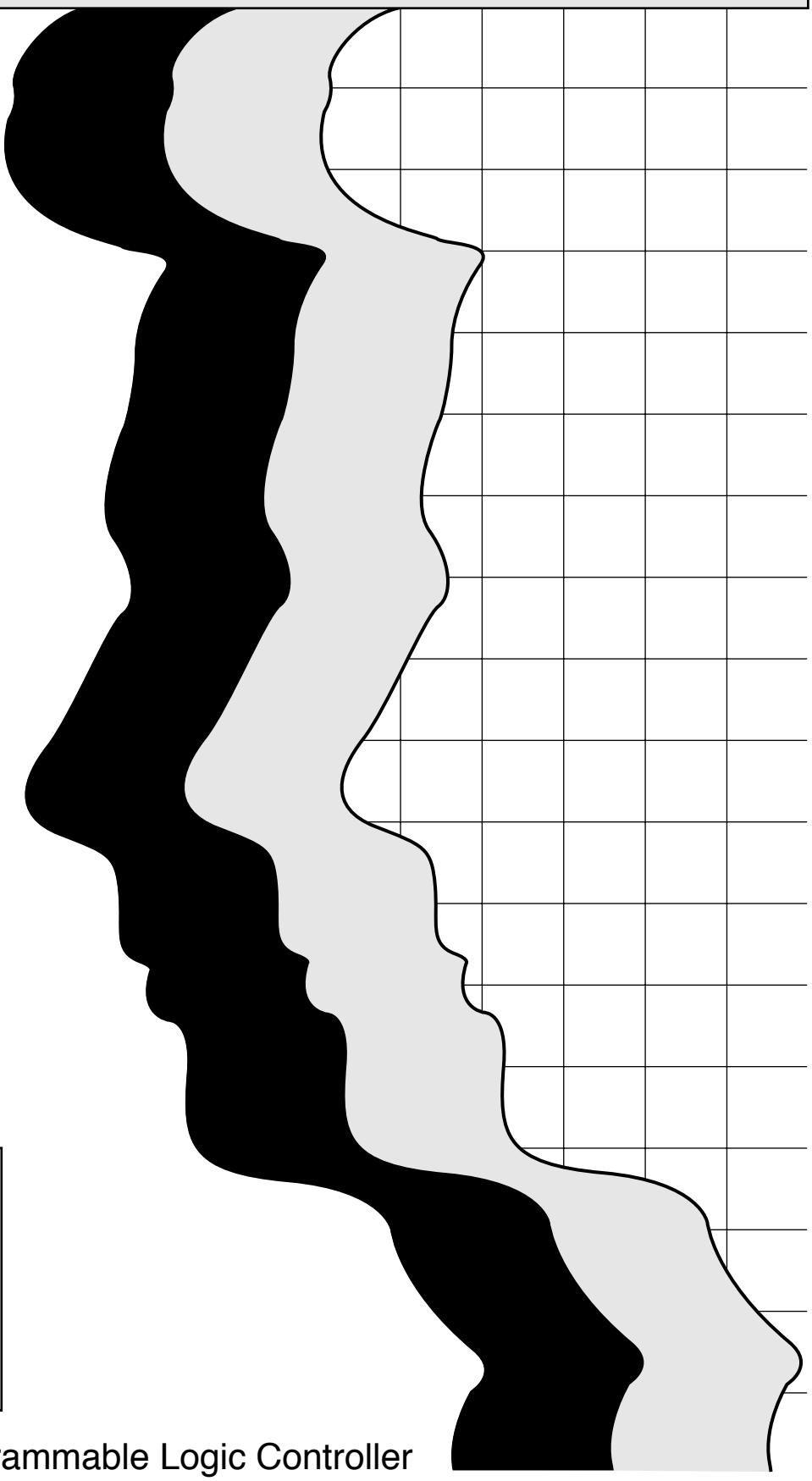
MITSUBISHI

Positioning Module for A0J2 Type A0J2-D71

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 descriprion of the PC system safty precautions.

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

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

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

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

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

[System Design Precautions]

DANGER

- Safety circuits should be installed external to the programmable controller to ensure that the system as a whole will continue to operate safely in the event of an external power supply malfunction or a programmable controller failure. Erroneous outputs and operation could result in an accident.
  1) The following circuitry should be installed outside the programmable controller:
     Interlock circuitry for the emergency stop circuit protective circuit, and for reciprocal operations such as forward/reverse, etc., and interlock circuitry for upper/lower positioning limits, etc., to prevent machine damage.
  2) When the programmable controller detects an abnormal condition, processing is stopped and all outputs are switched OFF. This happens in the following cases:
     - When the power supply module's over-current or over-voltage protection device is activated.
     - When an error (watchdog timer error, etc.) is detected at the PC CPU by the self-diagnosis function.

     Some errors, such as input/output control errors, cannot be detected by the PC CPU, and there may be cases when all outputs are turned ON when such errors occur. In order to ensure that the machine operates safely in such cases, a failsafe circuit or mechanism should be provided outside the programmable controller. Refer to the CPU module user's manual for an example of such a failsafe circuit.
  3) Outputs may become stuck at ON or OFF due to an output module relay or transistor failure. An external circuit should therefore be provided to monitor output signals whose incorrect operation could cause serious accidents.
     In the case of output modules, excessive current flows applied continuously for a long time, for example due to a current exceeding the rating or short circuit at a load, can cause the generation of smoke, or fire. Therefore, install an external safety circuit, e.g. with a fuse.

- A circuit should be installed which permits the external power supply to be switched ON only after the programmable controller power has been switched ON. Accidents caused by erroneous outputs and motion could result if the external power supply is switched ON first.

- When a data link communication error occurs, the status shown below will be established at the faulty station. In order to ensure that the system operates safely at such times, an interlock circuit should be provided in the sequence program (using the communication status information).
  Erroneous outputs and operation could result in an accident.
  1) The data link data which existed prior to the error will be held.
  2) All outputs will be switched OFF at MELSECNET (II, /B, /10) remote I/O stations.
  3) At the MELSECNET/MINI-S3 remote I/O stations, all outputs will be switched OFF or output statuses will be held, depending on the E.C. mode setting.

  For details on procedures for checking faulty stations, and for operation statuses when such errors occur, refer to the appropriate data link manual.

[System Design Precautions]

⚠ CAUTION

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

[Cautions on Mounting]

⚠ CAUTION

- Use the PC in an environment that conforms to the general specifications in the manual.
  Using the PC in environments outside the ranges stated in the general specifications will cause electric shock, fire, malfunction, or damage to/deterioration of the product.

- Make sure that the module fixing projection on the base of the module is properly engaged in the module fixing hole in the base unit before mounting the module.
  Failure to mount the module properly will result in malfunction or failure, or in the module falling.

- Extension cables should be securely connected to base unit and module connectors. Check for loose connection after installation.
  A poor connection could result in contact problems and erroneous inputs/outputs.

- Plug the memory firmly into the memory socket. Check for loose connection after installation.
  A poor connection could result in erroneous operation.

[Cautions on Wiring]

DANGER

- Switch off the external power supply before staring installation and wiring work.
  Failure to do so could result in electrical shocks and equipment damage.

- After installation and wiring is completed, be sure to attach the terminal cover before switching the power ON and starting operation.
  Failure to do so could result in electrical shocks.

CAUTION

- Be sure to ground the FG and LG terminals, carrying out at least class 3 grounding work with a ground exclusive to the PC.
  Otherwise there will be a danger of electric shock and malfunctions.

- Carry out wiring to the PC correctly, checking the rated voltage and terminal arrangement of the product.
  Using a power supply that does not conform to the rated voltage, or carrying out wiring incorrectly, will cause fire or failure.

- Outputs from multiple power supply modules should not be connected in parallel. Failure to do so could cause the power supply module to overheat, resulting in a fire or module failure.

- Tighten the terminal screws to the stipulated torque.
  Loose screws will cause short circuits, fire, or malfunctions.
  Overtightening of screws can cause damages to the screws and/or the module, resulting in fallout, short circuits,or malfunction.

- Make sure that no foreign matter such as chips or wiring offcuts gets inside the module.
  It will cause fire, failure or malfunction.

- Connectors for external connections should be crimped, pressure welded, or soldered in the correct manner using the correct tools.
  For details regarding crimping and pressure welding tools, refer to the input/output module user's manual.
  A poor connection could cause shorts, fire, and erroneous operation.

[Cautions on Startup and Maintenance]

DANGER

- Do not touch terminals while the power is ON.
  This will cause malfunctions.
- Make sure that the battery is connected properly. Do not attempt to charge or disassemble the battery, do not heat the battery or place it in a flame, and do not short or solder the battery.
  Incorrect handling of the battery can cause battery heat generation and ruptures which could result in fire or injury.
- Switch all phases of the external power supply off when cleaning the module or retightening theterminal or module mounting screws. Not doing so could result in electric shock.
  Undertightening of terminal screws can cause a short circuit or malfunction.
  Overtightening ofscrews can cause damages to the screws and/or the module, resulting in fallout, short circuits,or malfunction.

CAUTION

- Read the manuals carefully and thoroughly confirm safety before performing online operations with a peripheral device connected to the CPU module in the RUN state (especially program changes, forced output, and changes in operation status).
- Do not disassemble or modify any module.
  This will cause failure, malfunction, injuries, 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 themodule.
- Do not drop or give an impact to the battery installed in the module.
  Otherwise the battery will be broken, possibly causing internal leakage of electrolyte.
  Do not use but dispose of the battery if it has fallen or an impact is given to it.
- Always make sure to touch the grounded metal to discharge the electricity charged in theelectricity charged in the body, etc., before touching the module.
  Failure to do say cause a failure or malfunctions of the module.

[Cautions on Disposal]

CAUTION

- Dispose of this product as industrial waste.
- When transporting lithium batteries, make sure to treat them based on the transport regulations.

REVISIONS

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

Print Date	*Manual Number	Revision
Apr., 1987	IB (NA) 66133-A	First edition
Dec., 1988	IB (NA) 66133-B	Correction CONTENTS, Page 1-2, 2-1, 2-2, 2-3, 2-11, 2-33, 2-57, 6-8, 6-15, 6-16, 6-19, 6-29, 6-31, 6-32, 6-34, 6-38, 6-41, 7-2, 7-3, 8-1, 9-1, APP-14, APP-15, APP-16, APP-17 Addition Page 6-30, 6-33, APP-11, APP-12, APP-13 "Instructions for Strategic Materials" added
Nov., 1987	IB (NA) 66133-C	Correction Sections 2.7.2, 6.3.2, 6.3.6, 6.3.7 Deletion Page 6-35
Apr., 1988	IB (NA) 66133-D	Correction Sections 2.2.1, 2.7.1, 6.1.2
Jul., 1988	IB (NA) 66133-E	Correction Chapter 1, Sections 2.2.2, 2.4, 2.5, 6.3.3(1), 6.3.6[2]-(4), 6.3.9(1), 7.2.1, 7.2.2, Chapter 8, Sections 8.1(3), 8.1.4 Table 8.6, Appendix 3.5, 3.6, 3.7, 3.8 Addition Appendix 3.2, 3.3, 3.4 Deletion Sections 2.4.2(2), (5), 6.3.2(2), 6.3.3(4)
Sep., 1988	IB (NA) 66133-F	Correction Sections 6.3.6[1]-(4), [2]-(4)
Feb., 1989	IB (NA) 66133-G	Correction Sections 2.4.1, 2.4.1(9), 2.4.2, 2.4.3(2), 6.4.1, 6.4.2(1), (2)
Aug., 1989	IB (NA) 66133-H	Correction Sections 2.4.2, 6.3.8, 8.1.1, Appendix 1.2 Addition Sections 2.7.2
Feb., 1990	IB (NA) 66133-I	Correction Sections 2.5.4 Fig. 2.39, 6.1.2 Fig. 6.2, (6), 6.3.3(4)(b), 6.3.6[1](3), 6.4.3 (Technical news No. 106C), 8.1.1, Table 8.3 Addition Sections 2.4.1(9), 2.6(2), (5), (16), 4.2.1 (Technical news No. 84B)
Oct., 1990	IB (NA) 66133-J	Correction Sections 2.4.2(2)(a), 2.6 Fig. 2.4.2, 6.1.2 Fig. 6.2(3), (Technical news No. 174), 6.3.8(3) (Technical news No. 174) Addition Chapter 1, Appendix 4(2)
Apr., 1991	IB (NA) 66133-K	Correction Chapter 1, Sections 2.4.2, 3.5 Addition Appendix 2.1, 2.2, 2.3, 3.5
Sep., 1992	IB (NA) 66133-L	Correction Appendix 3.3, 3.4

Print Date	*Manual Number	Revision
Mar., 1993	IB (NA) 66133-M	Addition Chapter 1, Sections 2.5.3, Fig. 2.38, Appendix 3.10
Sep., 1993	IB (NA) 66133-N	Correction Section 2.7.2 Table 2.1 Addition Sections 6.1.2, Fig. 6.2, 6.3.3(4)(a), (b), 6.3.4(4), 6.3.5(4), 6.3.6[1](4), [2](4), 6.3.7(4),6.4.3(2) Deletion Chapter 1
Sep., 1997	IB (NA) 66133-O	Correction Chapter 1, Sections 2.7.2, Appendix 3.1 to 3.10 Addition Section 2.4.1(3) Deletion Chapter 1, Appendix 4(2)
Oct., 2003	IB (NA) 66133-P	Correction SAFETY PRECAUTIONS,CONTENTS,Chapter1, Chapter 3, Section 3.1 to 3.8, Chapter 4, Section 4.1 to 4.2.5, Chapter 5, Section 5.1 to 5.2.3, Chapter 6, Section 6.1 to 6.2, Chapter 7, Section 7.1 to 7.4.3, Chapter 8, Section 8.1 to 8.2.2, Chapter 9, Section 9.1 to 9.2.7, Chapter 10, Section 10.1 to 10.2.2, Appendix 4(2) Addition Manuals, Chapter 2, Sections 2.1,2.2, Appendix 6, 6.1, 6.2, WARRANTY

CONTENTS

About Manuals

The following manuals are 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/zero return 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)

1. INTRODUCTION

This manual deals with the specifications, handling, and programming of an A0J2-D71 positioning module (referred to as D71) which is used in combination with a MELSEC-A series A0J2 CPU unit.
These modules are hereinafter called the "D71" unless it is necessary to distinguish between them.
The D71 operates with a MELSEC-A series PC CPU (A0J2(H)CPU). For details of combinations of the D71 and PC CPUs, refer to 2.1.

In this manual, the positioning software packages and peripheral devices are referred to by the following abbreviations:

- SW0-AD71PE type positioning module software package
- SW0IX-AD71PE type positioning module software package

] "AD71P"

- A6GPPE / A6PHPE ➡ "A6GPP"
- AD71TU type teaching unit ➡ "AD71TU"

] **The A6GPP booted up with AD71P and the AD71TU are generically called "peripheral devices".**

POINT

In this manual, D71 I/O numbers assigned from the PC CPU assume that the D71 unit number has been set to 0.

Packing list:

Description	Quanitiy
A0J2-D71 positioning unit	1
20-pin connector for external wiring (for X and Y axes)	2
A0J2C01 (extension cable)	1

Refer also to the following manuals:

SW0GP-AD71P Operating Manual
AD71TU Operating Manual
A0J2CPU User's Manual
A0J2 Data Link User's Manual
A0J2 Programming Manual

POINT

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20-pin connector for external wiring (for X and Y axes)	2
A0J2C01 (extension cable)	1

2. SYSTEM CONFIGURATION

This chapter explains the system configuration where the AD71 and PLC CPU can be combined.

2.1 A0J2D71 Overall Configuration

The following shows the arrangement of the AD71 and peripheral devices.

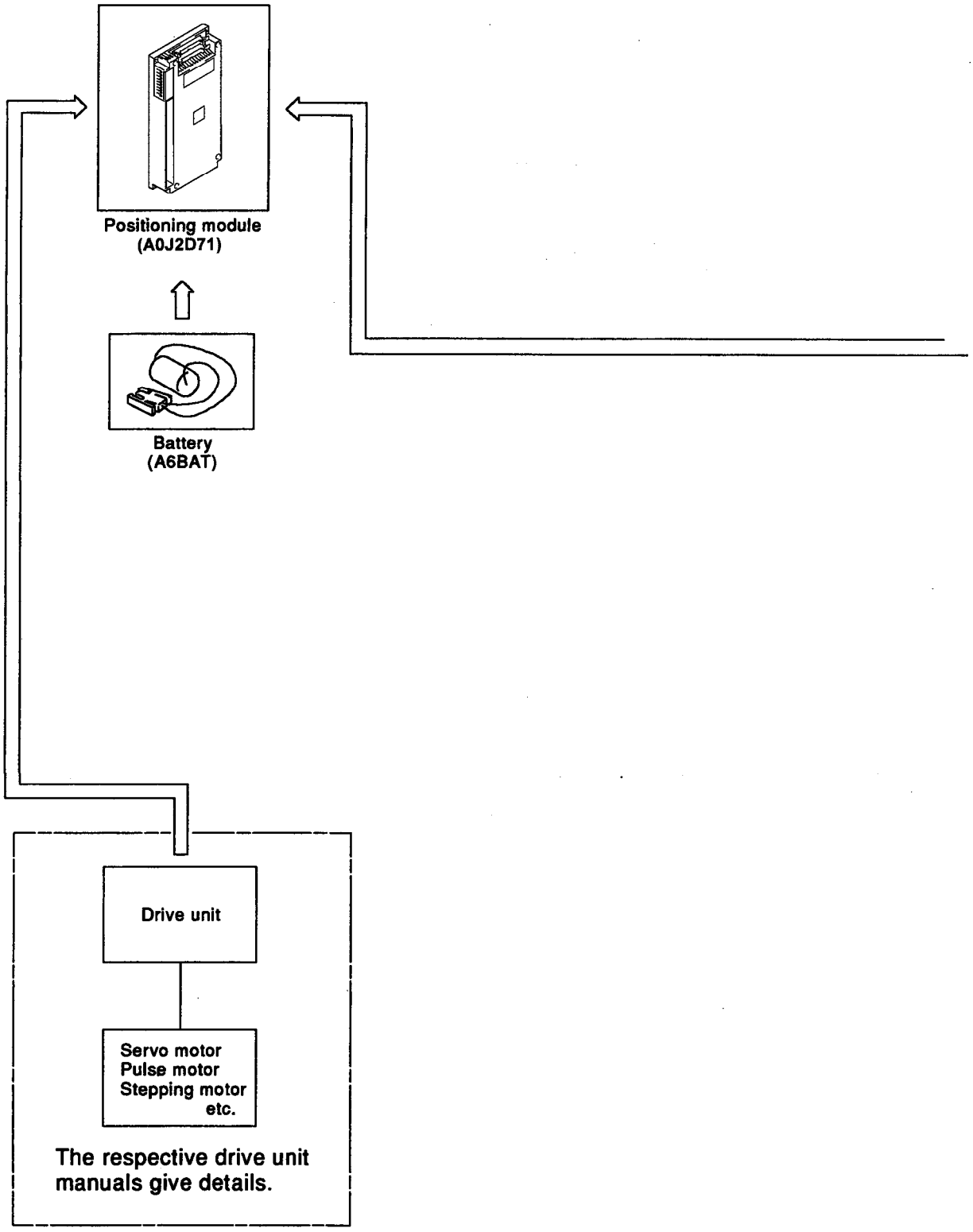
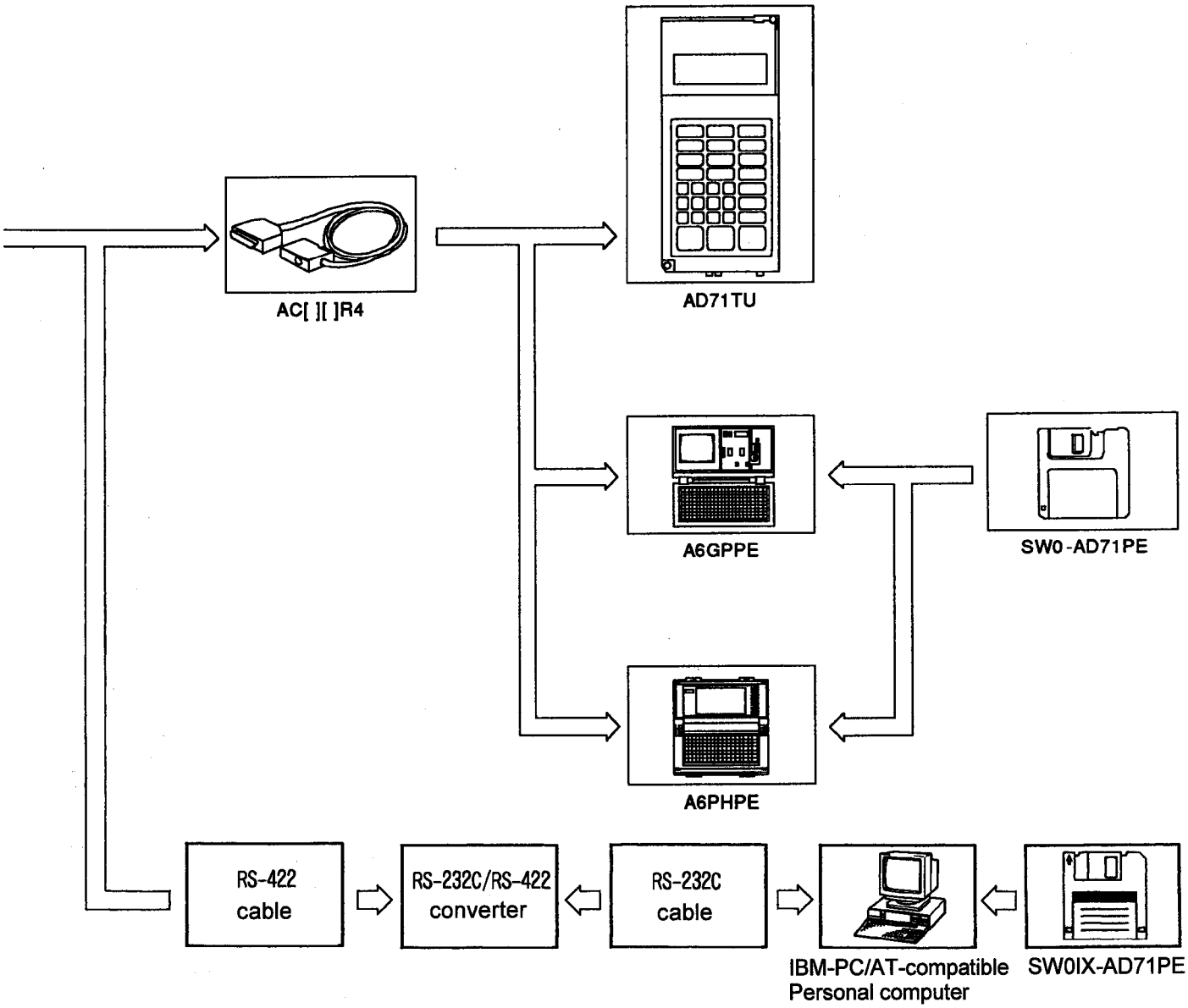


Fig. 2.1 Overall Configuration



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 Programming Equipment

The following table indicates the equipment available for programming the A0J2-D71.

<table>
<tr><th>Unit Division</th><th>Type</th><th>Remarks</th></tr>
<tr><td rowspan="2">Positinning module software package</td><td>SW0GP-AD71PE</td><td>A6GPPE/A6PHPE software package</td></tr>
<tr><td>SW0IX-AD71PE</td><td>PC/AT software package</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 rowspan="2">RS-422 cable</td><td>AC30R4</td><td>Cable for connecting CPU and A6GPPE. 3 m (9.84 ft) length.</td></tr>
<tr><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). 3m (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-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>

The positioning functions provided by the D71 are shown in Table 2.3.

Function		Sequence Program or A6GPP or AD71TU (Test Operation)	
		Two-axis Independent Operation	Two-axis Interpolation Operation
Manual pulse generator operation		The pulses generated by the operation of the manual pulse generator are input to the D71 and positioning is executed according to the number of input pulses.	Unavailable
Jog operation		Jog operation is executed while the jog operation instruction given from the PC CPU or A6GPP stays ON.	Unavailable
Zero return		Zero return is executed when the zero return start instruction is given from the PC CPU or A6GPP. On completion of zero return, the present value is corrected to the value stored at the zero point address.	Unavailable
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 the speed the two axes reach the set position simultaneously. (Linear interpolation)
	Continuous positioning	Moves consecutively to a series of positions after receiving a single start signal.	Positioning is executed continuously in the interpolation mode in the same manner as in the two-axis independent operation.
	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 2.3 Positioning Control Functions

POINTS

(1) Error compensation and backlash compensation functions are valid for all the functions shown in Table 2.3

(2) When executing positioning by a sequence program, it is possible to output a preset M code from the D71 to the PC CPU at the start or completion of positioning. Note that this output is not possible in positioning operation using the A6GPP.

(3) The D71 present value can be re-written before positioning is started using the sequence program or A6GPP.

(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).

2.3 System Configuration

The following describes the outline of the D71 operation and the positioning system.

2.3.1 Positioning System Using D71

The following explains the operation of the positioning system configured using the D71 using Fig. 2.1.

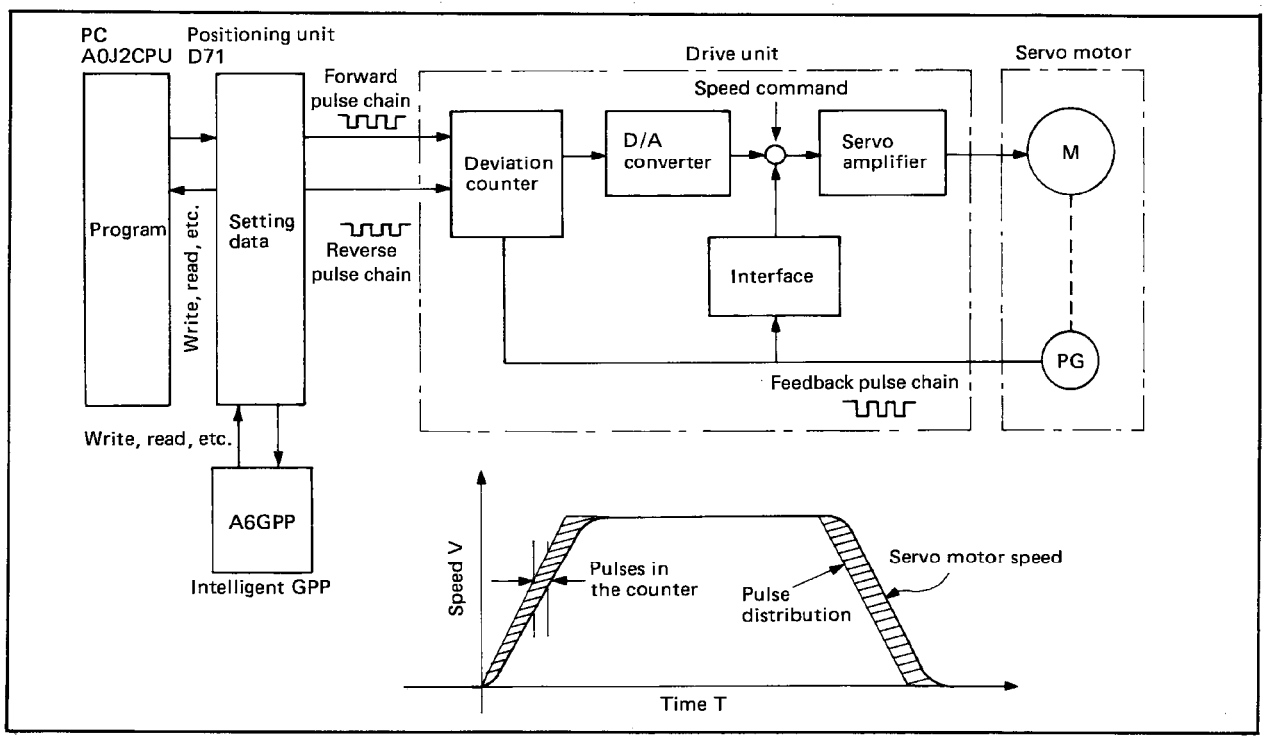


Fig. 2.1 Positioning System Block Diagram

Output of the D71 is pulse chain.

As the pulse chain is output from the D71, pulses are accumulated in the deviation counter and accumulated pulses are converted into the DC analog voltage, which is used as the speed command, by the D/A converter. The motor starts rotating in response to the speed command given from the drive unit and as the motor starts rotating the pulse generator PG generates feedback pulses in proportion to the number of motor rotations to deduct the accumulated pulses in the deviation counter.

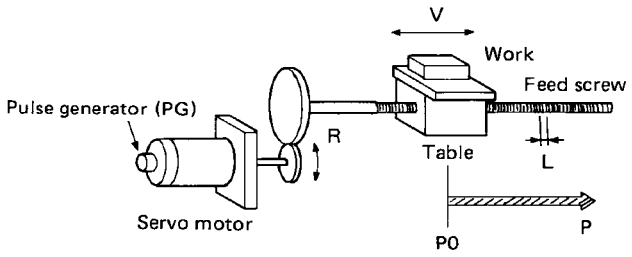
The motor keeps rotating with a certain number of droop pulses remained in the deviation counter.

When the D71 stops outputting the command pulses, the droop pulses in the deviation counter decreases causing the motor speed to lower, and the motor stops rotating when the droop pulses in the deviation counter is zeroed.

Motor rotation is controlled by the pulse chain output from the D71 in the following manner: motor speed is controlled in proportion to the frequency of the command pulses and motor rotation angle in proportion to the number of output command pulses.

Therefore, an axis can be moved by the required distance in proportion to the number of pulses in the pulse chain by predetermining the axis travel distance per pulse. The pulse output frequency determines 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 : Moving part 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 value

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

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, the D71 calculates and outputs the necessary pulse chain in reference to the positioning target address and positioning is executed according to the output pulse chain by setting the amount of distance to be moved (travel distance) by one pulse, acceleration/deceleration time, positioning speed, positioning address, etc.

2.3.2 D71 interfaces

Fig. 2.2 indicates the signal communications between the D71 and external devices.

○ Communication between PC CPU and D71

The D71 is connected to the PC CPU by the I/O cable for sending/receiving the control signals and data.

{ Control signals. . . . I/O signals given in Section 2.6 (page 2-50).
{ Data . . . . . .Written to and read from the buffer memory by the PC CPU. Detailed in Section 2.4 (page 2-10).

○ Communication between A6GPP (or AD71TU) and D71

Data write, D71 test, D71 monitor, etc. via the D71's RS422 connector.

○ Communications between drive unit and D71

Control signal communication to and from the drive unit and pulse chain output from the D71. (For the I/O interface, refer to Section 2.7 (page 2-56).)

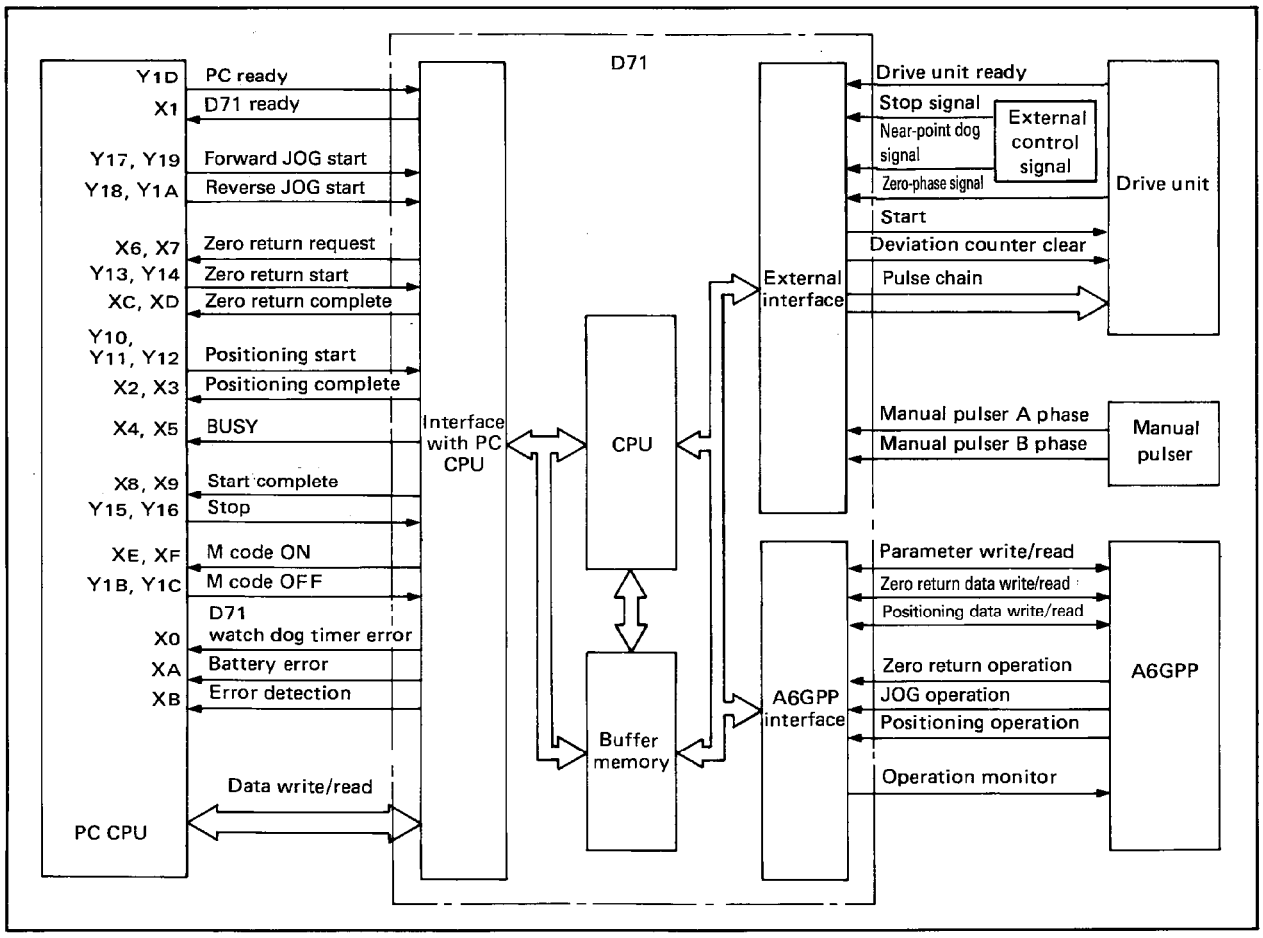
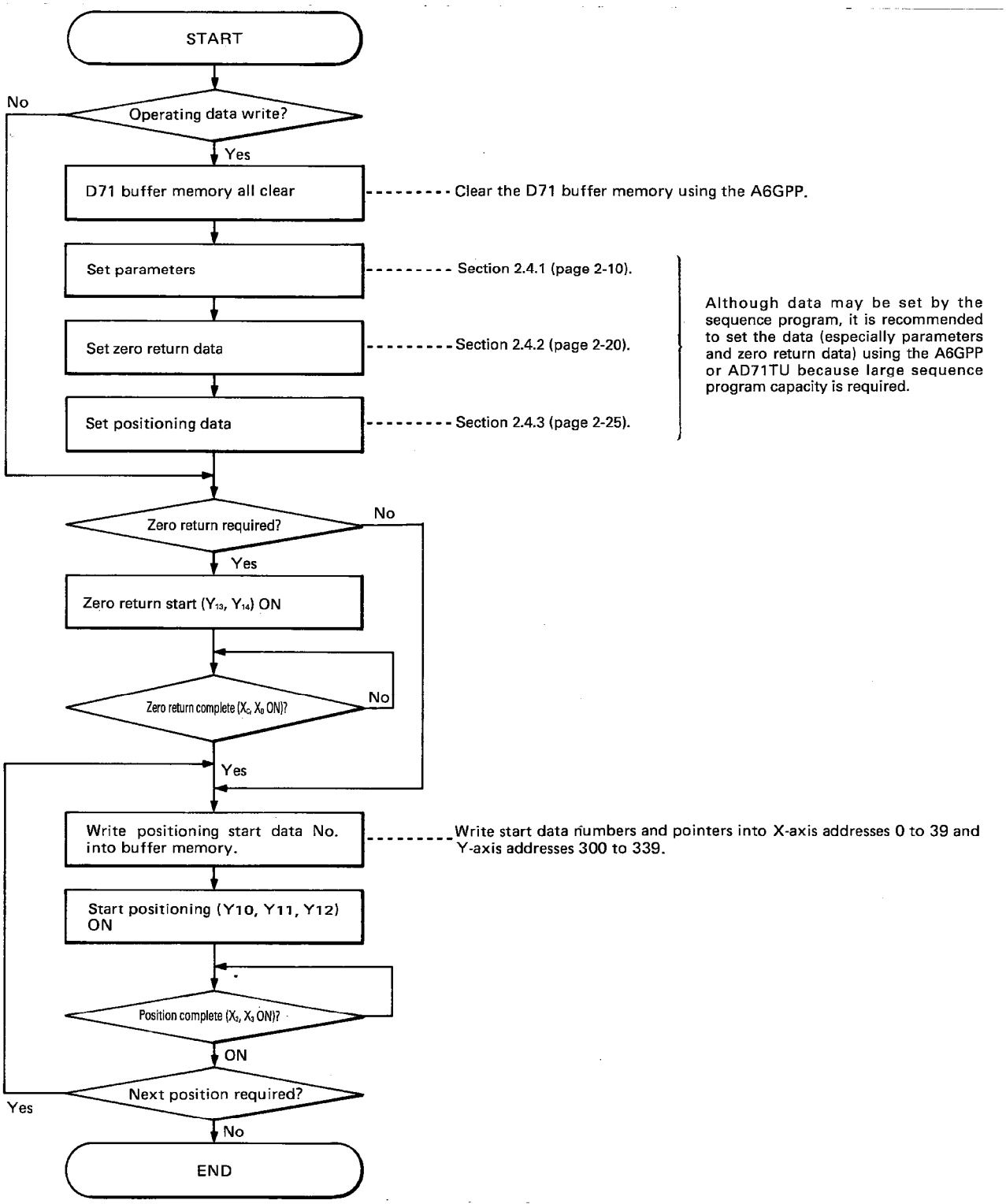


Fig. 2.2 D71 Function Block Diagram

2.3.3 D71 operation

Fig. 2.2 PC initiated positioning procedure



POINTS

(1) For zero return start and positioning start conditions, refer to Chapter 6.

(2) Table 2.4 shows the data related to the control signals (positioning function) output from the PC CPU.

Data \ Function		Manual Pulse Generator Operation	JOG Operation	Zero Return	Positioning
Parameter	Unit setting	○	○	○	○
	Travel per pulse	○	○	○	○
	Speed limit value		○	○	○
	JOG speed limit value		○		
	Starting bias speed		○	○	○
	Backlash compensation	○	○		○
	Upper stroke limit				○
	Lower stroke limit				○
	Error compensation	○	○		○
	Travel per 1 pulse during manual pulse generator	○			
	Acceleration and deceleration times		○	○	○
	Positioning complete signal output time				○
	Pulse output mode	○	○	○	○
	Rotation direction setting	○	○	○	○
	Positioning method				○
	M code ON/OFF timing				○
Zero return data	Zero return direction	○	○	○	○
	Zero return method			○	
	Zero return address	○	○	○	○
	Zero return speed			○	
	Zero return creep speed			○	
	Zero return dwell time			○	
	Torque limit			○	
Positioning data	Positioning information				○
	Positioning speed				○
	Positioning address				○
	Dwell time				○
Other	Start data area				○
	Speed change data		○*	○*	○*
	JOG speed		○		
	Manual pulse generator operation enable	○			

Table 2.4 Relation between Data and Positioning Functions

* Indicates functions used to change the speed when the D71 is BUSY.

2.4 Format and Functions of Operating Data

The following three blocks of data are required for positioning using the D71. This data is written to the buffer memory which will be explained in Section 2.5 (page 2-32).

- Parameters
- Zero return data
- Positioning data

Operating data is written using:

1) A6GPP or AD71TU. . . .For details, refer to the SW0GP-AD71P 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).

2.4.1 Parameters

This is the general information required for positioning. Table 2.5 gives a list of all the parameters which must be set for the D71.

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 2.5. Note that the data in the parameter area remains at the user defined values.

Parameters are checked when:

1) the power is switched on;
2) parameters are transferred from the A6GPP to the D71;
3) "PC ready signal" from the PC CPU to the D71 switches from "off" to "on"; or
4) (1) zero return, (2) positioning, (3) JOG operation, or (4) manual pulse generator has been selected in A6GPP test mode.

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

No.	Item	mm		inch		degree		PULSE(PLS)		Initial 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/s	20000	$\times 10^{1}$ PLS/s
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/s	2000	$\times 10^{1}$ PLS/s
5	Starting bias speed	0 to 12000	$\times 10^{1}$ mm/min	0 to 12000	$\times 1$ inch/min	0 to 12000	$\times 1$ degree/min	0 to 20000	$\times 10^{1}$ PLS/s	0	$\times 10^{1}$ PLS/s
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 1 m)	$\times 10^{-1}$ μm	±0 to 100000 (per 100 inch)	$\times 10^{-5}$ inch	±0 to 100000 (per 100 deg)	$\times 10^{-5}$ degree	—	—	0	—
10	Travel per 1 pulse during manual pulse generator	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(ms)								1000	ms
12	Positioning complete signal output time	0 to 20000(ms)								300	ms
13	Pulse output mode	0 : PLS+SIGN(B type) 1 : Forward PLS or reverse PLS(A type)								As previous setting *	—
14	Direction setting	0 : Present value increase when forward pulse is output 1 : Present value increase when reverse pulse is output								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 2.5 Parameter List

Among the parameters indicated above, the speed limit value and JOG speed limit value are multiple of 6.1 (PLS/s).
For example, if "speed limit value = 200 (PLS/s)" is set, the value that is a multiple of 6.1 (PLS/s) and closest to 200 (PLS/s) is actually set.

$$\frac{200}{6.1} = 32.78688\cdots\cdots \text{(decimal fraction cut-off)}$$

Thus, actual speed is 6.1 x 32 = 195.2 (PLS/s).

POINTS

(1) No. 2 to No. 12 are set from the sequence program. The D71 automatically multiplies any numerical data received from the sequence program by the relevant factor. For example, if the D71 receives the constant K = 2000 from the sequence program and the units have been defined as mm/min, the speed output to the drive is 20,000 mm/min (i.e. 2000 x 10^1 mm/min).

(2) When setting No.1 and No.13 to NO.16 from the sequence program, refer to Section 2.5.5 (page 2-48).

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 travel distance per pulse as determined by the mechanics of the system.
- Controls the number of pulses contained in the pulse chain from the D71.

(3) Speed limit value

- Specifies the maximum speed for positioning (or zero return).
- When 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.
- When a new speed is called accidentally 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.
- Set the speed limit value within the range indicated below according to the travel distance per pulse.

$$\frac{V\ (\text{unit/min})}{\{a\ (\text{unit/PLS}\} \times 60} \leq 200{,}000\ (\text{PLS/s})$$

V: Speed limit value (unit/min)
a: Travel distance per pulse (unit/PLS)

Example) If the travel distance is 1 (μm/PLS)

$$\frac{V\ (\text{mm/min})}{\{a\ (\text{mm/pulse}\} \times 60} \leq 200{,}000\ (\text{PLS/s})$$

$$V\ (\text{mm/min}) \leq 200{,}000\ (\text{PLS/s}) \times 0.001\ (\text{mm/PLS}) \times 60$$

$$\underline{V \leq 12{,}000\ (\text{mm/min})}$$

If the travel distance per pulse is 1 (μm/PLS), set the speed limit at a value smaller than 12,000 (mm/min).

(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 2.5 and must not exceed the speed limit value.
- When 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 6-22).

(5) Starting bias speed

- A minimum starting speed is required for the smooth operation of some motors (e.g. pulse motors or stepping motors). This may be set as a starting bias speed.
- The starting bias speed is used for positioning, JOG operation, and zero return. See Fig. 2.3.

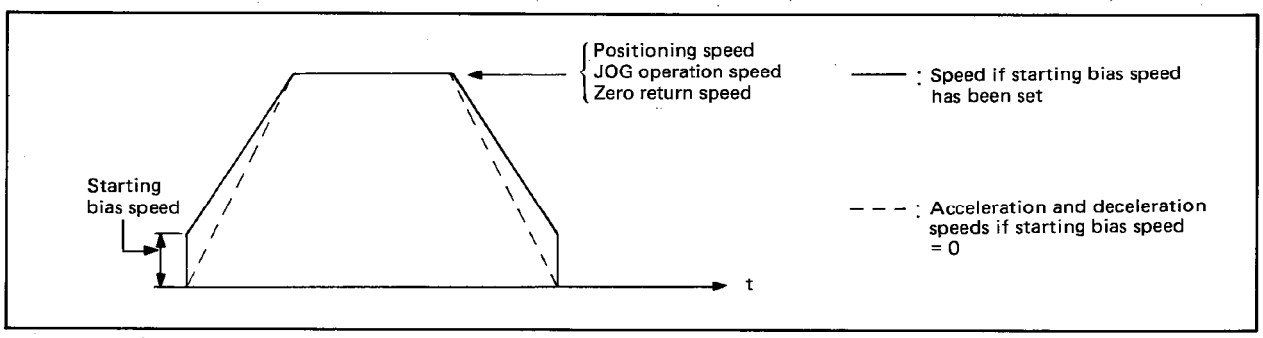


Fig. 2.3 Speed Change When Starting Bias Speed Is Set

For positioning with interpolation between axes, the starting bias speed set for the axis with the shorter distance to travel is ignored; positioning is controlled by the starting bias speed of the other axis with the longer distance to travel.

(6) Backlash compensation

- Allows a backlash compensation (see Fig. 2.4) 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 pulse generator operation, pulse output begins as soon as the number of input pulses exceeds the backlash compensation amount each time the direction of movement changes. (If the number of input pulses is less than the backlash compensation, feed pulses are not generated but the D71 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.
  Note that the backlash compensation feed pulse is therefore generated if the travel is less than the backlash compensation.
- Backlash compensation is valid after zero return. After redefining the backlash compensation, always zero the system.

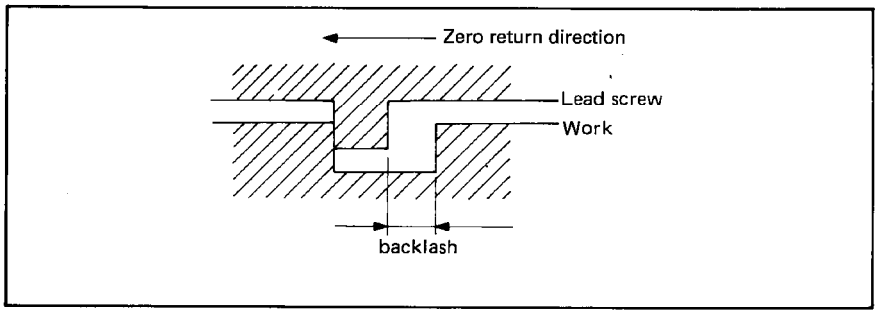


Fig. 2.4 Backlash Compensation

(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 pulse generator operation, 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 pulse generator operation, the stroke limit is ignored.

(9) Error compensation

The processing to compensate for the error between the set travel distance and the distance the axis has actually traveled is called the error compensation. To set the error compensation value, first move an axis by the set distance of travel after setting "0" for the amount of error offset per 1 meter if the unit is "mm" (100 inches if "inch" or 100 degrees if "degree") in automatic start. After completing positioning, measure the distance the axis has actually traveled and calculate the amount of error compensation and backlash compensation using the following formula. Error compensation is valid for manual pulse generator operation, JOG operation, and positioning operation.

- Unit: mm

$$\text{Amount of error compensation } (10^{-1}\ \mu\text{m}) = \left(\frac{\text{Set value (mm)}}{\text{Measured value (mm)}} - 1\right) \times 10^7$$

- Unit: inch

$$\text{Amount of error compensation } (10^{-5}\ \text{inch}) = \left(\frac{\text{Set value (inch)}}{\text{Measured value (inch)}} - 1\right) \times 10^7$$

- Unit: degree

$$\text{Amount of error compensation } (10^{-5}\ \text{degree}) = \left(\frac{\text{Set value (degree)}}{\text{Measured value (degree)}} - 1\right) \times 10^7$$

- If there is mechanical errors, calculate the backlash compensation amount as indicated below to set.

$$\text{Amount of backlash compensation} = \text{Measured amount of backlash compensation} \times \frac{\text{Set value}}{\text{Measured value}}$$

(10) Manual pulse generator travel increment per pulse

- Defines the distance travelled each time a manual pulse generator command is given.
- The D71 counts the number of manual pulse generator commands input and transmits the appropriate number of output pulses. (The speed is fixed at 20000 PLS/s.)
- During manual pulse generator operation 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. 2.5.)

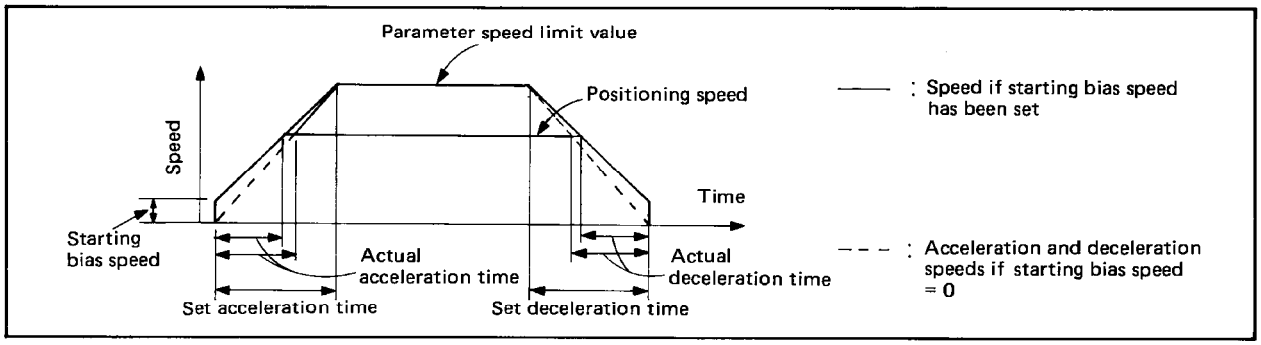


Fig. 2.5 Acceleration and Deceleration Times

- The acceleration and deceleration times cannot be set independently.
- Acceleration and deceleration are controlled at a constant value.
- When the positioning speed is very much lower than the parameter speed limit, the acceleration/deceleration time is comparatively short.
  Therefore, the maximum value of the positioning speed must be equal to or close to the value set for the parameter (speed limit).
- Acceleration/deceleration time is valid for zero return, 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.)

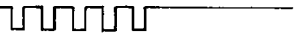
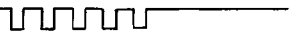
(12) Positioning complete signal duration

Sets the duration of the "positioning complete signal" from the D71.
Positioning is considered to be complete after the D71 terminates pulse output and the predetermined dwell time has elapsed.

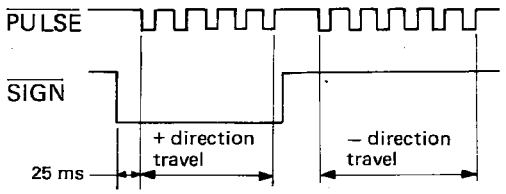
(13) Pulse output mode

Defines the output mode from D71.

- Forward pulse or reverse pulse, two pulse chains.

Forward feed pulse $\overline{\text{PULSE F}}$	$\overline{\text{PULSE F}}$ 	A type
Reverse feed pulse $\overline{\text{PULSE R}}$	$\overline{\text{PULSE R}}$ 	

- PLS + SIGN

Feed pulse $\overline{\text{PULSE}}$	Forward and reverse feed pulses. Travel direction is controlled by direction sign ($\overline{\text{SIGN}}$). 	B type
Direction sign $\overline{\text{SIGN}}$	Low in forward direction. High in reverse direction. (Present value increases in forward direction and decreases in reverse.)	

(14) Direction setting

Selects the direction for which the present value increases. (Set 0 when using forward pulse output. Set 1 when using reverse pulse output.)

(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. 2.6.)

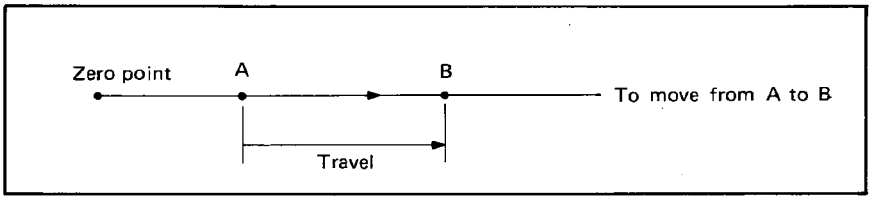


Fig. 2.6 Incremental Method

- In absolute mode positioning, positions are reached with reference to a zero point address. (See Fig. 2.7.)

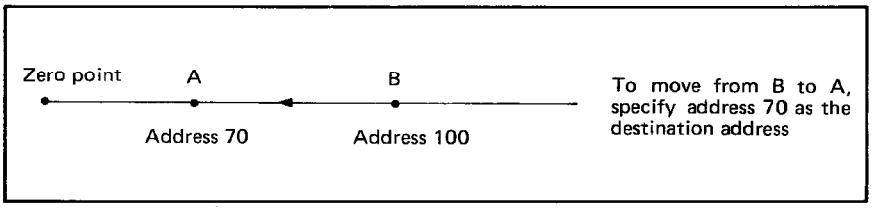


Fig. 2.7 Absolute Method

- 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 2.4.3 (page 2-25).)

(16) M code ON/OFF timing

An M code means a code number (1 to 255) assigned by the user to execute miscellaneous functions (clamp/unclamp, start/stop of drill, tool change, etc.) after the completion of position control by the D71. The corresponding operation can be executed by creating the program to turn ON/OFF the relay circuit at the PC CPU.

- 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 A6GPP 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 preset M code data is stored to the buffer memory before starting positioning operation.
  The "M code ON" signal is given at approximately the same time as the positioning operation starts.

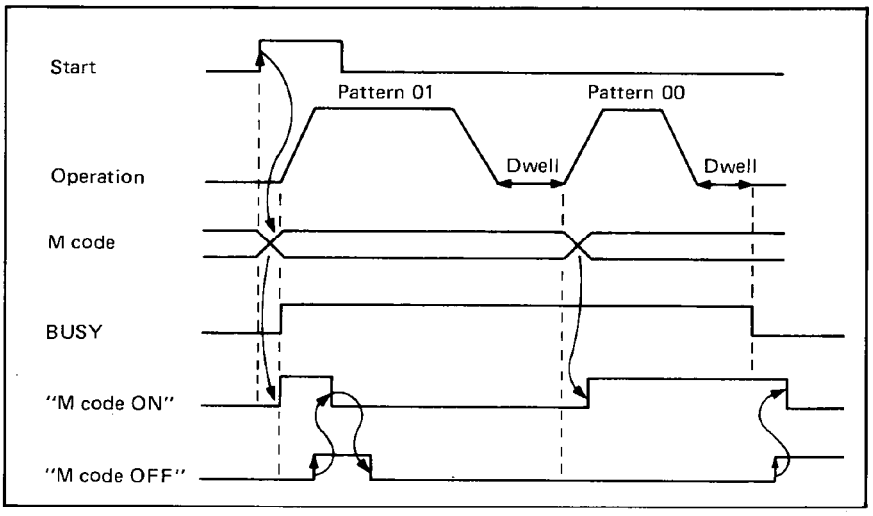


Fig. 2.8 WITH Mode Signal Timing

- AFTER mode
  The preset M code data is stored to the buffer memory before starting positioning operation.
  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 coad ON" signal is not given.

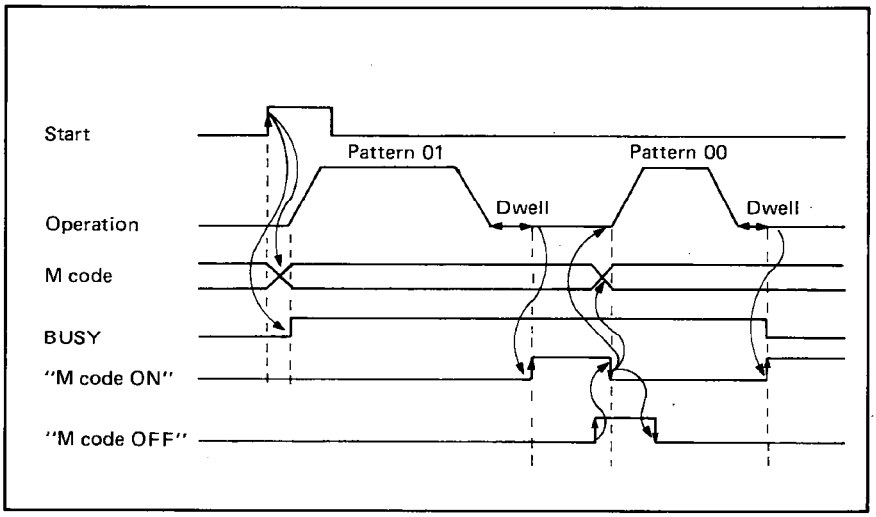


Fig. 2.9 AFTER Mode Signal Timing

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" (speed changed and positioning then continued) and the "M code ON" signal is not given. (For details of the positioning pattern, refer to Section 2.4.3. (page 2-25).)**
- **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 (Y1D) is off; or**
  3. **Zero return, positioning, JOG operation, or manual pulse generator mode is selected in the A6GPP test mode.**

In the positioning processing that begins with pattern 11 (positioning is continued after changing the speed), the M code ON signal is turned ON at the following timing depending on the positioning processing of pattern 00 (end of positioning) or pattern 01 (continuing positioning).
WITH mode ····· At the start
AFTER mode ····· At the end
However, the M code is set before the start of positioning processing of pattern 11.

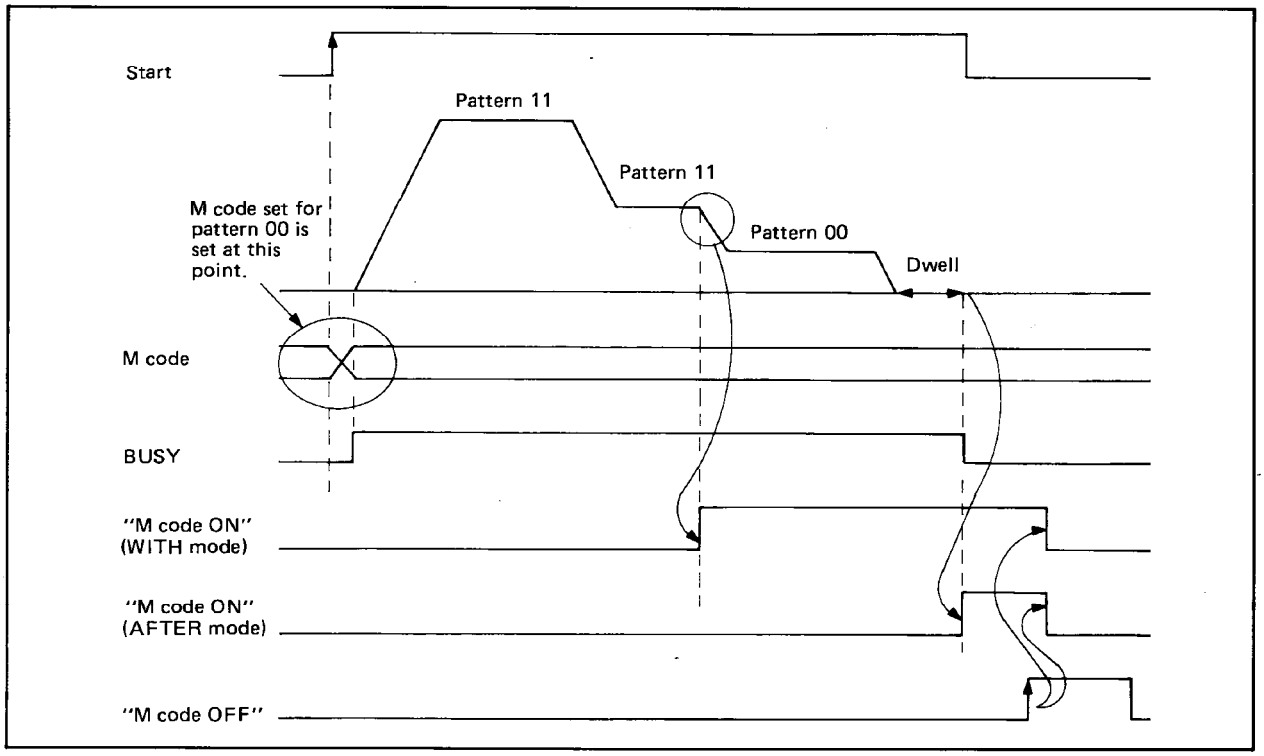


Fig. 2.10 "M Code ON" Signal Timing for Positioning Pattern "11"

REMARK

In Fig. 2.10 above, the M code ON timing is explained for both the WITH and AFTER modes. In actual operation, however, the mode is either WITH or AFTER and the M code is turned ON corresponding to the specified mode.

2.4.2 Zero return data

This defines a home position or zero point for the D71. Refer to Table 2.6.
Zero return data is checked when:

1) Parameters or zero return data is transferred from the A6GPP to the D71;
2) "PC ready signal" output from the PC CPU to the D71 changes from OFF to ON; or
3) Zero return, positioning, JOG operation, or manual pulse generator is selected in A6GPP test mode.

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

Table 2.6 Zero return Data

POINTS

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

**(2) Setting number "0" or "1" for zero return direction and that "0", "1", or "2" for zero return method is the number set at the peripheral equipment (GPP, TU).
When setting No. 1 and No. 2 from the sequence program, refer to Section 2.5.6 (page 2-49).**

REMARK

Among the zero return data indicated in Table 2.6, the zero return speed and creep speed values are multiple of 6.1 (PLS/s).
For example, if "zero return speed value = 200 (PLS/s)" is set, the value that is a multiple of 6.1 (PLS/s) and closest to 200 (PLS/s) is actually set.

$$\frac{200}{6.1} = 32.78688\cdots\cdots\text{(decimal fraction cut-off)}$$

Thus, actual speed is 6.1 x 32 = 195.2 (PLS/s).

Zero return data is explained below:

(1) Zero return direction

- Specifies the direction for zero return.

IMPORTANT

Zero return is controlled according to the zero return direction and speed. Deceleration starts when the near-point dog signal is turned ON. Always ensure that the zero return direction is correct for the drive system used.

(2) Zero return methods

The following three zero return methods are provided.

a) Zero-phase signal from pulse generator (PG)
b) Stop by stopper (1) and dwell timer time-out
c) Stop by stopper (2) and signal from drive unit

(a) Zero-phase signal from PG

In this method, an axis stops when the zero-phase signal output from the PG is received as shown in Fig. 2.11.
Note that a PG that has the function to output the zero-phase signal must be used. (See Fig. 2.12.)

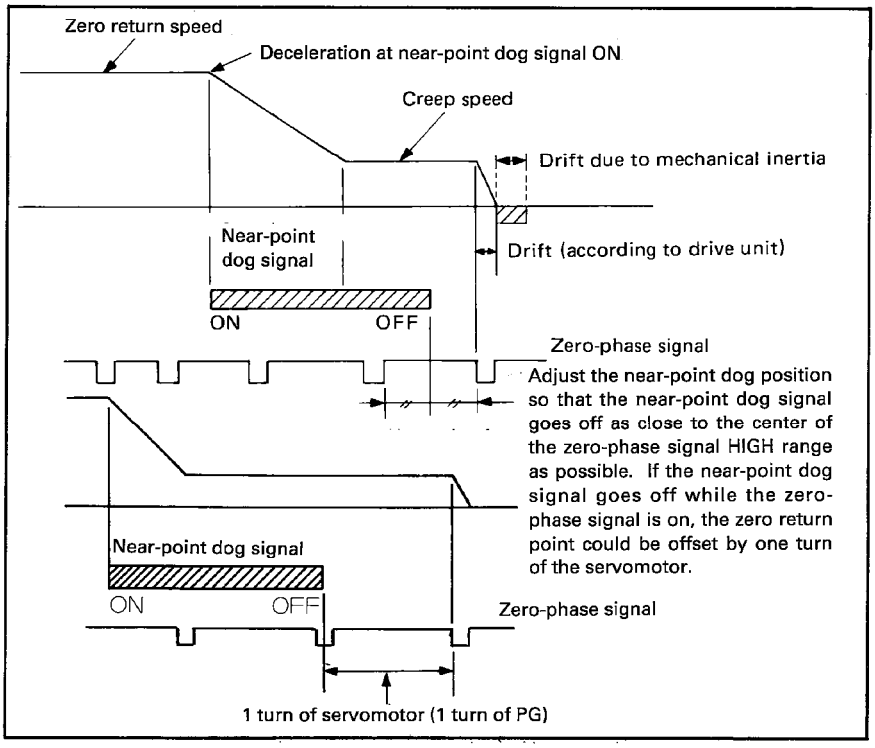


Fig. 2.11 Zero return Using a Zero-Phase Signal from PG

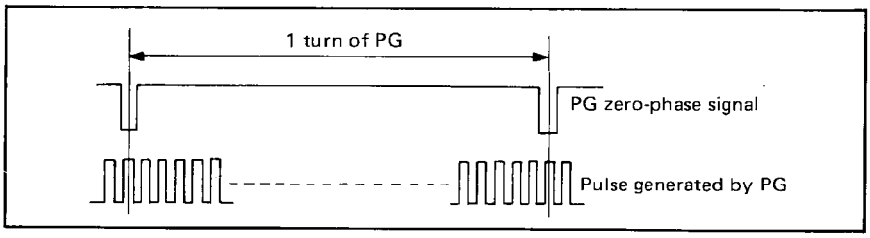


Fig. 2.12 Feedback Pulse Format

(b) Stop by stopper - 1 (count-up of dwell timer)

Zero return completes on count up of the dwell timer after the operation of the near-point dog (See Fig. 2.13-1.).

In this case, zero return does not complete unless the dwell timer counts up even if the near-point dog signal goes off while the dwell timer is counting.

Apply torque limit to the servomotor after it has reached the creep speed. For details, see (7) in Section 2.4.2.

If torque limit is not applied to the servo motor, the servo motor may be damaged when an axis travel is stopped by the stopper.

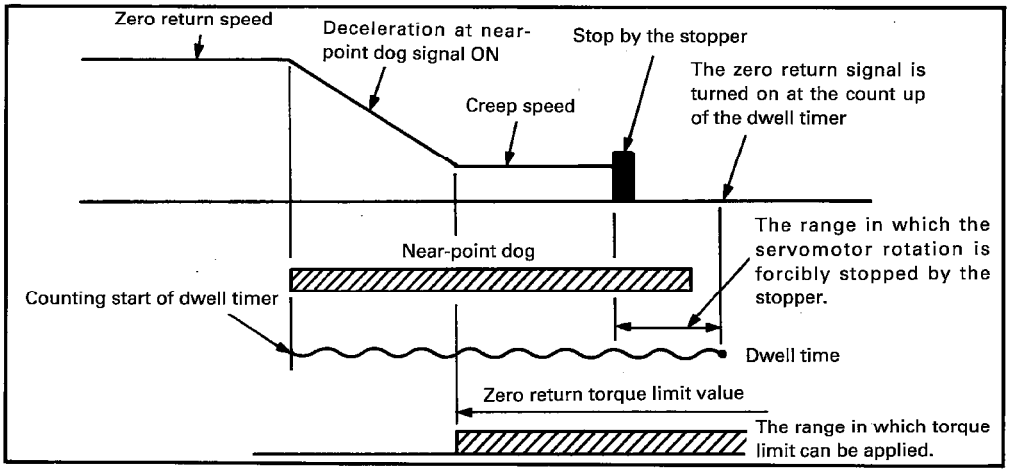


Fig. 2.13-1 Zero Return by Stopper (1)

(c) Stop by stopper - 2 (external stop instruction)

In this method, a stop instruction is input externally when an axis is brought to a stopper (See Fig. 2.13-2.).

After the near-point dog signal is turned ON, the zero-phase signal (stop instruction) is forcibly input to the zero-phase signal terminal using an external switch, etc. The zero-point dog signal may be ON or OFF when the zero-phase signal (stop instruction) is input.

Apply torque limit to the servomotor after it has reached the creep speed. For details, see (7) in Section 2.4.2.

If torque limit is not applied to the servo motor, the servomotor may be damaged when an axis travel is stopped by the stopper.

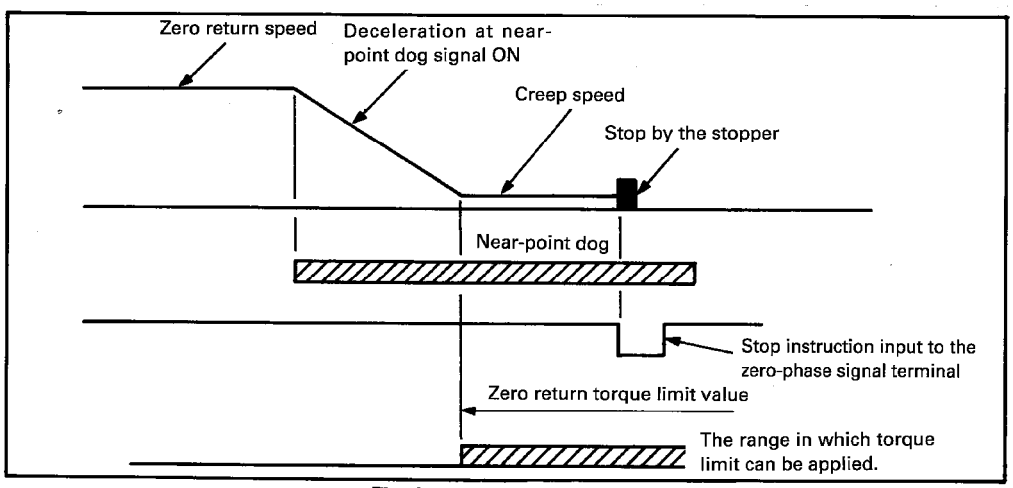


Fig. 2.13-2 Using a stopper

REMARK

Input the stop instruction after the motor speed has lowered to the creep speed. If the stop instruction is input before the motor speed has lowered to the creep speed, undue force is applied to the motor and the mechanical system causing them to be damaged.

(3) Zero return address

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

(4) Zero return speed

- Sets the zero return speed. (Refer to Fig. 2.14)

(5) Creep speed

- The axis travel speed decelerated from the zero return speed at turning on of the near-point dog signal during zero return operation is called creep speed (See Fig. 2.14.).
- The creep speed has influence on detection error if zero return is controlled by the zero-phase signal and on the magnitude of impacts if zero return is controlled using a stopper. Therefore, the creep speed must be determined taking error range and allowable shock into consideration.

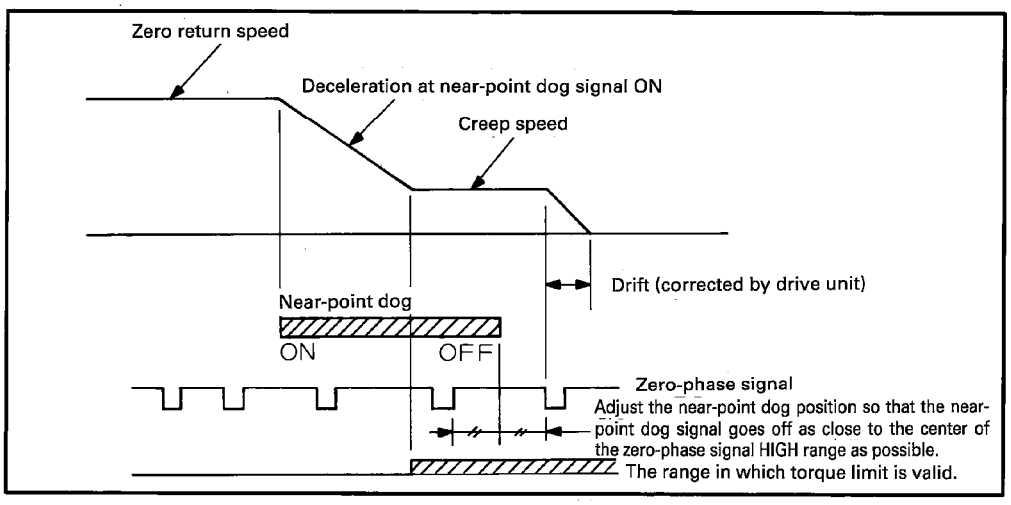


Fig. 2.14 Zero Return Speed and Creep Speed

(6) Zero return dwell time

- The zero return dwell time means the length of time in which the zero return is completed after turning ON of the near-point dog signal in the zero return operation using a stopper (1).
- Set the length of time in which an axis stops moving by the stopper after its speed has been stabilized at the creep speed.
- The setting (within the allowable setting range) for this parameter is disregarded in zero return other than zero return controlled by a stopper (1).

(7) Torque limit

- Sets a limit for the servo motor torque after the creep speed is reached as required by some drive units.

POINT

- **A D/A converter module is necessary for torque limiting.**
- **This parameter must always be set when zero return is controlled using a stopper (2).**
- **Any value within the setting range may be specified if the torque limit is not being used.**

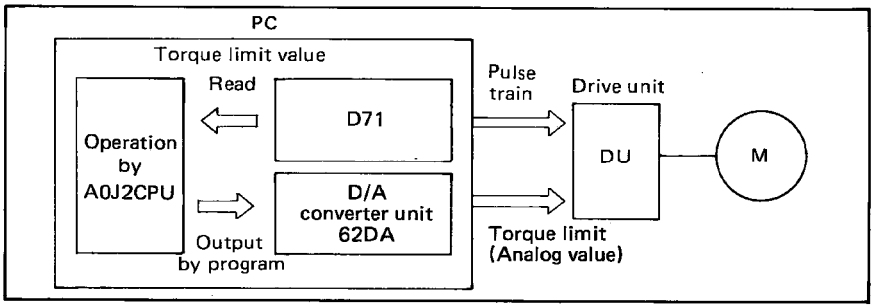


Fig. 2.15 Torque Limit Block Diagram

2.4.3 Positioning data

Positioning data is used in the D71 to execute positioning control (i.e. control other than zero return, manual pulse generator and JOG operation).
Refer to Table 2.7.
Table 2.7 shows one block of positioning data. 400 blocks can be set for the X and Y axes, respectively. (The data number is assigned in the range of 1 to 400.)
Positioning control is executed by referencing the position data that corresponds to the data number set in the positioning start area in the buffer memory.
Positioning data is checked when positioning is started.

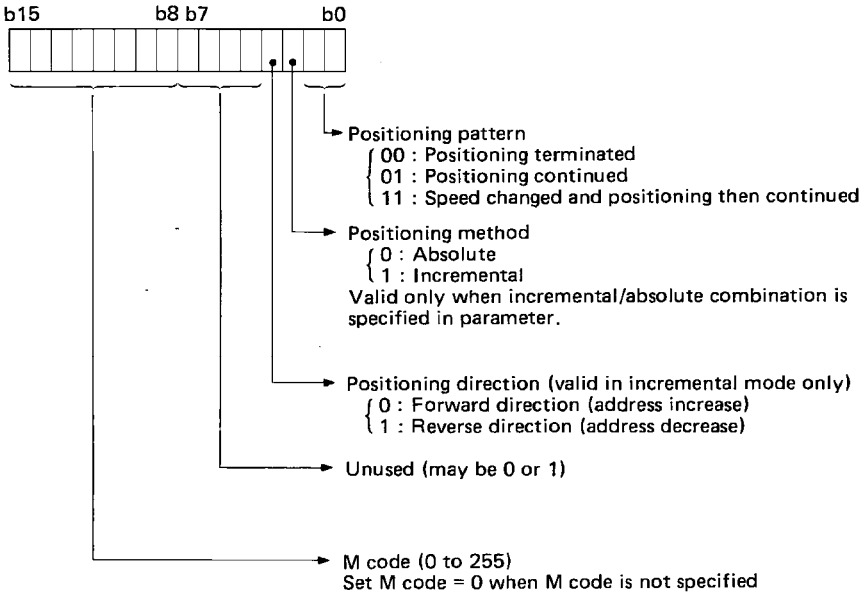
<table>
<tr><th colspan="2">No. / Item</th><th colspan="8">Setting Data</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Positioning information</td><td colspan="8"> 
</td></tr>
<tr><td colspan="2">mm</td><td colspan="2">inch</td><td colspan="2">degree</td><td colspan="2">PULSE</td></tr>
<tr><td></td><td></td><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>x 10^{1} PLS/s</td></tr>
<tr><td>3</td><td>Positioning address</td><td>0 to 162 x 10^{7}</td><td>$\times 10^{-1}\mu$m</td><td>0 to 162 x 10^{7}</td><td>$\times 10^{-5}$inch</td><td>0 to 162 x 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 (x 10^{1} ms)</td></tr>
</table>

Table 2.7 Positioning Data List

POINT

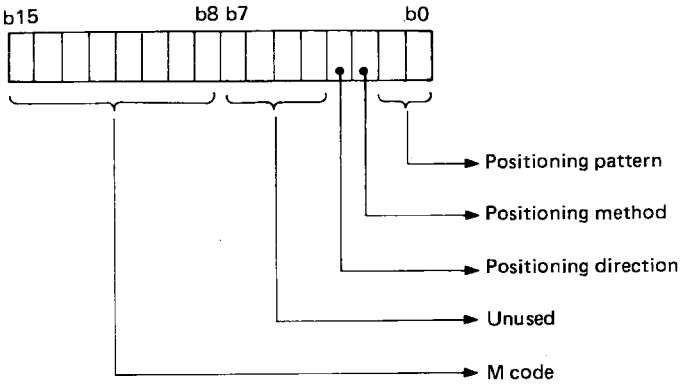
No. 2 to No. 4 can be set from the sequence program.

IB (NA) 66133-O

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) Positioning is completed at the specified address and then the positioning is continuously executed using the next data number (positioning address).

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.

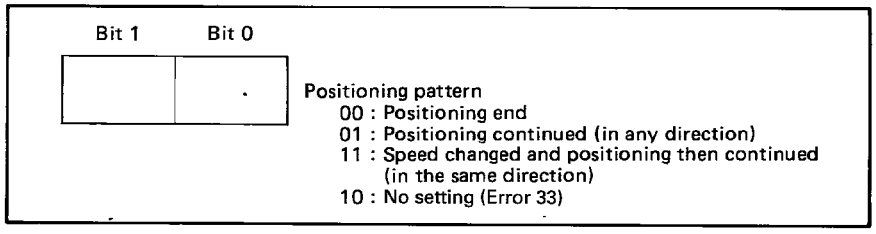


Fig. 2.16 Positioning Pattern

- Positioning terminated

  Drives to the specified address, positioning is complete after the dwell time has elapsed.

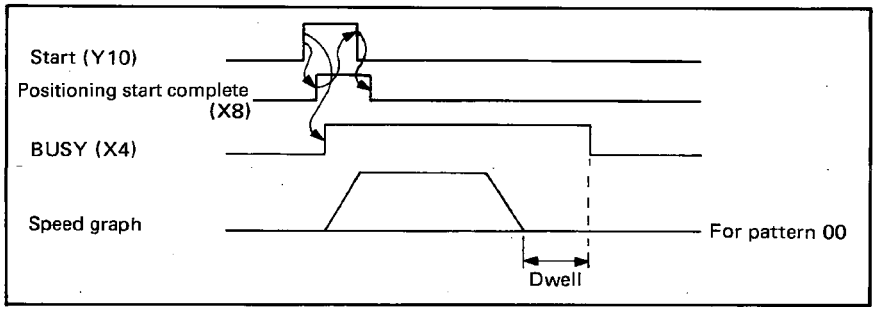


Fig. 2.17 Pattern 00

- Positioning continued

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

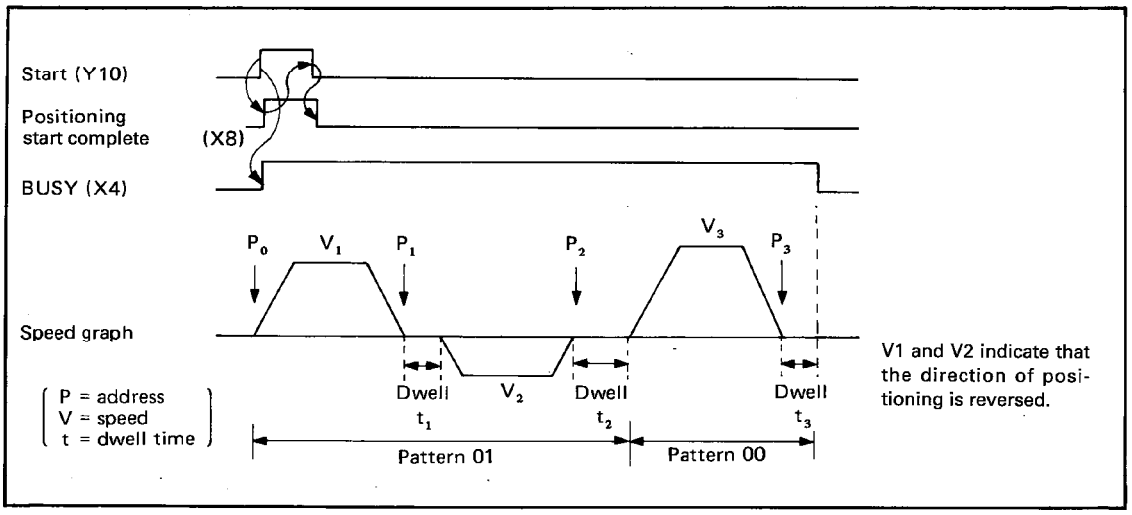


Fig. 2.18 Pattern 01

POINT

Pattern 00 should be set for the last position in a series of continuous operations by pattern 01.
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

The positions are reached consecutively 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. 2.19)

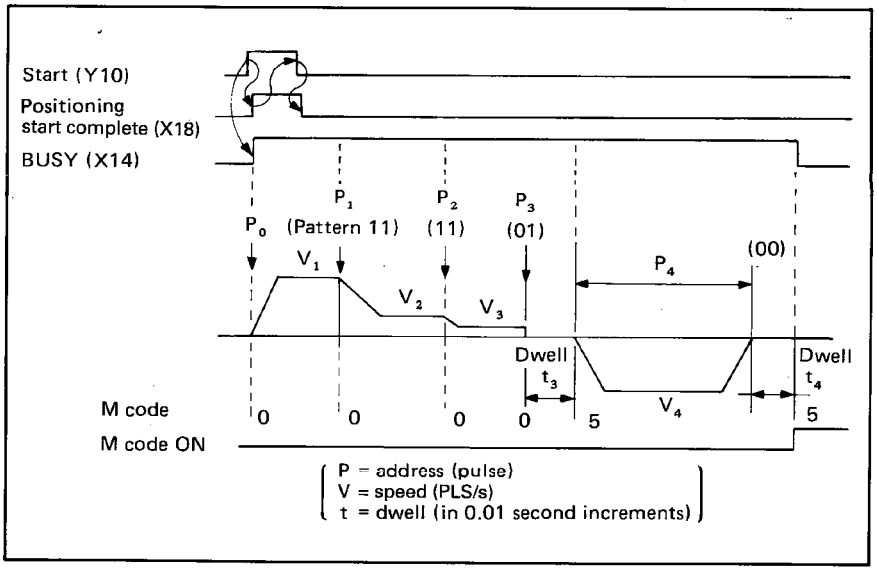


Fig. 2.19 Pattern 11

Table 2.8 shows the positioning data for Fig. 2.19. 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 2.8 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, (set the speed change point before the deceleration point.), 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

The positioning method specified in the positioning data is valid only when "combination of incremental and absolute" is set for the positioning method parameter.

POINT

The positioning method cannot be changed if pattern 11 has been specified.
(If the "combination of incremental and absolute" is specified, it is possible to change the positioning method after the execution of pattern 00 or pattern 01.)

(c) Positioning direction

For incremental mode positioning, the direction of travel relative to the positioning data No. 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 data No. (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 relevant to the position data No.

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. 2.20 which uses the following data:

	X Axis	Y Axis
Parameter set value : speed limit value	20kPLS/s	50kPLS/s
Positioning data set value : positioning speed	20kPLS/s	50kPLS/s

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.

$$\text{X-axis positioning speed} = 50 \times \frac{100}{200} = 25\,\text{kPLS/s}$$

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

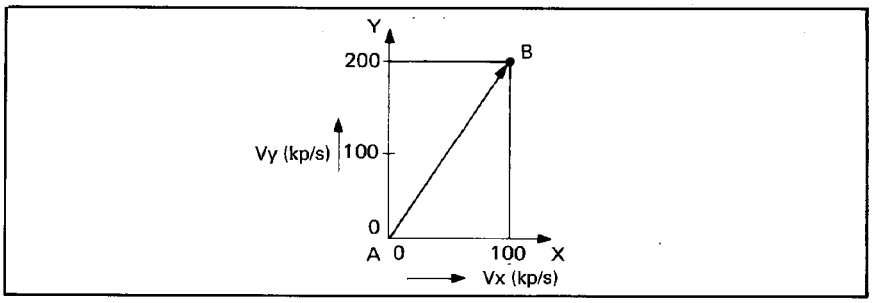


Fig. 2.20 Linear Interpolation

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 100PPS).

POINT

The set speed of the axis with shorter travel distance is disregarded in linear interpolation. Therefore, if travel distances and speeds differs largely between X and Y axes, actual travel speed of X or Y axis may become larger than the set speed. (The speed limit value is ignored.)
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.

REMARK

Actual positioning speed is a multiple of 6.1 (PLS/s).
For example, if "positioning speed = 200 (PLS/s)", the maximum speed to be output by the D71 is determined as shown below.
200 = 6.1 x n·····n = 32.7868·····
Therefore, the maximum speed is 6.1 x 32 = 195.2 (PLS/s).

(3) Positioning address

Set the positioning address meeting the positioning method.
(In the incremental method, set a travel distance and in the absolute method, set an address value.)

(4) Dwell time

The dwell time is the period of time indicated in Fig. 2.21 below.

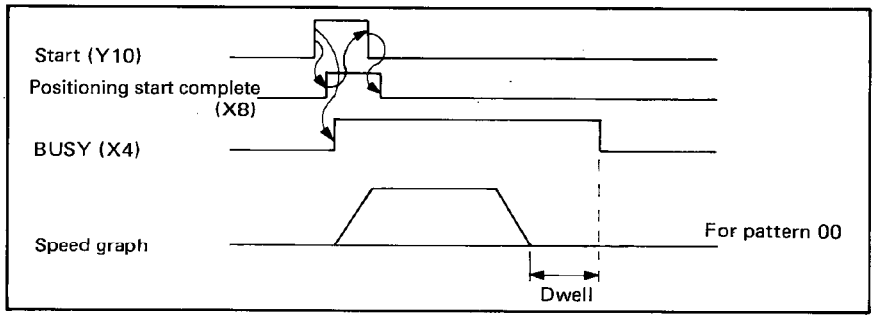


Fig. 2.21 Pattern 00

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

2.5 Buffer Memory

The D71 has battery backed buffer memory for communication of data with the PC CPU.
The data stored in the buffer memory area is shown in Fig. 2.22 and the D71 executes positioning control using the data stored in this area.
The following methods can be used to read or write the data shown in Fig. 2.22.

Data can be read from the buffer memory as follows:

- Reading data using the sequence program

  One word (16-bit) or two word data can be read by using the buffer read application instructions (FROM).

- Reading data using the A6GPP

  Data can be read in a variety of A6GPP modes.
  For details, refer to the SW0GP-AD71P Operating Manual.

Data can be written to the buffer memory as follows:

The writing of data may be restricted depending on the status of the D71. General write conditions are shown in Fig. 2.22. For further details, refer to Section 2.5.1 to 2.5.6.

- Writing data from the sequence program

  One word (16-bit) or two word data can be written by using the buffer write application instructions (TO).

- Writing data from the A6GPP

  Data stored in the memory area of A6GPP is transferred in blocks to buffer memory area in the D71.
  The conditions for writing data using the A6GPP correspond to the write processing indicated above.

An additional function allows individual pieces of positioning data to be written to the buffer memory if the D71 is BUSY. For details, refer to the SW0GP-AD71P Operating Manual.

REMARK

For buffer memory access instructions, refer to Chapter 6 "Programming."

Address			Description	Write Condition	
				Sequence program	A6GPP or AD71TU
0 to 200	X-axis positioning start data		Area for positioning start data numbers, etc. (For X axis)	Depends on data.	Write enabled when both X-axis and Y-axis BUSY signals are off.
201	Error reset		Area for error reset	Write enabled at any time	Write enabled at any time
			Unused	–	–
300 to 500	Y-axis positioning start data		Area for positioning start data numbers, etc. (For Y axis)	Depends on data.	Write enabled when both X-axis and Y-axis BUSY signals are off.
			Unused	–	–
512 to 767	For OS		OS RAM. Writing here is not allowed.	Write disabled	Write disabled
			Unused	–	–
768 to 3871			X axis positioning data area described in Section 2.4.3 (Maximum 400 positions) Data format as follows: Positioning information: 2 bytes (16 bits) Positioning speed: 2 bytes (16 bits) Dwell time: 2 bytes (16 bits) Positioning address: 4 bytes (32 bits)	Write enabled at any time	Block transfer of positioning data from A6GPP to D71 is only enabled when PC ready signal is off.
3872 to 4271	Positioning information	X-axis positioning data			
4272 to 4671	Positioning speed				
4672 to 5071	Dwell time				
5072 to 5871	Positioning address				
5872 to 6271	Positioning information	Y-axis positioning data	Y axis positioning data area described in Section 2.4.3 (Maximum 400 positions) Data format as for X axis.	Write enabled at any time	
6272 to 6671	Positioning speed				
6672 to 7071	Dwell time				
7072 to 7871	Positioning address				
7872 to 7887	X-axis parameters		Parameter area explained in Section 2.4.1 (X axis)	Write only enabled when PC ready signal is off.	Write only enabled when PC ready signal is off.
7892 to 7907	Y-axis parameters		Parameter area explained in Section 2.4.1 (Y axis)		
7912 to 7918	X-axis zero return data		Zero return data area described in Section 2.4.2 (X axis)		
7922 to 7928	Y-axis zero return data		Zero return data area described in Section 2.4.2 (Y axis)		

The above data may be read at any time.
Addresses are expressed in decimal (1 address = 2 bytes (16 bits))

Fig. 2.22 Buffer Memory Map

2.5.1 Positioning start data

The positioning start data area is shown in Fig. 2.23. 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 D71 from the A6GPP.

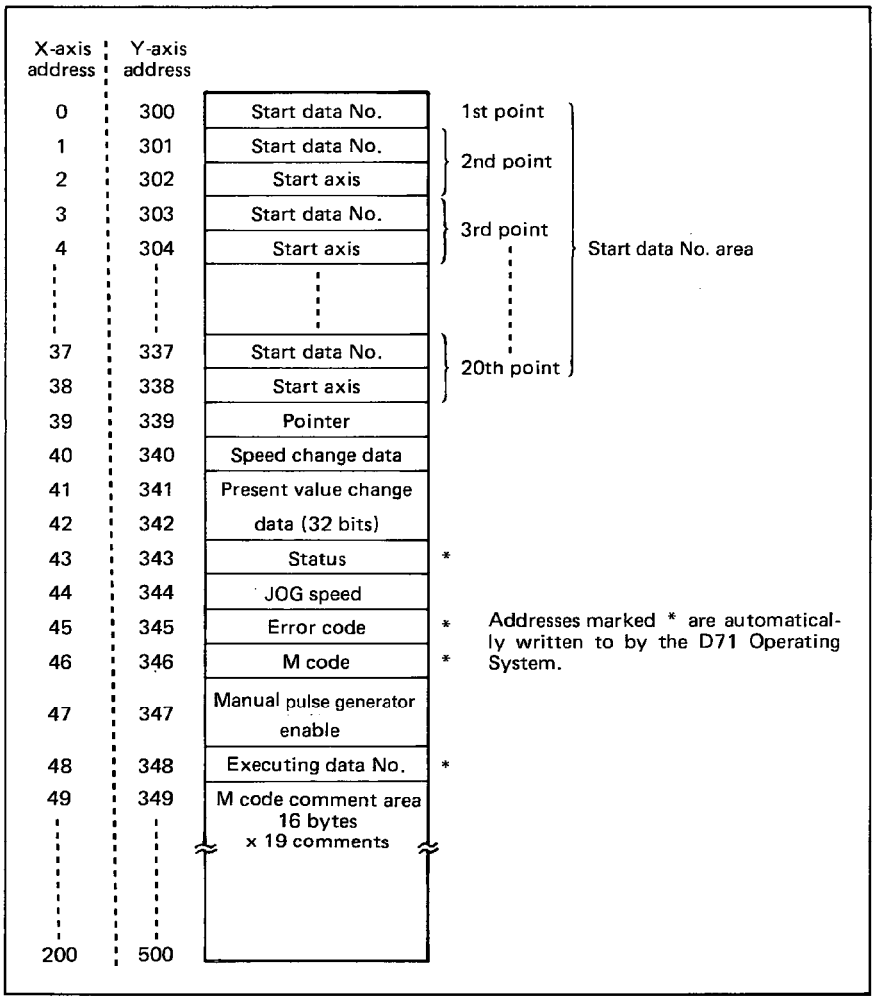


Fig. 2.23 Positioning Start Data

(1) 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 2.7 page 2-25). This data overrides the speed set in the positioning data. Speed change is illustrated in Fig. 2.24 below.

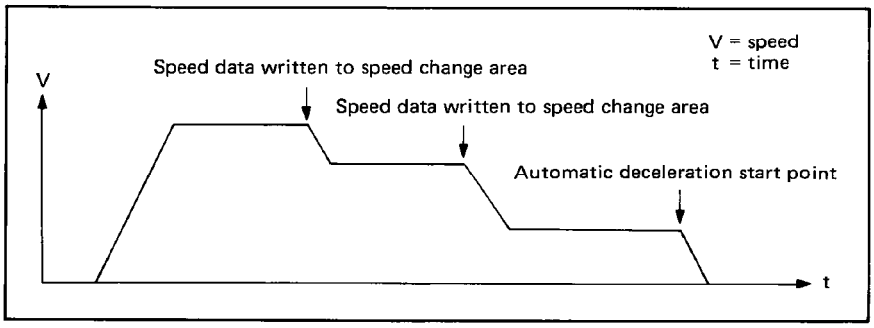


Fig. 2.24 Speed Change Example

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 manual pulse generator mode;**
- **after a stop command or after the JOG signal is turned off; or**
- **during interpolation positioning.**

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

To change the present value data in the D71, write the new value to these addresses.

POINT

The present value cannot be changed while the D71 is BUSY. Present value data is two words long, one word data cannot be written.

(3) 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 the start of JOG operation is valid.

(4) Manual pulse generator enable area (X axis: address 47, Y axis: address 347)

Enable or disable of manual pulse generator is written to bit 0 shown in Fig. 2.25. This data may be written at any time.

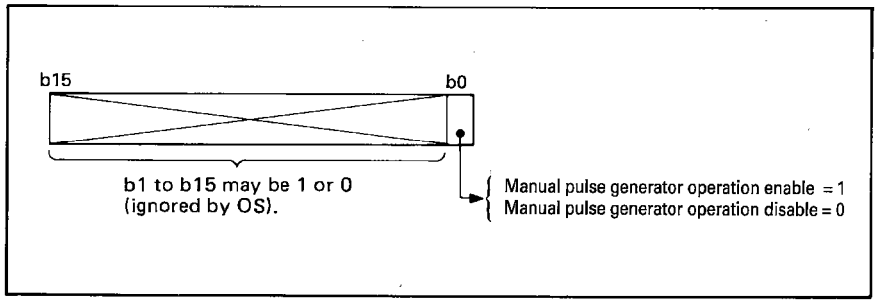


Fig. 2.25 Manual pulse generator Enable

(5) 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 A6GPP or sequence program).
Comments may be written to M code numbers 1 to 19 for both X and Y axes.
This can be used in the following cases:

- To monitor by A6GPP
- To display using an external device by reading out with a sequence program

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

Is reserved for the information shown in Fig. 2.26 and is set by the D71 OS.

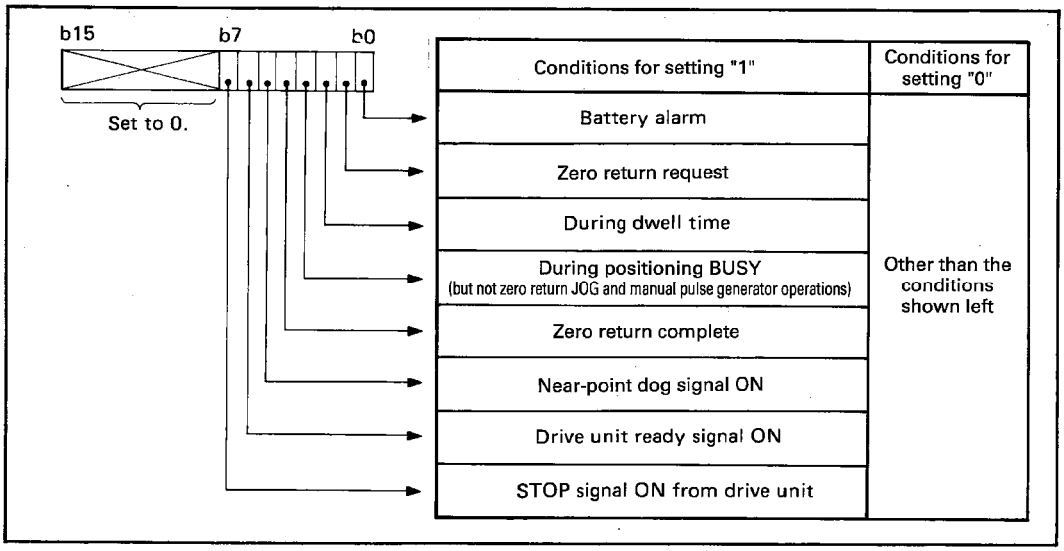


Fig. 2.26 Status Area

POINT

The status area is used by the D71 OS and data must be written here.

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

An error code is stored to this area when the D71 OS turns ON the error detection signal (XB) after detecting an error.

POINT

- **The error code area is used by the D71 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.**

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

The D71 OS sets the M code, which is set in the positioning data, as shown in Fig. 2.27.

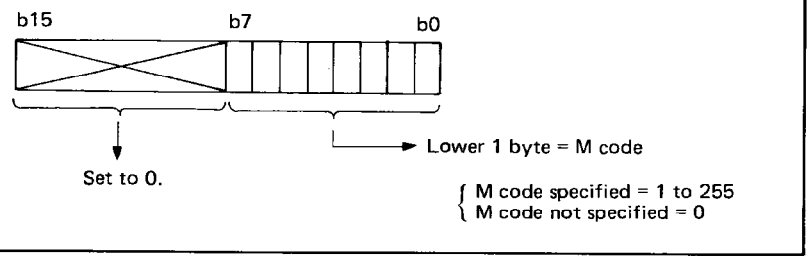


Fig. 2.27 M Code Area

POINT

- **The M code area is used by the D71 OS and data must be written here.**
- **For M code data timing details, refer to Section 2.4.1 (16) (page 2-17).**

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

The D71 OS sets the data No. for which positioning is presently executed. This number is retained until the next positioning operation begins. (Refer to Fig. 2.28).

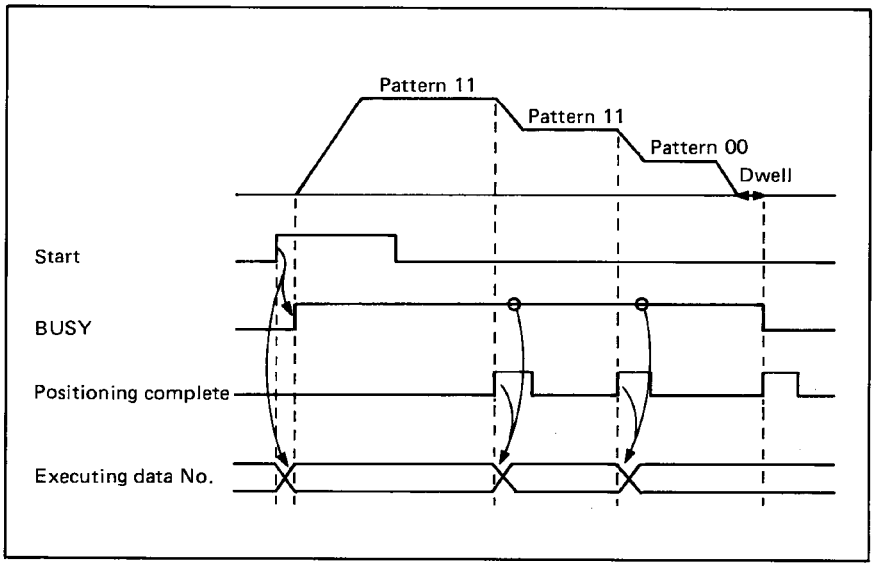


Fig. 2.28 Current Data No. Updata Timing

POINT

The executing data No. area is used by the D71 OS and data must be written here.

(10) Start data number area

The D71 executes positioning in the order of the data numbers by a single start signal and completes positioning at the completion of positioning in pattern 00.
To execute a series of positioning continuously in this manner, there must be an area where the start data No., start axis, and other related data. This area is called the start data No. area.
As shown in Fig. 2.29, a maximum of 20 points can be set in the start data No. area.

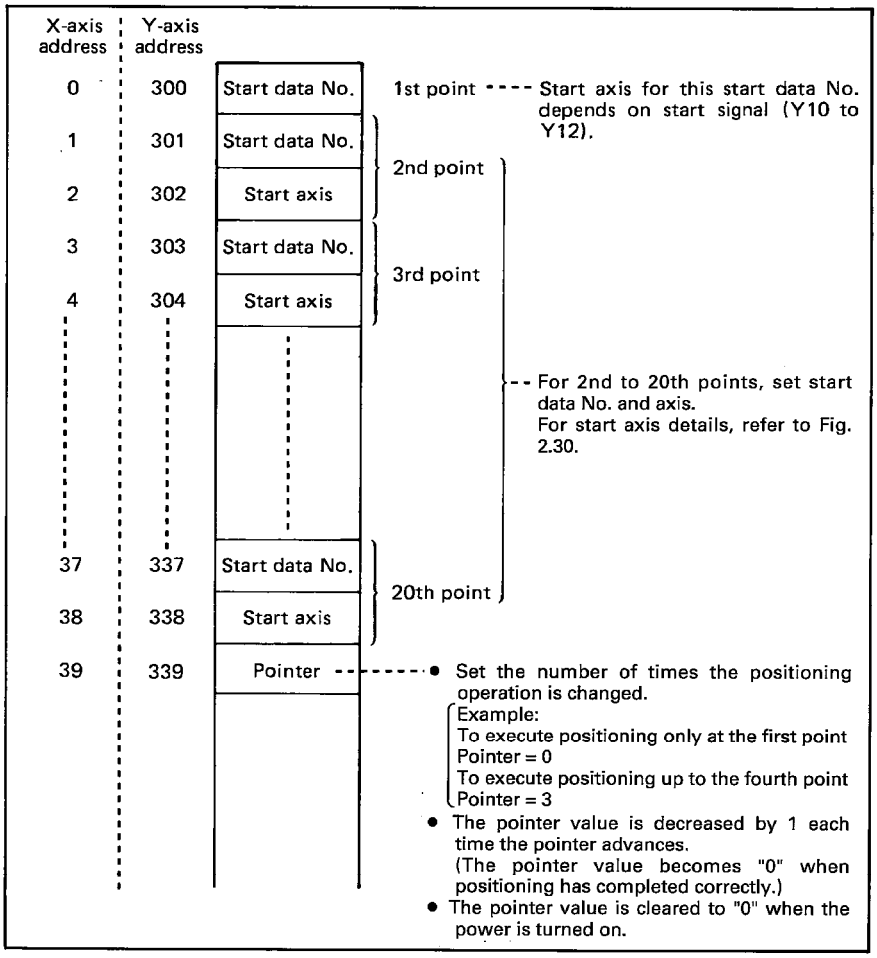


Fig. 2.29 Start Data Area

POINT

- **At the completion of positioning using the start data No. of the 20th point, positioning is completed even if the pointer value is not "0". In this case, an error code is set.**
- **The BUSY signal stays ON while control of positioning is being switched to the next point after the completion of positioning at one point.**

(a) Start axis area details

Use the lower two bits of these addresses to define the start axis. (See Fig. 2.30.)

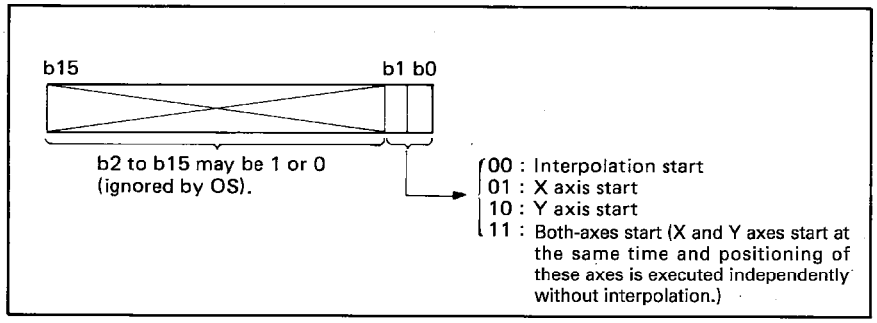


Fig. 2.30 Start Axis Area

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. 2.31.

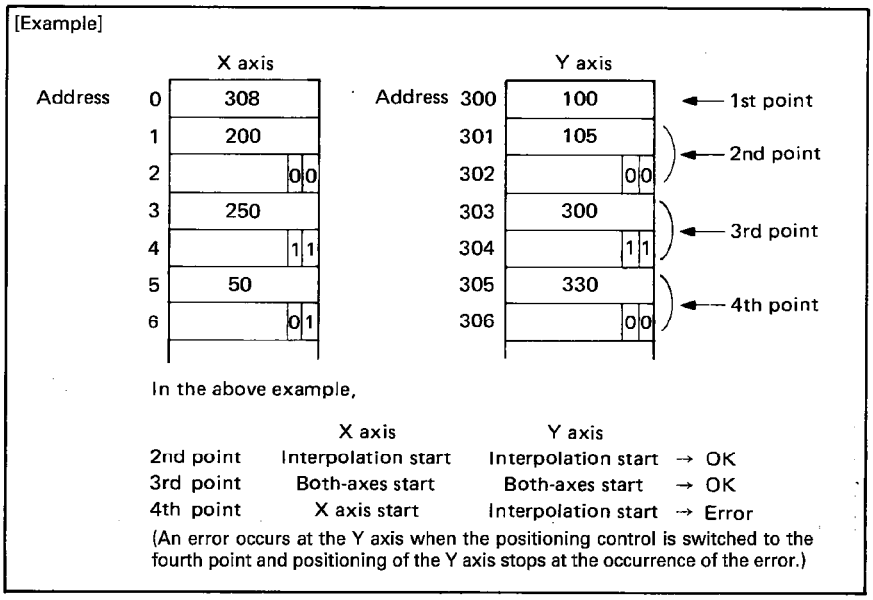


Fig. 2.31 Start Data Example 1

2) If the Y axis is set as the start axis (10) in the start data No. area for the X axis, the data of such a point is disregarded (positioning is not executed) and the control advances to the next point (See Fig. 2.32.). This is also true if the X axis is set as the start axis (01) in the start data No. area for the Y axis.

[Example]

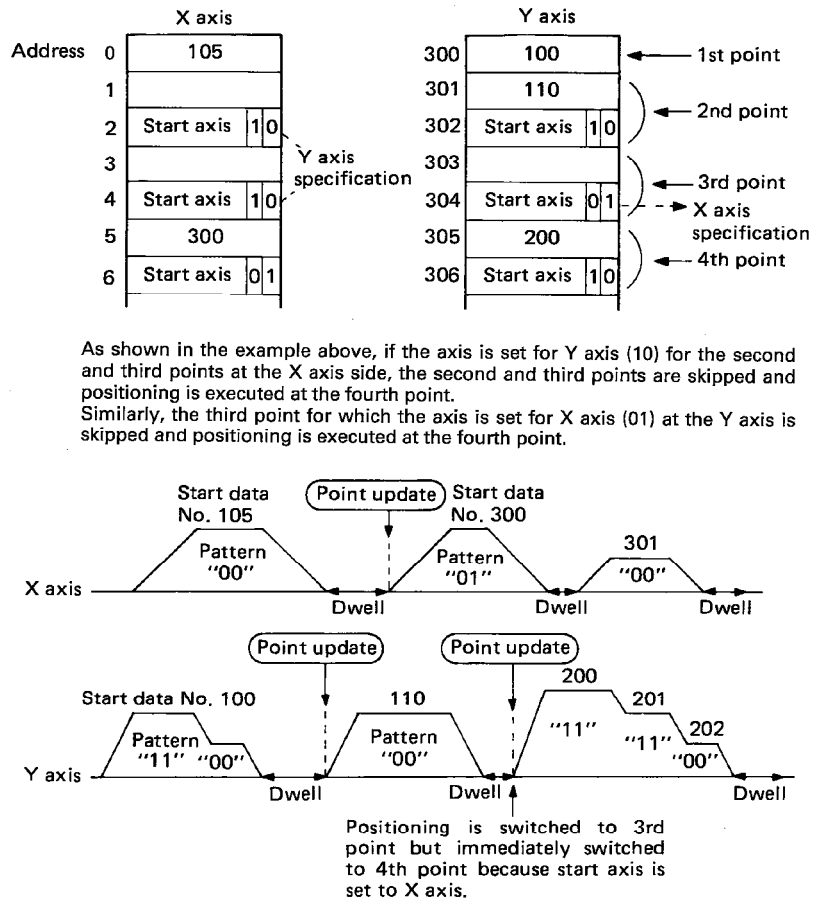


Fig. 2.32 Start Data Example 2

3) If the interpolation start (00) or both-axis start (11) is set for the start axis of either of the two axes, the mating axis automatically starts positioning using the start data No. set at the location of the same point when the mating axis is not BUSY (See Fig. 2.33.).
In this case, an error occurs if the "M code ON" signal of the mating axis is ON.

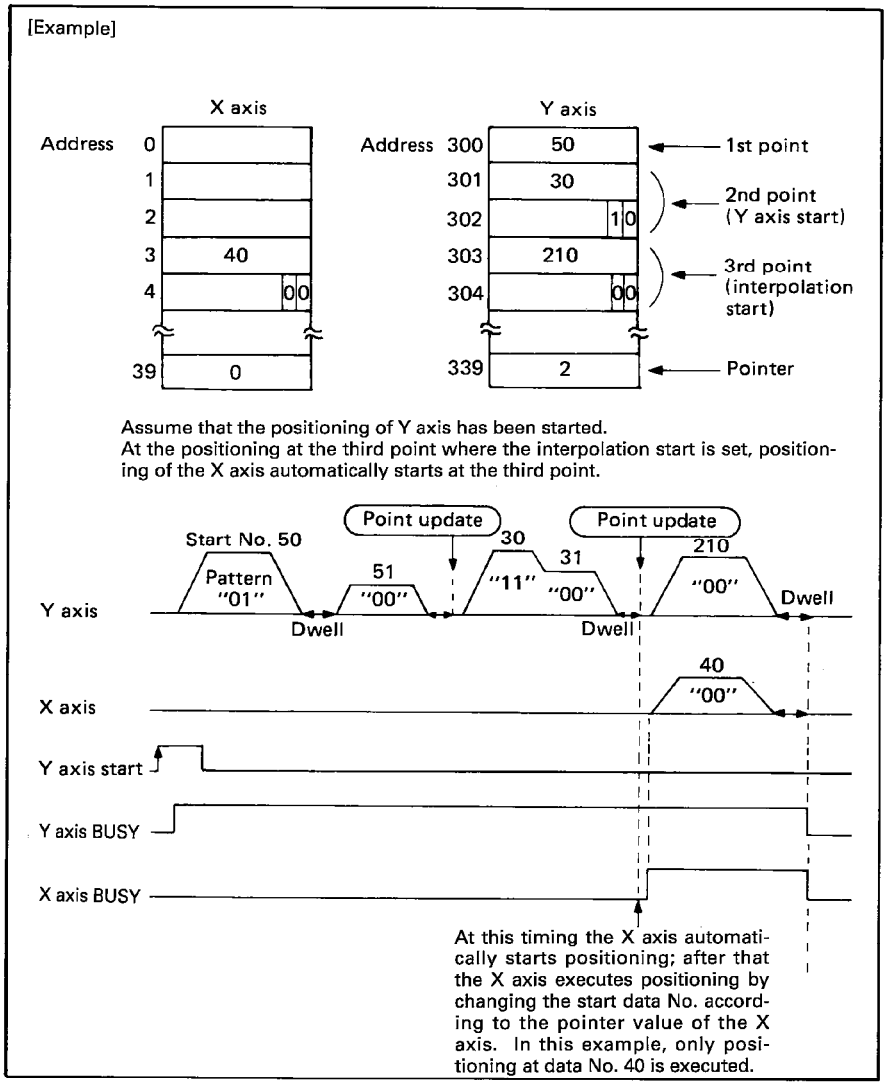
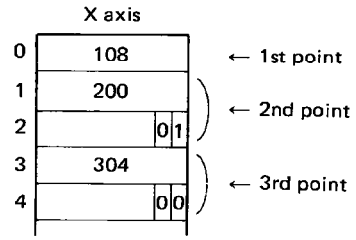


Fig. 2.33 Start Data Example 3

4) If the interpolation start (00) or both-axis start (11) is set for the start axis of either of the two axes, an error occurs and positioning processing of that axis is stopped if the mating axis is BUSY in other than positioning (See Fig. 2.34.).

[Example]



Assume that X-axis positioning processing is being executed with the X-axis start signal turned ON.
If the Y-axis is BUSY due to zero return, JOG operation or manual pulse generator operation when the positioning point of the X axis is switched to the third point, the X axis does not start positioning in the interpolation mode but its positioning processing is stopped with an error code set.

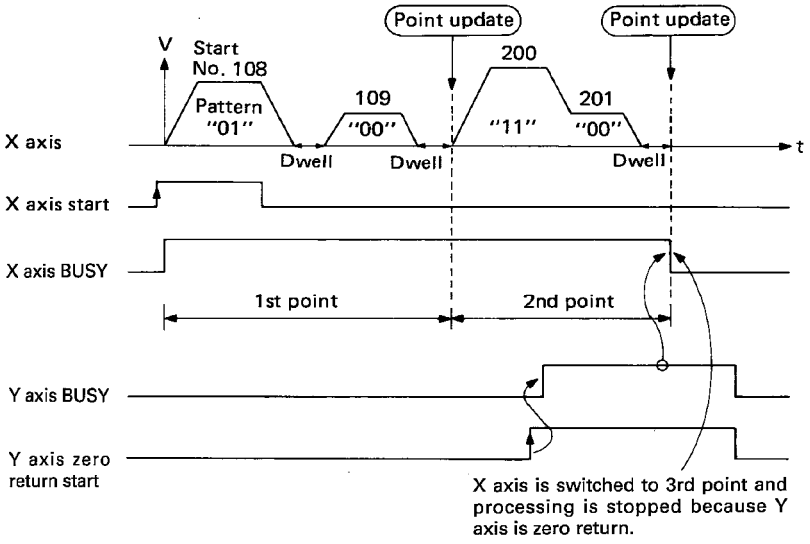
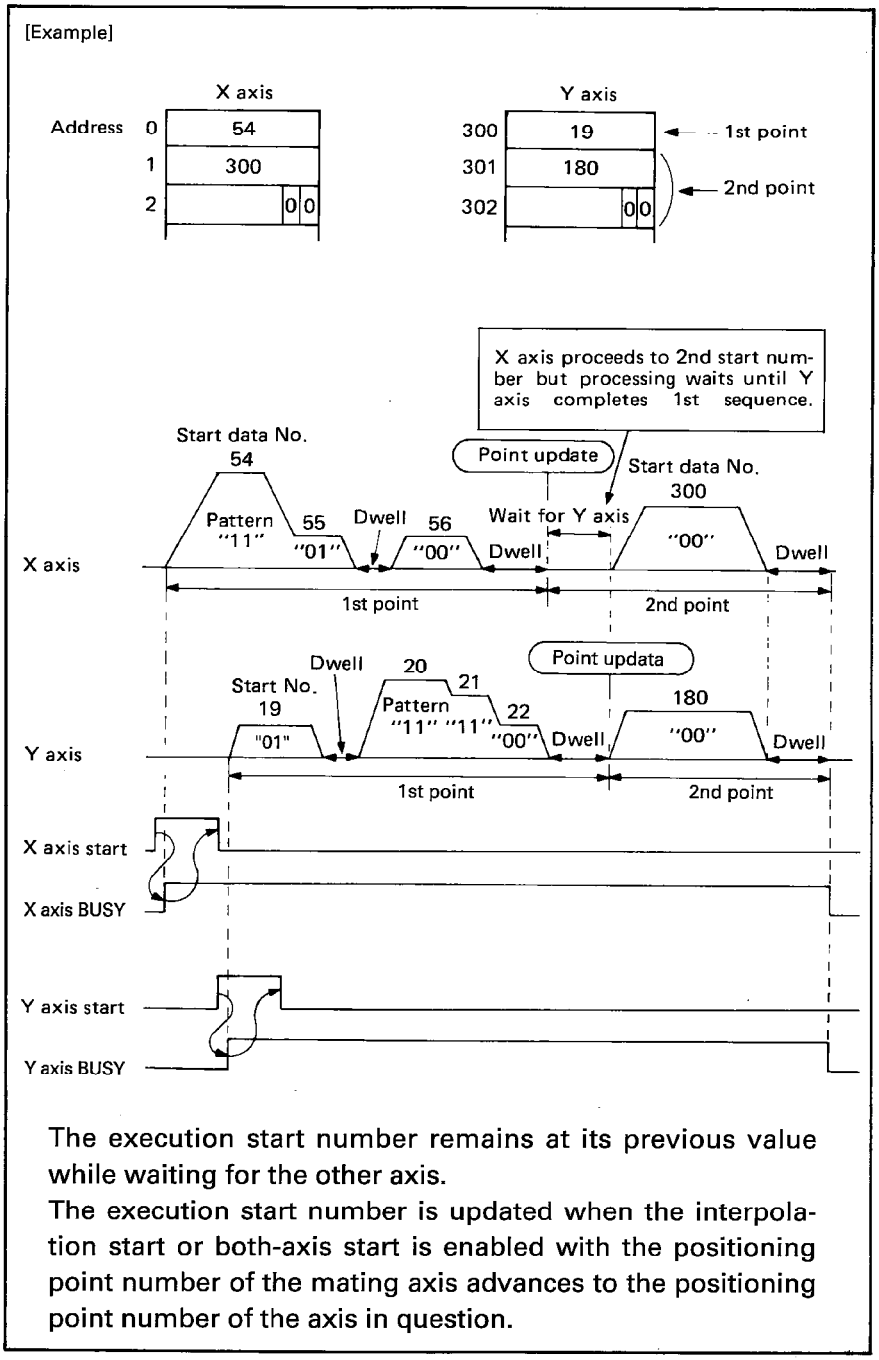


Fig. 2.34 Start Data Example 4

5) If the interpolation start (00) or both-axis start (11) is set for the start axis of either of the two axes, the processing differs depending on the contents of positioning processing of the mating axis if the mating axis is executing positioning.
   - If the mating axis is executing positioning at a point number smaller than the positioning point of the axis in question, its positioning processing is suspended until positioning processing of the mating axis advances to the same point number or the mating axis BUSY state goes off. The state of the axis in question remains BUSY while its positioning processing is suspended (See Fig. 2.35.).

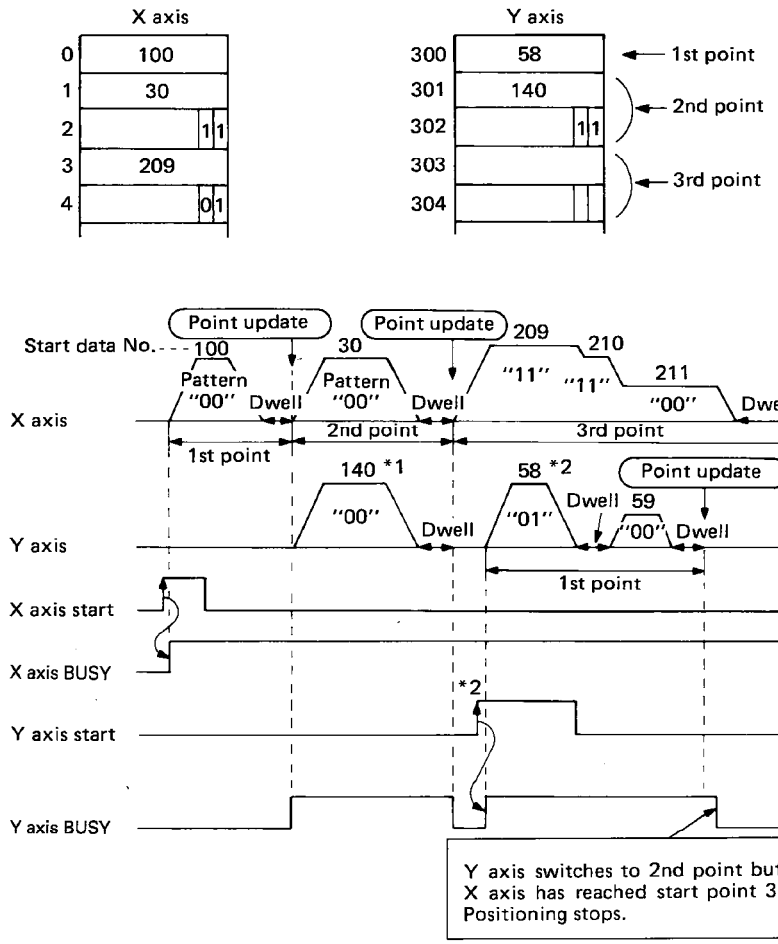


The execution start number remains at its previous value while waiting for the other axis.
The execution start number is updated when the interpolation start or both-axis start is enabled with the positioning point number of the mating axis advances to the positioning point number of the axis in question.

Fig. 2.35 Start Data Example 5

- Processing will stop if one axis proceeds ahead of the other and dual axis processing is called. See Fig. 2.36.

[Example]



*1: Since the second point of the X axis is both-axis start, the second point data No. of the Y axis (No. 140) starts.

*2: After the completion of positioning of the X and Y axes, executed by the both-axis start data, data No. 58 starts in response to the Y axis start instruction during the positioning of the X axis to the third point.

Fig. 2.36 Start Data Example 6

2.5.2 Error reset area (Address 201)

Set "0" to bit 0 of address 201 by a sequence program, the error codes of both axes are cleared and the error detection signal (XB) is turned OFF.
(Bit 0 is automatically reset by OS after the execution of the error reset processing.)

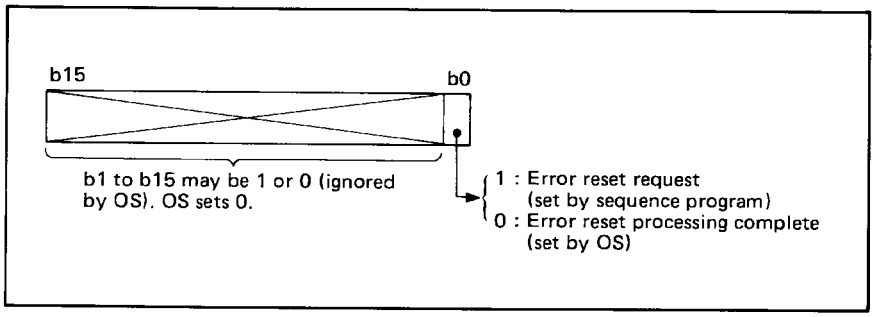


Fig. 2.37 Error Reset Area Details

2.5.3 OS data area (Address 512 to 767)

Addresses 512 to 767 are used by the OS.
This area cannot be used for writing the data by the user.
For the data shown in Fig. 2.38, the user can use them by reading it out with a sequence program, etc.
(For the procedure to read out the data, refer to Section 6.3.2 (page 6-6).)

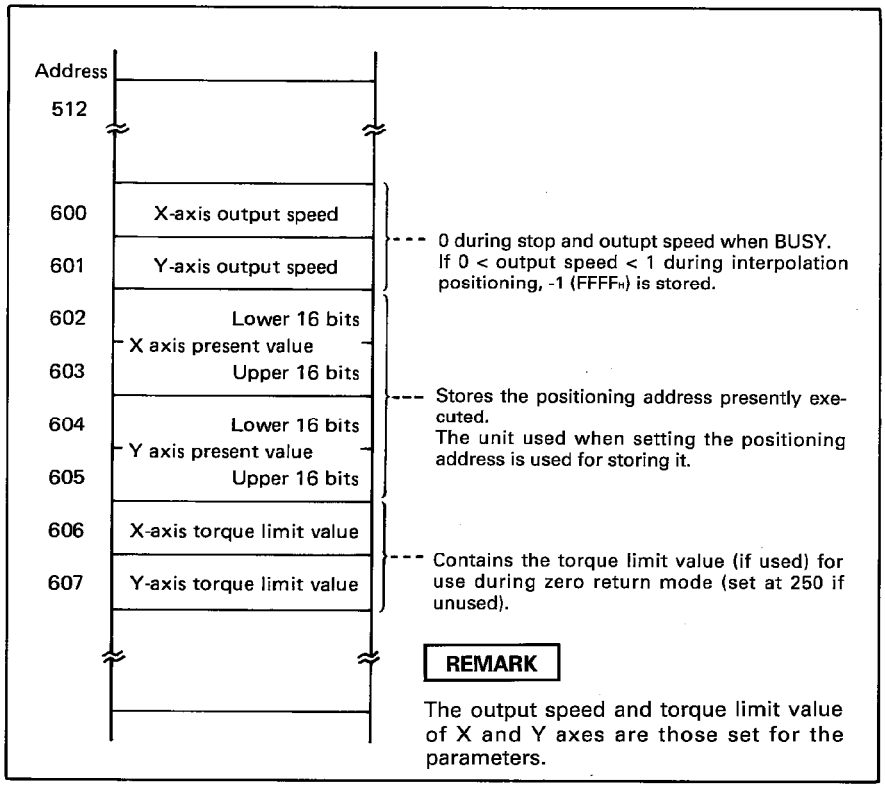


Fig. 2.38 OS Data Area

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

This area stores the positioning data explained in Section 2.4.3. The positioning data consists of positioning information, positioning speed, dwell time, and positioning address as shown in Fig. 2.39. 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)

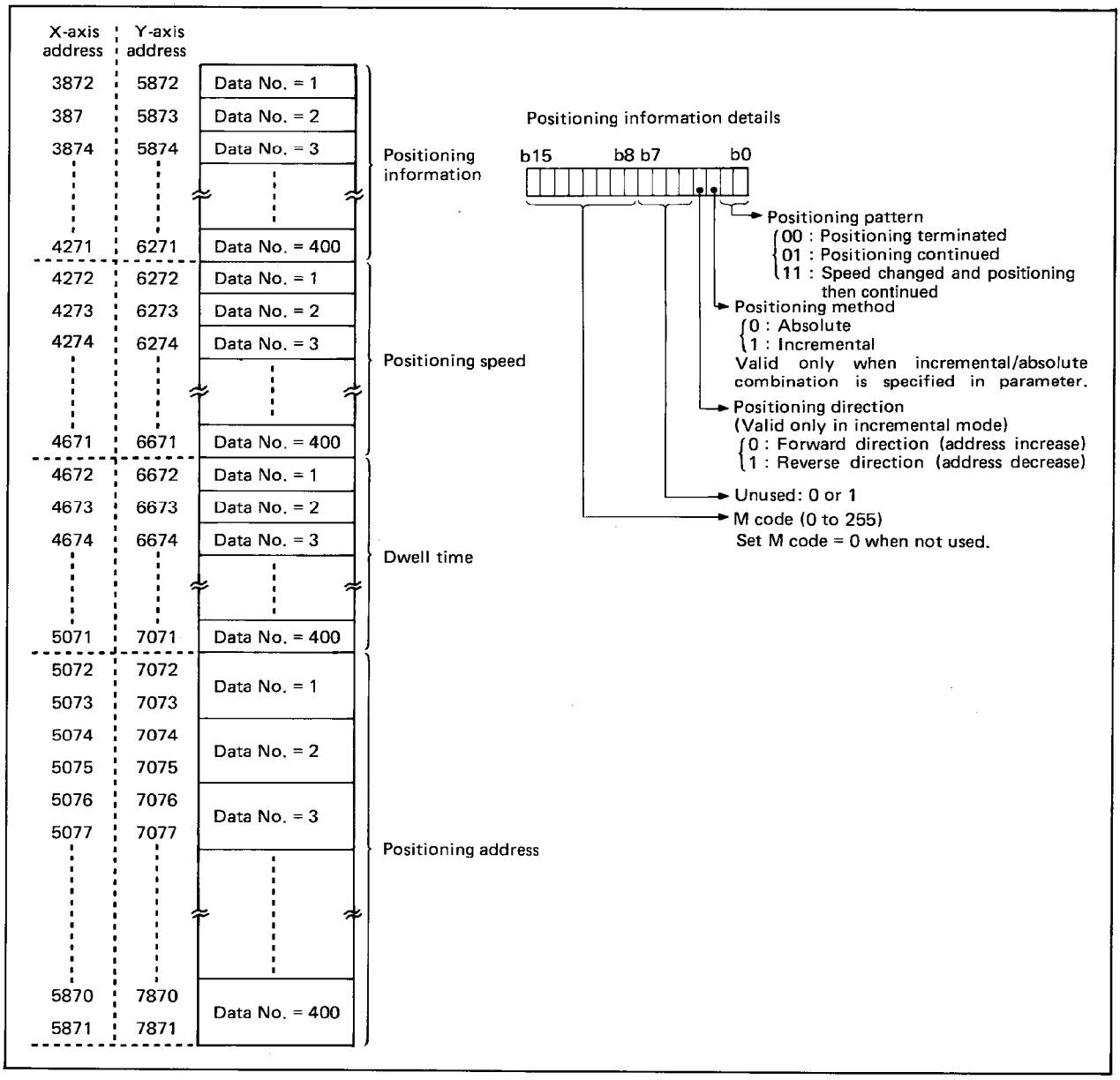


Fig. 2.39 Positioning Data Area

Conversion from data number to buffer memory address
To set the positioning data using a sequence program corresponding to the data No., convert the data No. to the buffer memory address by the following calculation.

Conversion of Data No. 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 $A_1=A_2+1$

REMARK

A conversion table is given in Appendix 5.

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

Stores the parameters described in Section 2.4.1.

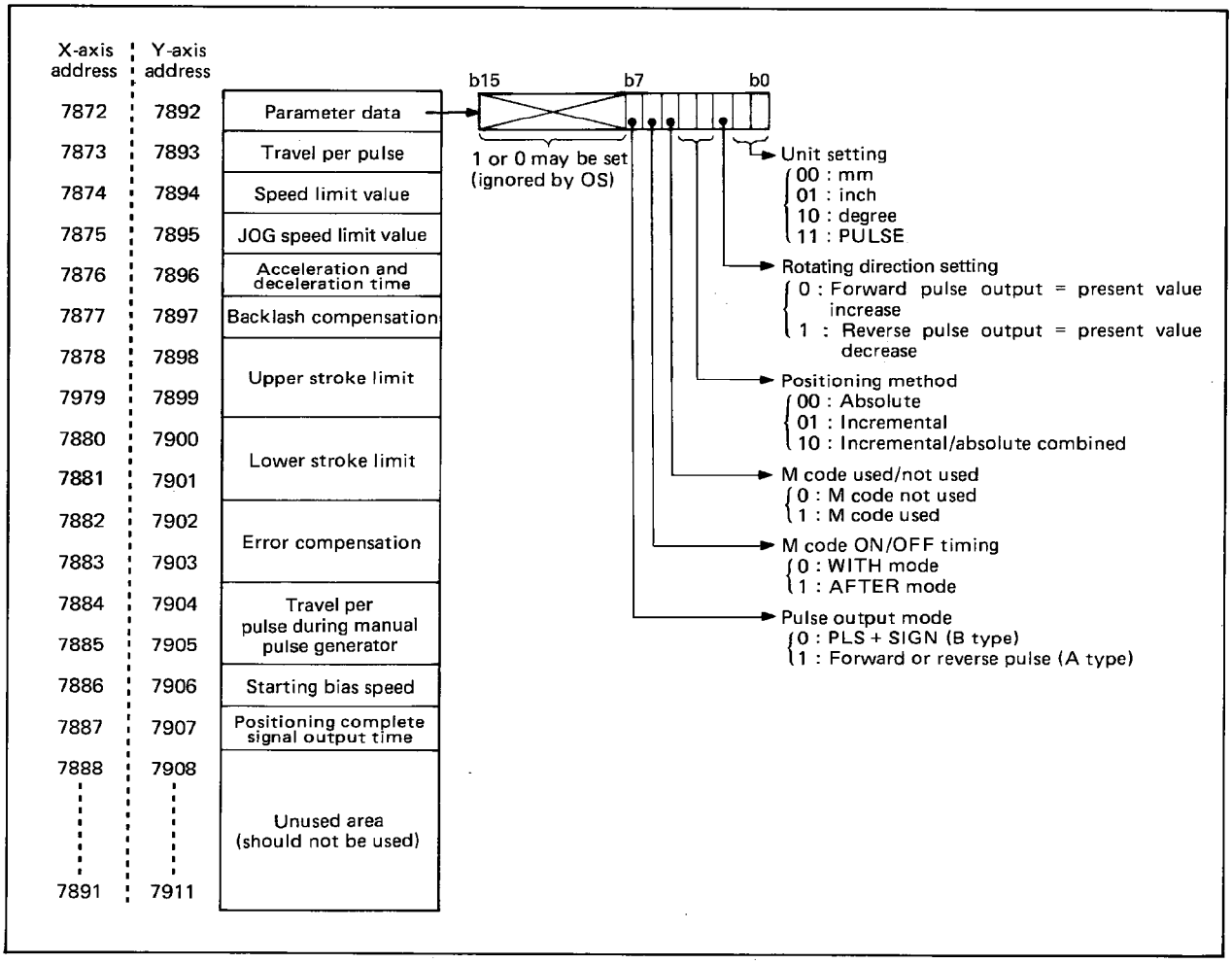


Fig. 2.40 Parameter Area

2.5.6 Zero return data area (X axis: address 7912 to 7918, Y axis: address 7922 to 7928)

Stores zero return data described in Section 2.4.2.

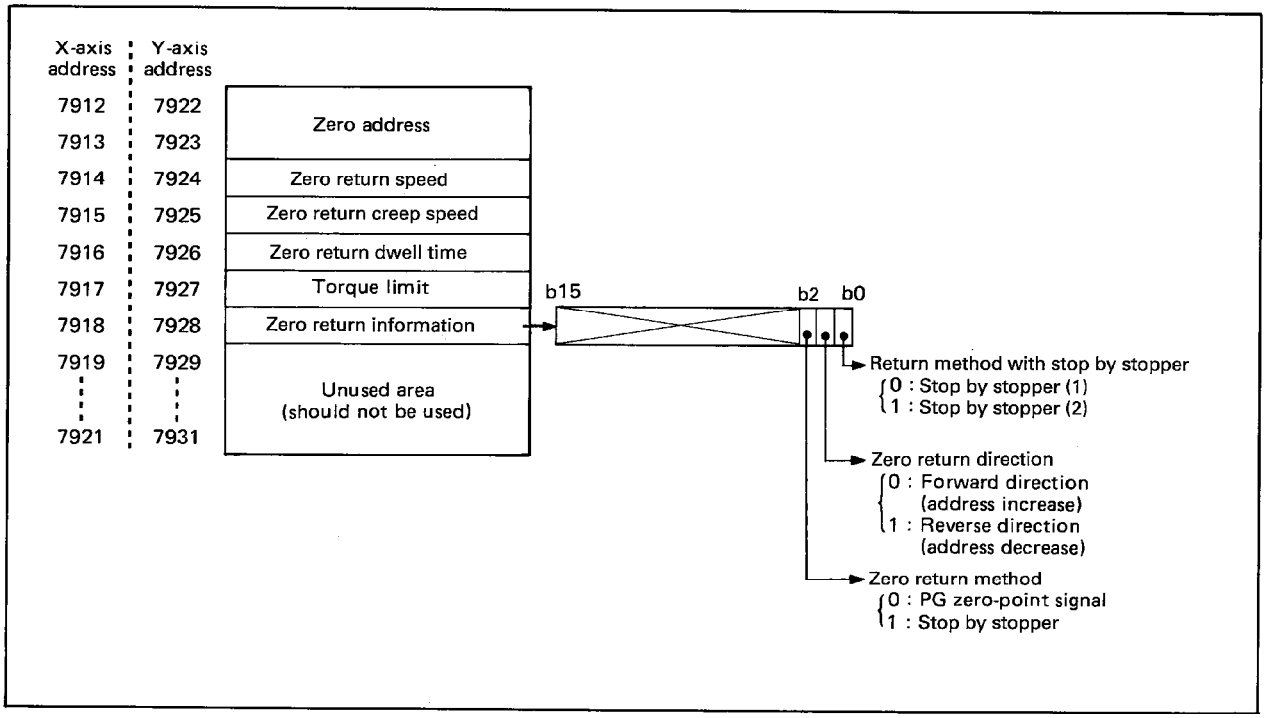


Fig. 2.41 Zero return Data Area

2.6 I/O Signals To and From PC CPU

The D71 uses 16 inputs and 16 outputs for communications with the PC CPU. I/O signal assignment and functions are given below. (64 I/O points are occupied.)
Table 2.9 shows I/O signals with the D71 unit number set to 0. Device X indicates an input signal from the D71 to the PC CPU. Device Y indicates an output signal from the PC CPU to the D71.

Signal Direction: D71 to PC CPU			Signal Direction: PC CPU to D71		
Device No.	Signal		Device No.	Signal	
X0	Watch dog timer error (detected by D71)		Y10	X axis	Positioning start
X1	D71 ready		Y11	Y axis	
X2	X axis	Positioning complete	Y12	Inter-polation	
X3	Y axis		Y13	X axis	Zero return start
X4	X axis	BUSY	Y14	Y axis	
X5	Y axis		Y15	X axis	Stop
X6	X axis	Zero return request	Y16	Y axis	
X7	Y axis		Y17	X axis	Forward JOG start
X8	X axis	Positioning start complete	Y18	X axis	Reverse JOG start
X9	Y axis		Y19	Y axis	Forward JOG start
XA	Battery error		Y1A	Y axis	Reverse JOG start
XB	Error detection		Y1B	X axis	M code OFF
XC	X axis	Zero return complete	Y1C	Y axis	
XD	Y axis		Y1D	PC ready	
XE	X axis	M code ON	Y1E	} Used by the system Not released for the user	
XF	Y axis		Y1F		

Table 2.9 I/O Signal List

IMPORTANT

- **Since Y1E and Y1F, and Y (Y0 to YF) assigned the same number as X shown in Table 2.9 are used by the system, the user is not allowed to use them.**
  If Y1E and/or Y1F is used by a sequence program, correct operation of the D71 is not guaranteed. Note that it is necessary to turn OFF YD to YF by a user program only when the D71 is installed in a remote I/O station. For details, refer to Section 6.4 (page 6-46).

- **Y20 to Y3F may be used as internal memories (M).**

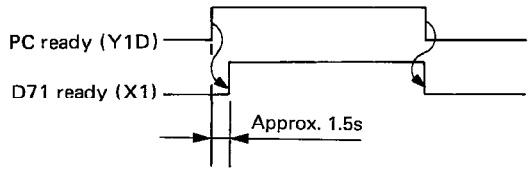
I/O signal details
The following gives details of the ON/OFF timing, conditions, etc. of the I/O signals. Device numbers in ( ) correspond to the device No. indicated in Table 2.9.

(1) Watch dog timer error (X0)

Switches on when the D71 self-diagnostics detect a watch dog timer error.

(2) D71 ready (X1)

The D71 read signal (X1) is turned ON and OFF according to turning ON and OFF of the PC ready signal (Y1D). Used for interlocking, etc. in the sequence program.



(3) Positioning complete (X2, X3)

Switches on for a period set in the parameters after each position is reached. (Ignored if the positioning complete signal output time = 0.)
Switched off at positioning start, zero return start, manual pulse generator mode start, JOG start, and power on.
If positioning is stopped midway, the positioning complete signal does not switch on.

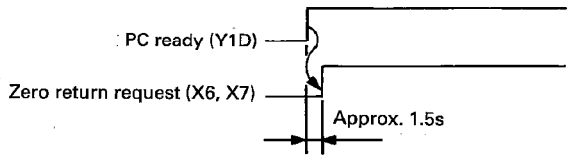
(4) BUSY (X4, X5)

Switches on at positioning start, zero return start, manual pulse generator mode start, and JOG start. Switches off after pulse output and dwell time have elapsed. (Remains on during positioning.)
Switches on while the test operation is being used on the A6GPP.

(5) Zero return request (X6, X7)

Switches on under the following conditions. Switches off upon completion of zero return.

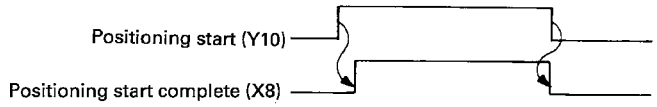
D71 power is switched on;
Drive unit ready signal ($\overline{\text{READY}}$) has turned off in BUSY state; PC ready signal (Y1D) has turned on;



Parameters and/or zero return data has been written from the A6GPP; zero return is started; or
1) zero return, 2) positioning, 3) JOG operation, or 4) manual pulse generator has been selected in A6GPP test mode.

(6) Positioning start complete (X8, X9)

Switches on to confirm that the D71 has started the specified operation. Switches off when the start signal turns off.



Does not switch on in A6GPP test mode.

(7) Battery error (XA)

Switches on when battery voltage drops.

(8) Error detection (XB)

Switched on by any of the errors in Chapter 8. Switched off when the error is reset. For resetting, refer to Section 2.5.2 (page 2-46).

(9) Zero return complete (XC, XD)

Switches on to indicate the completion of zero return. Switched off at the start of the JOG, positioning and manual pulse generator mode.

(10) M code ON (XE, XF)

In the WITH mode, this signal is turned ON at the start of positioning and in the AFTER mode, it is turned OFF at the completion of positioning.
The "M code ON" signal is turned OFF when the "M code ON" signal is turned OFF.
The "M code ON" signal stays OFF if no M code is specified (M code = 0). It also stays OFF during the execution of a test using the A6GPP.

REMARK

An M code means a code number (1 to 255) assigned by the user to execute miscellaneous functions (clamp/unclamp, start/stop of drill, tool change, etc.) after the completion of position control by the D71.
The corresponding operation can be executed by creating the program to turn ON/OFF the relay circuit at the PC CPU.

(11) Positioning start (Y10, Y11, Y12)

These are positioning start signals and the leading edge of the signal triggers positioning.

(12) Zeroing start (Y13, Y14)

These are zero return signals and the leading edge of the signal triggers zero return operation.

(13) Stop (Y15, Y16)

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.

(14) JOG start (Y17 to Y1A)

JOG operation is executed while the signal is ON. When it goes OFF, axis travel automatically decelerates and stops.

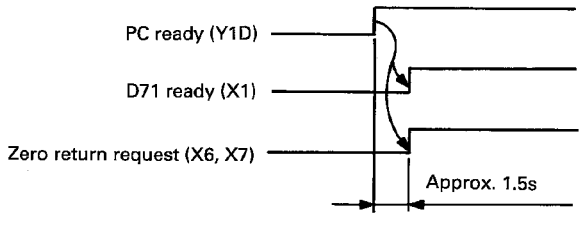
(15) M code OFF (Y1B, Y1C)

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

(16) PC ready (Y1D)

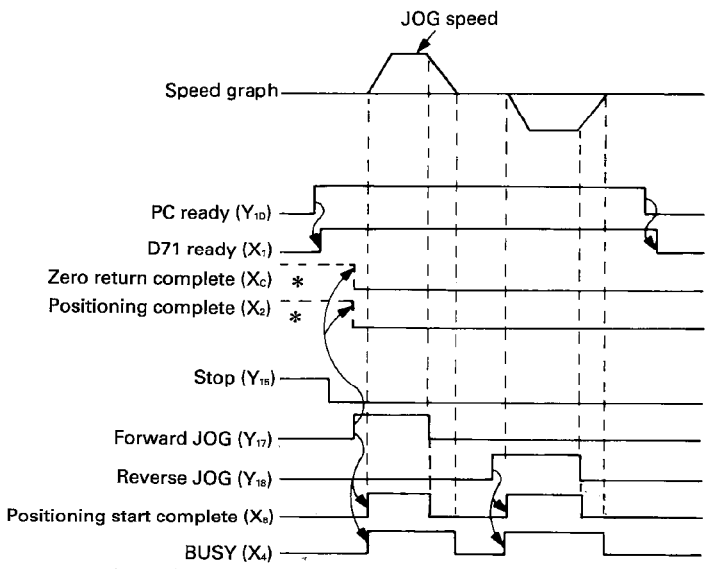
The signal notifies the D71 the normal state of the PC CPU and the signal must be ON at the start of positioning, zero return, and JOG operation in other than the test mode using the A6GPP.
The following control actions occur when the PC ready signal switches from off to on. (The leading edge of the PC ready signal is disregarded if even one axis is in the BUSY state due to the execution of the test using the A6GPP.)

1) Parameter check and initialization;
2) Zero return data check; and
3) Zero return request ON, D71 ready signal ON

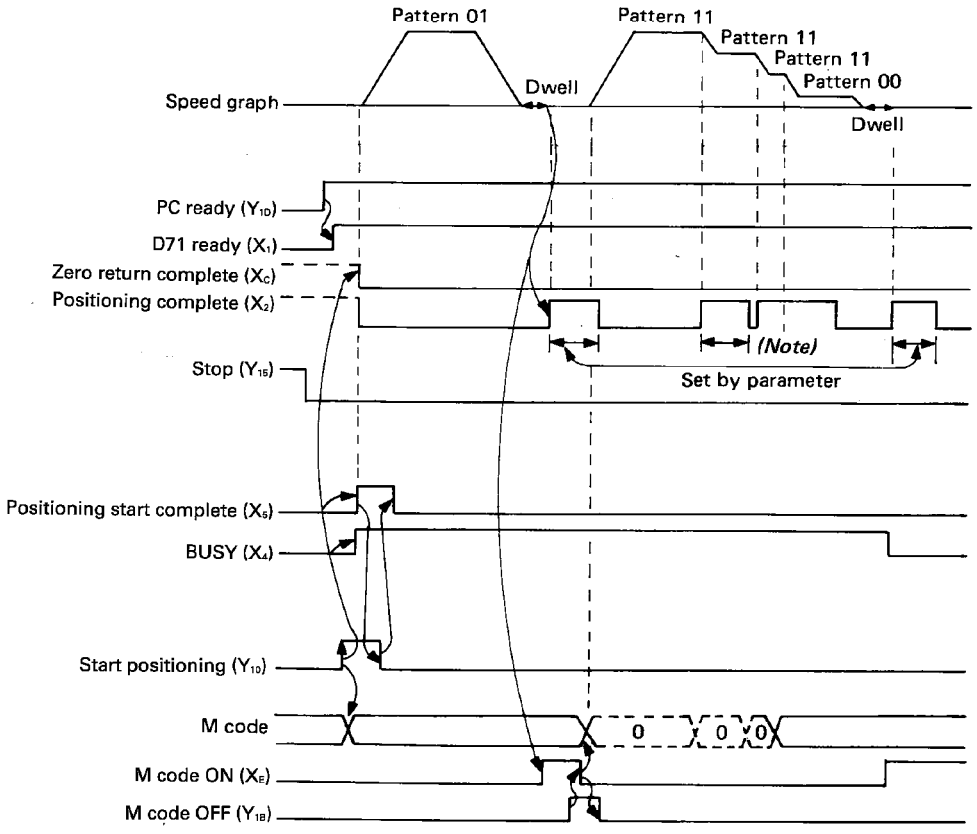


Switching the PC ready signal off while the D71 is BUSY causes positioning to stop, and the "M code ON" signal to be disabled as well as the M code to be cleared. (The processing is executed when neither of the axes is in the BUSY state.)

JOG operation



Positioning operation

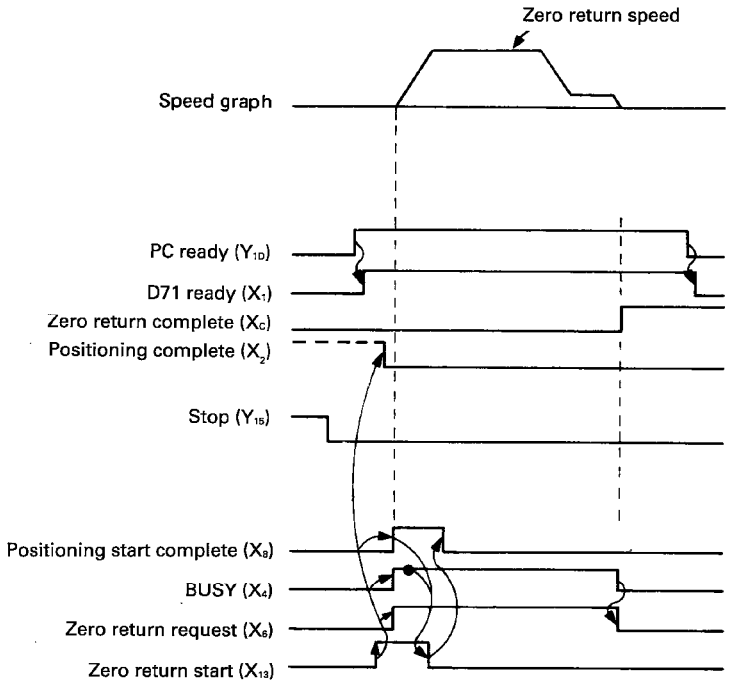


POINT

If positioning operation is shorter than the positioning complete signal output time in the parameter, the positioning complete signal may be output continuously.

*** : If the signal marked with (*) is already ON when the positioning start signal is turned ON, the signal marked with (*) is turned OFF when the positioning start signal is turned ON.**

Zero return



Manual pulse generator operation

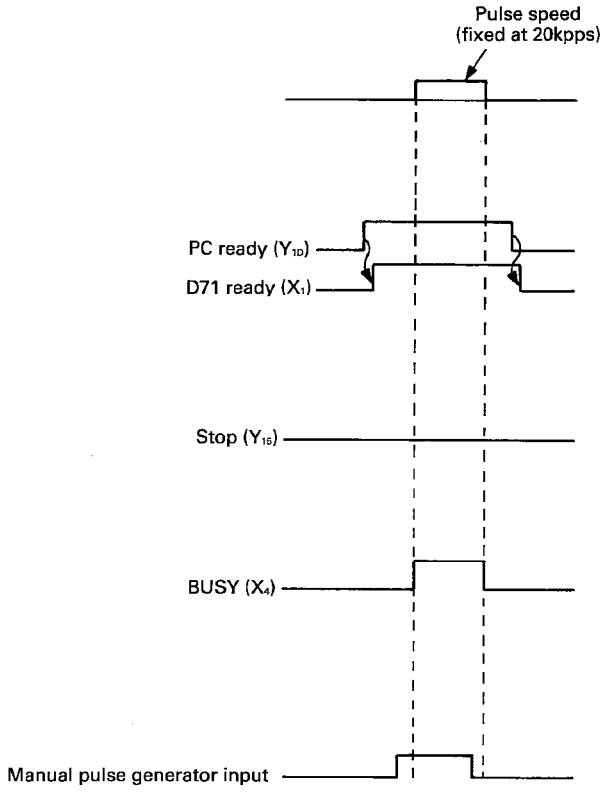


Fig. 2.42 I/O Signal ON/OFF Timing

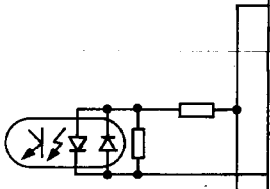
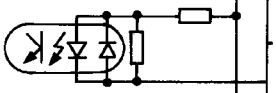
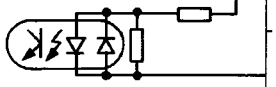
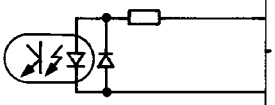
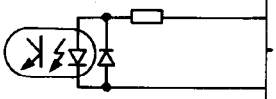
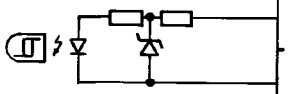
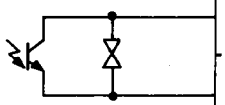
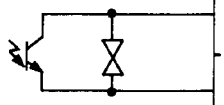
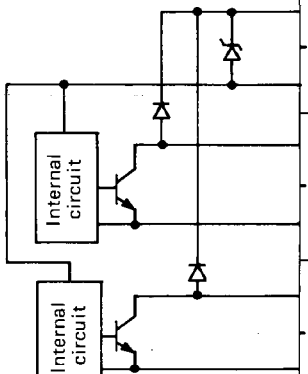
2.7 I/O Interface with External Equipment

2.7.1 D71 electrical specifications

I/O	Signal	Description
Input	Supply power	5 to 24 VDC (Prepare a 4.75 to 26.4 V stabilized power supply.) 50 mA (maximum)
	Drive unit ready (READY) Stop signal (STOP) Near-point dog signal (DOG)	High : (Supply power voltage – 1 V) or more (Input current: 0.3 mA or less) Low : (Supply power voltage – 3 V) or less (Input current: 2.5 mA or more)
	Manual pulse generator A phase (PULSER A) Manual pulse generator B phase (PULSER B)	High : 4.5 V or more, 3 mA or more Low : 1.0 V or less, 0 mA Pulse width : 1 ms or more
	Zero phase signal (PGO)	High : (Supply power voltage – 1 V) or more (Input current: 0.3 mA or less) Low : (Supply power voltage – 3 V) or less (Input current: 2.5 mA or more) Pulse width : 50 μs or more Pulse rise time : 3 μs or less Pulse fall time : 3 μs or less
Output	Start signal (START) Error counter clear (CLEAR)	Output form : Open collector Load voltage : 4.75 to 26.4 VDC Load current : 10 mA (maximum)
	Forward feed pulse (PULSE F) Reverse feed pulse (PULSE R)	Output form : Open collector, output duty ratio 50 % ± 10 % Load voltage : 4.75 to 26.4 VDC Load current : 20 mA (maximum) Use within the range 2 to 15 mA. If load current is less than 2 mA, add a load resistor.

Table 2.10 D71 Electrical Specifications

2.7.2 I/O interface electrical details

I/O	Circuit	Pin Number X axis	Pin Number Y axis	Signal	Description
Input		1	1	Power supply (+)	5 to 24 VDC (external supply)
		2	2	Drive unit ready $\overline{\text{READY}}$	(1) Low when the servo drive unit is normal and able to receive the feed pulses. (2) D71 checks the drive unit ready signal prior to start. If not ready, the D71 outputs a zero return request. (3) Arrange for drive unit errors, e.g. control power error to set this signal high. (4) Switching this signal to high during positioning stops the operation. Resetting the signal will not restart operation.
		3	3	Stop signal $\overline{\text{STOP}}$	(1) Low to stop positioning. Signal duration 20 ms or more. (2) Input switches start signal ($\overline{\text{START}}$) off (high). Start signal will not then restart.
		4	4	Near-point dog signal $\overline{\text{DOG}}$	(1) The signal used to detect the near point in zero return operation. The signal is low when the near-point dog is detected. (2) In the zero return operation using the zero-phase signal, the zero point is established at the grid point appearing first after the near-point dog is released.
		14	14	Manual pulse generator A phase $\overline{\text{PULSER A}}$	Refer to Table 2.10.
		15	15		
		16	16	Manual pulse generator B phase $\overline{\text{PULSER B}}$	Refer to Table 2.10.
		17	17		
		8	8	Zero-phase signal $\overline{\text{PGO}}$	(1) The zero-phase signal is used as the zero point signal for zero return operation. Generally, the zero-phase grid signal of a pulse encoder is used. The signal is low at the zero-phase. (2) For the zero return operation that uses a stopper with the zero return complete signal input externally, this signal is used.first after the near-point dog is released.
		9	9		
Output		10	10	Start $\overline{\text{START}}$	(1) Low while positioning. (2) On (low) during feed pulse output and dwell. This signal can be used as the brake release signal for the servomotor equipped with a mechanical brake. However, the circuit should usually be configured externally so that the mechanical brake operates when the servo system power is switched OFF, the servo motor is switched OFF, or at the occurrence of an alarm. Feed pulse output after this signal turns on.
		11	11		
		12	12	Error counter clear $\overline{\text{CLEAR}}$	The signal is output two times at the start of zero point return - before output of feed pulses and after the stop of feed pulse output - to reset the droop pulses in the deviation counter of the servo unit. $\overline{\text{CLEAR}}$ 20 ms (1st time) 20 ms (2nd time) Before feed pulse output After feed pulse output
		13	13		
		5	5	(+) 24 V power (+) 5 to 15 V power	5 to 24 VDC (external supply) 18 for 5 to 15 VDC 5A for 24 VDC
		18	18		
		6	6	A type: Forward feed pulse $\overline{\text{PULSE F}}$ / B type: Feed pulse $\overline{\text{PULSE}}$	Forward and reverse feed pulses The direction of operation is judged from the direction sign ($\overline{\text{SIGN}}$). B type: $\overline{\text{PULSE}}$, $\overline{\text{SIGN}}$; 25 ms; + direction travel — direction travel A type: $\overline{\text{PULSE F}}$, $\overline{\text{PULSE R}}$
		7	7		
		19	19	A type: Reverse feed pulse $\overline{\text{PULSE R}}$ / B type: Direction sign $\overline{\text{SIGN}}$	
		20	20		

Select A or B type by parameter setting. (For details, refer to Section 2.4.1.)

Table 2.11 D71 I/O Interface

2.8 Battery Specifications

Item \ Type	A6BAT
Nominal voltage	3.6 VDC
Guarantee period	5 years
Total power failure time	300 days (7200 hours)
Application	Power failure back-up for buffer memory
Size mm (inch)	ϕ 16 (0.62) x 30 (1.17)

Table 2.13 Battery Specifications

3. SPECIFICATIONS

This section describes the general specifications, functions, setting data, buffer memory, and input/output interface of the D71.

3.1 General Specifications

<table>
<tr><th>Item</th><th colspan="5">Specifications</th></tr>
<tr><td>Operating ambient temperature</td><td colspan="5">0 to 55 °C</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="5">-20 to 75 °C</td></tr>
<tr><td>Operating ambient humidity</td><td colspan="5">10 to 90 %RH, non-condensing</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="5">10 to 90 %RH, non-condensing</td></tr>
<tr><td rowspan="3">Vibration resistance</td><td rowspan="3">Conforms to *JIS C 0911</td><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Sweep Count</td></tr>
<tr><td>10 to 55 Hz</td><td>–</td><td>0.075 mm (0.003 inch)</td><td rowspan="2">10 times ** (1 octave / minute)</td></tr>
<tr><td>55 to 150 Hz</td><td>1 g</td><td>–</td></tr>
<tr><td>Shock resistance</td><td colspan="5">Conforms to JIS C 0912 (10 g x 3 times in 3 directions)</td></tr>
<tr><td>Noise durability</td><td colspan="5">By noise simulator of 1500 Vpp noise voltage,
1 μs noise width and 25 to 60 Hz noise frequency</td></tr>
<tr><td>Dielectric withstand voltage</td><td colspan="5">500 VAC for 1 minute across DC external terminals and ground</td></tr>
<tr><td>Insulation resistance</td><td colspan="5">5 MΩ or larger by 500 VDC insulation resistance tester across
AC external terminals and ground</td></tr>
<tr><td>Operating ambience</td><td colspan="5">Free of corrosive gases. Dust should be minimal.</td></tr>
<tr><td>Cooling method</td><td colspan="5">Self-cooling</td></tr>
</table>

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 10 Hz to 20 Hz, from 20 Hz to 40 Hz, from 40 Hz to 20 Hz, and 20 Hz to 10 Hz are referred to as one octave.

* JIS : Japanese Industrial Standard

3.2 Performance Specifications and Functions

3.2.1 D71 performance specifications

Item		Performances and Specifications
Number of I/O points		64
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, AD71TU 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 command	1 to 16,252,928 (PULSE) Max. 162 (m) (command unit: 0.1 to 10 μm/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)
	Speed command	10 to 200000 (PLS/s) (command unit: 10 PLS/s) 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 (ms)
	Backlash compensation	0 to 65535 x position command unit (0 to 255 pulses if unit is PULSE)
	Error compensation	The AD71 may be "calibrated" to allow for mechanical errors.
Zero return function		With zero address change function. Zero return direction and speed depend on setting.
Jog operation function		JOG operation by JOG start signal input.
Manual pulse generator operation function		Operation using manual pulse generator.
M function		M code output
Internal current consumption		5 VDC, 0.65 A
External supply voltage, current		4.75 to 26.4 V, max. 50 mA
Size mm (in.)		41 (1.6) [H] x 132 (5.15) [W] x 250 (9.75) [D]
Weight kg (lb)		0.75 (1.65)

Table 3.2 Performance Specifications

3.2.2 Functions

The D71 has the two-axis control function; it drives two axes either independently or in the coordinated control mode (linear interpolation positioning mode). It also provides the functions related to the positioning function.
The following two methods are provided to realize these functions:

- Test operation by A6GPP or teaching unit ..... By connecting the A6GPP or AD71TU to the D71, positioning is executed by the operation of the A6GPP or AD71TU. This operation is used for checking a program or for performing test operation.
- Sequence program ..... Positioning is executed by the program of the PC CPU.

For the operation by test run of the A6GPP, refer to the SW0GP-AD71P Operating Manual.
For use of the AD71TU, refer to the AD71TU Operating Manual.
Positioning control functions are shown below.

Function	Sequence Program or A6GPP (Test Operation)	
	Two-axis Independent Operation	Two-axis Interpolation Operation
Error detection	An error coad is provided by OS of the D71 if a data setting or positioning control error occurs. (For details of the error codes, refer to Chapter 8.) *OS stands for Operating System.	
Set data read and write	D71 set data (parameters, zero return data, positioning data) can be read and written.	
Present value and speed read	Present value data and speed data can be read from the D71. (Present value can be read and monitored during positioning.)	
Teaching (positioning data write)	After executing positioning in JOG or other mode operation, the present value can be written as the positioning data. (In the linear interpolation mode, the data is written for each axis)	

The positioning functions provided by the D71 are shown in Table 3.3.

Function		Sequence Program or A6GPP or AD71TU (Test Operation)	
		Two-axis Independent Operation	Two-axis Interpolation Operation
Manual pulse generator operation		The pulses generated by the operation of the manual pulse generator are input to the D71 and positioning is executed according to the number of input pulses.	Unavailable
Jog operation		Jog operation is executed while the jog operation instruction given from the PC CPU or A6GPP stays ON.	Unavailable
Zero return		Zero return is executed when the zero return start instruction is given from the PC CPU or A6GPP. On completion of zero return, the present value is corrected to the value stored at the zero point address.	Unavailable
Posi-tioning	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 the speed the two axes reach the set position simultaneously. (Linear interpolation)
	Continuous positioning	Moves consecutively to a series of positions after receiving a single start signal.	Positioning is executed continuously in the interpolation mode in the same manner as in the two-axis independent operation.
	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

POINTS

(1) Error compensation and backlash compensation functions are valid for all the functions shown in Table 3.3

(2) When executing positioning by a sequence program, it is possible to output a preset M code from the D71 to the PC CPU at the start or completion of positioning. Note that this output is not possible in positioning operation using the A6GPP.

(3) The D71 present value can be re-written before positioning is started using the sequence program or A6GPP.

(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 System Configuration

The following describes the outline of the D71 operation and the positioning system.

3.3.1 Positioning System Using D71

The following explains the operation of the positioning system configured using the D71 using Fig. 3.1.

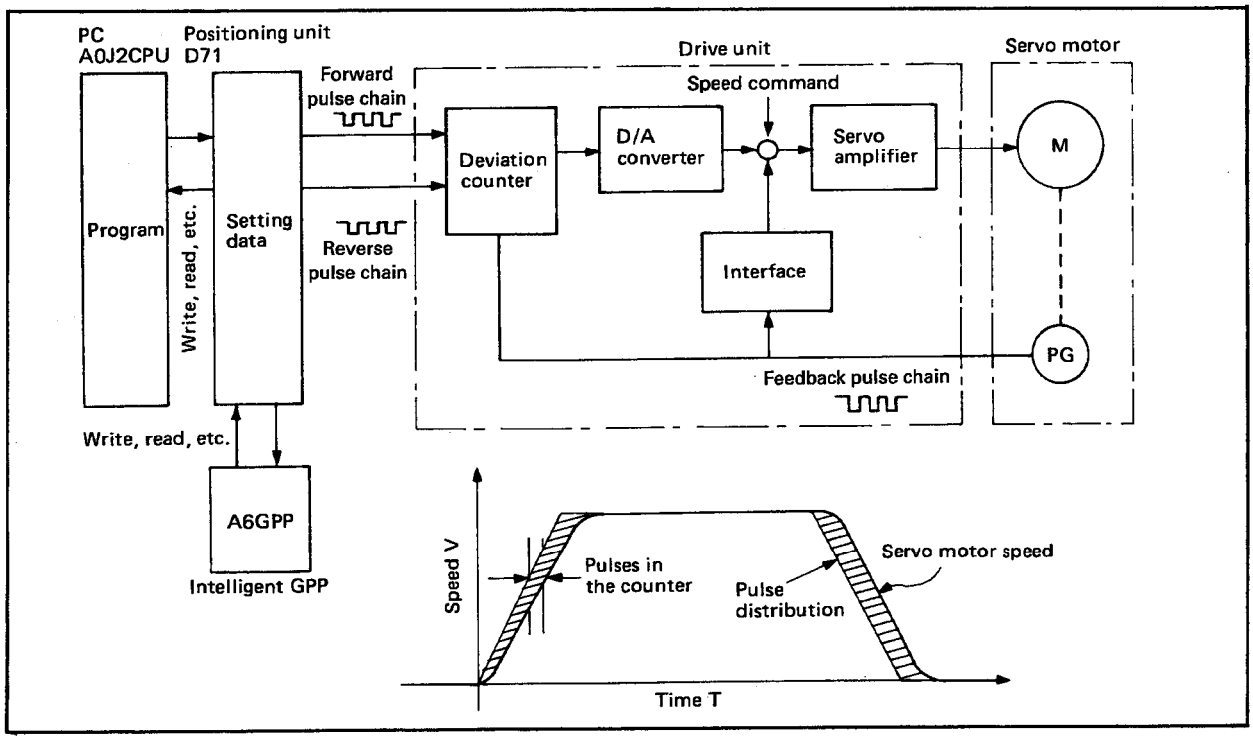


Fig. 3.1 Positioning System Block Diagram

Output of the D71 is pulse chain.

As the pulse chain is output from the D71, pulses are accumulated in the deviation counter and accumulated pulses are converted into the DC analog voltage, which is used as the speed command, by the D/A converter. The motor starts rotating in response to the speed command given from the drive unit and as the motor starts rotating the pulse generator PG generates feedback pulses in proportion to the number of motor rotations to deduct the accumulated pulses in the deviation counter.

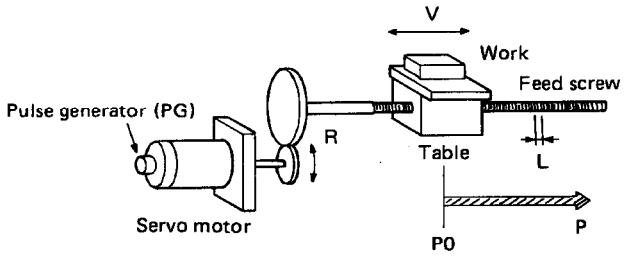
The motor keeps rotating with a certain number of droop pulses remained in the deviation counter.

When the D71 stops outputting the command pulses, the droop pulses in the deviation counter decreases causing the motor speed to lower, and the motor stops rotating when the droop pulses in the deviation counter is zeroed.

Motor rotation is controlled by the pulse chain output from the D71 in the following manner: motor speed is controlled in proportion to the frequency of the command pulses and motor rotation angle in proportion to the number of output command pulses.

Therefore, an axis can be moved by the required distance in proportion to the number of pulses in the pulse chain by predetermining the axis travel distance per pulse. The pulse output frequency determines 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 : Moving part 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 value

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

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, the D71 calculates and outputs the necessary pulse chain in reference to the positioning target address and positioning is executed according to the output pulse chain by setting the amount of distance to be moved (travel distance) by one pulse, acceleration/deceleration time, positioning speed, positioning address, etc.

3.3.2 D71 interfaces

Fig. 3.2 indicates the signal communications between the D71 and external devices.

- Communication between PC CPU and D71

  The D71 is connected to the PC CPU by the I/O cable for sending/receiving the control signals and data.

  Control signals. . . . I/O signals given in Section 3.6
  Data . . . . . .Written to and read from the buffer memory by the PC CPU. Detailed in Section 3.4

- Communication between A6GPP (or AD71TU) and D71

  Data write, D71 test, D71 monitor, etc. via the D71's RS422 connector.

- Communications between drive unit and D71

  Control signal communication to and from the drive unit and pulse chain output from the D71. (For the I/O interface, refer to Section 3.7

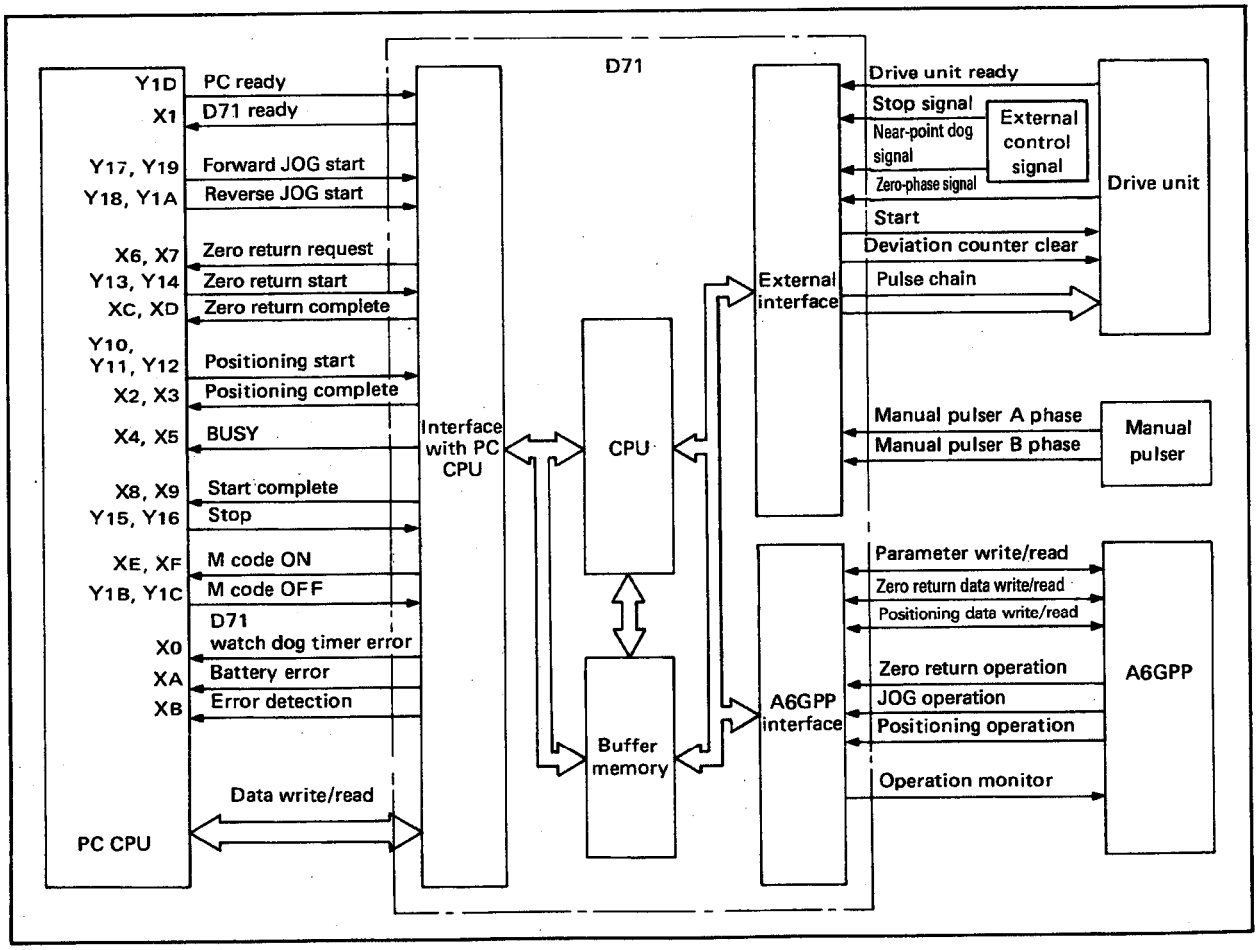
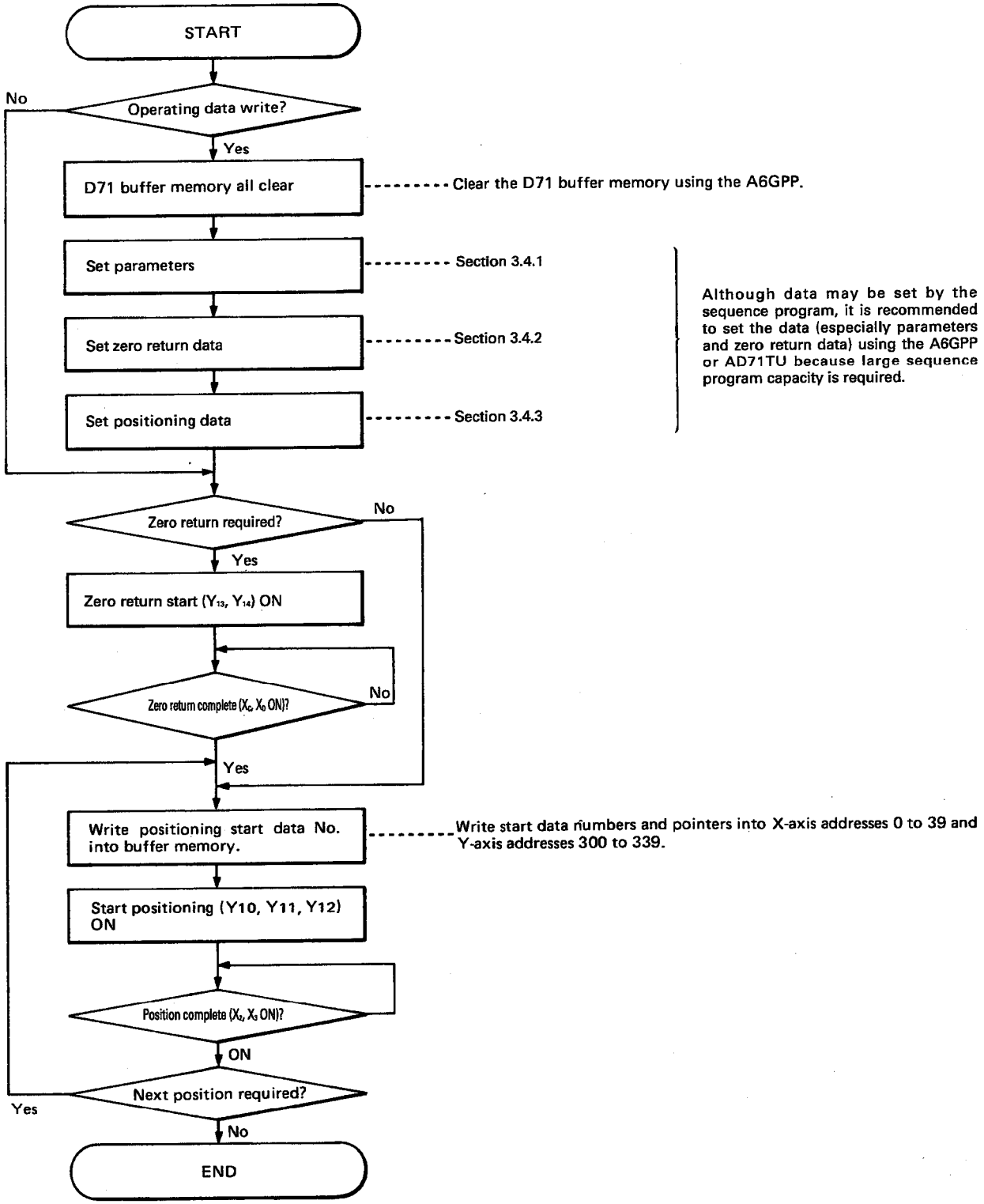


Fig. 3.2 D71 Function Block Diagram

3.3.3 D71 operation

Fig. 3.2 PC initiated positioning procedure



POINTS

(1) For zero return start and positioning start conditions, refer to Chapter 7.

(2) Table 3.4 shows the data related to the control signals (positioning function) output from the PC CPU.

Data \ Function		Manual Pulse Generator Operation	JOG Operation	Zero Return	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 1 pulse during manual pulse generator	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
Zero return data	Zero return direction	O	O	O	O
	Zero return method			O	
	Zero return address	O	O	O	O
	Zero return speed			O	
	Zero return creep speed			O	
	Zero return 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		
	Manual pulse generator operation enable	O			

Table 3.4 Relation between Data and Positioning Functions

* Indicates functions used to change the speed when the D71 is BUSY.

3.4 Format and Functions of Operating Data

Setting data is data that is necessary for an A0J2-D71 to do positioning control.
Setting data is the general term for the following three kinds of data:

Setting data
- Parameter
- Zero return data
- Positioning data

Setting data is written using the following two methods:

1) By a peripheral device or AD71TU
2) By a sequence program

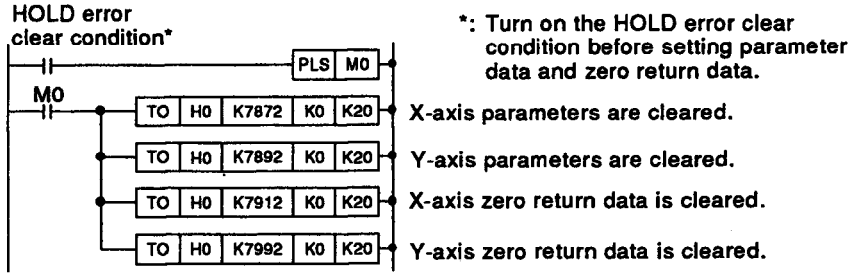
It is necessary to set data for two (X and Y) axes.

POINTS

(1) All-clear data
Before writing setting data, use a peripheral device to do all clear processing of the memory.

A HOLD error (error No. 51) may occur when the power supply is turned on without executing all clear processing.

The following figure shows an example of a sequence program which clears parameters and the zero return data area.



(2) Data setting when using either the X or Y axis
When using either the X or Y axis, write parameter and zero return data to the axis not used.

> Writing data must be a value in the setting range given in the User's Manual. However, even if an initial value (default value) is set by a parameter, there is no problem.

If zero return is done without writing data, an error occurs, and the error detection signal (X0B) goes ON.

(3) Initialization of parameters

If all parameters are not set or an error outside the setting range is detected by parameter checking, the A0J2-D71 will be controlled using the initial values shown in Table 3.5.
However, parameter area data remains as user-set values.

3.4.1 Parameters

Parameters are the basic data which enable the D71 to do positioning control. The data in Table 3.5 is contained in parameters.

Parameters are checked when:

1) The power is turned ON;
2) Parameters are sent from a peripheral device to an D71;
3) A PC CPU ready signal from the PC CPU to the D71 switches from OFF to ON;
4) (1) zero return, (2) positioning, (3) jog operation, or (4) inching has been selected in the peripheral device test mode.

However, error code and error detection signals are not given for 1) above (power ON parameter check).

No.	Item	mm		inch		degree		PULSE(PLS)		Initial 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/s	20000	$\times 10^{1}$ PLS/s
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/s	2000	$\times 10^{1}$ PLS/s
5	Starting bias speed	0 to 12000	$\times 10^{1}$ mm/min	0 to 12000	$\times 1$ inch/min	0 to 12000	$\times 1$ degree/min	0 to 20000	$\times 10^{1}$ PLS/s	0	$\times 10^{1}$ PLS/s
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 1 m)	$\times 10^{-1}$ μm	±0 to 100000 (per 100 inch)	$\times 10^{-5}$ inch	±0 to 100000 (per 100 deg)	$\times 10^{-5}$ degree	—	—	0	—
10	Travel per 1 pulse during manual pulse generator	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(ms)								1000	ms
12	Positioning complete signal output time	0 to 20000(ms)								300	ms
13	Pulse output mode	0 : PLS+SIGN(B type) 1 : Forward PLS or reverse PLS(A type)								As previous setting *	—
14	Direction setting	0 : Present value increase when forward pulse is output 1 : Present value increase when reverse pulse is output								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

Among the parameters indicated above, the speed limit value and JOG speed limit value are multiple of 6.1 (PLS/s).
For example, if "speed limit value = 200 (PLS/s)" is set, the value that is a multiple of 6.1 (PLS/s) and closest to 200 (PLS/s) is actually set.

$$\frac{200}{6.1} = 32.78688\cdots\cdots \text{(decimal fraction cut-off)}$$

Thus, actual speed is 6.1 x 32 = 195.2 (PLS/s).

POINTS

(1) No. 2 to No. 12 are set from the sequence program. The D71 automatically multiplies any numerical data received from the sequence program by the relevant factor. For example, if the D71 receives the constant K = 2000 from the sequence program and the units have been defined as mm/min, the speed output to the drive is 20,000 mm/min (i.e. 2000 x 10^1 mm/min).

(2) When No. 11 "Acceleration and deceleration times" is set to 5000ms or more, it must be set from the sequence program. Refer to Section 3.5.5.

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 travel distance per pulse as determined by the mechanics of the system.
- Controls the number of pulses contained in the pulse chain from the D71.

(3) Speed limit value

- Specifies the maximum speed for positioning (or zero return).
- When 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.
- When a new speed is called accidentally 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.
- Set the speed limit value within the range indicated below according to the travel distance per pulse.

$$\frac{V\ (\text{unit/min})}{\{a\ (\text{unit/PLS}\} \times 60} \leq 200{,}000\ (\text{PLS/s})$$

V: Speed limit value (unit/min)
a: Travel distance per pulse (unit/PLS)

Example) If the travel distance is 1 (μm/PLS)

$$\frac{V\ (\text{mm/min})}{\{a\ (\text{mm/pulse}\} \times 60} \leq 200{,}000\ (\text{PLS/s})$$

$$V\ (\text{mm/min}) \leq 200{,}000\ (\text{PLS/s}) \times 0.001\ (\text{mm/PLS}) \times 60$$

$$\underline{V \leq 12{,}000\ (\text{mm/min})}$$

If the travel distance per pulse is 1 (μm/PLS), set the speed limit at a value smaller than 12,000 (mm/min).

(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.
- When 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 7.3.4

(5) Starting bias speed

- A minimum starting speed is required for the smooth operation of some motors (e.g. pulse motors or stepping motors). This may be set as a starting bias speed.
- The starting bias speed is used for positioning, JOG operation, and zero return. See Fig. 3.3.

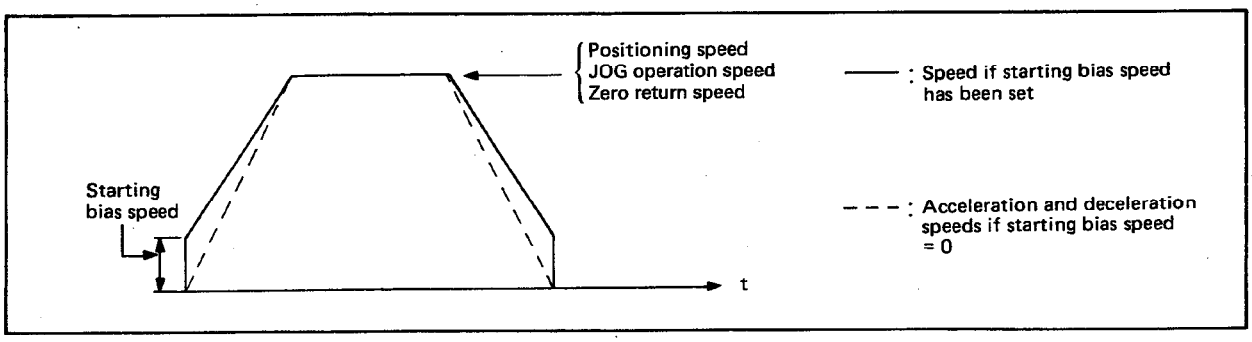


Fig. 3.3 Speed Change When Starting Bias Speed Is Set

For positioning with interpolation between axes, the starting bias speed set for the axis with the shorter distance to travel is ignored; positioning is controlled by the starting bias speed of the other axis with the longer distance to travel.

(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 pulse generator operation, pulse output begins as soon as the number of input pulses exceeds the backlash compensation amount each time the direction of movement changes. (If the number of input pulses is less than the backlash compensation, feed pulses are not generated but the D71 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.
  Note that the backlash compensation feed pulse is therefore generated if the travel is less than the backlash compensation.
- Backlash compensation is valid after zero return. After redefining the backlash compensation, always zero the system.

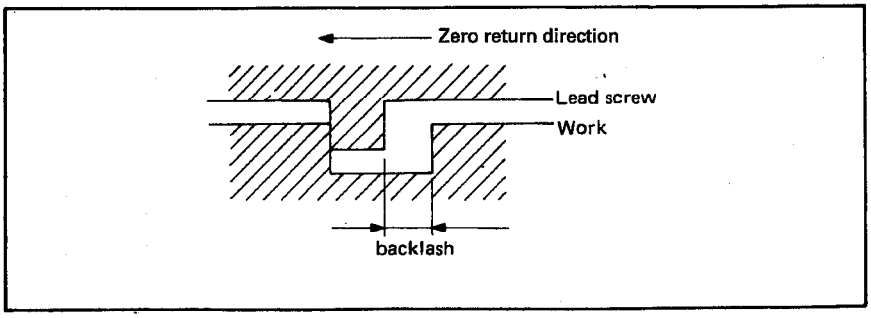


Fig. 3.4 Backlash Compensation

(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 pulse generator operation, 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 pulse generator operation, the stroke limit is ignored.

(9) Error compensation

The processing to compensate for the error between the set travel distance and the distance the axis has actually traveled is called the error compensation. To set the error compensation value, first move an axis by the set distance of travel after setting "0" for the amount of error offset per 1 meter if the unit is "mm" (100 inches if "inch" or 100 degrees if "degree") in automatic start. After completing positioning, measure the distance the axis has actually traveled and calculate the amount of error compensation and backlash compensation using the following formula. Error compensation is valid for manual pulse generator operation, JOG operation, and positioning operation.

- Unit: mm

$$\text{Amount of error compensation } (10^{-1}\ \mu\text{m}) = \left(\frac{\text{Set value (mm)}}{\text{Measured value (mm)}} - 1\right) \times 10^7$$

- Unit: inch

$$\text{Amount of error compensation } (10^{-5}\ \text{inch}) = \left(\frac{\text{Set value (inch)}}{\text{Measured value (inch)}} - 1\right) \times 10^7$$

- Unit: degree

$$\text{Amount of error compensation } (10^{-5}\ \text{degree}) = \left(\frac{\text{Set value (degree)}}{\text{Measured value (degree)}} - 1\right) \times 10^7$$

- If there is mechanical errors, calculate the backlash compensation amount as indicated below to set.

$$\text{Amount of backlash compensation} = \text{Measured amount of backlash compensation} \times \frac{\text{Set value}}{\text{Measured value}}$$

(10) Manual pulse generator travel increment per pulse

- Defines the distance travelled each time a manual pulse generator command is given.
- The D71 counts the number of manual pulse generator commands input and transmits the appropriate number of output pulses. (The speed is fixed at 20000 PLS/s.)
- During manual pulse generator operation 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.)

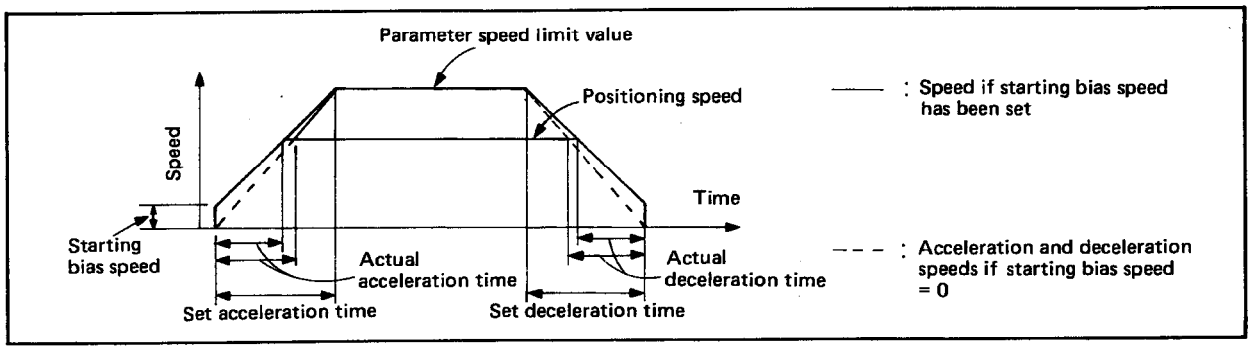


Fig. 3.5 Acceleration and Deceleration Times

- The acceleration and deceleration times cannot be set independently.
- Acceleration and deceleration are controlled at a constant value.
- When the positioning speed is very much lower than the parameter speed limit, the acceleration/deceleration time is comparatively short.
  Therefore, the maximum value of the positioning speed must be equal to or close to the value set for the parameter (speed limit).
- Acceleration/deceleration time is valid for zero return, 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 D71.
Positioning is considered to be complete after the D71 terminates pulse output and the predetermined dwell time has elapsed.

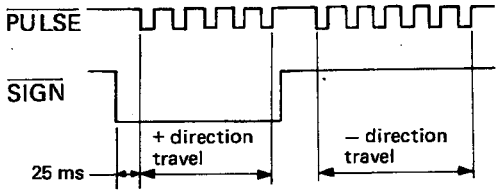
(13) Pulse output mode

Defines the output mode from D71.

- Forward pulse or reverse pulse, two pulse chains.

Forward feed pulse $\overline{\text{PULSE F}}$	$\overline{\text{PULSE F}}$ 	A type
Reverse feed pulse $\overline{\text{PULSE R}}$	$\overline{\text{PULSE R}}$ 	

- PLS + SIGN

Feed pulse $\overline{\text{PULSE}}$	Forward and reverse feed pulses. Travel direction is controlled by direction sign ($\overline{\text{SIGN}}$). 	B type
Direction sign $\overline{\text{SIGN}}$	Low in forward direction. High in reverse direction. (Present value increases in forward direction and decreases in reverse.)	

(14) Direction setting

Selects the direction for which the present value increases. (Set 0 when using forward pulse output. Set 1 when using reverse pulse output.)

(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.)

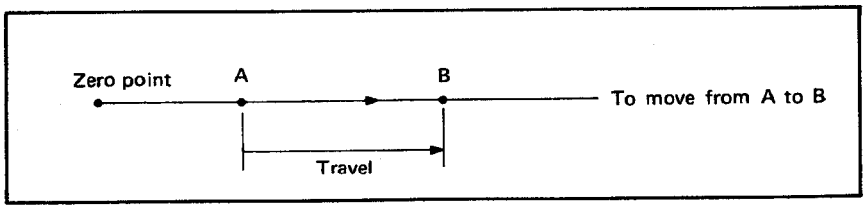


Fig. 3.6 Incremental Method

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

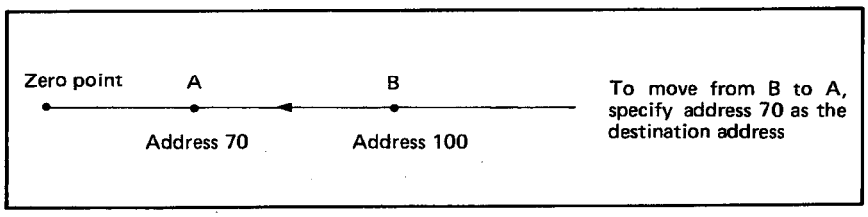


Fig. 3.7 Absolute Method

- 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)

(16) M code ON/OFF timing

An M code means a code number (1 to 255) assigned by the user to execute miscellaneous functions (clamp/unclamp, start/stop of drill, tool change, etc.) after the completion of position control by the D71. The corresponding operation can be executed by creating the program to turn ON/OFF the relay circuit at the PC CPU.

- 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 A6GPP 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 preset M code data is stored to the buffer memory before starting positioning operation.
  The "M code ON" signal is given at approximately the same time as the positioning operation starts.

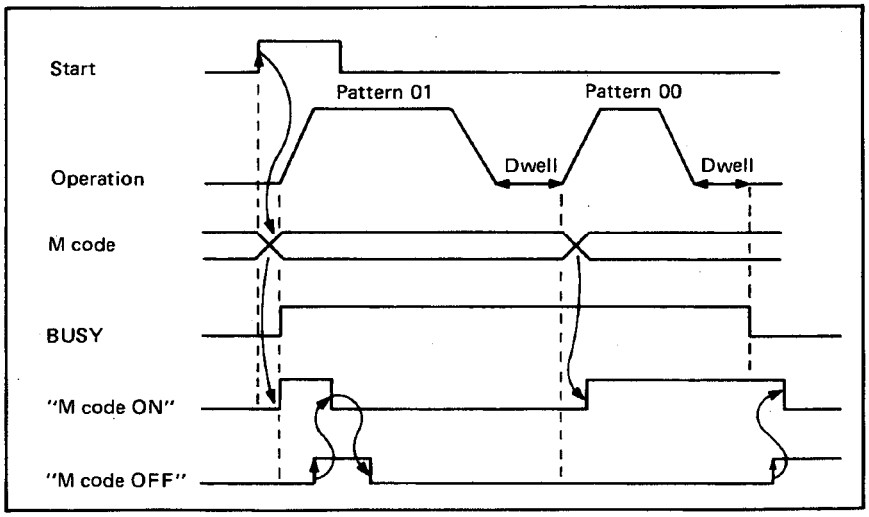


Fig. 3.8 WITH Mode Signal Timing

- AFTER mode
  The preset M code data is stored to the buffer memory before starting positioning operation.
  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 coad ON" signal is not given.

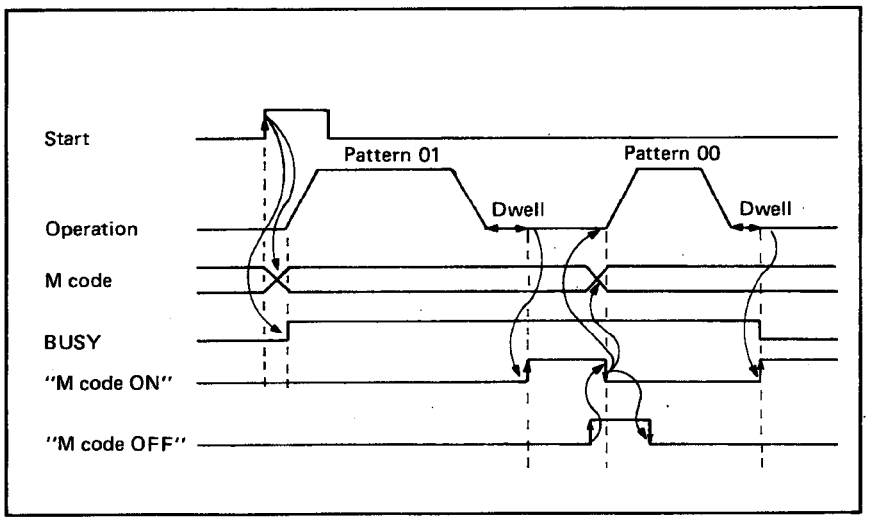


Fig. 3.9 AFTER Mode Signal Timing

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" (speed changed and positioning then continued) and the "M code ON" signal is not given. (For details of the positioning pattern, refer to Section 3.4.3.)**
- **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 (Y1D) is off; or**
  3. **Zero return, positioning, JOG operation, or manual pulse generator mode is selected in the A6GPP test mode.**

In the positioning processing that begins with pattern 11 (positioning is continued after changing the speed), the M code ON signal is turned ON at the following timing depending on the positioning processing of pattern 00 (end of positioning) or pattern 01 (continuing positioning).
WITH mode ····· At the start
AFTER mode ····· At the end
However, the M code is set before the start of positioning processing of pattern 11.

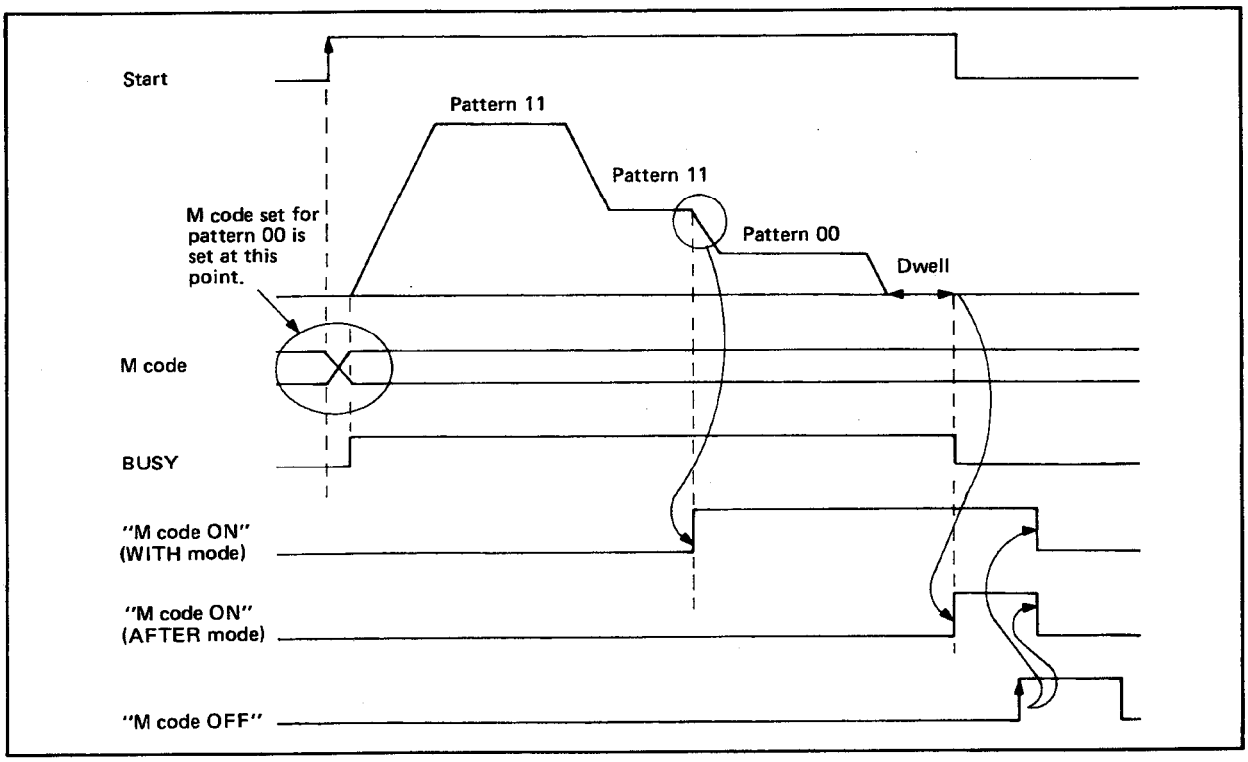


Fig. 3.10 "M Code ON" Signal Timing for Positioning Pattern "11"

REMARK

In Fig. 3.10 above, the M code ON timing is explained for both the WITH and AFTER modes. In actual operation, however, the mode is either WITH or AFTER and the M code is turned ON corresponding to the specified mode.

3.4.2 Zero return data

This defines a home position or zero point for the D71. Refer to Table 3.6.
Zero return data is checked when:

1) Parameters or zero return data is transferred from the A6GPP to the D71;
2) "PC ready signal" output from the PC CPU to the D71 changes from OFF to ON; or
3) Zero return, positioning, JOG operation, or manual pulse generator is selected in A6GPP test mode.

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

Table 3.6 Zero return Data

POINTS

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

**(2) Setting number "0" or "1" for zero return direction and that "0", "1", or "2" for zero return method is the number set at the peripheral equipment (GPP, TU).
When setting No. 1 and No. 2 from the sequence program, refer to Section 3.5.6**

REMARK

Among the zero return data indicated in Table .6, the zero return speed and creep speed values are multiple of 6.1 (PLS/s).
For example, if "zero return speed value = 200 (PLS/s)" is set, the value that is a multiple of 6.1 (PLS/s) and closest to 200 (PLS/s) is actually set.

$$\frac{200}{6.1} = 32.78688\cdots$$ (decimal fraction cut-off)

Thus, actual speed is 6.1 x 32 = 195.2 (PLS/s).

Zero return data is explained below:

(1) Zero return direction

- Specifies the direction for zero return.

IMPORTANT

Zero return is controlled according to the zero return direction and speed. Deceleration starts when the near-point dog signal is turned ON. Always ensure that the zero return direction is correct for the drive system used.

(2) Zero return methods

The following three zero return methods are provided.

a) Zero-phase signal from pulse generator (PG)
b) Stop by stopper (1) and dwell timer time-out
c) Stop by stopper (2) and signal from drive unit

(a) Zero-phase signal from PG

In this method, an axis stops when the zero-phase signal output from the PG is received as shown in Fig. 3.11.
Note that a PG that has the function to output the zero-phase signal must be used. (See Fig. 3.12.)

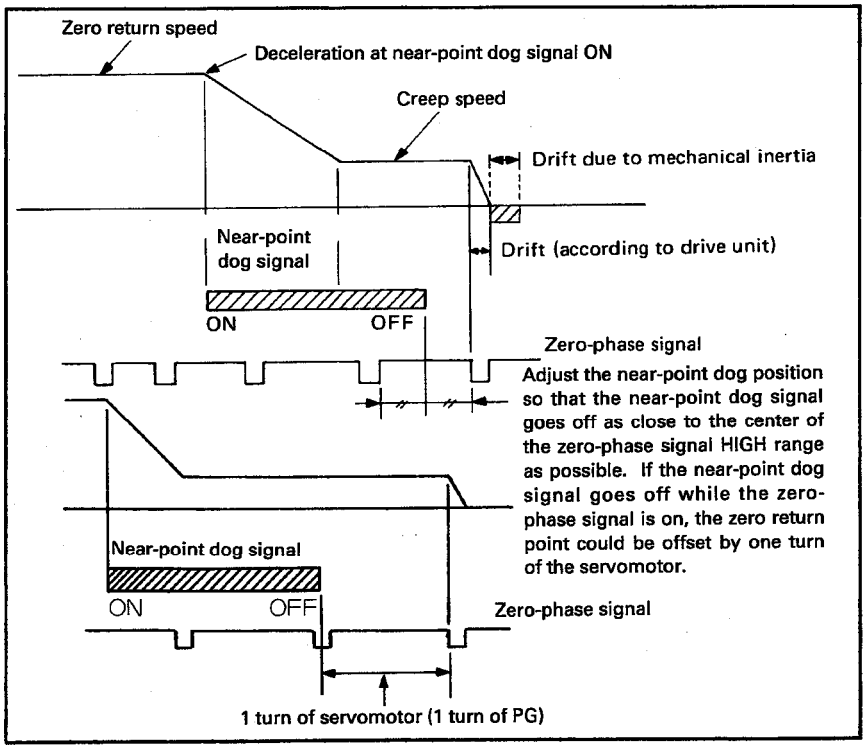


Fig. 3.11 Zero return Using a Zero-Phase Signal from PG

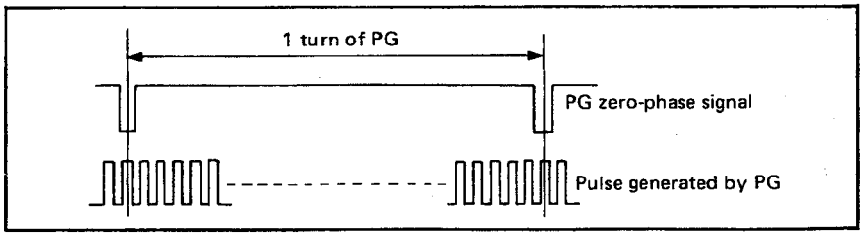


Fig. 3.12 Feedback Pulse Format

(b) Stop by stopper - 1 (count-up of dwell timer)

Zero return completes on count up of the dwell timer after the operation of the near-point dog (See Fig. 3.13-1.).

In this case, zero return does not complete unless the dwell timer counts up even if the near-point dog signal goes off while the dwell timer is counting.

Apply torque limit to the servomotor after it has reached the creep speed. For details, see (7) in Section 3.4.2.

If torque limit is not applied to the servo motor, the servo motor may be damaged when an axis travel is stopped by the stopper.

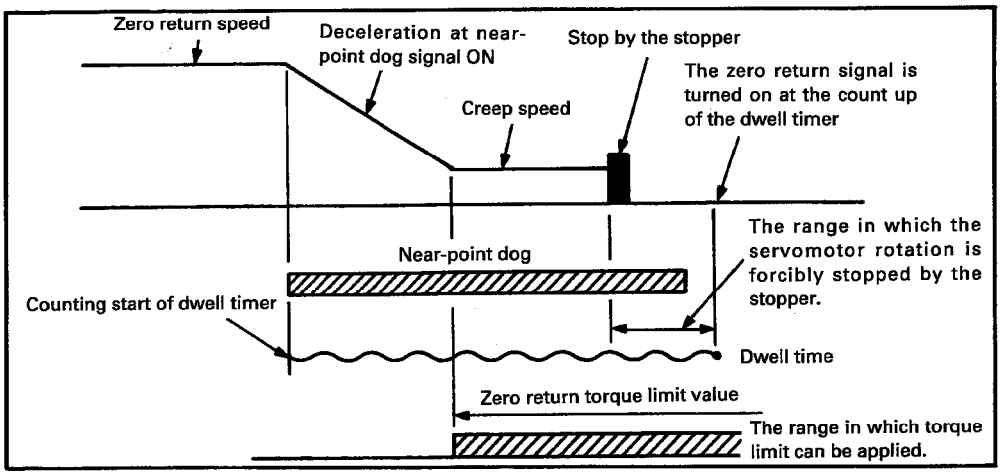


Fig. 3.13-1 Zero Return by Stopper (1)

(c) Stop by stopper - 2 (external stop instruction)

In this method, a stop instruction is input externally when an axis is brought to a stopper (See Fig. 3.13-2.).

After the near-point dog signal is turned ON, the zero-phase signal (stop instruction) is forcibly input to the zero-phase signal terminal using an external switch, etc. The zero-point dog signal may be ON or OFF when the zero-phase signal (stop instruction) is input.

Apply torque limit to the servomotor after it has reached the creep speed. For details, see (7) in Section 3.4.2.

If torque limit is not applied to the servo motor, the servomotor may be damaged when an axis travel is stopped by the stopper.

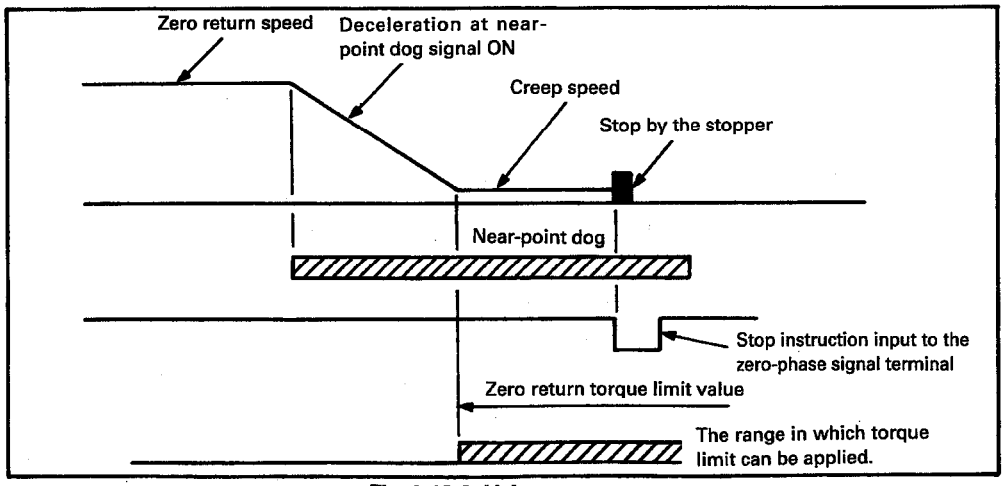


Fig. 3.13-2 Using a stopper

REMARK

Input the stop instruction after the motor speed has lowered to the creep speed. If the stop instruction is input before the motor speed has lowered to the creep speed, undue force is applied to the motor and the mechanical system causing them to be damaged.

(3) Zero return address

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

(4) Zero return speed

- Sets the zero return speed. (Refer to Fig. 3.14)

(5) Creep speed

- The axis travel speed decelerated from the zero return speed at turning on of the near-point dog signal during zero return operation is called creep speed (See Fig. 3.14.).
- The creep speed has influence on detection error if zero return is controlled by the zero-phase signal and on the magnitude of impacts if zero return is controlled using a stopper. Therefore, the creep speed must be determined taking error range and allowable shock into consideration.

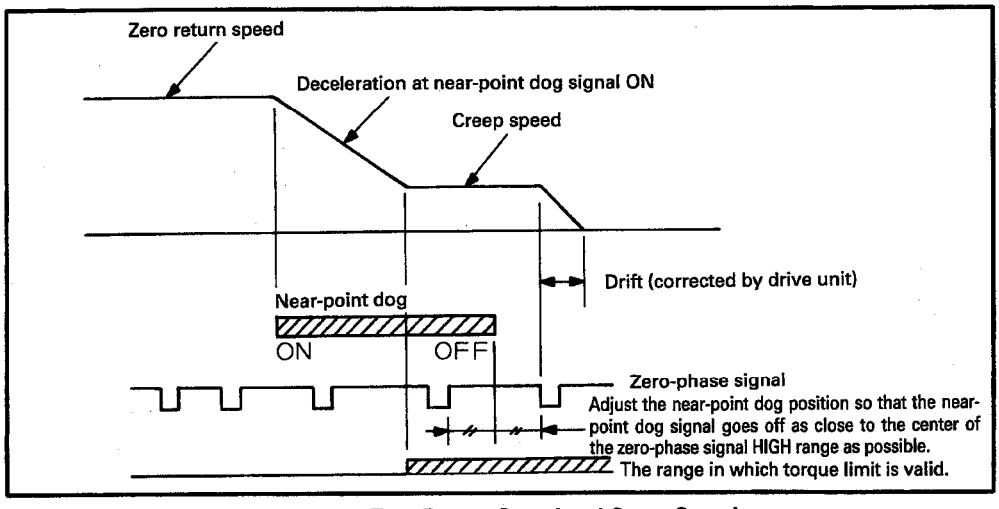


Fig. 3.14 Zero Return Speed and Creep Speed

(6) Zero return dwell time

- The zero return dwell time means the length of time in which the zero return is completed after turning ON of the near-point dog signal in the zero return operation using a stopper (1).
- Set the length of time in which an axis stops moving by the stopper after its speed has been stabilized at the creep speed.
- The setting (within the allowable setting range) for this parameter is disregarded in zero return other than zero return controlled by a stopper (1).

(7) Torque limit

- Sets a limit for the servo motor torque after the creep speed is reached as required by some drive units.

POINT

- **A D/A converter module is necessary for torque limiting.**
- **This parameter must always be set when zero return is controlled using a stopper (2).**
- **Any value within the setting range may be specified if the torque limit is not being used.**

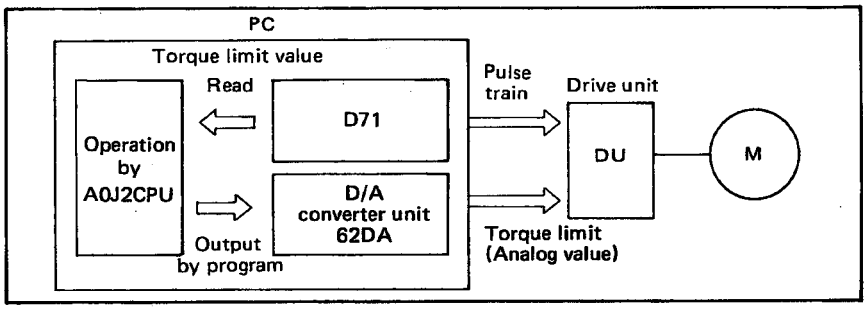
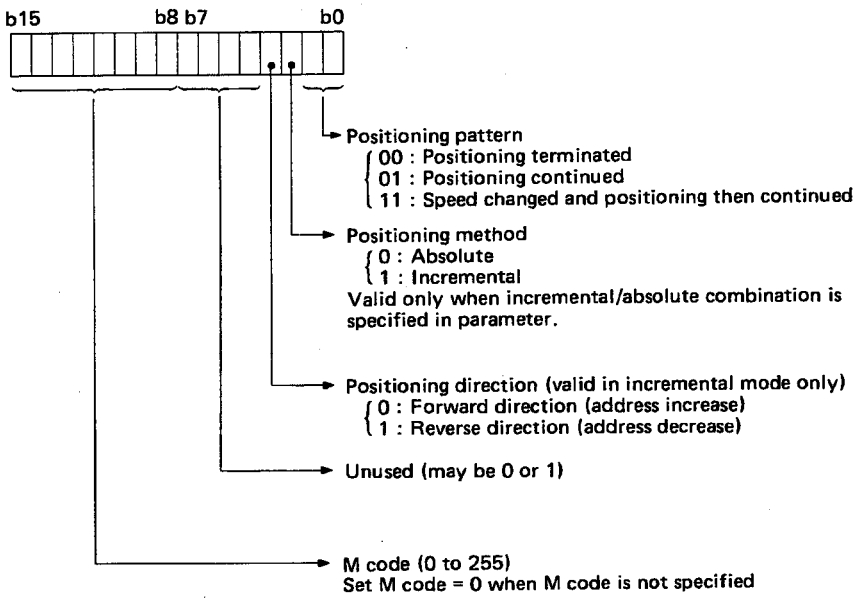


Fig. 3.15 Torque Limit Block Diagram

3.4.3 Positioning data

Positioning data is used in the D71 to execute positioning control (i.e. control other than zero return, manual pulse generator 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 data number is assigned in the range of 1 to 400.)
Positioning control is executed by referencing the position data that corresponds to the data number set in the positioning start area in the buffer memory.
Positioning data is checked when positioning is started.



No.	Item	Setting Data							
		mm		inch		degree		PULSE	
		Setting range	Unit	Setting range	Unit	Setting range	Unit	Setting range	Unit
2	Positioning speed	1 to 12000	$\times 10^{1}$ mm/min	1 to 12000	$\times 1$ inch/min	1 to 12000	$\times 1$ deg/min	1 to 20000	$\times 10^{1}$ PLS/s
3	Positioning address	0 to 162×10^{7}	$\times 10^{-1}\mu$m	0 to 162×10^{7}	$\times 10^{-5}$inch	0 to 162×10^{7}	$\times 10^{-5}$deg	0 to 16252928	PLS
4	Dwell time	0 to 499 ($\times 10^{1}$ ms)							

Table 3.7 Positioning Data List

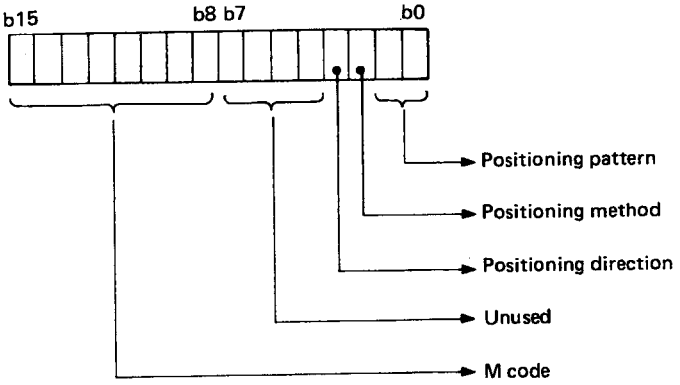
POINT

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

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) Positioning is completed at the specified address and then the positioning is continuously executed using the next data number (positioning address).

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.

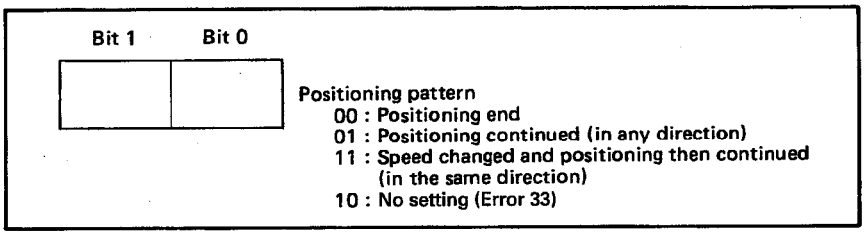


Fig. 3.16 Positioning Pattern

- Positioning terminated

  Drives to the specified address, positioning is complete after the dwell time has elapsed.

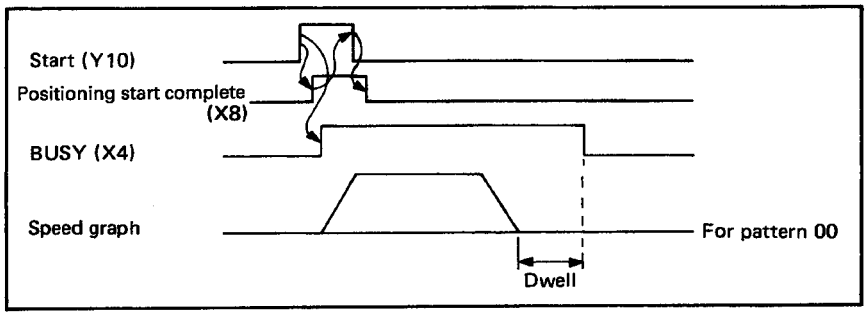


Fig. 3.17 Pattern 00

- Positioning continued

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

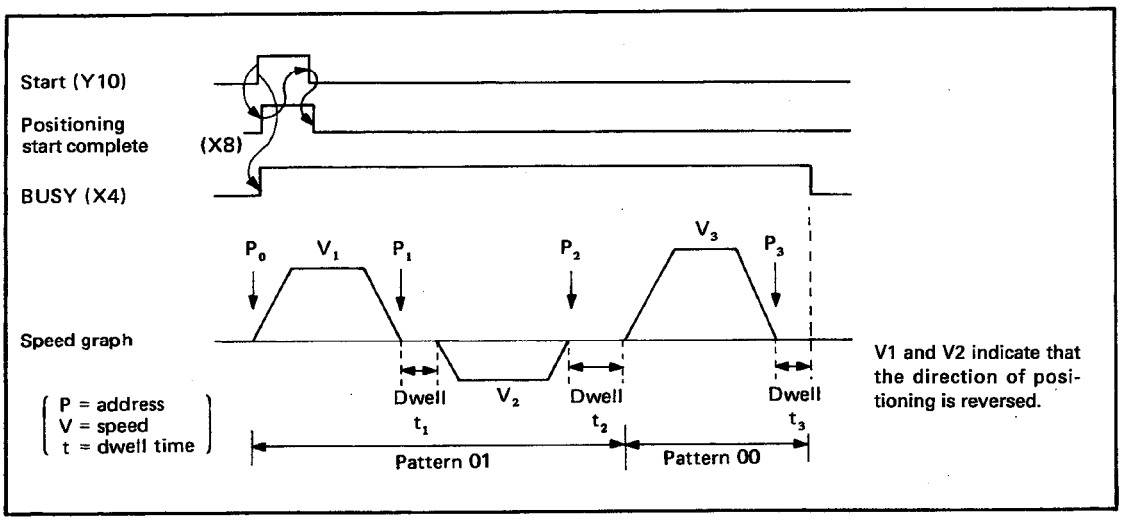


Fig. 3.18 Pattern 01

POINT

Pattern 00 should be set for the last position in a series of continuous operations by pattern 01.
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

The positions are reached consecutively 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)

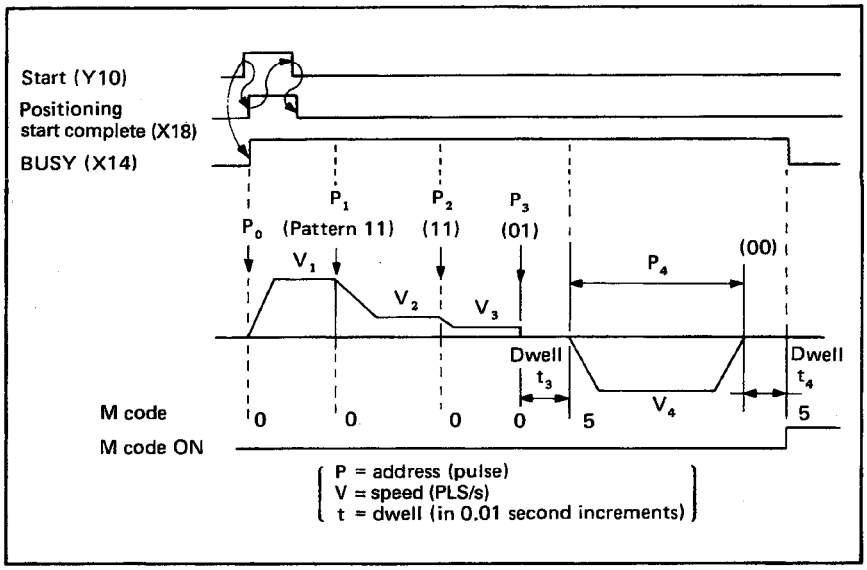


Fig. 3.19 Pattern 11

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, (set the speed change point before the deceleration point.), 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

The positioning method specified in the positioning data is valid only when "combination of incremental and absolute" is set for the positioning method parameter.

POINT

The positioning method cannot be changed if pattern 11 has been specified.
(If the "combination of incremental and absolute" is specified, it is possible to change the positioning method after the execution of pattern 00 or pattern 01.)

(c) Positioning direction

For incremental mode positioning, the direction of travel relative to the positioning data No. 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 data No. (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 relevant to the position data No.

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/s	50kPLS/s
Positioning data set value : positioning speed	20kPLS/s	50kPLS/s

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.

$$\text{X-axis positioning speed} = 50 \times \frac{100}{200} = 25\,\text{kPLS/s}$$

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

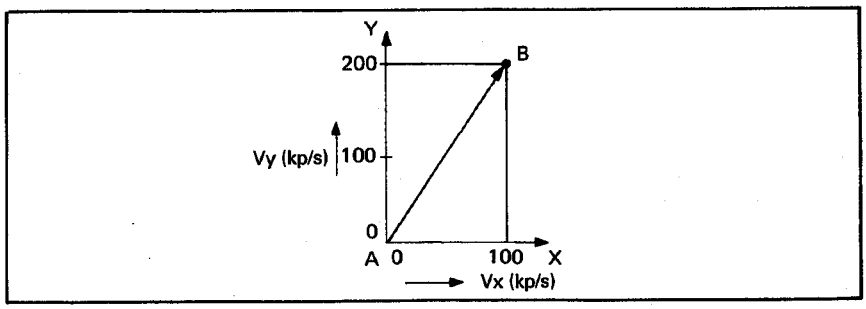


Fig. 3.20 Linear Interpolation

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 100PPS).

POINT

The set speed of the axis with shorter travel distance is disregarded in linear interpolation. Therefore, if travel distances and speeds differs largely between X and Y axes, actual travel speed of X or Y axis may become larger than the set speed. (The speed limit value is ignored.)
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.

REMARK

Actual positioning speed is a multiple of 6.1 (PLS/s).
For example, if "positioning speed = 200 (PLS/s)", the maximum speed to be output by the D71 is determined as shown below.
200 = 6.1 x n·····n = 32.7868·····
Therefore, the maximum speed is 6.1 x 32 = 195.2 (PLS/s).

(3) Positioning address

Set the positioning address meeting the positioning method.
(In the incremental method, set a travel distance and in the absolute method, set an address value.)

(4) Dwell time

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

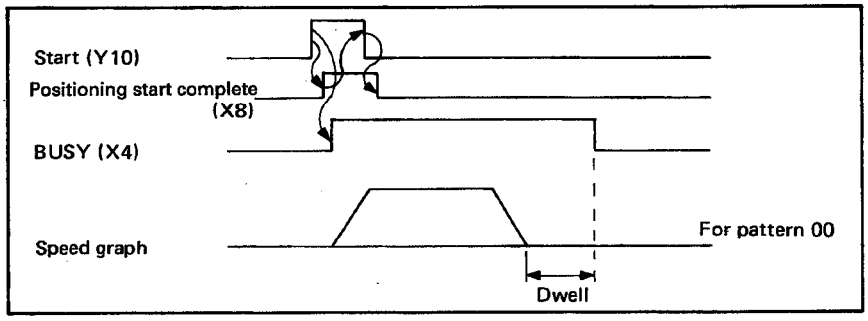


Fig. 3.21 Pattern 00

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

3.5 Buffer Memory

The D71 has battery backed buffer memory for communication of data with the PC CPU.
The data stored in the buffer memory area is shown in Fig. 3.22 and the D71 executes positioning control using the data stored in this area.
The following methods can be used to read or write the data shown in Fig. 3.22.

Data can be read from the buffer memory as follows:

- Reading data using the sequence program

  One word (16-bit) or two word data can be read by using the buffer read application instructions (FROM).

- Reading data using the A6GPP

  Data can be read in a variety of A6GPP modes.
  For details, refer to the SW0GP-AD71P, SW0IX-AD71PE Operating Manual.

Data can be written to the buffer memory as follows:

The writing of data may be restricted depending on the status of the D71. General write conditions are shown in Fig. 3.22. For further details, refer to Section 3.5.1 to 3.5.6.

- Writing data from the sequence program

  One word (16-bit) or two word data can be written by using the buffer write application instructions (TO).

- Writing data from the A6GPP

  Data stored in the memory area of A6GPP is transferred in blocks to buffer memory area in the D71.
  The conditions for writing data using the A6GPP correspond to the write processing indicated above.

An additional function allows individual pieces of positioning data to be written to the buffer memory if the D71 is BUSY. For details, refer to the SW0GP-AD71P, SW0IX-AD71PE Operating Manual.

REMARK

For buffer memory access instructions, refer to Chapter 7 "Programming."

POINT

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

Address			Description	Write Condition	
				Sequence program	A6GPP or AD71TU
0 to 200	X-axis positioning start data		Area for positioning start data numbers, etc. (For X axis)	Depends on data.	Write enabled when both X-axis and Y-axis BUSY signals are off.
201	Error reset		Area for error reset	Write enabled at any time	Write enabled at any time
			Unused	–	–
300 to 500	Y-axis positioning start data		Area for positioning start data numbers, etc. (For Y axis)	Depends on data.	Write enabled when both X-axis and Y-axis BUSY signals are off.
			Unused	–	–
512 to 767	For OS		OS RAM. Writing here is not allowed.	Write disabled	Write disabled
768 to 3871			Unused	–	–
3872 to 4271	Positioning information	X-axis positioning data	X axis positioning data area described in Section 3.4.3 (Maximum 400 positions) Data format as follows: Positioning information: 2 bytes (16 bits) Positioning speed: 2 bytes (16 bits) Dwell time: 2 bytes (16 bits) Positioning address: 4 bytes (32 bits)	Write enabled at any time	Block transfer of positioning data from A6GPP to D71 is only enabled when PC ready signal is off.
4272 to 4671	Positioning speed				
4672 to 5071	Dwell time				
5072 to 5871	Positioning address				
5872 to 6271	Positioning information	Y-axis positioning data	Y axis positioning data area described in Section 3.4.3 (Maximum 400 positions) Data format as for X axis.	Write enabled at any time	
6272 to 6671	Positioning speed				
6672 to 7071	Dwell time				
7072 to 7871	Positioning address				
7872 to 7887	X-axis parameters		Parameter area explained in Section 3.4.1 (X axis)	Write only enabled when PC ready signal is off.	Write only enabled when PC ready signal is off.
7892 to 7907	Y-axis parameters		Parameter area explained in Section 3.4.1 (Y axis)		
7912 to 7918	X-axis zero return data		Zero return data area described in Section 3.4.2 (X axis)		
7922 to 7928	Y-axis zero return data		Zero return data area described in Section 3.4.2 (Y axis)		

The above data may be read at any time.
Addresses are expressed in decimal (1 address = 2 bytes (16 bits))

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 D71 from the A6GPP.

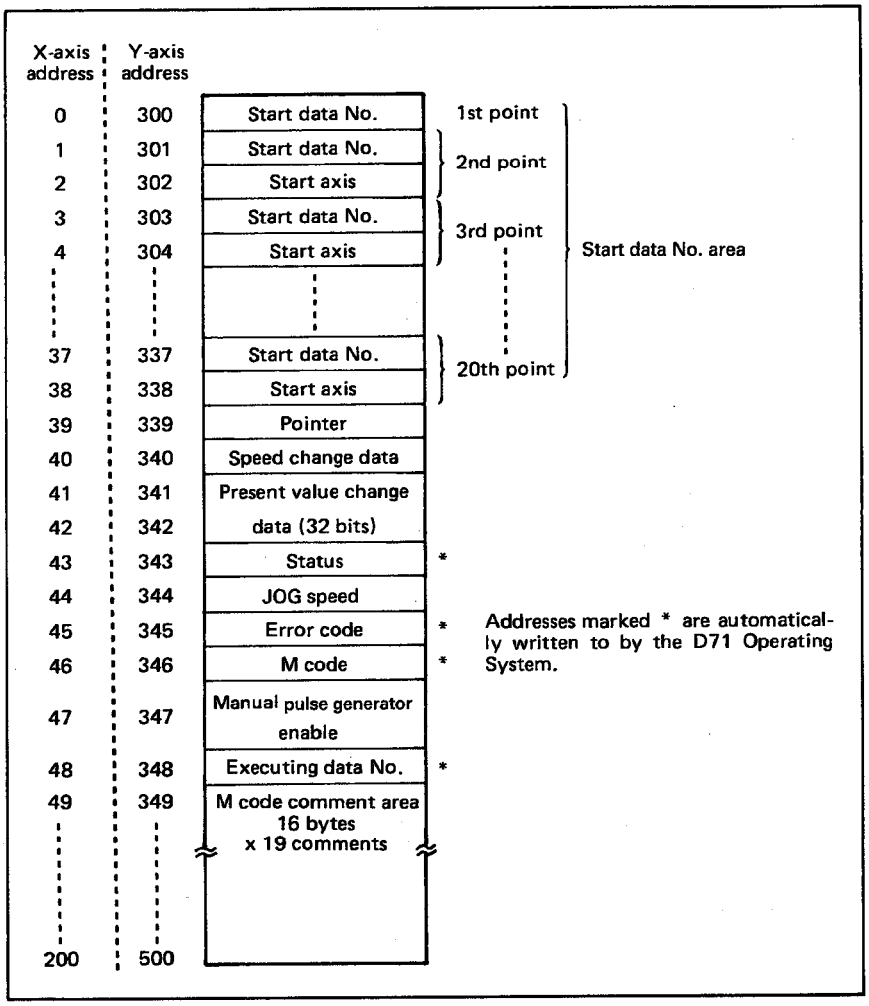


Fig. 3.23 Positioning Start Data

(1) 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). This data overrides the speed set in the positioning data. Speed change is illustrated in Fig. 3.24 below.

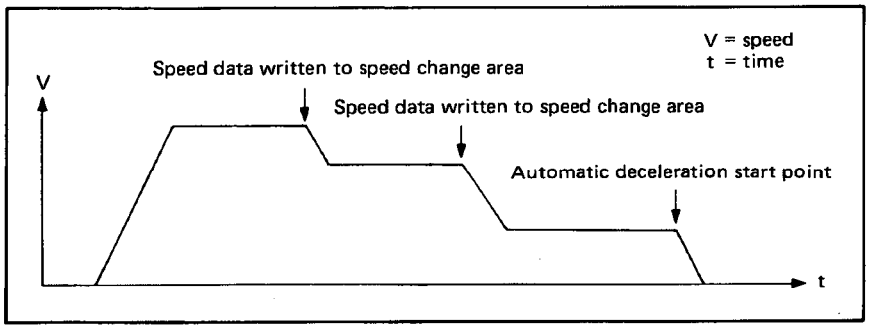


Fig. 3.24 Speed Change Example

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 manual pulse generator mode;**
- **after a stop command or after the JOG signal is turned off; or**
- **during interpolation positioning.**

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

To change the present value data in the D71, write the new value to these addresses.

POINT

The present value cannot be changed while the D71 is BUSY. Present value data is two words long, one word data cannot be written.

(3) 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 the start of JOG operation is valid.

(4) Manual pulse generator enable area (X axis: address 47, Y axis: address 347)

Enable or disable of manual pulse generator is written to bit 0 shown in Fig. 3.25. This data may be written at any time.

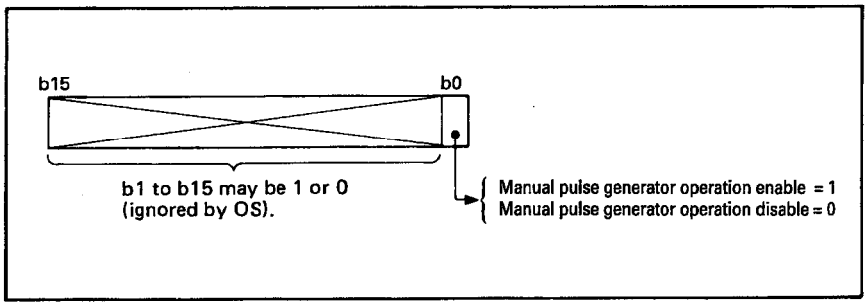


Fig. 3.25 Manual pulse generator Enable

(5) 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 A6GPP or sequence program).
Comments may be written to M code numbers 1 to 19 for both X and Y axes.
This can be used in the following cases:

- To monitor by A6GPP
- To display using an external device by reading out with a sequence program

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

Is reserved for the information shown in Fig. 3.26 and is set by the D71 OS.

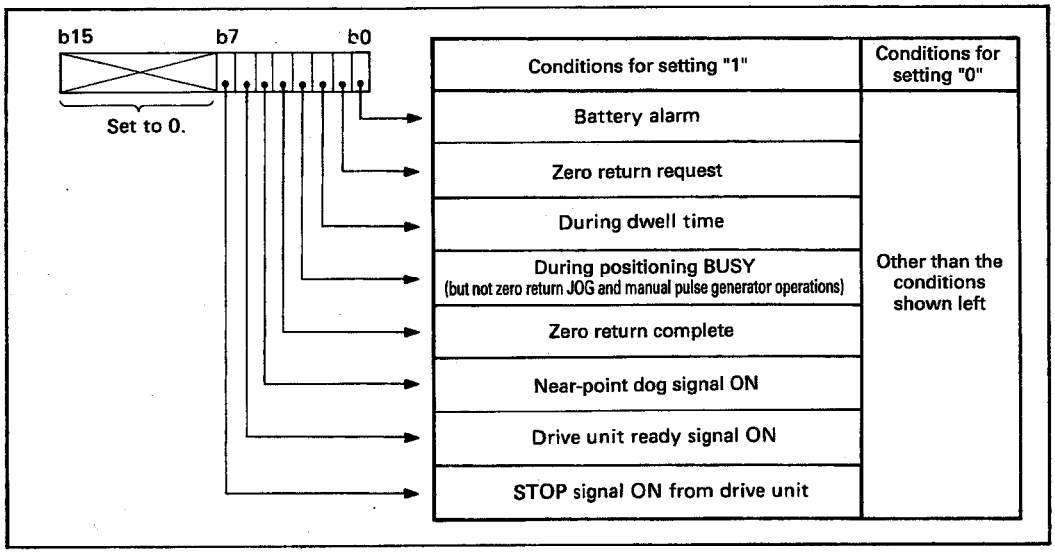


Fig. 3.26 Status Area

POINT

The status area is used by the D71 OS and data must be written here.

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

An error code is stored to this area when the D71 OS turns ON the error detection signal (XB) after detecting an error.

POINT

- **The error code area is used by the D71 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.**

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

The D71 OS sets the M code, which is set in the positioning data, as shown in Fig. 3.27.

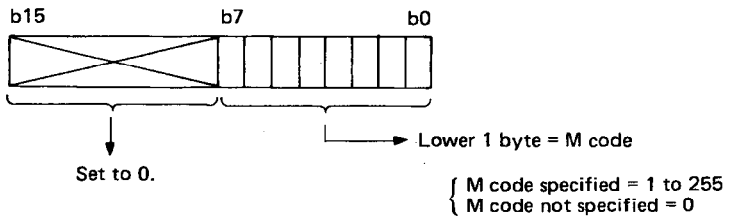


Fig. 3.27 M Code Area

POINT

- **The M code area is used by the D71 OS and data must be written here.**
- **For M code data timing details, refer to Section 3.4.1 (16)**

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

The D71 OS sets the data No. for which positioning is presently executed. This number is retained until the next positioning operation begins. (Refer to Fig. 3.28).

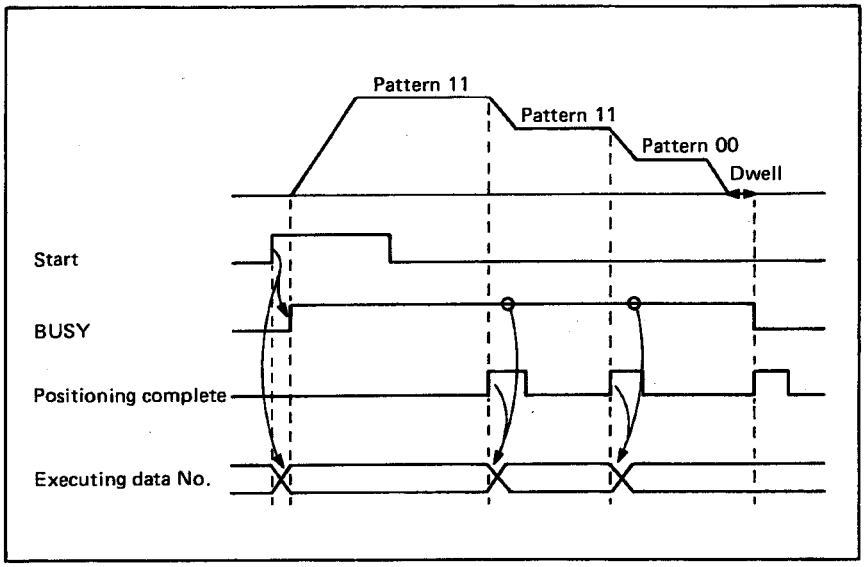


Fig. 3.28 Current Data No. Updata Timing

POINT

The executing data No. area is used by the D71 OS and data must be written here.

(10) Start data number area

The D71 executes positioning in the order of the data numbers by a single start signal and completes positioning at the completion of positioning in pattern 00.
To execute a series of positioning continuously in this manner, there must be an area where the start data No., start axis, and other related data. This area is called the start data No. area.
As shown in Fig. 3.29, a maximum of 20 points can be set in the start data No. area.

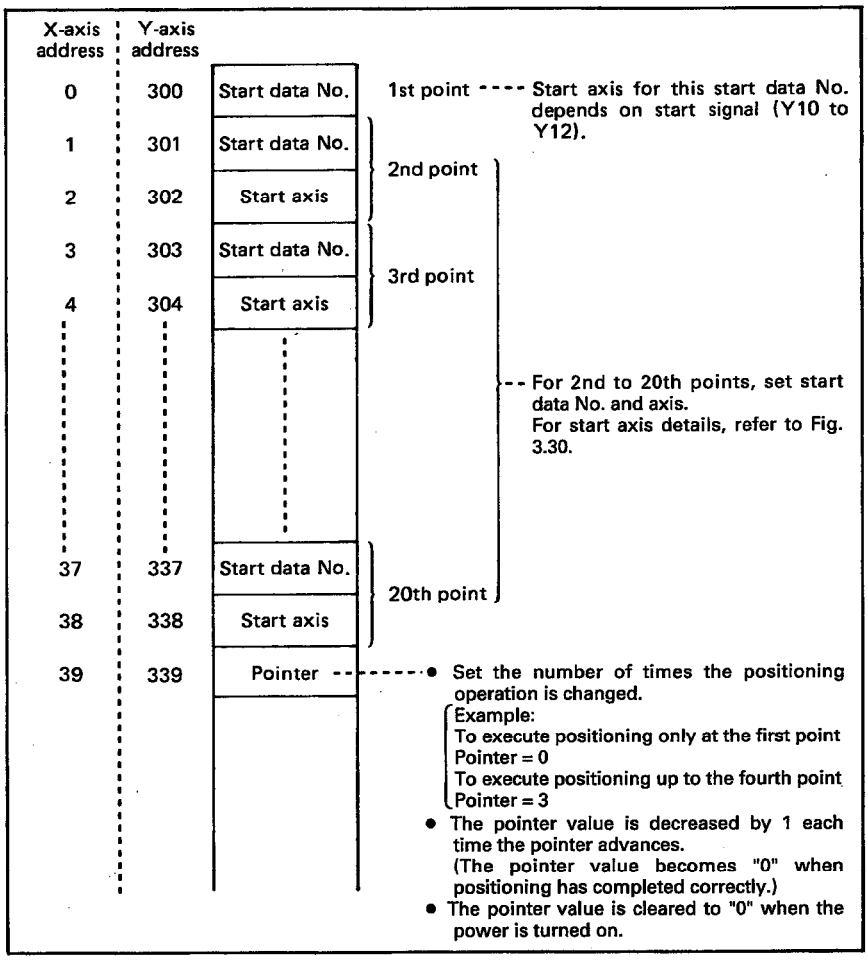


Fig. 3.29 Start Data Area

POINT

- **At the completion of positioning using the start data No. of the 20th point, positioning is completed even if the pointer value is not "0". In this case, an error code is set.**
- **The BUSY signal stays ON while control of positioning is being switched to the next point after the completion of positioning at one point.**

(a) Start axis area details

Use the lower two bits of these addresses to define the start axis. (See Fig. 3.30.)

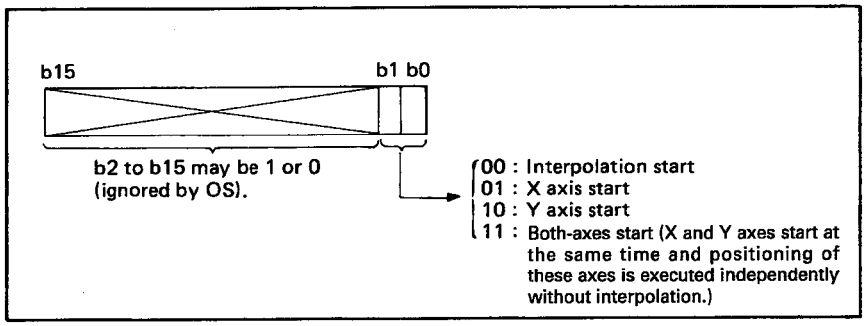


Fig. 3.30 Start Axis Area

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. 3.31.

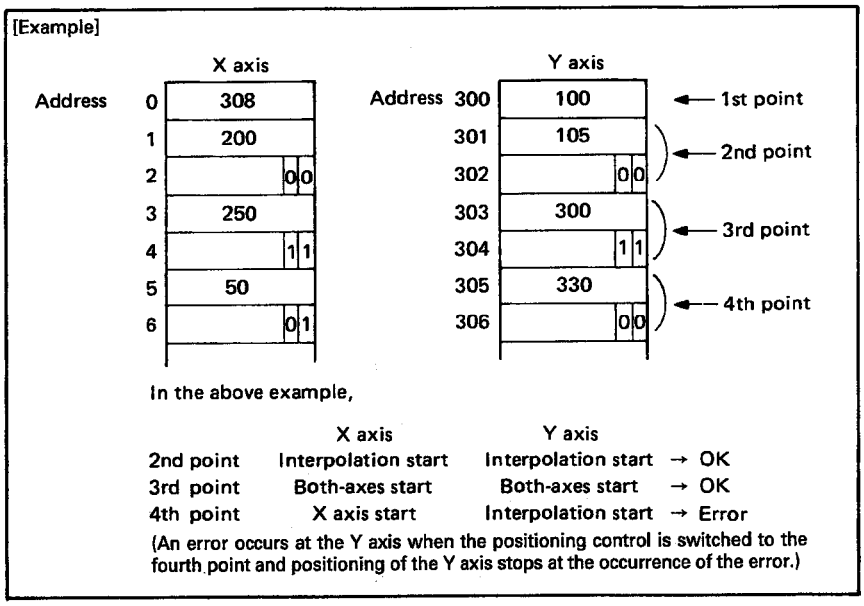


Fig. 3.31 Start Data Example 1

2) If the Y axis is set as the start axis (10) in the start data No. area for the X axis, the data of such a point is disregarded (positioning is not executed) and the control advances to the next point (See Fig. 3.32.). This is also true if the X axis is set as the start axis (01) in the start data No. area for the Y axis.

[Example]

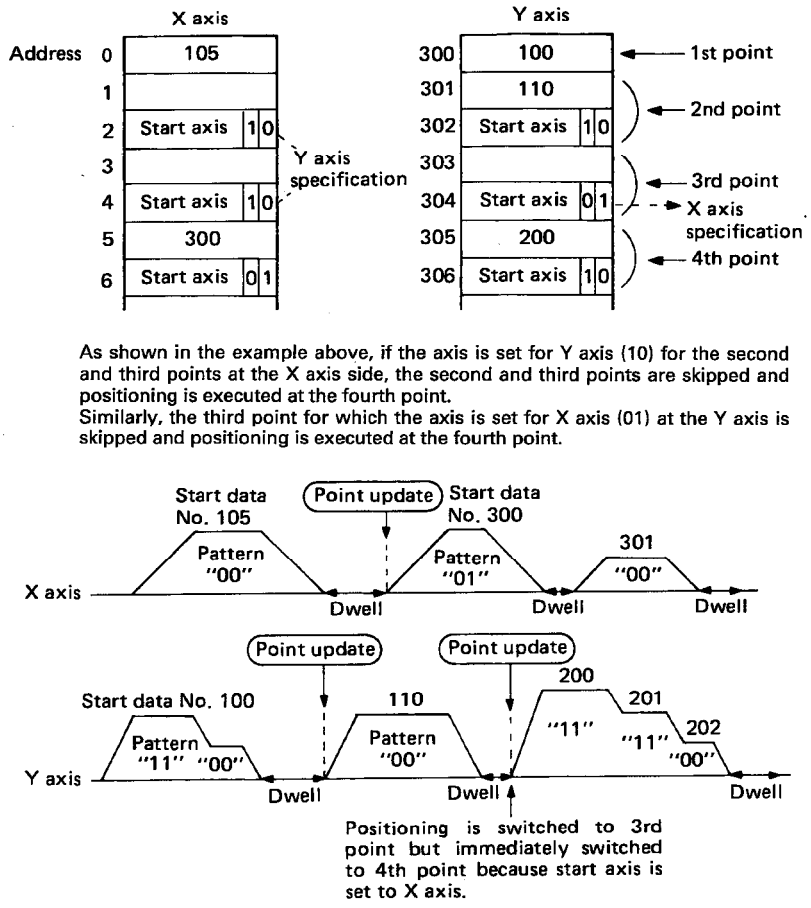


Fig. 3.32 Start Data Example 2

3) If the interpolation start (00) or both-axis start (11) is set for the start axis of either of the two axes, the mating axis automatically starts positioning using the start data No. set at the location of the same point when the mating axis is not BUSY (See Fig. 3.33.).
In this case, an error occurs if the "M code ON" signal of the mating axis is ON.

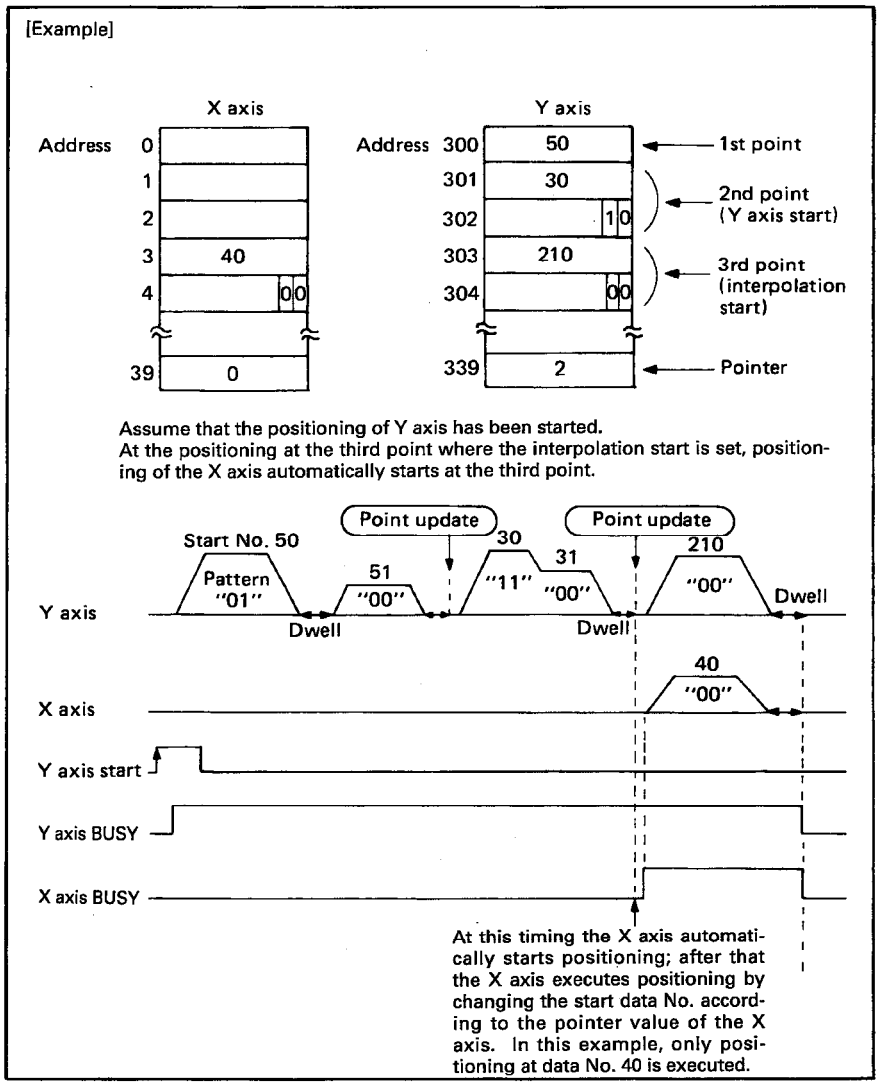
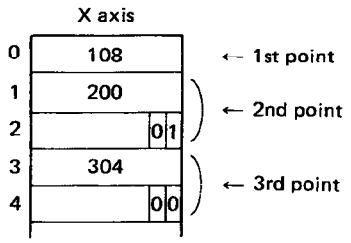


Fig. 3.33 Start Data Example 3

4) If the interpolation start (00) or both-axis start (11) is set for the start axis of either of the two axes, an error occurs and positioning processing of that axis is stopped if the mating axis is BUSY in other than positioning (See Fig. 3.34.).

[Example]



Assume that X-axis positioning processing is being executed with the X-axis start signal turned ON.
If the Y-axis is BUSY due to zero return, JOG operation or manual pulse generator operation when the positioning point of the X axis is switched to the third point, the X axis does not start positioning in the interpolation mode but its positioning processing is stopped with an error code set.

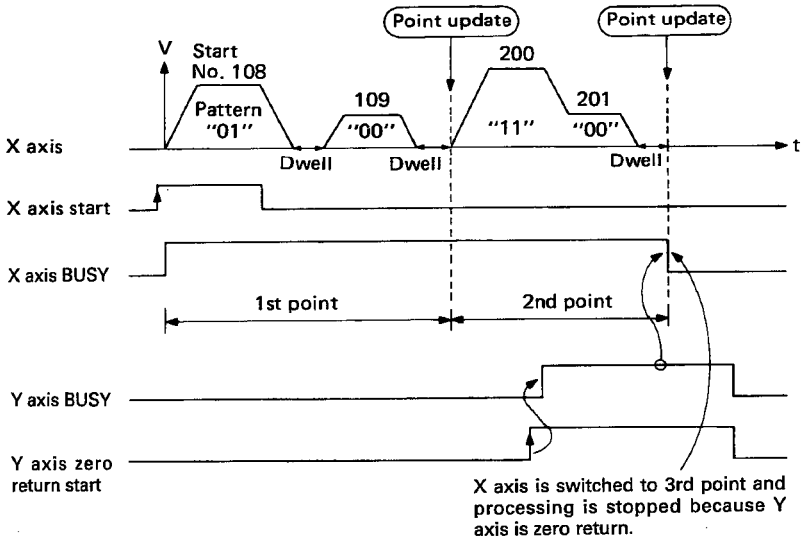
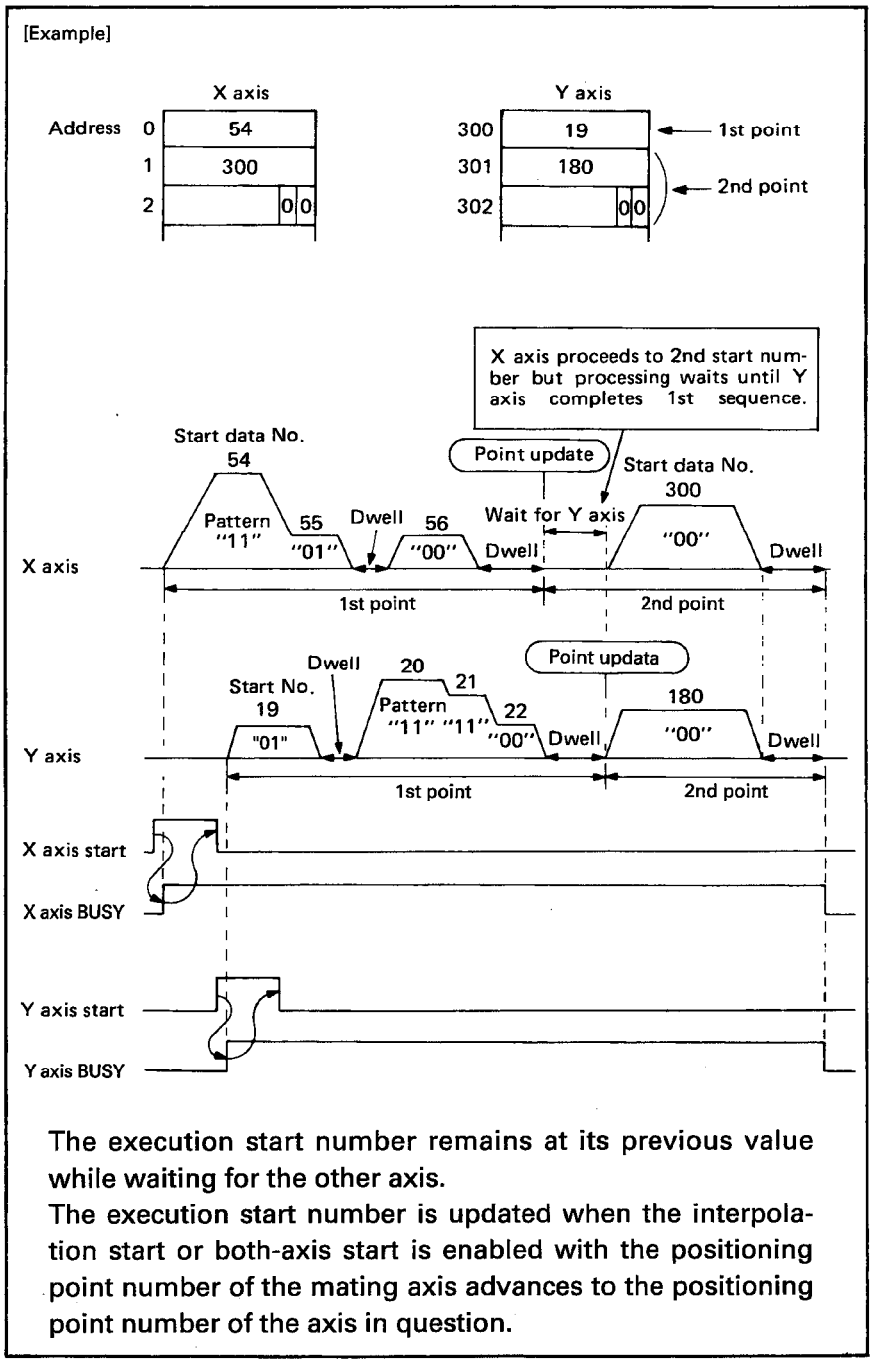


Fig. 3.34 Start Data Example 4

5) If the interpolation start (00) or both-axis start (11) is set for the start axis of either of the two axes, the processing differs depending on the contents of positioning processing of the mating axis if the mating axis is executing positioning.

- If the mating axis is executing positioning at a point number smaller than the positioning point of the axis in question, its positioning processing is suspended until positioning processing of the mating axis advances to the same point number or the mating axis BUSY state goes off. The state of the axis in question remains BUSY while its positioning processing is suspended (See Fig. 3.35.).

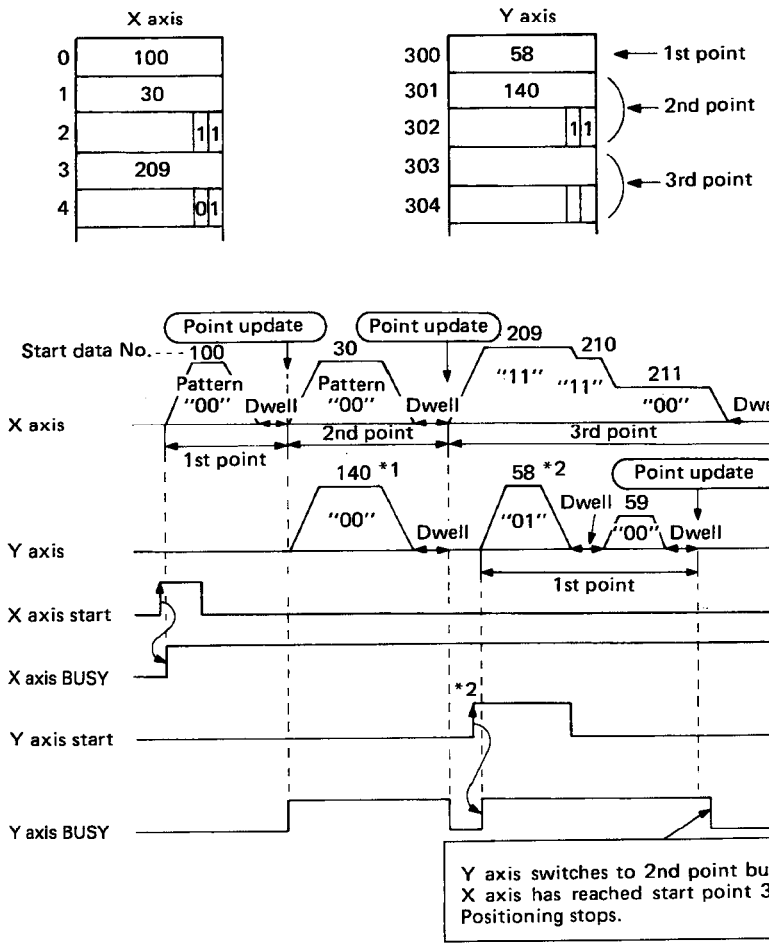


The execution start number remains at its previous value while waiting for the other axis.
The execution start number is updated when the interpolation start or both-axis start is enabled with the positioning point number of the mating axis advances to the positioning point number of the axis in question.

Fig. 3.35 Start Data Example 5

- Processing will stop if one axis proceeds ahead of the other and dual axis processing is called. See Fig. 3.36.

[Example]



*1: Since the second point of the X axis is both-axis start, the second point data No. of the Y axis (No. 140) starts.

*2: After the completion of positioning of the X and Y axes, executed by the both-axis start data, data No. 58 starts in response to the Y axis start instruction during the positioning of the X axis to the third point.

Fig. 3.36 Start Data Example 6

3.5.2 Error reset area (Address 201)

Set "0" to bit 0 of address 201 by a sequence program, the error codes of both axes are cleared and the error detection signal (XB) is turned OFF.
(Bit 0 is automatically reset by OS after the execution of the error reset processing.)

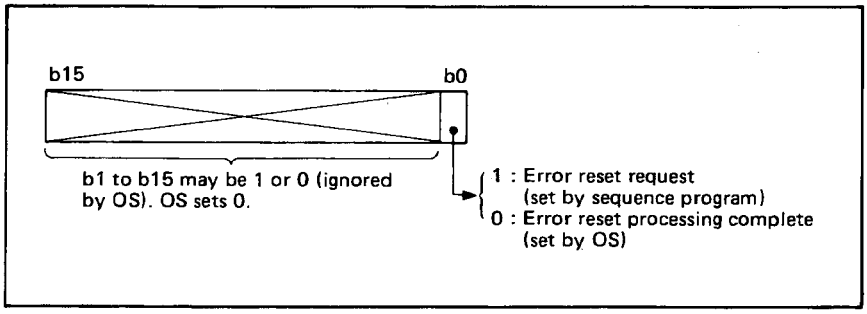


Fig. 3.37 Error Reset Area Details

3.5.3 OS data area (Address 512 to 767)

Addresses 512 to 767 are used by the OS.
This area cannot be used for writing the data by the user.
For the data shown in Fig. 3.38, the user can use them by reading it out with a sequence program, etc.
(For the procedure to read out the data, refer to Section 7.3.2.)

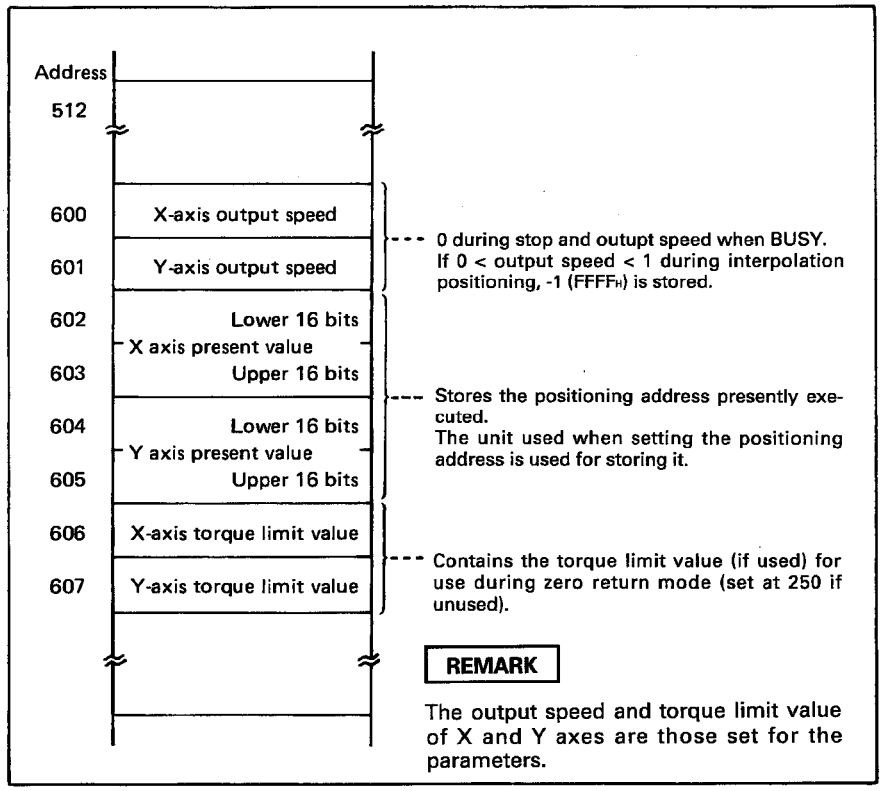


Fig. 3.38 OS Data Area

3.5.4 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)

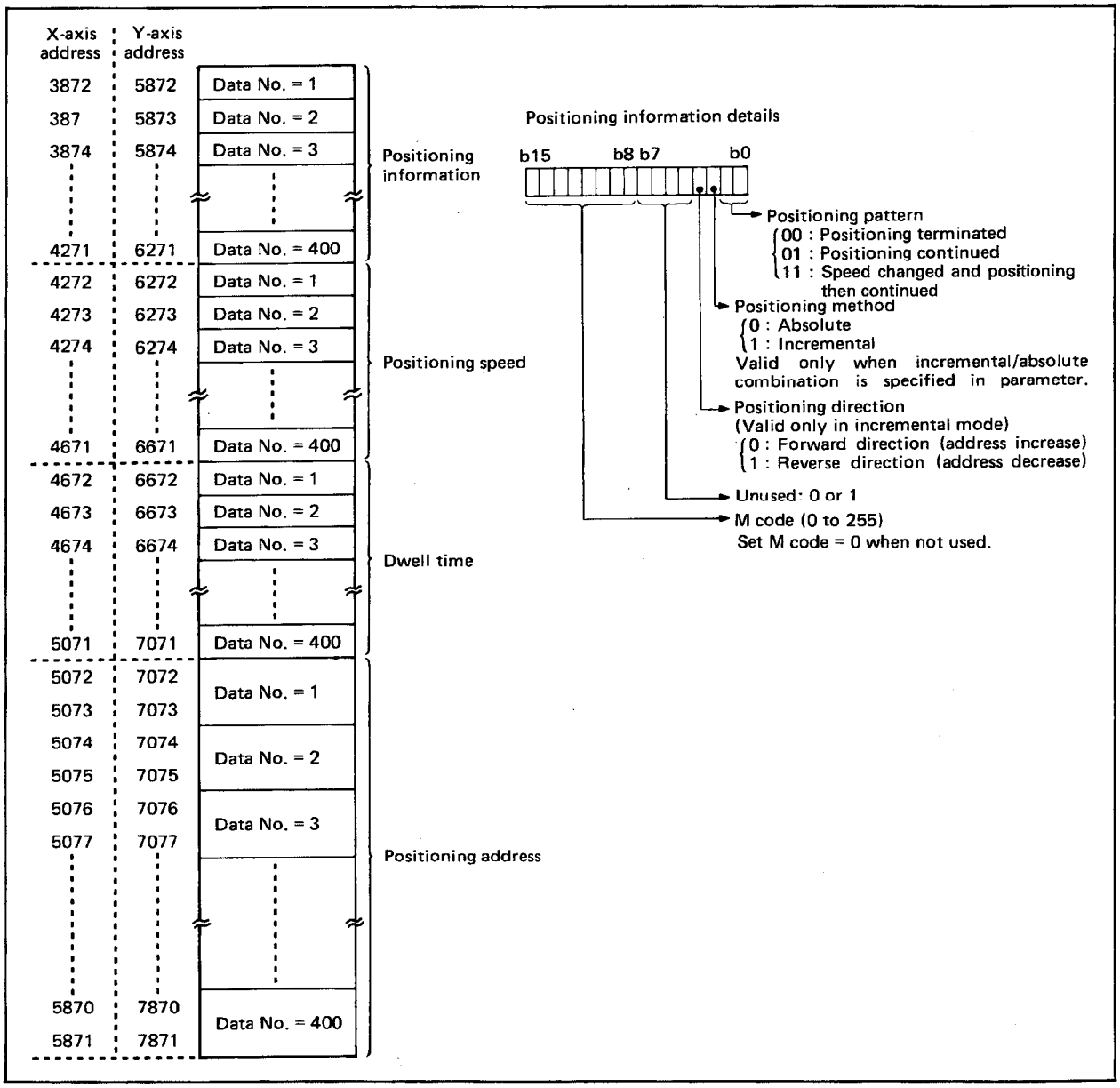


Fig. 3.39 Positioning Data Area

Conversion from data number to buffer memory address
To set the positioning data using a sequence program corresponding to the data No., convert the data No. to the buffer memory address by the following calculation.

Conversion of Data No. 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

REMARK

A conversion table is given in Appendix 5.

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

Stores the parameters described in Section 3.4.1.

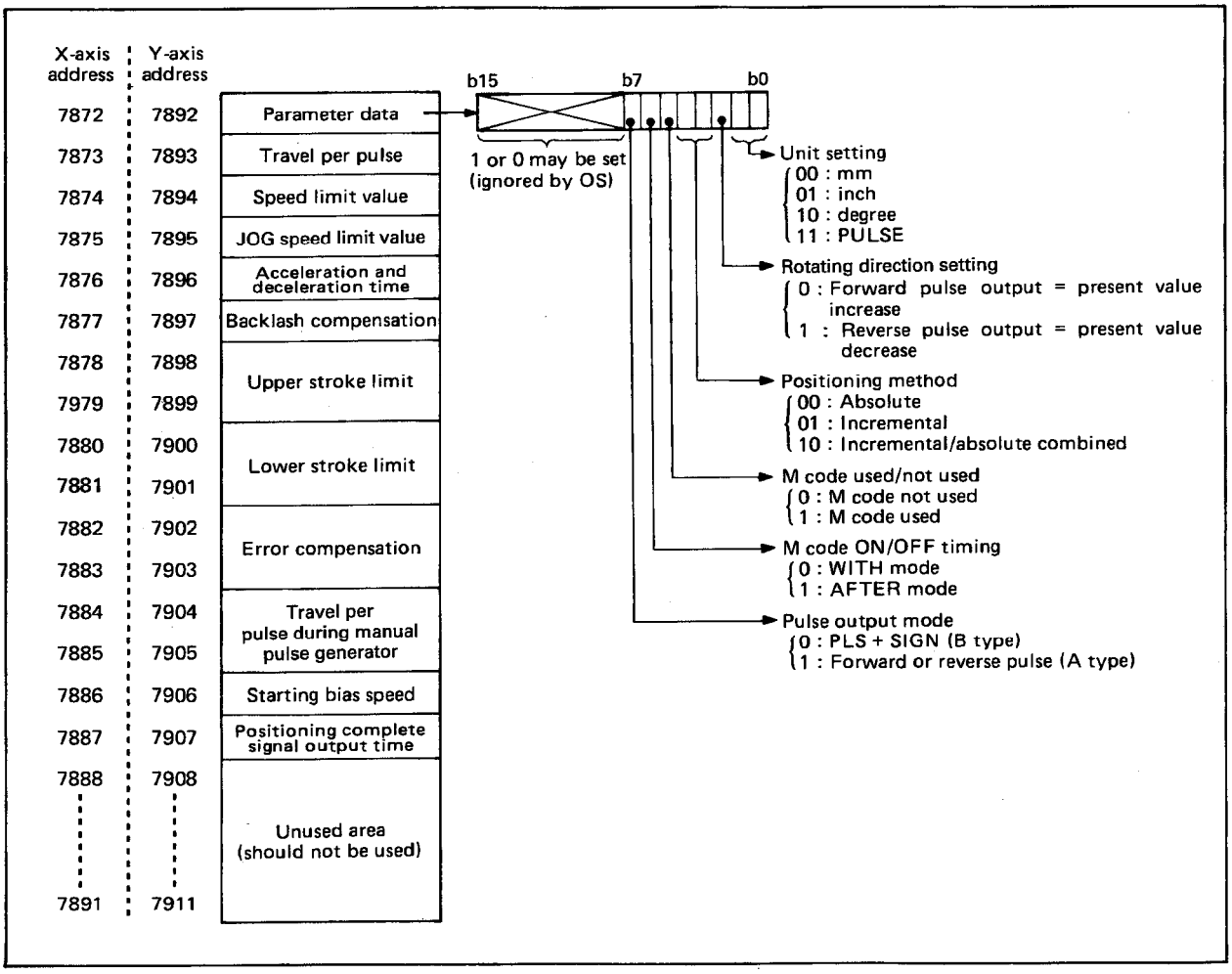


Fig. 3.40 Parameter Area

3.5.6 Zero return data area (X axis: address 7912 to 7918, Y axis: address 7922 to 7928)

Stores zero return data described in Section 3.4.2.

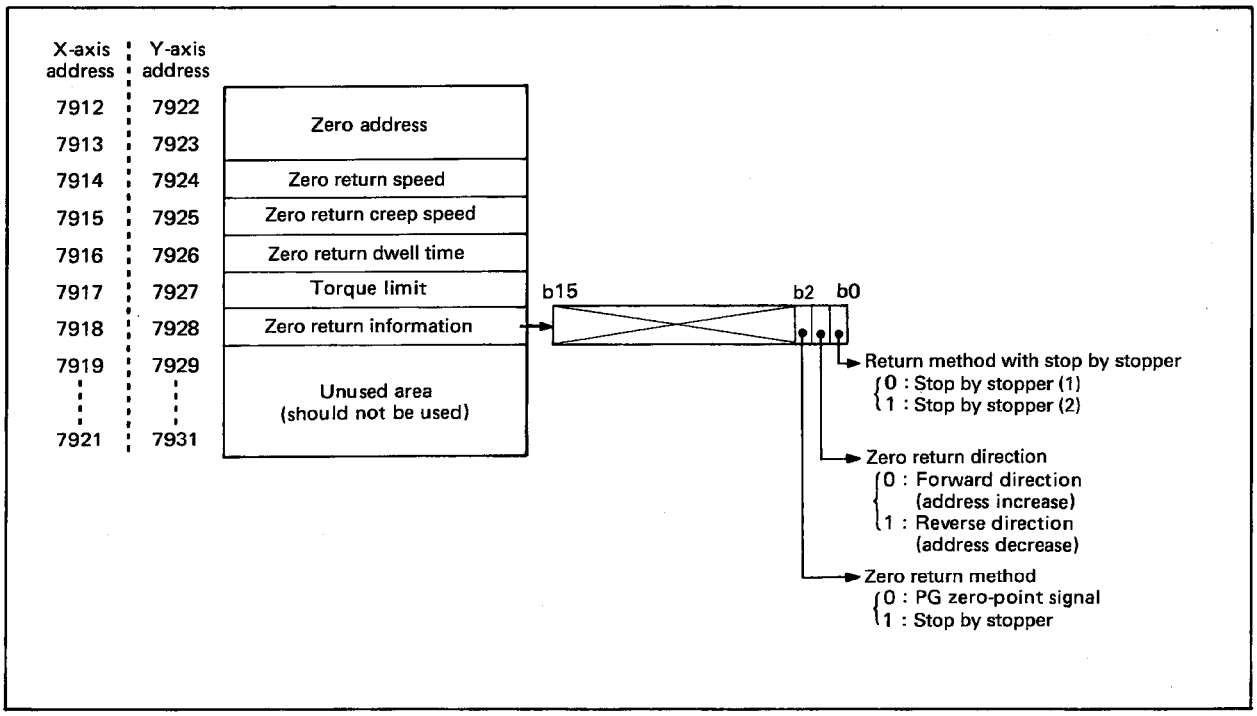


Fig. 3.41 Zero return Data Area

3.6 I/O Signals To and From PC CPU

The D71 uses 16 inputs and 16 outputs for communications with the PC CPU. I/O signal assignment and functions are given below. (64 I/O points are occupied.)
Table 3.9 shows I/O signals with the D71 unit number set to 0. Device X indicates an input signal from the D71 to the PC CPU. Device Y indicates an output signal from the PC CPU to the D71.

Signal Direction: D71 to PC CPU			Signal Direction: PC CPU to D71		
Device No.	Signal		Device No.	Signal	
X0	Watch dog timer error (detected by D71)		Y10	X axis	Positioning start
X1	D71 ready		Y11	Y axis	
X2	X axis	Positioning complete	Y12	Inter-polation	
X3	Y axis		Y13	X axis	Zero return start
X4	X axis	BUSY	Y14	Y axis	
X5	Y axis		Y15	X axis	Stop
X6	X axis	Zero return request	Y16	Y axis	
X7	Y axis		Y17	X axis	Forward JOG start
X8	X axis	Positioning start complete	Y18	X axis	Reverse JOG start
X9	Y axis		Y19	Y axis	Forward JOG start
XA	Battery error		Y1A	Y axis	Reverse JOG start
XB	Error detection		Y1B	X axis	M code OFF
XC	X axis	Zero return complete	Y1C	Y axis	
XD	Y axis		Y1D	PC ready	
XE	X axis	M code ON	Y1E	} Used by the system Not released for the user	
XF	Y axis		Y1F		

Table 3.9 I/O Signal List

IMPORTANT

- **Since Y1E and Y1F, and Y (Y0 to YF) assigned the same number as X shown in Table 3.9 are used by the system, the user is not allowed to use them.**
  If Y1E and/or Y1F is used by a sequence program, correct operation of the D71 is not guaranteed. Note that it is necessary to turn OFF YD to YF by a user program only when the D71 is installed in a remote I/O station. For details, refer to Section 7.4

- **Y20 to Y3F may be used as internal memories (M).**

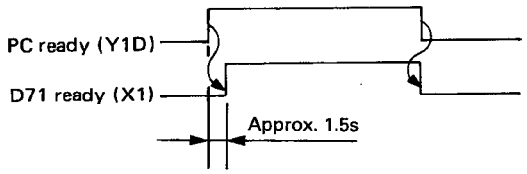
I/O signal details
The following gives details of the ON/OFF timing, conditions, etc. of the I/O signals. Device numbers in ( ) correspond to the device No. indicated in Table 3.9.

(1) Watch dog timer error (X0)

Switches on when the D71 self-diagnostics detect a watch dog timer error.

(2) D71 ready (X1)

The D71 read signal (X1) is turned ON and OFF according to turning ON and OFF of the PC ready signal (Y1D). Used for interlocking, etc. in the sequence program.



(3) Positioning complete (X2, X3)

Switches on for a period set in the parameters after each position is reached. (Ignored if the positioning complete signal output time = 0.)
Switched off at positioning start, zero return start, manual pulse generator mode start, JOG start, and power on.
If positioning is stopped midway, the positioning complete signal does not switch on.

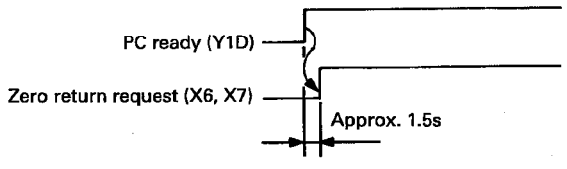
(4) BUSY (X4, X5)

Switches on at positioning start, zero return start, manual pulse generator mode start, and JOG start. Switches off after pulse output and dwell time have elapsed. (Remains on during positioning.)
Switches on while the test operation is being used on the A6GPP.

(5) Zero return request (X6, X7)

Switches on under the following conditions. Switches off upon completion of zero return.

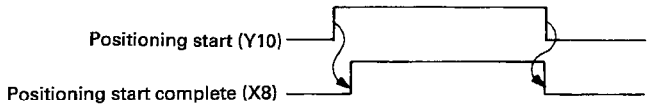
D71 power is switched on;
Drive unit ready signal ($\overline{\text{READY}}$) has turned off in BUSY state; PC ready signal (Y1D) has turned on;



Parameters and/or zero return data has been written from the A6GPP; zero return is started; or
1) zero return, 2) positioning, 3) JOG operation, or 4) manual pulse generator has been selected in A6GPP test mode.

(6) Positioning start complete (X8, X9)

Switches on to confirm that the D71 has started the specified operation. Switches off when the start signal turns off.



Does not switch on in A6GPP test mode.

(7) Battery error (XA)

Switches on when battery voltage drops.

(8) Error detection (XB)

Switched on by any of the errors in Chapter 9. Switched off when the error is reset. For resetting, refer to Section 3.5.2

(9) Zero return complete (XC, XD)

Switches on to indicate the completion of zero return. Switched off at the start of the JOG, positioning and manual pulse generator mode.

(10) M code ON (XE, XF)

In the WITH mode, this signal is turned ON at the start of positioning and in the AFTER mode, it is turned OFF at the completion of positioning.
The "M code ON" signal is turned OFF when the "M code ON" signal is turned OFF.
The "M code ON" signal stays OFF if no M code is specified (M code = 0). It also stays OFF during the execution of a test using the A6GPP.

REMARK

An M code means a code number (1 to 255) assigned by the user to execute miscellaneous functions (clamp/unclamp, start/stop of drill, tool change, etc.) after the completion of position control by the D71.
The corresponding operation can be executed by creating the program to turn ON/OFF the relay circuit at the PC CPU.

(11) Positioning start (Y10, Y11, Y12)

These are positioning start signals and the leading edge of the signal triggers positioning.

(12) Zeroing start (Y13, Y14)

These are zero return signals and the leading edge of the signal triggers zero return operation.

(13) Stop (Y15, Y16)

Terminates the current operation. (If the BUSY signal is on, the "M code ON" signal turns off.)
For restarting the operation see Section 7.3.9.

(14) JOG start (Y17 to Y1A)

JOG operation is executed while the signal is ON. When it goes OFF, axis travel automatically decelerates and stops.

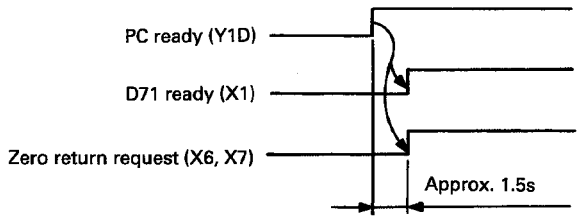
(15) M code OFF (Y1B, Y1C)

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

(16) PC ready (Y1D)

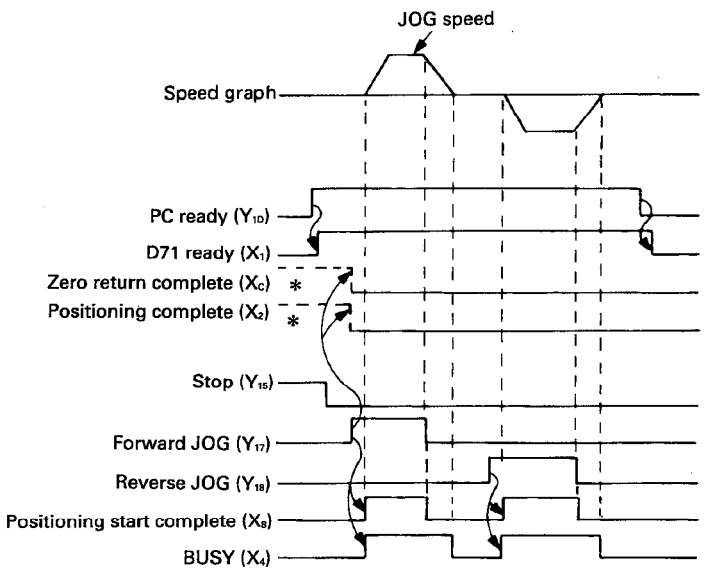
The signal notifies the D71 the normal state of the PC CPU and the signal must be ON at the start of positioning, zero return, and JOG operation in other than the test mode using the A6GPP.
The following control actions occur when the PC ready signal switches from off to on. (The leading edge of the PC ready signal is disregarded if even one axis is in the BUSY state due to the execution of the test using the A6GPP.)

1) Parameter check and initialization;
2) Zero return data check; and
3) Zero return request ON, D71 ready signal ON

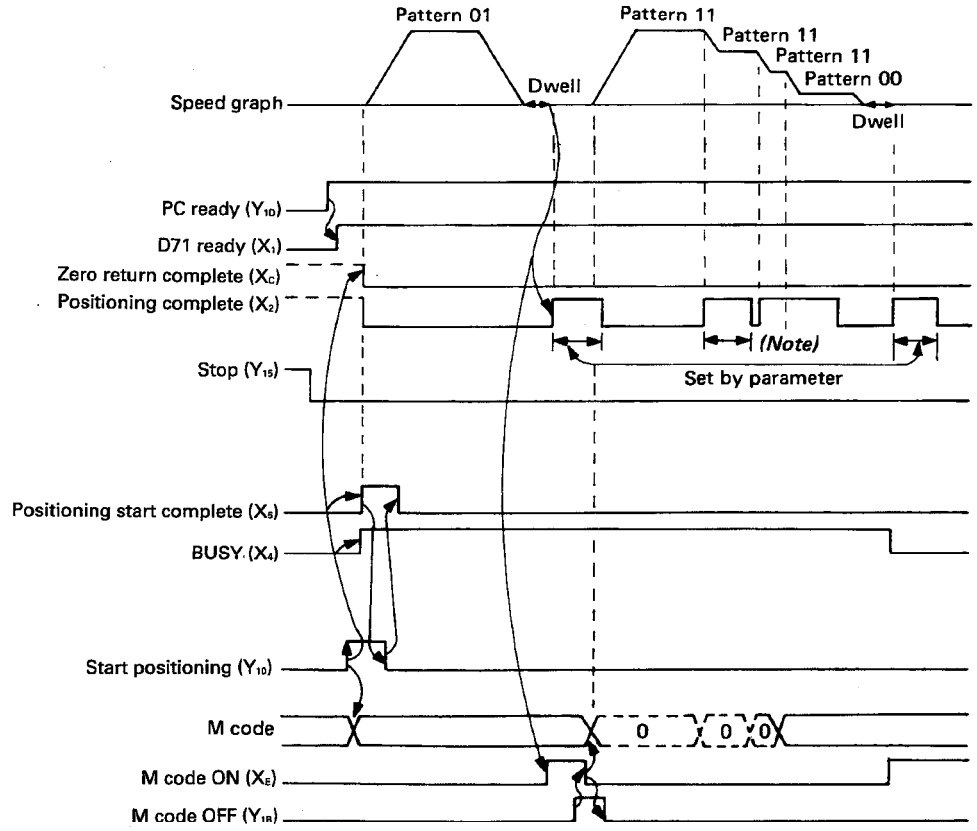


Switching the PC ready signal off while the D71 is BUSY causes positioning to stop, and the "M code ON" signal to be disabled as well as the M code to be cleared. (The processing is executed when neither of the axes is in the BUSY state.)

JOG operation



Positioning operation

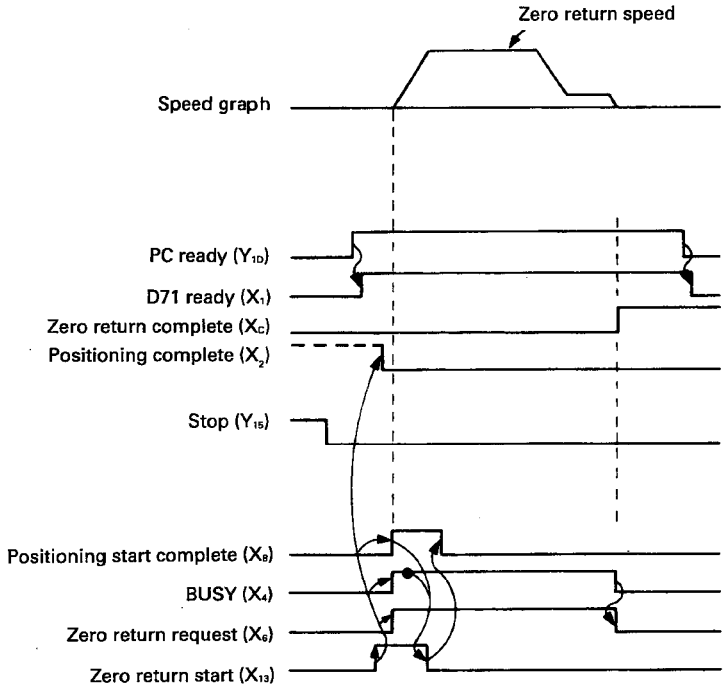


POINT

If positioning operation is shorter than the positioning complete signal output time in the parameter, the positioning complete signal may be output continuously.

*** : If the signal marked with (*) is already ON when the positioning start signal is turned ON, the signal marked with (*) is turned OFF when the positioning start signal is turned ON.**

Zero return



Manual pulse generator operation

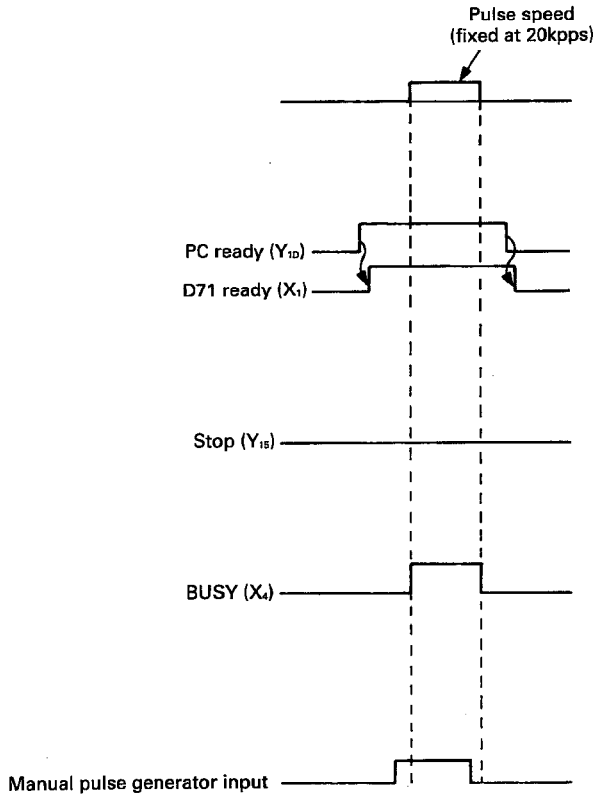


Fig. 3.42 I/O Signal ON/OFF Timing

3.7 I/O Interface with External Equipment

3.7.1 D71 electrical specifications

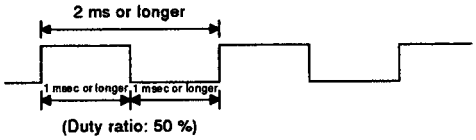
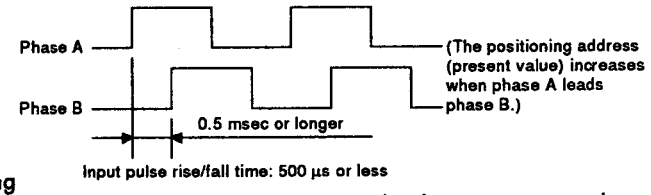
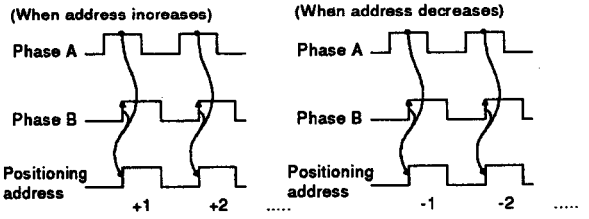
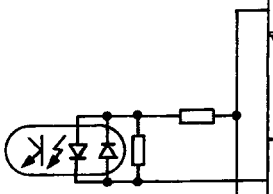
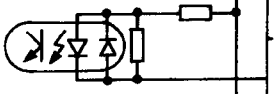
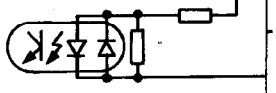
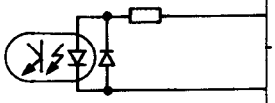
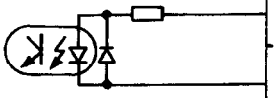
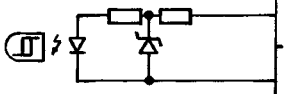
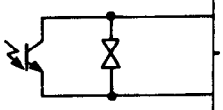
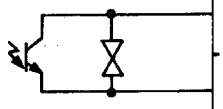
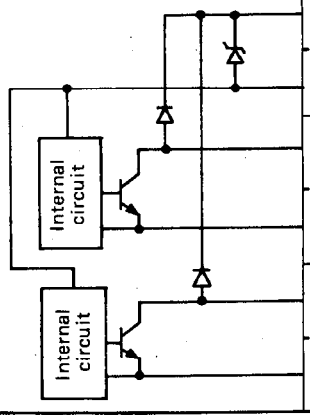
I/O	Signal	Description
Input	Supply power	5 to 24 VDC (Prepare a 4.75 to 26.4 V stabilized power supply.) 50 mA (maximum)
	Drive unit ready (READY) Stop signal (STOP) Near-point dog signal (DOG)	High : (Supply power voltage – 1 V) or more (Input current: 0.3 mA or less) Low : (Supply power voltage – 3 V) or less (Input current: 2.5 mA or more)
	Manual pulse generator A phase (PULSER A) Manual pulse generator B phase (PULSER B)	**Input signal voltage level** **HIGH level: voltage - 4.5 V or higher; current - 3 mA or higher** **LOW level: voltage - 1.0 V or less; current 0 mA** **Pulse width**  (Duty ratio: 50 %) **Phase difference**  Input pulse rise/fall time: 500 μs or less Timing **The positioning address set by the manual pulse generator varies as shown below:** 
	Zero phase signal (PGO)	High : (Supply power voltage – 1 V) or more (Input current: 0.3 mA or less) Low : (Supply power voltage – 3 V) or less (Input current: 2.5 mA or more) Pulse width : 50 μs or more Pulse rise time : 3 μs or less Pulse fall time : 3 μs or less
Output	Start signal (START) Error counter clear (CLEAR)	Output form : Open collector Load voltage : 4.75 to 26.4 VDC Load current : 10 mA (maximum) **Max. drop voltage when ON :0.6 V or less** **Leakage current when OFF :0.1 mA or less**
	Forward feed pulse (PULSE F) Reverse feed pulse (PULSE R)	Output form : Open collector, output duty ratio 50 % ± 10 % Load voltage : 4.75 to 26.4 VDC Load current : 20 mA (maximum) Use within the range 2 to 15 mA. If load current is less than 2 mA, add a load resistor.

Table 3.10 D71 Electrical Specifications

3.7.2 I/O interface electrical details

I/O	Circuit	Pin Number X axis	Pin Number Y axis	Signal	Description
Input		1	1	Power supply (+)	5 to 24 VDC (external supply)
		2	2	Drive unit ready $\overline{\text{READY}}$	(1) Low when the servo drive unit is normal and able to receive the feed pulses. (2) D71 checks the drive unit ready signal prior to start. If not ready, the D71 outputs a zero return request. (3) Arrange for drive unit errors, e.g. control power error to set this signal high. (4) Switching this signal to high during positioning stops the operation. Resetting the signal will not restart operation.
		3	3	Stop signal $\overline{\text{STOP}}$	(1) Low to stop positioning. Signal duration 20 ms or more. (2) Input switches start signal ($\overline{\text{START}}$) off (high). Start signal will not then restart.
		4	4	Near-point dog signal $\overline{\text{DOG}}$	(1) The signal used to detect the near point in zero return operation. The signal is low when the near-point dog is detected. (2) In the zero return operation using the zero-phase signal, the zero point is established at the grid point appearing first after the near-point dog is released.
		14	14	Manual pulse generator A phase $\overline{\text{PULSER A}}$	Refer to Table 3.10.
		15	15		
		16	16	Manual pulse generator B phase $\overline{\text{PULSER B}}$	Refer to Table 3.10.
		17	17		
		8	8	Zero-phase signal $\overline{\text{PGO}}$	(1) The zero-phase signal is used as the zero point signal for zero return operation. Generally, the zero-phase grid signal of a pulse encoder is used. The signal is low at the zero-phase. (2) For the zero return operation that uses a stopper with the zero return complete signal input externally, this signal is used.first after the near-point dog is released.
		9	9		
Output		10	10	Start $\overline{\text{START}}$	(1) Low while positioning. (2) On (low) during feed pulse output and dwell. This signal can be used as the brake release signal for the servomotor equipped with a mechanical brake. However, the circuit should usually be configured externally so that the mechanical brake operates when the servo system power is switched OFF, the servo motor is switched OFF, or at the occurrence of an alarm. Feed pulse output after this signal turns on.
		11	11		
		12	12	Error counter clear $\overline{\text{CLEAR}}$	The signal is output two times at the start of zero point return - before output of feed pulses and after the stop of feed pulse output - to reset the droop pulses in the deviation counter of the servo unit. $\overline{\text{CLEAR}}$ 20 ms (1st time) 20 ms (2nd time) Before feed pulse output After feed pulse output
		13	13		
		5	5	(+) 24 V power (+) 5 to 15 V power	5 to 24 VDC (external supply) 18 for 5 to 15 VDC 5 for 24 VDC **POINT** Supplied from either one. Improper wiring may fail the module.
		18	18		
		6	6	A type: Forward feed pulse $\overline{\text{PULSE F}}$ / B type: Feed pulse $\overline{\text{PULSE}}$	B type: Forward and reverse feed pulses. The direction of operation is judged from the direction sign ($\overline{\text{SIGN}}$). $\overline{\text{PULSE}}$ $\overline{\text{SIGN}}$ 25 ms + direction travel — direction travel
		7	7		
		19	19	Reverse feed pulse $\overline{\text{PULSE R}}$ / Direction sign $\overline{\text{SIGN}}$	A type: $\overline{\text{PULSE F}}$ $\overline{\text{PULSE R}}$
		20	20		

Select A or B type by parameter setting. (For details, refer to Section 3.4.1.)

Table 3.11 D71 I/O Interface

3.8 Battery Specifications

Item \ Type	A6BAT
Type	Thionyl chloride lithium battery
Nominal voltage	3.6 VDC
Guarantee period	5 years
Total power failure time	300 days (7200 hours)
Application	Power failure back-up for buffer memory
Size mm (inch)	ϕ 16 (0.62) x 30 (1.17)

Table 3.13 Battery Specifications

4. HANDLING

4.1 Handling Instructions

(1) The module case is plastic. Protect the D71 from mechanical shock and vibration.

(2) Pay attention so that off-cuts of wires, metal chips generated during drilling and other conductive materials will not enter the module. If any of such materials enter the module, remove them immediately.

(3) Switch off the PC power supply before connecting the I/O cable or removing the unit cover.

(4) Turn off the PC and drive unit powers before connecting or disconnecting the drive unit.
Connectors are designed to be plugged in only in the correct direction. Make sure that the connector is fit in the correct direction and insert it to the mating connector straight. After inserting the connector securely tighten the two fixing screws.
If a drive unit is not connected to the D71, fit the cover to the connector.

(5) When connecting an A6GPP or AD71TU to a D71, do so only when the D71 is not BUSY.
Connectors are designed to be plugged in only in the correct direction. Make sure that the connector is fit in the correct direction and insert it to the mating connector straight. After inserting the connector securely tighten the two fixing screws.
If an A6GPP or AD71TU is not connected to the D71, fit the cover to the connector.

4.2 Nomenclature

4.2.1 Nomenclature

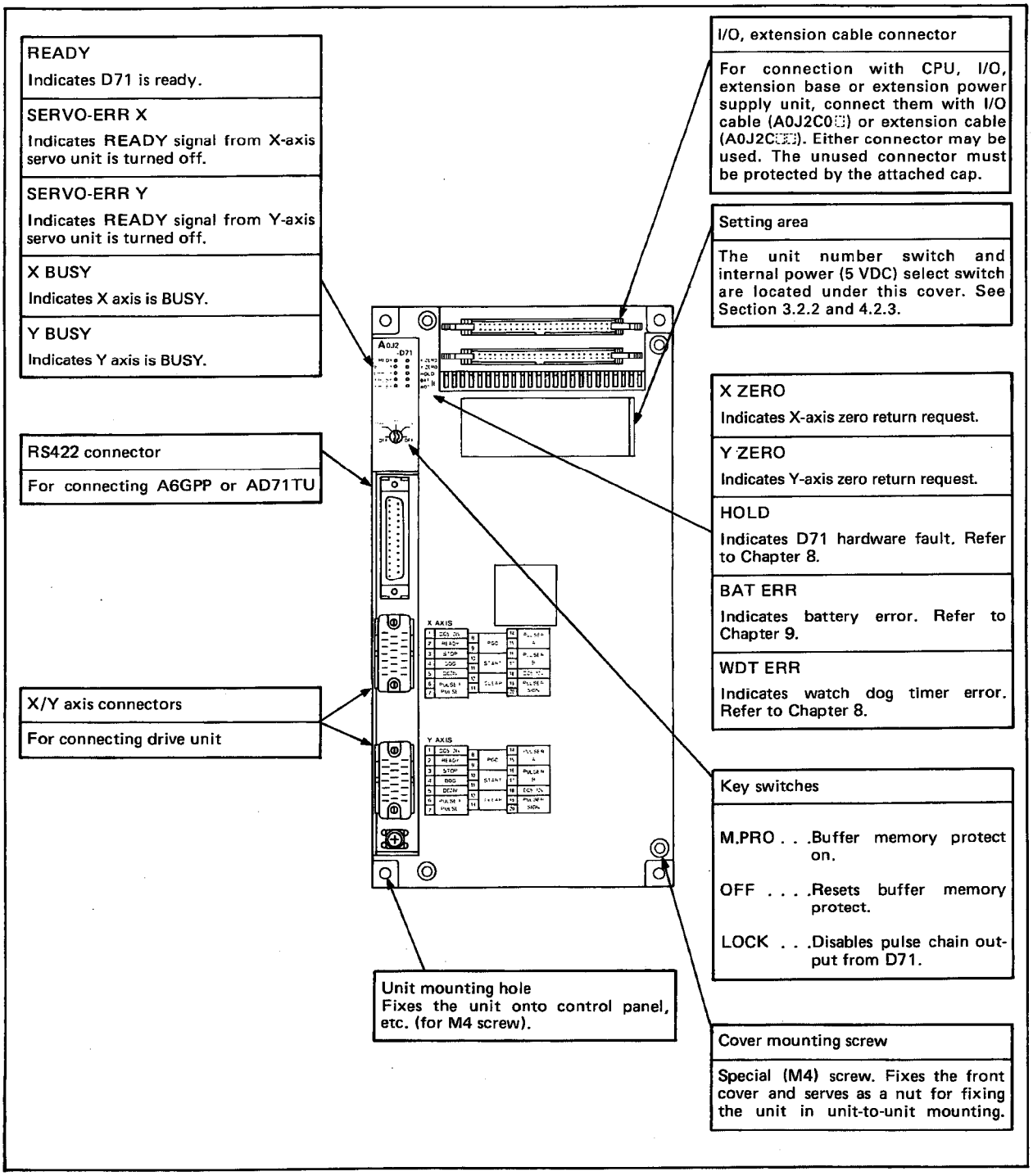


Table 4.1 D71 Nomenclature

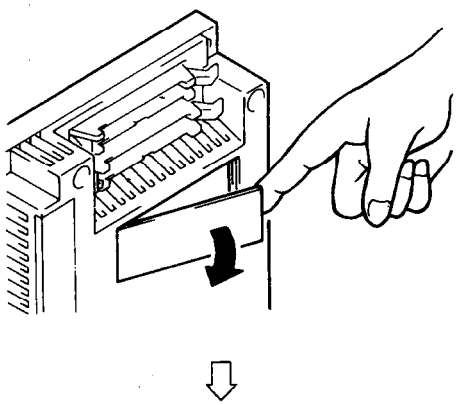
4.2.2 Setting the unit number

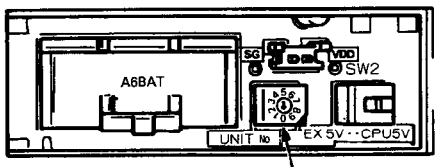
Remove the access cover from the unit as shown on the right.

Select 0 to 7 as appropriate on the unit number switch (using a screwdriver).

Replace the access cover.

Complete





	Unit Number Setting							
	0	1	2	3	4	5	6	7
Rotary switch setting for unit number setting								

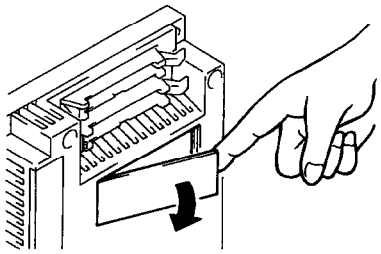
POINTS

(1) The unit number must match the stage number of the unit and should be set from 0 to 7. The same number should not be repeated on several units to prevent input/output errors.

(2) X and Y addresses are determined by the unit number. See Chapter 6.

4.2.3 Setting the internal power supply (5 VDC)

Remove the access cover from the unit as shown on the right.

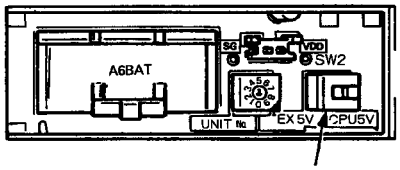


Set the internal power (5 VDC) select switch as appropriate.
CPU5V position: For supplying the power form the built-in power supply of the CPU unit.
EX5V position: For supplying the power from an extension power supply unit.

Replace the access cover.

Complete

Inside



Internal power (5 VDC) select switch

	Internal Power (5 VDC) Setting	
	Supplied from CPU built-in power supply	Supplied from extension power supply unit
Internal power (5 VDC) select switch	EX5V ◄——► CPU5V	EX5V ◄——► CPU5V

*Black area indicates the switch position.

POINTS

(1) When supplying the power from the CPU built-in power supply, the module will fail to operate correctly if the switch is set in the EX5V position. Make sure that the switch is set in the correct position before starting test operation.

(2) See Section 6.2 of the A0J2CPU User's Manual (CPU unit edition) for information on systems using the A0J2PW extension power supply.

4.2.4 Checking the internal power supply (5 VDC)

Use a circuit tester.

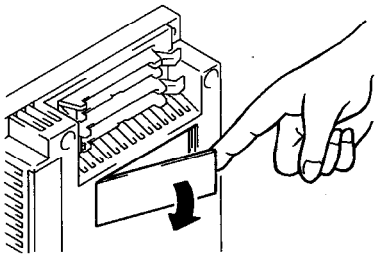
Remove the access cover from the unit as shown on the right.

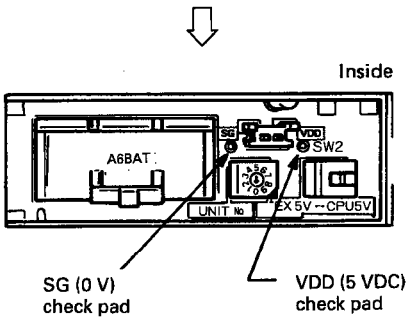
Measure the DC voltage between the VDD pad (+) and SG pad (–) on the printed circuit board.

Check that the internal power is between 4.75 and 5 VDC.

Replace the access cover.

Complete

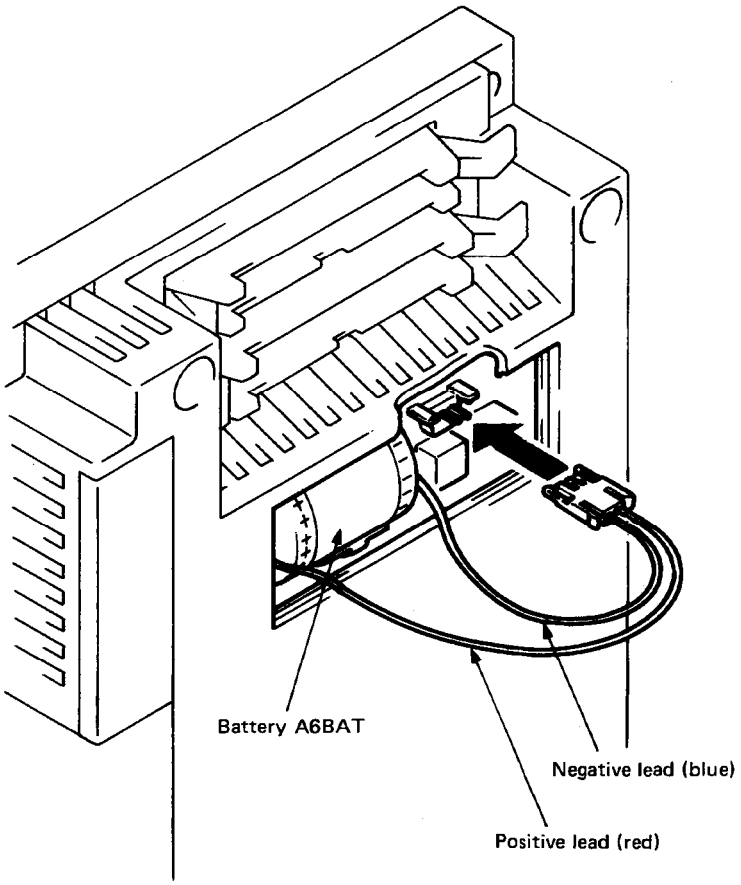




(Positions of the SG and VDD vary depending on I/O modules.)

4.2.5 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 D71. (For battery life, 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

5.1 Installation Environment

The following installation environments are unsuitable for this equipment.

(1) Ambient temperature outside the range 0 to 55 °C.

(2) Ambient humidity outside the range 10 to 90 %RH.

(3) Excessive condensation (e.g. due to sudden temperature changes)

(4) Corrosive and/or combustible gasses.

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

(6) Direct exposure to sunlight

(7) In the vicinity of strong power and magnetic fields.

(8) Excessive vibration and shock transmitted directly to the main unit.

5.2 Wiring

5.2.1 Wiring precautions

Appendix 5 gives examples of drive unit connection to the AD71. This section describes the cautions on connecting an external equipment (includes a drive unit) to the AD71.

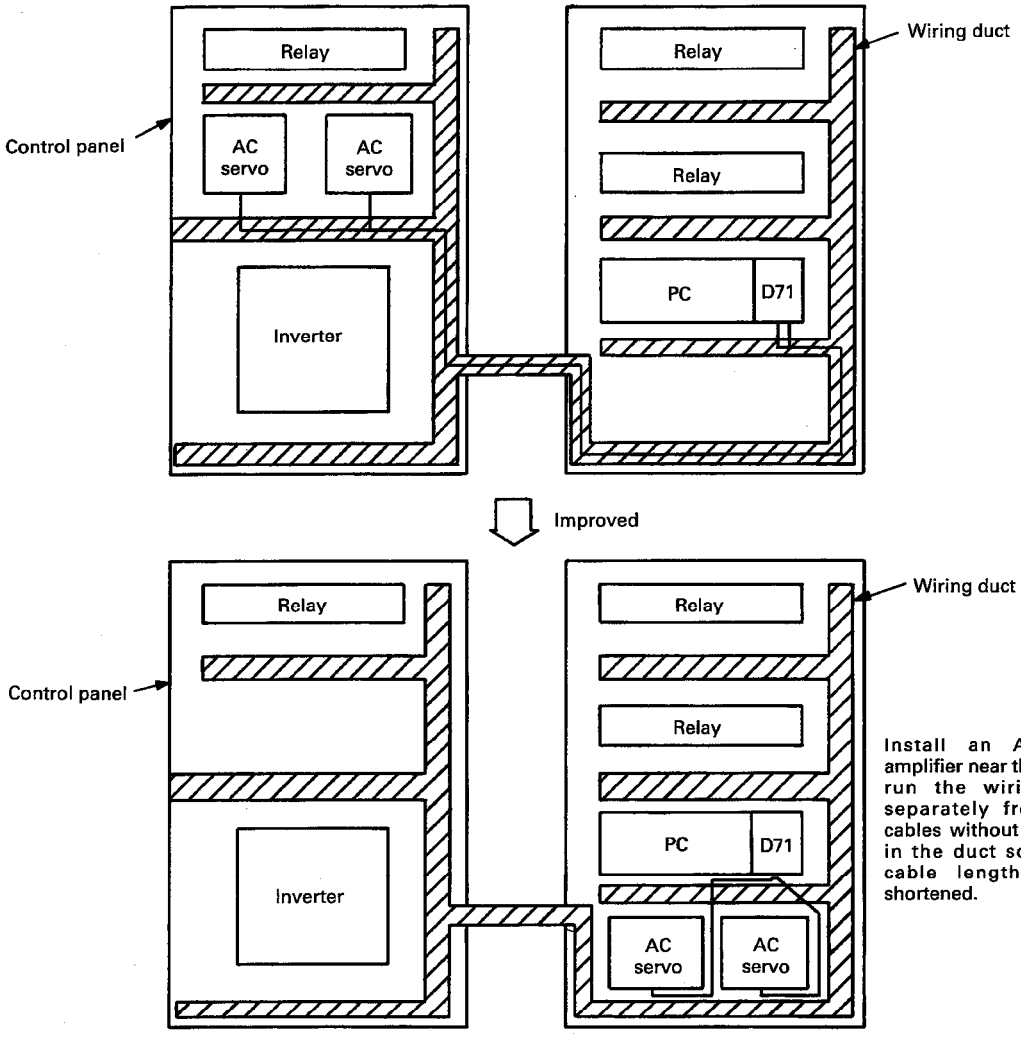
(1) Connection cable lenght

Generally, the length of the cable connecting a drive unit to the D71 is 1 to 3 meters. However, cable length varies depending on the drive unit specifications.
Before connecting a drive unit, check the specifications of the drive unit.

(2) I/O signal wiring

- Do not run the signal cables with or close to the power cables and main circuit cables.
- Separate I/O signal wires from other cables and use separate conduct where applicable.
- If the signal cables must be run in bundle with the power cables or main circuit cables, use the collective shield cable and ground the signal cables at the PC side.
- When running I/O signal wires in metal piping, this should be grounded.
- If the connection cable is long or runs close to the main circuit cable, etc., the module may malfunction due to noise.

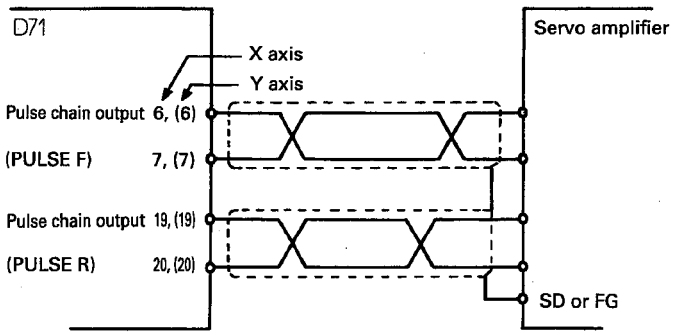
Incorrect and improved examples are shown below.



Install an AC servo amplifier near the D71 and run the wiring cable separately from other cables without running it in the duct so that the cable length can be shortened.

REMARK

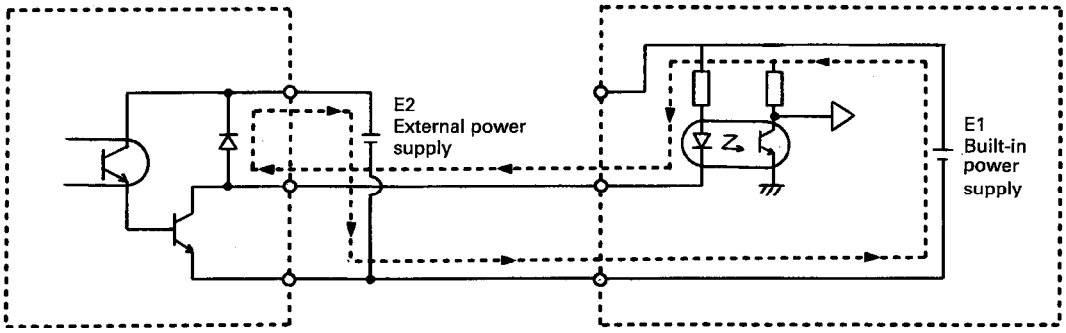
In the environment where the cable connecting a servo amplifier to the AD71 will generate excessive noises, use the twisted-pair shield cable for the connection to the pulse chain output terminals of the D71 separately from the shield cables used for other connections.



(3) Cautions on 24 VDC wiring

If the power is supplied from an external power supply although the servo drive unit has a built-in 24 VDC power supply, a revolving path circuit is sometimes formed causing malfunctioning of the module. Therefore, do not use an external power supply if the built-in power supply is available.

Revolving path circuit



If E1 > E2
Current flows the servo unit pulse input lines even when the pulse output of the D71 is off.

5.2.2 Drive unit connector

A connector is supplied with the D71 as an accessory.
When connecting a cable, disassemble the connector as shown in Fig. 5.1. Disassemble and reassemble the connector in the following steps.

1) Loosen and remove the four screws.
2) Open the covers at the connection area side and detach them.
3) Connect the cable (see the instructions (1) to (3) in the following page.).
4) Put the connection area in one of the covers.
5) Insert the fixing screws.
6) Place the other cover.
7) Tighten the four screws. Screws having longer thread portions are for cable clamps.
   Pay attention so that small screws and nuts will not be lost when the connector is disassembled.

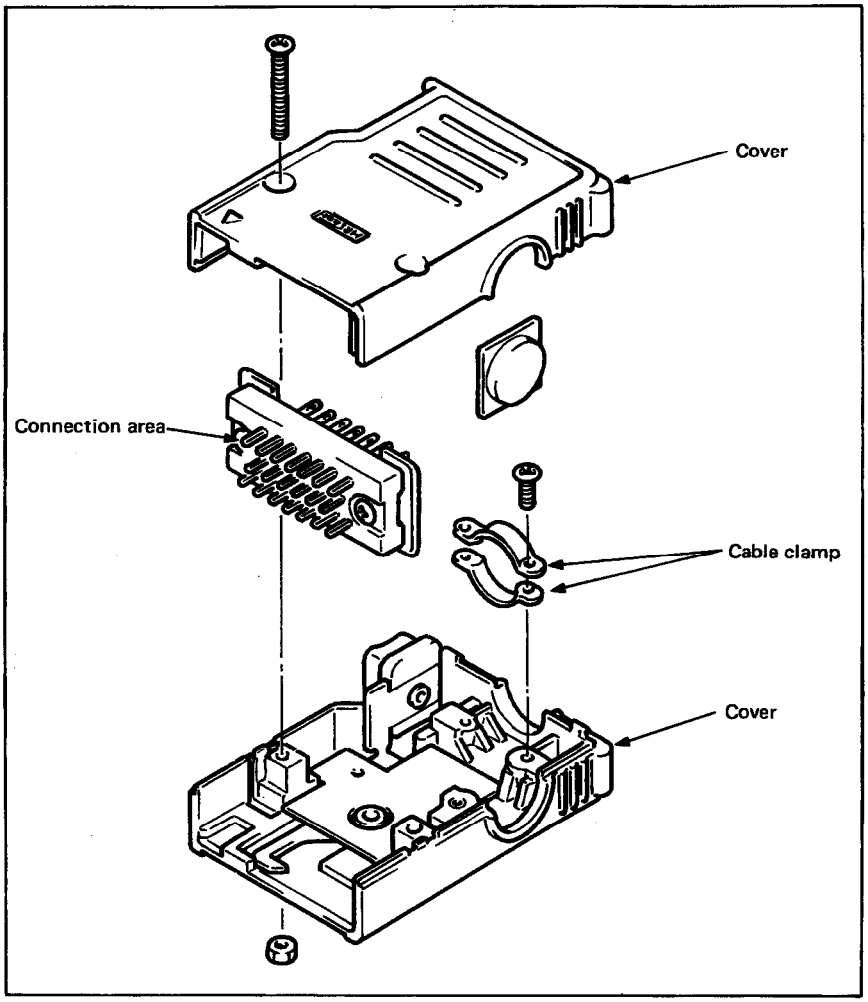


Fig. 5.1 Connector

5.2.3 Connecting the cable

Fig. 5.2 shows the connector pin configuration. Connect the wires correctly meeting the I/O numbers given in Section 3.7.

(1) Use wires smaller than 0.3 mm². If wires thicker than this limit are used, the wires cannot be passed through the cable clamps.

(2) Solder the wires. Strip the wire coating appropriately so that bare wires and solder whisker do not cause short circuit. It is recommended to place insulation tubes.

(3) Arrange wires so that they are evenly held in the cable clamp. When the number of wires is small, wind the tape on them so that the wires are securely held by the cable clamp.

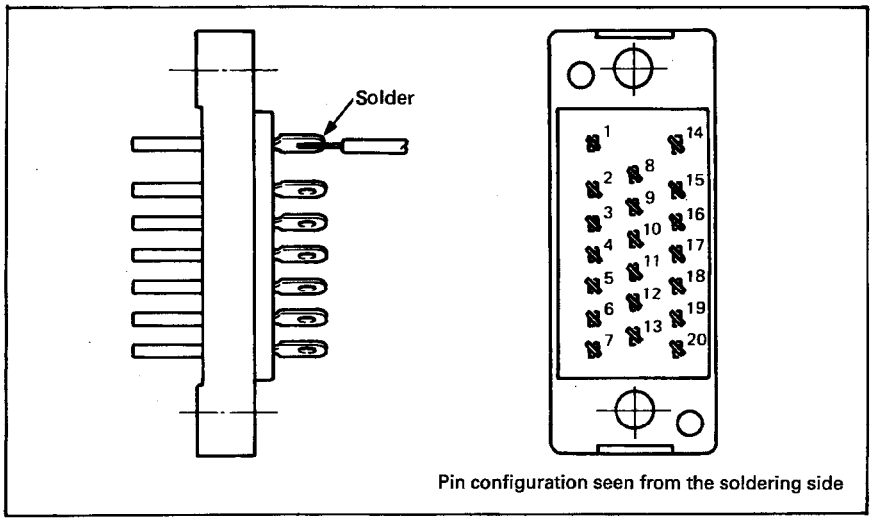


Fig. 5.2 Connection Area

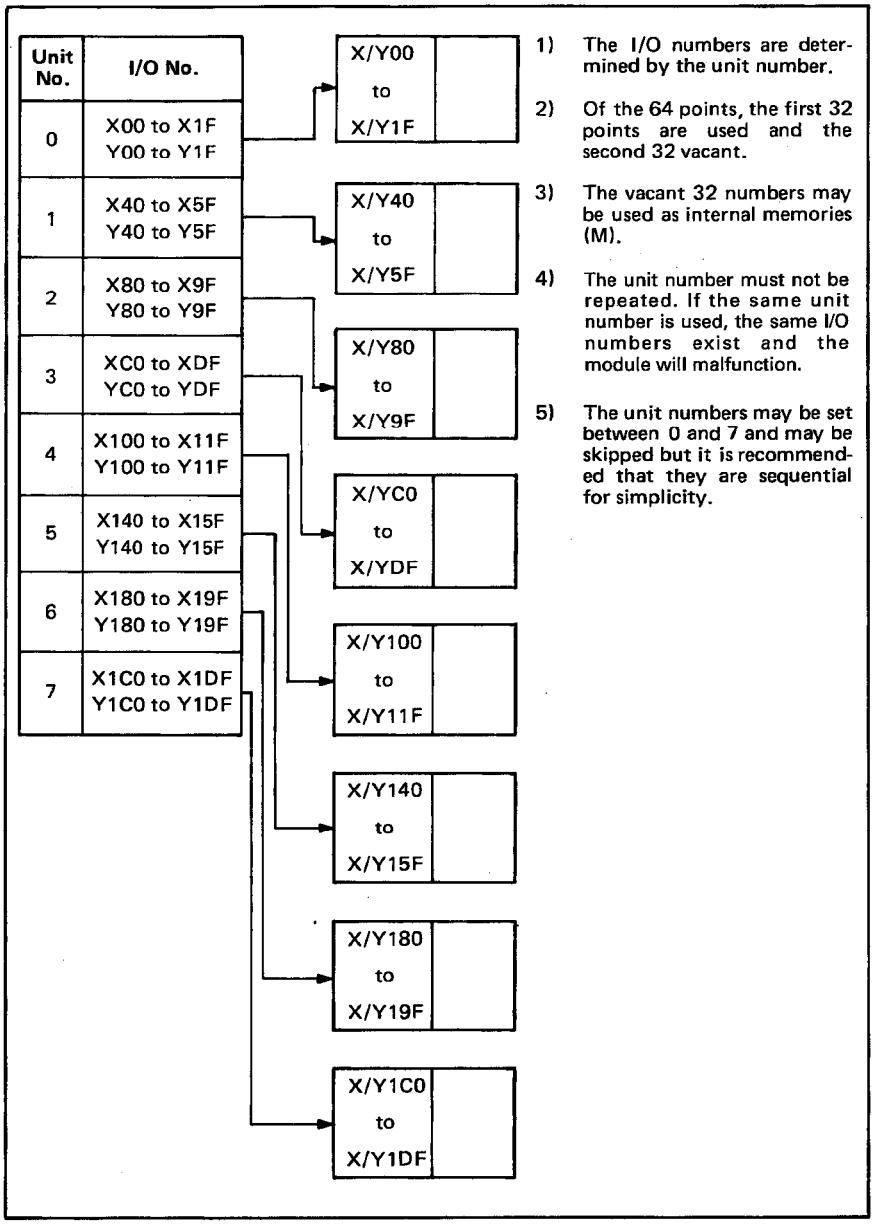
6. D71 I/O NUMBER ASSIGNMENT IN A0J2 SYSTEM

6.1 I/O Number Assignment

I/O number assignment is one of the requirements for constructing a system. I/O numbers must be assigned correctly as explained below.

(1) Input (X) and output (Y) numbers are hexadecimal. (0 to F)

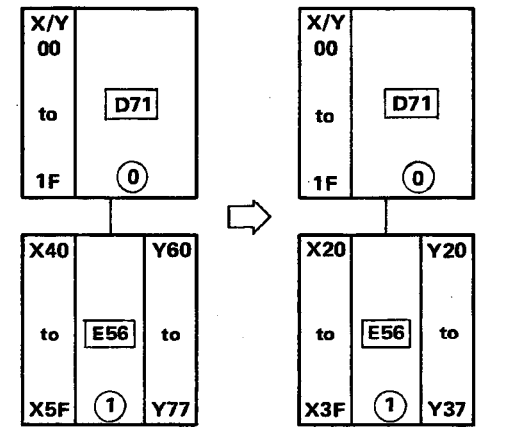
(2) I/O numbers are determined by the unit number. 64 points are occupied per unit.



6.2 Parallel I/O Assignment for Use with the Remote Station

Serial or parallel I/O assignment may be used for the I/O number assignment at a remote station containing the A0J2P25/R25. For details, refer to the A0J2 Data Link Unit User's Manual.
Notes on the parallel I/O assignment are given below.

POINT



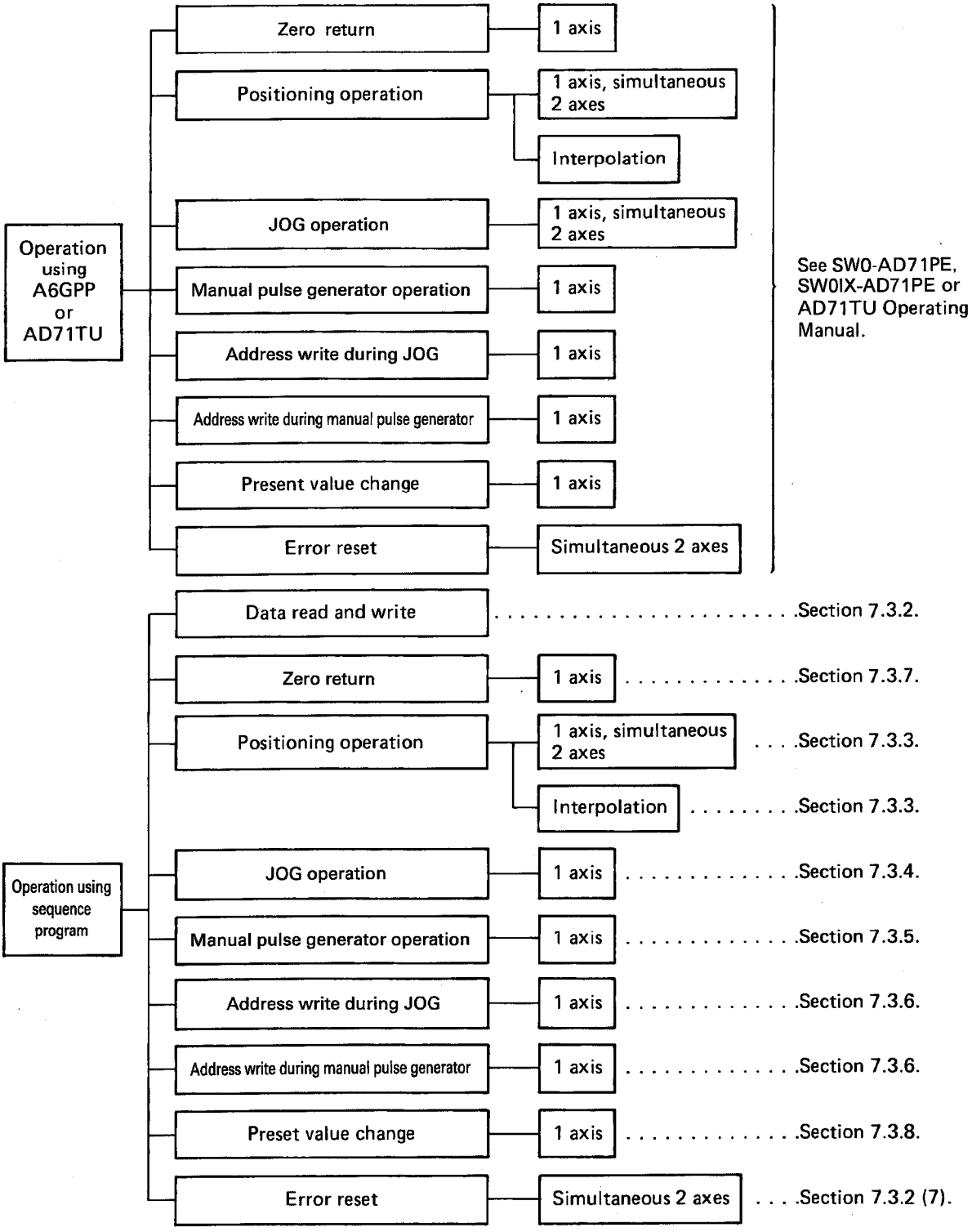
- When the parallel I/O assignment is used, the vacant 32 points of the first unit are skipped. In the example shown on the left, the E56 I/O unit begins from X20.

IB (NA) 66133-A

7. PROGRAMMING

7.1 Writing Programs

7.1.1 Program structure



REMARK

Unless otherwise specified, I/O numbers used in this manual assume that the D71 unit number has been set to 0.
If other number is assigned, change the X and Y numbers according to the assigned number.
The numbers of devices (M, D, T, etc.) used in the example program can be changed as required.

(1) The A6GPP represents an intelligent GPP and to be referred to as "GPP".

(2) The A0J2CPU is referred to as "A0J2CPU".

7.1.2 Notes on programming

(1) Sequence program condition

The following program steps should be used with the D71.

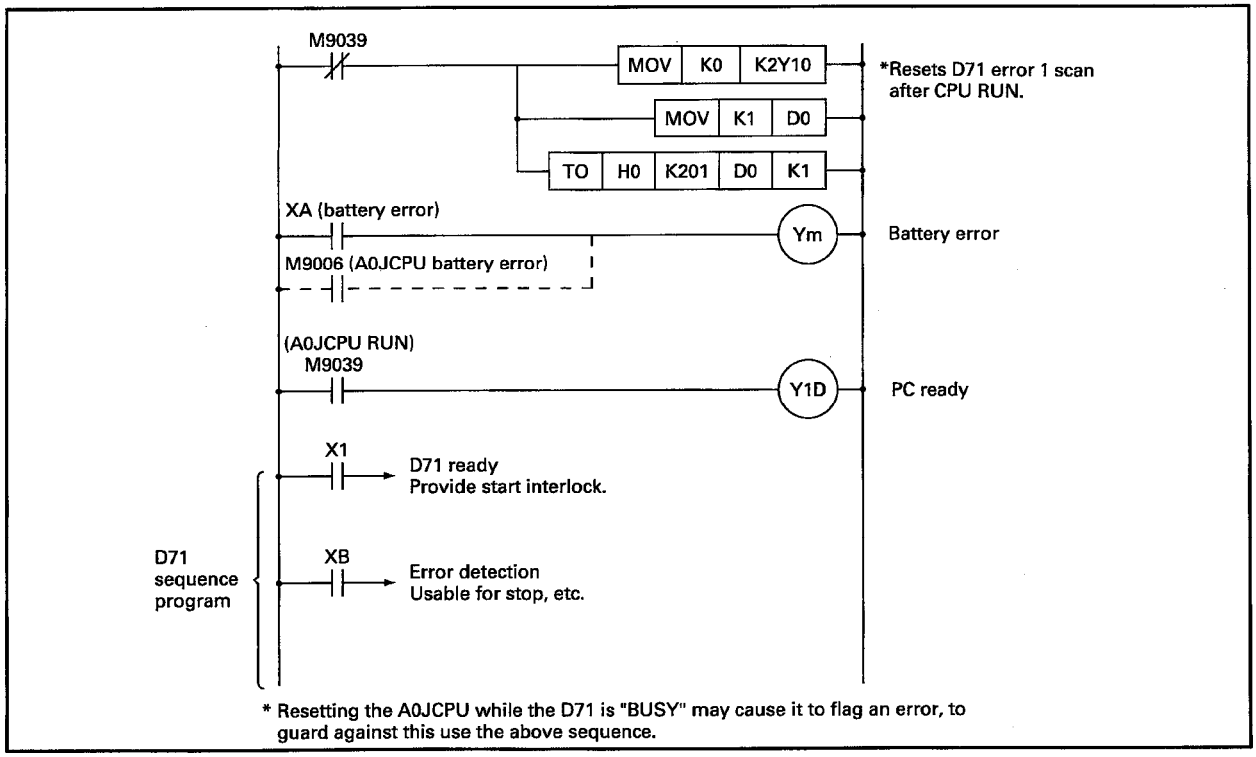


Fig. 7.2 Initial Program

(2) PC ready reset

If a sequence program checks errors, the program should be created so that the PC ready (Y1D) is reset at the detection of an error.

(3) Zero return

Zero return must always be executed after switching on the power.
(At power on, the present value in the positioning module cannot be guaranteed.)

(4) Near-point dog limit switch

Use a limit switch with high contact reliability. If the near-point dog signal is not input during zero return, an axis keeps traveling at the zero return speed.

(5) Overrun precautions

The upper and lower stroke limits will only be operable if the D71 is functioning normally. To ensure the safety of the system, it is recommended to install an external circuit that switches off the power to the motor by using the stroke end limit switches.

(6) Emergency stop signal

Since the STOP input signal is the deceleration and stop signal to be used in positioning, it cannot be used for emergency stop. In case of an emergency, stop the drive unit using the externally provided contact.

(7) Upper/lower stroke limit values

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

(8) Speed limit value

The speed limit parameter should be checked before operation.

(9) JOG speed

Set the JOG speed low when initially setting up the system.

(10) Speed for interpolation

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.

7.2 Operation Using GPP

It is possible to operate the D71 for positioning using the test mode of an A6GPP or AD71TU.
To operate the D71 in this manner, the following conditions apply.

1) Install a GPP or AD71TU to the D71.

2) Operation can be performed with the PC ready signal (Y1D) or D71 ready signal (X1) on or off.

3) Data cannot be transferred from or to the GPP when the D71 is "BUSY" and the GPP (or AD71TU) 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.)

7.3 A0JCPU Programming

7.3.1 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 D71 data must therefore be written to the buffer memory by the GPP.

(2) The parameters and zero return data is checked at power on and when the PC ready signal (Y1D) changes from OFF to ON.

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

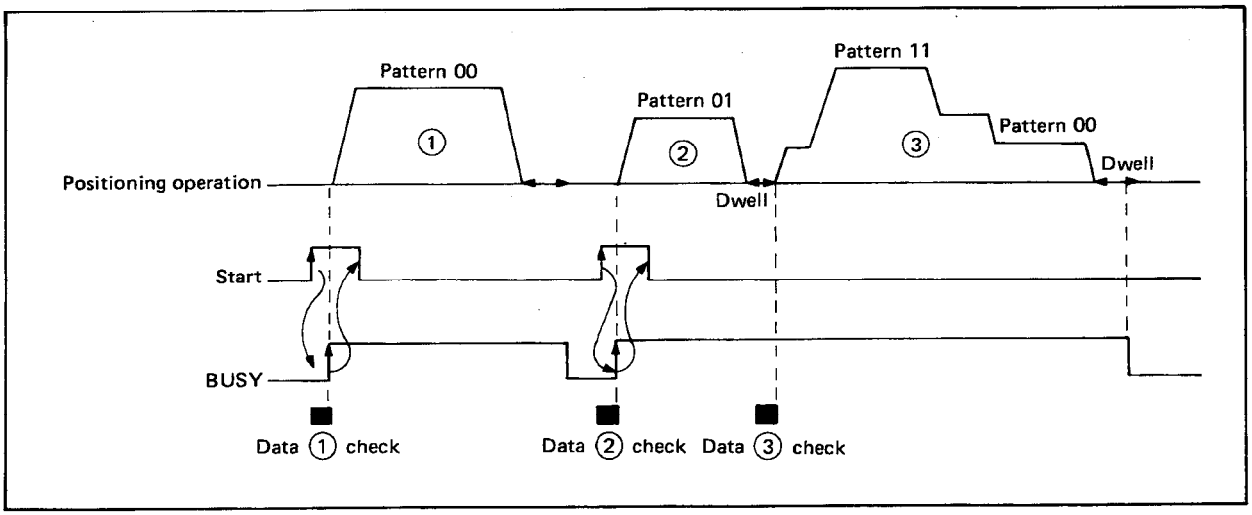


Fig. 7.3 Positioning Data Check

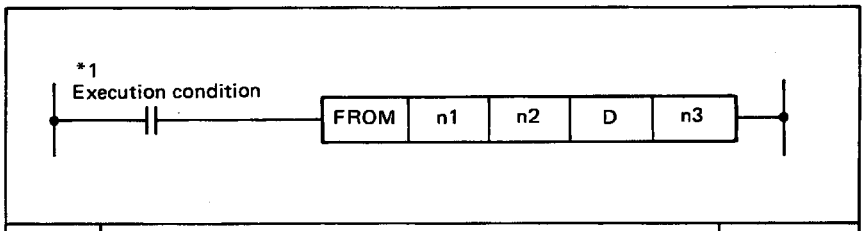
An error is flagged if the total distance requested exceeds the upper (or lower) stroke limit when incremental position addressing is used.

7.3.2 Data communication with PC program

(1) Read and write instructions

(a) Read from D71·····FROM instruction

[Format]



Symbol	Description	Device
n1	Upper 2 digits of the 3-digit head I/O number to which the D71 has been assigned (e.g. 4 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
n3	Number of words to be read	K, H

Fig. 7.4 Read Instruction FROM

Example: To read one word from buffer memory address 600 (X axis output speed) to D2 with the D71 assigned to X140 to X14F and Y150 to Y15F.

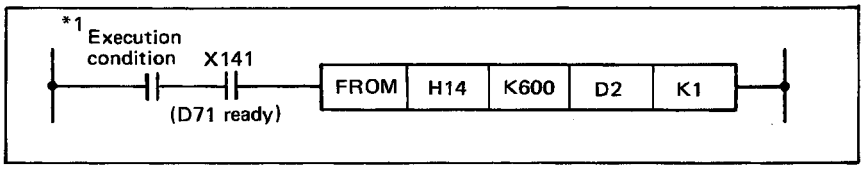


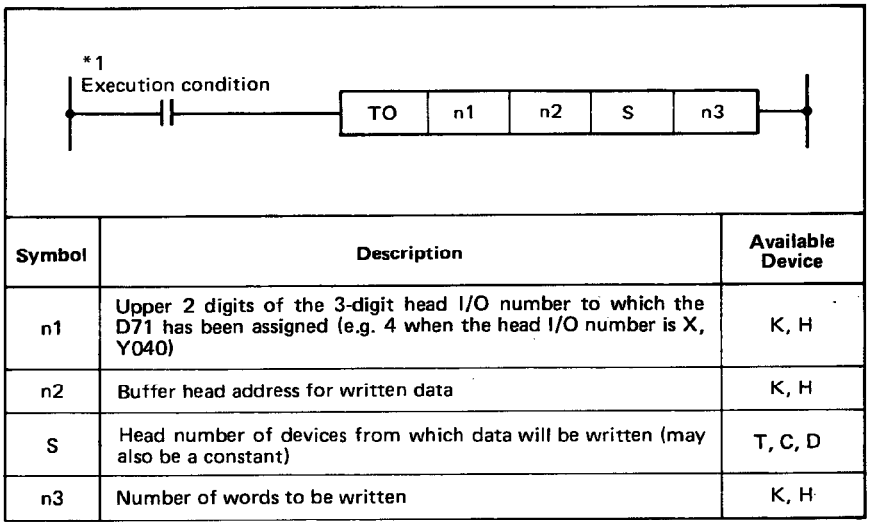
Fig. 7.5 Read Example

REMARK

*1: It is recommended to convert the execution condition into pulse.

(b) Write to D71·····TO instruction

[Format]



Symbol	Description	Available Device
n1	Upper 2 digits of the 3-digit head I/O number to which the D71 has been assigned (e.g. 4 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
n3	Number of words to be written	K, H

Fig. 7.6 Write Instruction TO

Example: To write positioning information to buffer memory address 3872, with the D71 assigned to X40 to 4F and Y50 to 5F.

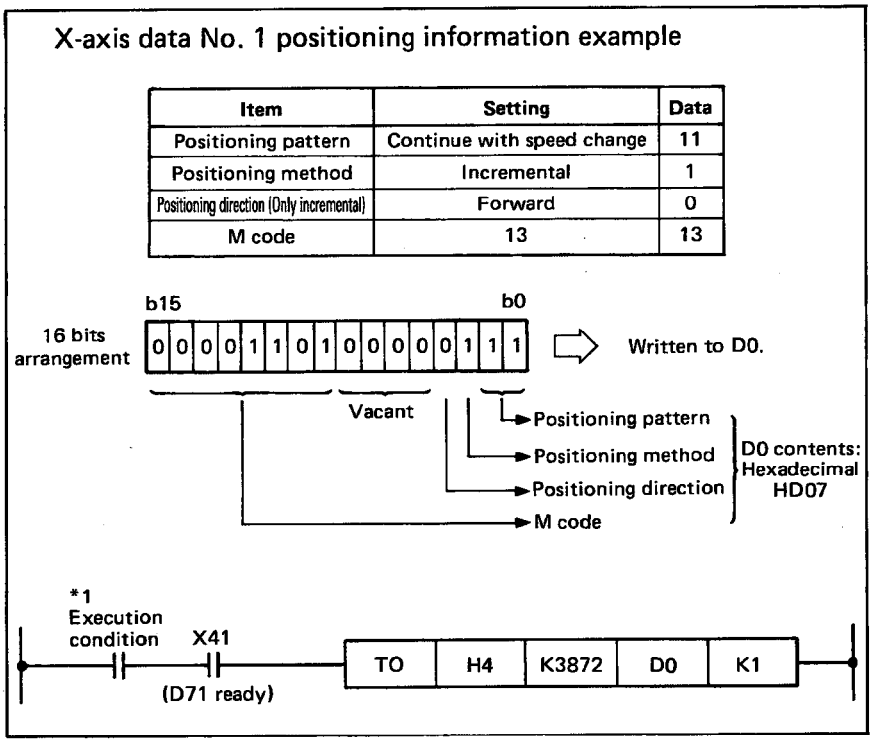


Fig. 7.7 Write Example

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.

REMARK

*1: It is recommended to convert the execution condition into pulse.

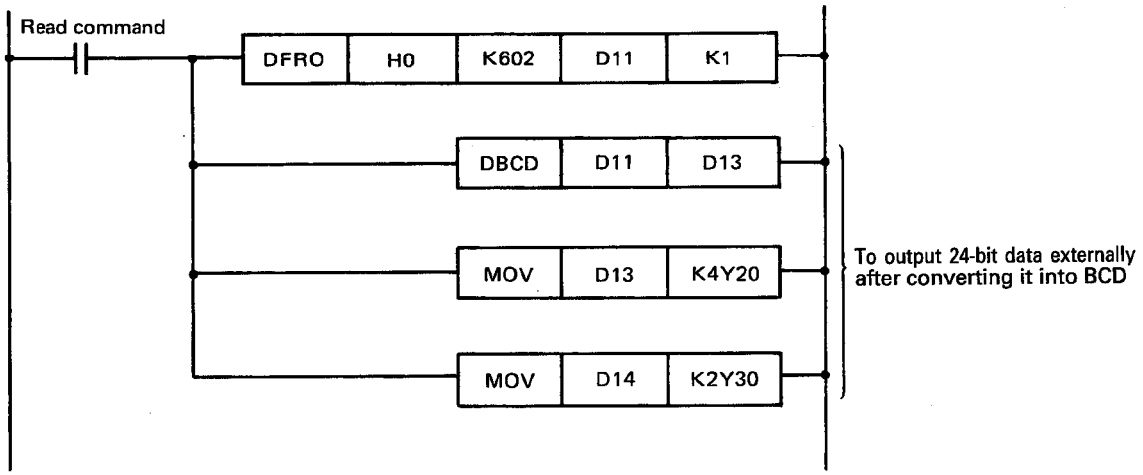
(2) Present value read program

[Example] Indication of X axis present value

[Notes]
(1) During positioning, the present value as stored in the D71 buffer memory lags behind the actual value by about 0.1 seconds.
(2) The present value is two words long.
(3) The example program assumes the present value of the X axis is smaller than 999999.

[Data transfer]

[Program]

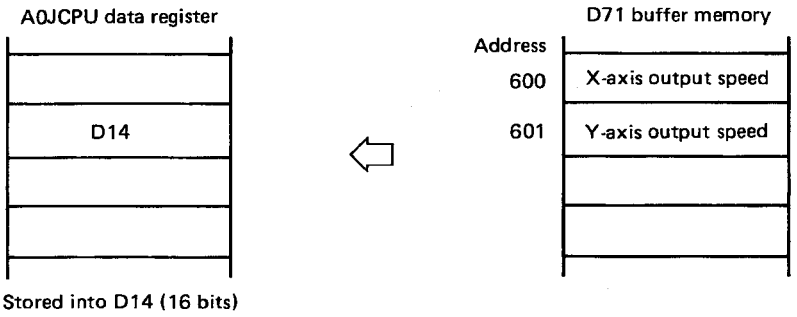


(3) Speed read while BUSY

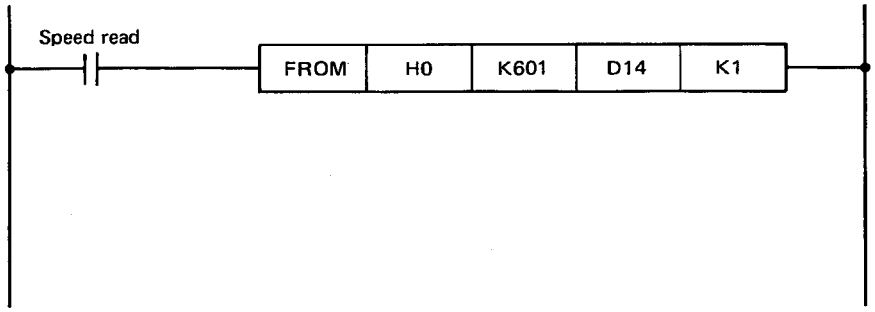
[Example] Y axis speed read

[Note] None

[Data transfer]



[Program]

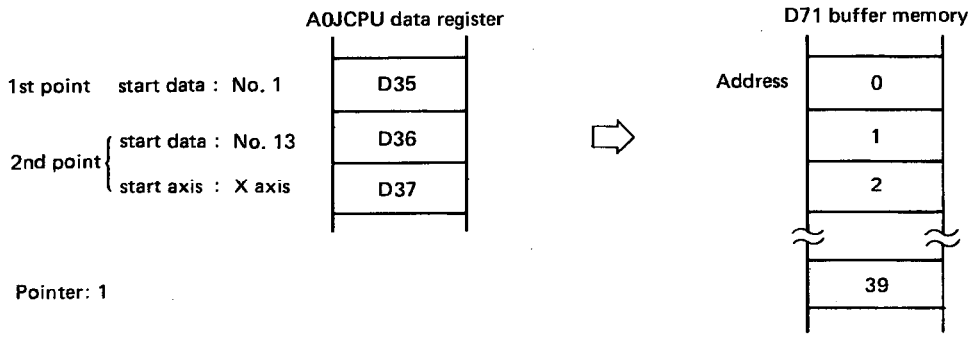


(4) Data number and pointer write

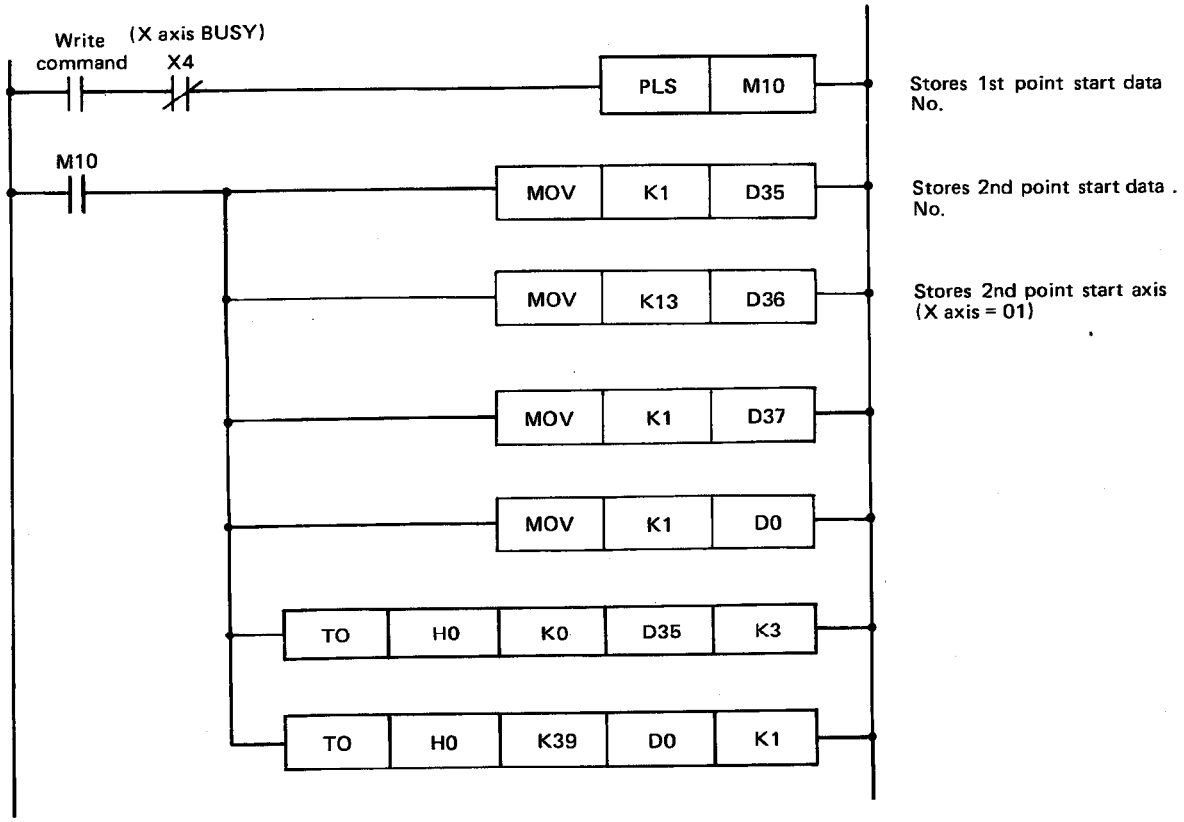
[Exmaple] X axis data number and pointer write

[Note] The relevant axis must not be BUSY.

[Data transfer]



[Program]



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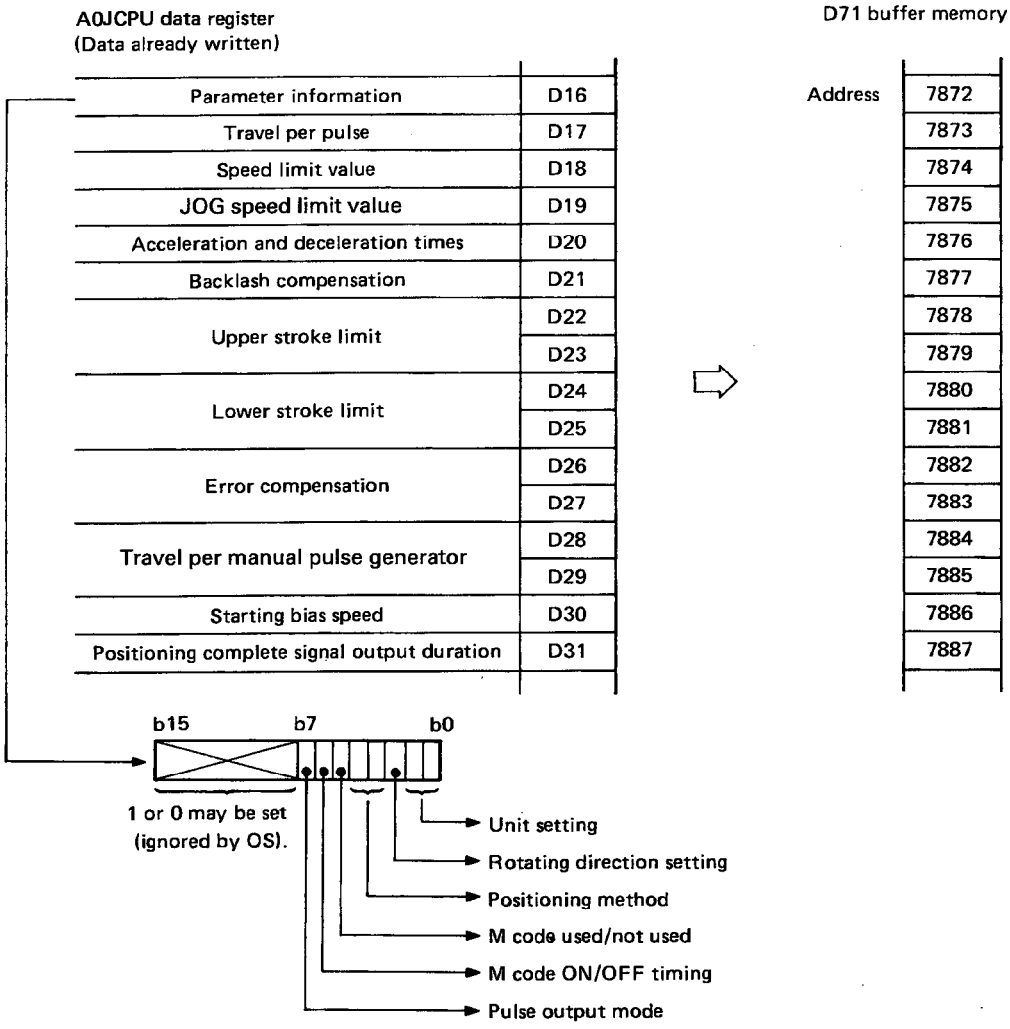
(5) Parameter and zero return data write

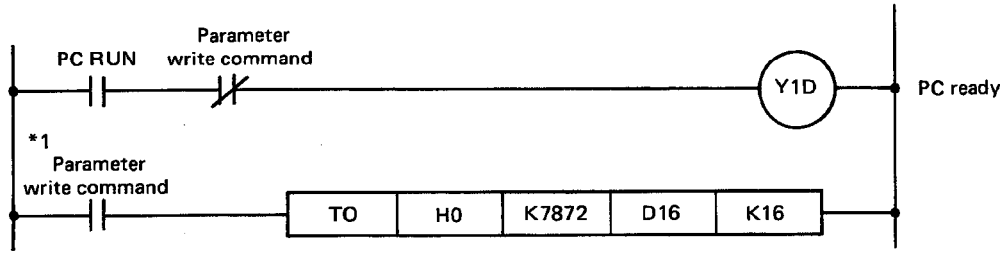
[Example] X axis parameter write – Assume that the parameters are already in D16 to 31

[Note] When writing parameters and zero return data, the PC ready signal (Y1D) should be OFF.

[Data transfer]



[Program]



REMARK

*1: It is recommended to convert the execution condition into pulse.

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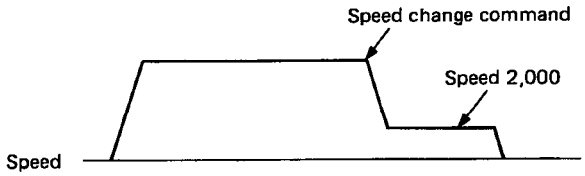
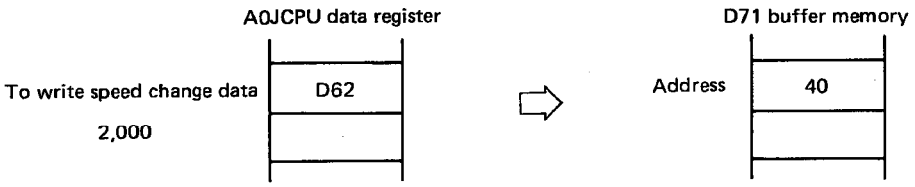
(6) Speed change when BUSY

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

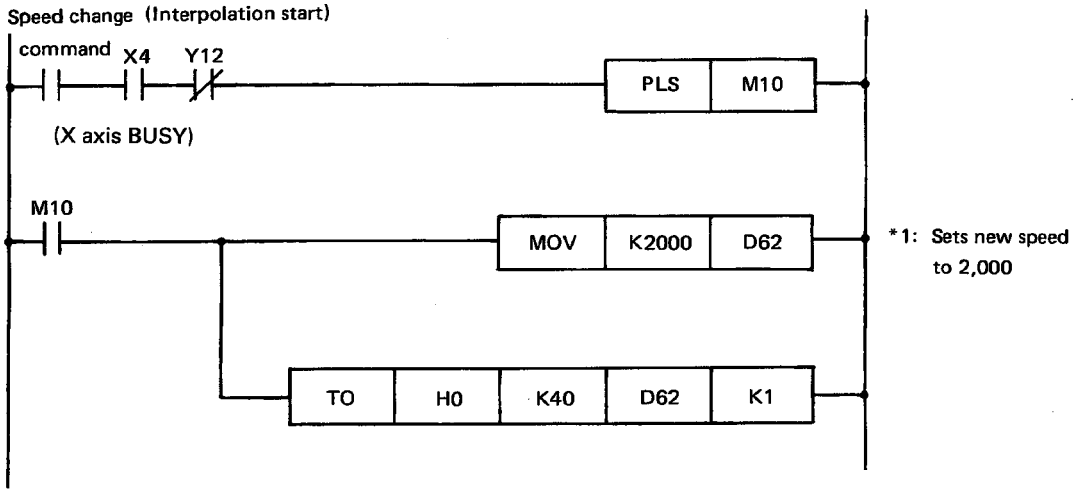
[Note] Speed cannot be changed during interpolation.



[Data transfer]



[Program]



POINT

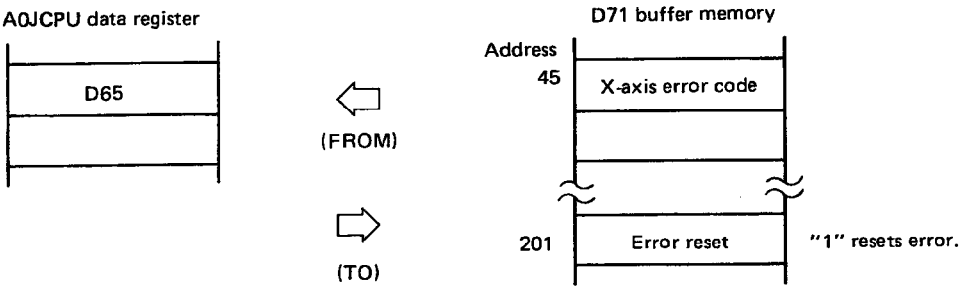
***1: When new speed is specified 2,000 in the program, actual speed is 20,000 mm/min (i.e. 2,000 x 10^1).**

(7) Error reset

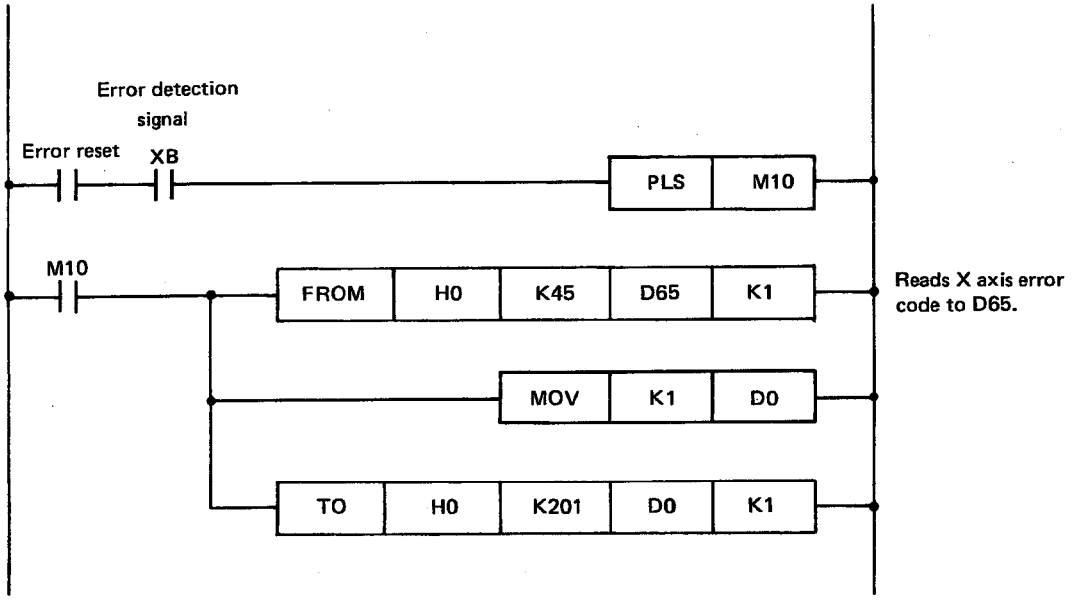
[Example] To read an error code and then reset it.

[Notes]
(1) The error detection (XB) 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]



REMARK

Writing "1" to the buffer memory error reset address resets the error code and XB. The error reset address is then automatically changed to "0".

7.3.3 Start positioning

Start programs are largely classified into the following two types.

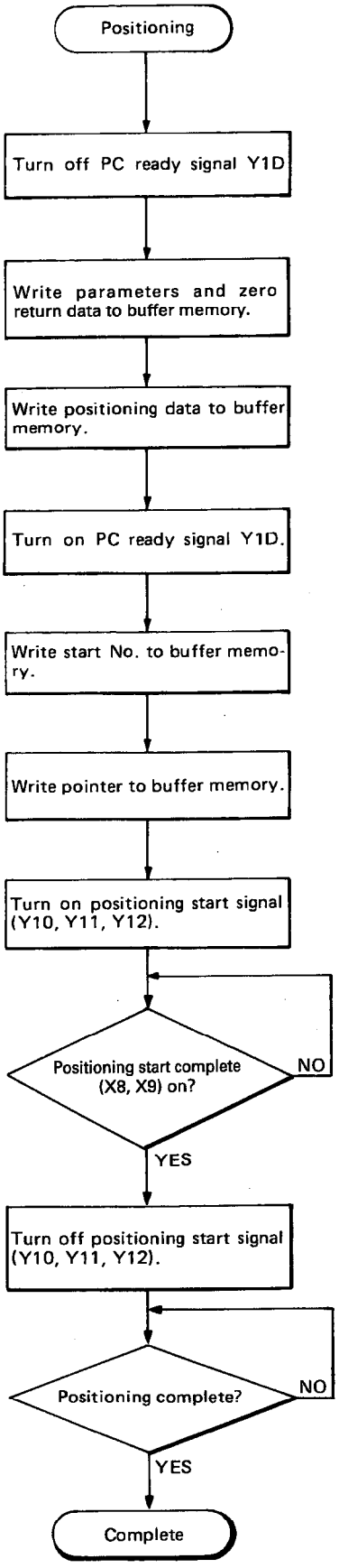
(a) When the setting data has been written by an GPP or AD71TU

In this case, a program can be simple since it is not necessary to make communications between an A0JCPU and the D71 to set the data.
This method will be convenient for the operation where the positioning data is less than 400 points and the set data is not changed frequently.

(b) When the setting data has been set externally

If positioning data is changed frequently, it is necessary to create a program that writes or reads the data at buffer memory through communications between an A0JCPU and the D71.
In this case, a large number of registers and large programs are necessary; operating time will be longer accordingly. Therefore, the programs must be simplified as long as possible.

(1) Flow chart



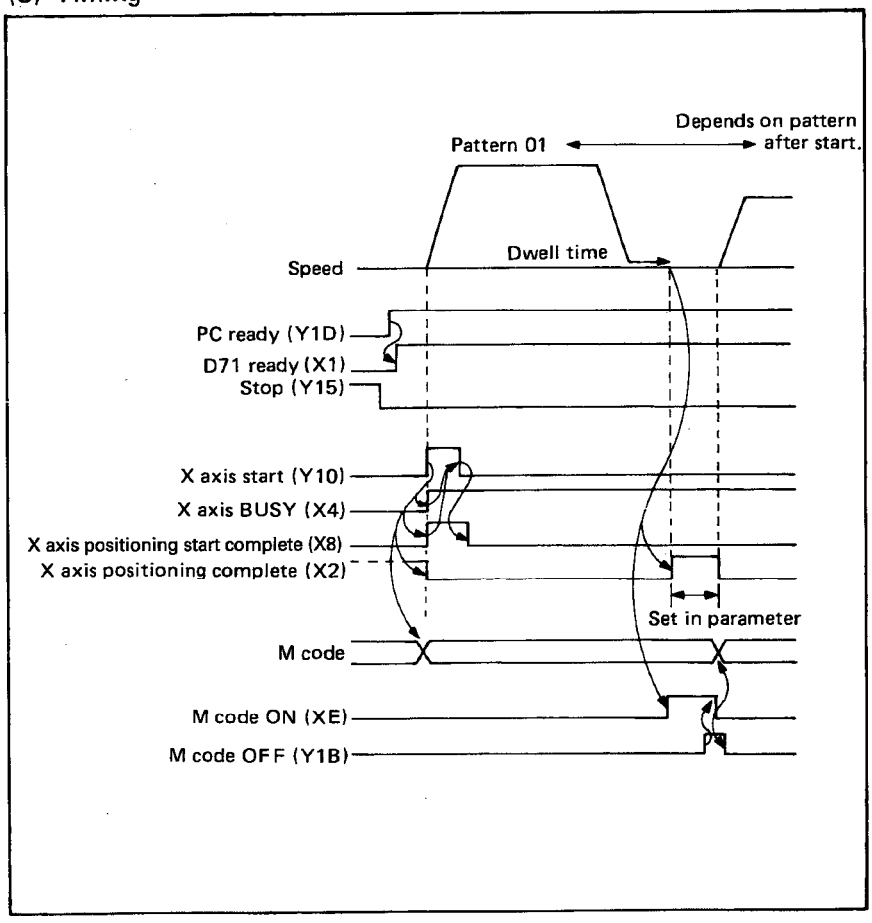
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	D71 ready (X1)	ON	*
	Relevant axis BUSY (X4, X5)	OFF	
	Relevant axis positioning start complete (X8, X9)	OFF	
	Relevant axis M code ON (XE, XF)	OFF	
	Relevant axis stop (Y15, Y16)	OFF	
	PC ready (Y1D)	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, X1 and Y1D may be off.

Table 7.1 Start Conditions

(3) Timing



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(4) Program

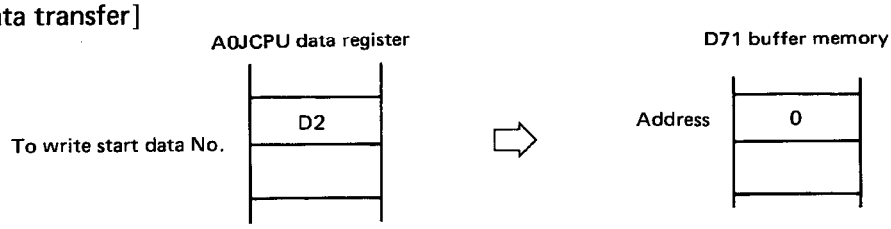
(a) Operating data already written from GPP

The following program assumes that parameters, zero return data, and positioning data have already been written to the D71 buffer memory using the GPP or AD71TU.

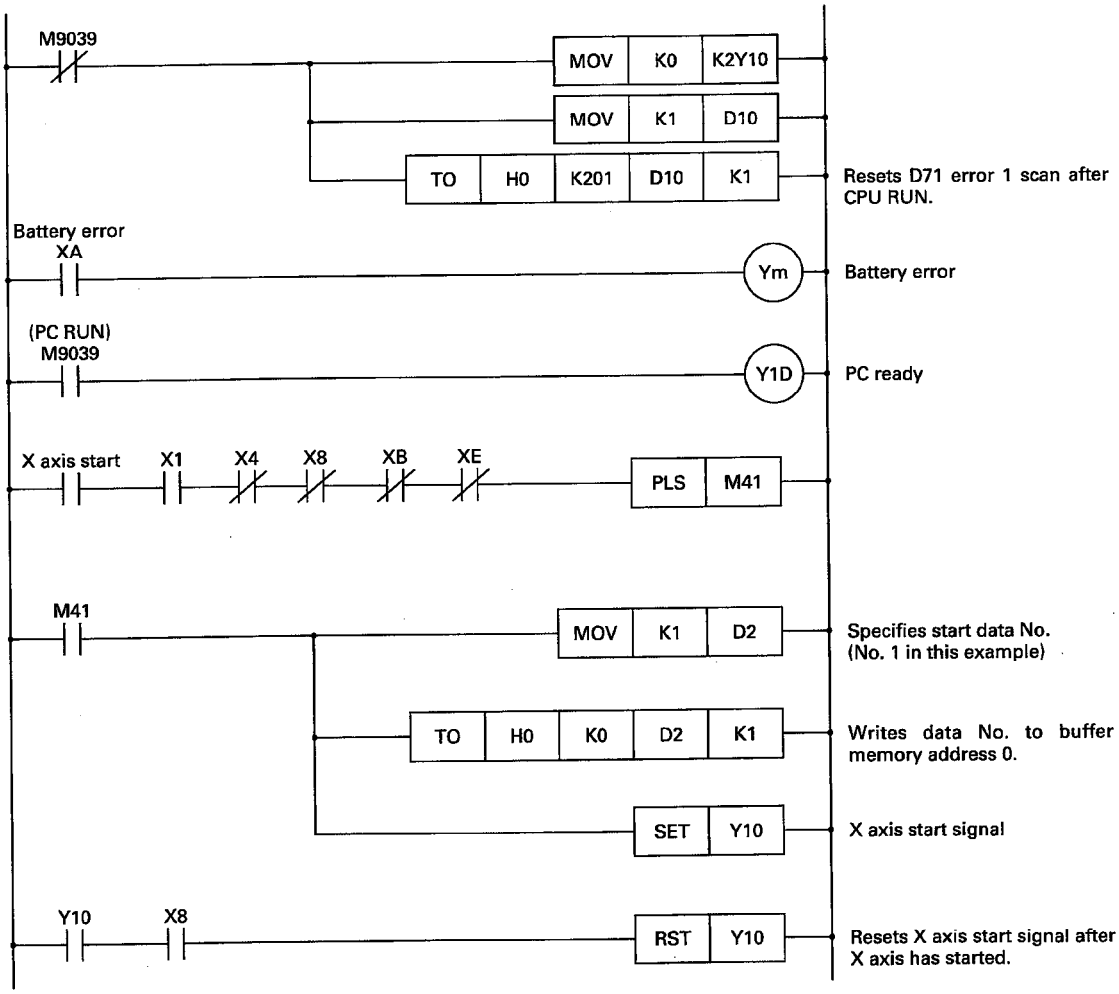
[Example] To start at X axis data number 1.

[Notes]
(1) For start conditions, see Table 7.1.
Provide interlocks as required depending on actual applications.
(2) Actual positioning operation depends on data No. 1 pattern setting.
(3) For stop during positioning, refer to Section 7.3.9.

[Data transfer]



[Program]



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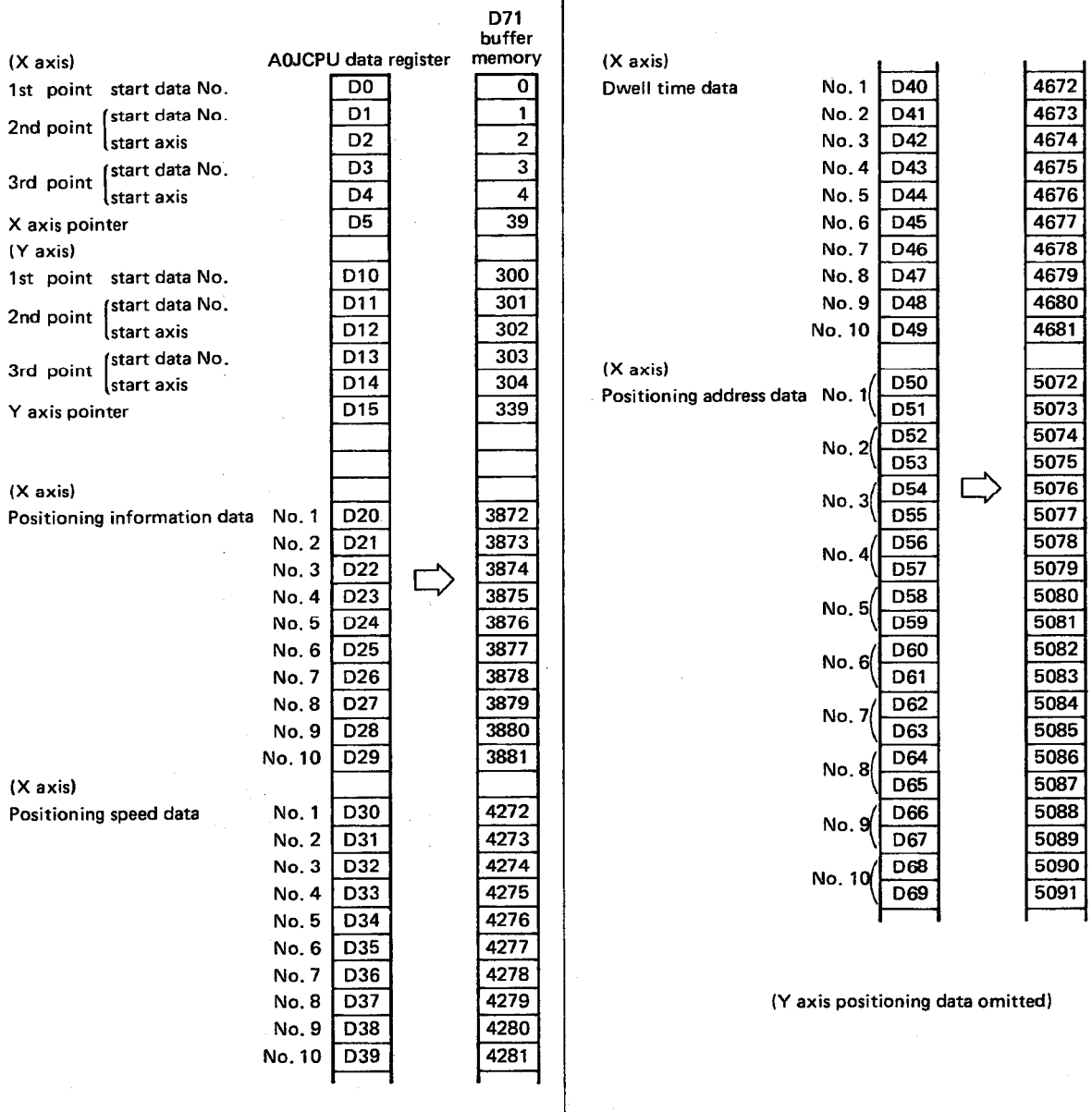
(b) Setting data specified using sequence program

Assumes data is stored in registers as shown in Table 7.2, page 7-18.

[Notes]
(1) For start conditions, see Table 7.1.
Provide interlocks as required depending on actual applications.
(2) For stop during positioning, refer to Section 7.3.9.
(3) To write parameters and zero return data, turn off PC ready signal (Y1D).

[Data transfer]



(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 manual pulse generator	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 manual pulse generator	D152	7904
	D153	7905
Starting bias speed	D154	7906
Positioning complete signal output duration	D155	7907
(X axis zero return data)		
Zero address	D160	7912
	D161	7913
Zero return speed	D162	7914
Zero return creep speed	D163	7915
Zero return dwell time	D164	7916
Torque limit	D165	7917
Zero return information	D166	7918
(Y axis zero return data)		
Zero address	D170	7922
	D171	7923
Zero return speed	D172	7924
Zero return creep speed	D173	7925
Zero return dwell time	D174	7926
Torque limit	D175	7927
Zero return information	D176	7928

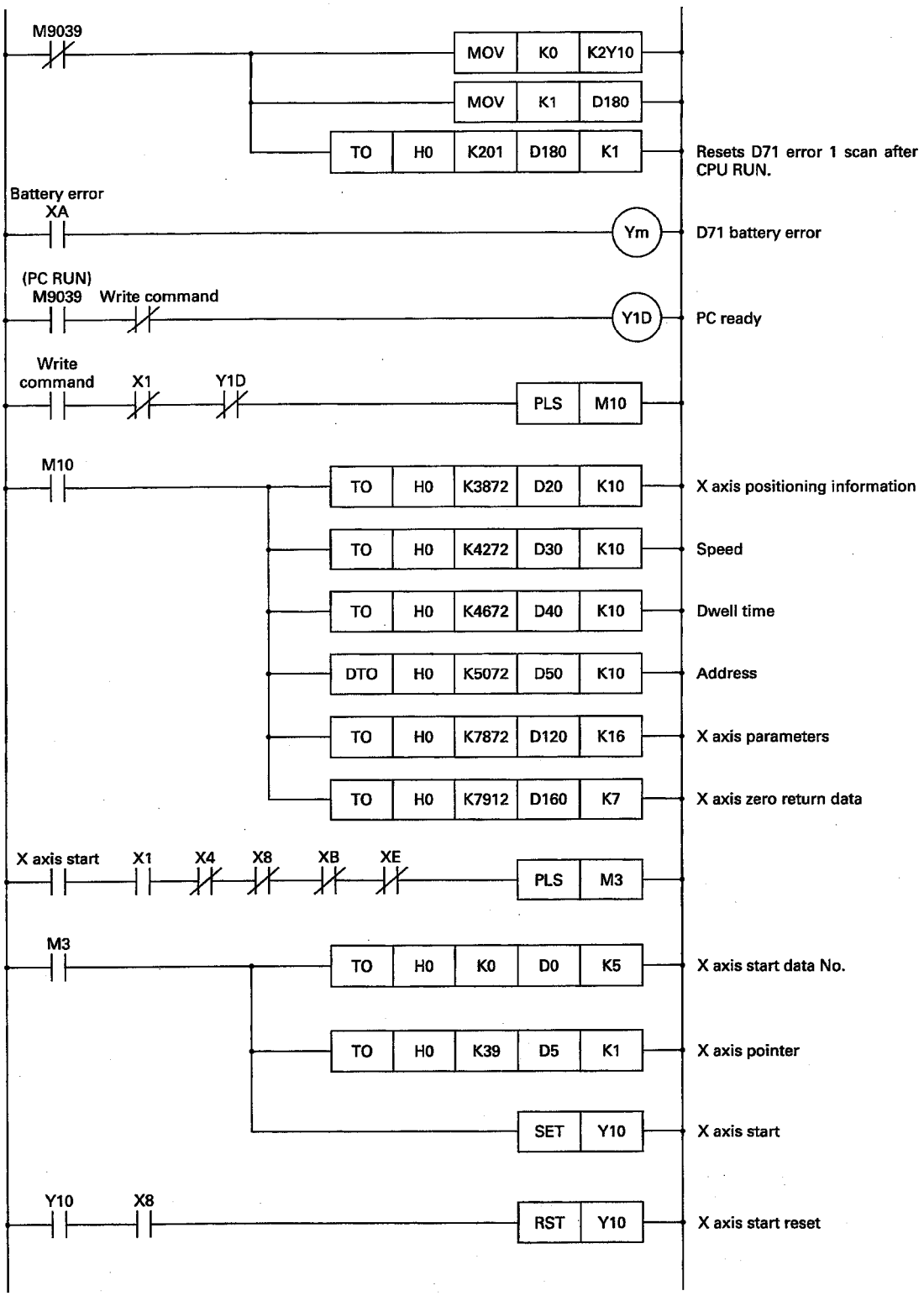
Item			Data Register
X axis start data number (3 points)			D0 to 4
X axis pointer (2)			D5
Y axis start data number (3 points)			D10 to 14
Y axis pointer (2)			D15
Positioning data	X axis	Positioning information (No. 1 to 10)	D20 to 29
		Positioning speed (No. 1 to 10)	D30 to 39
		Dwell time (No. 1 to 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 zero return data			D160 to 166
Y axis zero return data			D170 to 176

Table 7.2 Data Register Contents

REMARK

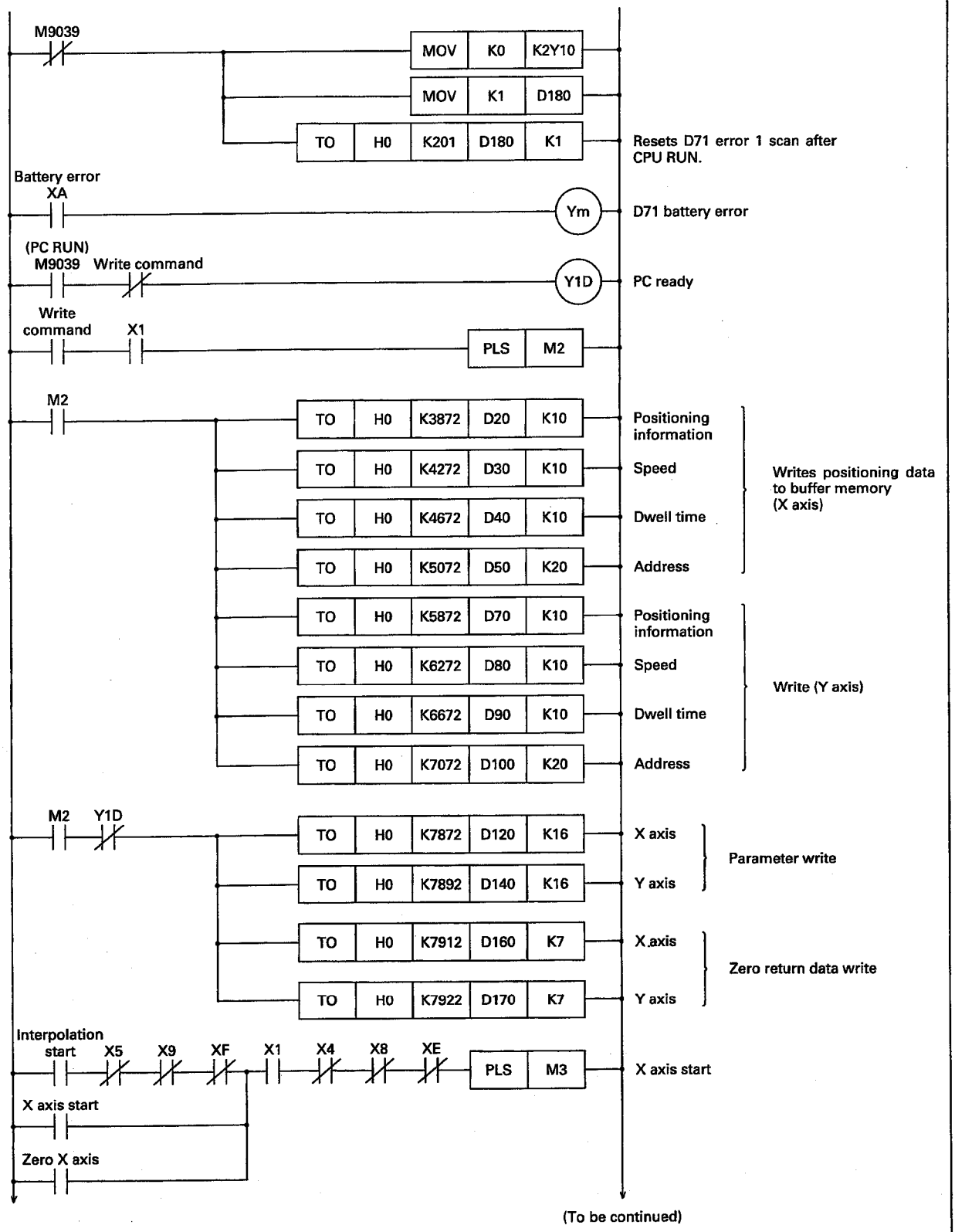
Assign data register numbers as required.
Note that the buffer memory addresses are predetermined.

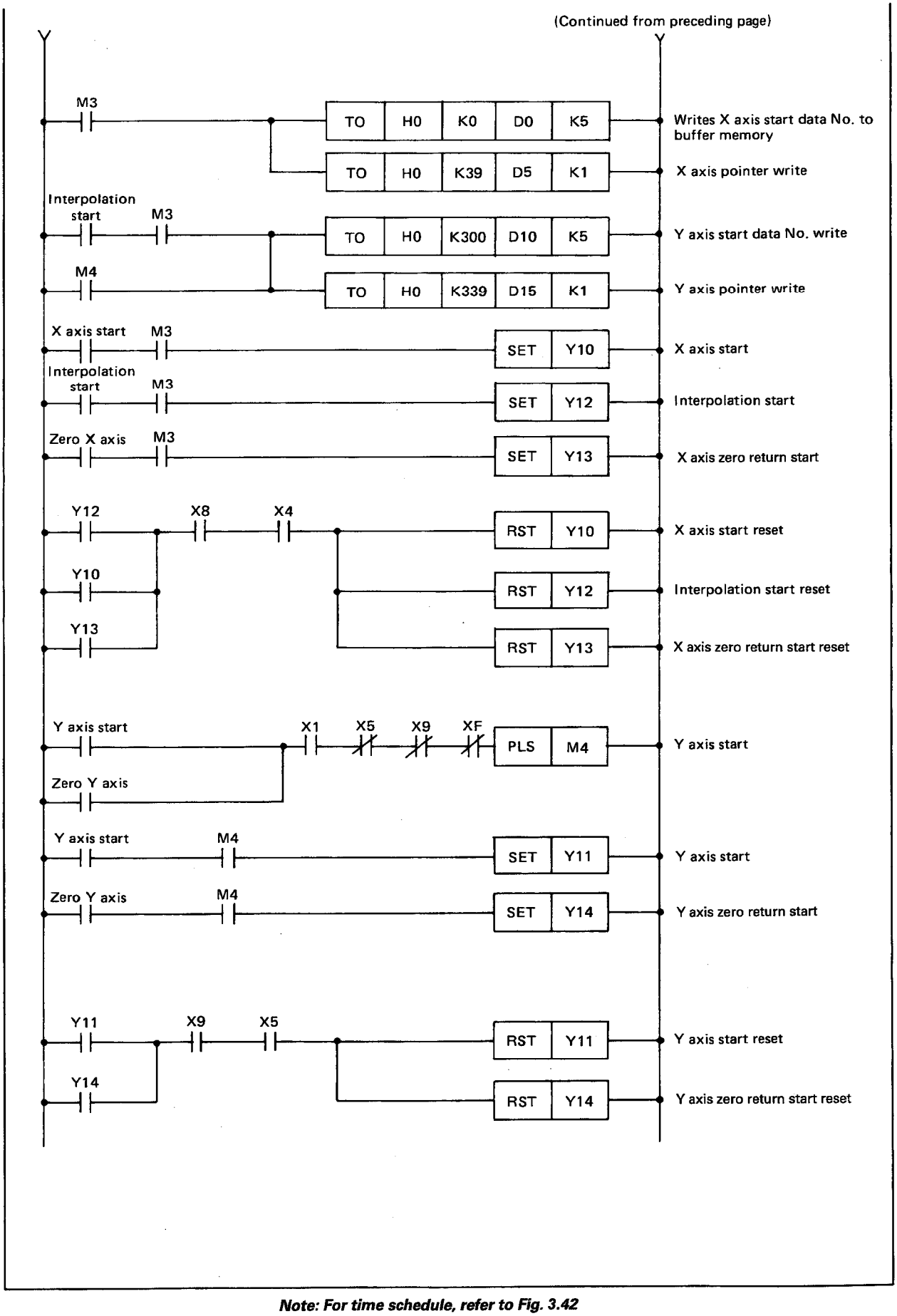
[Example 1] X axis start
(Among the data indicated above, the following program assumes that only X axis exists. Y axis is unnecessary.)



Timing is same as on Section 7.3.3 (3)

[Example 2] X, Y interpolation start

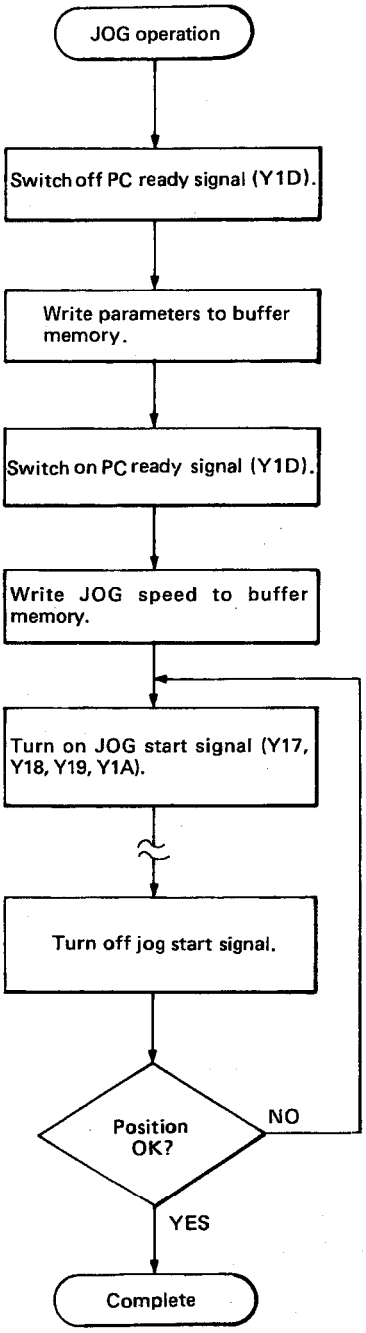




Note: For time schedule, refer to Fig. 3.42

7.3.4 JOG operation program

(1) Flow chart



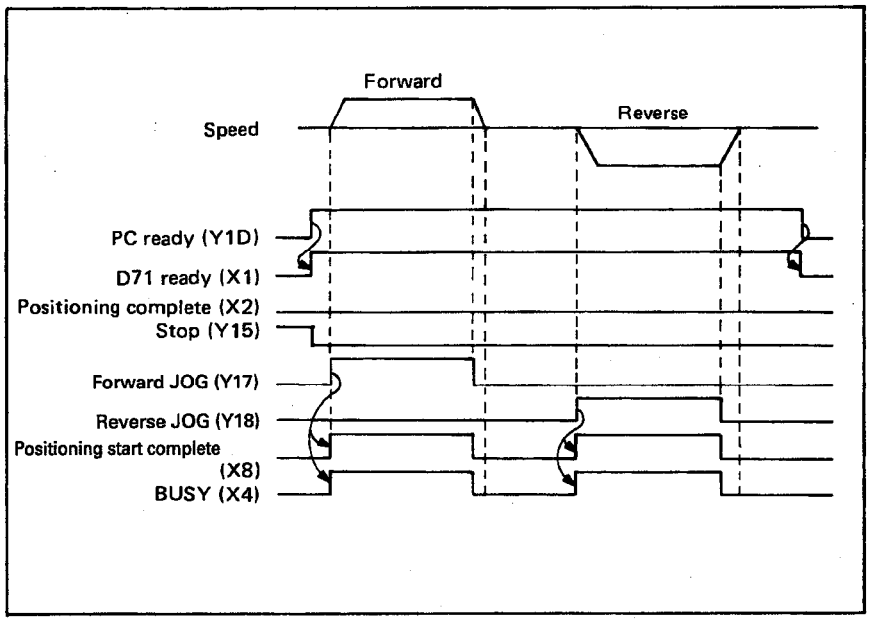
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	D71 ready (X1)	ON	*
	Relevant axis BUSY (X4,. X5)	OFF	
	Relevant axis positioning start complete (X8, X9)	OFF	
	Relevant axis M code ON (XE, XF)	OFF	
	Relevant axis stop (Y15, Y16)	OFF	
	PC ready (Y1D)	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, X1 and Y1D may be off.

Table 7.3 JOG Operation Start Conditions

(3) Timing



POINTS

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

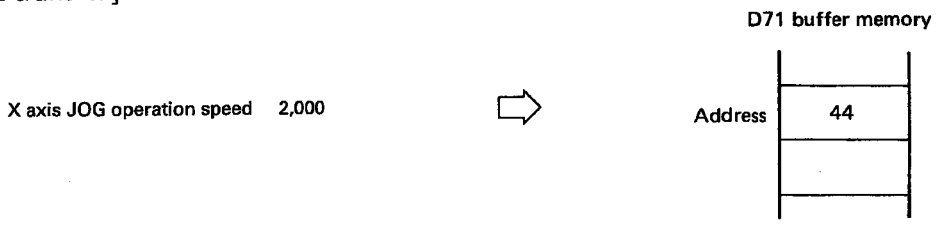
(2) When backlash compensation has been specified, the minimum movement allowed will be the backlash specified.

(4) Program

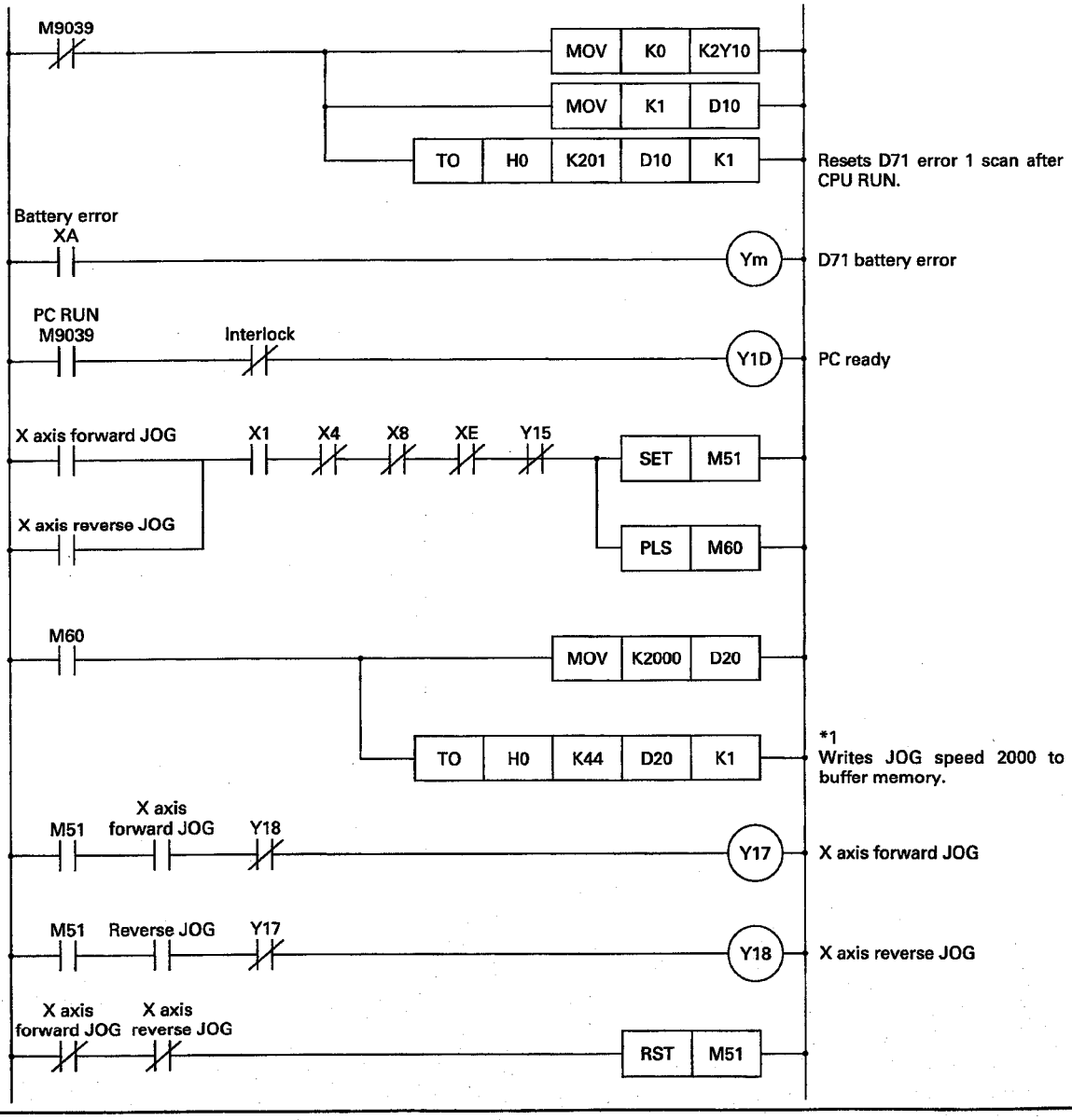
The drive is enabled for as long as the JOG switch is pressed.

[Example]	X axis JOG at speed 2,000 (20,000 mm/min)
[Note]	Start conditions are shown in Table 7.3. The JOG speed must be written to the buffer memory.

[Data transfer]



[Program]



REMARKS

1. The D71 will wait until the output speed is zero before giving a second JOG output.

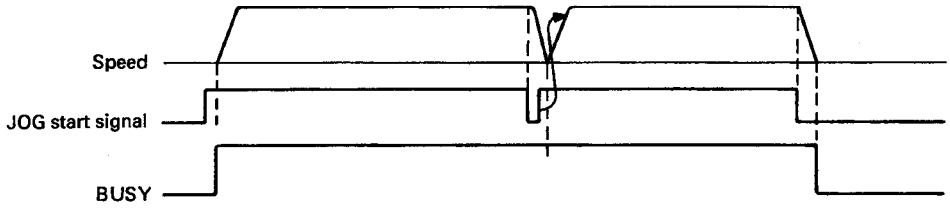


Fig. 7.8 JOG Repetition

2. Interpolation is not enabled during JOG operation.

3. The D71 defaults to forward JOG if both forward and reverse JOG commands are given simultaneously.

POINT

***1: When the JOG speed is specified 2,000 in the program, actual speed is 20,000 mm/min (i.e. 2,000 x 10^1).**

7.3.5 Manual pulse generator operating program

The operating principle for the manual pulse generator function is described below:

1) When the manual pulser instruction is given the pulse is transmitted to the D71.

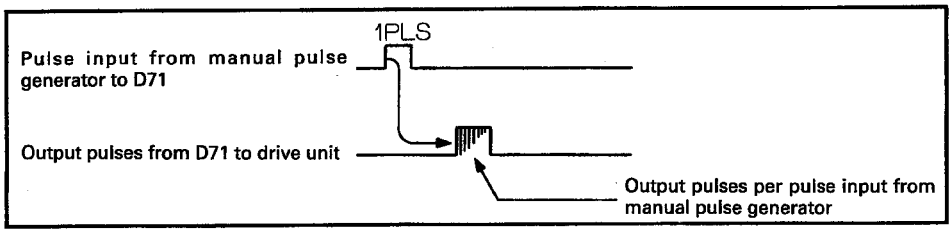
2) The number of manual pulses is converted into output pulses according to the following expression:

$$\text{Number of output pulses to drive} = \frac{R \times Q}{P} \quad \cdots\cdots \text{(Formula 1)}$$

Where P = "travel per pulse" in the parameters (not necessary if the unit setting is "PLS".)
Q = "travel per manual pulse generator" in the parameters
R = number of manual pulses

3) The D71 outputs the output pulses calculated by formula 1 above to the drive.
The D71 outputs the pulses in the following methods.

(a) At each input of a pulse from the manual pulse generator, the D71 outputs the D71 output pulses that correspond to one input pulse of the manual pulse generator to the drive unit.



(b) The time calculated below is required for the D71 to output the pulses in response to input of one pulse from the manual pulse generator.

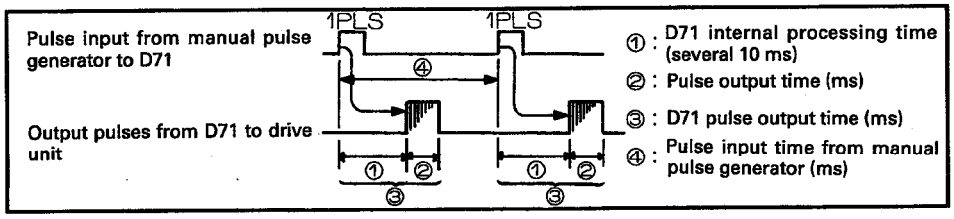
D71 pulse output time = (D71 internal processing time) + (Pulse output time)[ms]···(Formula 2)
(1) (2)

(1) D71 internal processing time : Several 10 ms

(2) Pulse output time :
(Axis travel distance per pulse of manual pulse generator) x (The number of pulses counted by D71) ÷ (Pulse output speed of D71)* [ms]...(Formula 3)

*The pulse output speed of D71 is 20 kpps (fixed)

After the completion of pulse output from the D71, it outputs the pulses in response to the pulse input next from the manual pulse generator in the period calculated by formula 2.



Therefore, it is not possible to move an axis smoothly by inputting pulses using the manual pulse generator. The axis will move intermittently if it is moved by the operation of the manual pulse generator.
If pulses are input from the manual pulse generator during the period shorter than the value calculated by formula 2, pulses to be output are accumulated in the D71. The pulses accumulated in the D71 are output in intervals of the internal processing time of the D71.

4) While pulses are output to the drive unit, the BUSY signal is ON for the axis for which the pulses are output.

POINTS

(1) After completing the manual pulse generator operation, always set "0" to the manual pulse generator enable area. If "1" remains set, positioning is executed unexpectedly when the manual pulse generator is touched by mistake.

(2) The pulses input by turning the manual pulse generator are counted only when the following two conditions are satisfied:

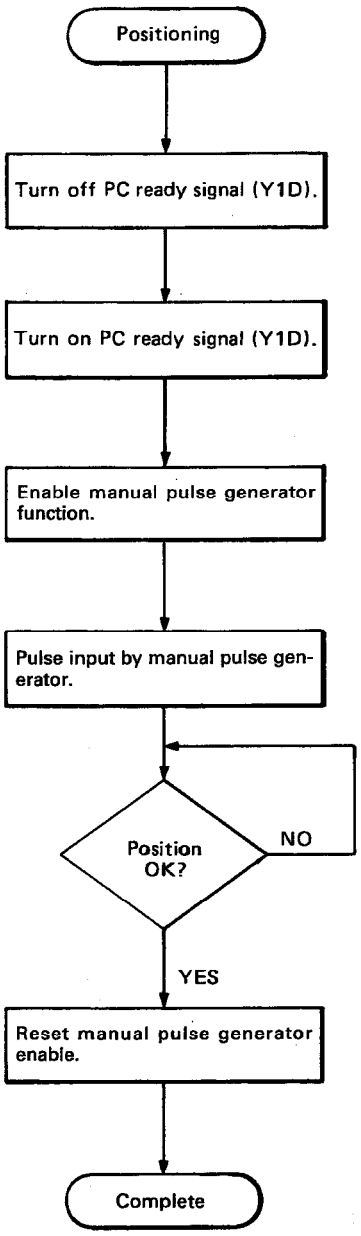
- "1" is set to the manual pulse generator enable area.
- The relevant axis is not BUSY, or is BUSY in manual pulse generator mode.

(3) The input and output counters which count the number of manual pulses given, are cleared approx. 0.2 s after disabling the function or switching off the PC ready signal (Y1D).
When the stop signals (Y15, Y16) 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 manual pulse input counter is not cleared if these is an error preventing operation. If pulses are continuously input to the D71 from the manual pulse generator after the occurrence of the error, the manual pulse input counter overflows and the input pulses cannot be retained correctly. Therefore, stop the operation of the manual pulse generator if the error occurs and set "0" to the manual pulse generator enable area to clear the manual pulse input counter. After that set "1" again and repeat the operation.

(1) Flow chart



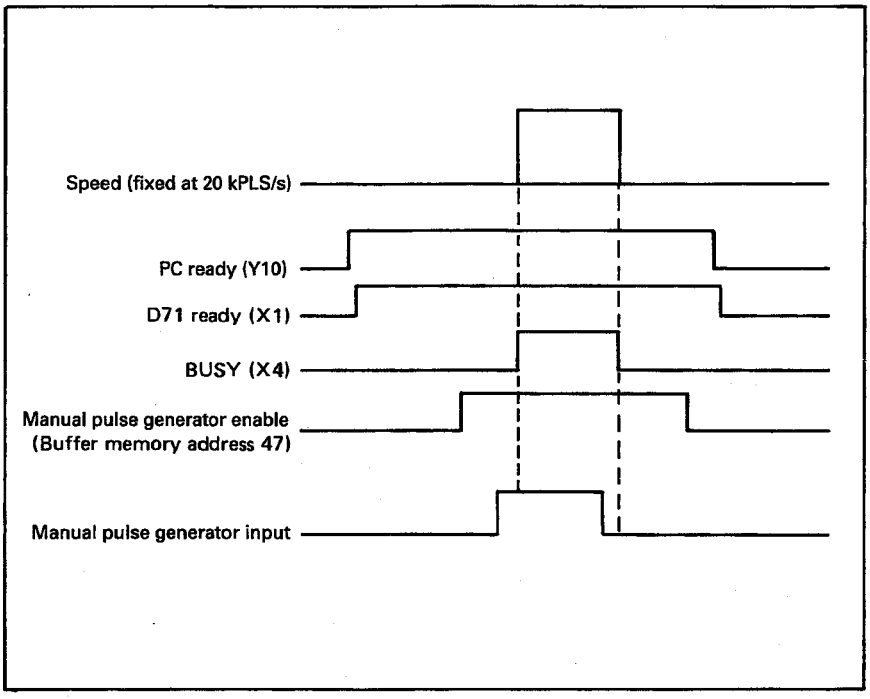
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	D71 ready (X1)	ON	*
	Relevant axis BUSY (X4, X5)	OFF	On during manual pulser pulse generation
	Relevant axis positioning start complete (X8, X9)	OFF	
	Relevant axis M code ON (XE, XF)	OFF	
	Relevant axis stop (Y15, Y16)	OFF	
	PC ready (Y1D)	ON	*
Others	"Manual pulse generator enable" in buffer memory {X axis 47 / Y axis 347}	Bit = 1	
	Parameters	Within setting range.	
	Neither axis should be busy if a BREAK (GPP) or STOP (AD71TU) signal has been received and positioning has stopped.		

*In GPP or AD71TU test mode, X1 and Y1D may be off.

Table 7.4 Start Conditions

(3) Timing



IMPORTANT

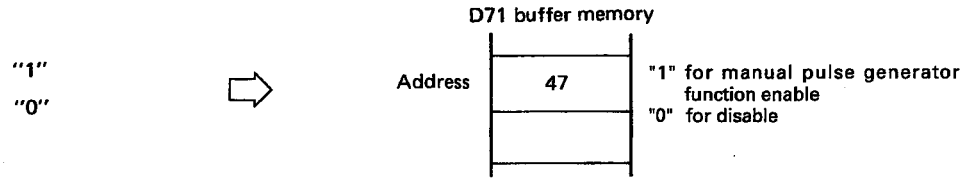
In the positioning, zero return, or JOG mode operation, an error (error code 73) occurs if the manual pulse generator is operated with "1" set to the manual pulse generator enable area while the BUSY signal is ON.
Therefore, set "0" to the manual pulse generator enable area in other than the manual pulse generator mode.

(4) Program

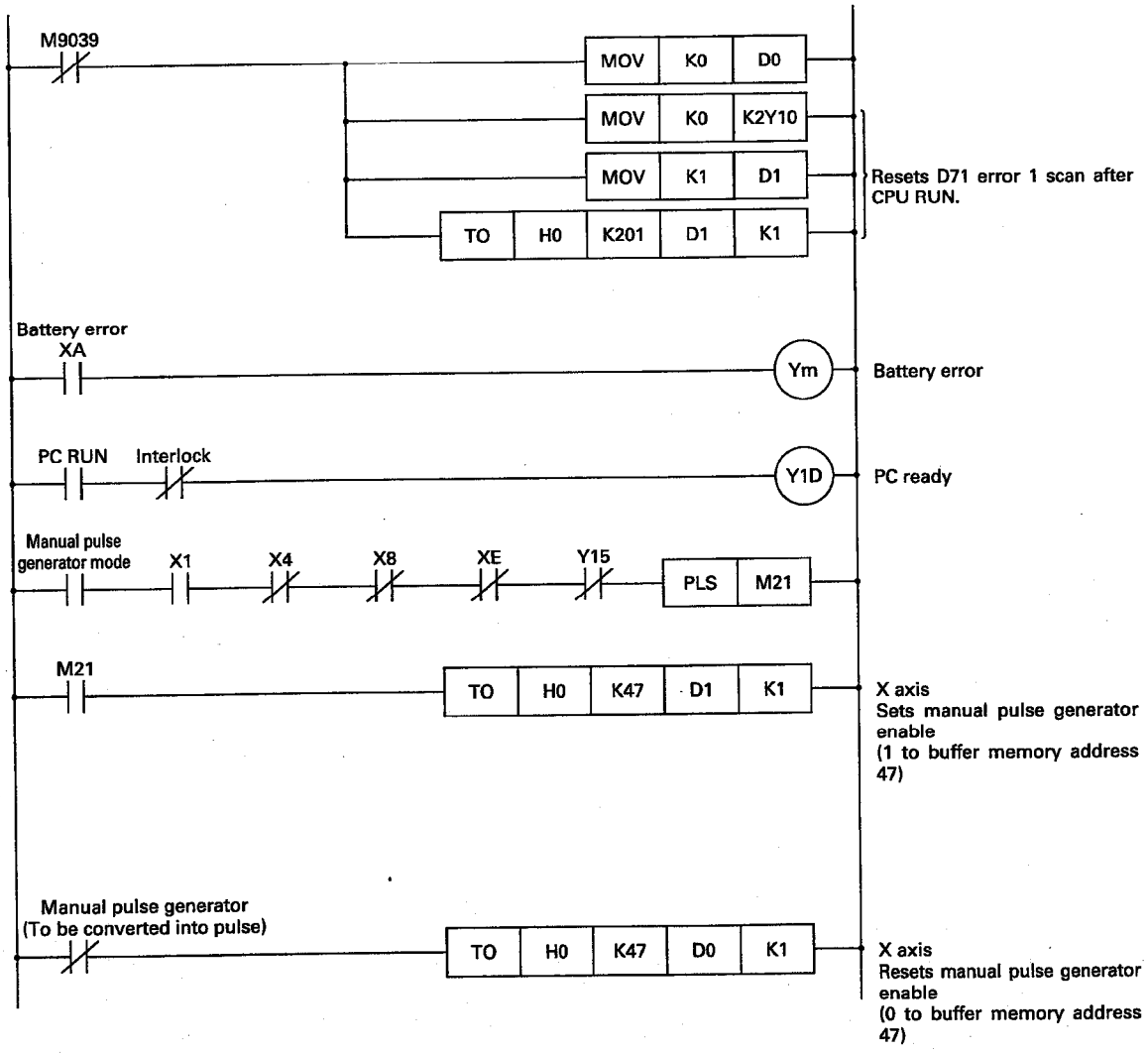
[Example] X axis manual pulse generator operation

[Note] Start conditions are shown in Table 7.4.

[Data transfer]



[Program]



7.3.6 Position address teaching

It is possible to write the position address by using the actual machine.
May be achieved as follows:

(1) JOG operation

Move an axis to the required position in JOG operation and write that address to the target data No. of the buffer memory in the D71.

(2) Manual pulse generator operation

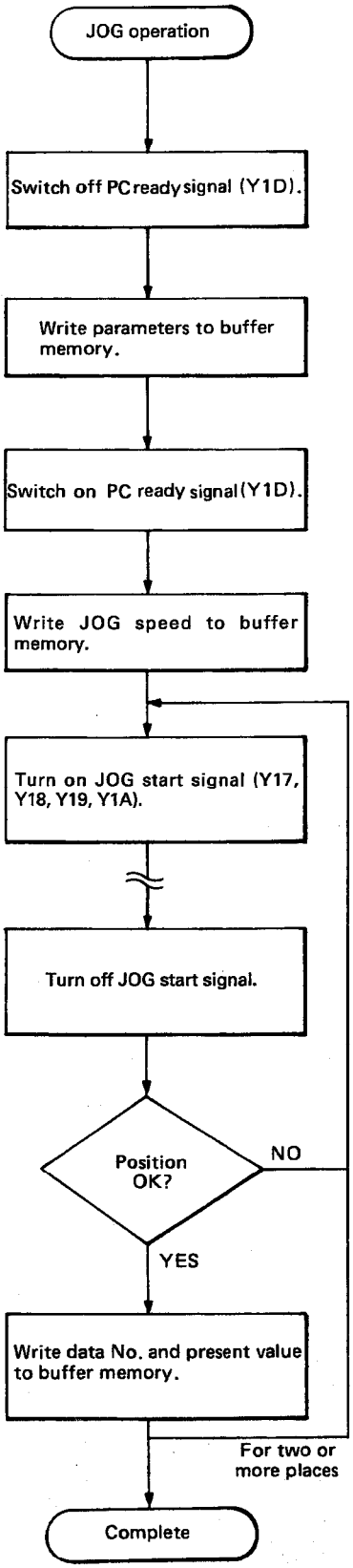
Fine positioning is made in JOG operation. A manual pulse generator is also necessary.
Move an axis to the required position by using the manual pulse generator, determine the address and write that address to the target data No. of the buffer memory in the D71.

(3) JOG then manual pulse generator combined

It is possible to determine rough position in JOG operation and make fine positioning by using the manual pulse generator.

[1] Address write by JOG operation

(1) Flow chart



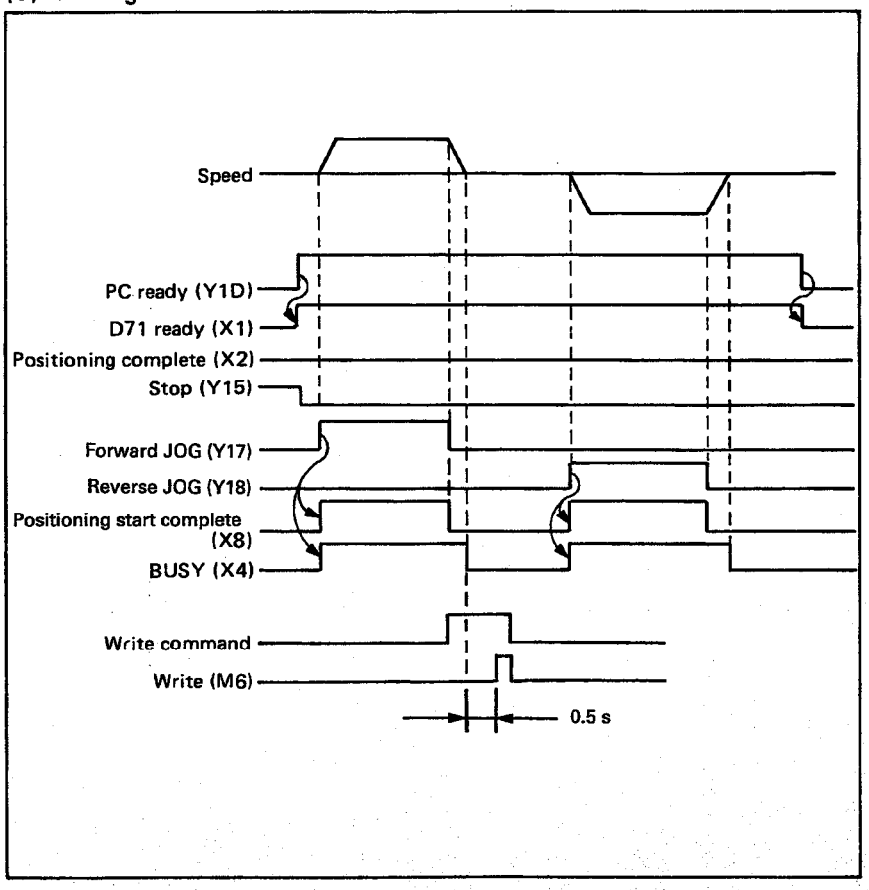
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	D71 ready (X1)	ON	*
	Relevant axis BUSY (X4, X5)	OFF	
	Relevant axis positioning start complete (X8, X9)	OFF	
	Relevant axis M code ON (XE, XF)	OFF	
	Relevant axis stop (Y15, Y16)	OFF	
	PC ready (Y1D)	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, X1 and Y1D may be off.

Table 7.5 Address Write Conditions Using JOG Operation

(3) Timing

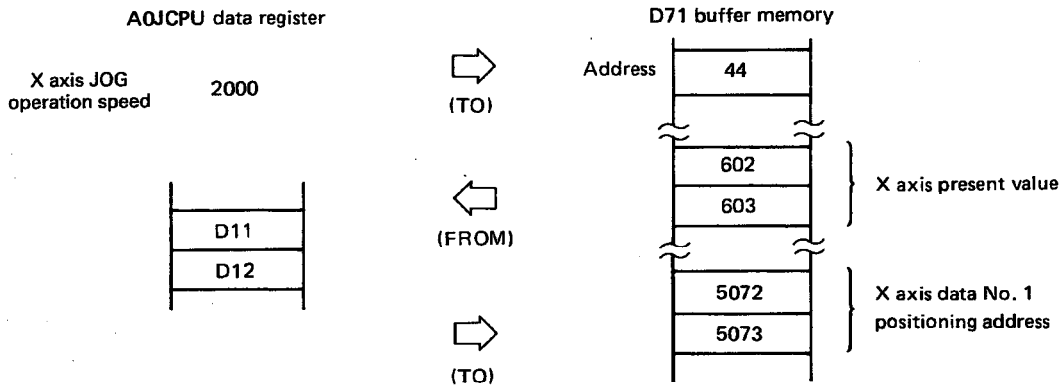


(4) Program

Move an axis to the required position in JOG operation and write the address to the planned data number.

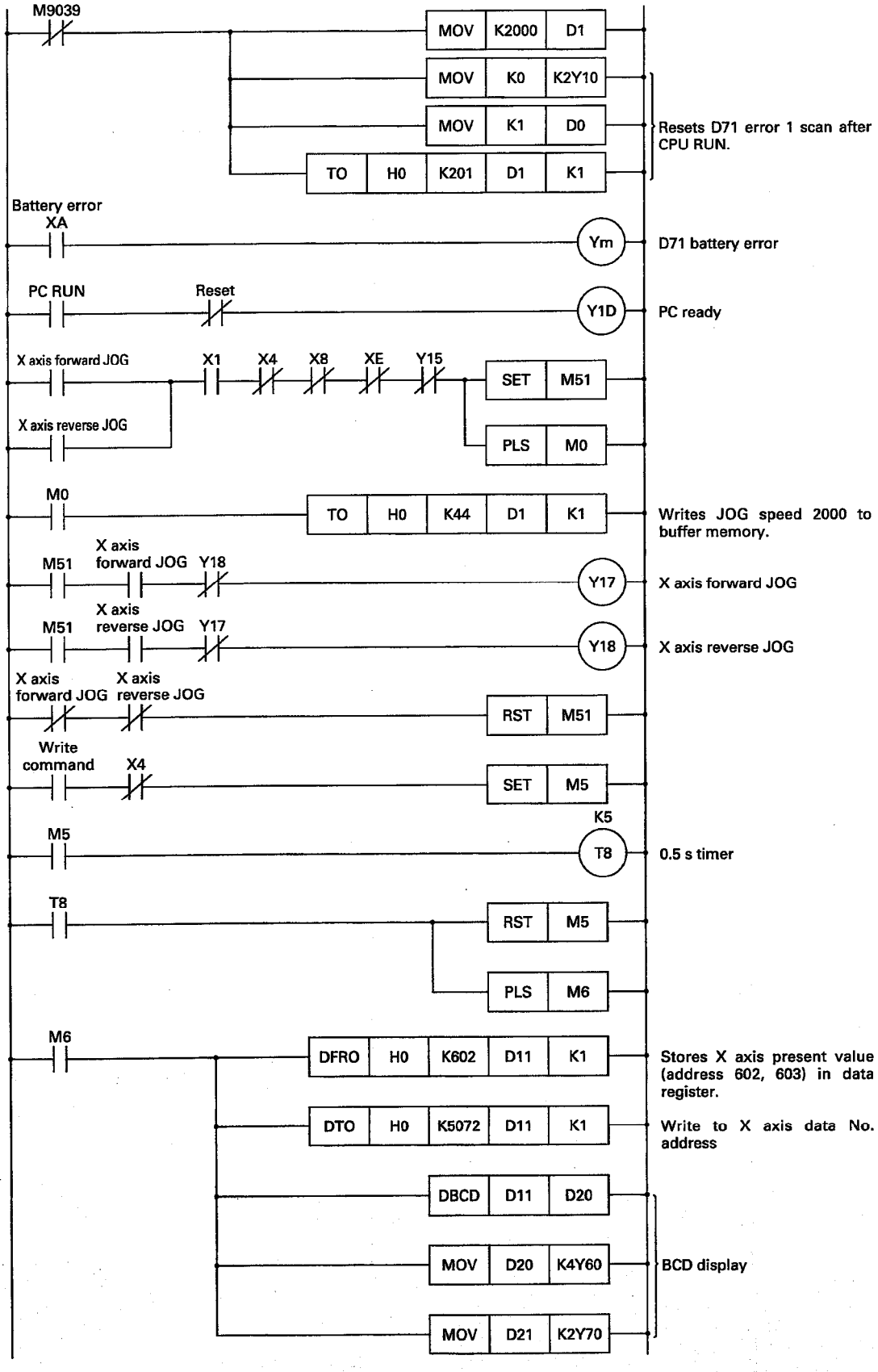
[Example]	X axis JOG and address written as data No. 1 (JOG speed = 2,000 (20,000 mm/min))
[Notes]	(1) Start conditions are shown in Table 7.5. (2) A delay of approx. 0.5 s occurs after positioning stops to allow the current value of the buffer memory to be updated. (3) This example assumes that the present value of the X axis is 999999 or less.

[Data transfer]



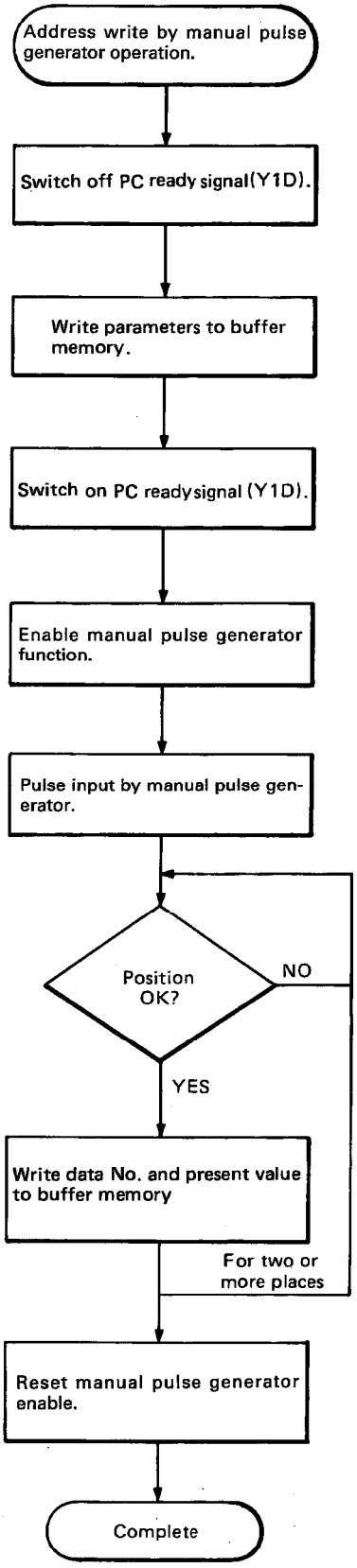
[Program]

To write address to data No. 1



[2] Address write by manual pulse generator operation

(1) Flow chart



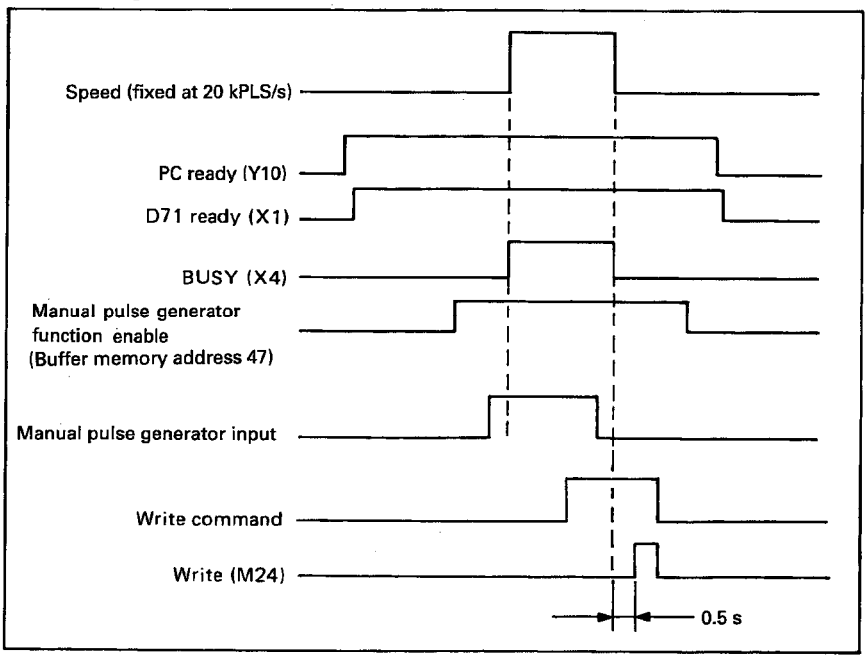
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	D71 ready (X1)	ON	*
	Relevant axis BUSY (X4, X5)	OFF	
	Relevant axis positioning start complete (X8, X9)	OFF	
	Relevant axis M code ON (XE, XF)	OFF	
	Relevant axis stop (Y15, Y16)	OFF	
	PC ready (Y1D)	ON	*
Others	Manual pulse generator function enable in buffer memory [X axis 47 / Y axis 347]	Bit 0 = 1	If "bit 0 = 0", pulses input by turning the manual pulse generator are disregarded. However, this does not cause an error.
	Parameters	Within setting range.	
	Neither axis should be busy if a BREAK (GPP) or STOP (AD71TU) signal has been received and positioning has stopped.		

*In GPP or AD71TU test mode, X1 and Y1D may be off.

Table 7.6 Address Write Conditions

(3) Timing



IMPORTANT

In the positioning, zero return, or JOG mode operation, an error (error code 73) occurs if the manual pulse generator is operated with "1" set to the manual pulse generator enable area while the BUSY signal is ON.

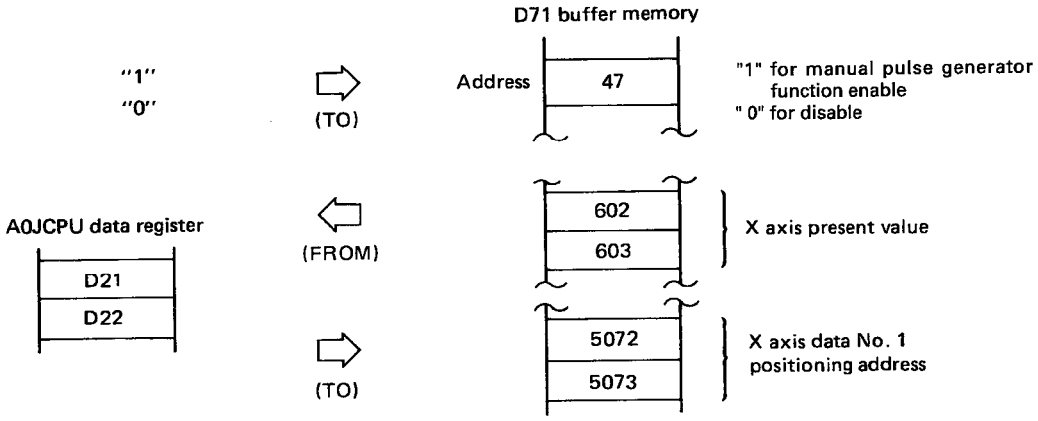
Therefore, set "0" to the manual pulse generator enable area in other than the manual pulse generator mode.

(4) Program

Move an axis to the required position by turning the manual pulse generator and write the address to the planned data number.

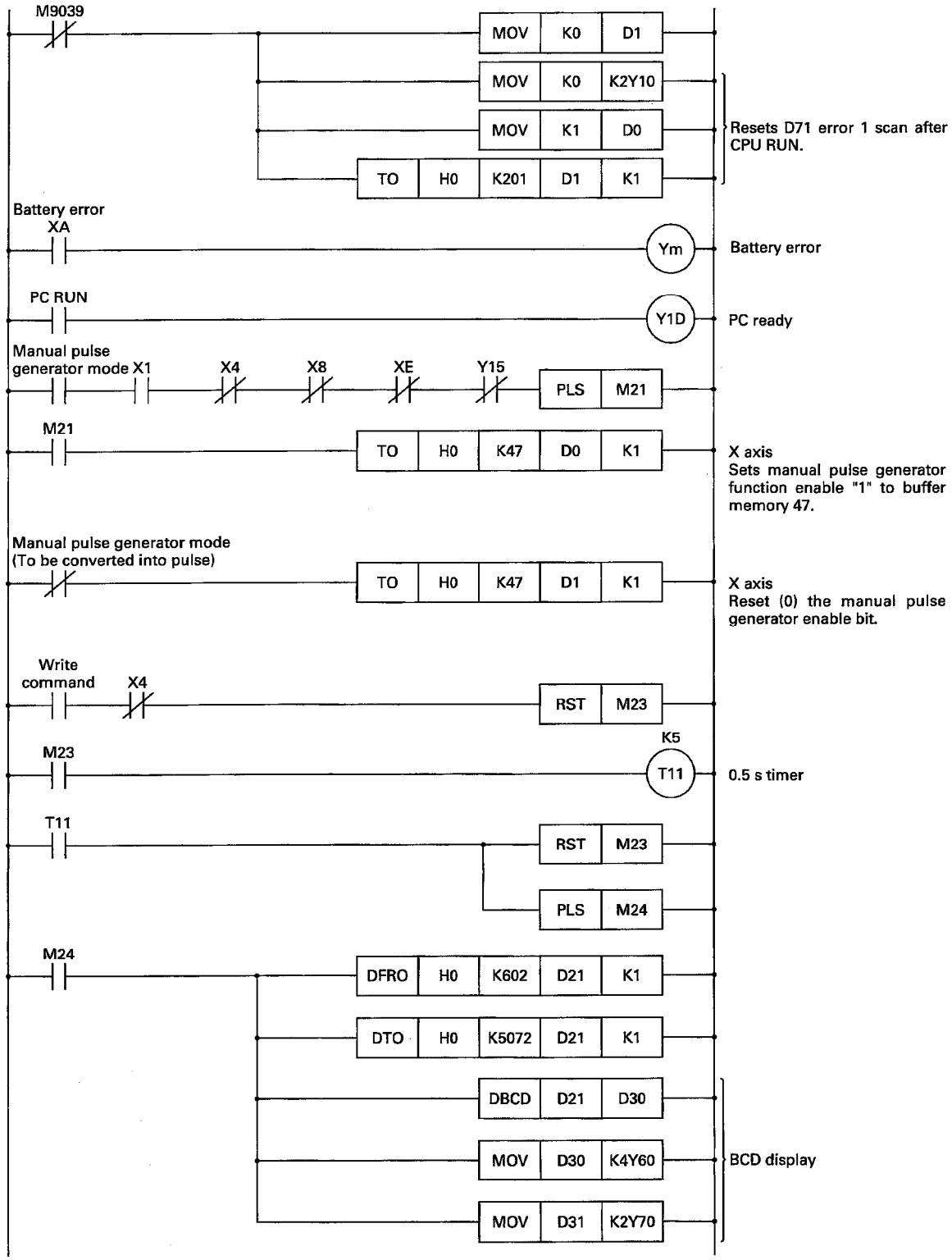
[Example]	Move X axis and address written as data No. 1.
[Notes]	(1) Start conditions are shown in Table 7.6. (2) A delay of approx. 0.5 s occurs after positioning stops to allow the current value of the buffer memory to be updated. (3) This example assumes that the present value of the X axis is 999999 or less.

[Data transfer]



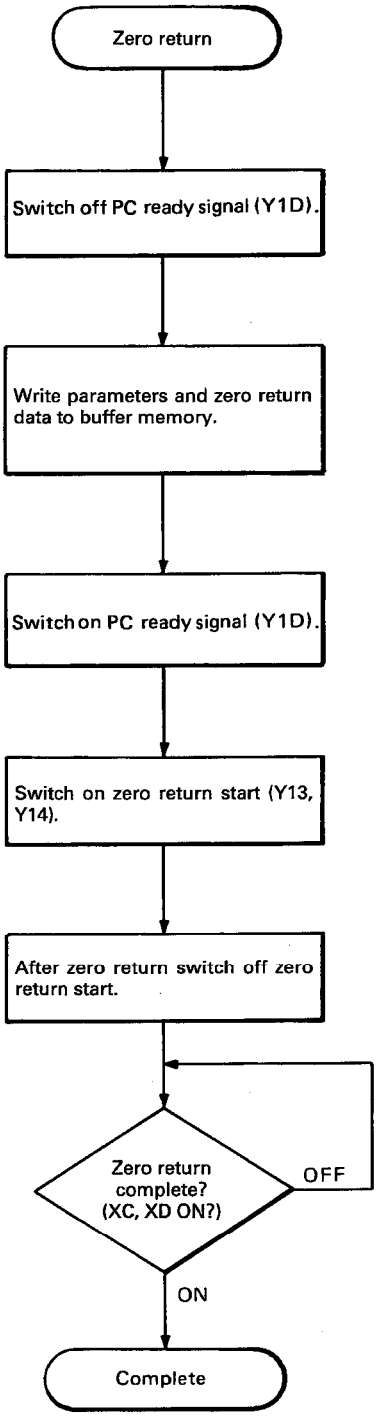
IB (NA) 66133-O

[Program]


M9039
MOV K0 D1
MOV K0 K2Y10
MOV K1 D0
TO H0 K201 D1 K1
Resets D71 error 1 scan after CPU RUN.
Battery error
XA
Ym
Battery error
PC RUN
Y1D
PC ready
Manual pulse generator mode X1
X4
X8
XE
Y15
PLS M21
M21
TO H0 K47 D0 K1
X axis
Sets manual pulse generator function enable "1" to buffer memory 47.
Manual pulse generator mode
(To be converted into pulse)
TO H0 K47 D1 K1
X axis
Reset (0) the manual pulse generator enable bit.
Write command
X4
RST M23
K5
M23
T11
0.5 s timer
T11
RST M23
PLS M24
M24
DFRO H0 K602 D21 K1
DTO H0 K5072 D21 K1
DBCD D21 D30
MOV D30 K4Y60
MOV D31 K2Y70
BCD display

7.3.7 Zero return program

(1) Flow chart



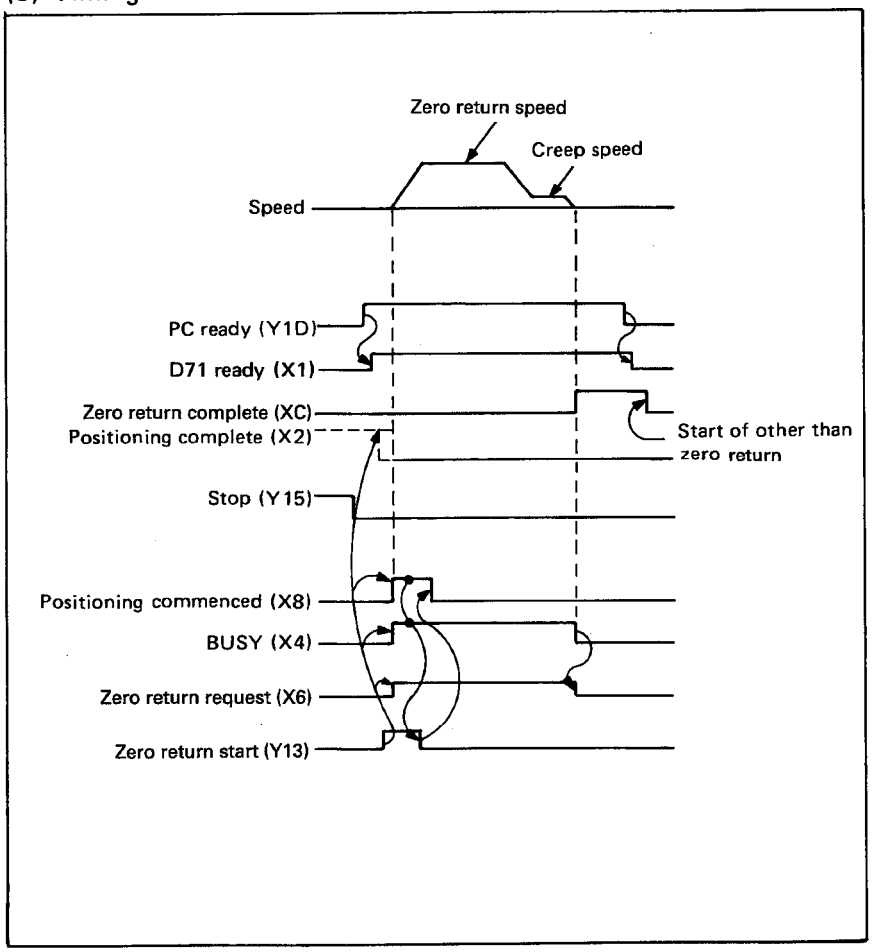
(2) Conditions

	Signal	State	Remarks
External signal	Drive unit READY	ON	
	STOP	OFF	
Interface signal	D71 ready (X1)	ON	*
	Relevant axis is BUSY (X4, X5)	OFF	
	Relevant axis positioning start complete (X8, X9)	OFF	
	Relevant axis zero return complete (XC, XD)	OFF	
	Relevant axis M code ON (XE, XF)	OFF	
	Relevant axis stop (Y15, Y16)	OFF	
	PC ready (Y1D)	ON	*
Others	Zero return data	No error	
	Repetition of zero return start	Max. twice consecutively.	
	Neither axis should be busy after BREAK (GPP) or STOP (AD71TU) has been received and positioning has stopped.		

*In GPP or AD71TU test mode, X1 and Y1D may be off.

Table 7.7 Zero return Conditions

(3) Timing

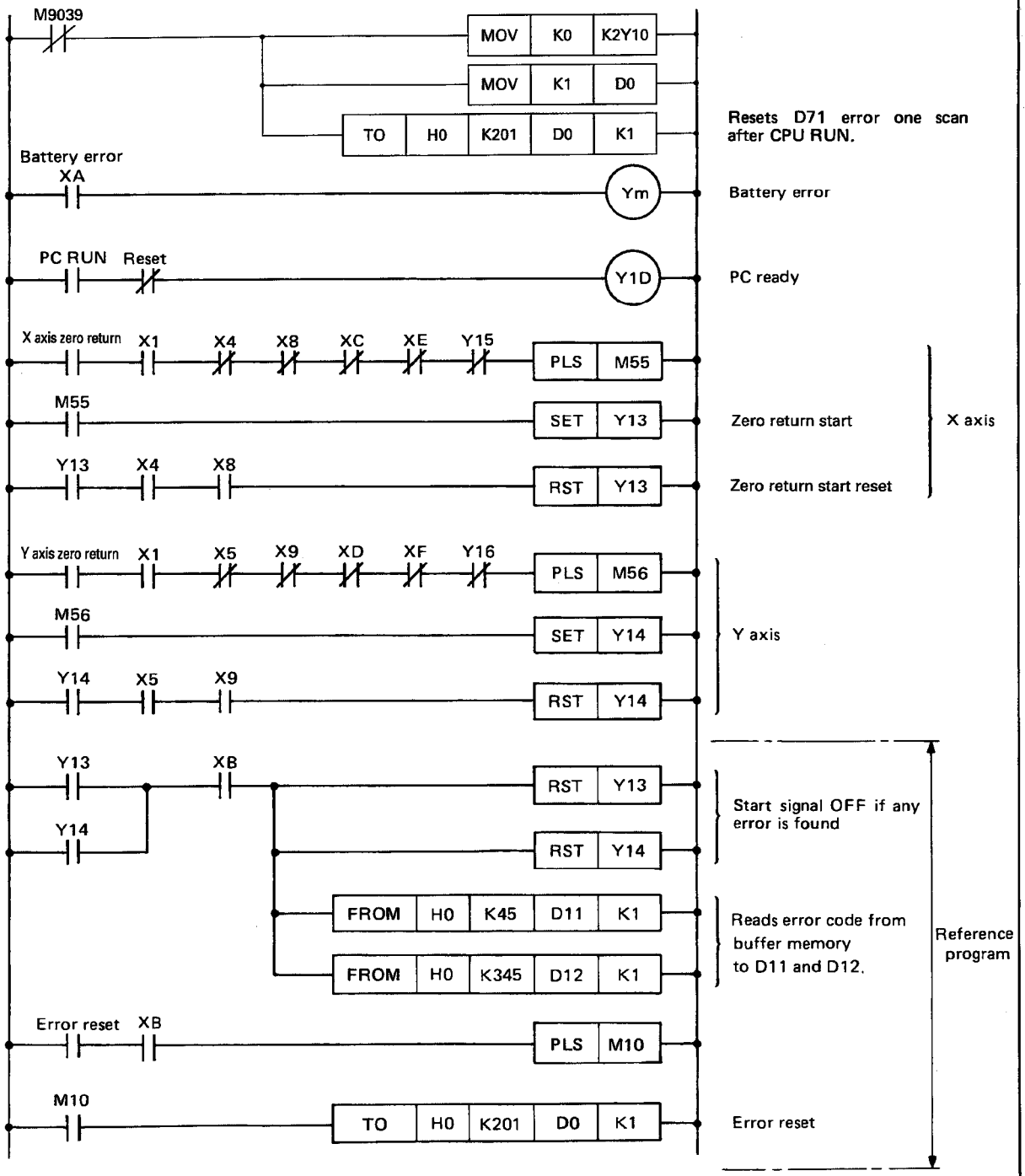


(4) Program

[Example] Execute zero return by specifying the zero return command.
(Reference: If an error occurs, zero return stops and the error code is read out to the data register.)

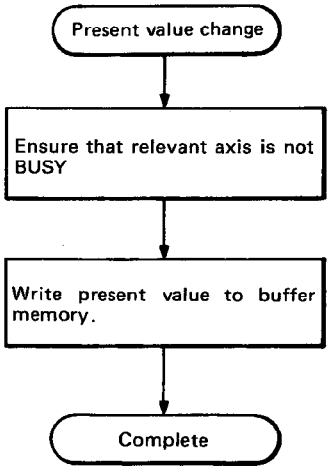
[Notes]
(1) Start conditions are shown in Table 7.7.
(2) Interpolation is not enabled during zero return.
Giving a simultaneous zero return command to both axes causes one axis to delay about 50 ms before starting.
(3) The system may only be zeroed once. Repeating the zero return command with no intermediate operation will give an error.

[Program]



7.3.8 Present value change

(1) Flow chart



(2) Conditions

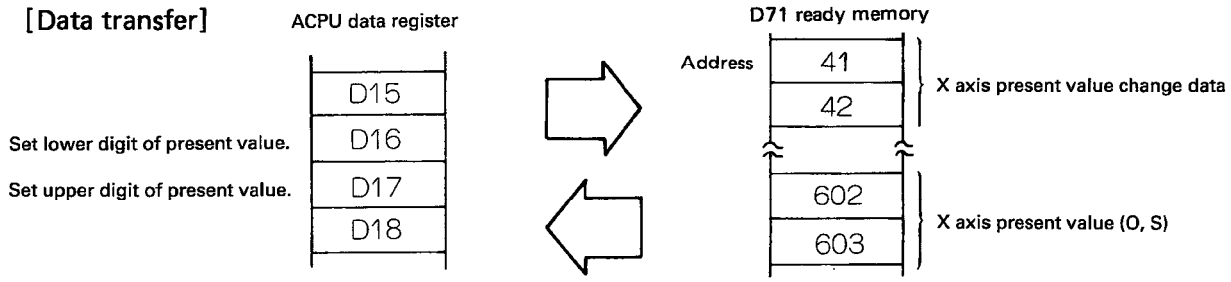
Signal	State	Remarks
Relevant axis BUSY	OFF	

Table 7.8 Present Value Change Condition

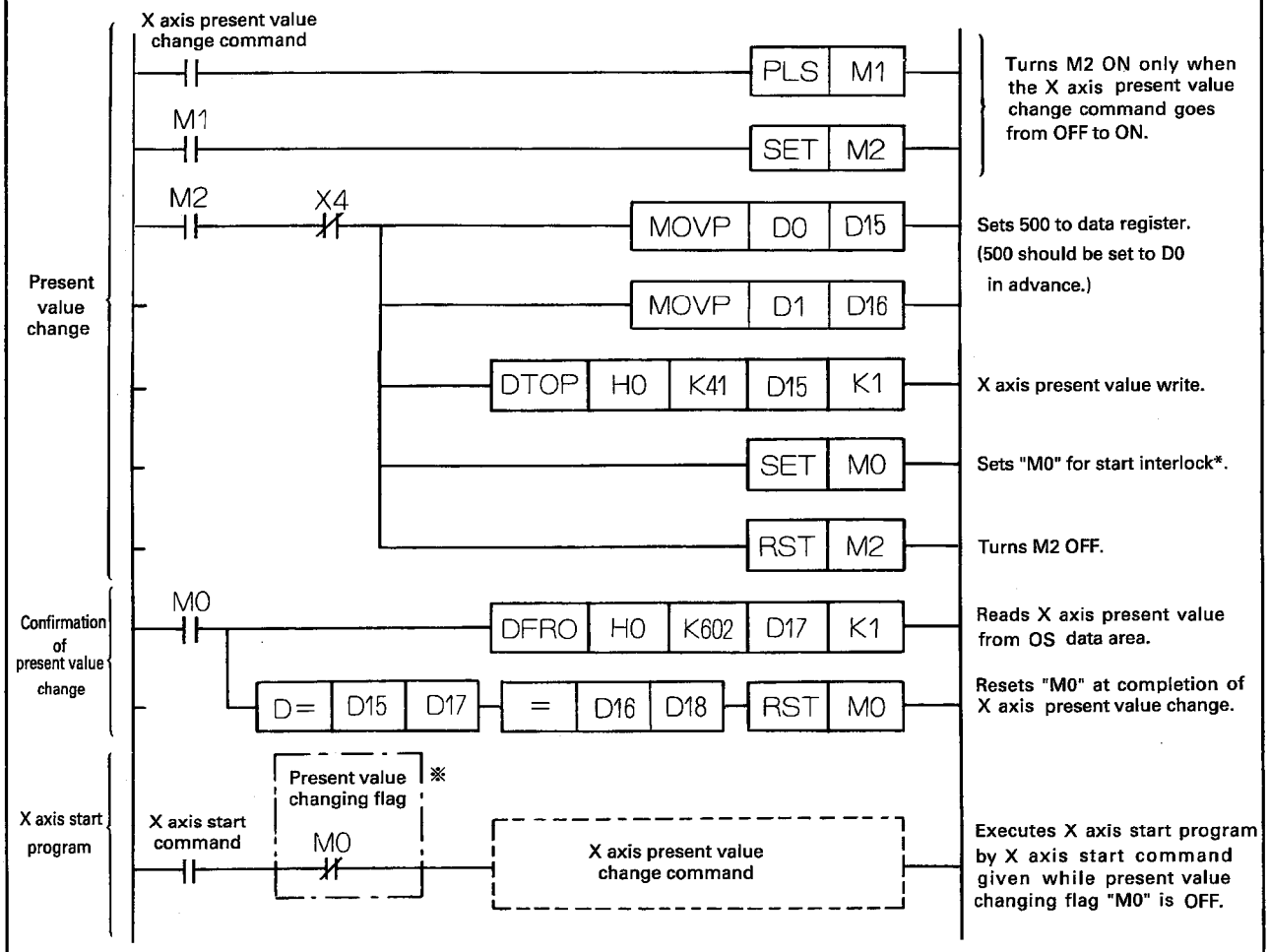
(3) Program

[Example] To set the X axis present value to 500

[Data transfer]



[Program]



※ This disables execution of X axis start program while "M0" is ON (present value is being changed.).

REMARKS

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

2. Zero return will always set the present value back to the zero address, however the zero return data and the parameters should be written to the buffer memory before zero return.

7.3.9 Positioning stop

The positioning process may be stopped while the D71 is BUSY as follows:

Item	Valid Signal	Independent Operation		Inter-polation Operation
		Relevant axis	Other axis	
STOP signal from drive unit ON	↑	O		O
PC ready signal (Y1D) OFF*	↓	O	O	O
Stop signal from PC (Y15, Y16) ON*	↑	O		O
BREAK key input from GPP or STOP key input from AD71TU	↑	O	O	O

O indicates that the signal is valid.
*In GPP or AD71TU test mode, positioning is not stopped if Y1D is on or off.

Table 7.9 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 7.9, the system is decelerated to a stop.
Stop control at upper and lower limits of stroke and emergency stop should be performed using external circuits.

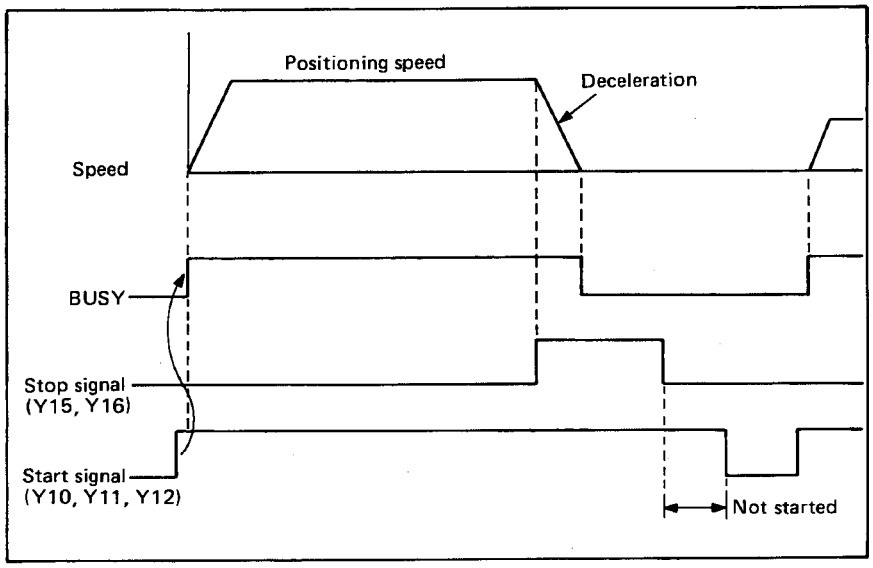


Fig. 7.9 Stop Signal

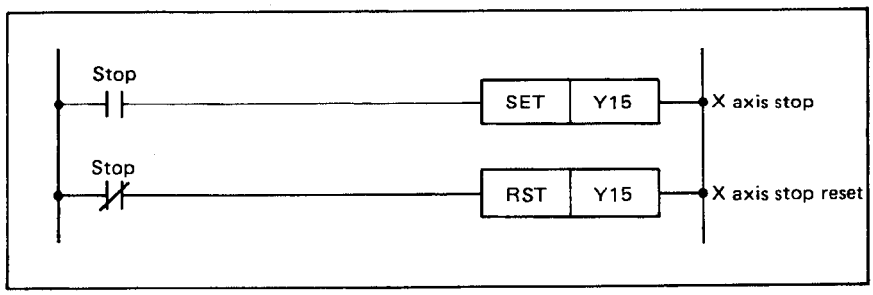


Fig. 7.10 Stop Program Example

(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 zero return, positioning stops immediately.

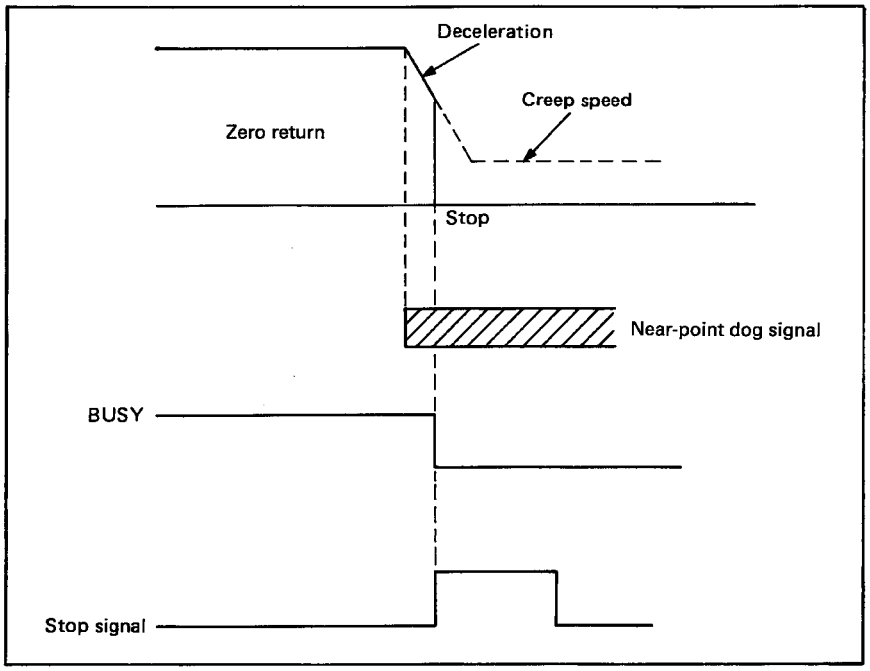


Table 7.11 Stop Command Received during Zero return Deceleration

IMPORTANT

Giving the stop command at any point after the near-point dog signal has been actuated will invalidate the zero return process. In this case the system must be manually driven (JOG operation) to a point before the near-point dog signal and the process repeated.

(c) Stop signal reset

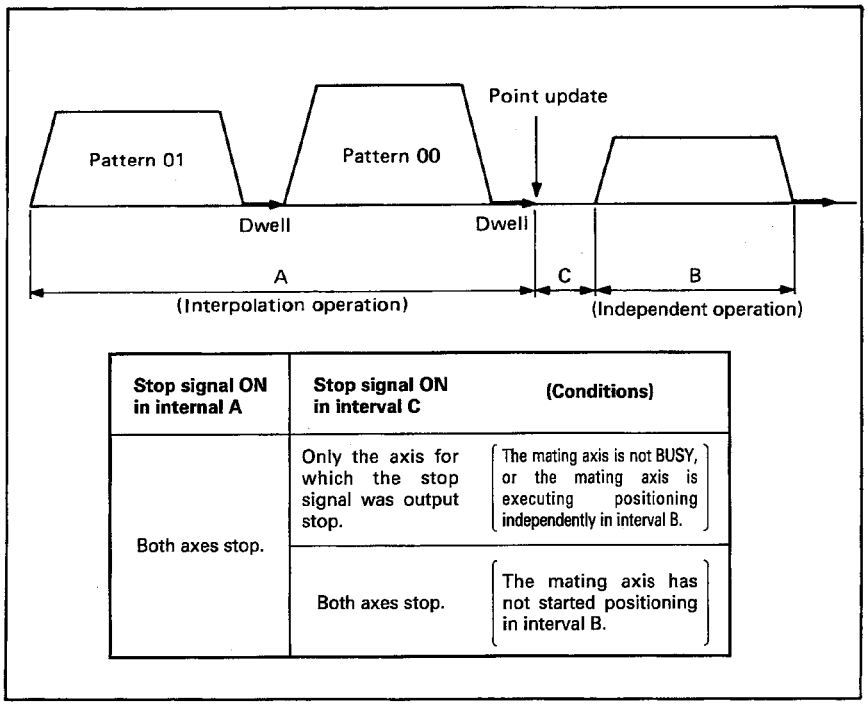
If the stop signal is reset while the start signal (Y10, Y11, Y12) is ON, it does not cause sudden start of operation. (The start signal is valid at the leading edge.)

(d) M code

The conditions shown in Table 7.9 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 D71 has reached (see below).



Stop signal ON in internal A	Stop signal ON in interval C	(Conditions)
Both axes stop.	Only the axis for which the stop signal was output stop.	The mating axis is not BUSY, or the mating axis is executing positioning independently in interval B.
	Both axes stop.	The mating axis has not started positioning in interval B.

Fig. 7.12 Stop during Interpolation

(2) Other stop signals

In addition to the four stop signals in Table 7.9, the following also stop processing while the D71 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)		○	○	○
D71 bus error		○	○	○

Table 7.10 Stop Signals (Hardware)

(3) Restart after stop

(a) Restart to the next address

The following table shows whether or not restart to the next address is possible depending on the positioning method and if automatic data No. change function is used.

	Absolute	Incremental
	2-axis independent operation / 2-axis interpolation operation	2-axis independent operation / 2-axis interpolation operation
Automatic data No. change function not used	Possible	Impossible
Automatic data No. change function used	Impossible	Impossible

REMARK

* Definition of "automatic data No. change function not used":
  The data number is set only at the first point (X axis address: 0, Y axis address: 300) in the positioning start data No. area in the D71.
* Definition of "automatic data No. change function used":
  Multiple data numbers are set in the positioning start data No. area (X axis address: 0 to 39, Y axis address: 300 to 399) in the D71.

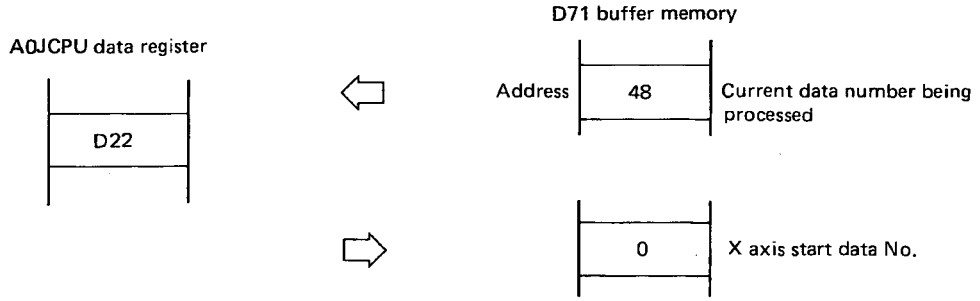
For the mode for which "impossible" is entered in the table above, follow the operation indicated below to restart.

* Execute zero return and restart.
* Set the positioning data again and restart.

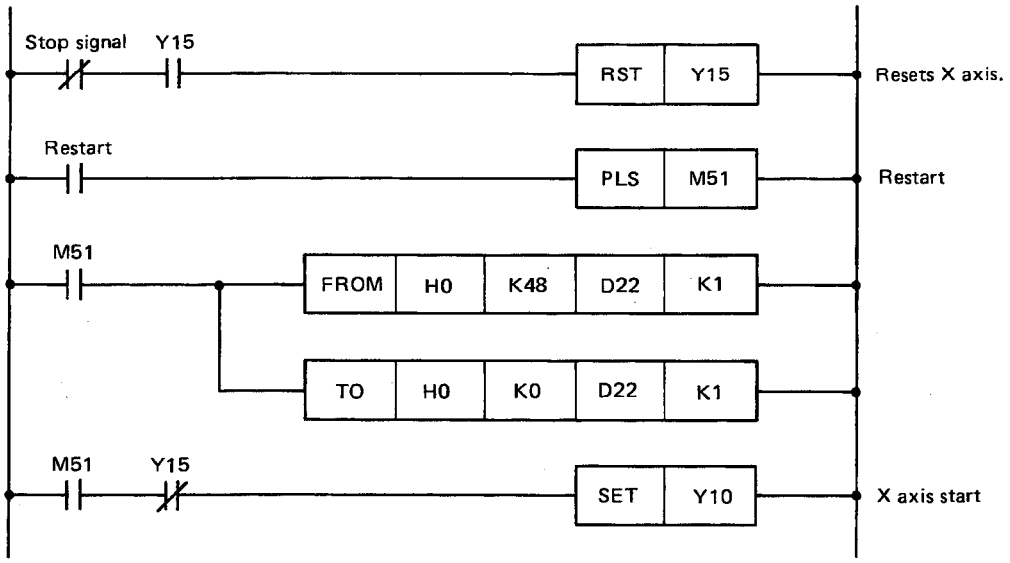
1) Automatic data number change function is not used in the absolute mode

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) Zero return procedure
Refer to Section 7.3.7.

(c) Restart after operation stop during zero return
Zero return start cannot be executed two times repeatedly. Perform the following operation before executing zero return again.
1) Execute positioning once using appropriate data No.
2) Execute positioning appropriately in the JOG mode operation. If the axis stops near the zero point, move back the axis to a position where the near-point dog limit switch is not actuated.

(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.

7.4 ACPU Remote I/O Station Programming

7.4.1 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 D71	: RTOP instruction
Data read from D71 to master	: RFRP instruction

Link registers (W) are used for data communications between the master station CPU and the D71. Therefore, enter a program to execute the following processing if necessary: to transfer the contents of a link register to other device after the execution of the RFR instruction, or to transfer the data, that should be transferred, to a link register before the execution of the RTO instruction.

(3) The RTOP and RFRP instructions cannot be executed in the same scan for one D71 in a remote I/O station. (These may be used in the same scan if addressed to separate D71 units.) All data communication must therefore be interlocked as shown in the examples that follow.
I/O numbers have been assigned as X_0 to $_{1F}$ and Y_0 to $_{1F}$.

(4) Control signals between master and remote stations.

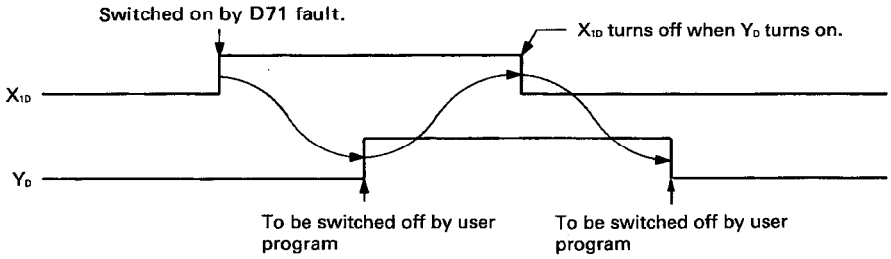
- Depending on the relationship between the master station scan time and the link scan time, there are cases that Y□□ is not output to a remote I/O station by using PLS Y□□.

- Since batch refresh method after the execution of the END (FEND) instruction is used for data communications between the master station and the remote I/O station, pulse output that executes the RST instruction after the execution of the SET instruction cannot be used.

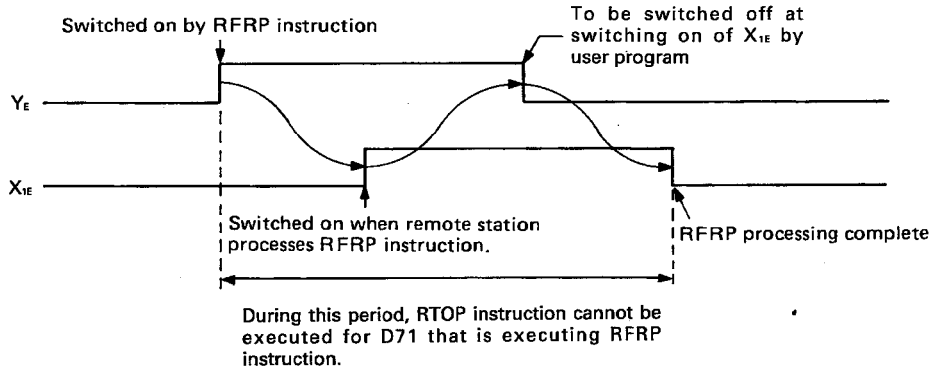
Signal Direction: PC CPU to D71		Signal Direction: D71 to PC CPU	
Device No.	Signal	Device No.	Signal
Y_0 to Y_C	Reserved	X_{10} to X_{1C}	Reserved
Y_D	Switches X_{1D} off.	X_{1D}	On indicates AD71 fault. RFRP and RTOP instructions cannot be used.
Y_E	Switched on by master station CPU when RFRP instruction is executed (data transferred from link unit to master station CPU). To be reset in user program after ensuring that X_{1E} is on.	X_{1E}	On while D71 in remote station is processing RFRP instruction.
Y_F	Switched on by master station CPU when RTOP instruction is executed (data transferred from master station CPU to link unit). To be reset in user program after ensuring that X_{1F} is on.	X_{1F}	On while D71 in remote station is processing RTOP instruction.

Timing

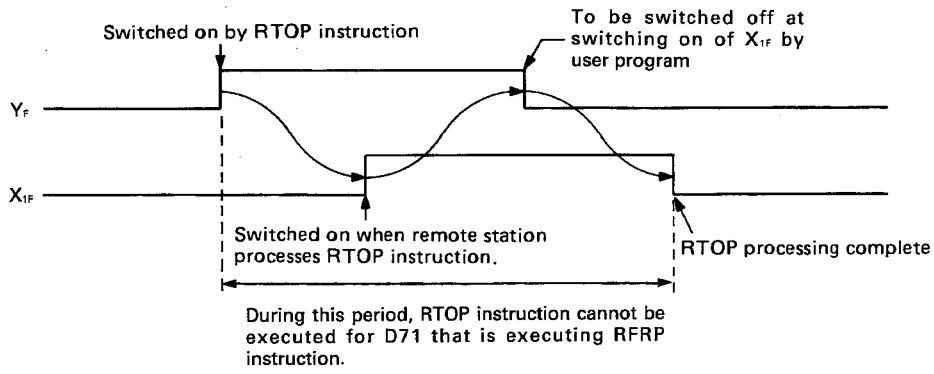
D71 fault. RTOP and RFRP instructions cannot be used.



Execution of RFRP instruction



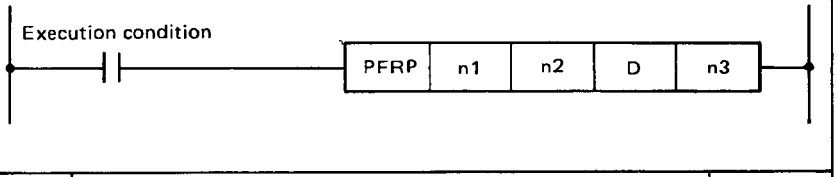
Execution of RTOP instruction



7.4.2 Reading and writing data

(1) Read from remote I/O station

[Format]



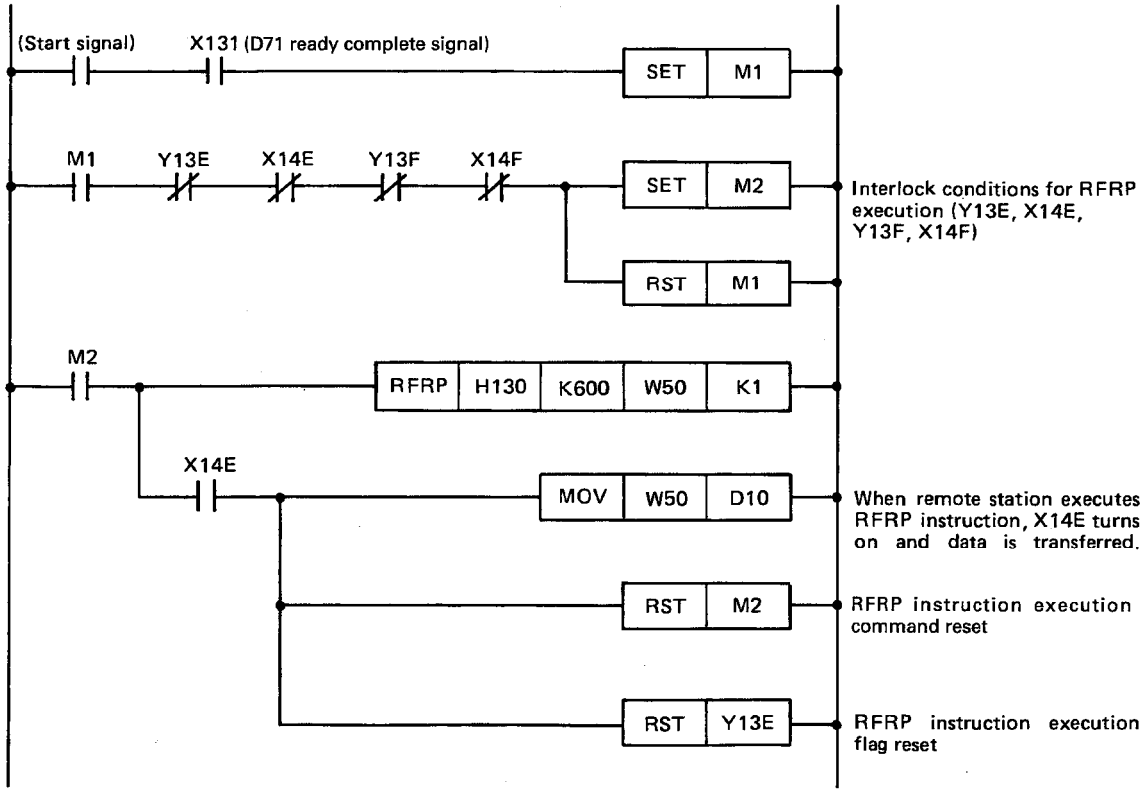
Symbol	Description	Available Device
n1	The first three digits of the D71 I/O number assigned by master station	K, H
n2	Head buffer address to be read	K, H
D	Head number of link registers where read-out data is stored.	W
n3	Number of data words to be read (1 to 16)	K, H

POINT

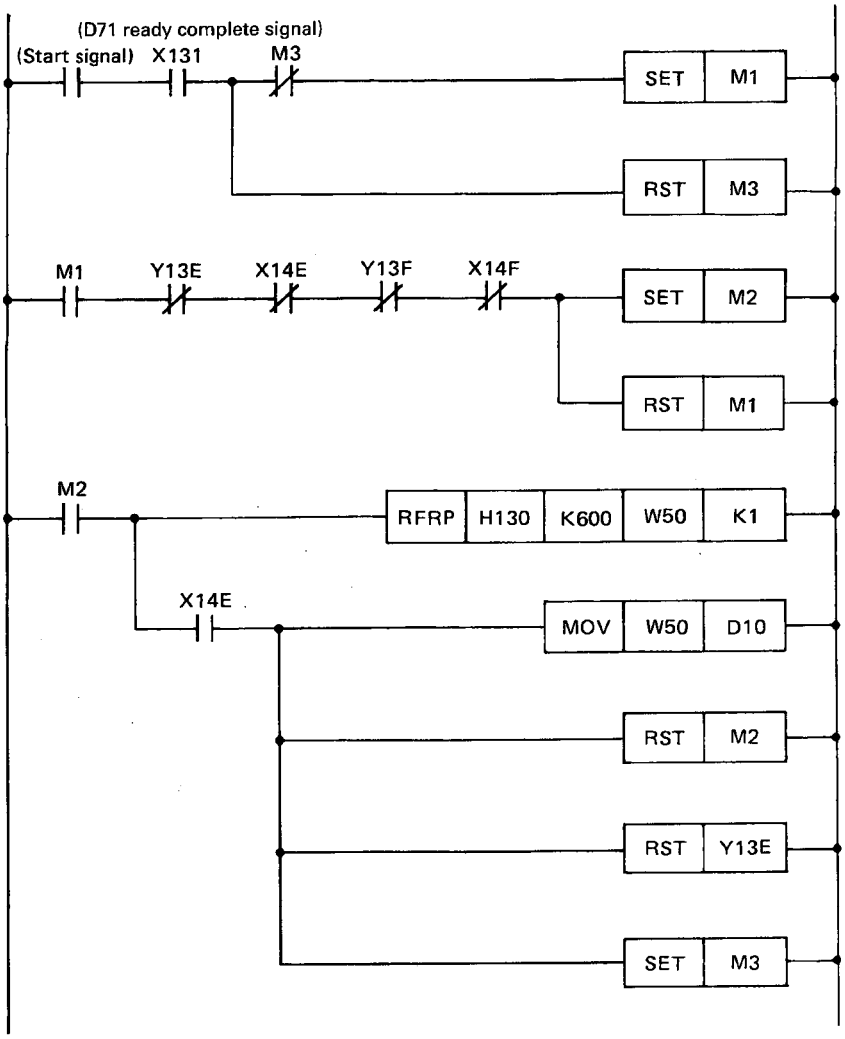
For "n1" that specifies the head number of the I/O numbers, specify three digits when specifying the RFRP or RTOP instruction.

Example: Reading one word from buffer memory address 600 (X axis output speed) of the remote I/O station D71 that corresponds to addresses X and Y130 to 14F of the master 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.

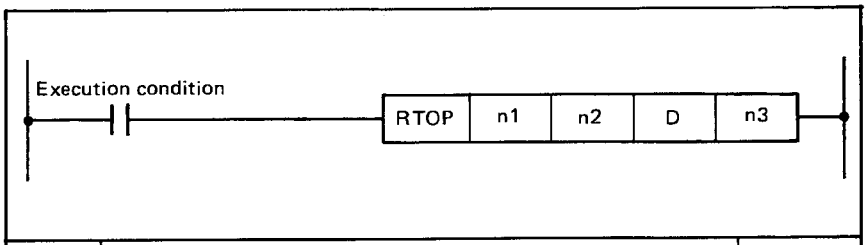
RFRP instruction execution command reset

RFRP instruction execution flag reset

Generates pulse for repetition

(2) Write to remote I/O station D71

[Format]



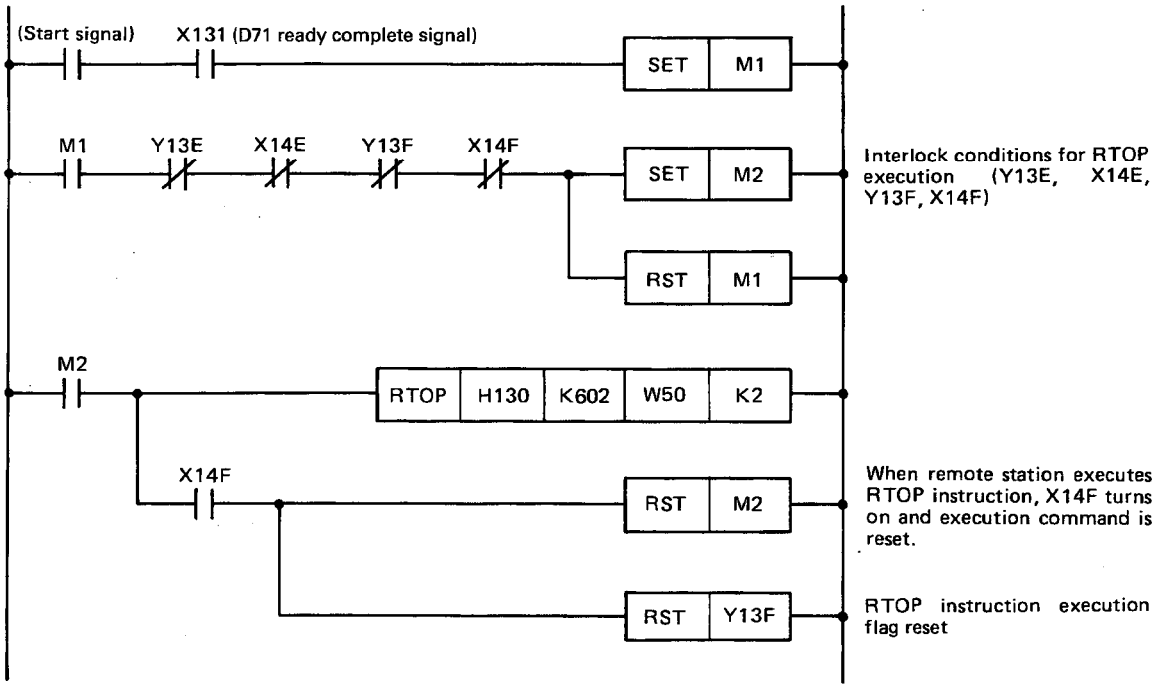
Symbol	Description	Available Device
n1	The first three digits of the D71 I/O number assigned by master station	K, H
n2	Head buffer address to which data will be written	K, H
D	Head number of link registers where read-out data is stored.	W
n3	Number of data words to be written (1 to 16)	K, H

POINT

For "n1" that specifies the head number of the I/O numbers, specify three digits when specifying the RFRP or RTOP instruction.

Example: Writing two words beginning with W50 into two words in buffer memory addresses 602 and 603 (X axis present value) of the I/O station D71 that corresponds to addresses X and Y130 to 14F of the master station.

To write once on receiving the start signal



7.4.3 Program example

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

1. Parameters, zero return data, and positioning data should all have been written to the D71 in the remote I/O station using the A6GPP (SW0-AD71P).
2. The D71 should have been assigned from the master station to X, Y100 to 11F.
3. 64 link registers are used (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) Link parameters

* LINK *

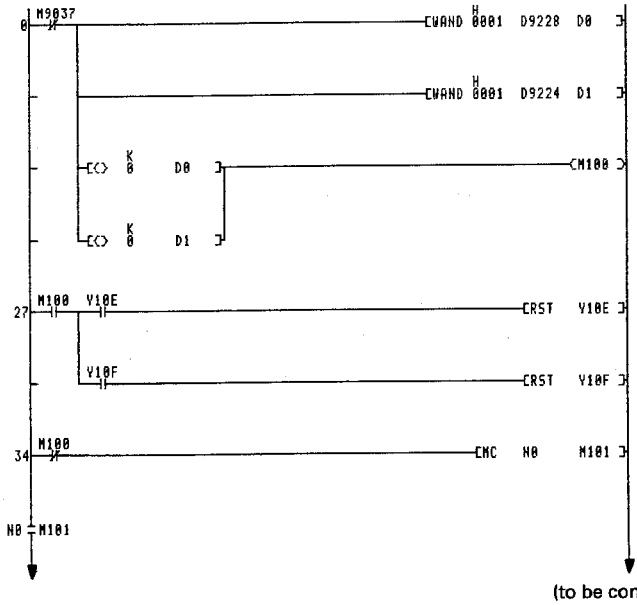
MASTER	SLAVE PC STATIONS	M → ALL L		W. D. T FOR LINK 10 ms	INTER-MITTENT 10 ms
		B	W		
M	1	-	-	20	XXXX

M : B ←→ ALL L : B –
M : W ←→ ALL L : W –
M : W ⟶ ALL L : W 100-13F
M : W ⟵ ALL L : W 200-23F
M : Y ⟶ ALL L : X –
M : Y ⟶ ALL L : Y 100-11F
M : X ⟵ ALL L : Y –
M : X ⟵ ALL L : X 100-11F

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	100-11F	000-01F	100-11F	000-01F
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-

M : MASTER L : LOCAL R : REMOTE

(2) Example program



Detects the error of remote I/O station No. 1. (Error if D9228 bit 0 = 1)

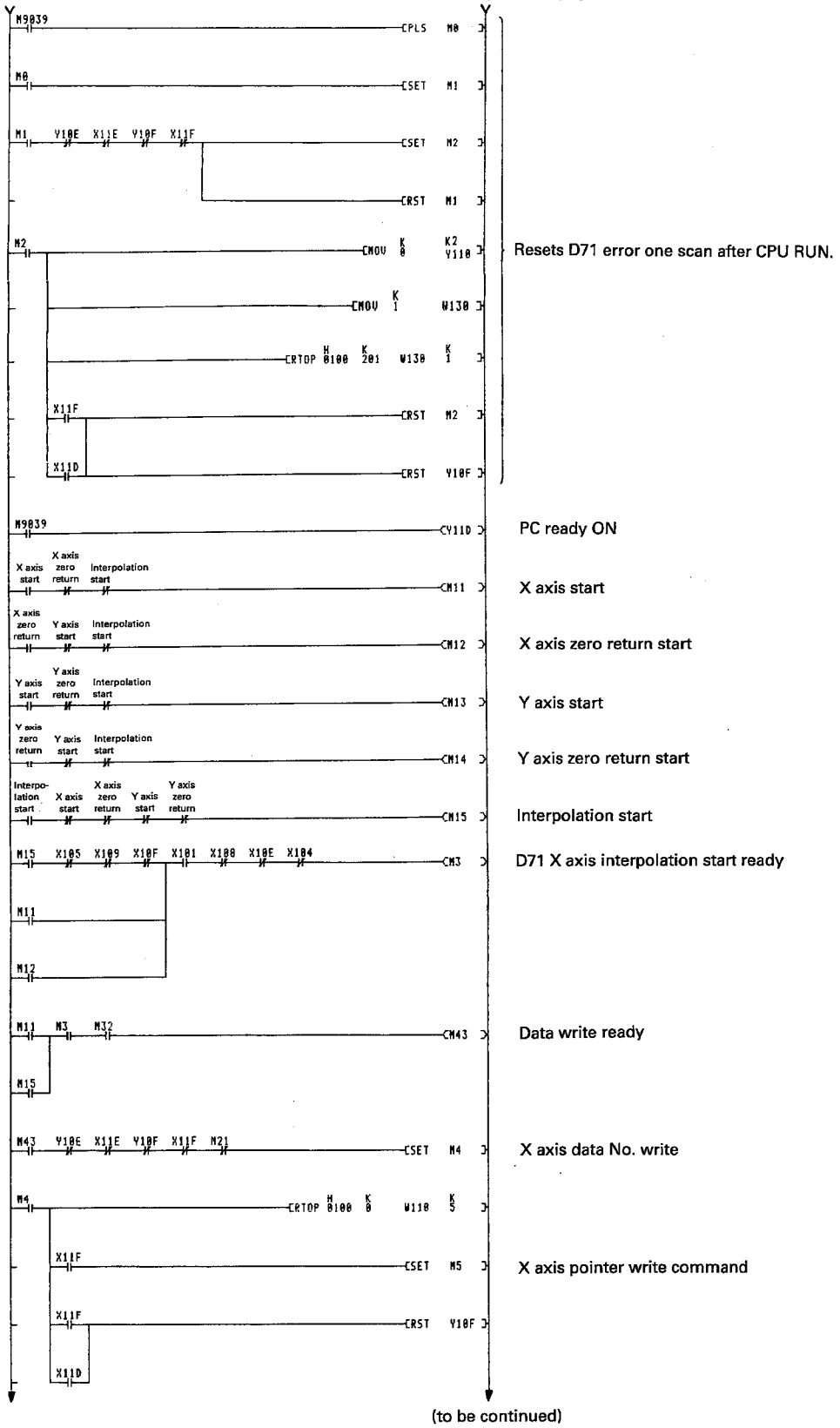
Detects "in parameter communications" at remote I/O station No. 1. ("In parameter communications" if D9224 bit 0 = 1)

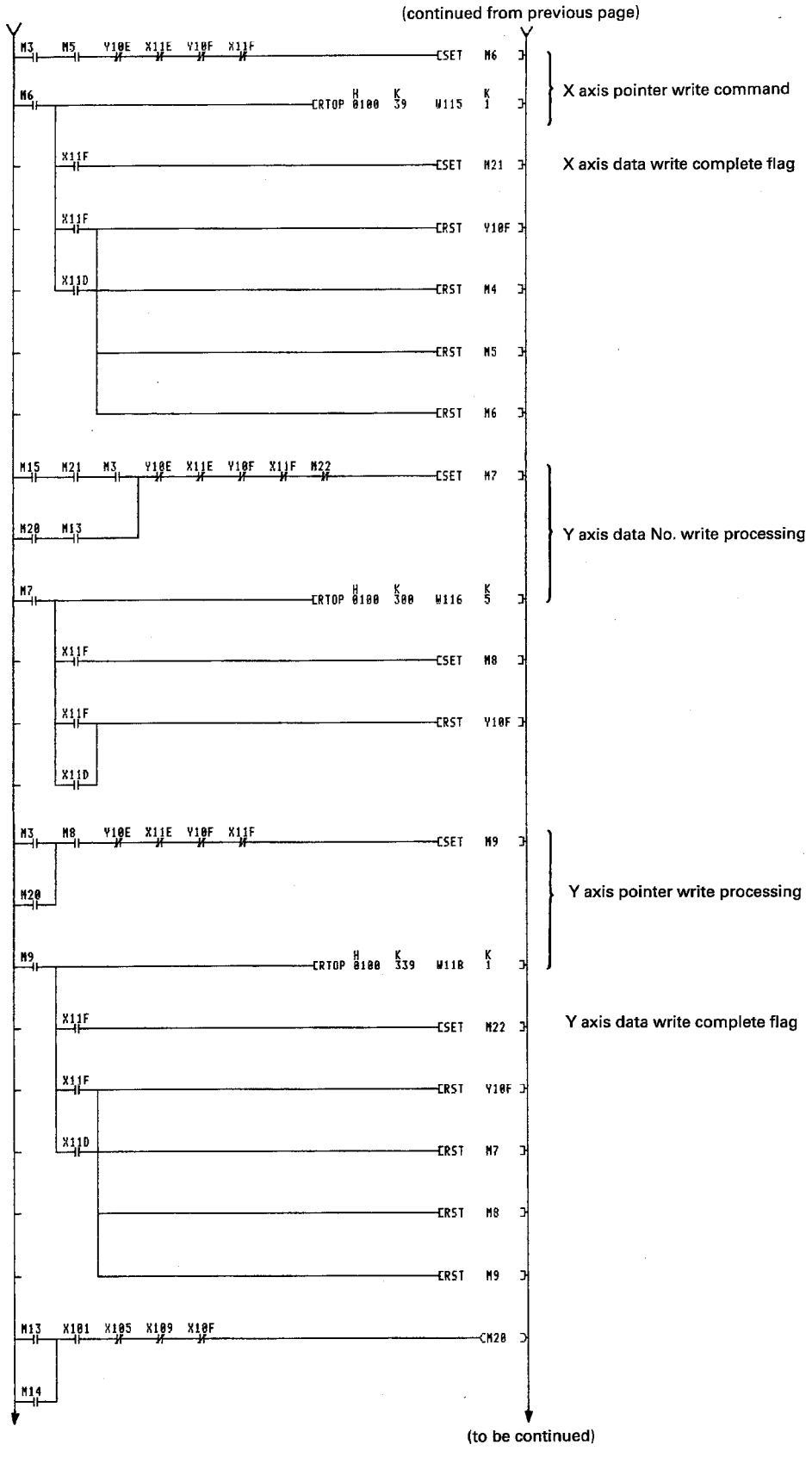
M1 is turned on if an error state or in parameter communications state is detected with remote I/O station No. 1.

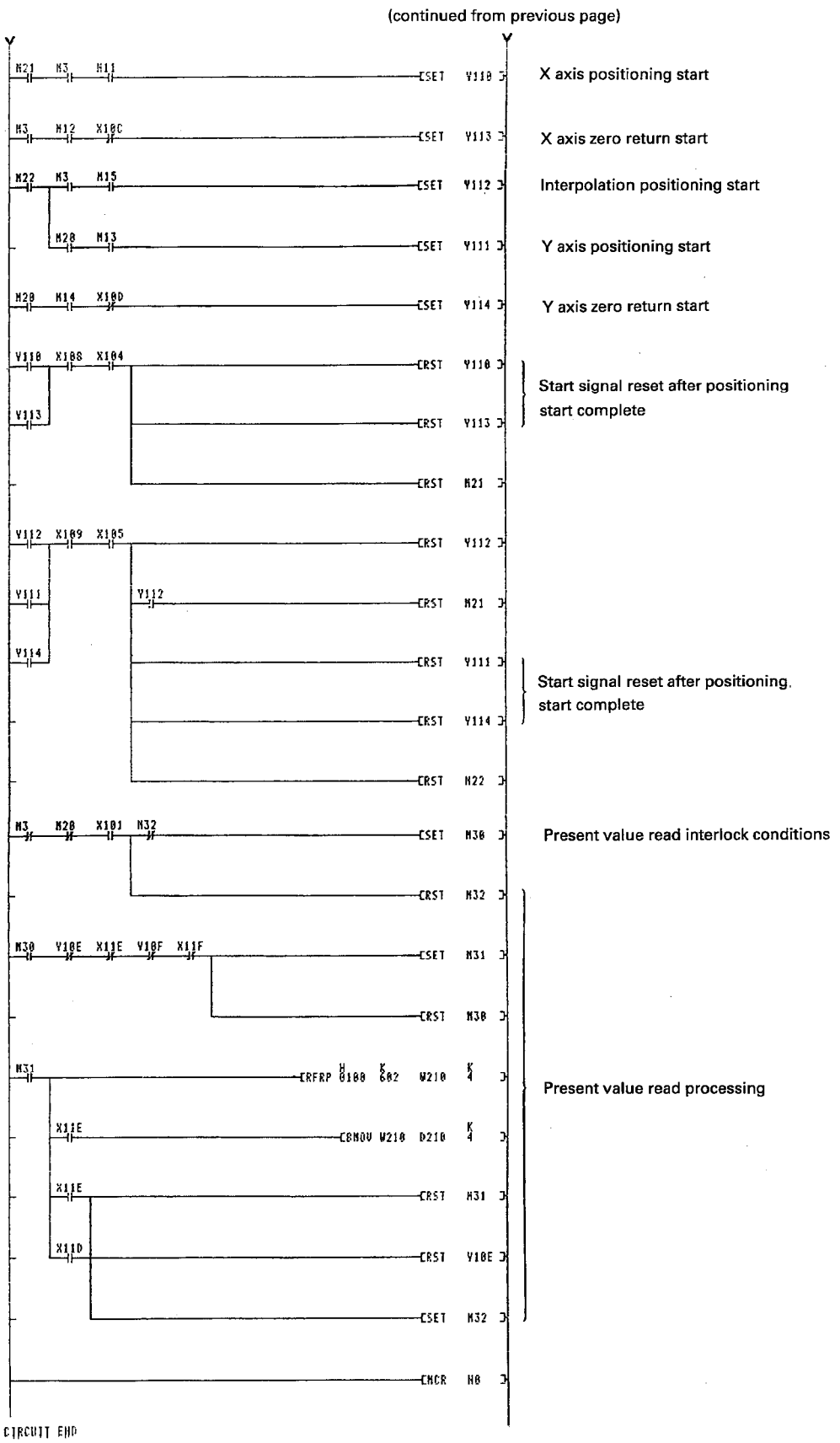
Resets the handshaking signal Y0E (YnE) and Y0F (YnF) if a communication error occurs during the execution of RFRP or RTOP signal at remote I/O station No. 1.

(to be continued)

(continued from previous page)




(continued from previous page)
M3 M5 Y10E X11E Y10F X11F
SET M6
M6
CRTOP H0100 K39 W115 K1
X axis pointer write command
X11F
SET M21
X axis data write complete flag
X11F
RST Y10F
X11D
RST M4
RST M5
RST M6
M15 M21 M3 Y10E X11E Y10F X11F M22
SET M7
M20 M13
Y axis data No. write processing
M7
CRTOP H0100 K300 W116 K5
X11F
SET M8
X11F
RST Y10F
X11D
M3 M8 Y10E X11E Y10F X11F
SET M9
M20
Y axis pointer write processing
M9
CRTOP H0100 K339 W118 K1
X11F
SET M22
Y axis data write complete flag
X11F
RST Y10F
X11D
RST M7
RST M8
RST M9
M13 X101 X105 X109 X10F
M20
M14
(to be continued)


(continued from previous page)
X axis positioning start
X axis zero return start
Interpolation positioning start
Y axis positioning start
Y axis zero return start
Start signal reset after positioning start complete
Start signal reset after positioning start complete
Present value read interlock conditions
Present value read processing
CIRCUIT END

8. CHECK LISTS

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

8.1 General Check List

Before testing the D71, check the following:

	Check Point	Description	Check
1	Battery	• Check that battery leads are connected to the printed circuit board.	
2	Parameter setting	• Check that parameters have been set. • Check that values are correct.	
3	Zero return data setting	• Check that zero return data has been set. • Check that values are correct.	
4	Positioning data	• Check that positioning data has been set. • Check that values are correct.	

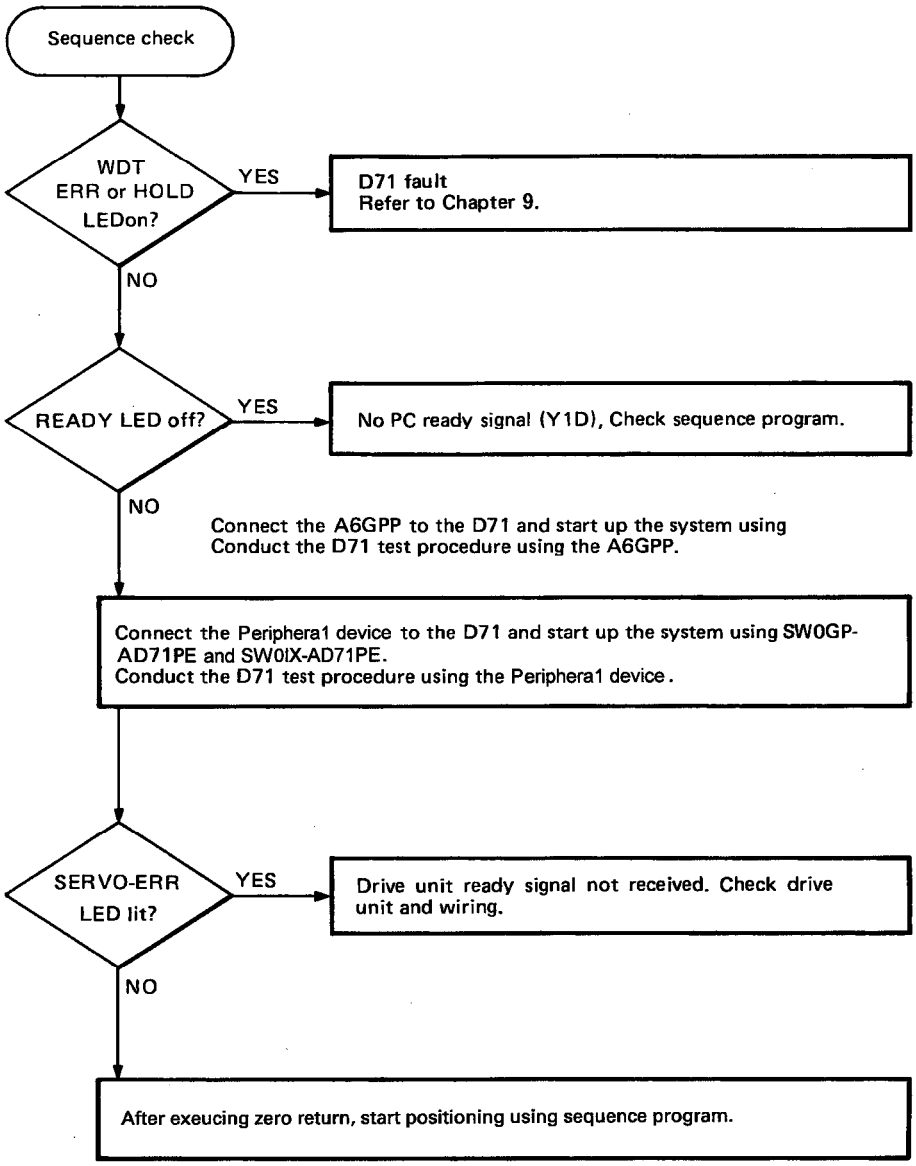
Table 8.1 General Check List

8.2 Tests and Adjustments

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

8.2.1 Sequence check

Use the following procedure to check the system.
Set the key switch on the D71 front panel to "LOCK." This only changes the present value and allows checking of the positioning functions with the feed pulse output stopped.



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8.2.2 Checking positioning operation

After completing the checks given in Section 8.2.1, move the key switch on the D71 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 SW0GP-AD71PE and SW0IX-AD71PE monitoring function to check for error codes etc.

9. TROUBLESHOOTING

Errors may be detected by:

1) the D71 CPU; or
2) the peripheral device during program development and debugging.

This section describes errors detected by the D71 CPU, for other errors see the SW0GP-AD71PE and SW0IX-AD71PE Operating Manual.

9.1 Errors Detected by D71

The D71 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. An error code is displayed at the lower left portion of the GPP screen.

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

(3) Error reset

Errors are reset by writing a "1" to buffer address 201. (See Section 7.3.2)
For resetting of errors using the peripheral device, refer to the SW0GP-AD71PE and SW0IX-AD71PE Operating Manual.

(4) Error detection

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

Error codes are classified as shown in Table 9.1.

Error Code	Error Classification	Remarks
1 to 46	Data range error	Refer to Section 9.1.1.
50 to 51	D71 HOLD error	Refer to Section 9.1.2.
60 to 64	Buffer memory write disable error	Refer to Section 9.1.3.
70 to 79	D71 start and operation error	Refer to Section 9.1.4.
80 to 81	D71 BUSY stop error	Refer to Section 9.1.5.

Table 9.1 Error Code Classification

9.1.1 Data range errors

Any of the operations shown in Table 9.2 will prompt a data range check by the D71 as shown below.

Data	Operation
Parameters	• At power on* • When parameters have been transferred from the A6GPP to the D71. • When PC ready signal (Y1D) changes from OFF to ON. • When positioning, zero return, JOG, or manual pulse generator has been selected in A6GPP test mode.
Zero return data	• When parameters or zero return data has been transferred from the A6GPP to the D71. • When PC ready signal (Y1D) changes from OFF to ON. • When positioning, zero return, JOG, or manual pulse generator has been selected in A6GPP test mode.
Positioning data	• At the start of positioning

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

Table 9.2 Data Range Check

If an error occurred, find the cause of the error by checking the error code, correct the data to the value within the allowable setting range, then write the correct data again.
A list of error codes is shown in Table 9.3.

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 2.5, Section 2.4.1. However, the parameter area data remain as set by the user.

Error Code	Data Type	Check Point	Check Range	Remarks
0			Normal	
1	Parameter	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: $\frac{V\ (unit/mm)}{\{a\ (unit/PLS)\} \times 60} \leqq 200{,}000$ PLS/s) 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	PLS unit 0~ 255 mm unit 0~ 65535 inch unit 0~ 65535 degree unit 0~ 65535	*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 pulse during manual pulse generator	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	Zero return data	Zero address	0 to 1,620,000,000 in mm, inch, or degree 0 to 16,252,928 in PLS	*2
21		Zero return 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 9.3 Data Range Error Codes (Continue)

Error Code	Data Type	Check Point	Check Range	Remarks
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	For interpolation start (00) and both-axis start (11), the axis travel distance of the X and Y axes must be the same.	
46		Start axis	At the interpolation start (00) and both-axis start (11), the status of the mating axis is checked if it is BUSY or if it is executing positioning processing for the point before the automatic positioning point. An error occurs if the mating axis is executing positioning processing.	

*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: If amount of travel per pulse is set to "1".

Table 9.3 Data Range Error Codes

9.1.2 "HOLD" LED

The errors shown in Table 9.4 are indicated by the D71 "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. If the HOLD LED lights, check the cause of the error by referring to Section 9.2).

Error Code	Check Point	Error Definition	Corrective Action(s)
50	Operation element (8231)	Operation time-out error (hardware fault)	Replace the D71
51		Operation error (overflow, underflow, etc.)	
51	AD71	The entire memory has not been cleared.	Clear the entire memory using a peripheral device or the sequence program.
50,51		Operation error due to noise (overflow, underflow, etc.)	Perform either of the following reset operations. Using the reset key switch of the CPU module. By switching power off and then on.

Table 9.4 D71 Hold Error Codes

In the event of any of the above errors occurring 1) turn off the D71 ready (X1) and 2) force BUSY processing to stop. The start signal is then not accepted.

9.1.3 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 9.5.

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 Y1D is on.
64	Monitoring present value area Speed area	Data written from PC to a write prohibit address.

Table 9.5 Buffer Memory Write Error Codes

9.1.4 AD71S7 start and operation errors

The errors described below are those that preclude starting of the AD71S7 due to conditions in itself although the start instruction is given from the PC CPU or those detected during the operation of the AD71S7.

Error Code	Error	Corrective Action
70	No READY signal	Set the drive unit ready.
71	External stop signal (3.3) input at the start.	Turn off the external stop signal (3.3).
72	AD71S7 ready (X1) and PC ready (Y1D) 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 (Y15, Y16) ON at the start. Stop processing initiated by [BREAK] key operation at A6GPP or A6PHP.	• Turn off the stop signal (Y15, Y16). • Cancel the stop processing initiated by A6GPP or A6PHP.
77	Zero return repeated two times or more consecutively.	Zero return cannot be repeated two times or more. Start the operation after 1 executing positioning at a point before the near-point dog in JOG operation, or 2 executing positioning once.
78	Zero return attempted with zero return complete signal on.	Zero return already completed.
79	When converted into the pulses, the designated value is outside the range of 0 to 16252928 pulses.	• Return the present value to within the stroke limit range using JOG or manual pulse generator operation. • Zero the system. • Change the present value.

Table 9.6 AD71S7 Start and Operation Error Codes

Note 1: Start includes;
- Zero return start
- Jog operation
- Manual pulse

2: For interpolation starts,error codes are always given for both axes even if one axis has an error.

9.1.5 D71 BUSY (positioning) stop errors

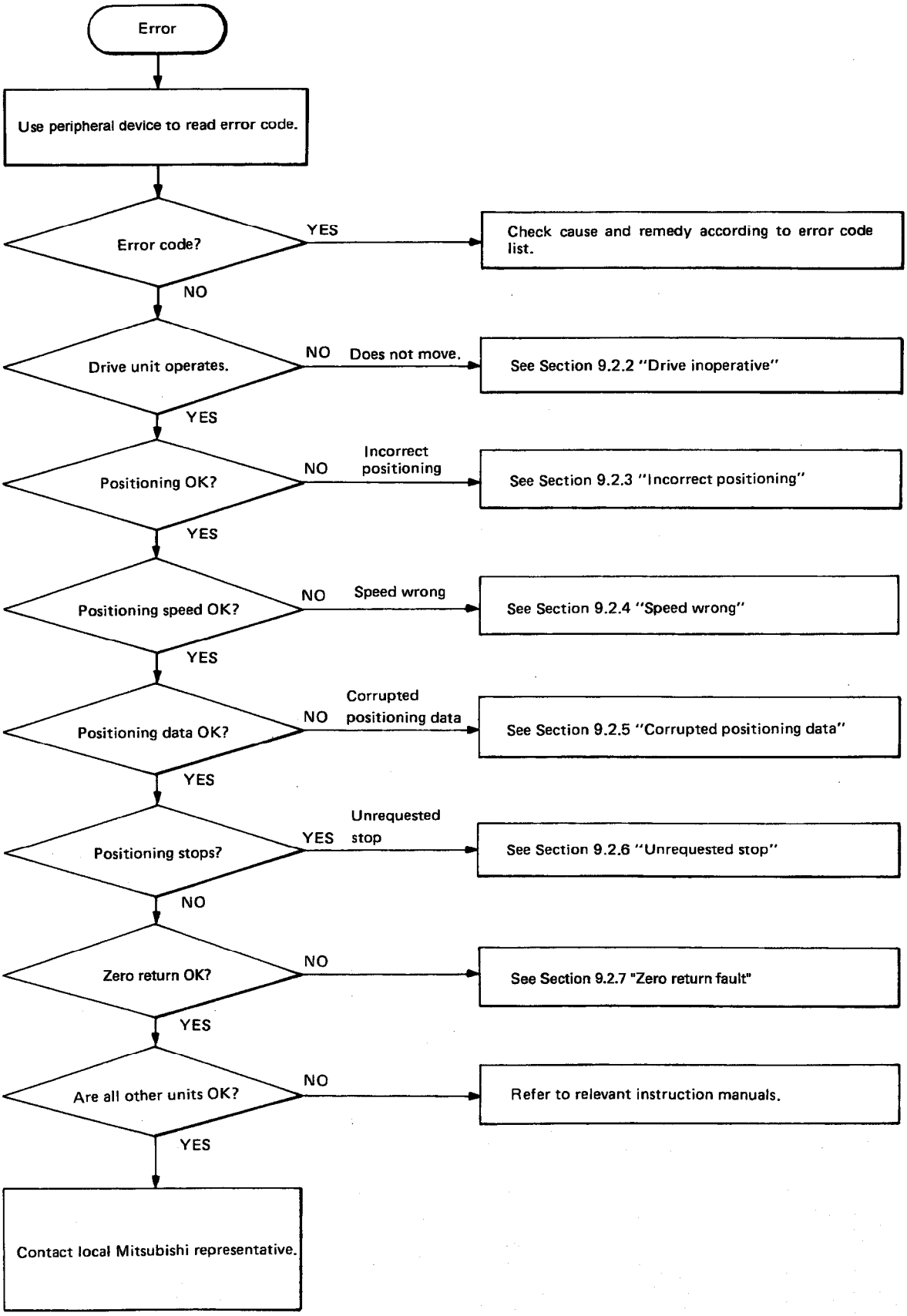
The following error codes result from the D71 losing the READY signal while it is BUSY or zero return is stopped.

Error Code	Factor	Corrective Action
80	READY lost while D71 is BUSY.	Check drive unit and READY signal.
81	Zero return stopped.	Zero return is not allowed more than twice consecutively. If necessary JOG to a safe position in front of near-point dog and restart zero return.

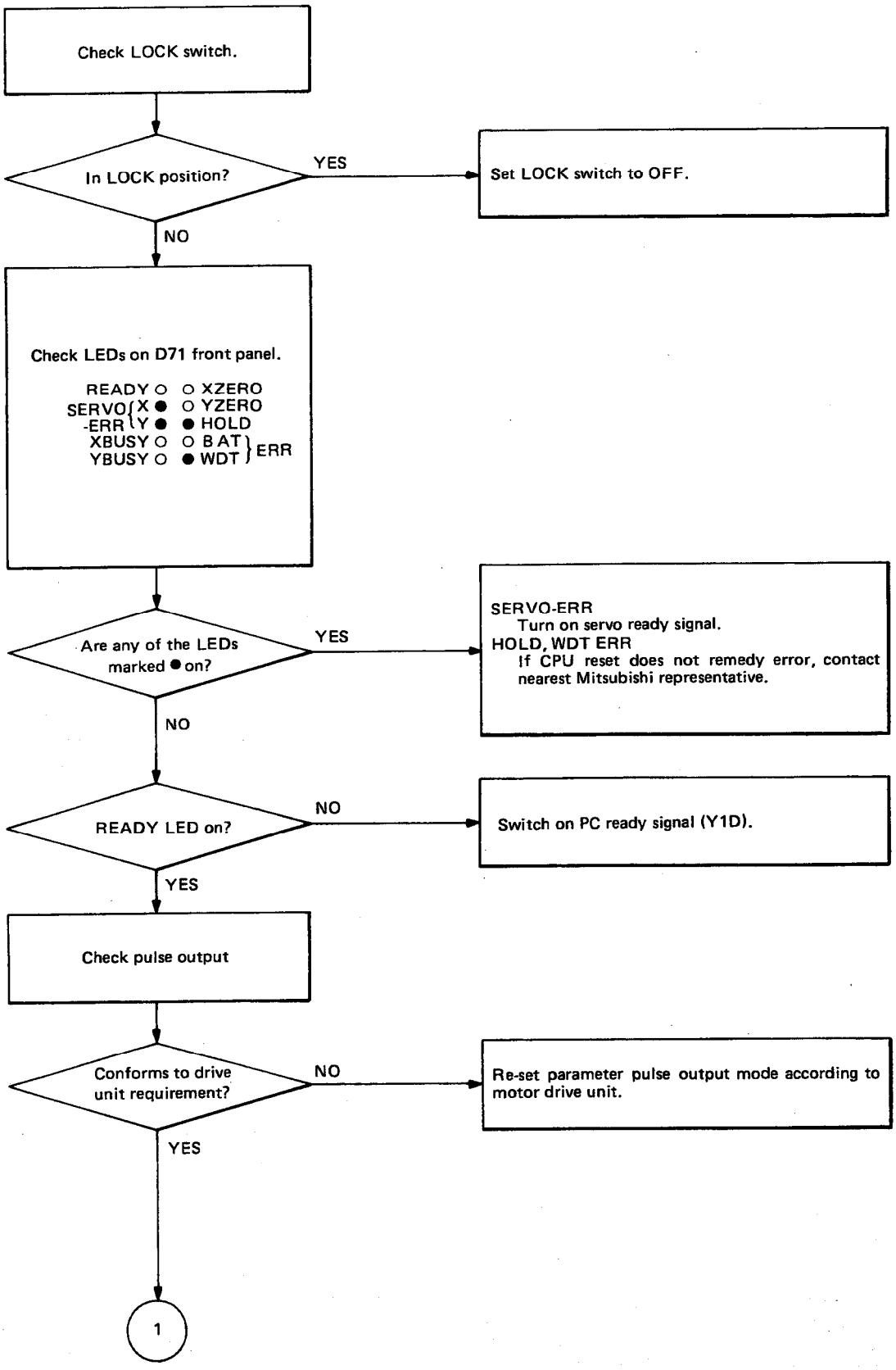
Table 9.7 BUSY Error Codes

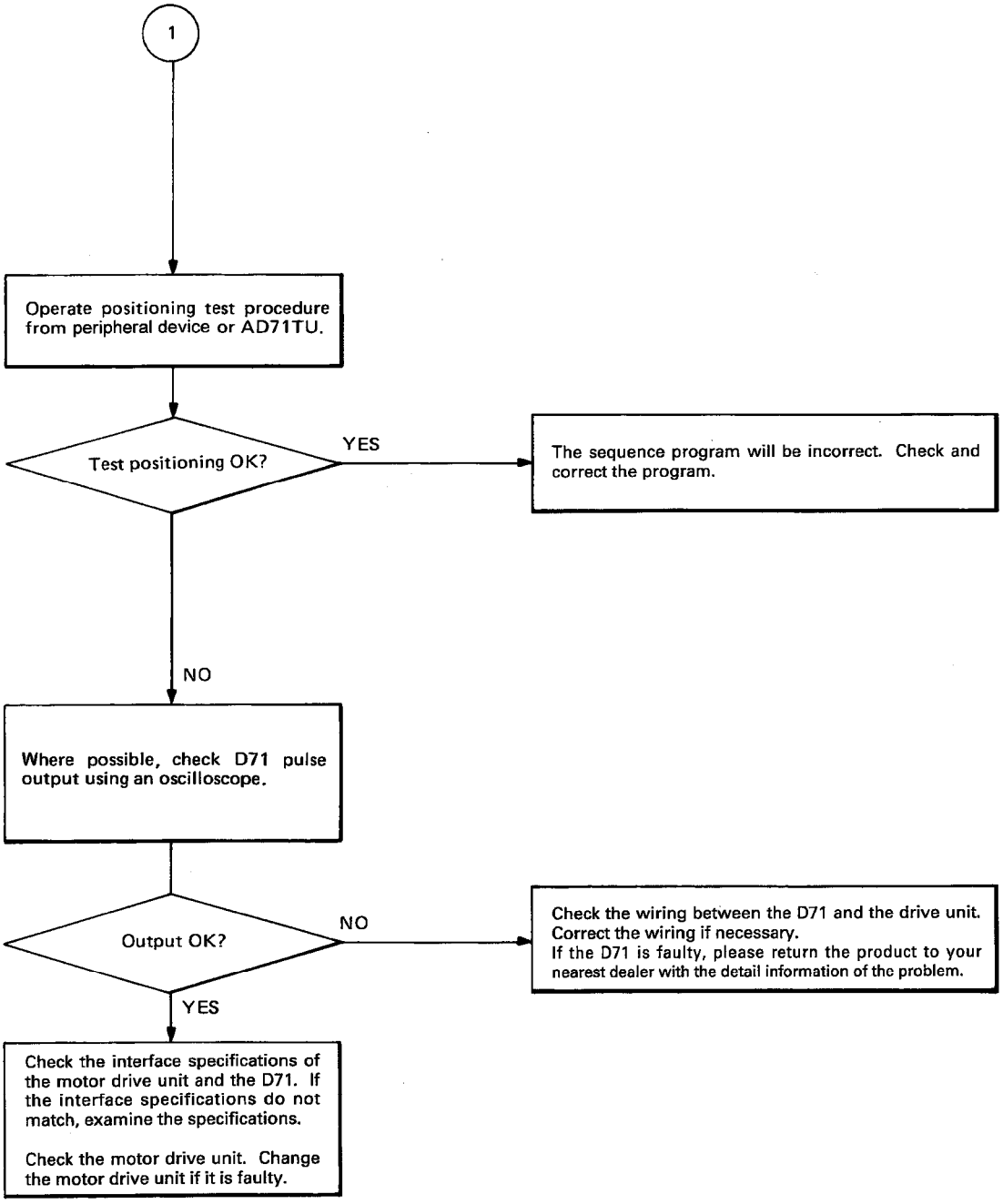
9.2 Troubleshooting

9.2.1 General troubleshooting



9.2.2 Drive inoperative




1
Operate positioning test procedure from peripheral device or AD71TU.
Test positioning OK?
YES
The sequence program will be incorrect. Check and correct the program.
NO
Where possible, check D71 pulse output using an oscilloscope.
Output OK?
NO
Check the wiring between the D71 and the drive unit. Correct the wiring if necessary.
If the D71 is faulty, please return the product to your nearest dealer with the detail information of the problem.
YES
Check the interface specifications of the motor drive unit and the D71. If the interface specifications do not match, examine the specifications.
Check the motor drive unit. Change the motor drive unit if it is faulty.

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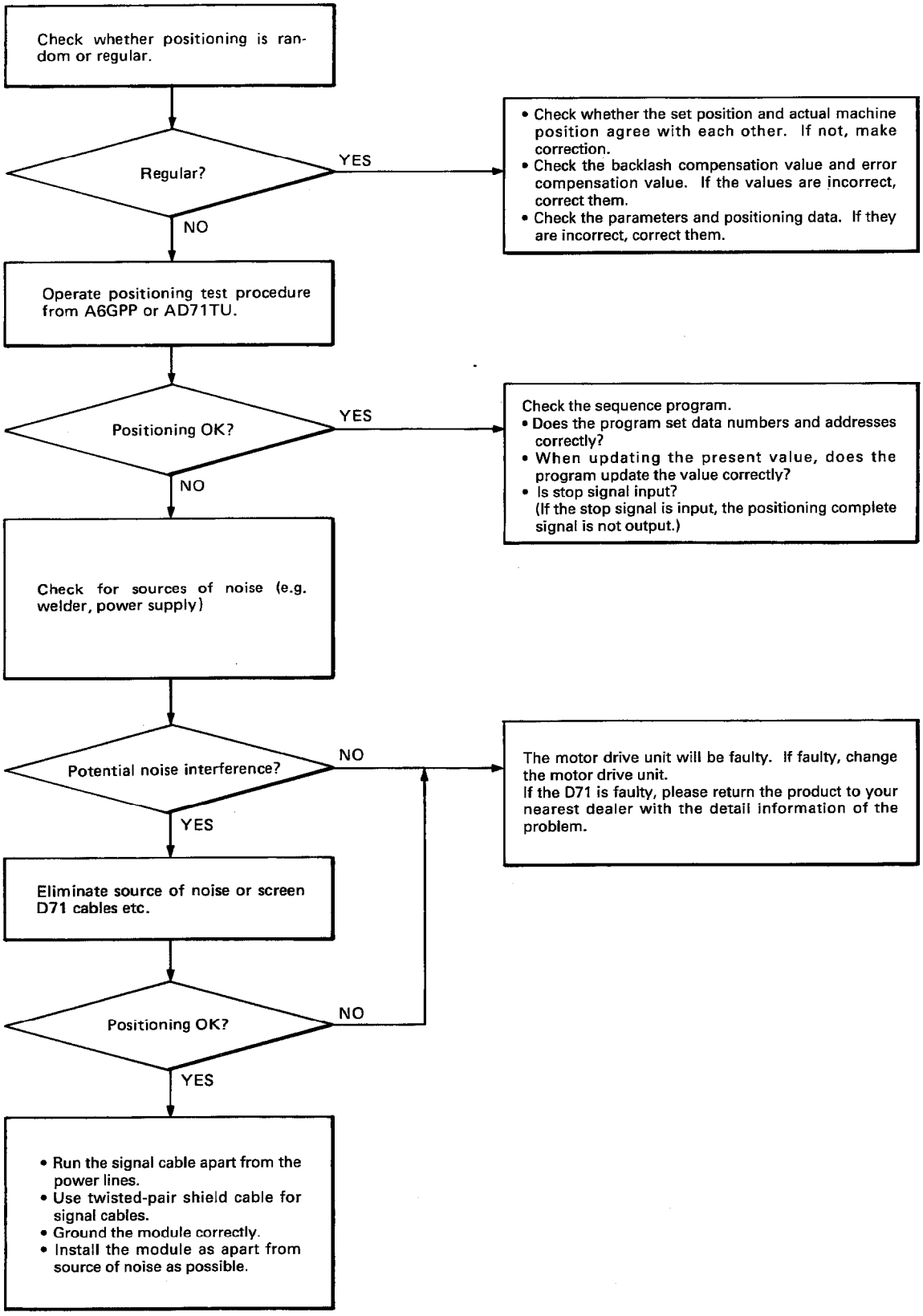
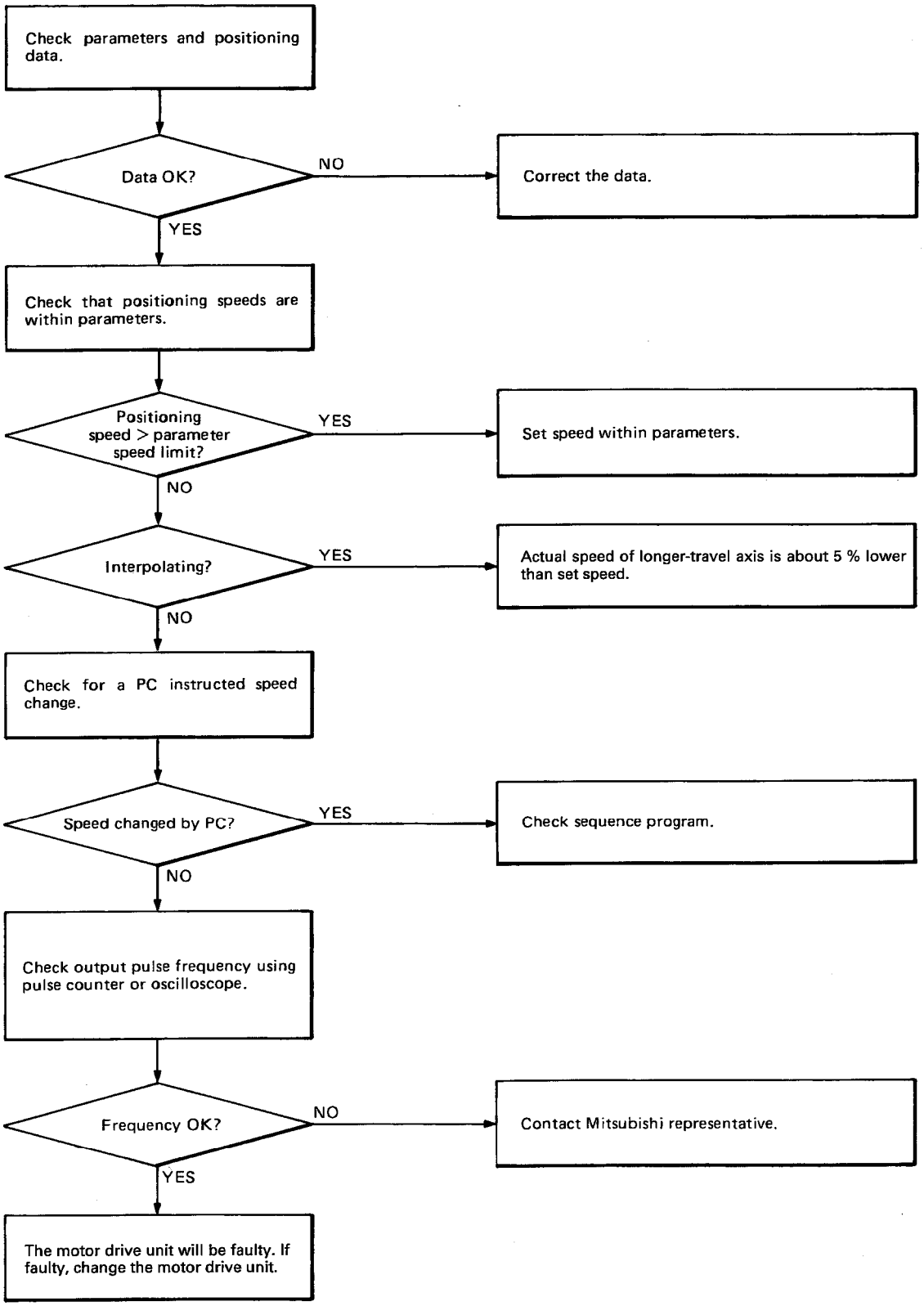
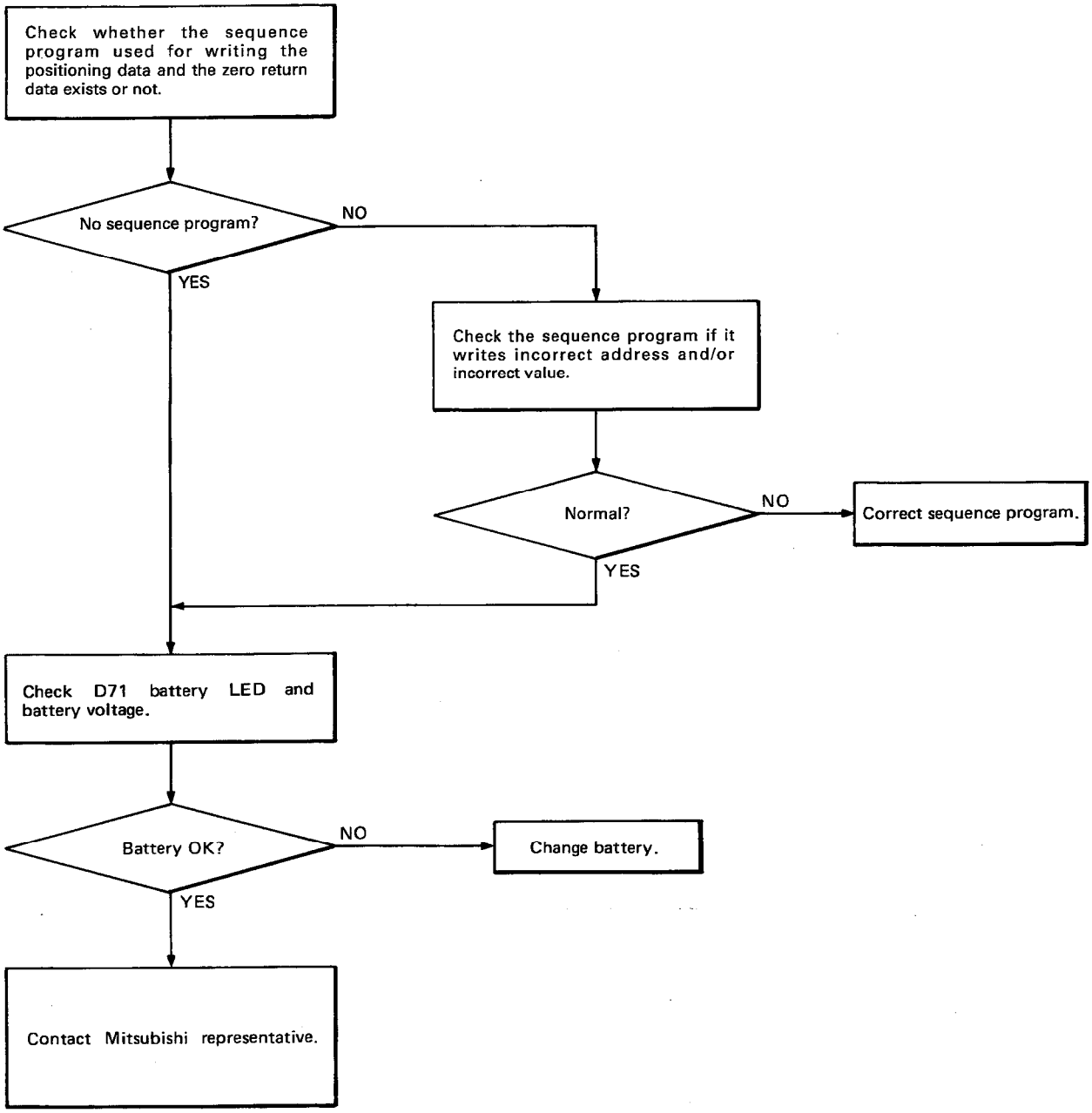
9.2.3 Incorrect positioning



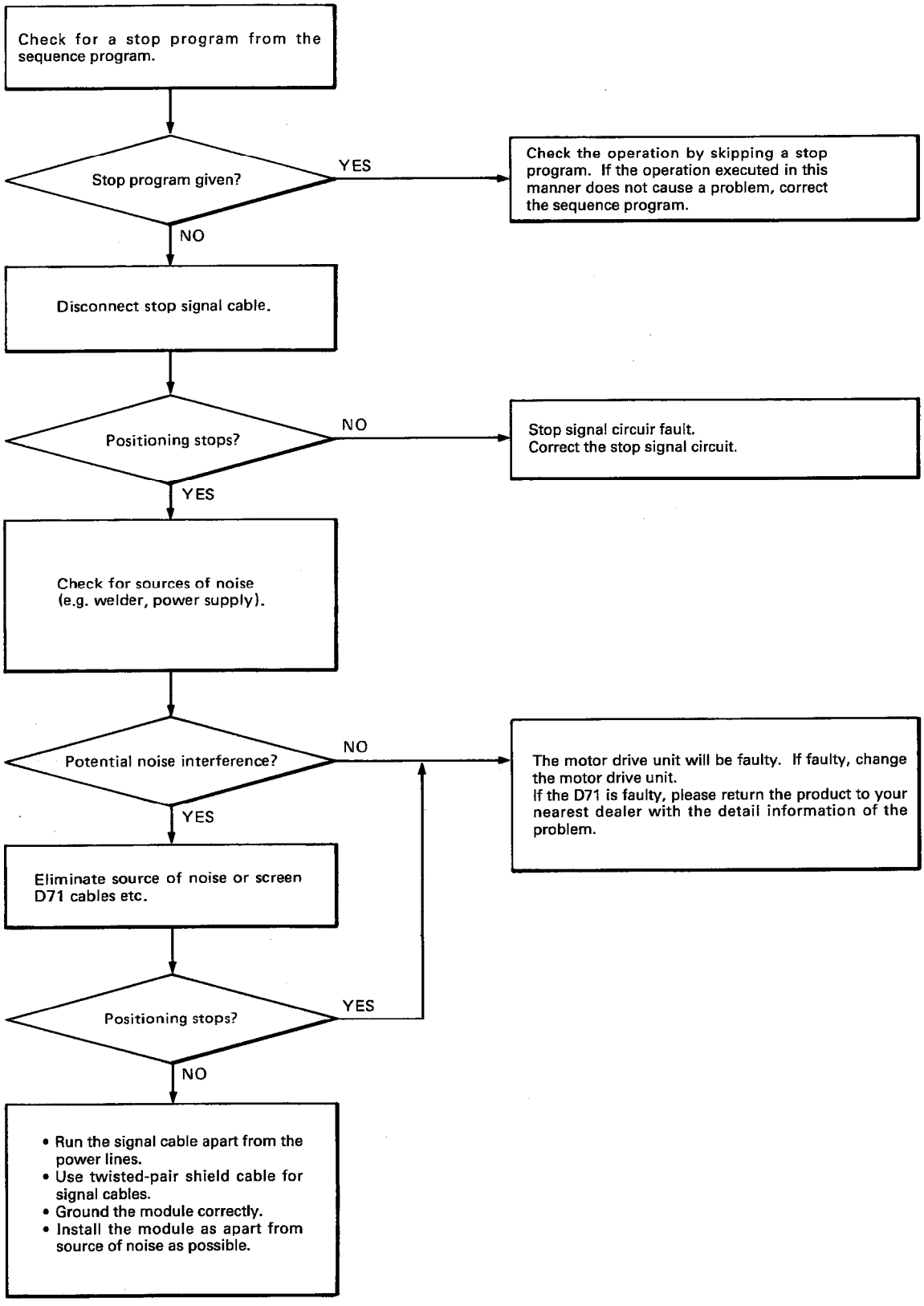
9.2.4 Speed wrong



9.2.5 Corrupted positioning data

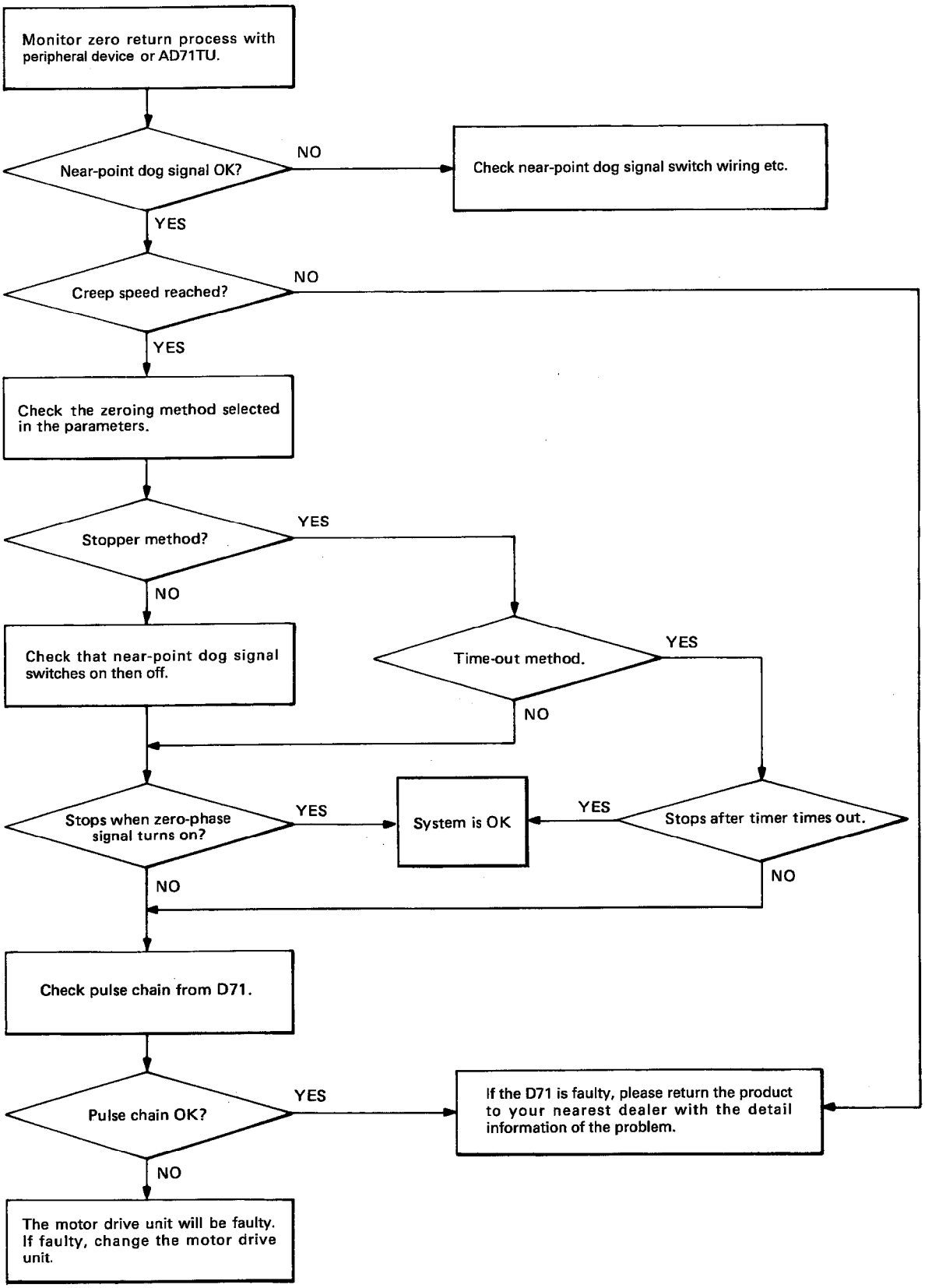


9.2.6 Unrequested stop

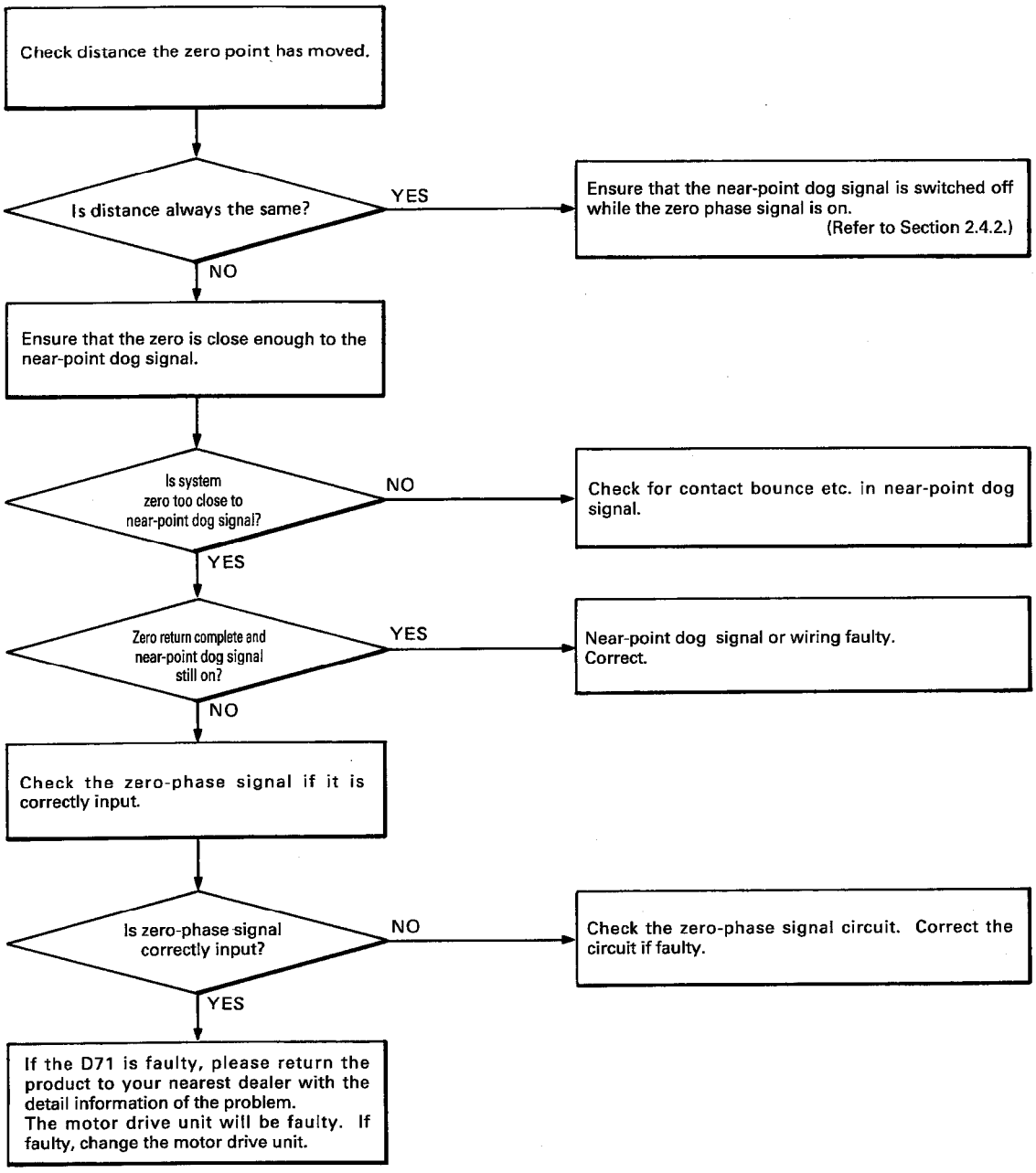


9.2.7 Zero return fault

(1) Partial zero return



(2) System zero has moved



Note

For the system employing the stopper for zero return control, check the stop signal if it is input correctly and the setting of the timer. If there are no problems in the check, the D71 or the motor drive unit will be faulty. Change the faulty hardware (D71 or motor drive unit).

10. MAINTENANCE

This chapter describes the maintenance of the D71 (module maintenance and battery replacement).
For other units and modules (power supply units, CPU units, I/O modules, special function modules, etc.), refer to the user's manual of the individual units and modules.

10.1 Unit Storage

The D71 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 D71 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.
(If the D71 has not been operated for over 10 months, the setting data in the D71 could have been lost. In this case, the setting data must be checked before operating the D71.)

10.2 Battery Change

10.2.1 Battery change frequency

When the data backup battery voltage drops, the LED on the D71 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 } Power off time in a week

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.

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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 (3.6 V 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.

10.2.2 Changing the battery

Fig. 10.1 shows battery changing procedure.

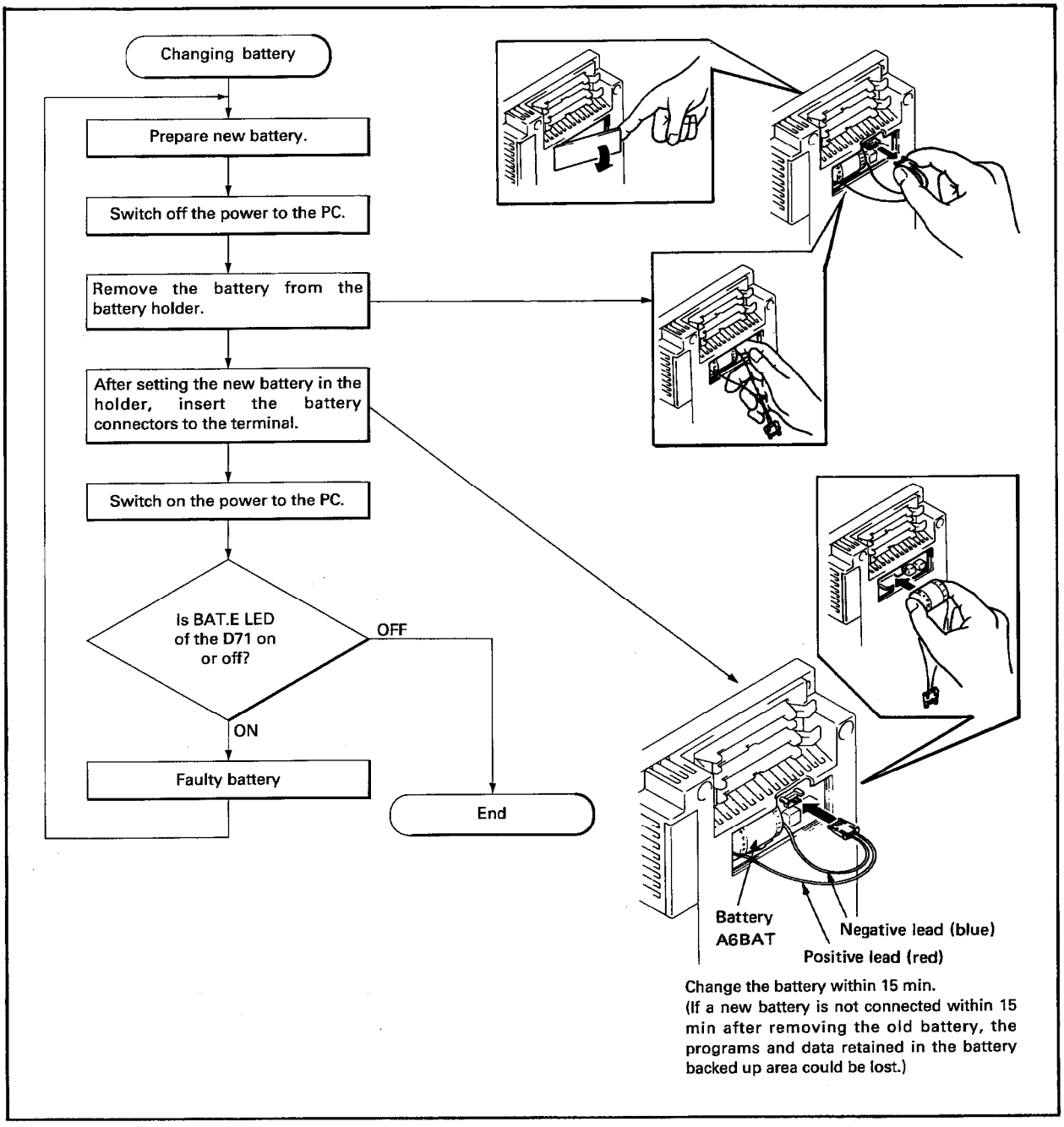


Fig . 10.1 Changing the Battery

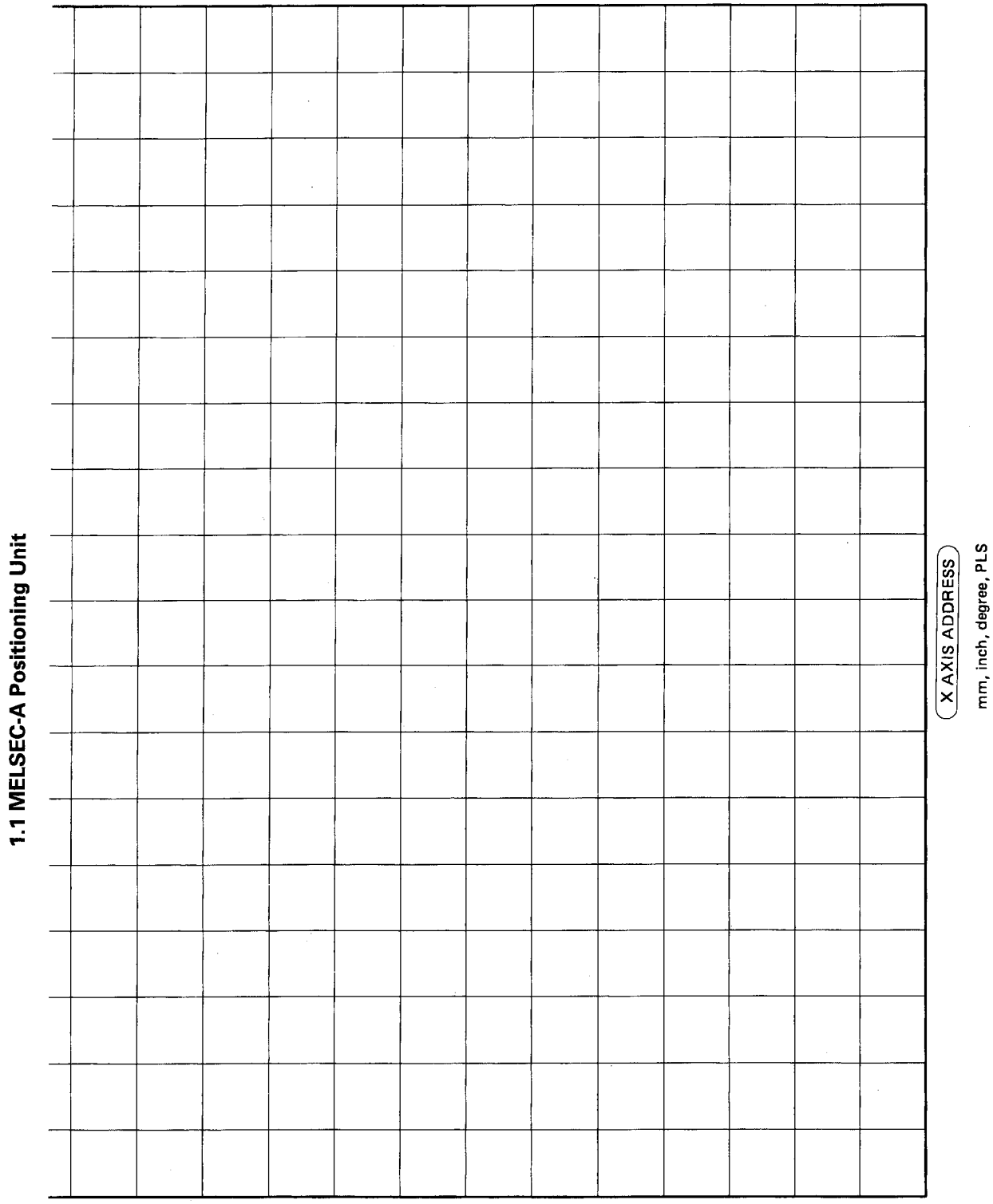
IMPORTANT

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.

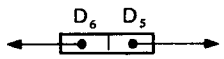
APPENDICES

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/s
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 2,000	X10 PLS/s
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/s
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 1 m)	$X10^{-1}$ μm	±0 to 100,000 (per 100 inch)	$X10^{-5}$ inch	±0 to 100,000 (per 100 deg)	$X10^{-5}$ deg	—	
10	Travel per pulse during manual pulse generator	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 ms							
12	Positioning complete signal output time	300			0 to 20,000 ms							
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

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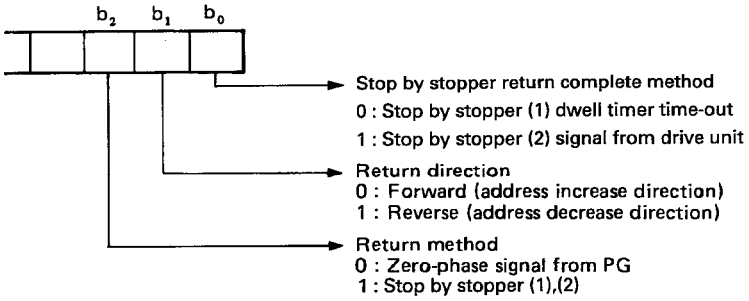
(2) Zero return data

	Item	X Axis	Y Axis	mm		inch		degree		PULSE (PLS)	
				Setting Range	Unit	Setting Range	Unit	Setting Range	Unit	Setting Range	Unit
1	Zero return direction			0 : forward direction (address increase) 1 : reverse direction (address decrease)							
2	Zero return method			See below.							
3	Zeto return 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	0to16,252,928	PLS
4	Zero return speed			1to12,000	X10 mm/ min	1to12,000	X1 inch/ min	1to12,000	X1 deg/ min	1to20,000	X10 PLS/s
5	Creep speed			1to12,000	X10 mm/ min	1to12,000	X1 inch/ min	1to12,000	X1 deg/ min	1to20,000	X10 PLS/s
6	Dwell			0 to 499 X 10 ms							
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

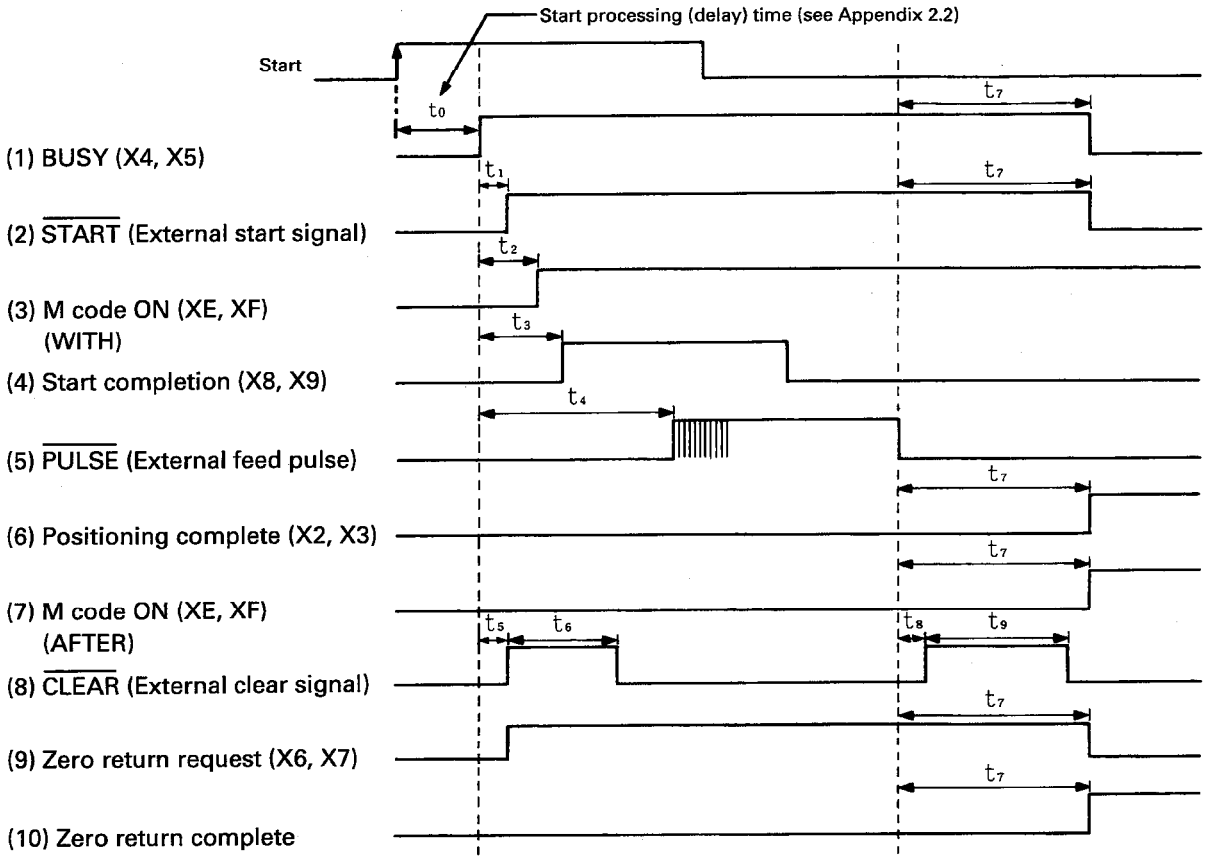
M CODE	X AXIS	M CODE	Y AXIS
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	
16		16	
17		17	
18		18	
19		19	

Maximum 16 characters per comment

APPENDIX 2 D71 SIGNAL OUTPUT TIMING

2.1 Signal Output Timing

The signal output timing in positioning operation and zero return operation is indicated below.



	Positioning Control			Zero Return	
	X axis	Y axis	Interpolation	X axis	Y axis
t_1(ms)	0.2	0.2	0.3	49.1	49.1
t_2(ms)	0.3	0.3	0.6		
t_3(ms)	0.5	0.5	0.8	0.4	0.4
t_4(ms)	18.4	18.4	18.4	58.3	58.3
t_5(ms)				0.1	0.1
t_6(ms)				49.5	49.5
t_7(ms)	1.4	1.4	1.4	17.7	17.7
t_8(ms)				0.7	0.7
t_9(ms)				16.5	16.5

Note 1: The timing chart above is for positioning in pattern "00" and pointer "0".

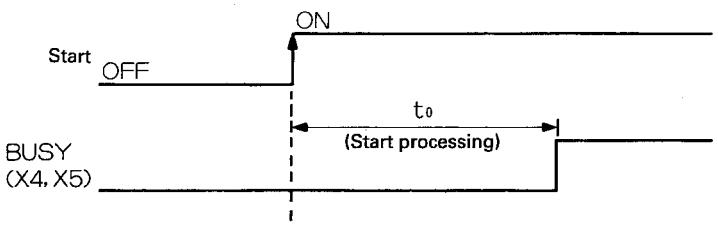
Note 2: (8) to (10) indicates the timing chart for zero return operation.

Note 3: The timing chart above assumes that dwell time is "0" in positioning.

2.2 Delay time at start

Time (t_1) required for the BUSY signal (X4, X5) of the D71 to turn on after turning on of the start signal is described below.

The timing chart of the start signal and the BUSY signal is shown below.



(1) Factors causing fluctuation in start processing time

The following factors cause fluctuation in duration until the BUSY signal goes on.

1) Execution of FROM/TO instruction during start processing
   * If FROM/TO instruction is executed, priority is given to the execution of FROM/TO instruction causing delay of several hundreds ms to several s in start processing.
   * There is no delay when FROM/TO instruction is not executed.

2) Operating status of the other axis
   * Several tens ms delay occurs if start processing is executed while the other axis is operating.
   * There is no delay when the other axis is in halt.

3) Intervention of peripheral equipment during start processing
   * Several tens ms delay occurs if an intervention of a peripheral equipment occurs during start processing.
   * There is no delay when no peripheral equipment is connected.

4) Number of speed change points in positioning pattern (11)
   * Length of delay time depends on the number of speed change points in a single positioning pattern (11) (approximately several tens ms per point).

(2) Start processing time (t_0)

Table 2.1 shows the measured start processing time under the condition the processing time is not influenced by fluctuation factors (1), 2), 3)) indicated above.

1) FROM/TO instruction is not executed during start processing.
2) The other axis is not operating.
3) There is no intervention by a peripheral equipment.

Table 2.1 Start Processing Time

	Mode of Operation		Min. value of t_0 (ms)*1	Max. value of t_0 (ms)*2
1	Zero return start		5.5±5	14±12
2	JOG start		4.5±5	33±12
3	Positioning control	Independent movement control	15±5	58±12
		Interpolation control	61±5	94±12
4	Positioning pattern (11) Positioning/Changing speed continued	Number of speed change points: 4 points	61±5	94±12

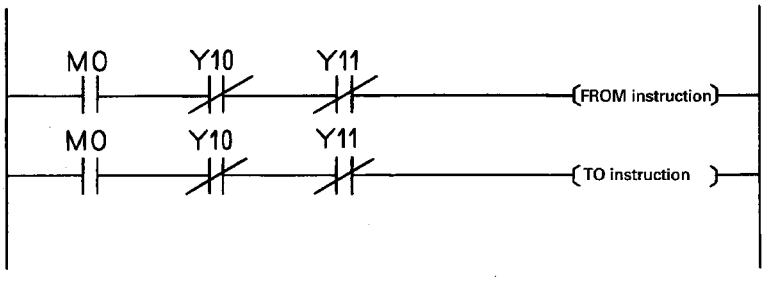
*1: "t_0" will be minimum in start processing when X and Y axes start moving
1. After the completion of zero return
2. After the completion of positioning
3. After the completion of present value change

*2: "t_0" will be maximum in start processing when X and Y axes moving
1. After the suspension of zero return
2. After the suspension of positioning
3. After stopping the operation in speed control mode
4. After stopping JOG operation

Note 1 Feed pulses are output t4 ms after turning ON of the BUSY signal (X4, X5). (See Appendix 2.1.)

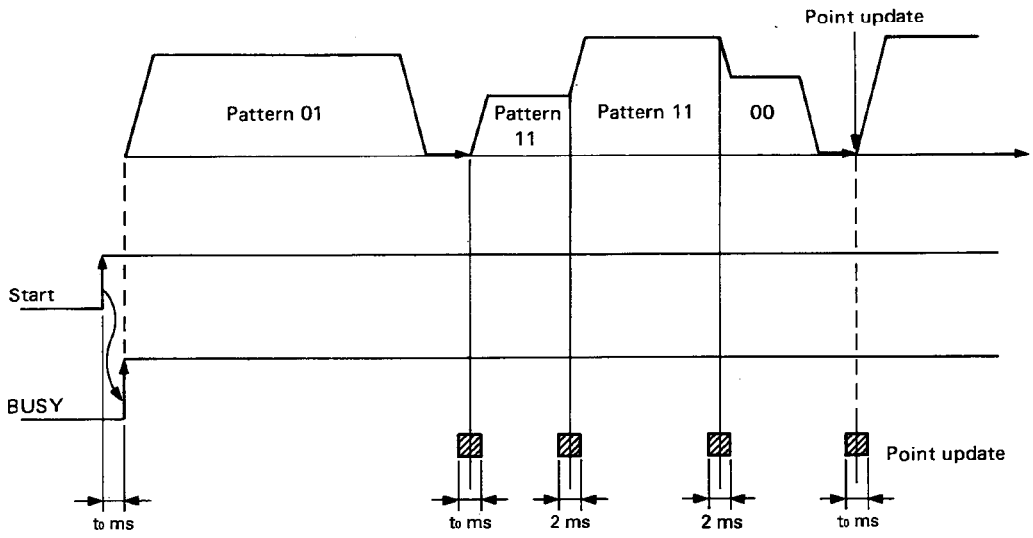
POINT

To avoid execution of FROM/TO instruction during start processing, use the start signal (Y10, Y11) as the interlock for FROM/TO instruction.



2.3 D71 Processing Times

(1) Pattern operation



The above time indicates D71 processing times and does not include PC operating time.

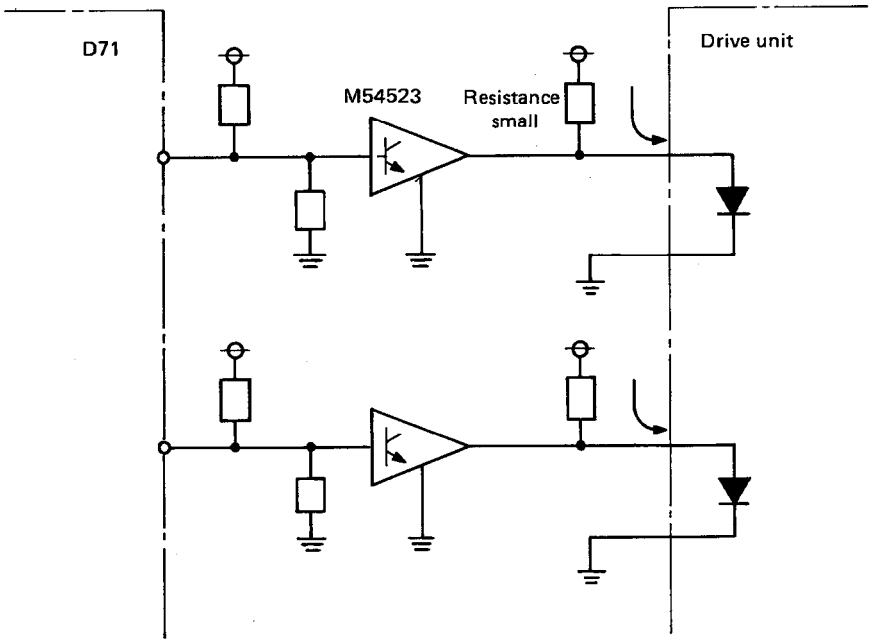
APPENDIX 3 Connection with Servo Motors

The following connection diagrams are provided as examples only and do not indicate the availability or otherwise of the drives shown.

[CAUTION]

(1) The D71 output is a sink output pulse chain.
The drive unit should be sink input.

(2) For use with source input drive units, use the interface shown below.

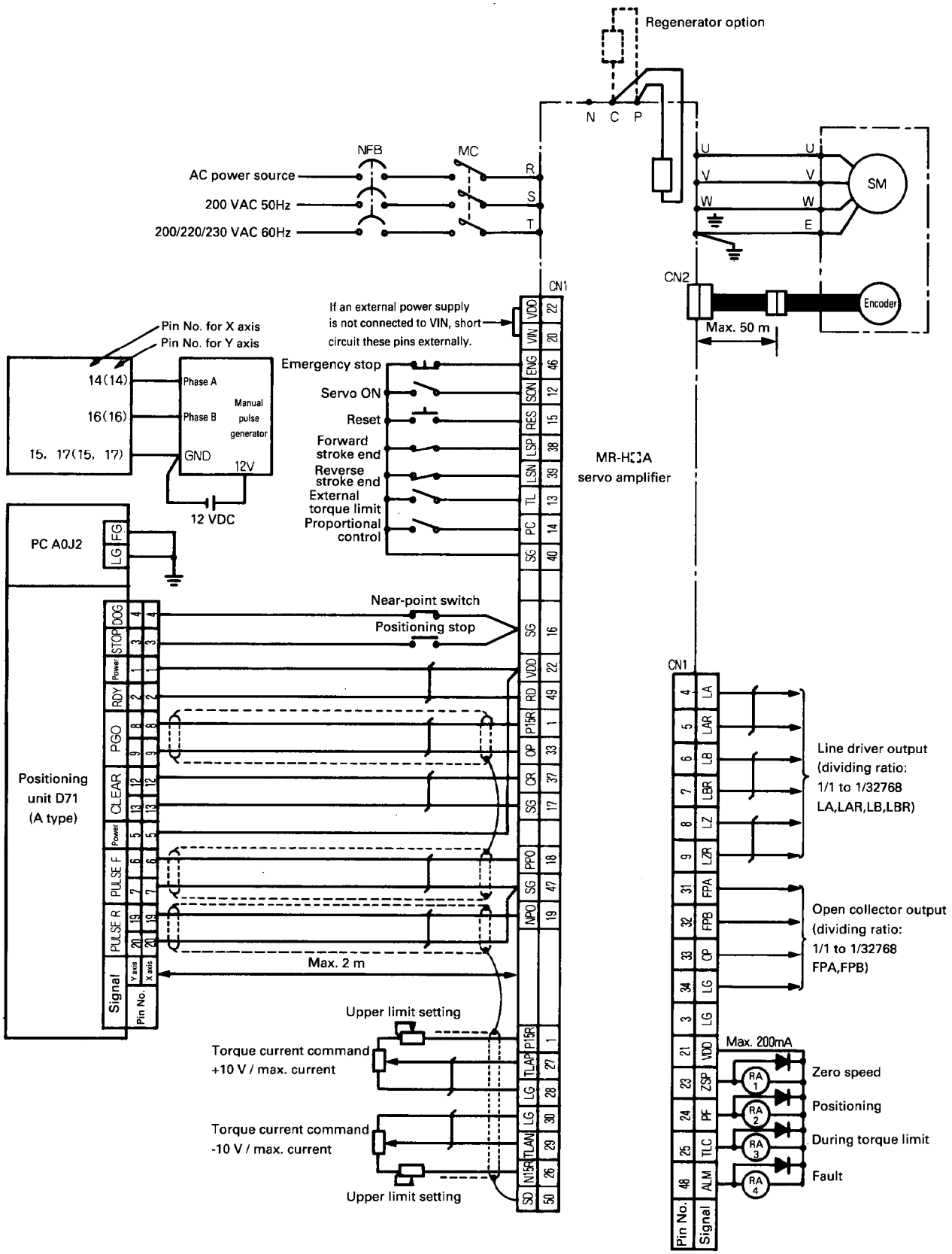


Signal Reversing Example

(3) For other signal lines of the drive unit, refer to the instruction manual of the individual models of the drive unit to be used.

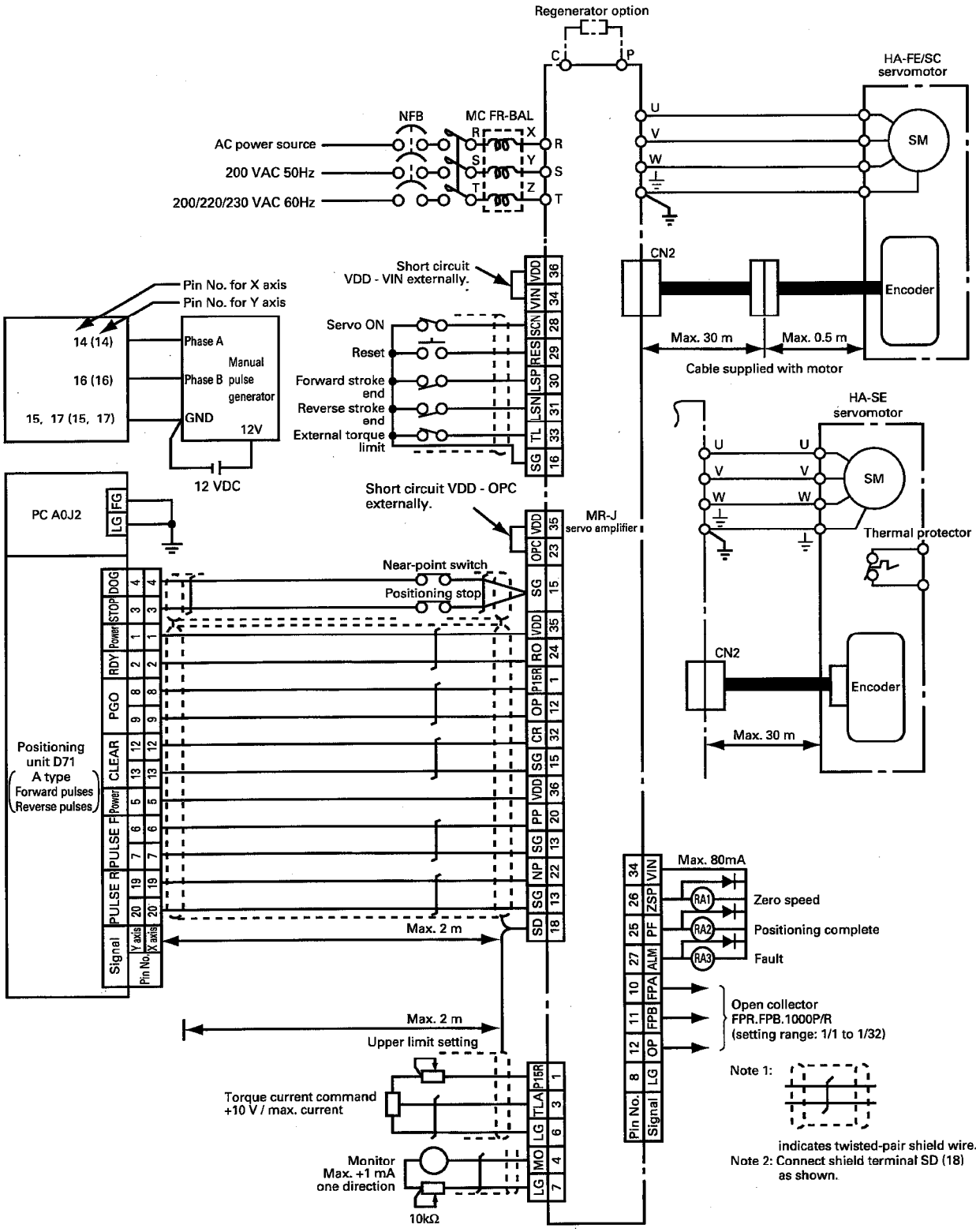
3.1 Connection with Mitsubishi MELSERVO-H

A type output



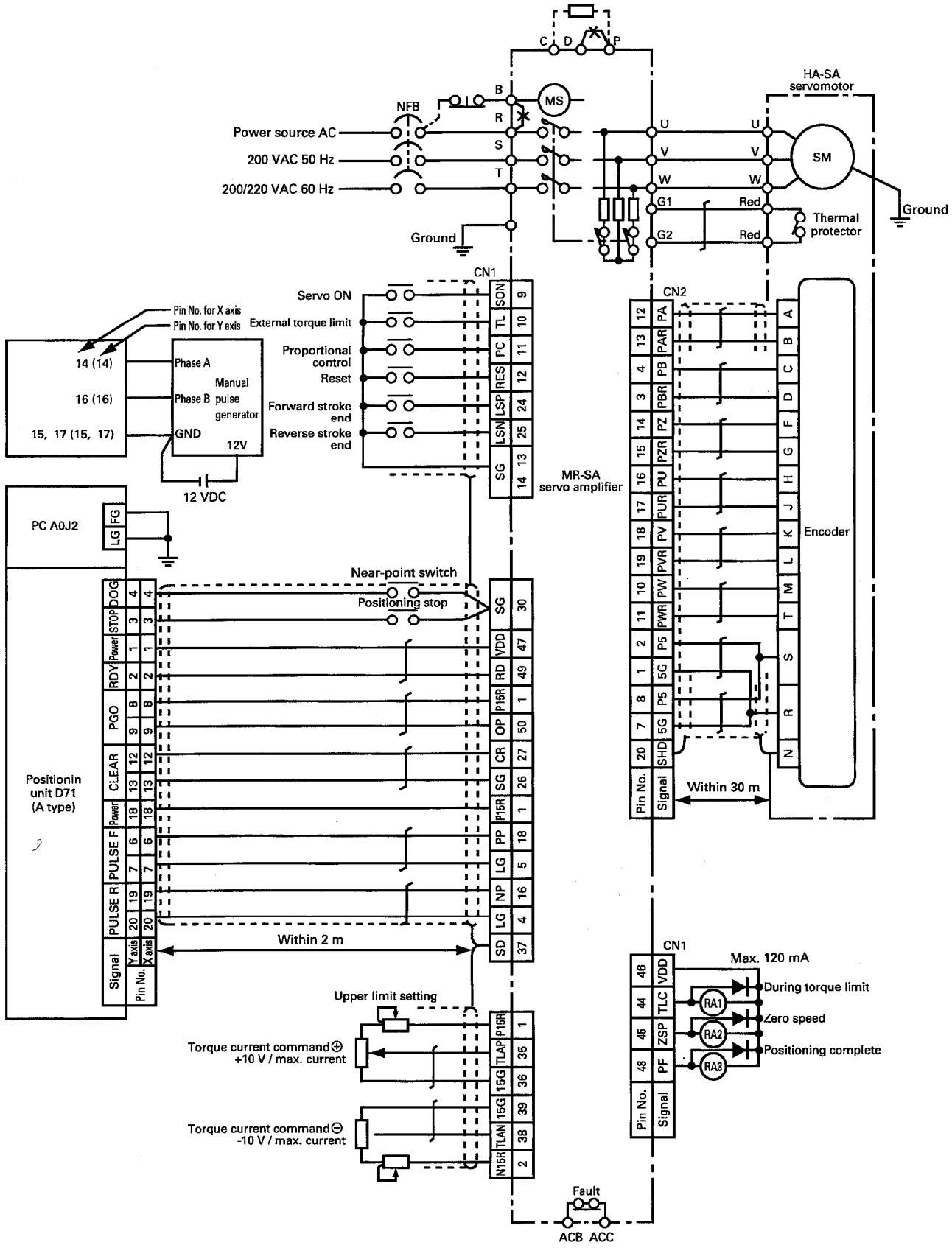
3.2 Connection with Mitsubishi MELSERVO-J

A type output



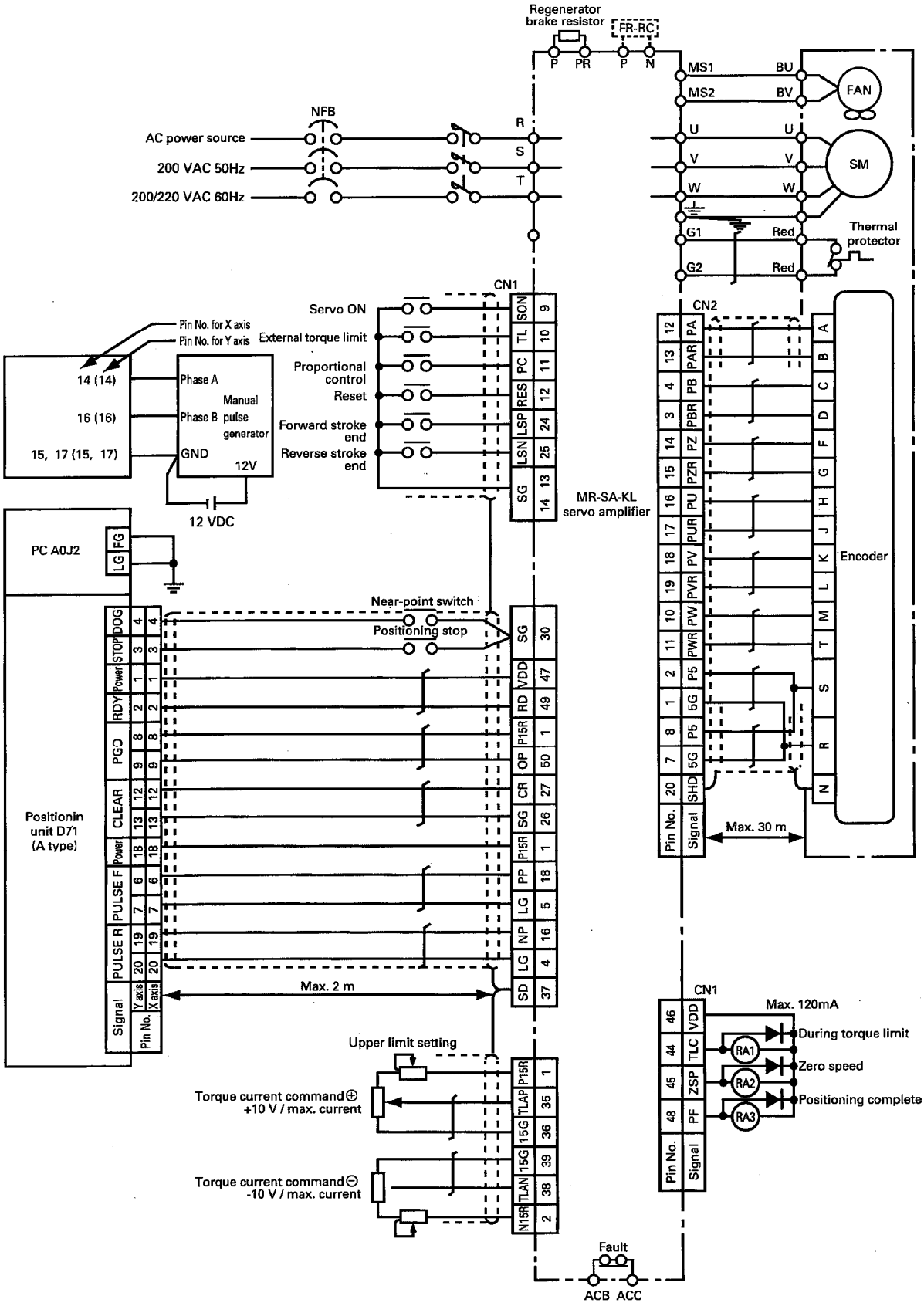
3.3 Connection with Mitsubishi MELSERVO-SA

A type output.



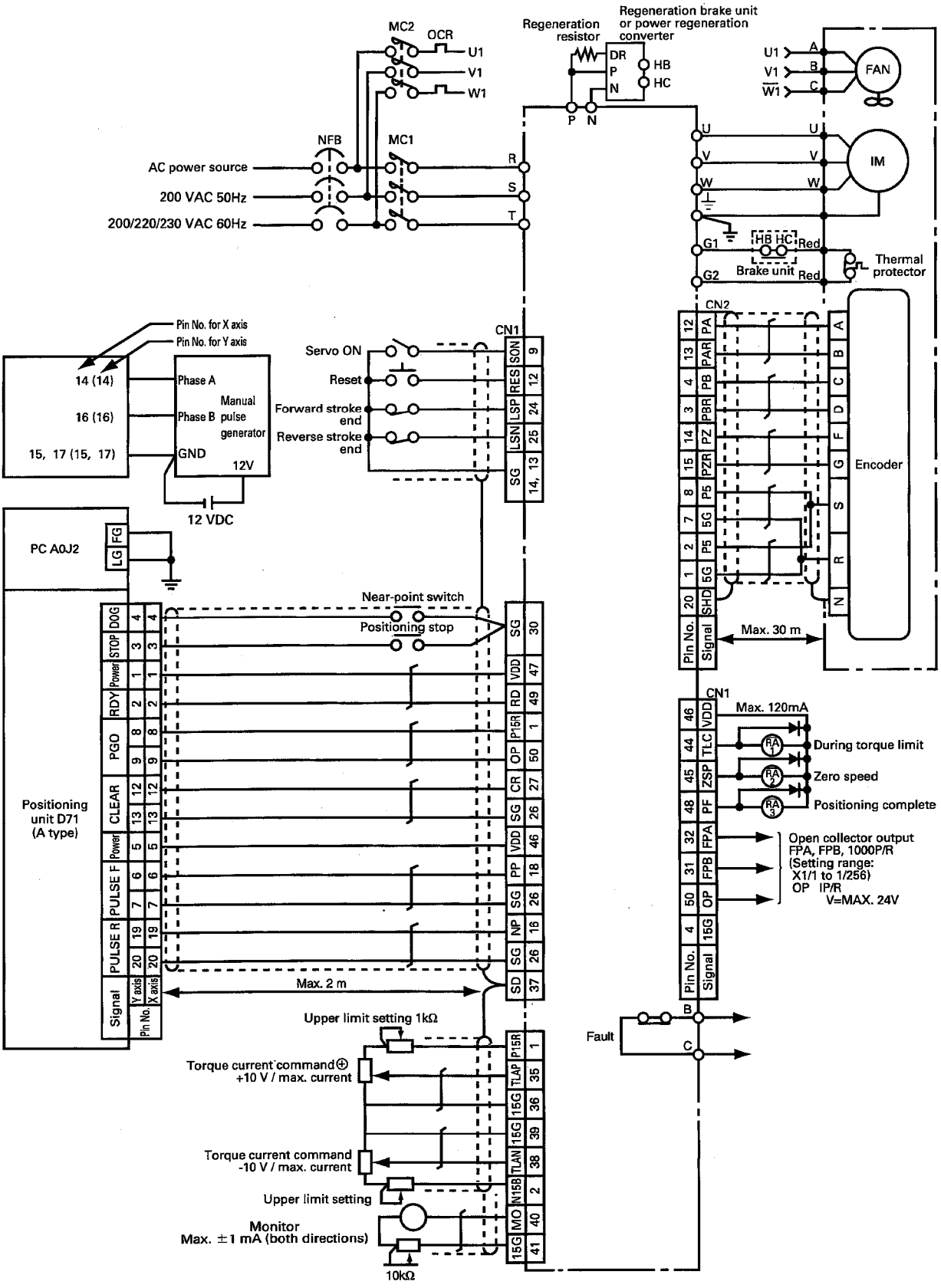
3.4 Connection with MELSERVO-SA-KL

A type output



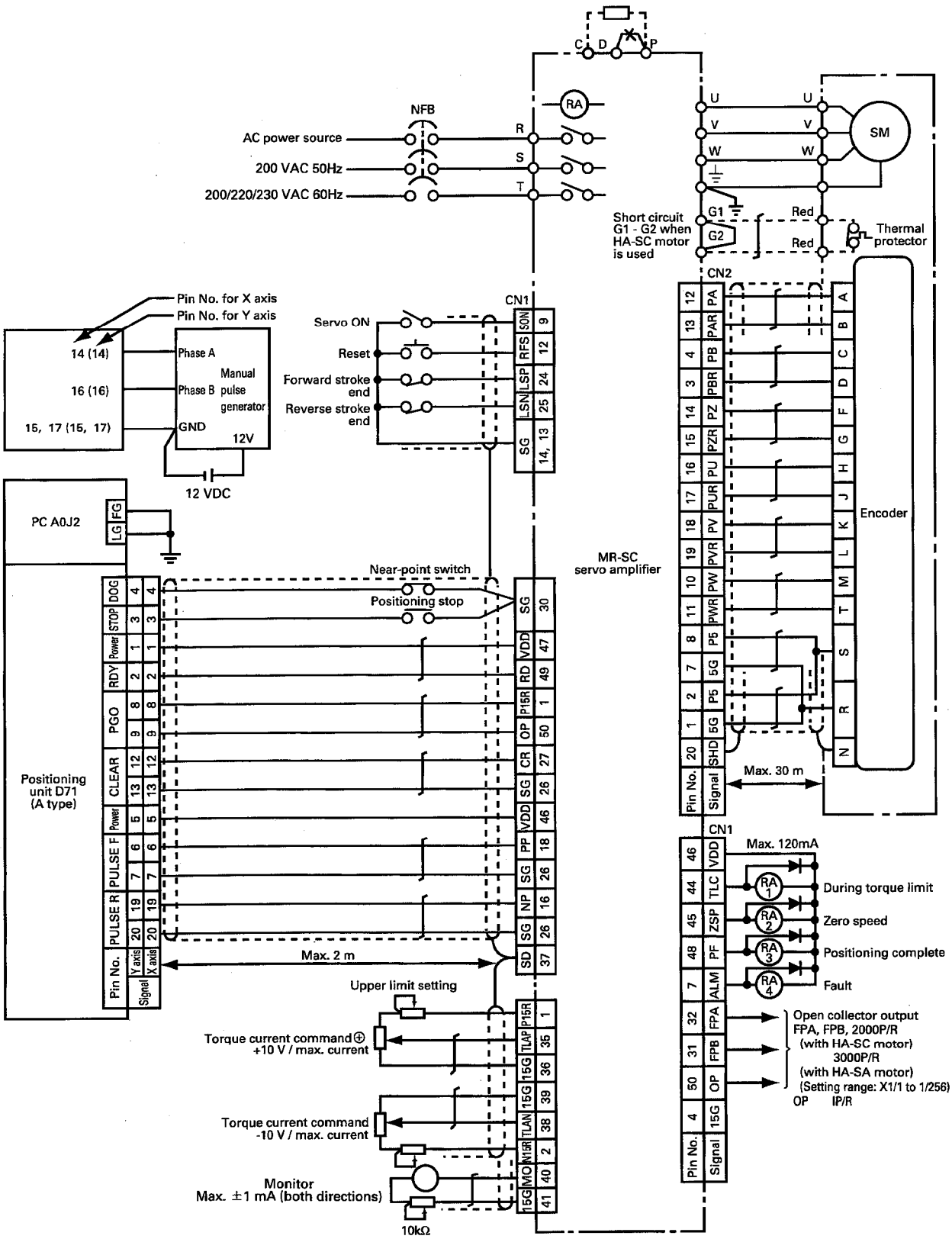
3.5 Connection with MELSERVO-VA

A type output



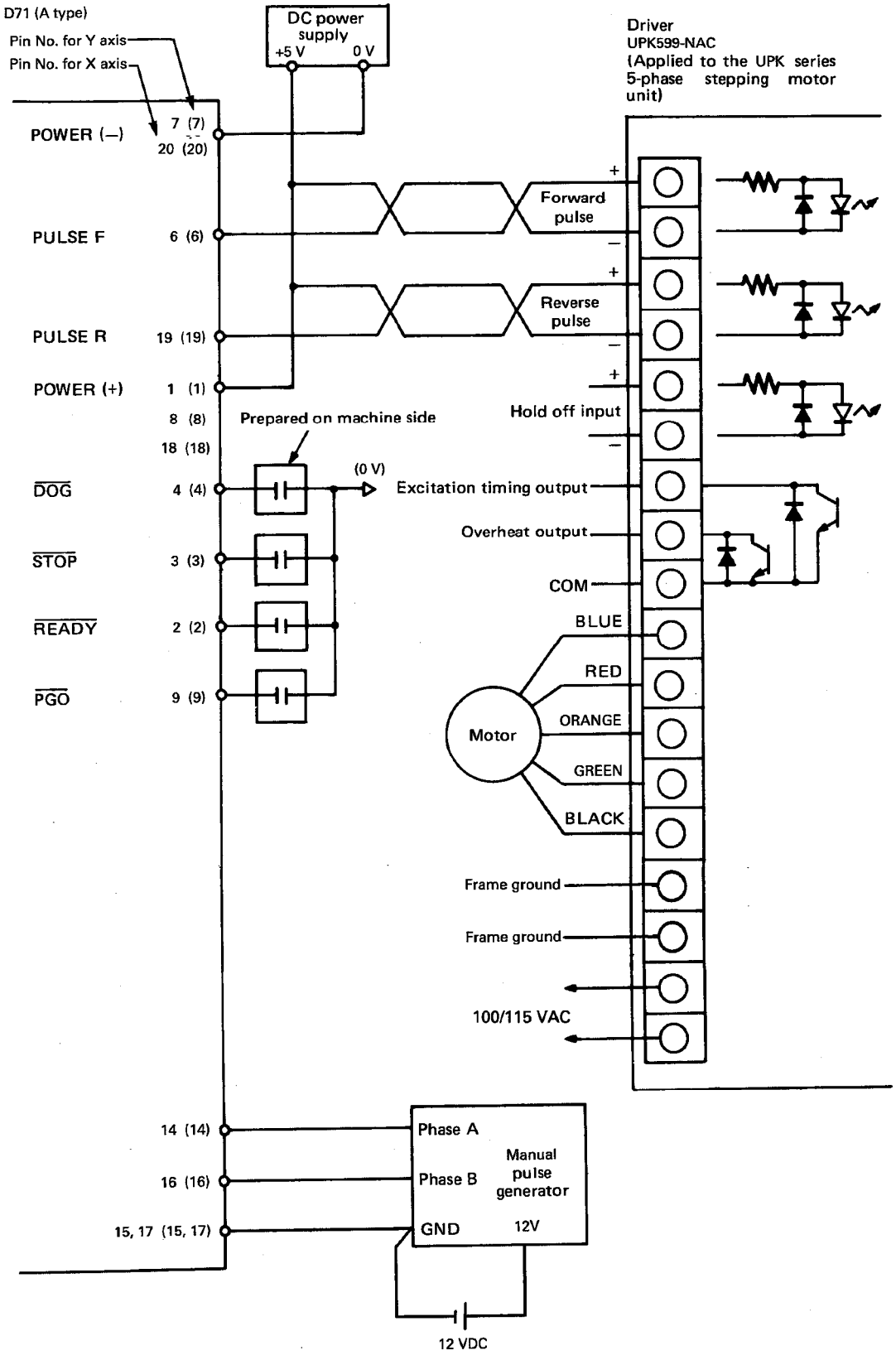
3.6 Connection with MELSERVO-SC

A type output



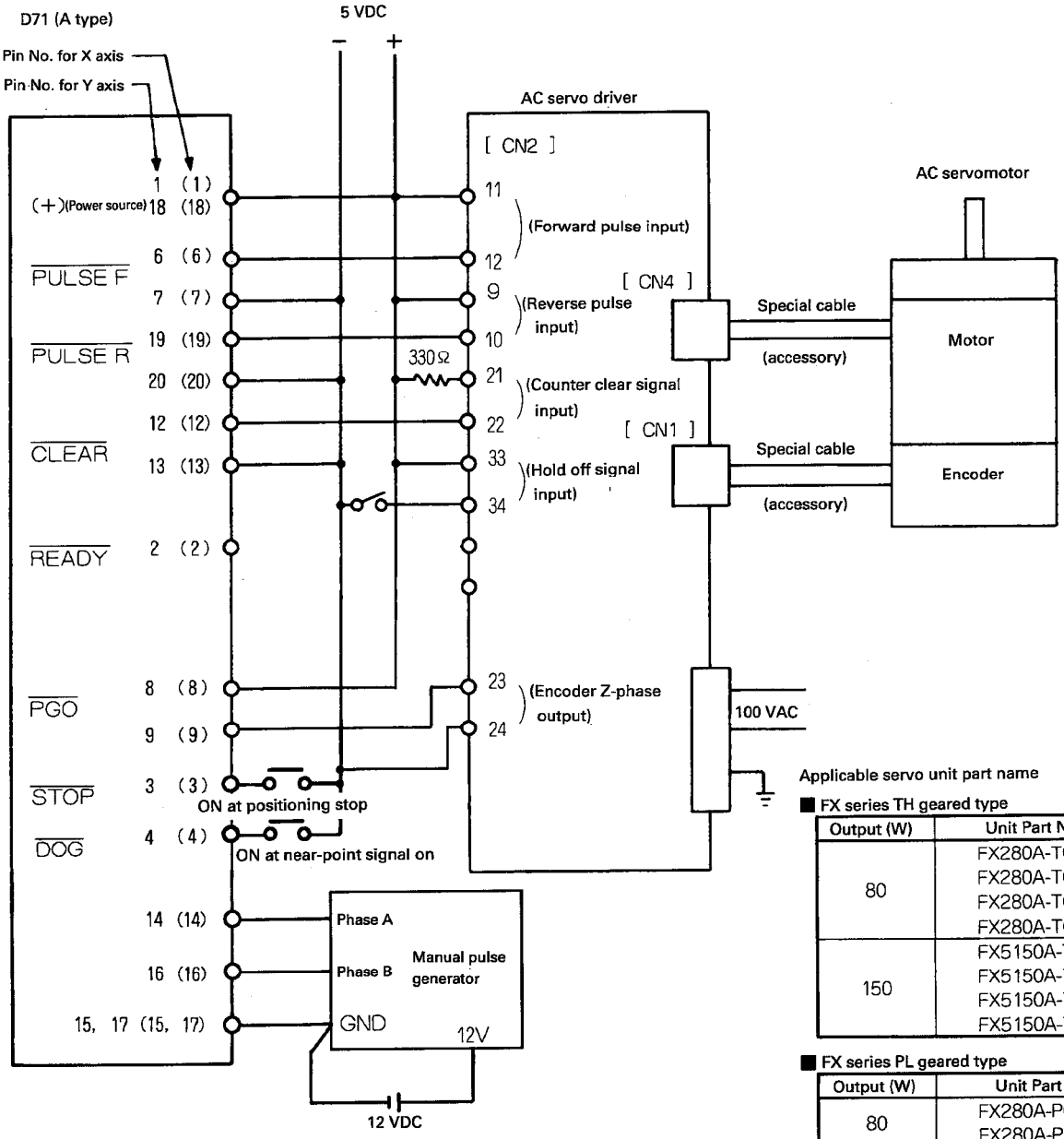
3.7 Connection with Oriental's stepping motor

One motor. A type output.



3.8 Connection with Oriental's AC servomotor

One motor. A type output.



Use multi-core twisted-pair shield wire for wiring.

Applicable servo unit part name

■ FX series TH geared type

Output (W)	Unit Part No.
80	FX280A-TG5 FX280A-TG10 FX280A-TG20 FX280A-TG30
150	FX5150A-TG5 FX5150A-TG10 FX5150A-TG20 FX5150A-TG30

■ FX series PL geared type

Output (W)	Unit Part No.
80	FX280A-PG7, 2 FX280A-PG36
150	FX5150A-PG7, 2 FX5150A-PG36

■ FX series harmonic geared type

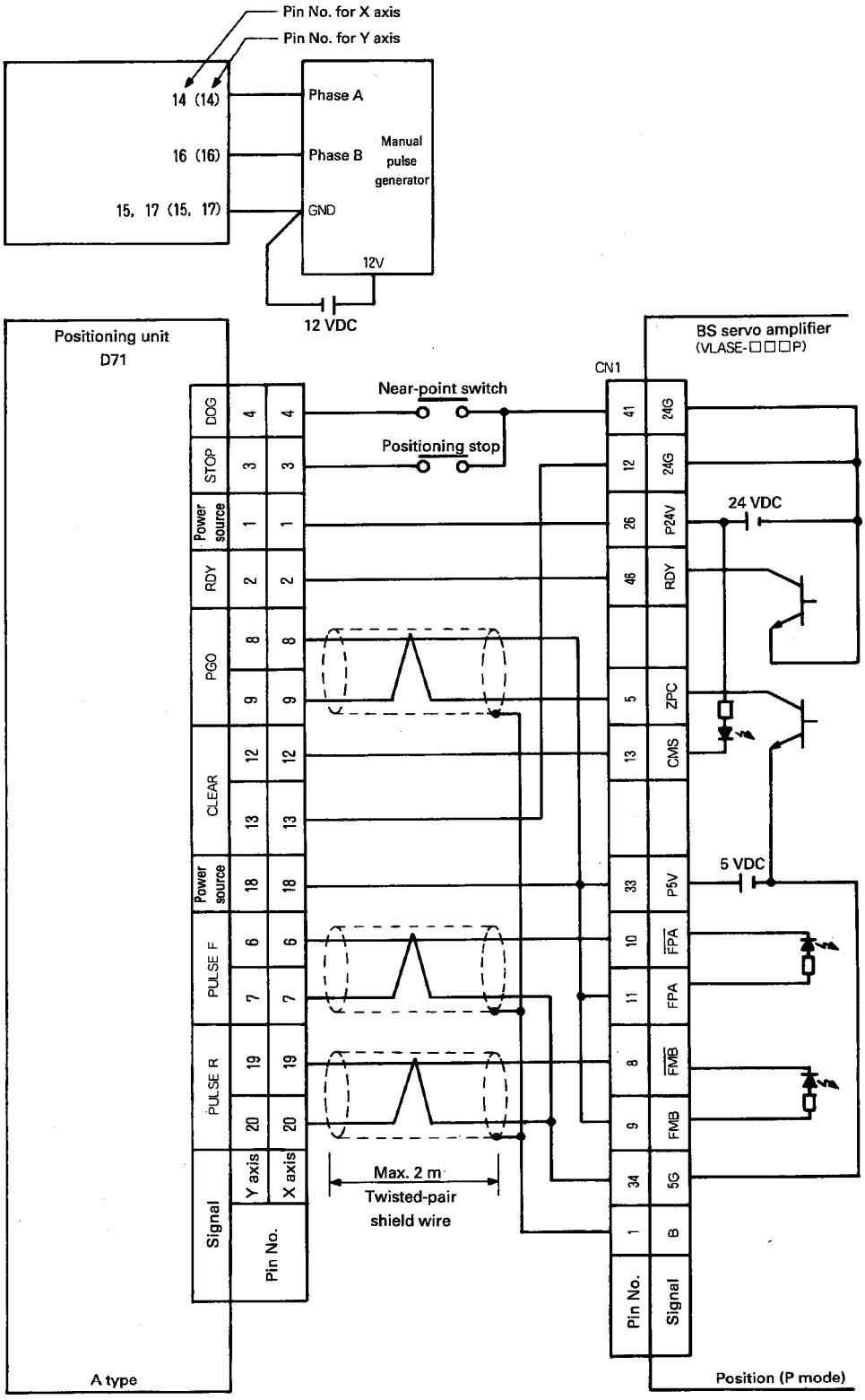
Output (W)	Unit Part No.
50	FX250A-HG50 FX250A-HG100
150	FX5150A-HG50 FX5150A-HG100

■ FX series round-shaft type

Output (W)	Unit Part No.
50	FX250-A
80	FX280-A
100	FX4100-A
200	FX4200-A

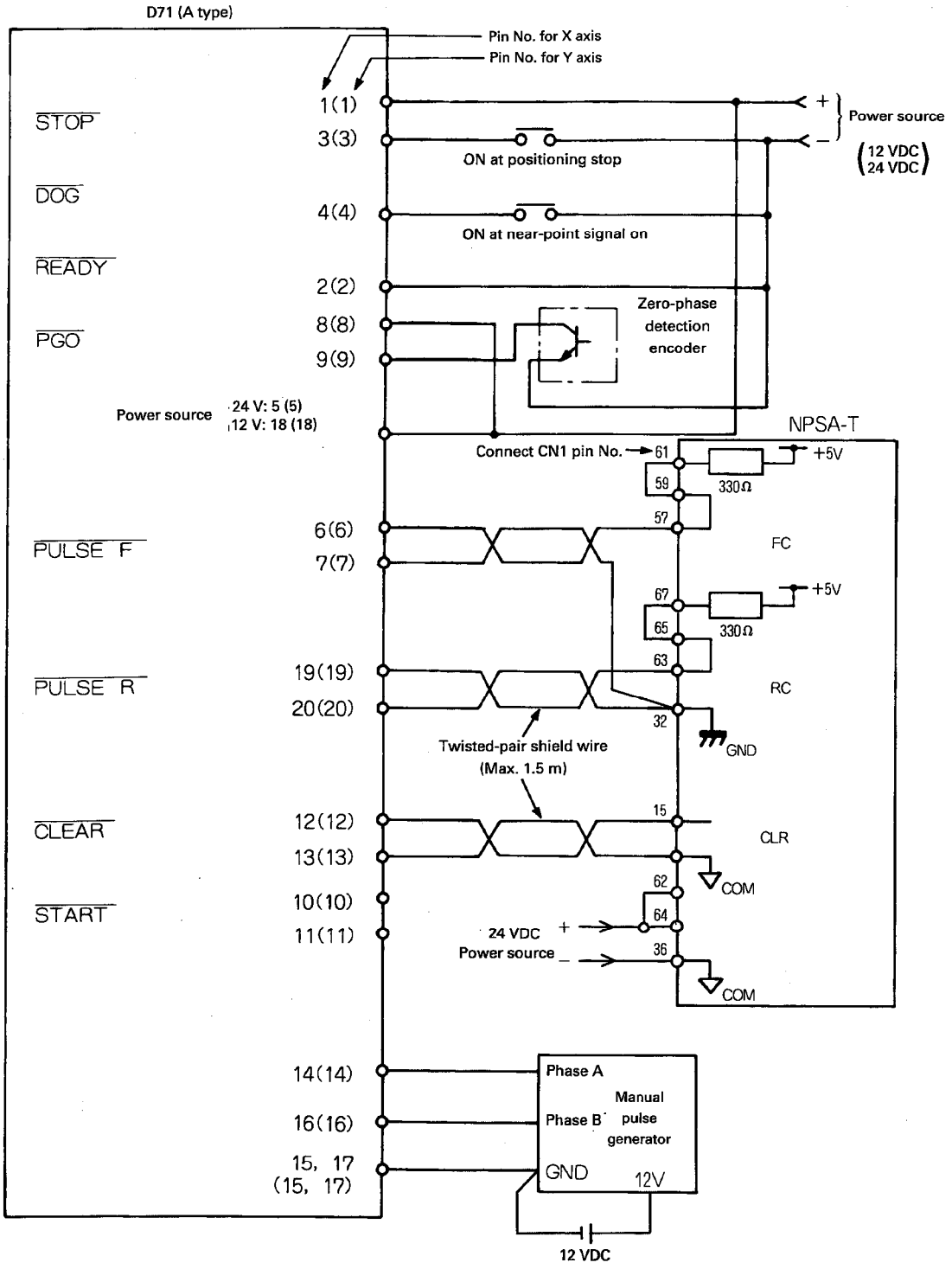
3.9 Connection with Toei Electric's BS servo amplifier

BS servo amplifier control mode: P mode A type D71 output



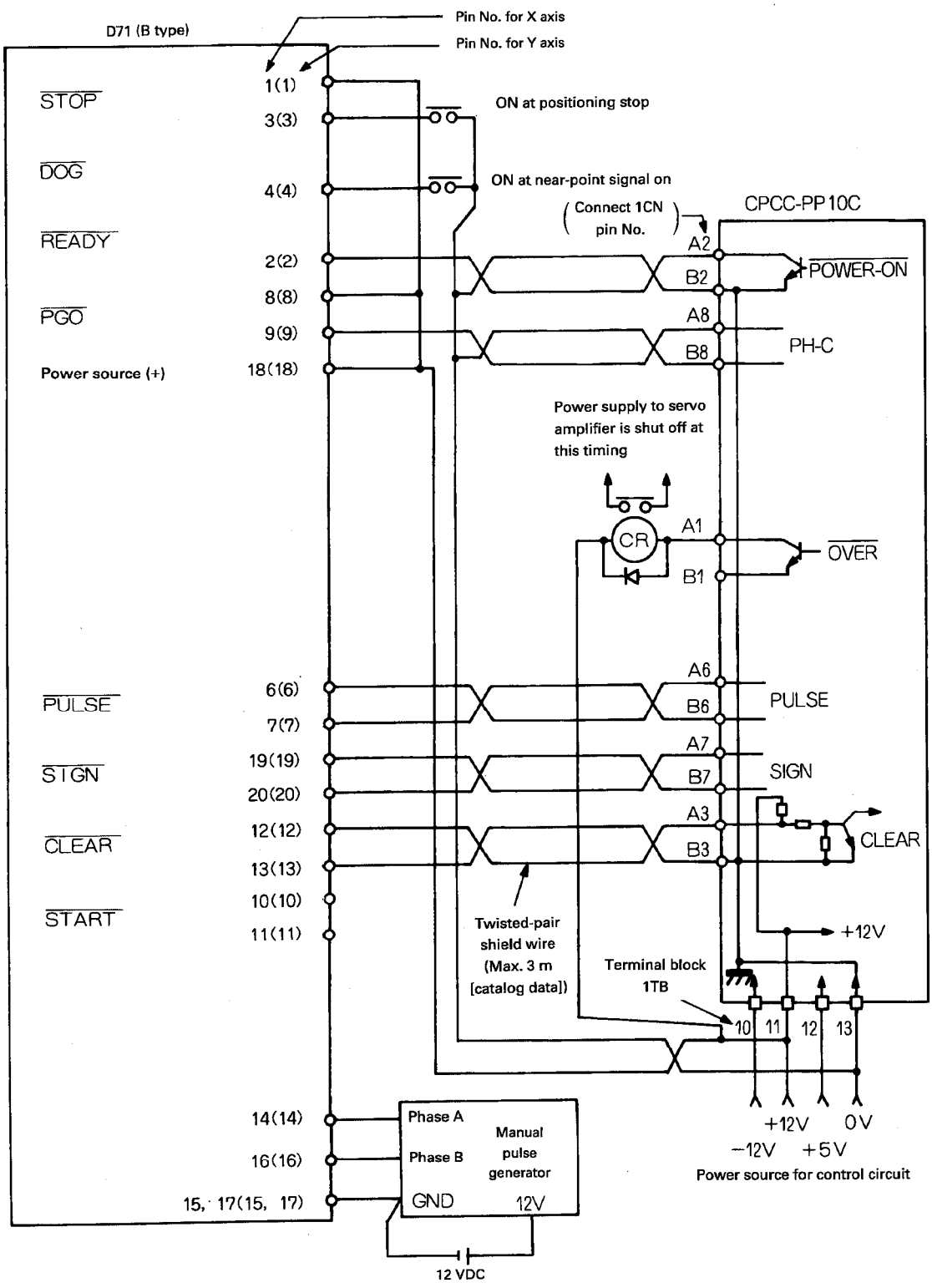
3.10 Connection with Nikki Denso's AC servo controller (NPSA-T)

A type D71 output



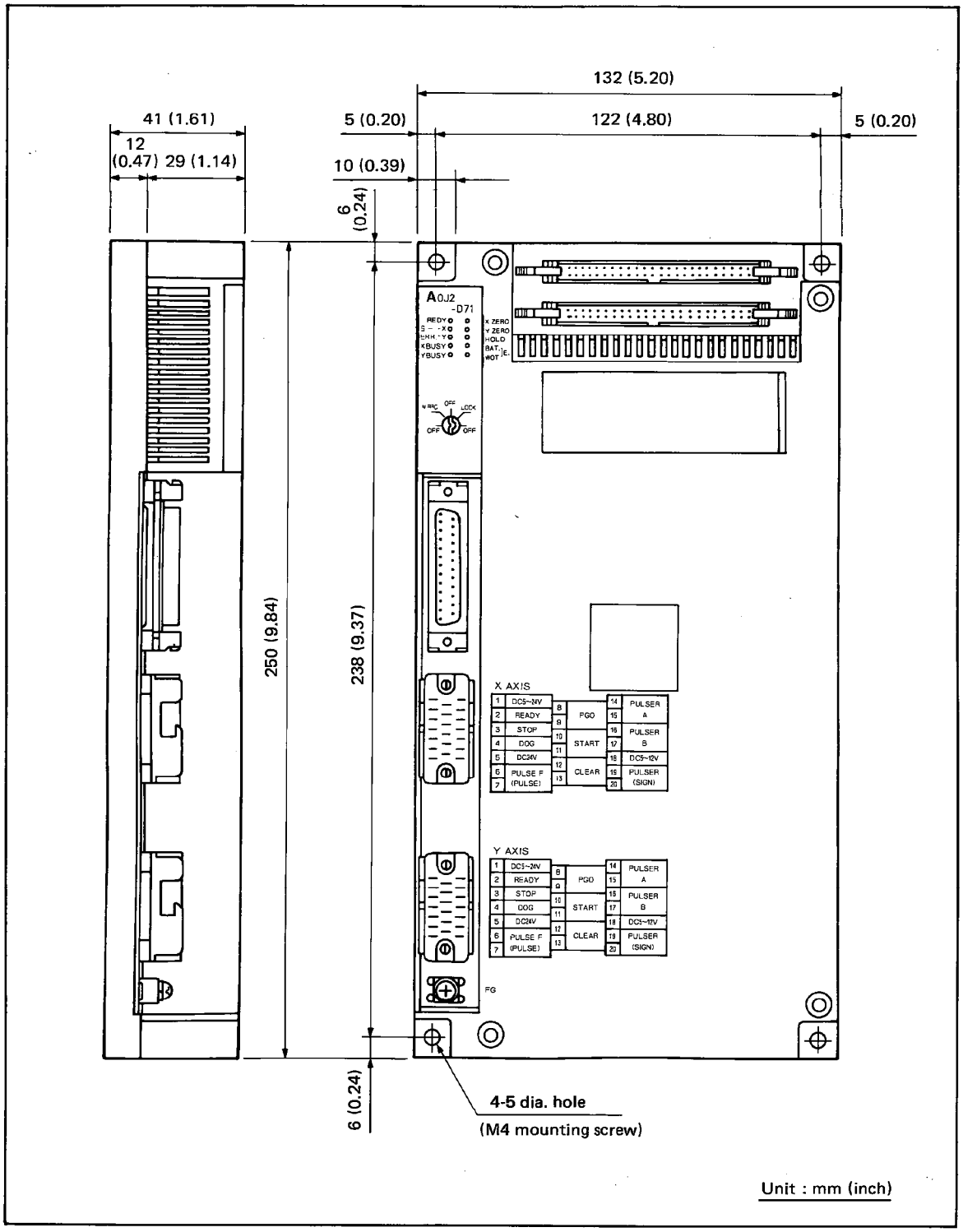
3.11 Connection with Yasukawa Electric's POSITION PACK-10C

B type D71 output
PULSE and SIGN: Set at 5 V in the POSITION PACK



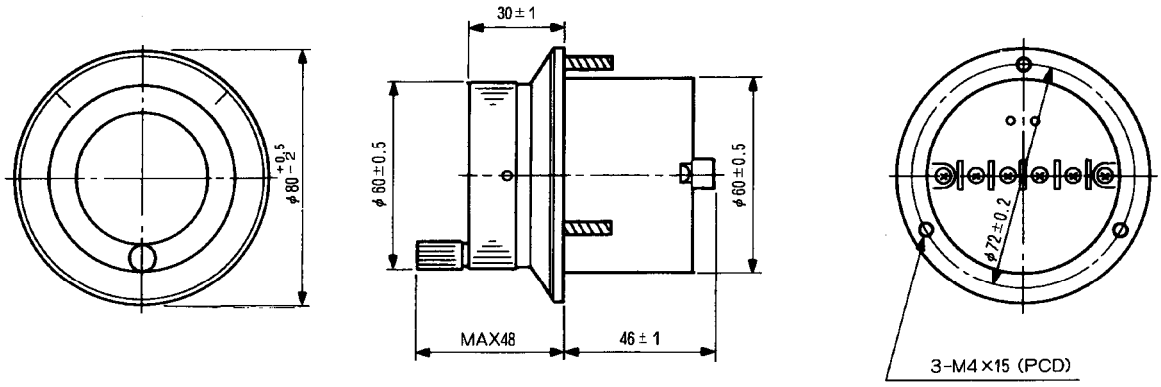
APPENDIX 4 Dimensions

(1) D71



(2) Manual pulse generator

(a)OSM-01-2(C)



Unit : mm(inch)

APPENDIX 5 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 6 Precautions for Transportation

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

APPENDIX 6.1 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 6.2 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.

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WARRANTY

Please confirm the following product warranty details before starting use.

1. Gratis Warranty Term and Gratis Warranty Range

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

[Gratis Warranty Term]

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

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

[Gratis Warranty Range]

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

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

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

2. Onerous repair term after discontinuation of production

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

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

3. Overseas service

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

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

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

5. Changes in product specifications

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

6. Product application

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

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

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

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

Positioning Module for A0J2 Type A0J2-D71

User's Manual

MODEL	A0J2-D71-USERS-E
MODEL CODE	13J626
IB(NA)-66133-P(0310)MEE	

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