137	4537	4937	5602	5603	6137	6537	6937	7602	7603
267	4138	4538	4938	5604	5605	6138	6538	6938	7604	7605
268	4139	4539	4939	5606	5607	6139	6539	6939	7606	7607
269	4140	4540	4940	5608	5609	6140	6540	6940	7608	7609
270	4141	4541	4941	5610	5611	6141	6541	6941	7610	7611
271	4142	4542	4942	5612	5613	6142	6542	6942	7612	7613
272	4143	4543	4943	5614	5615	6143	6543	6943	7614	7615
273	4144	4544	4944	5616	5617	6144	6544	6944	7616	7617
274	4145	4545	4945	5618	5619	6145	6545	6945	7618	7619
275	4146	4546	4946	5620	5621	6146	6546	6946	7620	7621
276	4147	4547	4947	5622	5623	6147	6547	6947	7622	7623
277	4148	4548	4948	5624	5625	6148	6548	6948	7624	7625
278	4149	4549	4949	5626	5627	6149	6549	6949	7626	7627
279	4150	4550	4950	5628	5629	6150	6550	6950	7628	7629
280	4151	4551	4951	5630	5631	6151	6551	6951	7630	7631
281	4152	4552	4952	5632	5633	6152	6552	6952	7632	7633
282	4153	4553	4953	5634	5635	6153	6553	6953	7634	7635
283	4154	4554	4954	5636	5637	6154	6554	6954	7636	7637
284	4155	4555	4955	5638	5639	6155	6555	6955	7638	7639
285	4156	4556	4956	5640	5641	6156	6556	6956	7640	7641
286	4157	4557	4957	5642	5643	6157	6557	6957	7642	7643
287	4158	4558	4958	5644	5645	6158	6558	6958	7644	7645
288	4159	4559	4959	5646	5647	6159	6559	6959	7646	7647
289	4160	4560	4960	5648	5649	6160	6560	6960	7648	7649
290	4161	4561	4961	5650	5651	6161	6561	6961	7650	7651
291	4162	4562	4962	5652	5653	6162	6562	6962	7652	7653
292	4163	4563	4963	5654	5655	6163	6563	6963	7654	7655
293	4164	4564	4964	5656	5657	6164	6564	6964	7656	7657
294	4165	4565	4965	5658	5659	6165	6565	6965	7658	7659
295	4166	4566	4966	5660	5661	6166	6566	6966	7660	7661
296	4167	4567	4967	5662	5663	6167	6567	6967	7662	7663
297	4168	4568	4968	5664	5665	6168	6568	6968	7664	7665
298	4169	4569	4969	5666	5667	6169	6569	6969	7666	7667
299	4170	4570	4970	5668	5669	6170	6570	6970	7668	7669
300	4171	4571	4971	5670	5671	6171	6571	6971	7670	7671

Positioning Data No.and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
301	4172	4572	4972	5672	5673	6172	6572	6972	7672	7673
302	4173	4573	4973	5674	5675	6173	6573	6973	7674	7675
303	4174	4574	4974	5676	5677	6174	6574	6974	7676	7677
304	4175	4575	4975	5678	5679	6175	6575	6975	7678	7679
305	4176	4576	4976	5680	5681	6176	6576	6976	7680	7681
306	4177	4577	4977	5682	5683	6177	6577	6977	7682	7683
307	4178	4578	4978	5684	5685	6178	6578	6978	7684	7685
308	4179	4579	4979	5686	5687	6179	6579	6979	7686	7687
309	4180	4580	4980	5688	5689	6180	6580	6980	7688	7689
310	4181	4581	4981	5690	5691	6181	6581	6981	7690	7691
311	4182	4582	4982	5692	5693	6182	6582	6982	7692	7693
312	4183	4583	4983	5694	5695	6183	6583	6983	7694	7695
313	4184	4584	4984	5696	5697	6184	6584	6984	7696	7697
314	4185	4585	4985	5698	5699	6185	6585	6985	7698	7699
315	4186	4586	4986	5700	5701	6186	6586	6986	7700	7701
316	4187	4587	4987	5702	5703	6187	6587	6987	7702	7703
317	4188	4588	4988	5704	5705	6188	6588	6988	7704	7705
318	4189	4589	4989	5706	5707	6189	6589	6989	7706	7707
319	4190	4590	4990	5708	5709	6190	6590	6990	7708	7709
320	4191	4591	4991	5710	5711	6191	6591	6991	7710	7711
321	4192	4592	4992	5712	5713	6192	6592	6992	7712	7713
322	4193	4593	4993	5714	5715	6193	6593	6993	7714	7715
323	4194	4594	4994	5716	5717	6194	6594	6994	7716	7717
324	4195	4595	4995	5718	5719	6195	6595	6995	7718	7719
325	4196	4596	4996	5720	5721	6196	6596	6996	7720	7721
326	4197	4597	4997	5722	5723	6197	6597	6997	7722	7723
327	4198	4598	4998	5724	5725	6198	6598	6998	7724	7725
328	4199	4599	4999	5726	5727	6199	6599	6999	7726	7727
329	4200	4600	5000	5728	5729	6200	6600	7000	7728	7729
330	4201	4601	5001	5730	5731	6201	6601	7001	7730	7731
331	4202	4602	5002	5732	5733	6202	6602	7002	7732	7733
332	4203	4603	5003	5734	5735	6203	6603	7003	7734	7735
333	4204	4604	5004	5736	5737	6204	6604	7004	7736	7737
334	4205	4605	5005	5738	5739	6205	6605	7005	7738	7739
335	4206	4606	5006	5740	5741	6206	6606	7006	7740	7741
336	4207	4607	5007	5742	5743	6207	6607	7007	7742	7743
337	4208	4608	5008	5744	5745	6208	6608	7008	7744	7745
338	4209	4609	5009	5746	5747	6209	6609	7009	7746	7747
339	4210	4610	5010	5748	5749	6210	6610	7010	7748	7749
340	4211	4611	5011	5750	5751	6211	6611	7011	7750	7751
341	4212	4612	5012	5752	5753	6212	6612	7012	7752	7753
342	4213	4613	5013	5754	5755	6213	6613	7013	7754	7755
343	4214	4614	5014	5756	5757	6214	6614	7014	7756	7757
344	4215	4615	5015	5758	5759	6215	6615	7015	7758	7759
345	4216	4616	5016	5760	5761	6216	6616	7016	7760	7761
346	4217	4617	5017	5762	5763	6217	6617	7017	7762	7763
347	4218	4618	5018	5764	5765	6218	6618	7018	7764	7765
348	4219	4619	5019	5766	5767	6219	6619	7019	7766	7767
349	4220	4620	5020	5768	5769	6220	6620	7020	7768	7769
350	4221	4621	5021	5770	5771	6221	6621	7021	7770	7771

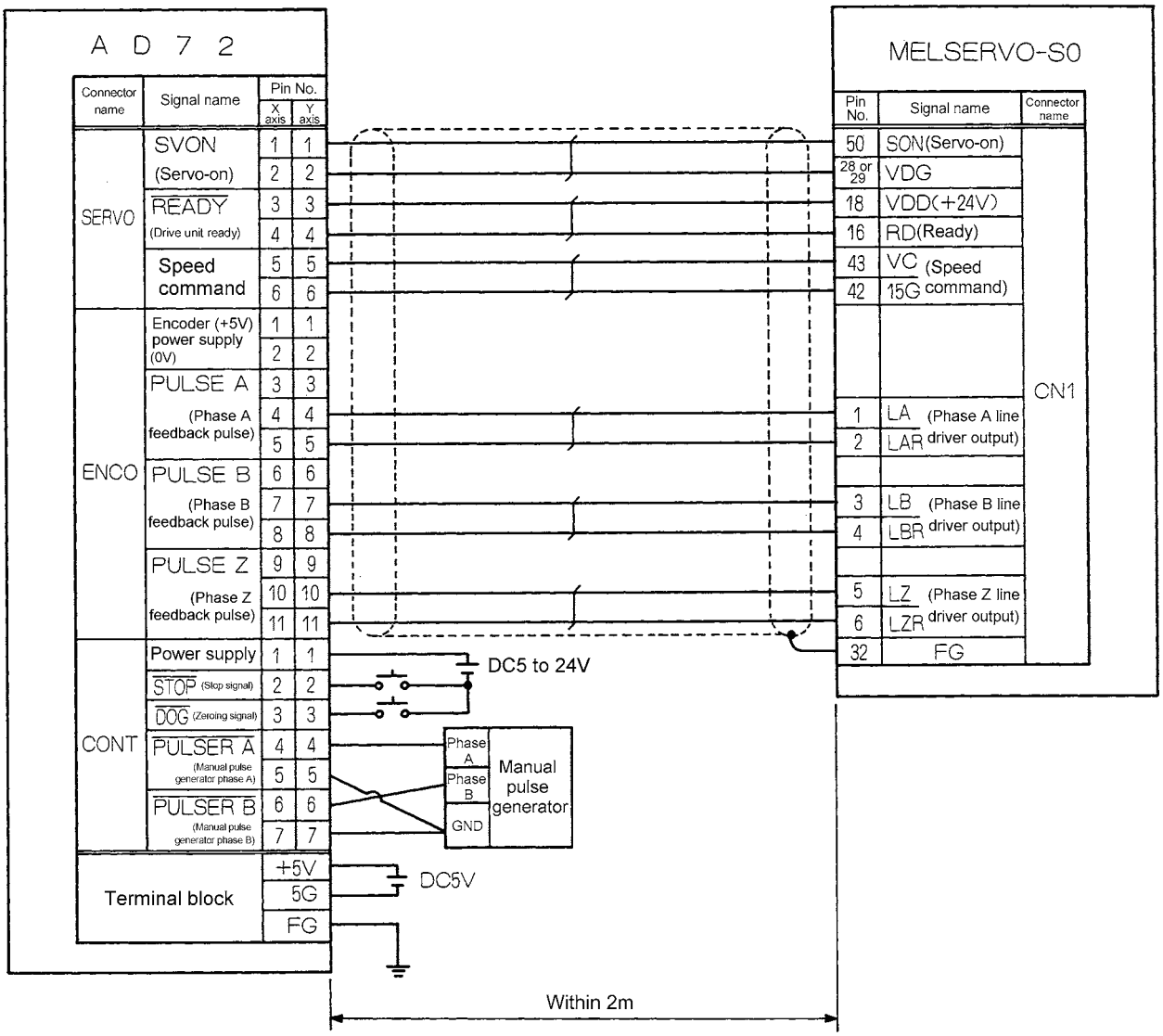
Positioning Data No.and Buffer Memory Address Conversion Table

Data No.	(X Axis)					(Y Axis)				
	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper	Positioning Information	Positioning Speed	Dwell Time	Positioning Lower	Address Upper
351	4222	4622	5022	5772	5773	6222	6622	7022	7772	7773
352	4223	4623	5023	5774	5775	6223	6623	7023	7774	7775
353	4224	4624	5024	5776	5777	6224	6624	7024	7776	7777
354	4225	4625	5025	5778	5779	6225	6625	7025	7778	7779
355	4226	4626	5026	5780	5781	6226	6626	7026	7780	7781
356	4227	4627	5027	5782	5783	6227	6627	7027	7782	7783
357	4228	4628	5028	5784	5785	6228	6628	7028	7784	7785
358	4229	4629	5029	5786	5787	6229	6629	7029	7786	7787
359	4230	4630	5030	5788	5789	6230	6630	7030	7788	7789
360	4231	4631	5031	5790	5791	6231	6631	7031	7790	7791
361	4232	4632	5032	5792	5793	6232	6632	7032	7792	7793
362	4233	4633	5033	5794	5795	6233	6633	7033	7794	7795
363	4234	4634	5034	5796	5797	6234	6634	7034	7796	7797
364	4235	4635	5035	5798	5799	6235	6635	7035	7798	7799
365	4236	4636	5036	5800	5801	6236	6636	7036	7800	7801
366	4237	4637	5037	5802	5803	6237	6637	7037	7802	7803
367	4238	4638	5038	5804	5805	6238	6638	7038	7804	7805
368	4239	4639	5039	5806	5807	6239	6639	7039	7806	7807
369	4240	4640	5040	5808	5809	6240	6640	7040	7808	7809
370	4241	4641	5041	5810	5811	6241	6641	7041	7810	7811
371	4242	4642	5042	5812	5813	6242	6642	7042	7812	7813
372	4243	4643	5043	5814	5815	6243	6643	7043	7814	7815
373	4244	4644	5044	5816	5817	6244	6644	7044	7816	7817
374	4245	4645	5045	5818	5819	6245	6645	7045	7818	7819
375	4246	4646	5046	5820	5821	6246	6646	7046	7820	7821
376	4247	4647	5047	5822	5823	6247	6647	7047	7822	7823
377	4248	4648	5048	5824	5825	6248	6648	7048	7824	7825
378	4249	4649	5049	5826	5827	6249	6649	7049	7826	7827
379	4250	4650	5050	5828	5829	6250	6650	7050	7828	7829
380	4251	4651	5051	5830	5831	6251	6651	7051	7830	7831
381	4252	4652	5052	5832	5833	6252	6652	7052	7832	7833
382	4253	4653	5053	5834	5835	6253	6653	7053	7834	7835
383	4254	4654	5054	5836	5837	6254	6654	7054	7836	7837
384	4255	4655	5055	5838	5839	6255	6655	7055	7838	7839
385	4256	4656	5056	5840	5841	6256	6656	7056	7840	7841
386	4257	4657	5057	5842	5843	6257	6657	7057	7842	7843
387	4258	4658	5058	5844	5845	6258	6658	7058	7844	7845
388	4259	4659	5059	5846	5847	6259	6659	7059	7846	7847
389	4260	4660	5060	5848	5849	6260	6660	7060	7848	7849
390	4261	4661	5061	5850	5851	6261	6661	7061	7850	7851
391	4262	4662	5062	5852	5853	6262	6662	7062	7852	7853
392	4263	4663	5063	5854	5855	6263	6663	7063	7854	7855
393	4264	4664	5064	5856	5857	6264	6664	7064	7856	7857
394	4265	4665	5065	5858	5859	6265	6665	7065	7858	7859
395	4266	4666	5066	5860	5861	6266	6666	7066	7860	7861
396	4267	4667	5067	5862	5863	6267	6667	7067	7862	7863
397	4268	4668	5068	5864	5865	6268	6668	7068	7864	7865
398	4269	4669	5069	5866	5867	6269	6669	7069	7866	7867
399	4270	4670	5070	5868	5869	6270	6670	7070	7868	7869
400	4271	4671	5071	5870	5871	6271	6671	7071	7870	7871

APPENDIX 4 Examples of Connection with Servo Amplifiers

There are various servo amplifiers available for the AD72.
This section shows examples of connection with servo amplifiers as of January, 1987.

4.1 Connection with Mitsubishi MELSERVO-S0 (Feedback pulse input: Differential output type)



IMPORTANT

When using the differential output type as the feedback pulse input, be careful as the feedback pulse exceeds 50KPPS when the servo motor is rotating at the rated speed.
When using the servo motor at the rated speed, use the open collector type shown in Appendix 3.2.

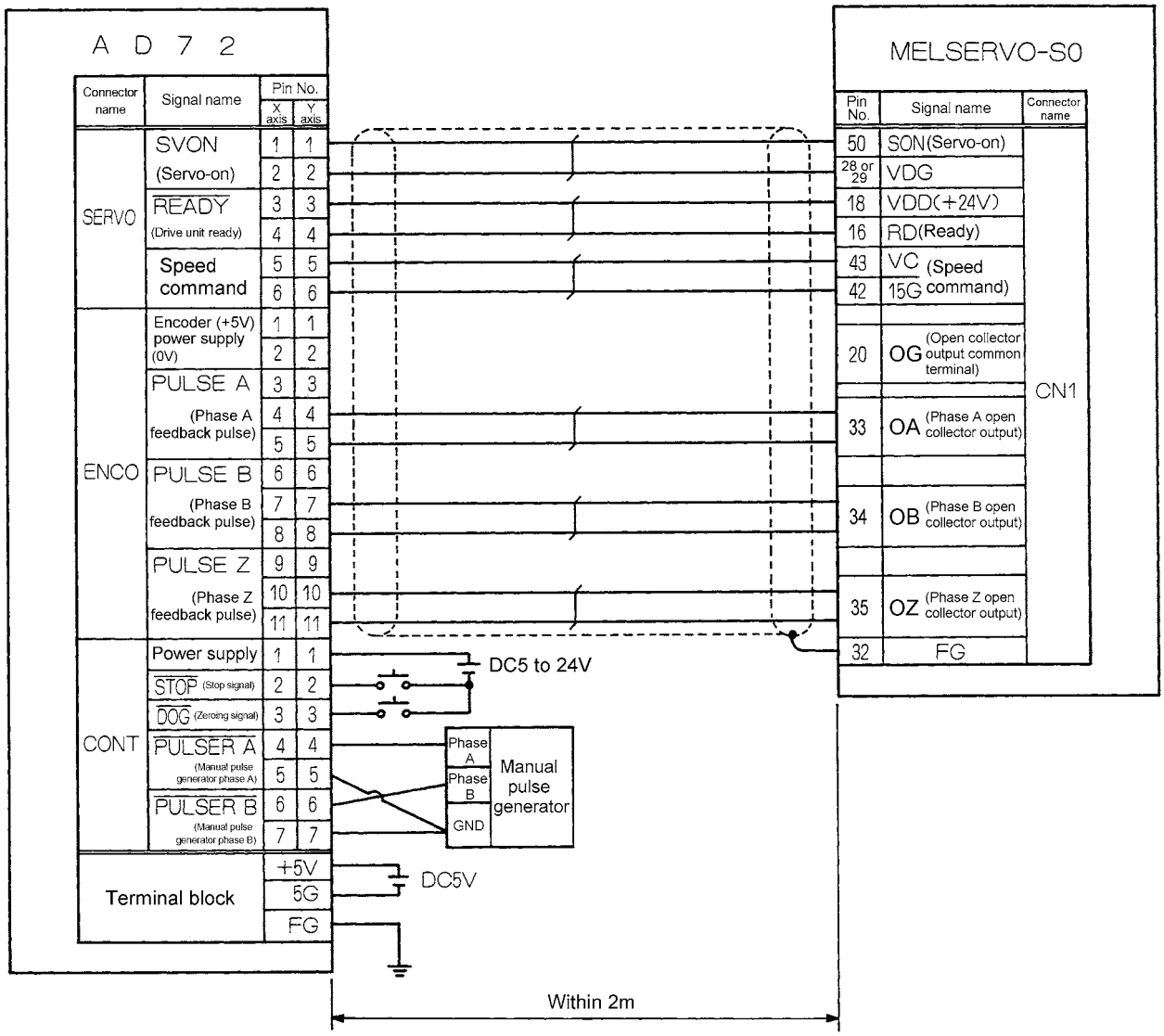
POINT

(1) Indicates a twisted pair shielded wire.

(2) Refer to the MELSERVO-S0 manual for the MELSERVO-S0 servo amplifier side wiring in other than the above diagram.

IB (NA) 66095-A

4.2 Connection with Mitsubishi MELSERVO-S0 (Feedback pulse input: Open collector output type)



IMPORTANT

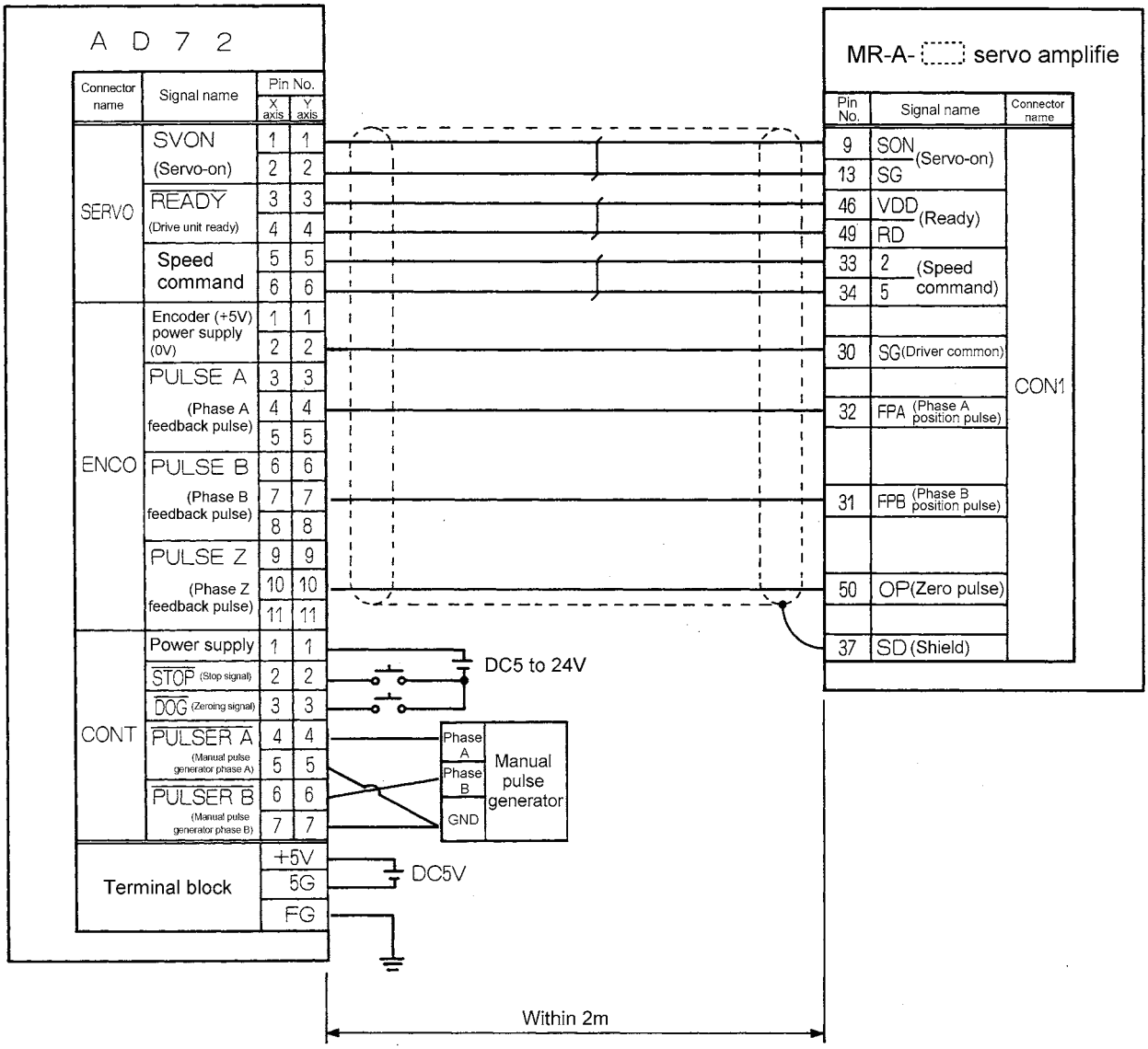
Set the switches so that the feedback output does not exceeds 50KPPS on the MELSERVO-S0 side.

POINT

(1) Indicates a twisted pair shielded wire.

(2) Refer to the MELSERVO-S0 manual for the MELSERVO-S0 servo amplifier side wiring in other than the above diagram.

4.3 Connection with Mitsubishi MELSERVO-A



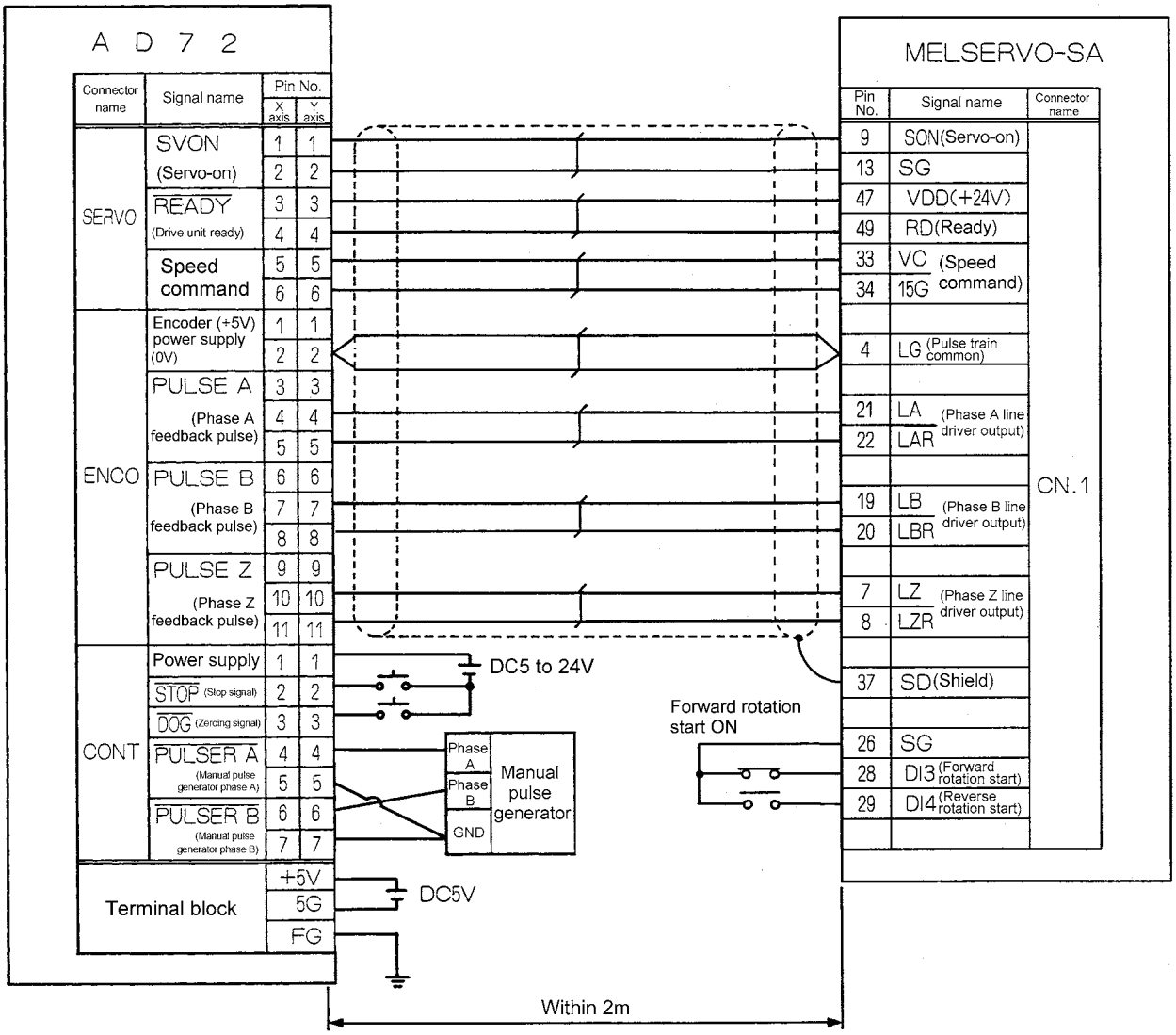
POINT

(1) The MR-A- U, MR-A- and MR-A- KL servo amplifiers cannot be used.

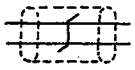
(2) Indicates a twisted pair shielded wire.

(3) Refer to the MR-A- S manual for the MR-A- S servo amplifier side wiring and signal cable shields in other than the above diagram.

4.4 Connection with Mitsubishi MELSERVO-SA



POINT

(1)  Indicates a twisted pair shielded wire.

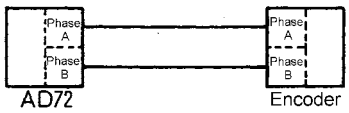
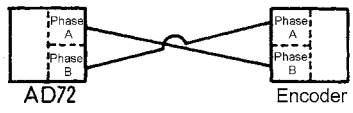
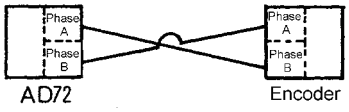
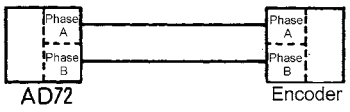
(2) Refer to the MELSERVO-SA manual for the MELSERVO-SA servo amplifier side wiring on other than the previous page.

(3) When connecting the MELSERVO-SA to the AD72, set the servo loop type to "02" (speed (analog, 3 speeds)) in the MELSERVO-SA parameter.

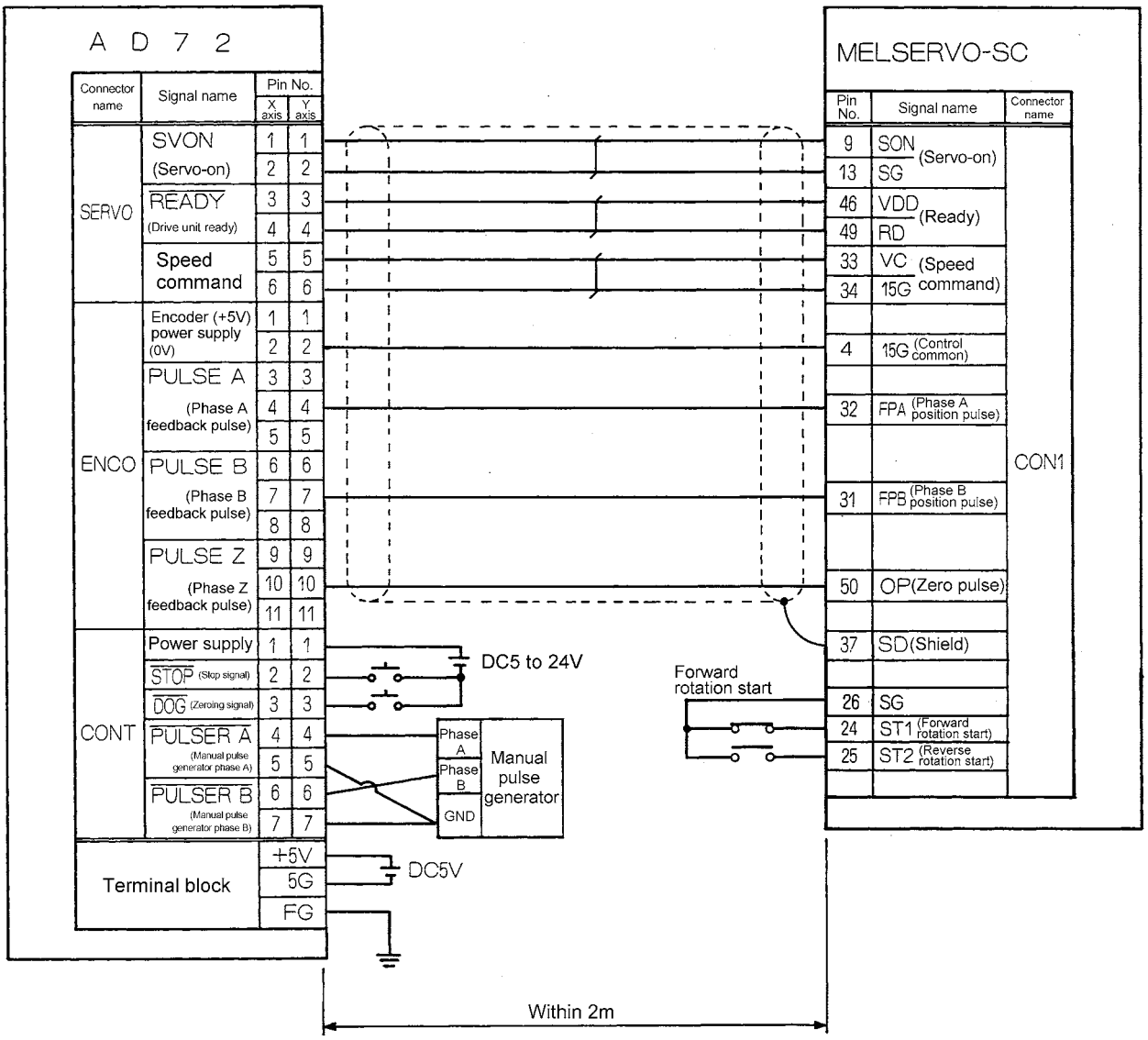
(4) The feedback pulse input of the AD72 is maximum 50Kpps. Therefore, set the encoder output division ratio of the MELSERVO-SA so that the feedback pulse does not exceed 50Kpps.
MELSERVO-SA 2000rpm series ..... 1/2 division setting
3000rpm series ..... 1/4 division setting

(5) On the previous page, the ENCO connector is connected under the following conditions.
- Rotation direction setting in AD72 parameter ··· 0
- Start signal of MELSERVO-SA ..... Forward rotation start ON
- Rotation direction of motor and encoder ..... Same

Under any other conditions, refer to the following table and connect the connector.

Rotation direction of motor and encoder	Rotation direction setting in parameter	Connection	
		MELSERVO-SA forward rotation start ON	MELSERVO-SA reverse rotation start ON
Same direction (Motor: forward rotation, encoder : forward rotation or Motor: reverse rotation, encoder : reverse rotation)	0		
	1		
Same direction (Motor: forward rotation, encoder : reverse rotation or Motor: reverse rotation, encoder : forward rotation)	0		
	1		

4.5 Connection with Mitsubishi MELSERVO-SC

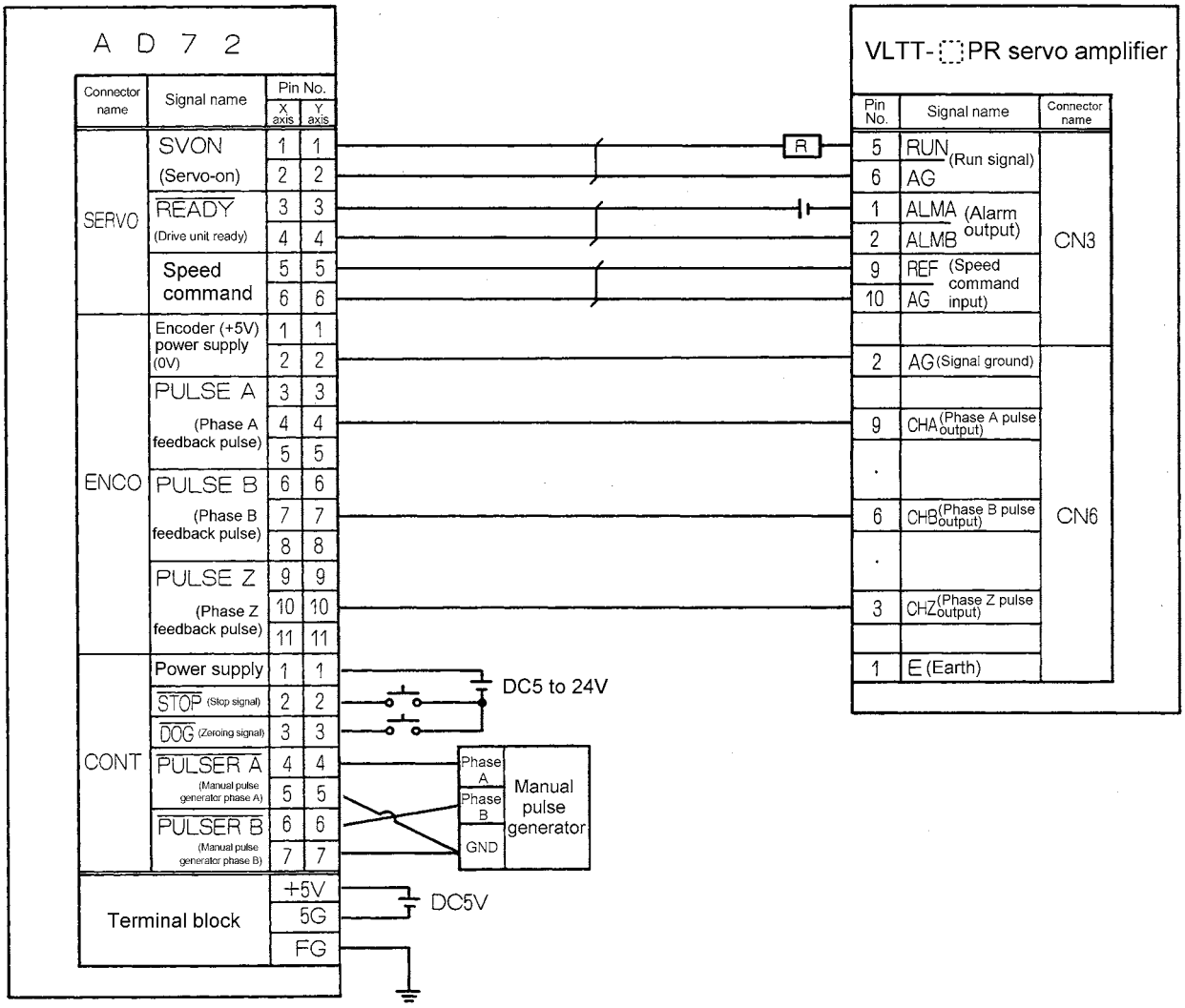


POINT

(1) Indicates a twisted pair shielded wire.

(2) Refer to the MELSERVO-SC manual for the MELSERVO-SC servo amplifier side wiring and signal cable shields in other than the above diagram.

4.6 Connection with Toei Electric's servo amplifier

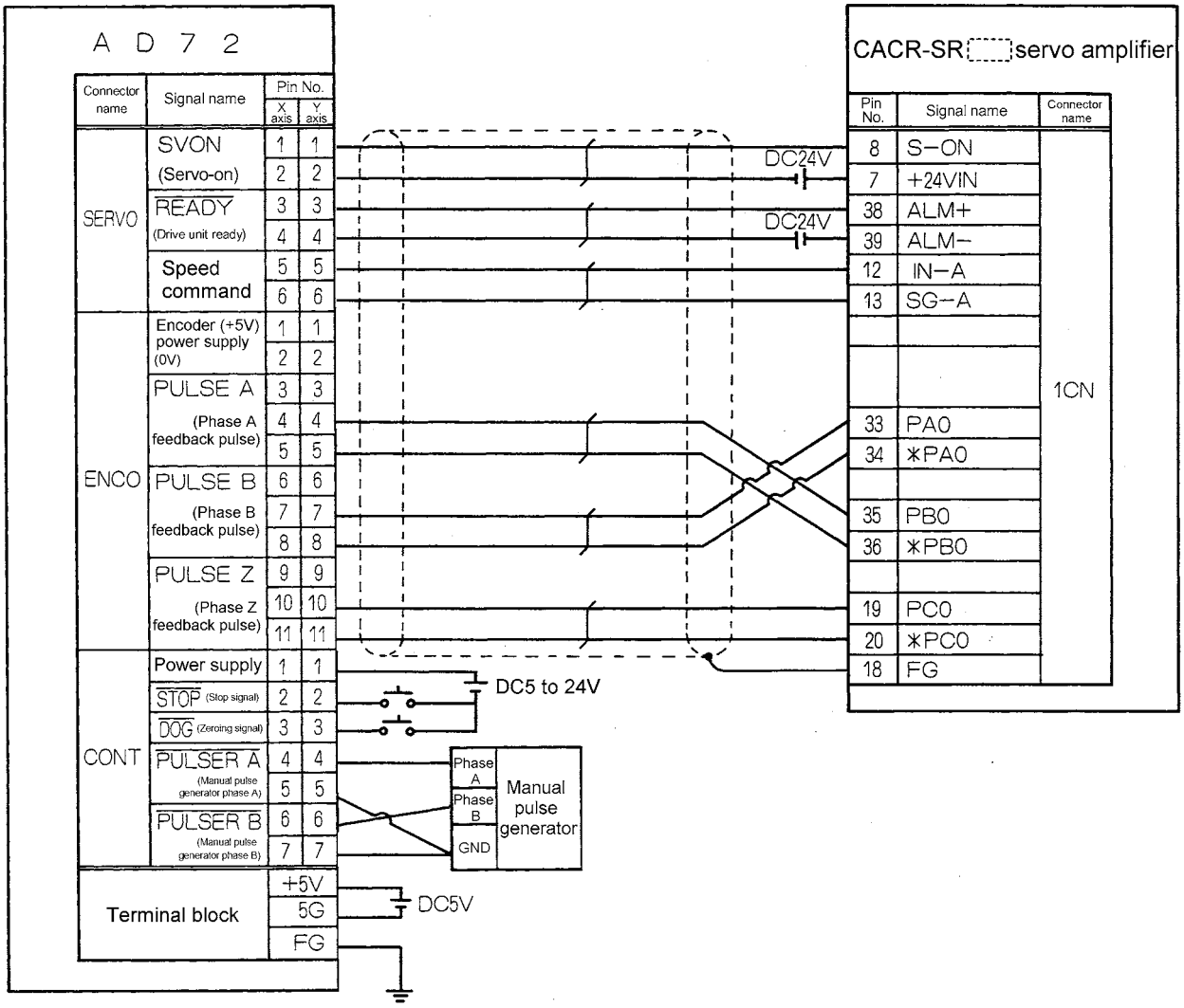


POINT

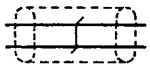
(1) Indicates a twisted pair shielded wire.

(2) Refer to the VLTT-☐PR manual for the VLTT-☐PR servo amplifier side wiring and signal cable shields in other than the above diagram

4.7 Connection with Yaskawa's servo amplifier fier



POINT

(1)  **Indicates a twisted pair shielded wire.**

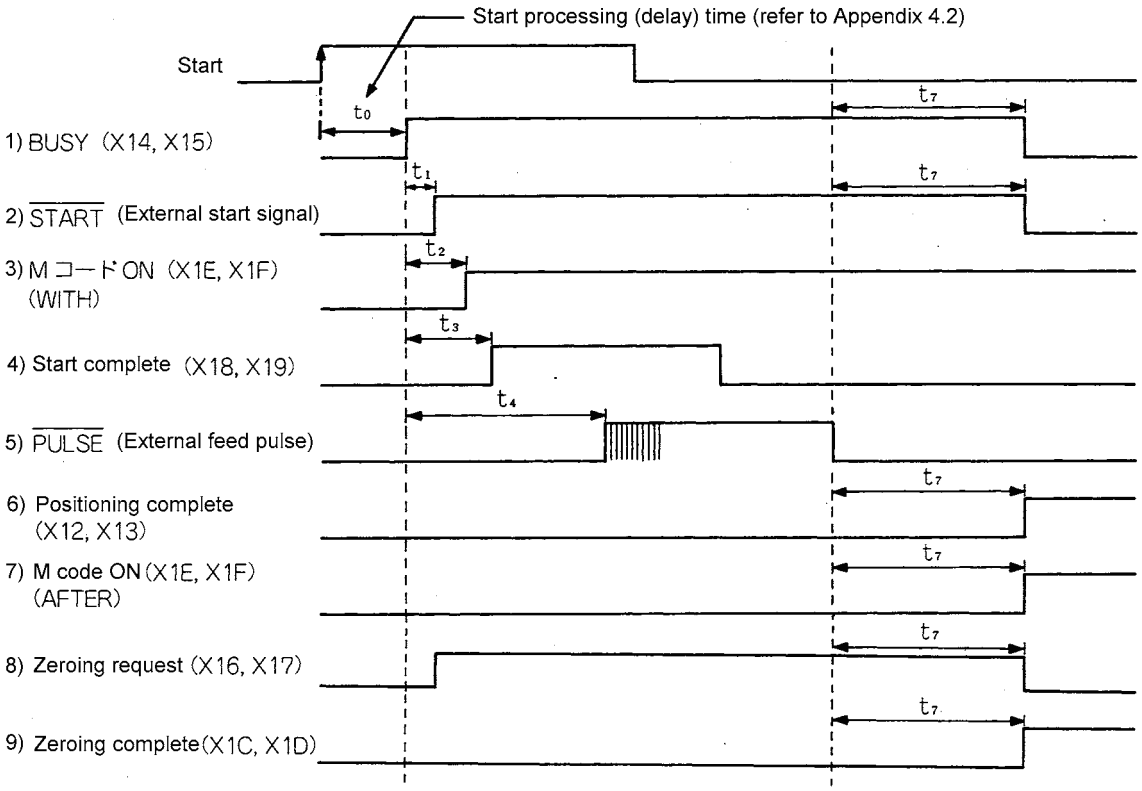
(2) Refer to the CACR-SR ☐ manual for the CACR-SR ☐ servo amplifier side wiring and signal cable shields in other than the above diagram.

(3) As Phase B of the feedback pulse from the CACR-SR ☐ servo amplifier leads Phase A leads by a phase angle of 90 degrees, Phase A and Phase B must be connected reversely as shown above.

APPENDIX 5 Timings of Signals from AD72(S1)

5.1 Output signal timings

The following chart shows the output signal timings when positioning and zeroing are executed.

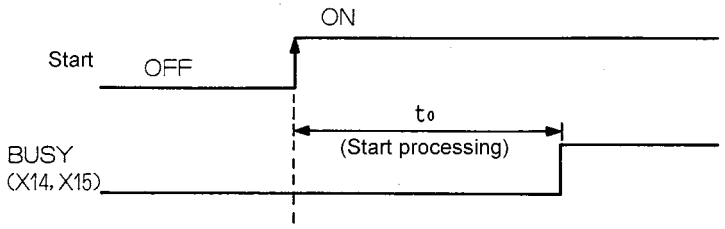


	Positioning control			Zeroing	
	X axis	Y axis	Interpolation	X axis	Y axis
t_1(m sec)	0.2	0.2	0.3	49.1	49.1
t_2(m sec)	0.3	0.3	0.6		
t_3(m sec)	0.5	0.5	0.8	0.4	0.4
t_4(m sec)	18.4 $^{-0}_{+4}$	18.4 $^{-0}_{+4}$	18.4 $^{-0}_{+4}$	58.3 $^{-0}_{+4}$	58.3 $^{-0}_{+4}$
t_5(m sec)	1.4	1.4	1.4	17.7	17.7

Note 1: Positioning in the position control mode is executed at the timing at pointer "0" in pattern "00".
Note 2: 8) and 9) are the timings applicable when zeroing is executed.
Note 3: The dwell time for positioning is measured as "0".

5.2 Start delay time

This section explains the time (t0) from when the start signal turns on until the BUSY signal (X14, X15) of the AD72 turns on.
The start signal and BUSY signal timings are shown below.



(1) Factors of start processing time variation
The following factors are responsible for the variation occurring until the BUSY signal turns on.

1) FROM/TO instruction during start processing
- A delay of several hundred ms to several s will occur when the FROM/TO instruction is executed since it is executed with priority.
- No delay will occur when the FROM/TO instruction is not executed.

2) Operating status of other axis
- A several ten ms delay will occur if start processing is executed while the other axis is operating.
- No delay will occur when the other axis is at a stop.

3) Peripheral device intervention during start processing
- Intervention from a peripheral device will cause a several ms delay.
- No delay will occur when no peripheral device is connected.

4) Number of speed change points in positioning pattern (11)
- A delay will occur as there are more speed change points in one positioning pattern (11). (Approx. 10ms per point)

(2) Start processing time (t0)
Table 4.1 shows the measured processing times in the following conditions that do not have the above variation factors (1), 2), 3)).

1) The FROM/TO instruction is not executed during start processing.
2) The other axis is not operating.
3) No peripheral device intervenes.

Table 4.1 Start Processing Time

	Operation Mode		t0 Minimum Value (ms)*1	t0 Maximum Value (ms)*2
1	Zeroing start		5.5±5	14±12
2	Jog start		4.5±5	33±12
3	Positioning control	Independent positioning start	15 ±5	58±12
		Interpolation positioning start	61 ±5	94±12
4	Positioning pattern (11) Positioning continued with speed change	*Number of speed* change points 4 points	61 ±5	94±12

*1: t0 is minimum when the X axis and Y axis start after:

1. Zeroing is completed
2. Positioning is completed
3. Present value change is completed.

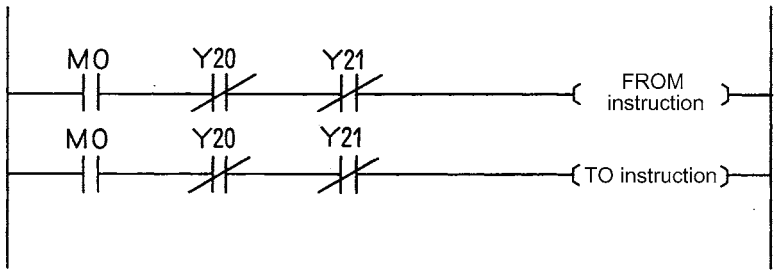
*2: t0 is maximum when the X axis and Y axis start after:

1. Zeroing stopped
2. Positioning stopped
3. Operation in speed control mode stopped
4. Jog operation stopped.

Note 1: A feedback pulse is output t4 (ms) after the BUSY signal (X14, X15) has turned on. (Refer to Appendix 4.1.)

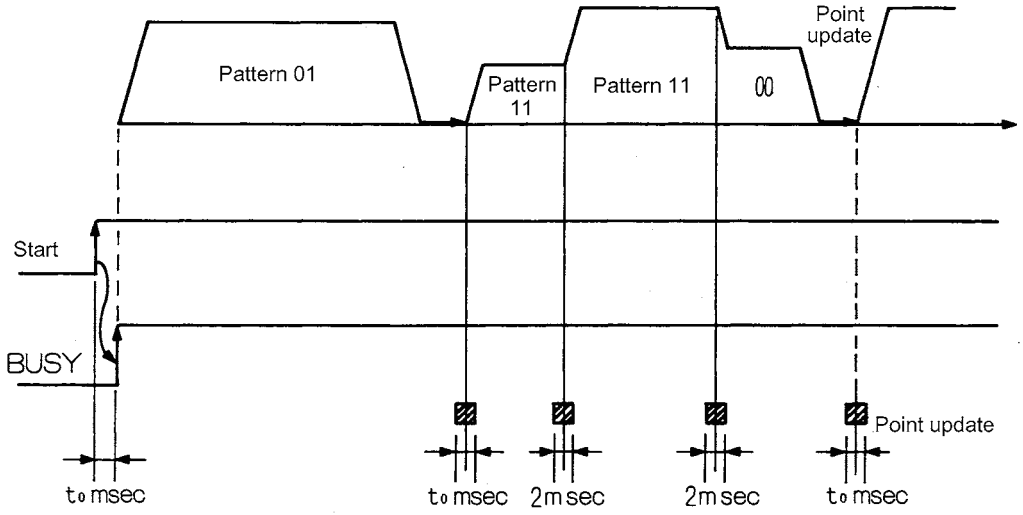
POINT

Use the start signals (Y20, Y21) as interlocks for the FROM/TO instruction so that the FROM/TO instruction is not executed during start processing.



5.3 AD72 processing time

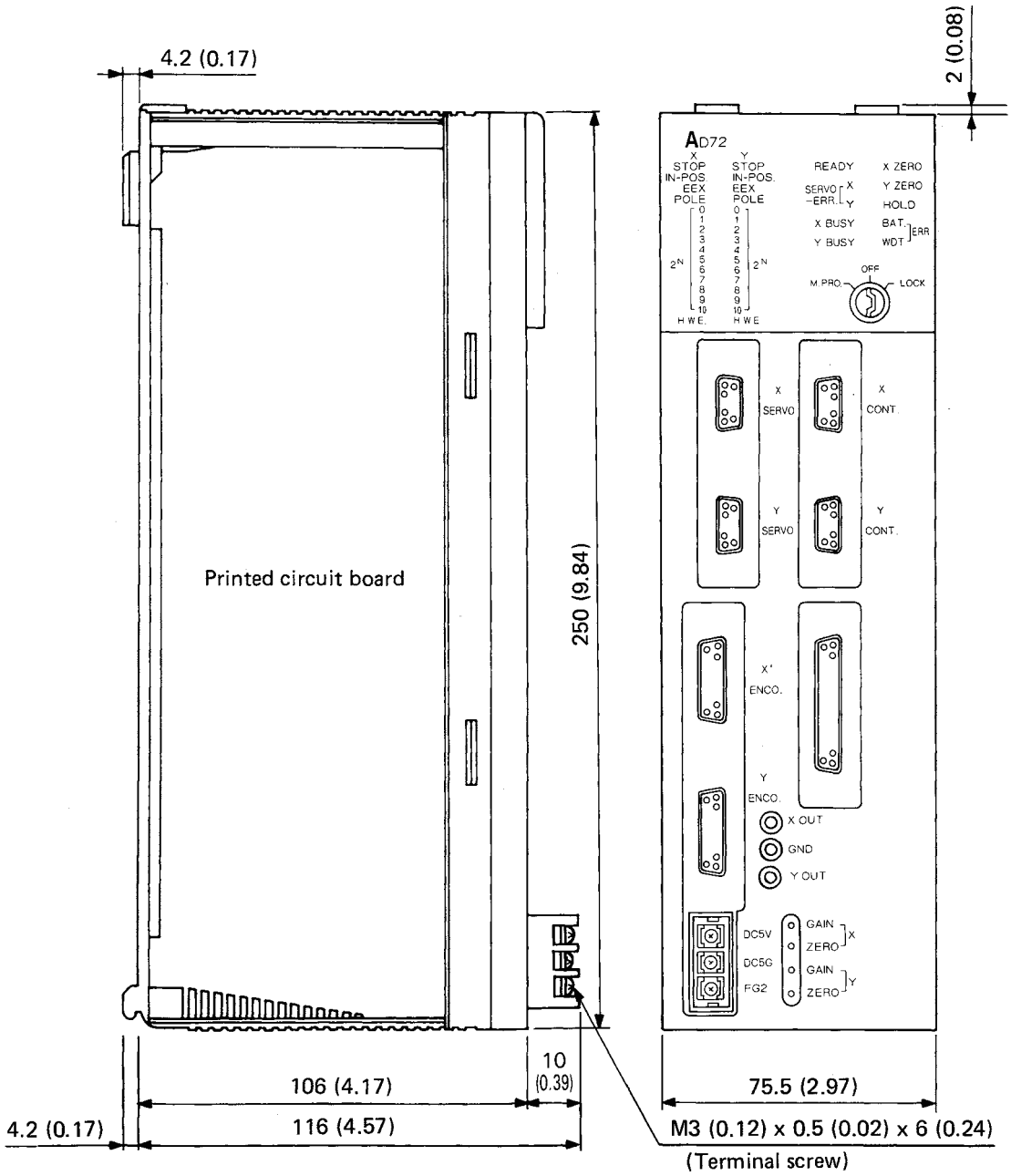
Operation in each pattern requires the following processing time.



The above time is a rough AD72 processing time and does not include a PLC operation time.

APPENDIX 6 Dimensions

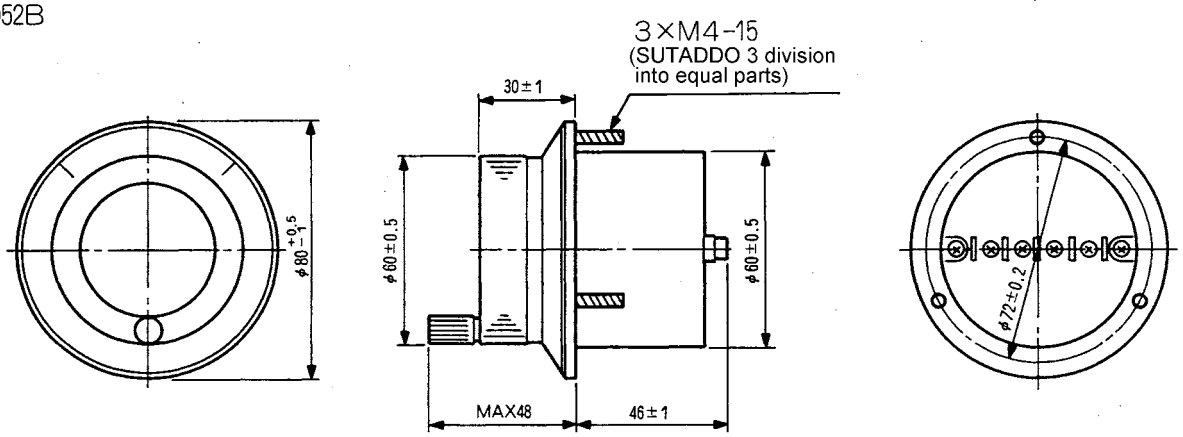
(1) AD72



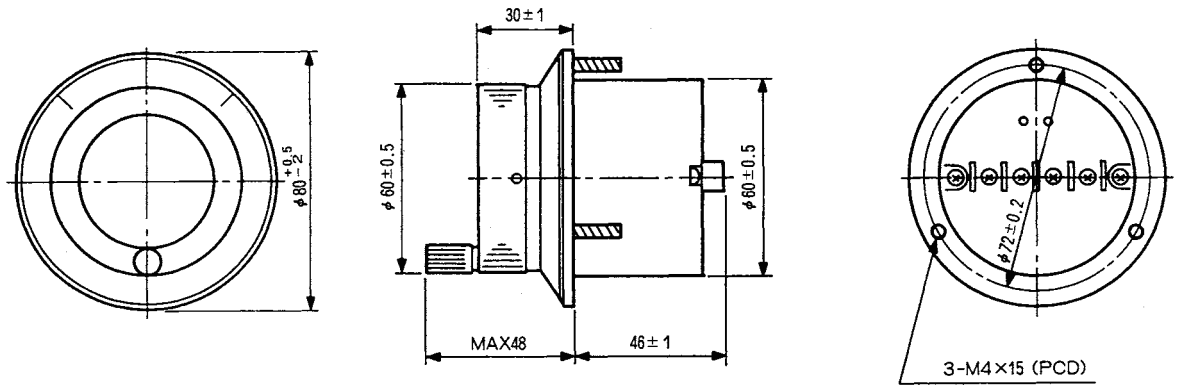
Unit : mm (inch)

(2) Manual pulse generator

(a)HD52B



(b)OSM-01-2(C)



APPENDIX 7 Precautions for Transportation

When transported, the lithium-containing battery must be handled in conformance to the transportation restrictions.

Appendix 7.1 Restricted model

The lithium battery used for the MELSEC-A series CPU is classified as in the following table.

Product Name	Model Name	Product Form	Handled as
A series battery	A6BAT	Single lithium battery	Non-dangerous goods

Appendix 7.2 Handling for transportation

Our battery is factory-packed in conformance to the transportation restrictions. When the customer transports the repacked or unpacked battery, conform to the IATA Dangerous Goods Regulations, IMDG Code and the corresponding country's transportation restrictions.
For details, contact your common carrier.

MEMO

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

(2) The Mitsubishi programmable logic controller has been designed and manufactured for applications in general industries, etc. Thus, applications in which the public could be affected such as in nuclear power plants and other power plants operated by respective power companies, and applications in which a special quality assurance system is required, such as for Railway companies or Public service purposes shall be excluded from the programmable logic 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 logic 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 AD72

User's Manual

MODEL	AD72-USERS-E
MODEL CODE	13J622
IB(NA)-66095-D(0603)MEE	

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS : 1-14 , YADA-MINAMI 5-CHOME , HIGASHI-KU, NAGOYA , JAPAN