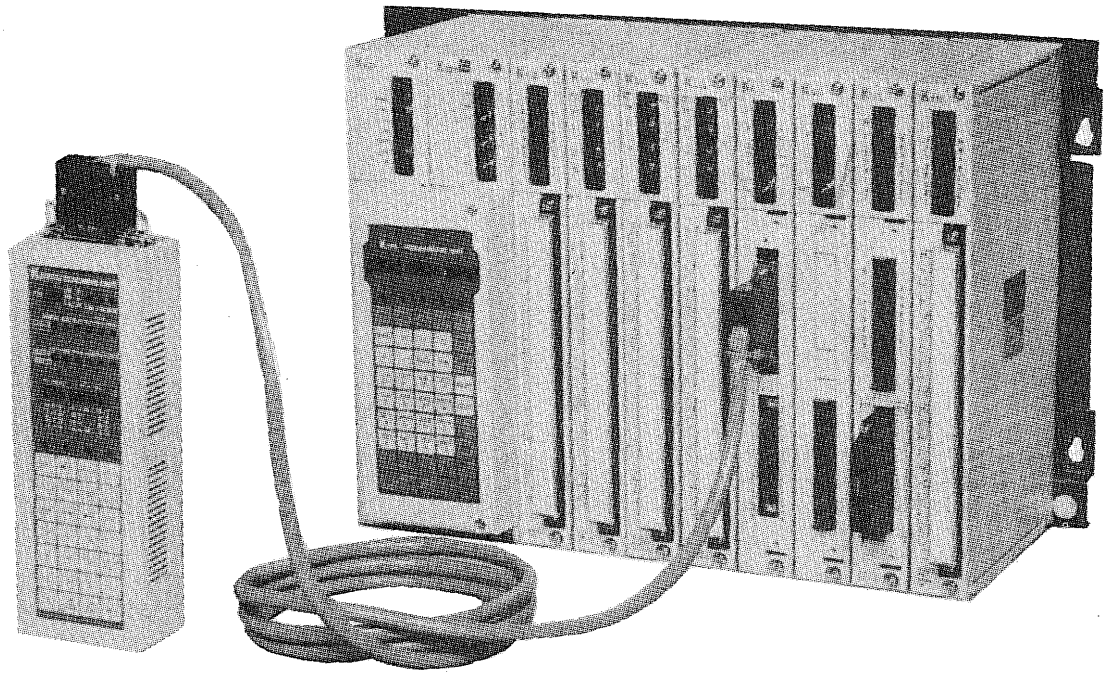
MITSUBISHI
PROGRAMMABLE CONTROLLER
MELSEC-K

Instruction Manual

Positioning Unit Type KD71

Teaching Unit for KD71 Type KD71TUE



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CONTENTS

SERVOS ONLY

1. Introduction

The Positioning Unit KD71 (hereafter abbreviated as KD71), is used for high-precision positioning control as one of the input/output peripherals of the MELSEC-K1, K2, K0J.

The KD71 has a microprocessor, whose output is a positioning pulse sequence, including acceleration and deceleration.

The output can be combined with various kinds of servo control drive units to perform positioning for a wide range of industrial equipment.

Features:

1. Full digital control

The use of a high-speed microprocessor has made possible small size and high performance, with high reliability.

2. One unit performs 2-axis control

With a single positioning unit, independent 2-axis control or simultaneous 2-axis control is possible.

3. Includes linear interpolation function.

A 2-axis linear interpolation function is included in the unit.

4. Includes backlash compensation function.

The backlash compensation function makes possible high-precision positioning possible.

5. Usable servo motors

Since the KD71 operates with pulse-sequence output, it can be used with DC servo motors, AC servo motors, stepping motors, and other drive units.

6. Positioning data settings

The setting of positioning data can be performed from the KD71 TU and sequencer CPU.

2. Composition

2-1 Component parts

The component parts used in conjunction with the positioning unit are as listed below

Table 2: Positioning unit component parts

Name	Model	Contents
Positioning unit	KD71	Positioning unit main body (output sync type)
Teaching unit	KD71TU	Positioning data input/output unit
Connection cable	K70CBL	Cable for connecting the KD71 and KD71TU (length 2m(78 inches))
Battery	K6BAT	Memory backup battery for IC-RAM memory and latch function.
Memory	1 KROM	EP-ROM (equivalent to type 2716, IC chip), 2K bytes.
Positioning unit	KD71S1	Positioning unit main body for use with MELDAS-S1 (output source type).

2-2 System composition

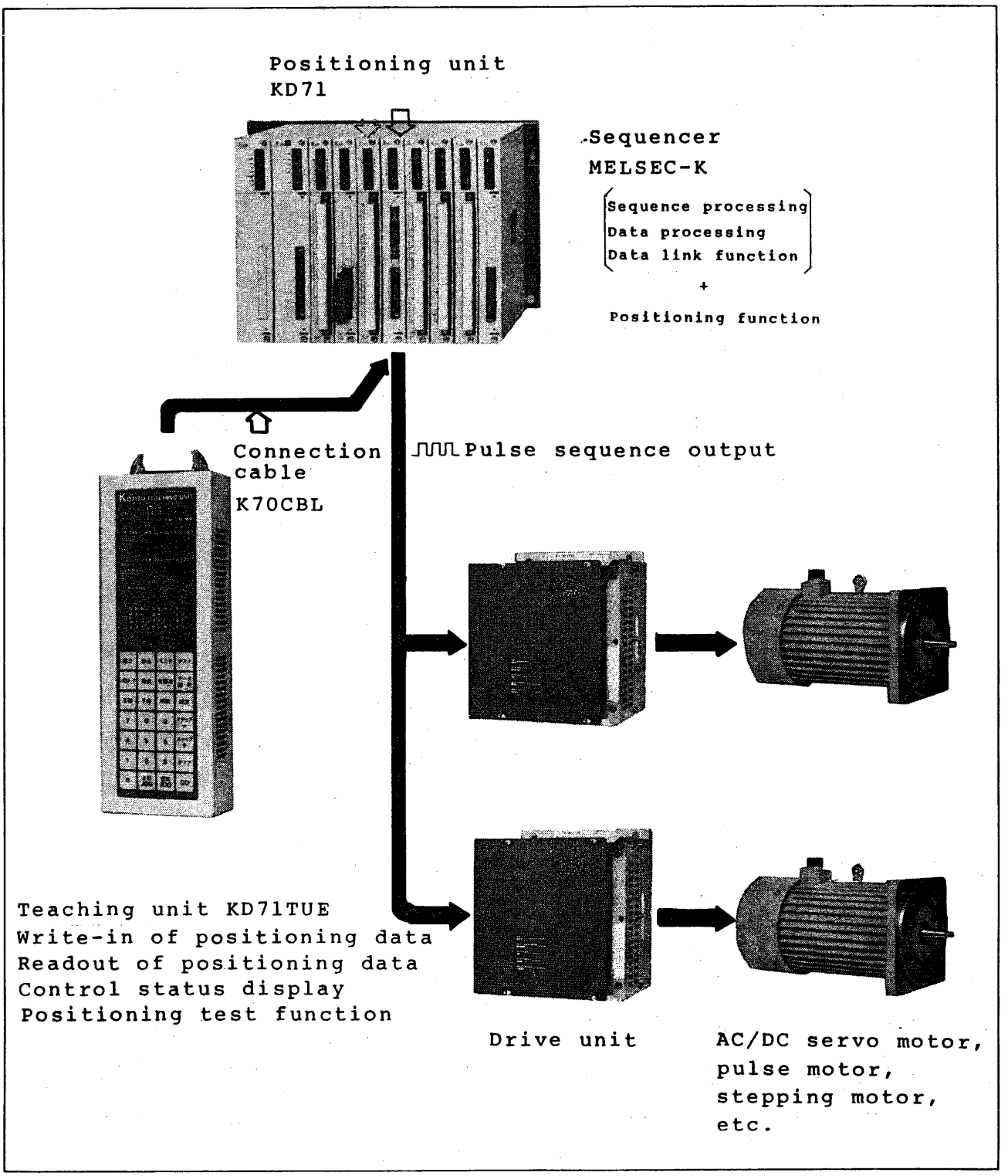
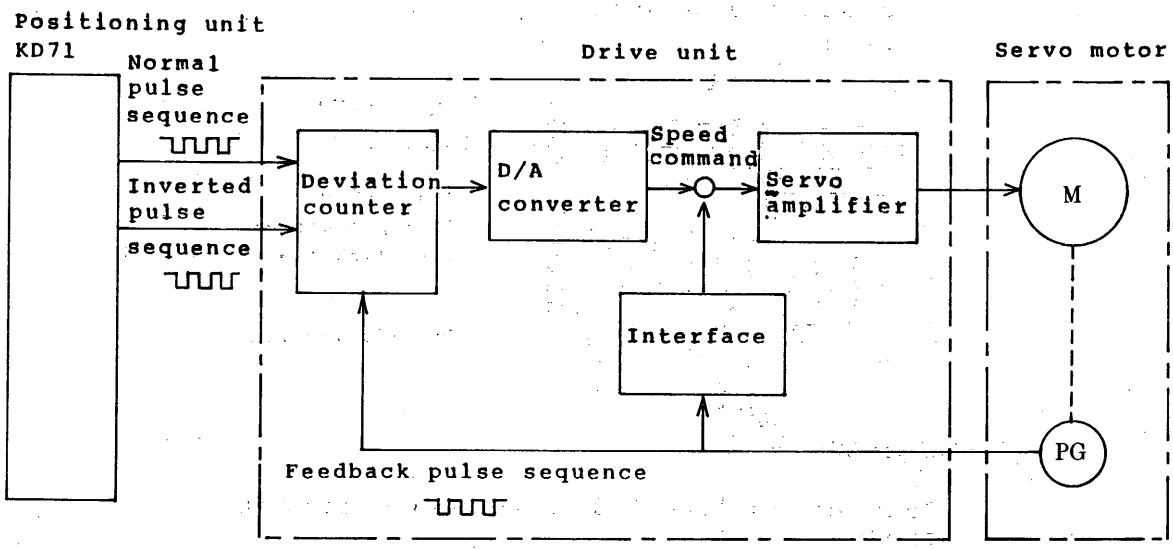


Fig. 2: System composition

3. Operation explanation

3-1 Principles of operation



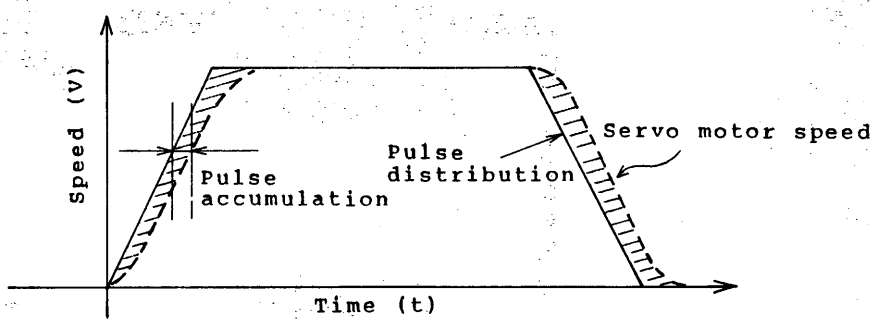


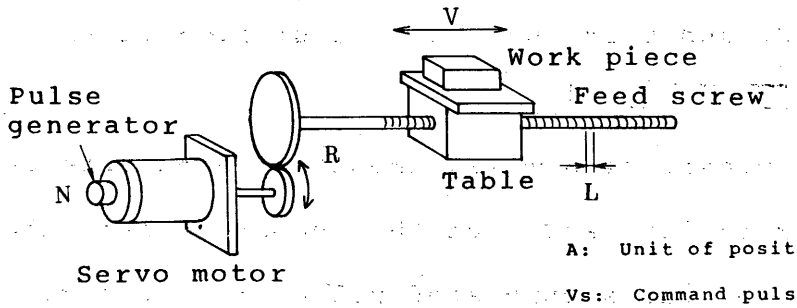
Fig. 3: Block diagram of positioning system operation

The output of the KD71 is a pulse sequence. When a pulse sequence is output, the pulses accumulate in the deviation counter, and this pulse accumulation is converted to direct current analog voltage by the D/A converter, thus becoming the speed command.

When the motor begins rotating as a result of the speed command, pulses in proportion to the amount of rotation are output from the pulse generator PG, and decrease the accumulation in the deviation counter.

The deviation counter preserves a fixed amount of accumulation, continuing the motor rotation, and when the command pulse output from the KD71 is stopped, the accumulated pulses in the deviation counter are reduced and speed is lowered, and when the accumulated pulses disappear, the motor stops. In other words, the rotating speed of the motor is proportional to the frequency of the command pulse, and the rotation angle of the motor is proportional to the number of command pulses output.

3-2 Outline design of the positioning system



A: Unit of position detection (mm/PULSE)
Vs: Command pulse frequency [PULSE/sec]
n: Pulse generator slits [SLIT/rev]
L: Feed screw lead [mm/rev]
R: Deceleration rate
V: Moving element speed [mm/sec]
N: Motor revolution [rpm]
K: Position loop gain [sec^{-1}]
ε: Accumulated pulses in deviation counter [PULSE]
$\Delta\varepsilon$: Stopping accuracy [PULSE]

(1) Unit of position detection

$$A = \frac{L}{R \times n} \left(mm / PULSE \right)$$

(2) Command pulse frequency

$$Vs = \frac{V}{A} \left(PULSE / sec \right)$$

(3) Pulse accumulation of deviation counter

$$\varepsilon = \frac{Vs}{K} \left(PULSE \right)$$

The amount of movement of one pulse is shown in (1), the amount of movement equaling the number of output pulses x A. The command pulse frequency is computed in (2) from the moving element speed and the unit of position detection.

The relation of the command pulse frequency and the pulse accumulation in the deviation counter is shown in (3).

The KD71 sets the position of the moving element in absolute value. When the zero point is Po, and the amount of movement from the zero point is ℓ, the following relation is obtained:

$$P = Po \pm \frac{\ell}{A}$$

4. Specifications

4-1 Performance specifications

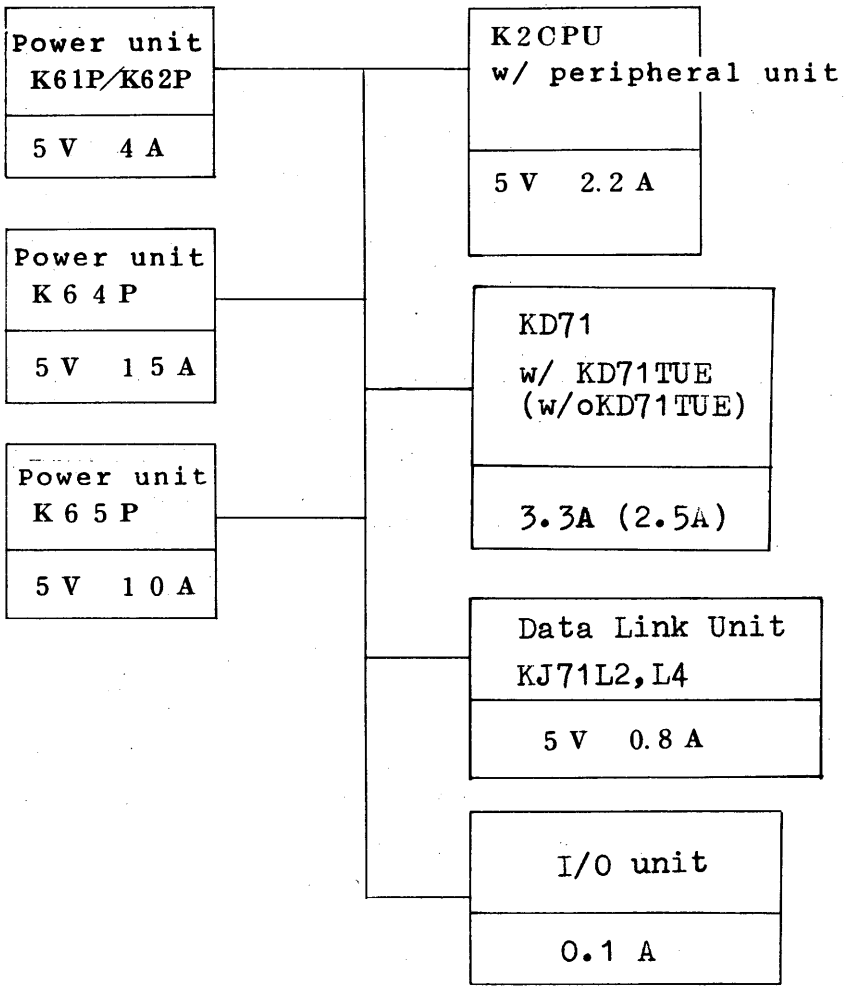
<table>
<tr><th>Item</th><th colspan="4">Specifications</th></tr>
<tr><td>No. of control axes</td><td colspan="2">2 axes (simul. 2-axis, independent 2-axis)</td><td>No. of exclusive I/O points</td><td>Handles 32 points</td></tr>
<tr><td>Maximum command value</td><td colspan="4">999,999 pulses 6 digit decimals</td></tr>
<tr><td>Maximum speed</td><td colspan="4">100 KPPS</td></tr>
<tr><td>Speed setting range</td><td colspan="4">4 PPS ∿ 100 KPPS, can be set in 4 PPS increments</td></tr>
<tr><td>Automatic acceleration/ deceleration time</td><td colspan="4">Linear accel/decel 0.1 ∿ 9.99 sec, settable in 10 ms increments</td></tr>
<tr><td></td><td colspan="4"></td></tr>
<tr><td>Data capacity</td><td colspan="4">400 data per axis (0 ∿ 399)</td></tr>
<tr><td>Setting method</td><td colspan="4">Can be input from teaching unit and sequencer CPU (K0J, K1, K2)</td></tr>
<tr><td>Zero point return function</td><td colspan="4">Includes zero point shift function, zero point return direction, speed parameters settings</td></tr>
<tr><td rowspan="2">Setting data</td><td>Parameter</td><td colspan="2">Zero point return data</td><td>Positioning data</td></tr>
<tr><td>Acceleration/deceleration time 0.1 ∿ 9.99 sec.
Torque restriction 10 250%
Backlash 0∿255 pulses
Speed restriction decimal-6 digits
Upper stroke limit decimal 4 digits
Upper stroke limit decimal 6 digits
JOG speed decimal 4 digits</td><td colspan="2">Zero point return mode
Zero point address decimal 6 digits
Creep speed decimal 6 digits
Torque restriction 10∿250%
Dwell 0.01∿9.99 sec.
Zero point return speed decimal 6 digits</td><td>Data number 0 ∿ 399
Positioning pattern
Positioning address decimal 6 digits
Speed decimal 6 digits
Torque restriction 10∿250%
Dwell 0.01∿9.99 sec.</td></tr>
<tr><td>RAM memory backup</td><td colspan="4">Condenser preservation 10 min. at 40°C.
Lithium battery, overall preservation time in event of power outage 300 days, battery life 5 years.</td></tr>
</table>

4-2 General specifications

Item	Specifications	
Ambient temperature	0 ∿ 55°C	
Ambient temperature (during storage)	-10 ∿ 75°C	
Relative humidity	10 ∿ 90 %RH (non-condensing)	
Relative humidity (during storage)	10 ∿ 90 %RH (non-condensing)	
Vibration protection	Conforms to JIS C 0911 II B3 type (16.7Hz compound amplitude 3 mm 2Hr)	
Shock protection	Conforms to JIS C 0912 (10 g, 3 times in each direction X, Y, Z)	
Noise protection	By noise limiter, noise voltage 1000V (P-P), noise width 1μs, noise frequency 25 ∿ 60Hz.	
Voltage protection	AC500V-1 min.	Input/output terminals encased
Insulation resistance	With 500V insulation resistance tester, 5MΩ or more	Input/output terminals encased

4-3 Power unit capacity

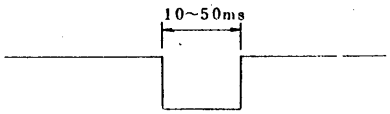
The capacity of the power unit, and the load current of the KD71 and the various I/O units is as shown below. The power unit should be selected by computing the total current consumed.



If the system is run without a sufficient power capacity, damage may result to the power unit, destruction of the sequenc sequence program, or malfunction of the CPU.

5. Input/Output interface

5-1 Signal names

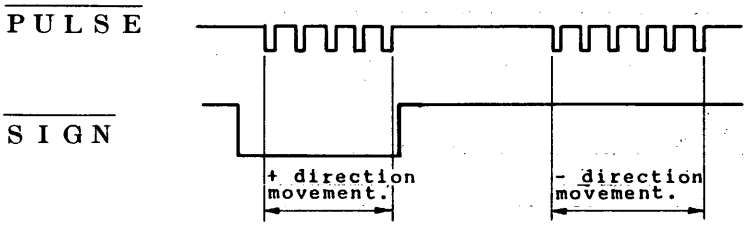
	Signal name	Contents
Input	Drive unit ready $\overline{\text{READY}}$	(1) Set on LOW when servo drive unit is normal and ready to accept feed pulses. (2) Before starting, the KD71 checks the drive unit ready signal, and if not in a ready status, outputs a zero point return demand. (3) Set to HIGH when drive unit is not capable of operation, e.g. when malfunction is found in control power or elsewhere.
	$\overline{\text{DOG}}$	(1) Used for near point detection during zero point return. Set on LOW for near point detection. (2) When zero point return is performed by zero-point signal, the zero point is the first grid point separated from DOG following the detection of the near-point DOG.
	Zero-point signal $\overline{\text{PGO}}$	(1) The zero-point signal is used during zero point return, and in general, the zero-point grid signal of the pulse encoder is used. At zero-point set to LOW. (2) When zero point return method is by stopper, and zero point return completion is input from external sources, this signal is also ysed. (For details refer to section 7-2-1).
	Positioning stop $\overline{\text{STOP}}$	(1) LOW when positioning is stopped. (2) When this signal is input, the KD71 stops execution of positioning, and sets the start signal (START) to OFF (HIGH).
Output	$\overline{\text{START}}$	(1) Low during execution of positioning. (2) During output of feed pulse or during dwell, start signal becomes ON (LOW). This signal is normally used as the brake release signal for mechanically-braked servos.
	Deviation counter clear $\overline{\text{CLEAR}}$	This is the pulse signal output before the execution of zero point return operation, and it resets the accumulation pulses of the servo unit's deviation counter. 
	Direction sign $\overline{\text{SIGN}}$	Low during normal, HIGH during inverted. Normal increases the current value, inverted decreases current value.
	Command pulse $\overline{\text{PULSE}}$	Common feed pulse for normal and inverted. Running direction is determined by direction sign (SIGN).
	Command pulse for normal direction $\overline{\text{PULSE F}}$	Feed pulse for normal (forward) use.
	Command pulse for inverted direction $\overline{\text{PULSE R}}$	Feed pulse for inverted (reverse) use.

The following outputs are used by selecting either A or B output using the switch built into the unit. (Refer to Fig. 8)

A type (SW2-2 OFF)

	Signal name	Contents
Output	Normal command pulse PULSE F	Feed pulse for normal (forward)
	Inverted command pulse PULSE R	Feed pulse for inverted (reverse)

B type (SW2-2 ON)

	Signal name	Contents
Output	Direction sign $\overline{\text{SIGN}}$	LOW during normal, HIGH during inverted. ((During normal, current value increases; during inverted, current value decreases).
	Command pulse $\overline{\text{PULSE}}$	Feed pulse for use with both normal and inverted. Running direction is determined by direction sign (SIGN). 

NOTES) 1. I/O signals are the same for X and Y axes.

2. For external connections and arrangement of connector pins, refer to section 9.

3. Selection of the output mode in Fig.8 is as follows: when SW2-2 is OFF, the mode is A; when SW2-2 is ON, mode is B (set to B by factory at time of shipping).

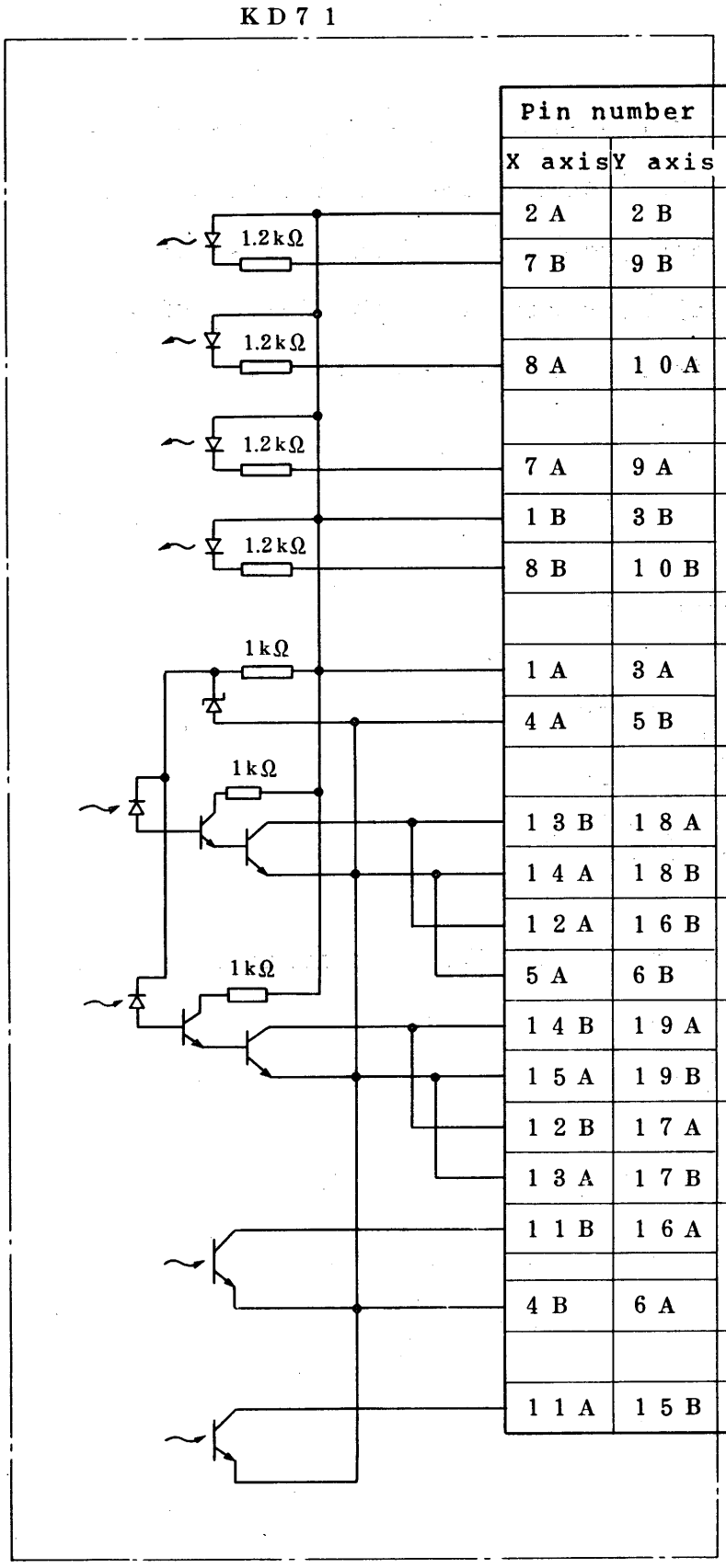
5-2 Electrical specifications

(1) Input

Signal name	Contents
Supplied power	DC 5 ~ 24 V (4.75 ~ 25V stabilized current) 150 mA (max))
$\overline{\text{STOP}}$ $\overline{\text{DOG}}$ $\overline{\text{READY}}$	At HIGH level supplied power voltage -1V or more (Input current 0.3mA or less) At LOW level supplied power voltage -3V or less (Input current 2.5mA or more)
$\overline{\text{PGO}}$	At HIGH level supplied power voltage -1V or more (Input current 0.3mA or less) At LOW level supplied power voltage -3V or less (Input current 2.5mA or more) Pulse width: 20 μs or more Pulse rise time : 3 μs or less Pulse fall time : 3 μs or less

(2) Output

Signal name	Contents
$\overline{\text{START}}$ $\overline{\text{CLEAR}}$ $\overline{\text{SIGN}}$	Output type: Open collector Load voltage: 4.75 ~ 25VDC Load current: 10mA (max) Output voltage at ON: 0.6V or less Current leakage at (OFF-state): 0.1mA or less
$\overline{\text{PULSE}}$ $\overline{\text{PULSE F}}$ $\overline{\text{PULSE R}}$	Output type: open collector Load voltage: 4.75 ~ 25VDC Load current: 10mA (max) Use with range of 2mA ~ 10mA When used with less than 2mA, add a dummy resistor. Pulse rise time and fall time: Both 3 μs or less



Pin number		Signal name	
X axis	Y axis	Type A	Type B
2 A	2 B	$\overline{\text{STOP}}$	$\overline{\text{STOP}}$
7 B	9 B		
8 A	10 A	$\overline{\text{DOG}}$	$\overline{\text{DOG}}$
7 A	9 A	$\overline{\text{READY}}$	$\overline{\text{READY}}$
1 B	3 B	$\overline{\text{PGO}}$	$\overline{\text{PGO}}$
8 B	10 B		
1 A	3 A	(+) Power supply DC 5～24V (outside	
4 A	5 B	(−) supply).	
13 B	18 A	$\overline{\text{PULSE F}}$	$\overline{\text{SIGN}}$
14 A	18 B		
12 A	16 B	Same as above.	Same as above.
5 A	6 B		
14 B	19 A	$\overline{\text{PULSE R}}$	$\overline{\text{PULSE}}$
15 A	19 B		
12 B	17 A	Same as above.	Same as above.
13 A	17 B		
11 B	16 A	$\overline{\text{CLEAR}}$	$\overline{\text{CLEAR}}$
4 B	6 A		
11 A	15 B	$\overline{\text{START}}$	$\overline{\text{START}}$

Fig. 5.1 KD71 I/O circuits.

5-3 Torque restriction

The KD71 includes a function for controlling torque. When performing torque restriction, the KD71's torque restriction value is readout by the KCPU sequence program, converted to analog by the D/A converter unit KA63A, and output to the drive unit. For reading the troque restriction value, refer to section 11-6.

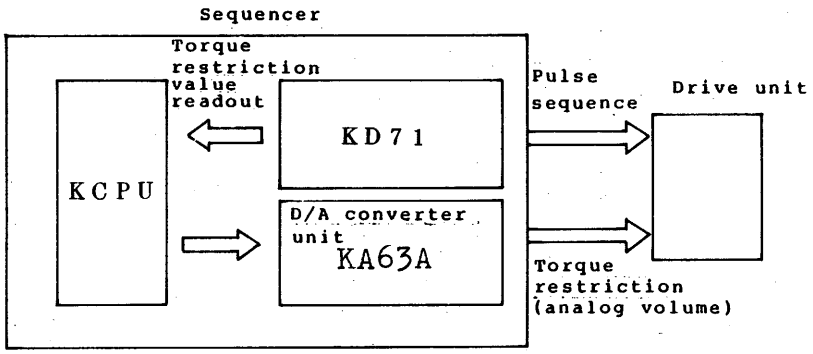
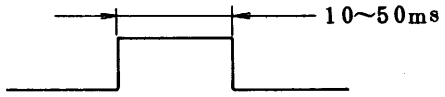
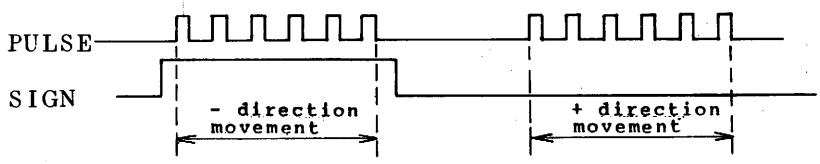


Fig. 5.2 Block diagram of torque restriction function

5-4 Interface for the KD71S1

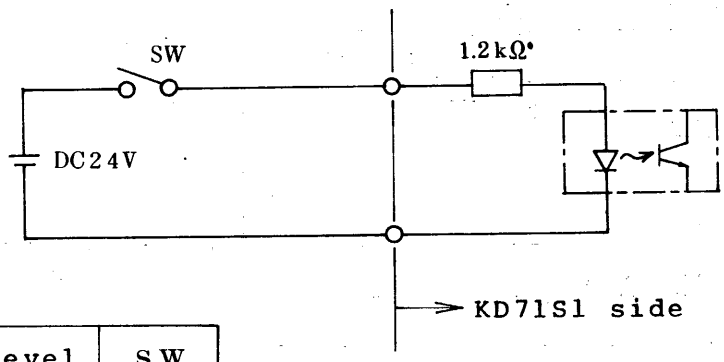
The positioning unit KD71S1 is connected to, and used with the Mitsubishi servo unit MELDAS-S1. The differences between the servo unit and the KD71 are the mode of input/output signals and the pin numbers only. Other functions, operations, and specifications are identical to the KD71. Select positioning functions, data transmission functions, and memory protect ON-OFF selector switches in accordance with Fig. 8.

5-4-1 I/O interface

	Signal name	Contents
Input	Drive unit ready R E A D Y	(1) Set to HIGH when the MELDAS-S1 is normal and ready to accept feed pulses. (2) Before starting, the KD71S1 checks the drive unit ready signal, and if not in a ready status, outputs a zero point return demand
	Near point signal D O G	(1) Used for near-point detection during zero point return. HIGH at near-point detection. (2) The zero point is the first grid point separated from the DOG following thedetection of the near-point DOG.
	Zero-point signal	(1) Zero point signal for zero point return, uses MELDAS-S1's grid ON signal (resolver phase angle 0). (2) When zero point return method is by stopper, and zero point return completion is input from external sources, this signal is also used.
	Positioning stop S T O P	(1) HIGH when positioning is stopped. (2) When this signal is present, the KD71S1 stops execution of positioning, and sets the start signal (START) to OFF (LOW).
Output	Start S T A R T	During output of feed pulse, or during dwell, start signal is ON (HIGH). This signal is normally used as the brake release signal for mechanically-braked servos.
	Clear signal C L E A R	For MELDAS-S1 alarm reset, this is the pulse signal output before execution of zero point return operation. 
	Direction sign S I G N	Used as the direction sign for pulse sequence commands. Differential output.
	Pulse sequence output P U L S E	This is the pulse sequence command, and is output differentially. 

5-4-2 Electrical specifications

(1) Input specifications

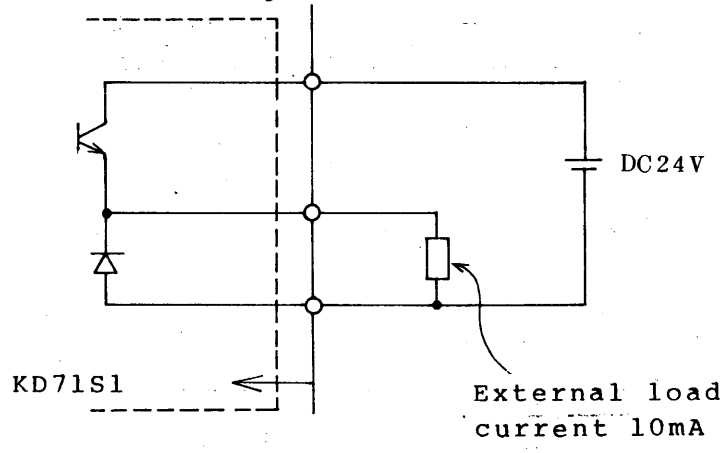


Level	SW
HIGH	ON
LOW	OFF

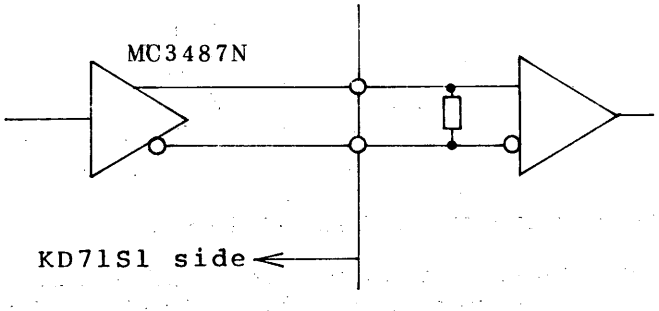
Note) When input is in the open status, this becomes a LOW signal input status.

(2) Output specifications

a) START, CLEAR signals



b) SIGN, PULSE signals



5-4-3 Connection example with MELDAS-S1

Fig. 5.3 shows the method of connection with the MELDAS-S1.

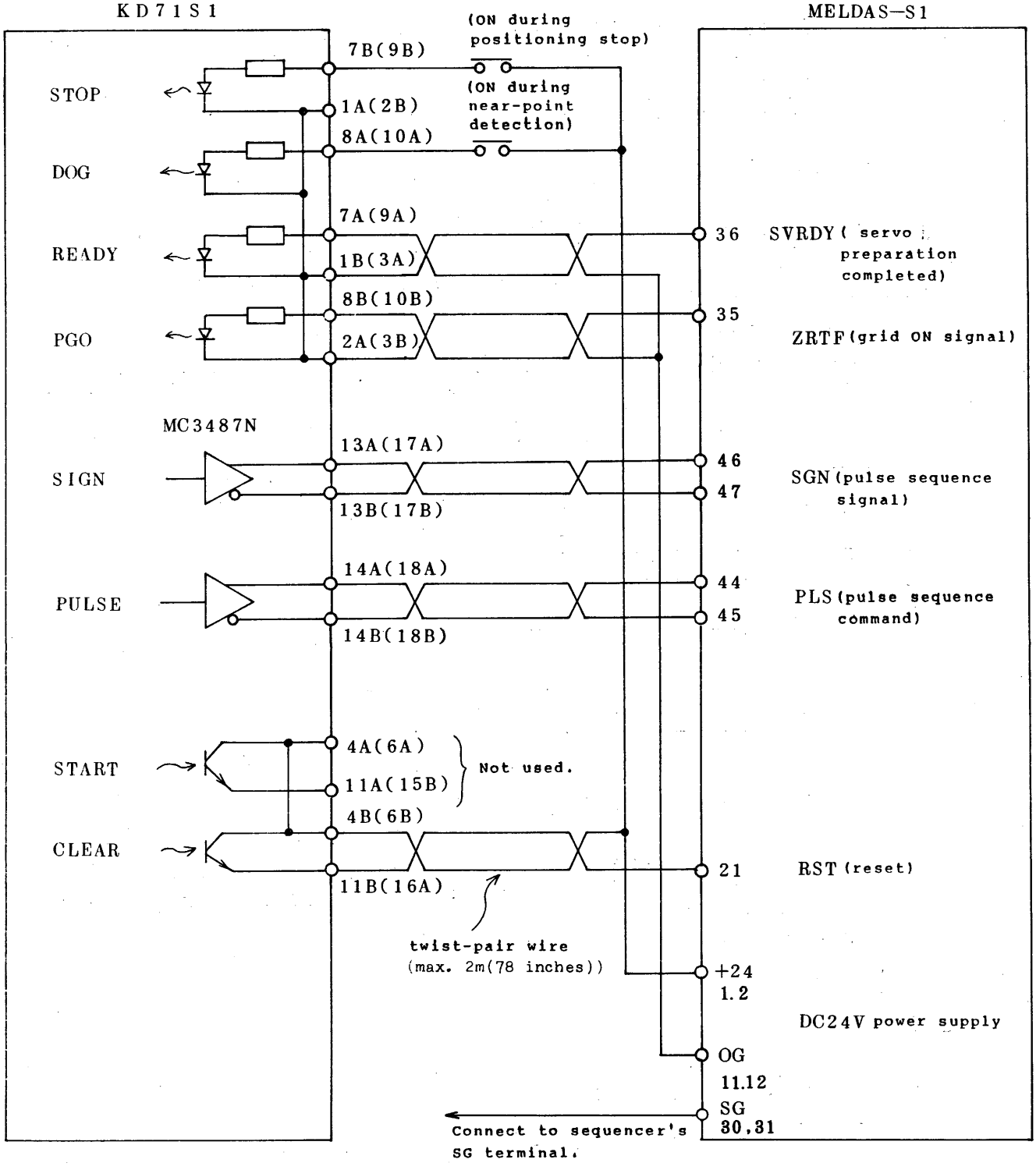


Fig. 5.3 Connection with the MELDAS-S1

The connections shown above are given for reference only, and are only those connections concerning the KD71S1. When performing actual connections, refer to the specifications of the MELDAS-S1.

6. Positioning method

The KD71 has the following positioning functions. And can be applied to various positioning units.

Table 6: Positioning functions

	Function	Independent	Interpolation
1	Zero point return	When zero point return is completed, corrects present value to zero point address.	
2	Positioning	Executes positioning from present position to set position at set speed.	Two axes execute positioning from present position to set position in straight line at movement speed (linear interpolation).
3	Positioning continuation	Continuous execution of positioning can be performed from one start signal.	Interpolation positioning can also be performed continuously the same as with independent positioning.
4	Positioning accompanying revisions in speed or torque (pattern revision)	At the set address, positioning pattern with revised speed or torque can be programmed.	
5	Speed revision during execution of positioning	During execution of positioning, forcible revision of speed can be performed by command from sequencer.	
6	Positioning stop	When positioning stop signal is present positioning operation presently being executed is stopped.	During execution of interpolation positioning, when a stop signal is input at either of the axes, both axes stop positioning simultaneously.

6-1 Zero point return (refer to section 7.2).

This function is for the purpose of more accurate memorization of the present position, and should be performed when turning on the power unit or when a zero point return demand signal is transmitted from the KD71.

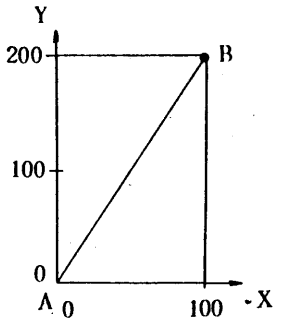
The zero point return demand is transmitted when the power unit is turned on, and during positioning when the drive unit ready signal is OFF. Upon completion of zero point return, the demand signal is turned OFF.

The present position is preserved during power failures, but you should make it a practice to perform zero point return when the power is restored.

6-2 Positioning (refer to section 7.3)

This performs positioning from the present position to the set position at the set speed. During interpolation, the positioning speed of the axis with the longest movement distance is given priority.

For example, in the illustration below, movement is from point A (0,0) to point B (100, 200).



Movement speed of X axis Vx = 100 Kpps

Movement speed of Y axis Vy = 50 Kpps, thus

Movement distance of X axis = 100

Movement distance of Y axis = 200

As a result,

the movement distance of the X axis is less than the movement distance of the Y axis, and Vy = 50 Kpps is given priority, with the result that $Vx = \frac{100}{4} = 25$ Kpps.

In this case, the set speed of the axis with the lesser movement distance is ignored. In the above example, even if the set speed of the X axis (Vx) were a value less than 25 Kpps, it would still move at 25 Kpps.

6-3 Positioning continuation

When the contents of the positioning pattern settings (refer to section 7-3-6) are set for positioning continuation, positioning can be performed continuously by a single start signal. The BUSY signal (X axis X14, Y axis Y15) remains ON during positioning continuation.

6-4 Speed and torque revisions

This function is used when executing positioning while revising speed or torque restriction values corresponding to an address.

6-5 Speed revision during execution of positioning

When it becomes necessary to revise speed during execution of positioning, the speed can be forcibly revised from the sequencer. With the speed revision signal (X axis Y15, Y axis Y16) turned ON, the revision will be made in the preset data (Y0∼YF) when the write signal Y1E is ON. The preset data in this case should be set to a value 1/10th of the desired speed.

6-6 Positioning stop

When you wish to interrupt the positioning process, the input signal $\overline{\text{STOP}}$ is set to LOW. The operation will decelerate according to the preset deceleration speed, and then stop.
To restart following the interruption of positioning, $\overline{\text{STOP}}$ is set to HIGH, and starting processing can be performed again.

6-7 Positioning start

After checking the following conditions, start processing for the KD71 can be executed.

(1) Drive unit ready signal ($\overline{\text{READY}}$) is input.

(2) Sequencer ready signal ($\overline{\text{Y1D}}$) is ON.

(3) The STOP input for the applicable axis is not input.

(4) A check of the range of designated data numbers shows that they are within the range 0∼399.

(5) Logic check of preset data:

1) Within range of stroke limits.

2) The numbers of pattern change preset data are continuous and within 10.

3) Within the pattern change preset data, there are no different direction settings.

4) At start of interpolation, the positioning pattern is set identically for X and Y axes.

5) If beginning at data number 399, the positioning pattern preset is 00.

(6) Applicable axis is not in BUSY status.

(7) Data numbers are not the same as those at time of previous start.

1) After executing a previous zero point return, zero point return cannot be performed again.

2) After executing positioning of previous data number 1, positioning of data number 1 will not be executed again. However, in the event a midpoint stop has been executed as the result of a STOP input, or if JOG has been executed, or if present value has been revised, the data number from the previous start becomes 400, and zero point return, 0∿399 can be designated for the next start.

For the method of starting from the CPU, refer to section 11-5, and for starting from the KD71TU, see section 10-7.

NOTES) 1. "KD71 preparation completion (X11) is ON" should be added to the starting conditions.

2. Starting from data number positioning speed 0 should be avoided. When start begins from positioning speed 0, the next start processing will not be performed until the sequencer ready signal (Y1D) is OFF.

3. When the UNLOCK-LOCK switch on the KD71 is selected in the LOCK condition, pulses will not be transmitted.

4. Starting with the STOP input should be avoided. If such a start is performed, the next start processing will not be performed until the sequencer ready signal (Y1D) is OFF.

7. Contents of settings data

7-1 Parameters

Data set as parameters are constantly valid during normal positioning. When the sequencer ready signal (Y1D) switches from OFF to ON, a check is performed to ascertain whether acceleration/deceleration time, torque restriction, speed restriction, and JOG speed are within the setting range. If one of the presets is not within the setting range, the initial values shown in Table 7-1 will be automatically set. Change the preset values from the sequencer program or from the KD71 TUE.

Table 7.1 Parameter initial settings

Acceleration/ deceleration time	1 sec
Torque restriction	250%
Backlash	0
Speed restriction	100Kpps
Upper stroke limit	999999
Lower stroke limit	0
JOG speed	9996 pps

*Since these values normally differ from those values actually used, always be sure to input preset values.

7-1-1 Acceleration/deceleration time

This function the time from the beginning of execution until the speed restriction values set by parameters are reached.

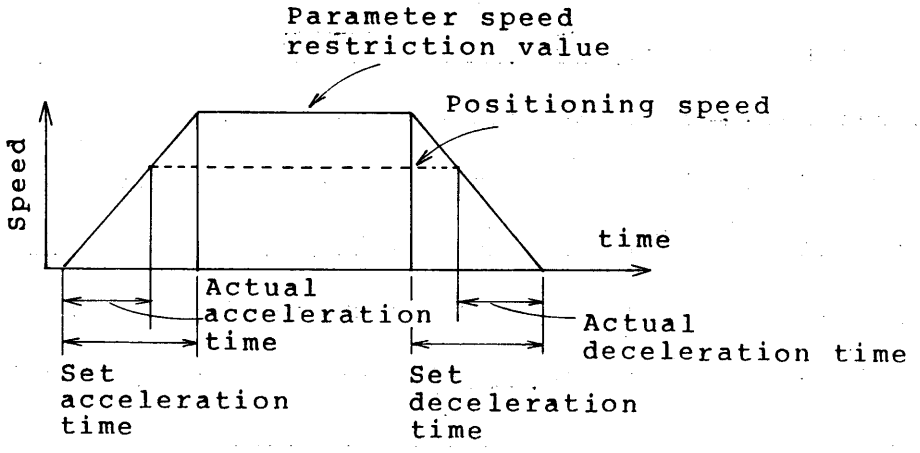


Fig. 7.1 Acceleration/deceleration time

1) Acceleration time and deceleration time are identical and cannot be set separately.

2) Fixed control of acceleration and deceleration is performed; if a positioning speed slower than the parameter speed is set, the acceleration time will be proportionally shorter.

7-1-2 Torque restriction

This funtion clamps the set value of troque generated by electric motors within a range of 10～250%. It is used for controlling servo motors at a torque equivalent to or less than the preset value.

7-1-3 Backlash compensation

The amount of motor backlash is converted into pulse numbers and entered.

When backlash is set, each time the movement direction changes, extra feed pulses corresponding to the amount of backlash are generated.

Backlash compensation becomes valid following execution of zero point return. Accordingly, in the event that revisions are made to backlash settings, zero point return should always be performed once. However, since the previous movement direction is memorized in the memory with its battery backup, zero point return is not required when power is turned off and then turned on again.

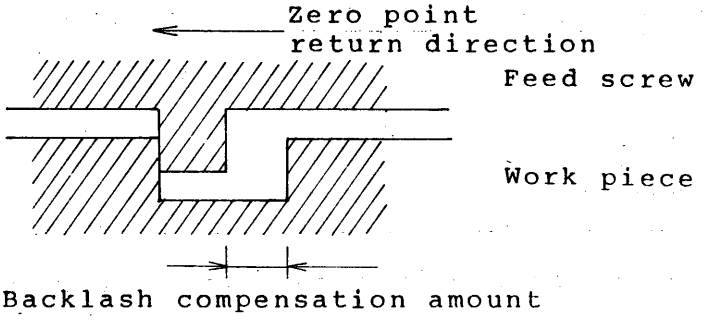
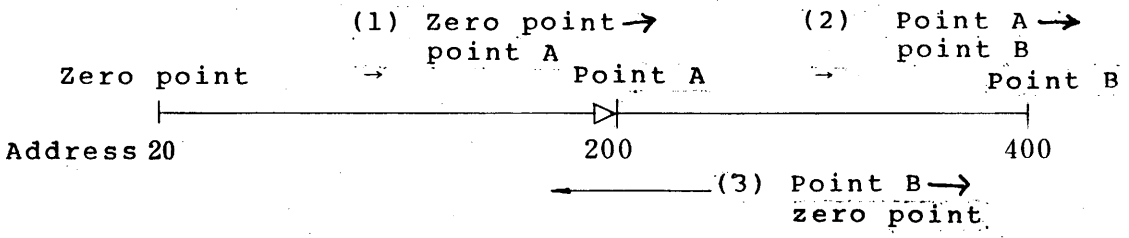


Fig. 7.2 Backlash compensation amount

NOTE) The address preset range at the time of backlash compensation entry should be within the following range:

0 + backlash compensation amount less than or equal to preset address (including zero point) less than or equal to 999999 - backlash compensation amount.

[Example] In the following illustration, when movement is from zero point → point A → point B → zero point, (backlash compensation amount 10),



In zero point → point A, at the time of zero point start a feed pulse compensation of 10 is given, and at A → B, there is no compensation, resulting in an operation like that shown in Fig. 7.3.

Operation	Present position at time of operation completion	Number of feed pulses	Backlash compensation
①	200	190	Yes
②	400	200	No
③	20	390	Yes

Fig. 7.3 Explanation of backlash compensation example

7-1-4 Speed restriction

This function sets speed restriction values. Even if a positioning speed value larger than the speed restriction value is set, it will be controlled at or below the speed restriction value. As shown in Fig. 7.1, the acceleration/deceleration time is the time until this speed restriction is reached. Since the acceleration is fixed until it reaches this speed preset value, when the speed restriction value and the maximum value of positioning speed are equal, the expected acceleration time can be achieved.
Speed restriction is effective also with respect to speed revision settings.

7-1-5 Upper and lower stroke limits

The movement range of the machine is that range at or below the upper stroke limit to a position at or above the lower stroke limit. At the start of positioning, a check is made of the stroke limit range, and positioning will not be executed in response to commands for positioning outside of that range.

7-1-6 JOG speed

JOG is an operation mode in which movement is performed only during the period of time in which the [NORMAL JOG] or [INVERT JOG] keys on the KD71TU are depressed. When the keys are released, movement stops. The speed in this case is the JOG setting speed. With JOG speed, automatic acceleration/deceleration is not performed, and the set speed is used.
The preset range for JOG speed is 4∿9996 pps.

7-2 Zero point return data

This is data used when executing zero point return.

7-2-1 Zero point return mode

Zero point return can be performed either by positioning by PG zero-point signal, or positioning by stopper. Also, positioning by stopper can be divided into two types: One is positioning by the dwell time after the near-point DOG* operates positioning completion. The other is positioning by the signal (input to the zero-point signal) which is generated from the servo drive unit and confirms that the set torque limit has been reached, and the unit is in the stop status.

The zero point should be set as the stroke end of either the normal or inverted directions.

The zero point return mode determines these zero point return methods and zero point return directions.

Mode designation

(Displayed on the data LEDs of the KD71TU)

Return completion detection designation for stopper
- 0: For timer from near-point dog operation
- 1: For signal from drive unit

Return direction
- 0: Normal direction (address increase direction)
- 1: Inverted direction (address decrease direction)

Return method
- 0: For PG zero- going signal
- 1: For stopper method

* Refer to page 10

[Example] Mode setting

Table 7.2

Mode	Return direction	Return method
0 0 0	Normal	By PG-zero point signal
0 1 0	Inverted	
1 0 0	Normal	By stopper, with timer
1 1 1	Inverted	By stopper,with signal from drive unit

NOTE 1) When zero point return is performed by PG zero point signal, the lowest order designation is ignored.

NOTE 2) When the mode is input by sequencer or by the KD71TU, numbers other than 0 and 1 cannot be input.

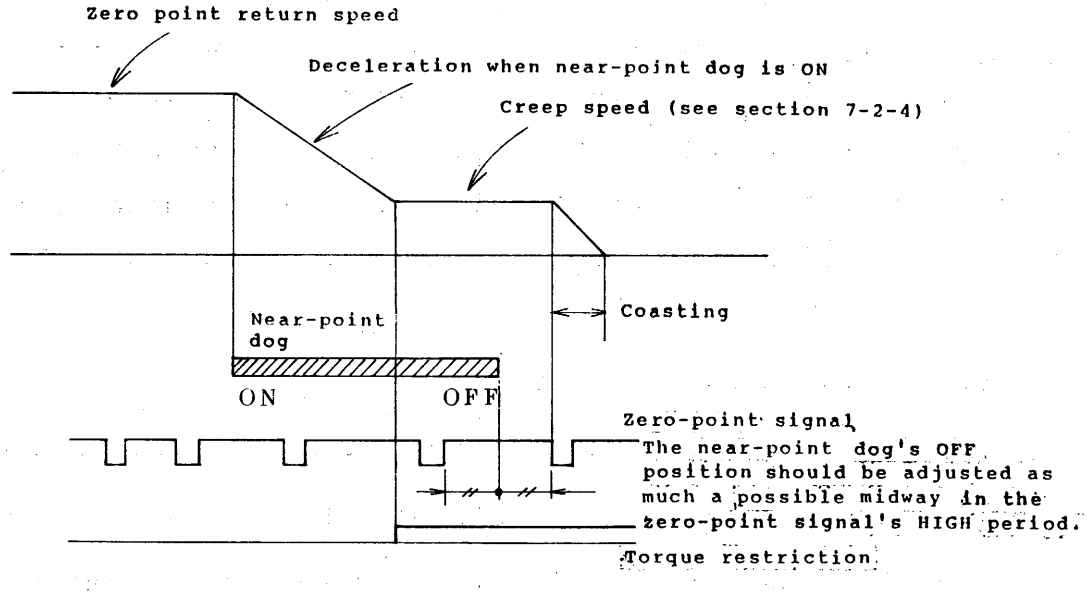


Fig. 7.4 Zero point return by zero-point signal

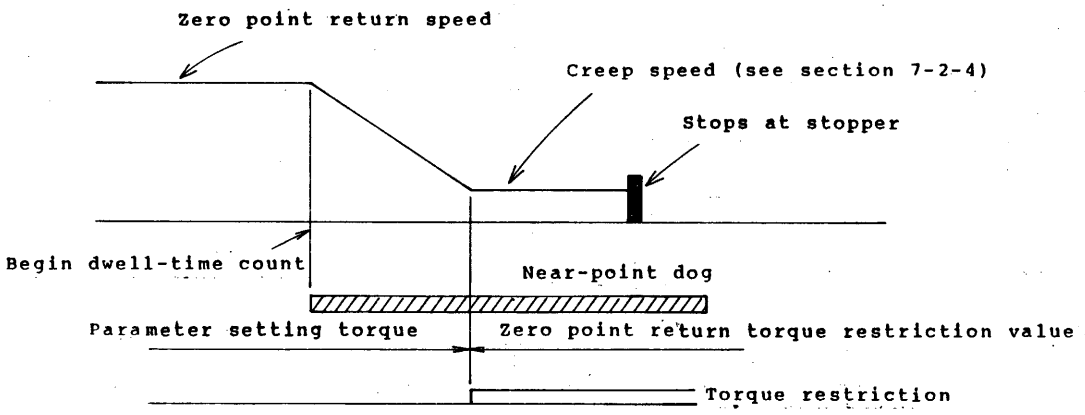


Fig. 7.5 Zero point return by stopper

In zero point return, if a $\overline{\text{STOP}}$ input is given while the near-point dog is ON, zero point return completion processing begins, and the current value is corrected to the zero point address.

7-2-2 Zero point address

This function sets the corrected address at the time of zero point return. At the point where zero point return is completed, the current value is corrected to the zero point address data. During positioning if the current value becomes confused, etc., it is necessary to perform zero point return and correct the present address.

7-2-3 Zero point return speed

This function sets the speed at time of zero point return. In the case of zero point return by zero-point signal, the address is corrected by the first zero-point signal after the near-point dog's change from ON to OFF. Accordingly, the speed should be lowered to a moderate creep speed before the near-point dog changes from ON to OFF. A sufficient length should also be maintained in the near-point dog.

7-2-4 Zero point return creep speed

Creep speed is related to the detection error when return is by zero-point signal, and it is related to the stopping impact when return is by stopper (refer to Fig. 7.4, 7.5). Accordingly, you should set the creep speed while taking into account the error range and size of impact.

7-2-5 Torque restriction

Torque restriction can be made as a parameter value. Until creep speed is reached, it is the parameter torque restriction value, and this torque restriction becomes effective after creep speed is achieved. Accordingly, a sufficient distance between near-point dog and stopper should be maintained so that deceleration to creep speed can be performed.

7-2-6 Dwell time T_D = NPD for specified time (S_{creep} + NPD)

When return is defined stopper with dwell time, this function sets the time from the near-point dog ON until the completion of positioning. Accordingly, you should allow sufficient time between the reaching of creep speed and the stopper.

7-3 Positioning data

This is data accessed during positioning.

7-3-1 Data NO.

Four hundred positioning data values can be set for X and Y axes respectively in addresses 0～399. With each data number, the following data values must be set:

7-3-2 Positioning address

The positioning address is designated by an absolute value within the coordinate system. To find this absolute value, refer to section 3.2. Also, since there is a stroke limit check at the time of start, be sure to make the positioning address within the range of the stroke limit.

7-3-3 Positioning speed

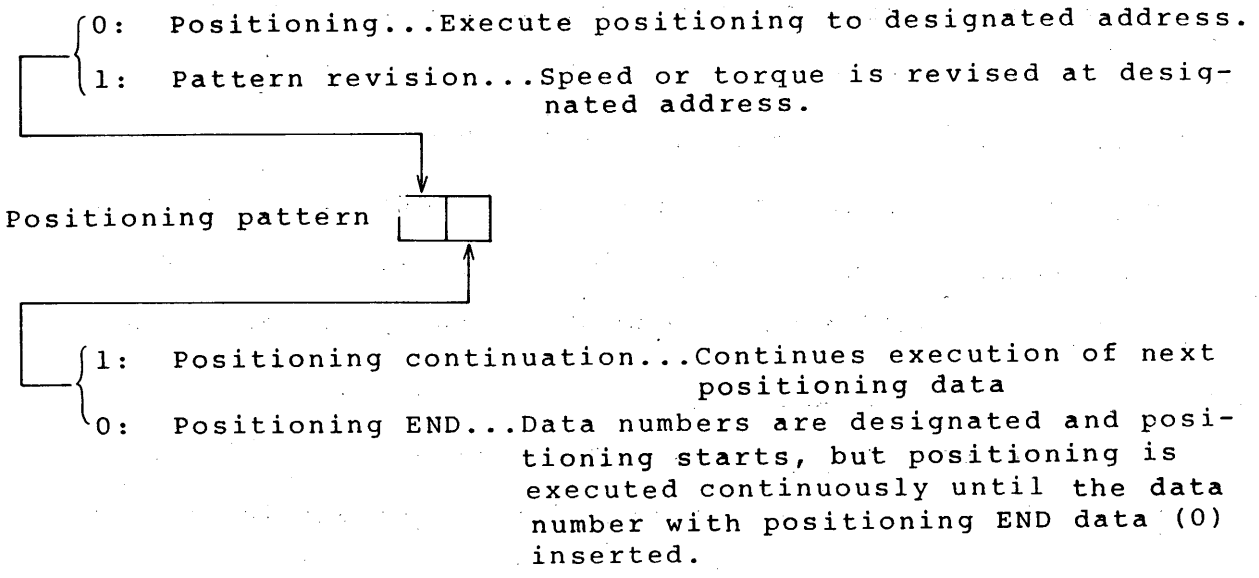
This function sets the speed at the time of positioning. A parameter speed restriction check is performed at the time of start, and if the speed is above the speed restriction value, the parameter speed restriction value will become the positioning speed.

7-3-4 Torque restriction

The torque restriction value is set in percentage. A parameter torque restriction check is performed at the time of start, and if the preset value is above the torque restriction, the torque restriction will become equal to the parameter torque restriction value. When torque restriction is not used, it is unnecessary to set the torque restriction value.

7-3-5 Dwell time

This function sets the waiting time following the completion of positioning. The time should be set at a value larger than the time required for the servo motor to stop at the completion of positioning.



NOTE) When the pattern is received from the sequencer or the KD71 TU, and numbers other than 0 or 1 are input, an error designation will result. Also, since there is no pattern designation 10, an error will also occur.

(NOTES REGARDING THE USE OF PATTERN REVISION)

1. A limit of 10 pattern revision points befor positioning continuation or positioning END is allowed. Accordingly, the number of settings for pattern 11 is a maximum of 9 points, after which 01 or 00 must follow.

2. When executing pattern revision, programming should be performed so that the movement directions are identical within any single string of operations. However, following a pattern with positioning continuation or positioning END, the movement may be changed if desired.

3. The speed parameters in revision may be either accelerating or decelerating. However, if a value is set higher than the parameter speed restriction value, the parameter value will become the output speed. The same applies for torque restriction.

4. The pattern revision function cannot be used when performing linear interpolation.

(NOTES REGARDING THE USE OF PATTERN CONTINUATION)

1. Continuous positioning may be performed with any number of continuous points. However, since data numbers are 0～399, data number 399 should always bé used for the positioning END command.

2. Continuous positioning is applicable also when performing linear interpolation. However, the pattern designation for both X and Y axes should be continuous.

A check of the above notes is made each time start is performed. If an erroneous setting is made, positioning will not be executed.

[Program example]

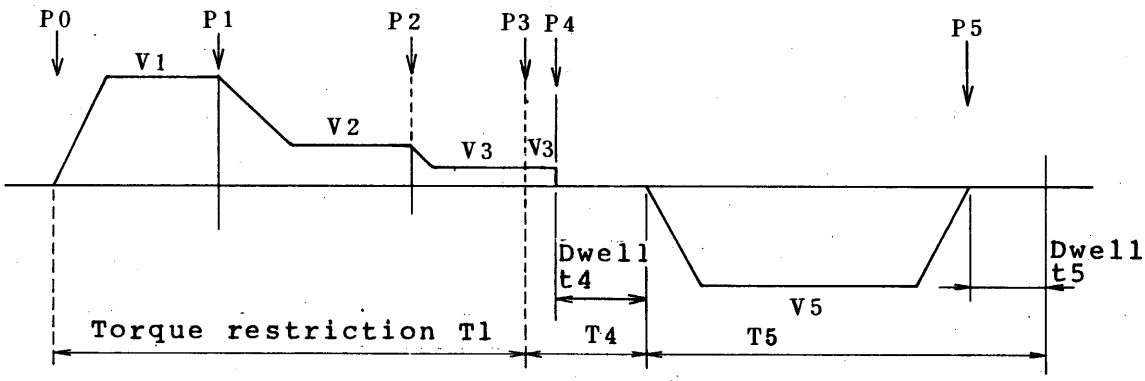


Fig. 7.6 Example of positioning patterncontrol

7.3

Data No		Preset data	
10	0	11	(Positioning pattern)
		P1	(Address)
		V1	(Speed)
		T1	(Torque)
		0	(Dwell)
	1	11	(Positioning pattern)
		P2	(Address)
		V2	(Speed)
		T1	(Torque)
		0	Dwell
	2	11	(Pattern revision command)
		P3	
		V3	
		T1	
		0	
		0	
	3	01	(Positioning continuation command)
		P4	
		V3	
		T4	
		t4	
	4	00	(Positioning END command)
		P5	
		V5	
		T5	
		t5	

In the example at left, data numbers 100 to 104 are used to set data, and data number 100 is used to start.

(1) With P1 address, speed is revised from V1 to V2.

(2) With P2 address, speed is revised from V2 to V3.

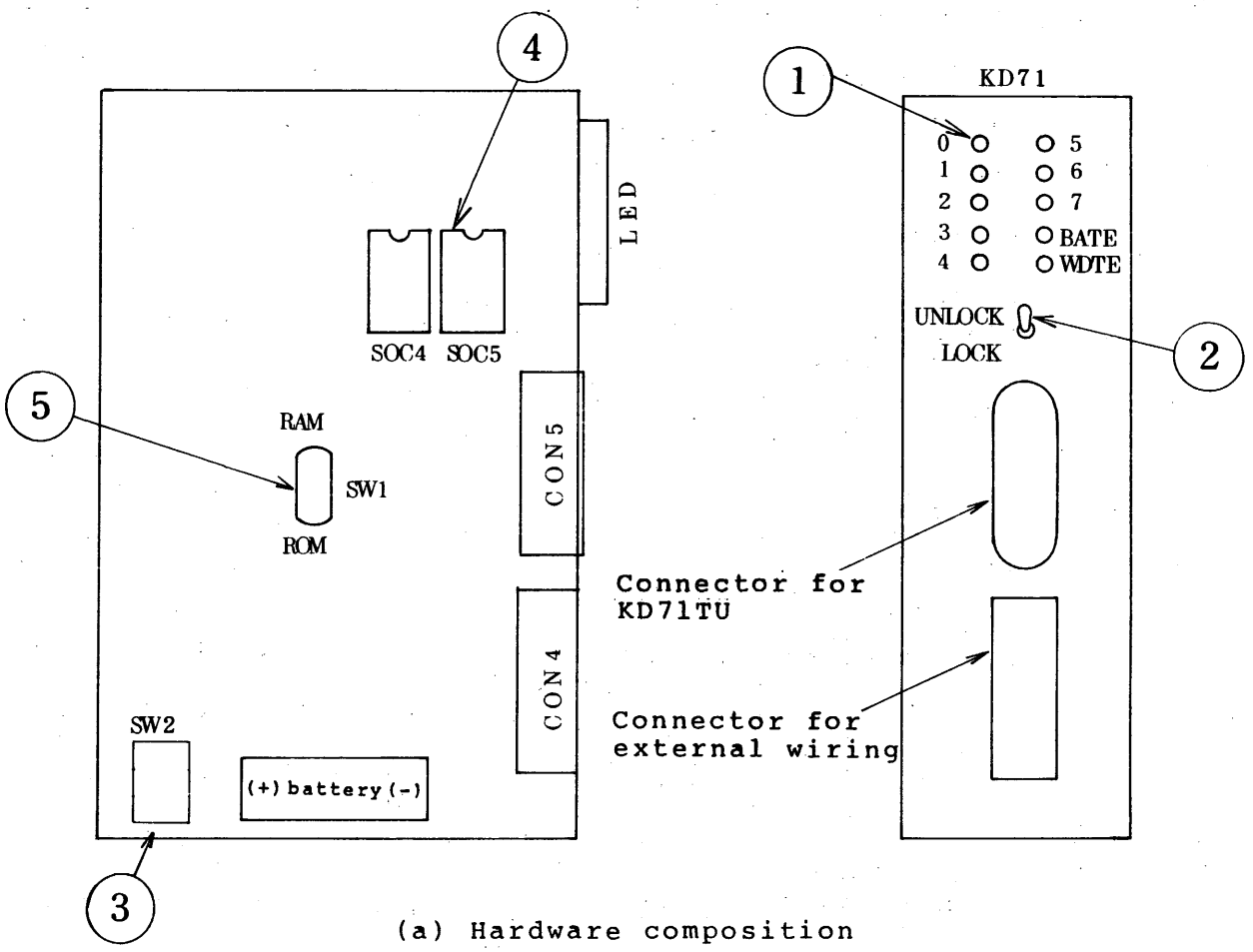
(3) With P3 address, torque is revised from T1 to T4.

(4) With P4 address, positioning is performed with t4 sec. of dwell time.

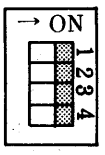
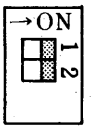
(5) After the end of the dwell time, positioning to P5 is performed, with t5 sec. of dwell time, and a single string of positioning is completed.

8. Hardware

8-1 Hardware composition and function of selector switch (SW2)



(a) Hardware composition

Switch name	KD71			KD71S1		
						
	No.	ON	OFF	No.	ON	OFF
A	1	(Not used)	(Not used)	-	-	-
B	2	Output B type SIGN + PULSE	Output A type Normal pulse + inverted pulse	-	-	-
C	3	Positioning function	Data transmission function	1	Positioning function	Data transmission function
D	4	Memory protection (write-in possible)	Memory protection (write-in not possible)	2	Memory protection (write-in possible	Memory protection (write-in not possible)

(b) Explanation of selector switch (SW2) functions.

Fig. 8 Hardware (indicating B circuit board removed)

8-2 LED display contents (1)

LED No	Contents (during positioning function)	Contents (during data transmission function)
0	Not lit (3 SW2-C ON)	Lit (3 SW2-C OFF))
1	KD71 ready	Transmitting data KCPU → KD71
2	X-axis servo unit error	Transmitting data KD71→KCPU
3	Y-axis servo unit error	Not lit
4	X-axis BUSY (also ON during dwell)	Not lit
5	Y-axis BUSY (also ON during dwell)	Not lit
6	X-axis zero point return demand	Not lit
7	Y-axis zero point return demand	Not lit
BATE	Battery error	Battery error
WDTE	Watchdog error	Watchdog error

8-3 UNLOCK-LOCK switch 2

When set to the LOCK position, the machine will not move, and program checks can be performed. (Feed pulses from the KD71 stop, and present value only changes).

8-4 Use of selector switch (SW2) 3

8-4-1 Memory protection

Following the setting of parameters, zero point return data, and positioning data, when writing is to be prohibited, SW2-D is set to OFF (the effective range of memory protection is data numbers 0～219).

8-4-2 Data transmission between sequencer and KD71

When using the K2CPU-S3:

Settings data can be transferred from the KD71TU to the sequencer program memory, or the sequencer program memory data can be transferred to the KD71.

Through the medium of the sequencer program memory, parameters, zero point return data, and positioning data can be written in to tape by the cassette loader (K6MT, K7MT), or the reverse, can be read out from the tape.

Also, it is possible to use the P-ROM writer unit (K6WU) to enter settings data into ROM.

Transferring data (KD71→ KCPU)

(1) The KCPU sequence program is stored, either by using the cassette loader, or by placing it into ROM.

(2) Confirm that the KCPU program memory is available in RAM.

(3) Set the KCPU's RUN switch to OFF.

(4) Set the KD71's SW2-C to OFF (LED 0 will light).

(5) Transfer data to the KCPU with the KD71TU. During transmission, LED 2 will light (Refer to section 10-8-4 for operation of the KD71TU).

(6) Store settings data from the sequencer CPU using either the cassette loader, or the P-ROM writer unit.

(7) Load the KCPU sequence program.

(8) Set the KD71's SW2-C to ON (LED 0 will go out).

(9) Set the KCPU's RUN switch to ON.

Transferring data (KCPU → KD71)

(1) Store the SCPU sequence program either by using the cassette loader, or by placing into ROM.

(2) Place the KCPU program memory into RAM.

(3) Set the KD71's SW2-C to OFF (LED 0 will light).

(4) Set the KCPU's RUN switch to OFF.

(5) Load the positioning settings data (stored on cassette tape or ROM) into the KCPU program memory.

(6) Transfer data from KCPU to KD71 using the KD71TU. During transmission, LED 1 will light (refer to section 10-8-4 for operation of the KD71TU).

(7) Load the KCPU sequence program.

(8) Set the KD71's SW2-C to ON (LED 0 will go out).

(9) Set the KCPU's RUN switch to ON.

8-5 Programming settings data into ROM 4 5

Parameters, zero point return data, and positioning data (data numbers 0～219) can be transferred using ROM.

Using the procedure outlined in section 8-4-2, enter the data into ROM, and install in SOC4 or SOC5.

EP-ROM MB8516 (2K bytes) first half: Insert in SOC4

second half: Insert in SOC5

During ROM transfer, SW1 set to ROM side (data no. 0～219: ROM; 220～399: RAM).

During RAM transfer, SW1 set to RAM side (data no. 0～399 can be used).

9. External connections

Connections to external machines such as drive units, etc., will be explained here using several drive unit examples. However, since the connection specifications on the drive unit side may be revised, the examples given here are for reference only. When actually performing connections, be sure to check again the actual specifications on the drive unit you plan to use.

9-1 Example of connections to the Toei Electric VELCONIC

Connections with the Toei Electric VELCONIC resolver-type position unit VLPP-15 are shown in Fig. 9.1. The output used on the KD71 is the A type.

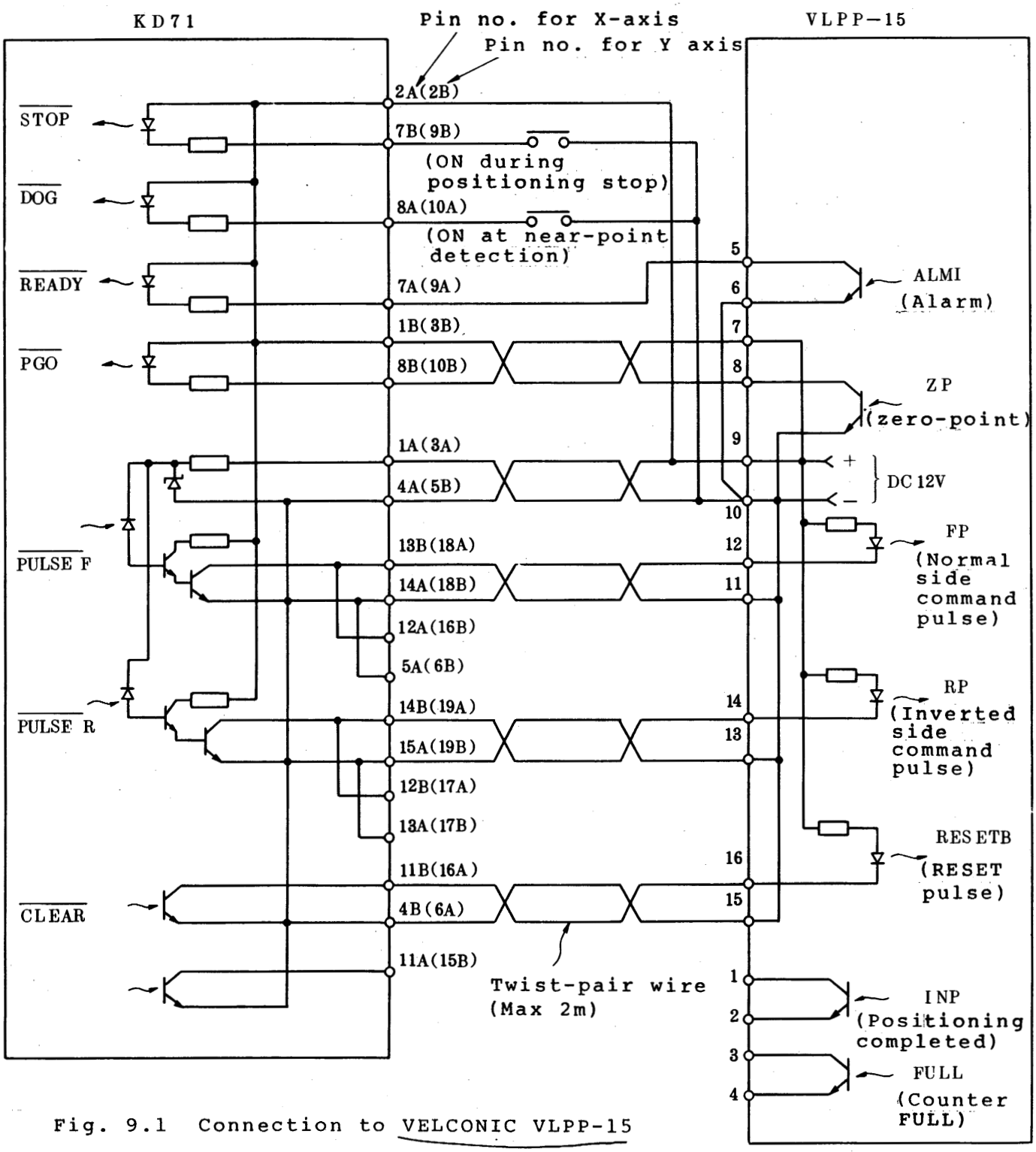


Fig. 9.1 Connection to VELCONIC VLPP-15

9-2 Example of connections to Nikki Electric DIGITAL S-PACK

Connections with the Nikki Electric DIGITAL S-PACK NDS-300A are shown in Fig. 9.2. The output used on the KD71 is the A type.

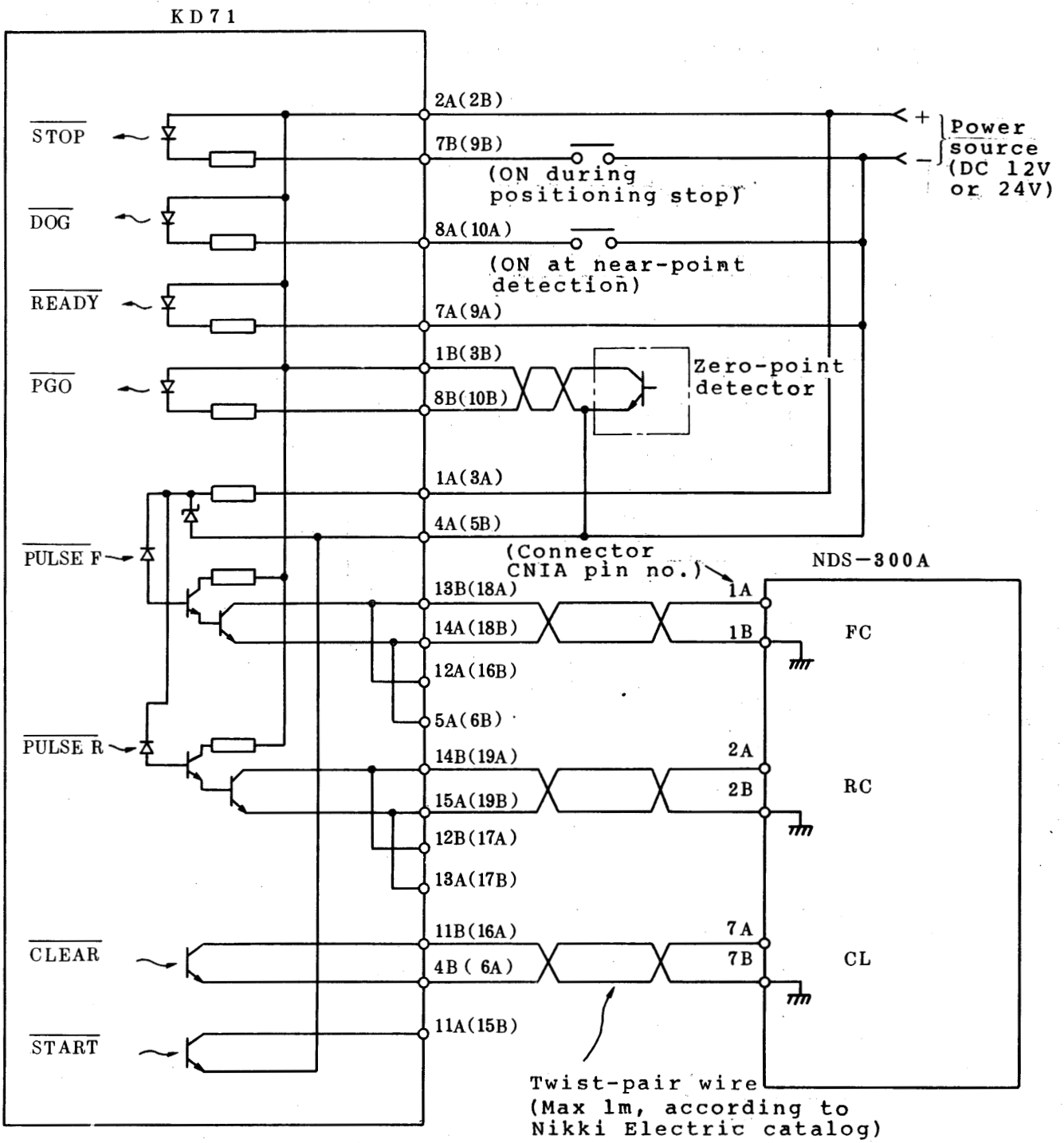


Fig. 9.2 Connections with the DIGITAL S-PACK NDS-300A

9-3 Example of connections to Yasukawa Electric POSITION PACK-10A

Connections to the POSITION PACK-10A are shown in Fig. 9.3. The output used on the KD71 is the B type.

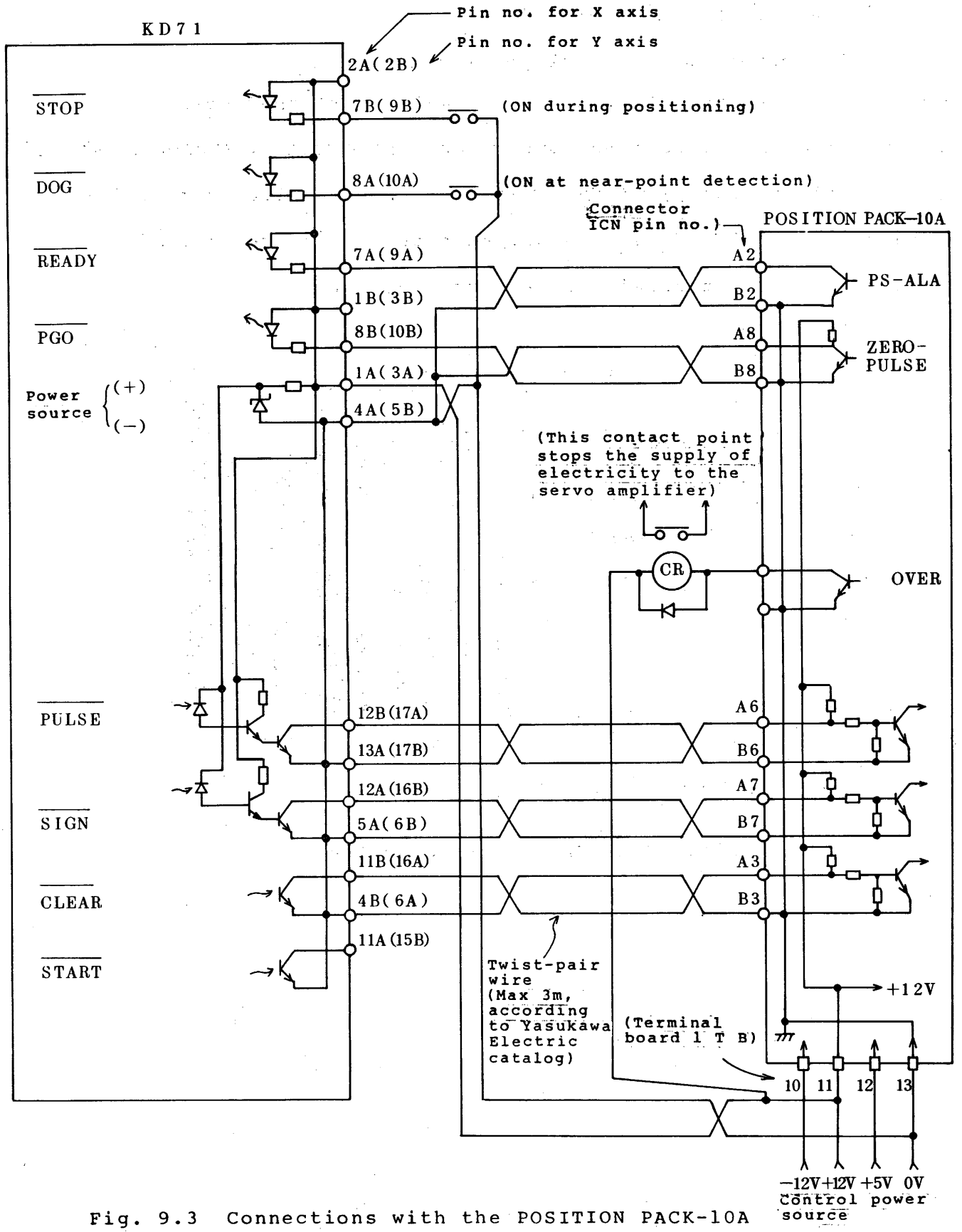


Fig. 9.3 Connections with the POSITION PACK-10A

10. Operating the teaching unit

10-1 Connection with the positioning unit

Connection with the KD71 main unit can be performed even during positioning operations, but to the best extent possible, you should perform connections when the unit is stopped. Also, the cable connection should be as straight as possible, since if it is connected askew, transmission errors may result.

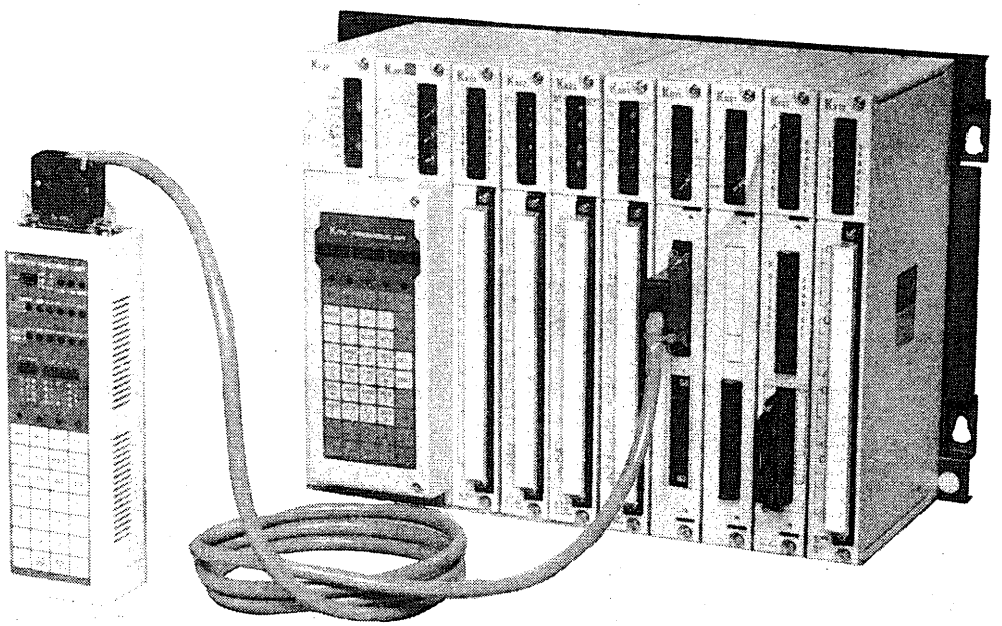


Fig. 10.1 KD71TU as connected

10-2 General operations

10-2-1 Key operations

DATA inputs from the keyboard are shown in LEDs and also in the display, so key operations should be performed while watching these indicators . A beeper is also provided, and the sound generated is of two kinds: a single short "beep" and a discontinuous "beep, beep, beep" sound.

(1) Short sound ("beep"): This sounds when performing key operations. Even when you think you pressed a key, if this beep is not heard, the process corresponding to that key will not be performed.

(2) Discontinuous sound("beep"), beep, beep"): This sounds when an incorrect key is pressed; an error code will be displayed. Perform the correct key operation again.

10-2-2 CLEAR key operation

When you mistakenly press a NUMBER KEY for data numbers or data, press the CLEAR key, and the display contents will be cancelled.

10-2-3 Even when the mode is revised, the data numbers will not be cleared.

Even if the mode key is revised, e.g. READOUT ⇄ WRITE-IN, resetting is not required.

10-3 Operating modes

The KD71TUE has the operating modes shown below.

- WRITE
  - Parameters
  - Zero point data
  - Positioning data
- READ
  - Parameters
  - Zero point data
  - Positioning data
- MONITOR
  - Present value, data no.
  - Status display
  - Error code monitor
- TEST
  - Zero point return
  - Positioning
  - JOG
- SPECIAL OPERATIONS
  - Memory clear
  - Write current value
  - Data transfer

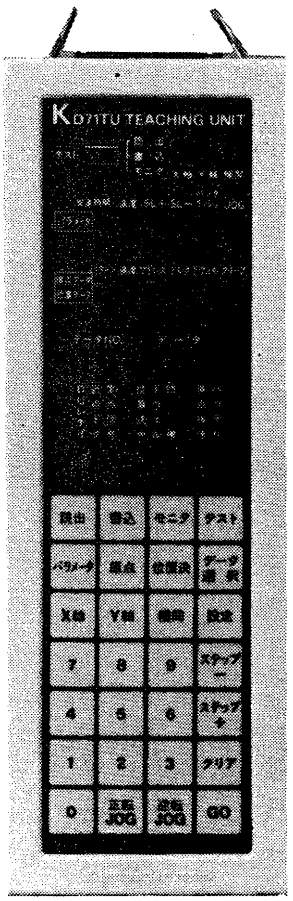


Fig. 10.2
External appearance of KD71TU

10-4 Write-in

For writing data into the memory.

[Operation]

Table 10.1 Write-in operation

Operation order	Procedure	Display
①	Test READ / WRITE / MONITOR — Slide switch set to write-in side	7 1
②	WRITE — Mode selection	Mode LED lights
③	PARAMETER / ZERO POINT / POSITIONING — Select one	For parameter, acceleration time LED lights. For zero point, or positioning, pattern LED lights
④	X-AXIS / Y-AXIS — Select one	LED for designated axis lights
⑤	SETTING [ ] ··· [ ] GO — Select data number Number key (NOTE) This operation is unnecessary if PARAMETER, ZERO POINT is selected in step 3.	Data number is shown on display
⑥	DATA SELECT — select type of data If the DATA SELECT key is pressed continuously, the data selection display LED will move. Press this key until the desired LED lights.	Display for data selection lights
⑦	[ ] ··· [ ] — WRITE data setting Number key	WRITE data is shown on display
⑧	GO — WRITE execution	Confirmed if beeper sounds.
⑨	STEP ± — Data number ± 1 (NOTE) This operation is unnecessary if PARAMETER ZERO POINT was selected in step 3.	Next (± 1) data number is displayed.

Steps 1 ∼ 8 are the basic operation steps. Following step 8, by going back to previous operations, repetitive operations can be performed. For example, to write in other data, go back to step 6; to write in data for another axis, go back to step 4; to write in the next data number, go to step 9;

The same is true if a key operation error is made.

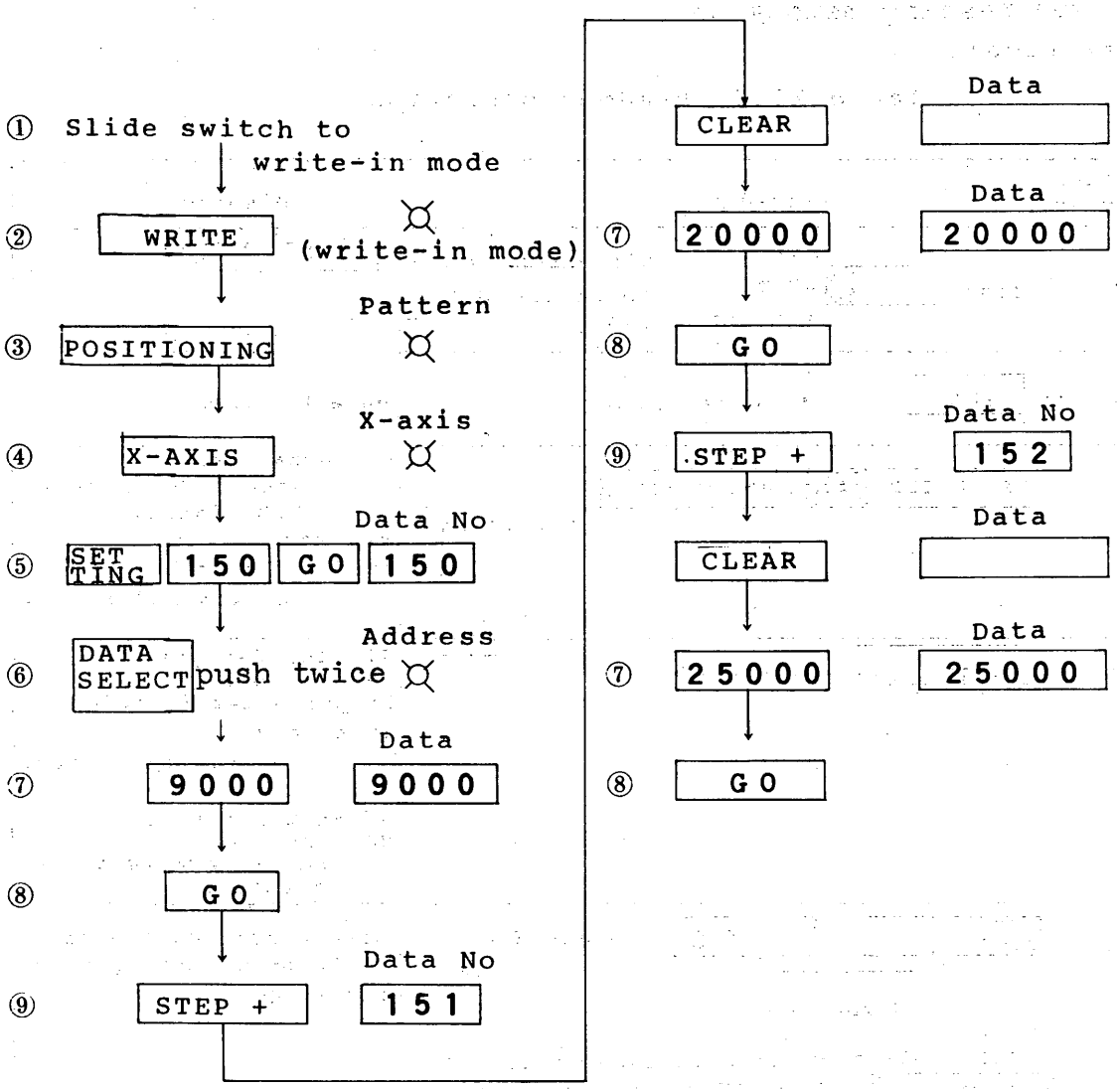
(NOTE) Parameter writing cannot be performed when the sequencer ready signal (YlD) is ON. Turn the sequencer ready signal OFF and then perform entry.

[Operation example]

Write in the addresses shown in table 10.2 in X-axis data numbers 150∼152:

Table 10.2 WRITE example

Data No	Address
150	9000
151	20000
152	25000


① Slide switch to write-in mode
② WRITE
(write-in mode)
③ POSITIONING
Pattern
④ X-AXIS
X-axis
⑤ SETTING 150 GO 150
Data No
⑥ DATA SELECT push twice
Address
⑦ 9000
Data 9000
⑧ GO
⑨ STEP +
Data No 151
CLEAR
Data
⑦ 20000
Data 20000
⑧ GO
⑨ STEP +
Data No 152
CLEAR
Data
⑦ 25000
Data 25000
⑧ GO

10-5 Readout

For reading memory data

[Operation]

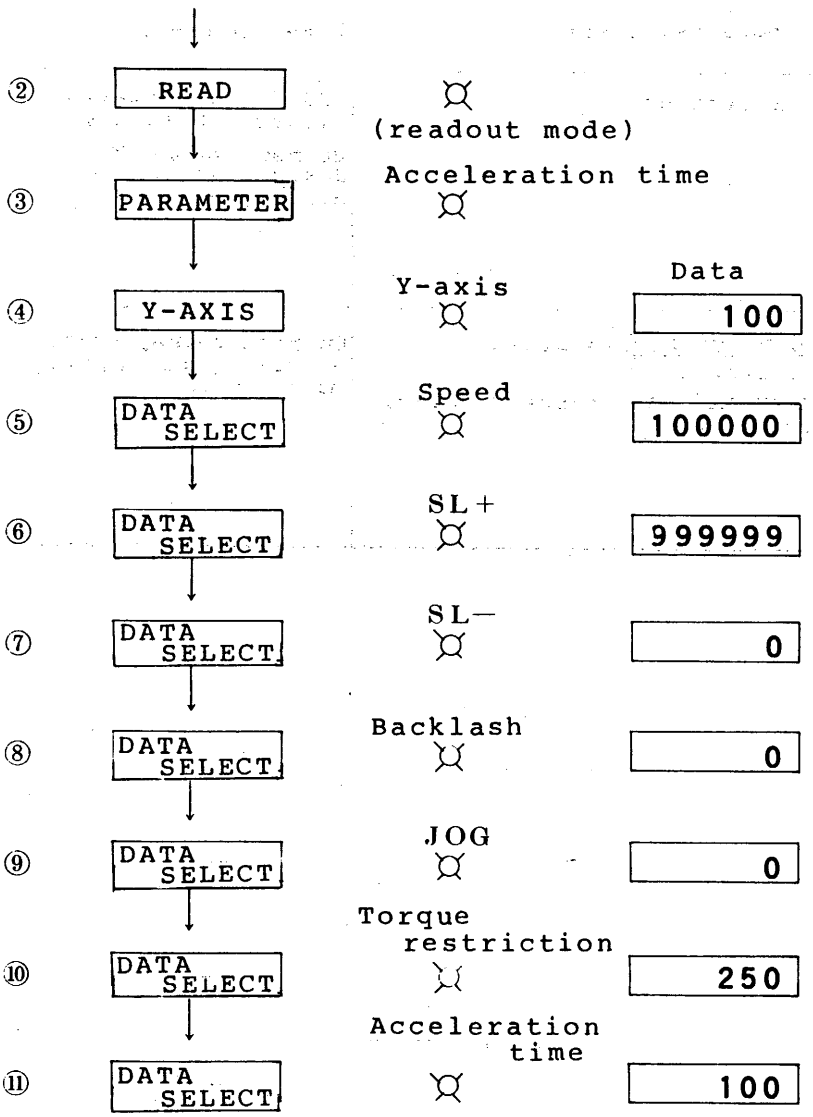
Table 10.3 Readout operation

Operation order	Procedure	Display
①	Test [ ] READ / WRITE / MONITOR Slide switch set to readout mode side.	[ ][ ]7[1][ru]
②	[READ] Mode selection.	Mode LED lights
③	[PARAMETER] [ZERO POINT] [POSITIONING] select one	For parameter, acceleration time LED lights. For zero point or positioning, pattern LED lights
④	[X AXIS] [Y AXIS] select one	LED for designated axis lights If parameter is selected in step 3, the acceleration time is displayed if zero point was selected, the pattern is shown in display
⑤	[SETTING] [ ] ··· [ ] [GO] Select data number Number key (NOTE) This operation is unnecessary if [PARAMETER] [ZERO POINT] was selected in step 3.	Data number displayed. Positioning data pattern displayed.
⑥	[DATA SELECT] select type of data. If the [DATA SELECT] key is pressed continuously, the data select display LED and the readout data will be displayed, and move from one to the next. Press the key until the desired readout data is displayed.	Data select LED lights; Selected data is displayed.
⑦	[STEP ±] Data number ± 1 (NOTE) This operation is unnecessary if [PARAMETER] [ZERO POINT] was selected in step 3.	Next (± 1) data number is displayed. Selected data is displayed.

Steps 1~6 are the basic operation steps. To then readout other data, press the DATA SELECT key. By going back to previous steps, repetitive operation can be performed. For example, to readout data for another axis, return to step 4, to readout the next data number, go to step 7.

[Operation example]

To readout Y-axis parameter values

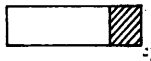
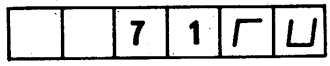


10-6 Monitor

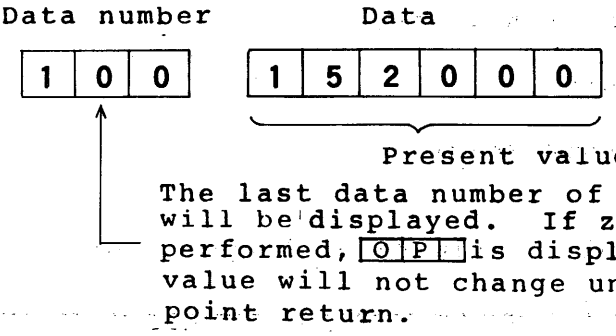
This is for monitoring the present value, KD71 status, and error codes.

[Operation]

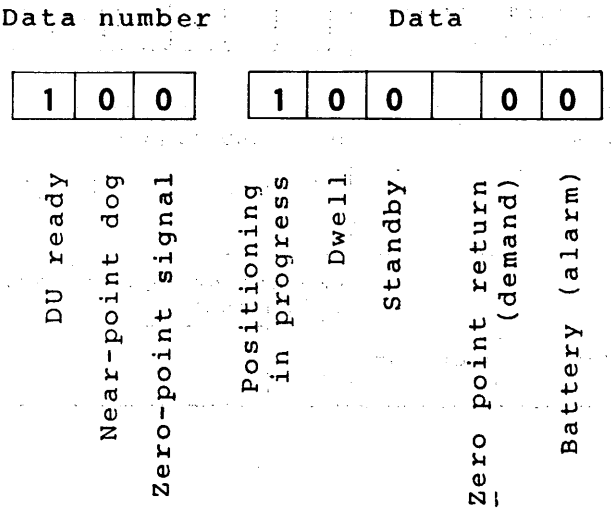
Table 10.4 Monitor operation

Operation order	Procedure	Display
①	Test  READ / WRITE / MONITOR Set slide switch to monitor mode side.	
②	MONITOR Mode selection	Mode LED lights
③	X-AXIS Y-AXIS select one	LED for designated axis lights. Data number and current value for designated axis are displayed.
④	(NOTE) When DATA SELECT is pressed, display will switch from (Current value) → (Status display) → (Error code).	Current value, status, or error code will be displayed.

[Example of data number, present value monitor]



[Example of status display]



In the status display, 0=OFF, and 1=ON. Zero point return means that a zero point return demand has been issued. Also, Battery"1"indicates that the battery is depleted.

10-7 Testing

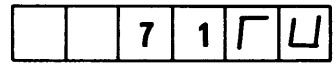
This is used for performing test runs, etc.

10-7-1 Zero point return

This initiates a zero point return start.

[Operation]

Table 10.5 Testing (zero point return) operation

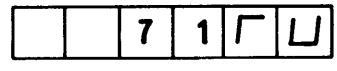
Operation order	Procedure	Display
①	TEST [▨] READ / WRITE / MONITOR — Set slide switch to test mode side	
②	[TEST] mode selection	Mode LED lights
③	[ZERO POINT] selection	—
④	[X-AXIS] [Y-AXIS] select one	LED for designated axis will light
⑤	[G O] Zero point return execution	—

10-7-2 Positioning

This initiates a positioning start.

[Operation]

Table 10.6 Test (positioning) operation

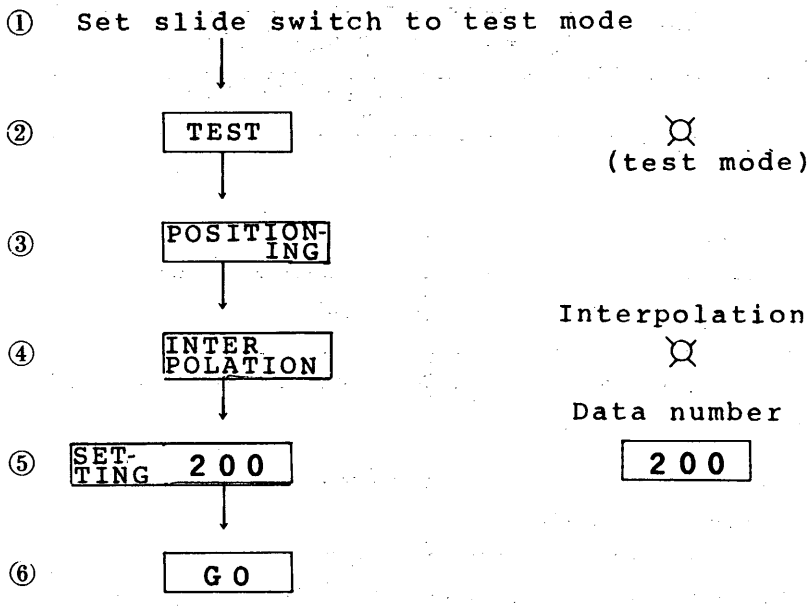
Operation order	Procedure	Display.
①	TEST [▨] READ / WRITE / MONITOR — Set slide switch to test mode side	
②	[TEST] mode selection	Mode LED lights
③	[POSITIONING] selection	—
④	[X-AXIS] [Y-AXIS] [INTER POLATION] select one	LED for designated axis will light
⑤	[SET-TING] [ ] ··· [ ] (Number key) Designate data number	Data number is displayed
⑥	[G O] Positioning execution	—

X-axis or Y-axis have been selected for independent start. In the case of interpolation start, monitor operation will not be performed.

(NOTE) Even if positioning is started in the KD71TU test mode, the start will be under exactly the same conditions set by the sequencer. As a result a parameter check, etc., will be performed at the start, and if any abnormal data is present, the start may not be performed. In the event that positioning is not executed at the start command, check the data once more. Pattern control can also of course be started in the test mode.

[Operation example]

To initiate an interpolation start with data number 200.



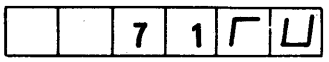
10-7-3 JOG

In JOG, positioning is performed only during the time the NORMAL JOG or INVERT JOG key is depressed. When the key is released, the operation is stopped. This is used when performing a check of positioning addresses, or a calculation. The speed in this case is the parameter JOG speed.

Also, the KD71TUE is equipped with a function for writing data into addresses which have been moved with JOG.

[Operation]

Table 10.7 JOG operation

Operation order	Procedure	Display
①	TEST [▨] READ / WRITE / MONITOR Set slide switch to test mode side	
②	TEST mode selection POSITIONING select	Mode LED lights
③	X-AXIS Y-AXIS select one	LED for designated axis lights
④	NORMAL JOG INVERT JOG select one JOG executed	—
⑤	WRITE-IN Mode selection	Mode LED lights
⑥	SET TING [ ] ---- [ ] Designate data number Number key	Data number is displayed
⑦	GO Address entry is executed	—

Steps 1 ~ 4 are for performing JOG. Following JOG, when steps 5 ~ 7 are performed, addresses of points moved by JOG are written in to the designated data numbers. The entry in this case is performed with the slide switch kept in the test mode.

(NOTE) In 10.7 6, only the positioning addresses are written in to the designated data numbers, thus it is necessary to separately enter other data.

[Operation example]

To perform JOG from points A and B, and to enter the address data for points A and B into data numbers 100, 101.

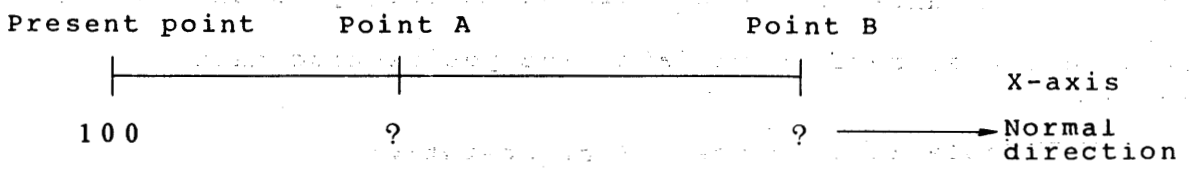
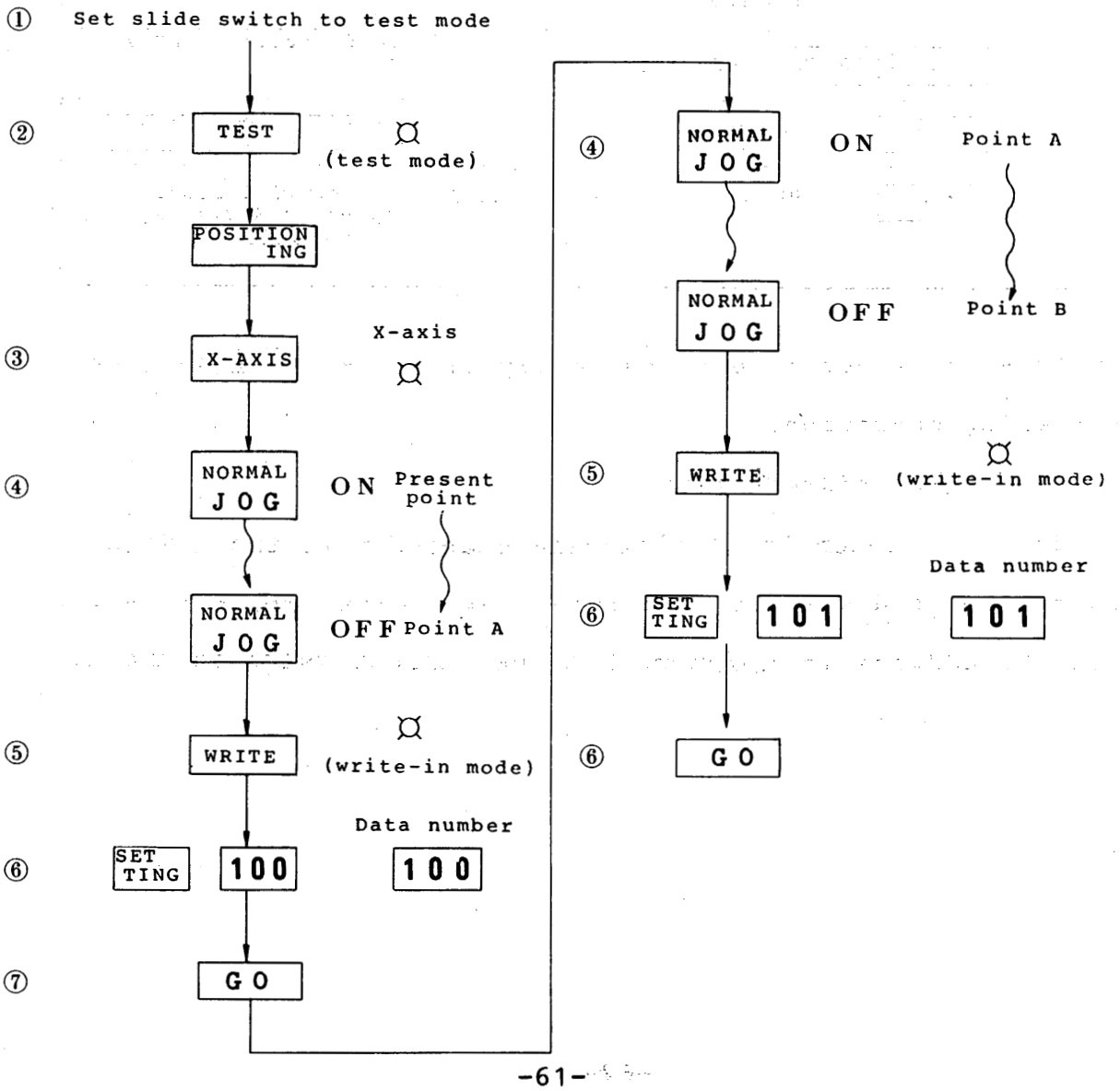


Fig. 10.3 Example of JOG operation.



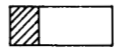
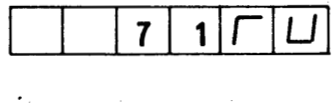
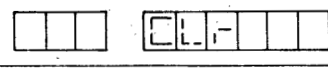
10-8 Special operations

10-8-1 Memory clear

This function clears all data memory. This operation should be performed first before entering data. However, if this operation is performed after data entry, it will be necessary to once again input parameters, zero point data, and positioning data.

[Operation]

Table 10.8 Memory clear operation

Operation order	Procedure	Display
①	TEST  READ WRITE MONITOR Set slide switch to test mode side	
②	TEST WRITE mode selection	Test, write LEDs light
③	CLEAR select	
④	GO GO Memory clear executed	Beeper will sound 3 times, and display will be cleared

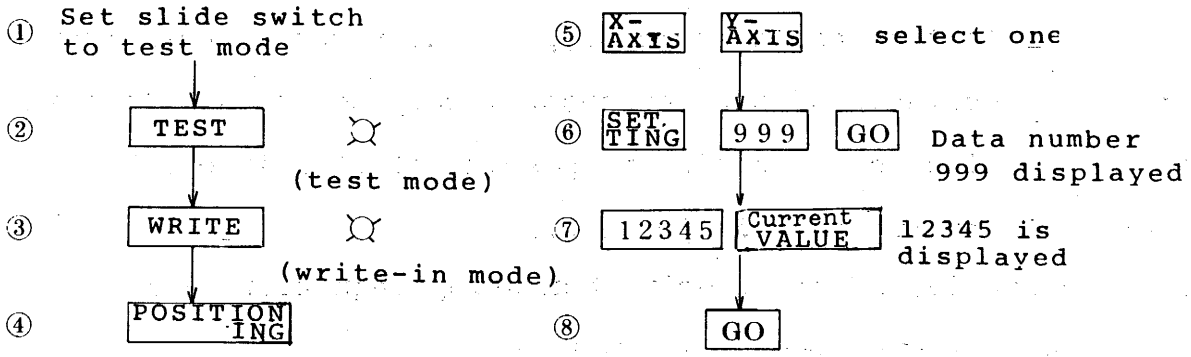
(NOTE) Be sure not to execute memory clear in the middle of positioning operation.

10-8-2 Address entry

This forcibly enter the positioning address with the KD71TU. This can be used without performing zero point return in cases where the address is unknown, but the current value is known.

[Operation]

In this example, the present value is taken to be 12345.

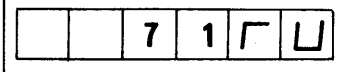
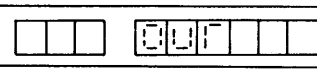


10-8-3 Data Transfer

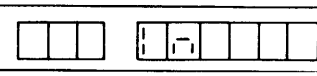
This function is used when transferring the contents of the KD71's data memory to the sequencer memory, or the reverse, when transferring the contents of the sequencer memory to the KD71's data memory. Applications include the placing of data into ROM or preservation on audio cassette, etc..

This function is effective only when using sequencer K2CPU-S3.

[Operation] Reading data from KD71 to KCPU

Operation order	Procedure	Display
①	Test  READ / WRITE / MONITOR — Set slide switch to test mode side	
②	TEST READ — mode selection	Test and readout LEDs light
③	GO	
④	GO — Transmission executed	Beeper sounds 3 times, and display is cleared

[Operation] DATA ENTRY from KCPU to KD71

Operation order	Procedure	Display
①	TEST  READ / WRITE / MONITOR — Set slide switch to test mode side	—
②	TEST WRITE — mode selection	Test, write LEDs light
③	GO	
④	GO — Transmission executed	Beeper sounds 3 times and display is cleared

11. Sequencer program

11-1 I/O signals and allocation

The KD71's sequencer side I/O signals are as follows. X and Y numbers indicate installation in the base unit's slot No. 0.

Table 11.1 KD71 I/O signals

Input Signals

I/O No.	Contents	
X 0	Data	2^0
X 1	〃	2^1
X 2	〃	2^2
X 3	〃	2^3
X 4	〃	2^4
X 5	〃	2^5
X 6	〃	2^6
X 7	〃	2^7
X 8	〃	2^8
X 9	〃	2^9
X A	〃	2^{10}
X B	〃	2^{11}
X C	〃	2^{12}
X D	〃	2^{13}
X E	〃	2^{14}
X F	〃	2^{15}
X 10	H/W normal	
X 11	KD71 ready	
X 12	X-axis servo unit error	
X 13	Y-axis servo unit error	
X 14	X-axis BUSY	
X 15	Y-axis BUSY	
X 16	X-axis zero point return demand	
X 17	Y-axis zero point return demand	
X 18	X-axis start completed	
X 19	Y-axis start completed	
X 1A	Battery error	
X 1B	Error detection	
X 1C	X-axis data	
X 1D	Y-axis data	
X 1E	Write-in completed	
X 1F	Readout completed	

Output Signals

I/O No.	Contents	
Y 0	Data	2^0
Y 1	〃	2^1
Y 2	〃	2^2
Y 3	〃	2^3
Y 4	〃	2^4
Y 5	〃	2^5
Y 6	〃	2^6
Y 7	〃	2^7
Y 8	〃	2^8
Y 9	〃	2^9
Y A	〃	2^{10}
Y B	〃	2^{11}
Y C	〃	2^{12}
Y D	〃	2^{13}
Y E	〃	2^{14}
Y F	〃	2^{15}
Y 10	X-axis designation	
Y 11	Y-axis designation	
Y 12	Interpolation start ⌐	
Y 13	X-axis start ⌐	
Y 14	Y-axis start ⌐	
Y 15	X-axis speed revision	
Y 16	Y-axis speed revision	
Y 17	X-axis zero point return start ⌐	
Y 18	Y-axis zero point return start ⌐	
Y 19	Parameter designation	
Y 1A	Zero point return data designation	
Y 1B	Positioning data designation	
Y 1C	Present value, torque, status	
Y 1D	Sequencer ready	
Y 1E	Write-in ⌐	
Y 1F	Readout ⌐	

Note) ⌐ indicates that this is effective at the signal's rise.

11-2 Signal exchange with sequencer

The method of signal exchange with the sequencer will be explained using a program example. The program example shown here is for reference use, and the entry and readout of settings data, revision of current value, speed revision, and readout of current value, torque, and status, all represent possible examples. Programs which are unnecessary for the system contents should be eliminated or abbreviated to enable the composition of a faster processing program.

Table 11.3 shows the numbers of the temporary memory M and data register D used in the program example. Programs for communication with the sequencer can be divided into the following:

(1) Entry of preset data.

(2) Readout of preset data.

(3) Readout of current value, torque, status.

(4) Current value revision.

(5) Speed revision.

(6) Start.

In communication with the KD71, the signal exchange programs listed above in 1~6 cannot be processed simultaneously. Always be sure that the program from the above list with the highest priority is executed.

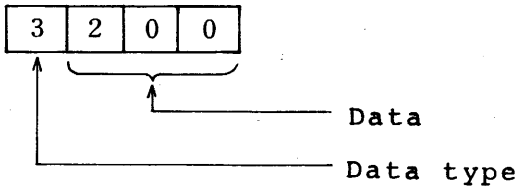
When performing the write-in or readout of preset data between the sequencer and KD71, the data type is appended when transferring the data. This is used for data discrimination when transmitting a large amount of data between the sequencer and KD71.

Table 11.2 Data types

Data designation / Data type	Y19	Y1A	Y1B	Y1C
	Parameter	Zero point return data	Positioning data	Present value, torque restriction
1	Acceleration / deceleration time	Zero point return mode	Data number	Present address upper order
2	Torque restriction	Zero point address (upper order)	Positioning address (upper order)	Present address lower
3	Backlash compensation	Present address (lower order)	Positioning address (lower order)	*Torque restriction value
4	Speed restriction (upper order)	Zero point return speed (upper order)	Speed (upper order)	*Status
5	Speed restriction (lower order)	Zero point return speed (lower order)	Speed (lower order)	
6	Upper stroke limit (upper order)	Zero point return creep speed (upper order)	Torque restriction	
7	Upper stroke limit (lower order)	Zero point return creep speed (Lower order)	Dwell time	
8	Lower stroke limit (upper order)	Torque restriction	Positioning pattern	
9	Lower stroke limit (upper order)	Dwell time		

*This indicates that only readout from the sequencer is possible. Other data can be entered or read.

Data discrimination is by the highest order digit of 4-digit data. Data transmission between KD71 ⟷ KCPU is performed by binary values. When transmitting data type 3 with data 200 as in the following case, the binary value 3000 (BB8H) and binary value 200 (C8H) are added to transmit the value 3200 (C80H).



Data designations for parameters, zero point return data, positioning, current value (torque restriction), should be designated with one of the codes Y19～Y1C from the sequencer.

Table 11.3 Signal exchange program using M, D

Data write-in program

	Setting data write-in				Present value revision		Speed revision
	Register	Parameter	Zero point return data	Positioning data			
Data register for Transfer data set use	D1	Accel/decel time	Zero point return mode	Data No.	D1	Present value upper order	D1 Speed
	D2	Torque restriction	Zero point address (upper order)	Address (upper order)	D2	Present value lower order	
	D3	Backlash	Zero point address (lower order)	Address (lower order)			
	D4	Speed restriction (upper order)	Zero point return speed (upper order)	Speed (upper order)			
	D5	Speed restriction (lower order)	Zero point return speed (lower order)	Speed (lower order)			
	D6	Upper SL (upper order)	Creep speed (upper order)	Torque restriction			
	D7	Upper SL (lower order)	Creep speed (lower order)	Dwell time			
	D8	Lower SL (upper order)	Torque restriction	Positioning pattern			
	D9	Lower SL (lower order)	Dwell time				
M for entry start	M0				M3		M6
M during entry	M1				M4		M7
D for write-in counter	D0				D0		
Entry completion pulse	M2				M5		
No. of program steps	Program example (1) 170		Example (2) 107		65		25
Communication time required	Program example (1) 18 scan		Example (2) 10 scan		4 scan		2 scan

Data readout program

	Setting data readout				Present value, torque, status readout
	Registar	Parameter	Zero point return data	Positioning data	
Data register for readout data set use	D1	Accel/decel time	Zero point return mode	Data No.	D1 Present value (upper order)
	D2	Torque restriction	Zero point address (upper order)	Address (upper order)	D2 Present value (lower order)
	D3	Backlash	Zero point address (lower order)	Address (lower order)	D3 Torque
	D4	Speed restriction (upper order)	Zero point return speed (upper order)	Speed (upper order)	D4 Status
	D5	Speed restruction (lower order)	Zero point return speed (lower order)	Speed (lower order)	
	D6	Upper SL (upper order)	Creep speed (upper order)	Torque restriction	
	D7	Upper SL (lower order)	Creep speed (lower order)	Dwell time	
	D8	Lower SL (upper order)	Torque restriction	Positioning pattern	
	D9	Lower SL (lower order)	Dwell time		
M for READ start	M 9				M12
M during read	M10				M13
D for readout counter	D 0				D0
Read completion pulse	M11				M14
Axis designation flag					M 8
Number of program steps	133				135
Communication time required	18 scan				16 scan

11-3 Writing in preset data

The method for entering paramerers, zero point return data, and positioning data from the sequencer to the KD71 is as follows:

11-3-1 Entry method

(1) Perform axis designation for X- or Y-axis.

X-axis designation.....Y10

X-axis designation Y11

(2) Designate either parameter, zero point return data, or positioning data.

Parameter.....Y19

Zero point return data.....Y1A

Positioning data.....Y1B

(3) Output setting data to Y0～YF. You should be aware of the following rules:

1 Always add data type to the preset data (refer to section 11-2).

2 When writing in positioning data, enter the data number first.

3 Data composed of 6 decimal digits are entered continuously with 3 upper-order digits and 3 lower-order digits. It does not matter in which order the entry of upper-order and lower-order is executed.

4 Entry of paramerers cannot be performed when the KCPU ready signal (Y1D) is ON.

(4) After output of the above (1)～(3), set the WRITE signal Y1E to ON. It does not matter in which order (1)～(3) are performed.

11-3-2 Write-in timing

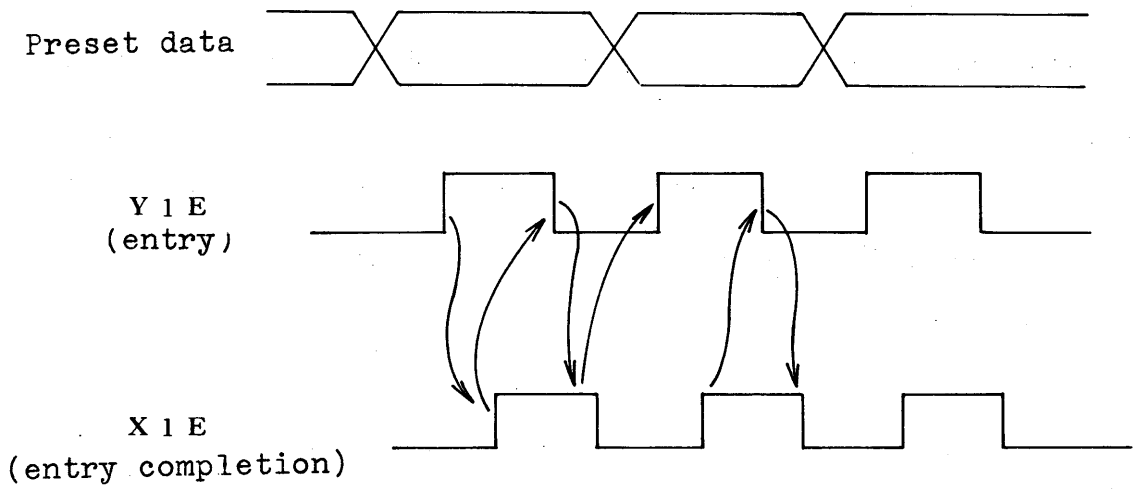


Fig. 11.1 Data entry timing

(1) After transmission of preset data, set WRITE signal (Y1E) to ON.

(2) The KD71 enters the preset data at the rise of the WRITE signal, and the entry completion signal (X1E) is turned ON.

(3) After confirming that the entry completion signal (X1E) is ON, set the entry signal (Y1E) to OFF.

(4) At the fall of the entry signal (Y1E), the entry completion signal (X1E) will be turned OFF in the KD71.

11-3-3 Example of a preset data entry program

This program has been constructed under the following conditions:

(1) Data registers corresponding to data types have been allocated as shown below, automatically adding the data types listed below to the program.

Data register number	D1	D2	D3	D4	D5	D6	D7	D8	D9
Data type	1	2	3	4	5	6	7	8	9

(2) The contents of D1∼D9 are transmitted in order, and data register D0 is used as a transfer counter for transfer order control.

(3) Temporary memory M0 is made into a pulse and used for transfer demand signal.

(4) After setting the preset data in D1∼D11, and designating the axis and either parameter zero point return data, or positioning data, set the transfer demand signal M0 to ON.

(5) Program example (1) is an example of a program which can enter either parameters, zero point return data, or positioning data.

(6) In program example (2), once the torque restriction, dwell time, and position pattern (of the parameters, zero point return data, and positioning data) have been written in by the KD71TU and are in the entry completion status, data numbers are designated, and the positioning address and speed only are written in.

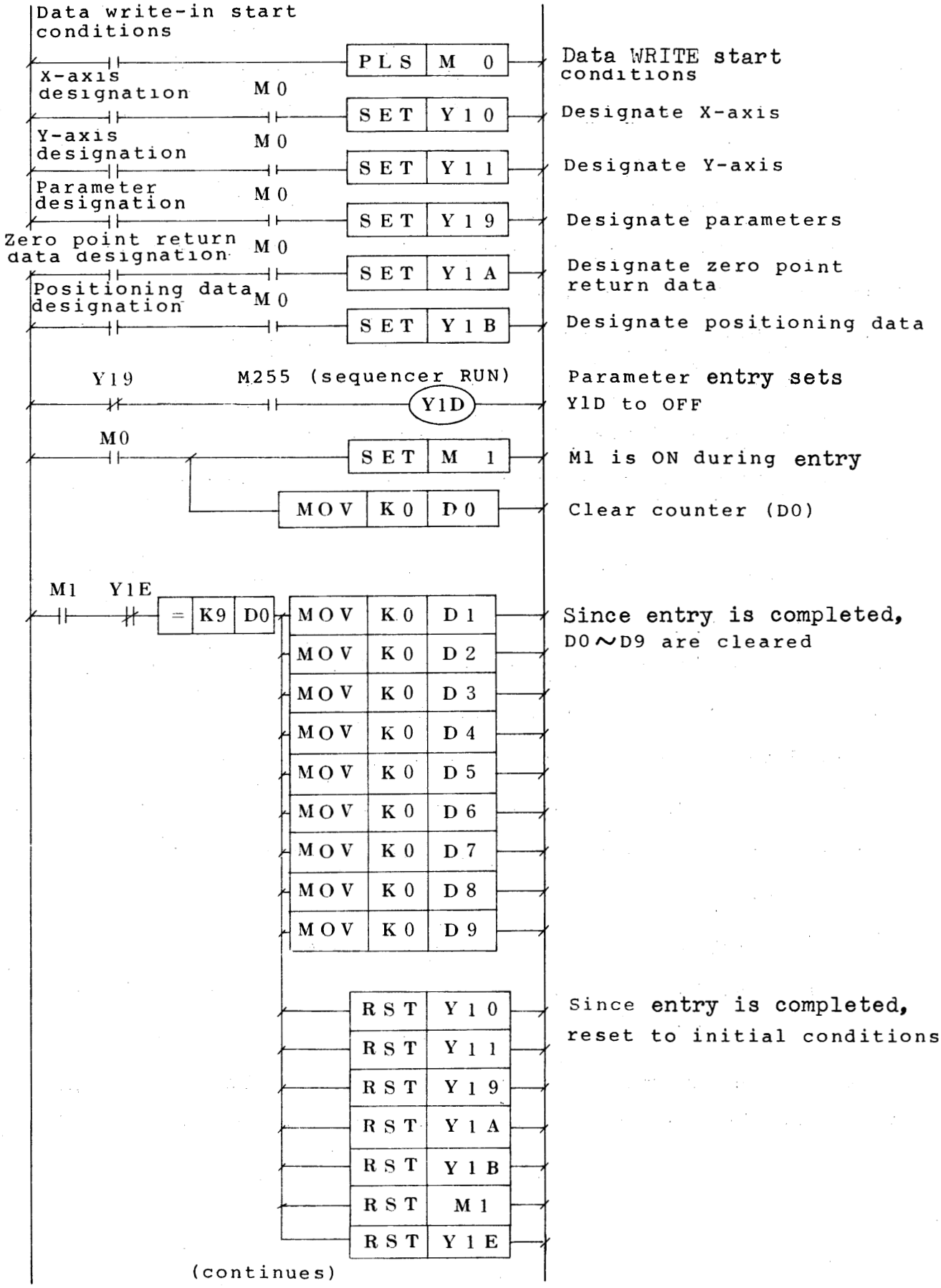
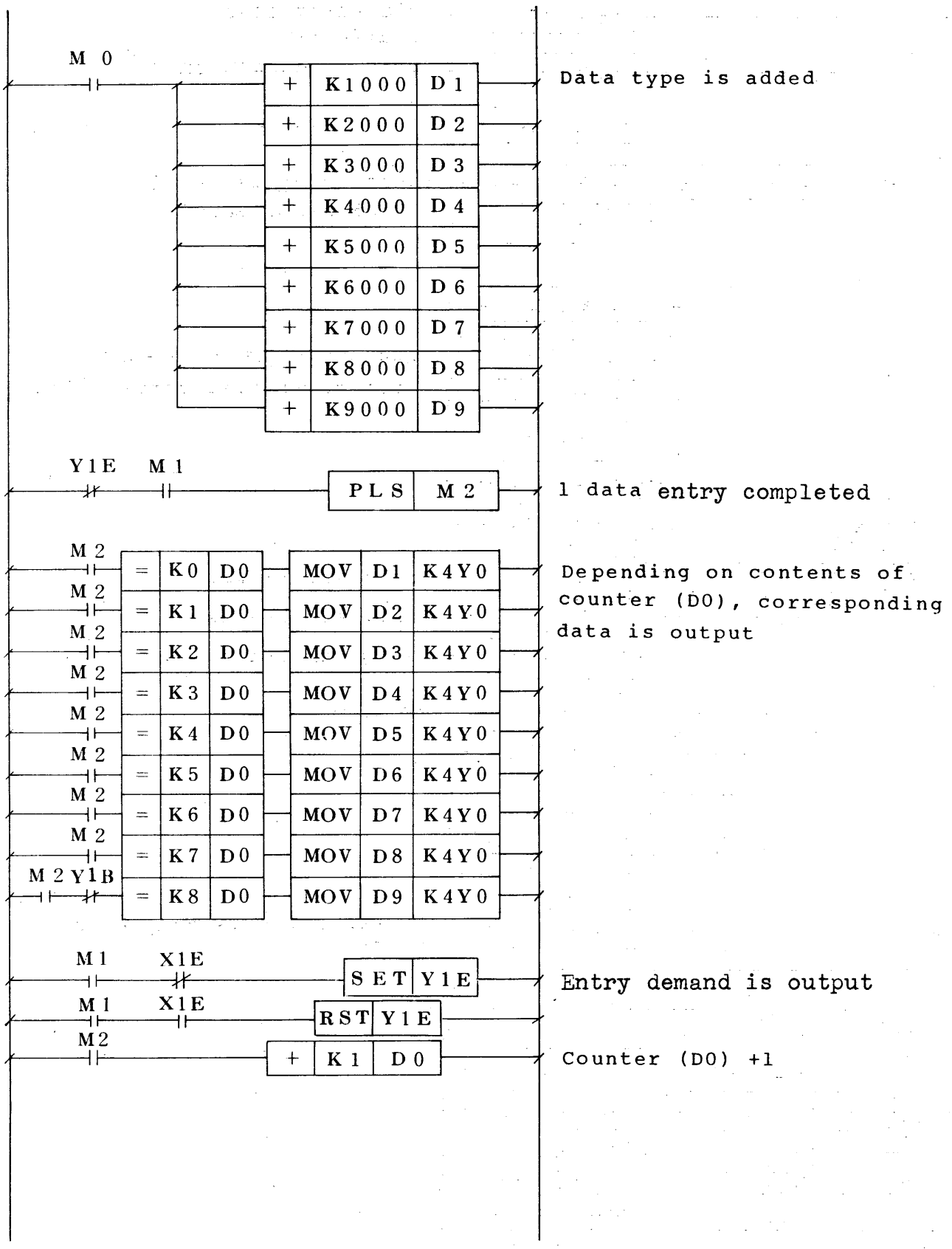


Fig. 11.2 Example of settings data write-in program (1)



Example of preset data entry program (1) (continuation)

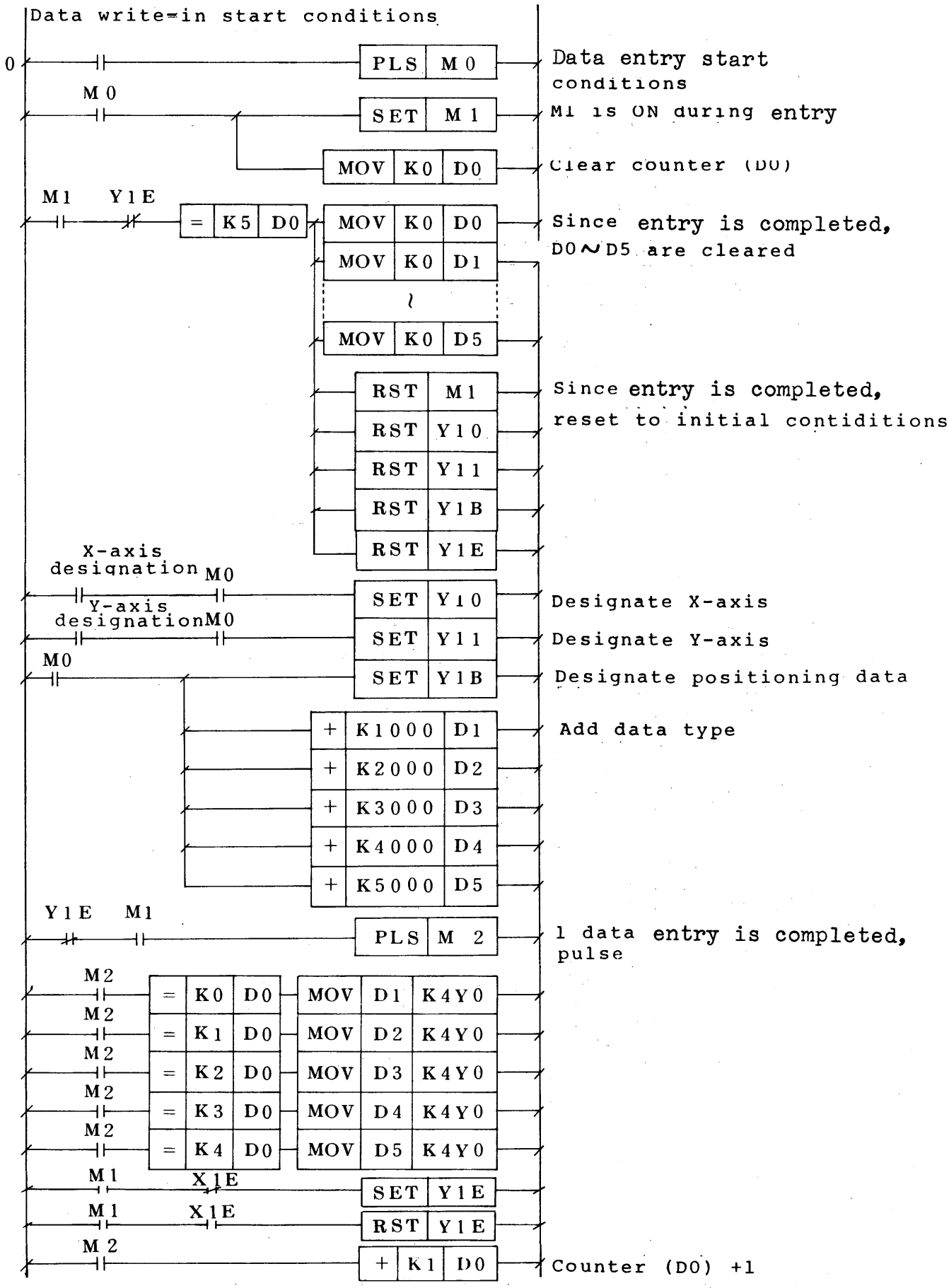


Fig. 11.3 Example of preset data entry program (2)

11-4 Readout of preset data

The method for reading out parameters, zero point return data, and positioning data from the KD71 is as explained below.

11-4-1 Readout method

(1) Perform axis designation for X- or Y-axis.

X-axis designation.....Y10

Y-axis designation.....Y11

(2) Designate either parameters, zero point return data, or positioning data.

Parameters.....Y19

Zero point return da-a.....Y1A

Positioning data.....Y1B

(3) Output readout data type to Y0～YF. Refer to section 11-2 for data types. In the case of positioning data, it is necessary to designate data numbers as well as data type.

(4) After the output of the above (1)～(3), set readout signal Y1F to ON. It does not matter in what order (1)～(3) are executed.

(5) Readout data is output to X0 XF. You should be aware of the following rules:

1 Data composed of 6 decimal digits are readout continuously with 3 upper-order digits and 3 lower-order digits. Only in the case of current value should the upper-order digits be readout first.

2 It does not matter whether the KCPU RUN signal (Y1D) is ON or OFF.

11-4-2 Readout timing

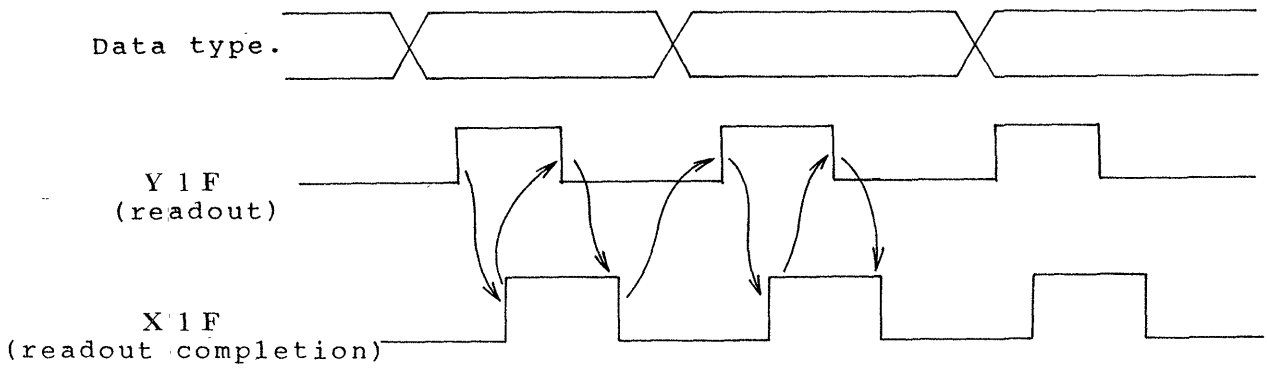


Fig. 11.4 Data readout timing.

(1) After transmission of data type, readout signal(Y1E) is turned ON.

(2) After reading the values indicated by data type at the rise of the readout signal, the KD71 turns the readout completion signal (X1F) ON.

(3) After confirming that the readout completion signal (X1F) is ON, turn the readout signal (Y1F) OFF.

(4) At the fall of the readout signal (Y1F), the readout completion signal (X1F) is turned OFF in the KD71.

11-4-3 Example of preset data readout program

The program was constructed under the following conditions:

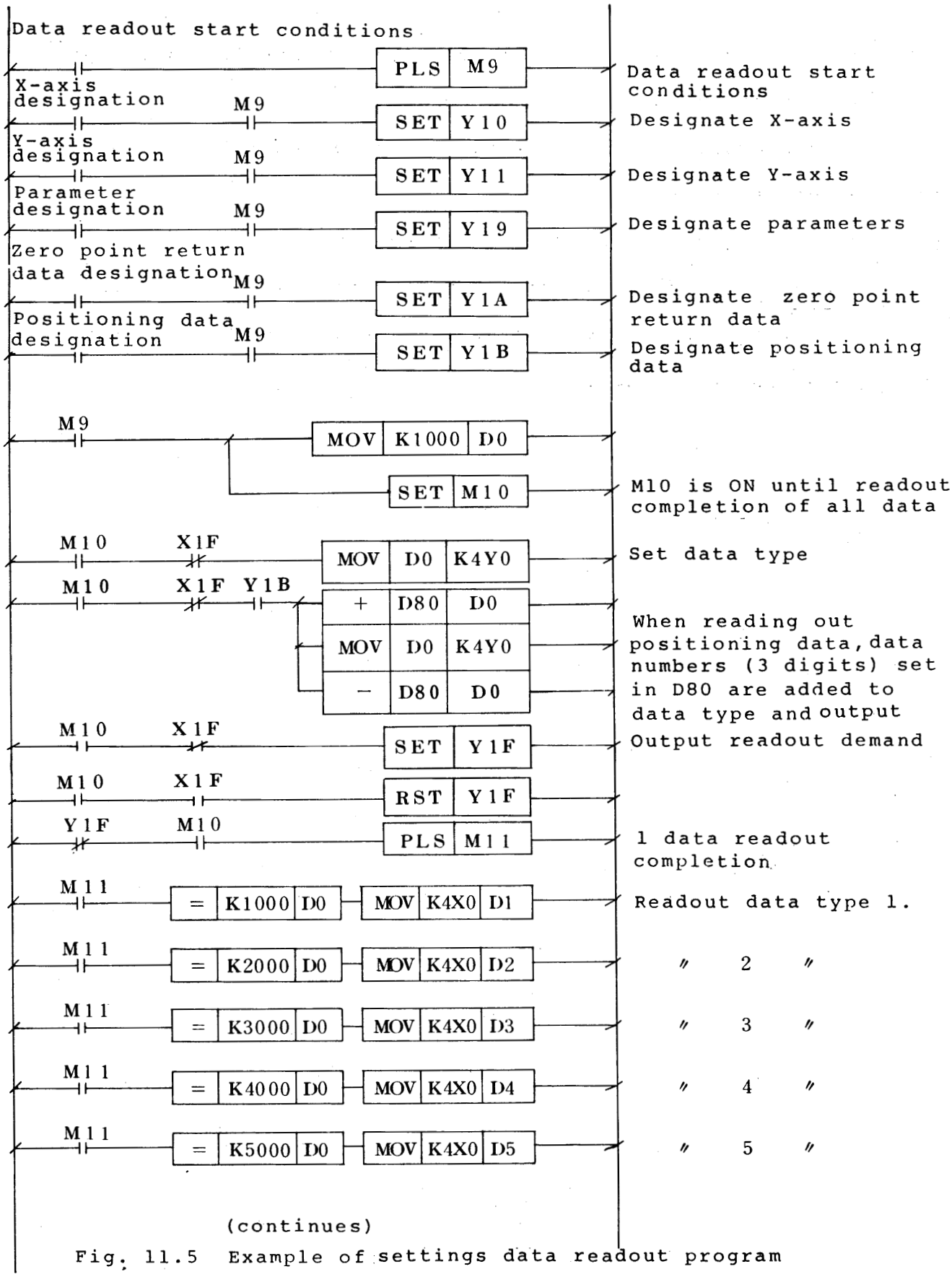
(1) The readout data corresponding to the data types is stored in the following data registers.

Data register no	D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9
Data type	1	2	3	4	5	6	7	8	9

(2) Data register D0 is used as transfer counter for data type transmission and transfer order control.

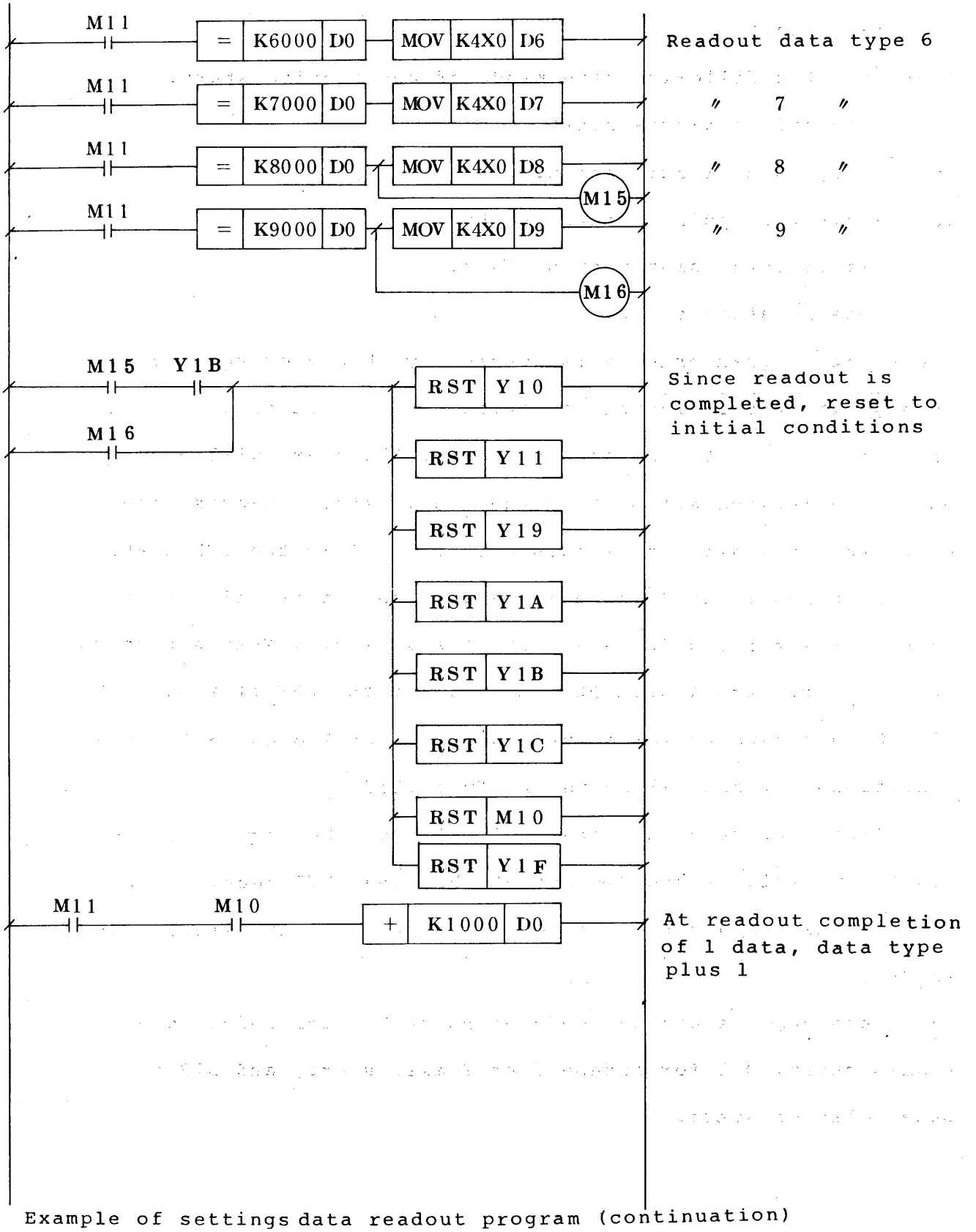
(3) The temporary memory M9 is made into pulses and used for transfer demand signal.

(4) After designating the axis and either parameters, zero point return data or positioning data, turn the readout demand signal M9 ON. In the case of positioning data, the desired readout data number is set in D80.



(continues)

Fig. 11.5 Example of settings data readout program



Example of settings data readout program (continuation)

11-5 Start

There are the following five kinds of positioning start:

(a) Independent X-axis start.

(b) Independent Y-axis start.

(c) X-axis zero point return start.

(d) Y-axis zero point return start.

(e) Interpolation start.

The start program example is possible with any of the above types, with the following conditions as prerequisites :

(1) With regard to (a) and (c) above, the start will occur only when interpolation start and X-axis start, X-axis zero point return start, and X-axis BUSY are all in the OFF status.

(2) With regard to (b) and (d) above, the start will occur only when interpolation start and Y-axis start, Y-axis zero point return start, and Y-axis BUSY are all in the OFF status.

(3) With regard to (e) above, the start will occur only when conditions (1) and (2) above are fulfilled.

(4) After output of the start signal from the sequencer, the start completion signal is output when the KD71 receives the start signal, and continues to be output until the start signal is OFF.

(5) Data numbers are set beforehand at D20 for independent X-axis start, D21 for independent Y-axis start, and D22 for interpolation start.

(6) Operation timing at time of start is shown in Fig. 11.6.

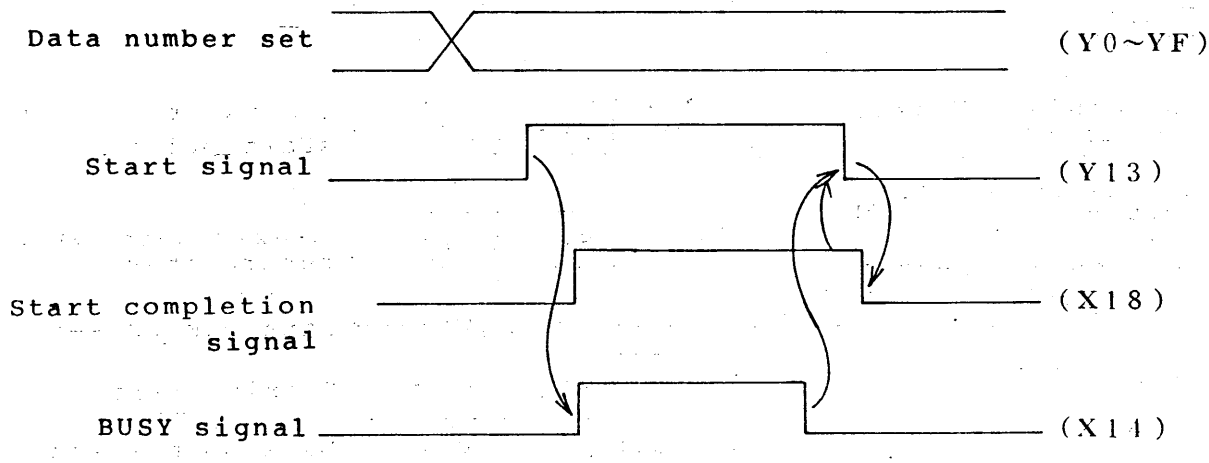


Fig. 11.6 Start operation timing
(signal names indicate X-axis)

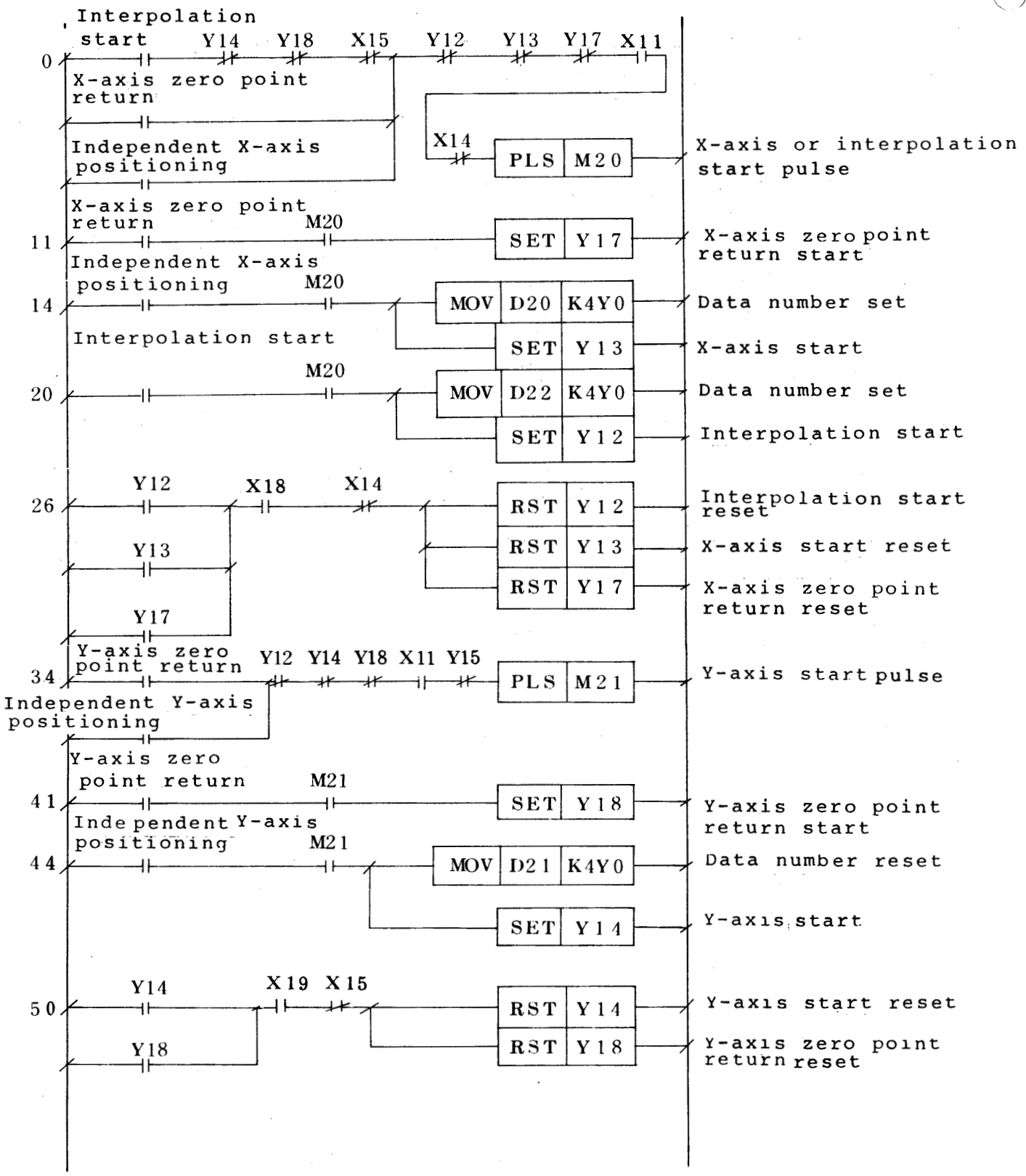


Fig. 11.7 Example of positioning start program

11-6 Readout of current value, torque, and status

This is a program for reading out the current value, torque, and status of the X-axis and Y-axis. While the various programs listed thus far--including preset data write-in, current value revision, speed revision, preset data readout, and start--are not running, the X- and Y-axis data are alternately read-out, and the x-axis data is stored in D88~D91, while the Y-axis data is stored in D92~D95.

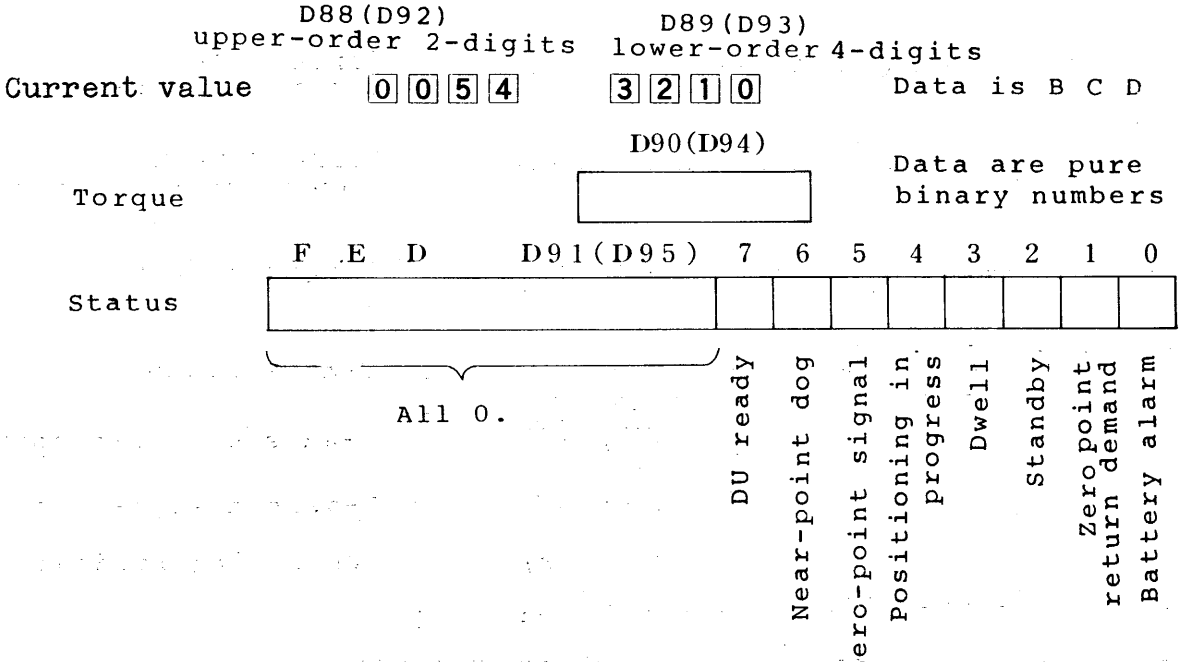
Current value, torque, and status readout programs are constructed with the following conditions as prerequisites:

(1) The temporary memory M8 is used as axis designation flag.

(2) Data register D0 is used for data type designation and read-out counter.

(3) Data registers D1~D4 are used as buffer registers for readout data.

(4) Readout data is stored as shown in the following. ( ) indicates Y-axis.



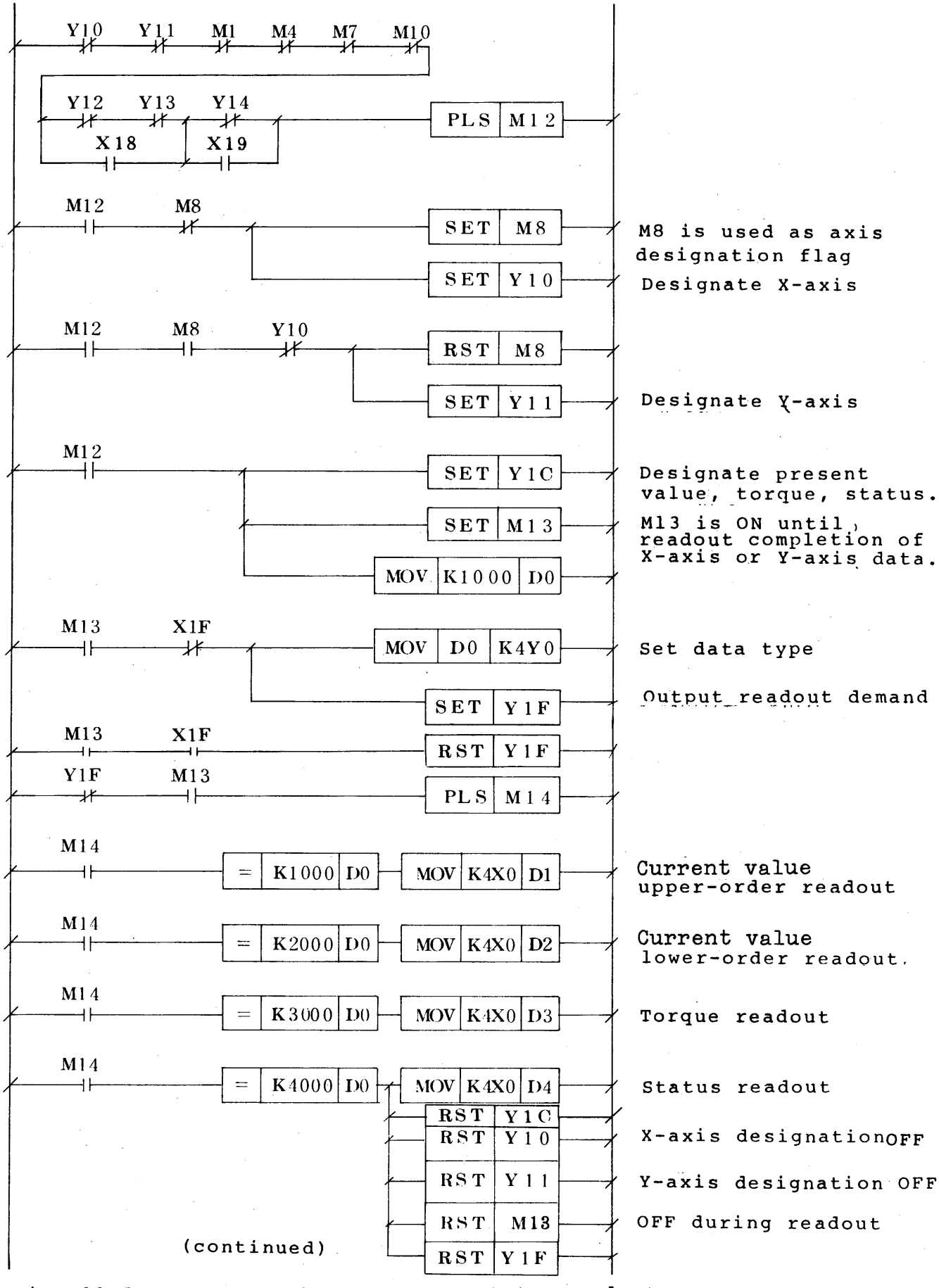
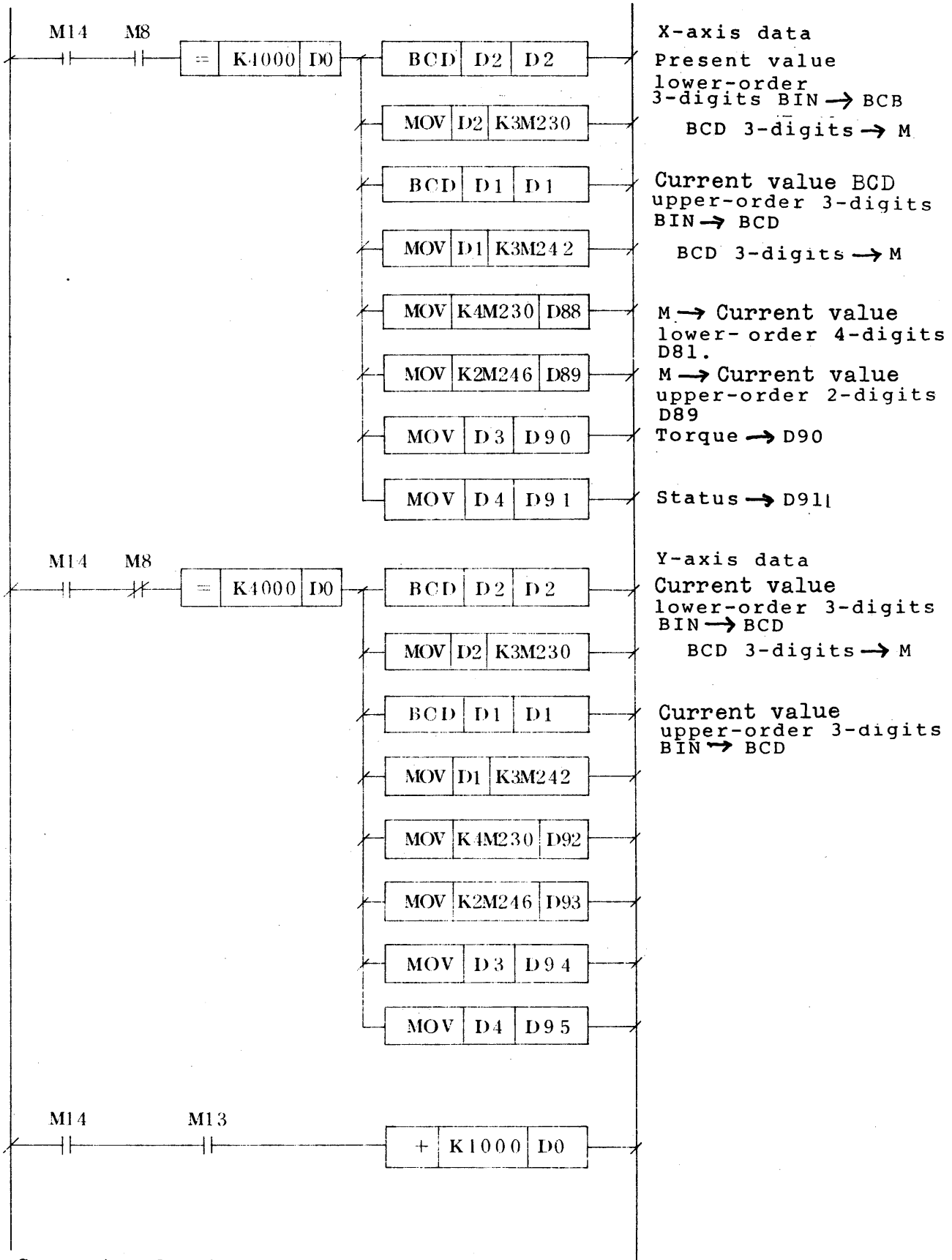


Fig. 11.8 Present value, torque, status readout

(5) M230 M253 are used for present value data, upper order 3-digits, lower-order 3-digits → upper-order 2-digits, lower-order 4-digits conversion.



Current value , torque, status readout (continuation)

11-7 Revision of current value

This is a program for writing into the KD71 the current values set in data registers D1 (current value, upper-order 3-digits) and D2 (current value, lower-order 3-digits). Do not perform current value revision during the execution of positioning operations.

11-8 Speed revisions

This revises the positioning speed to that set in data register D1. Speed revision is effective during the execution of positioning operations.

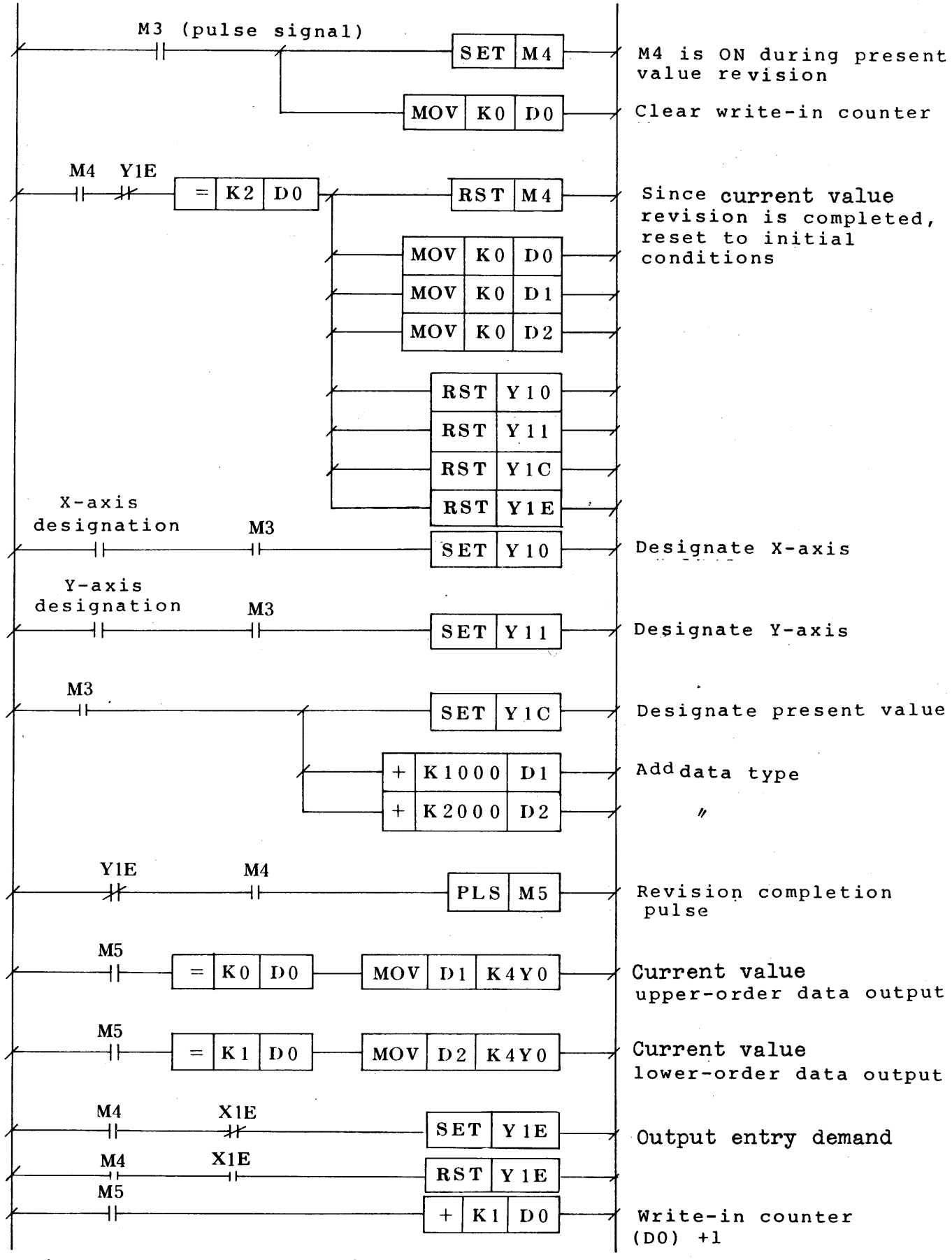


Fig. 11.9 Present value revision program

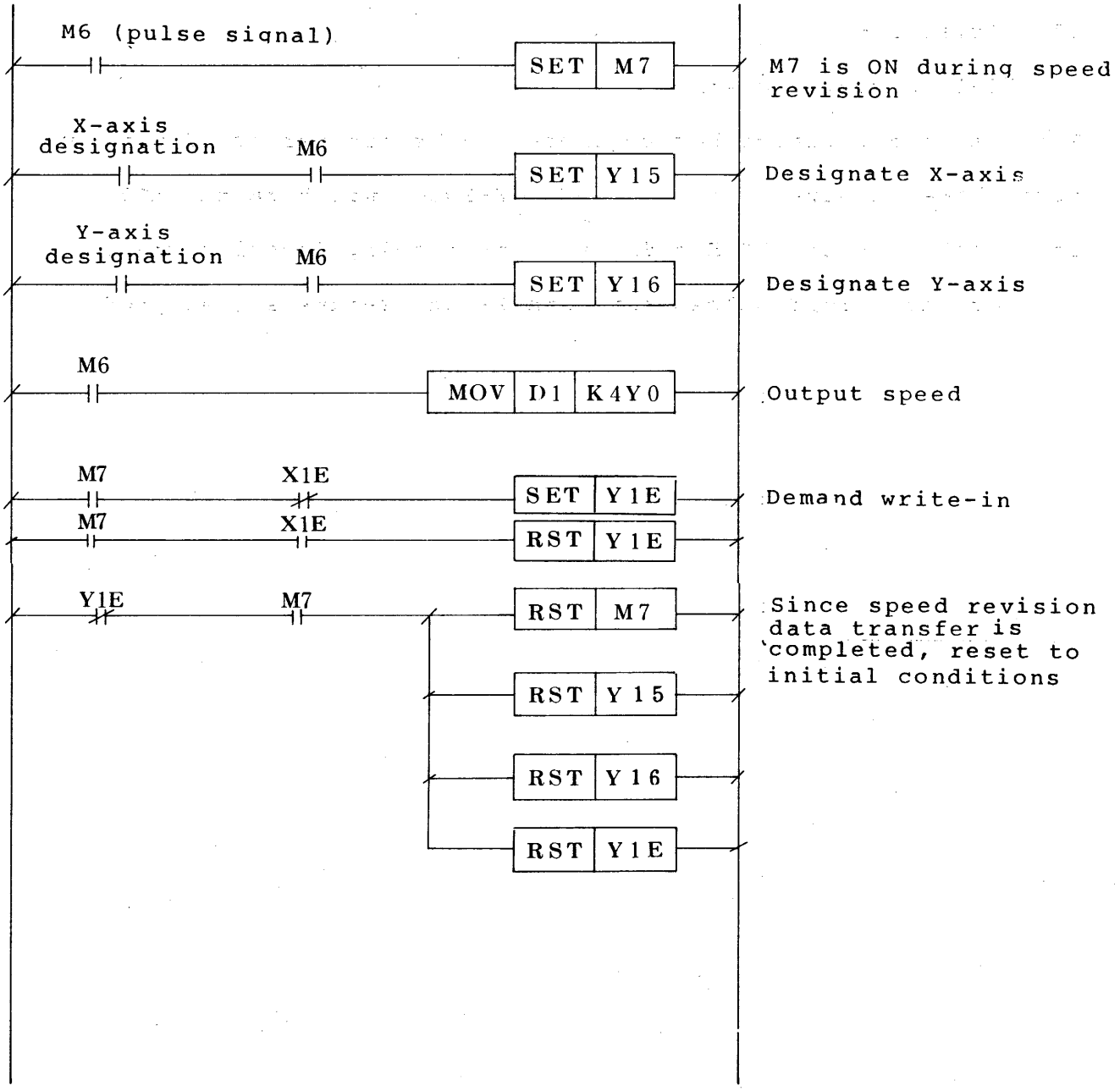
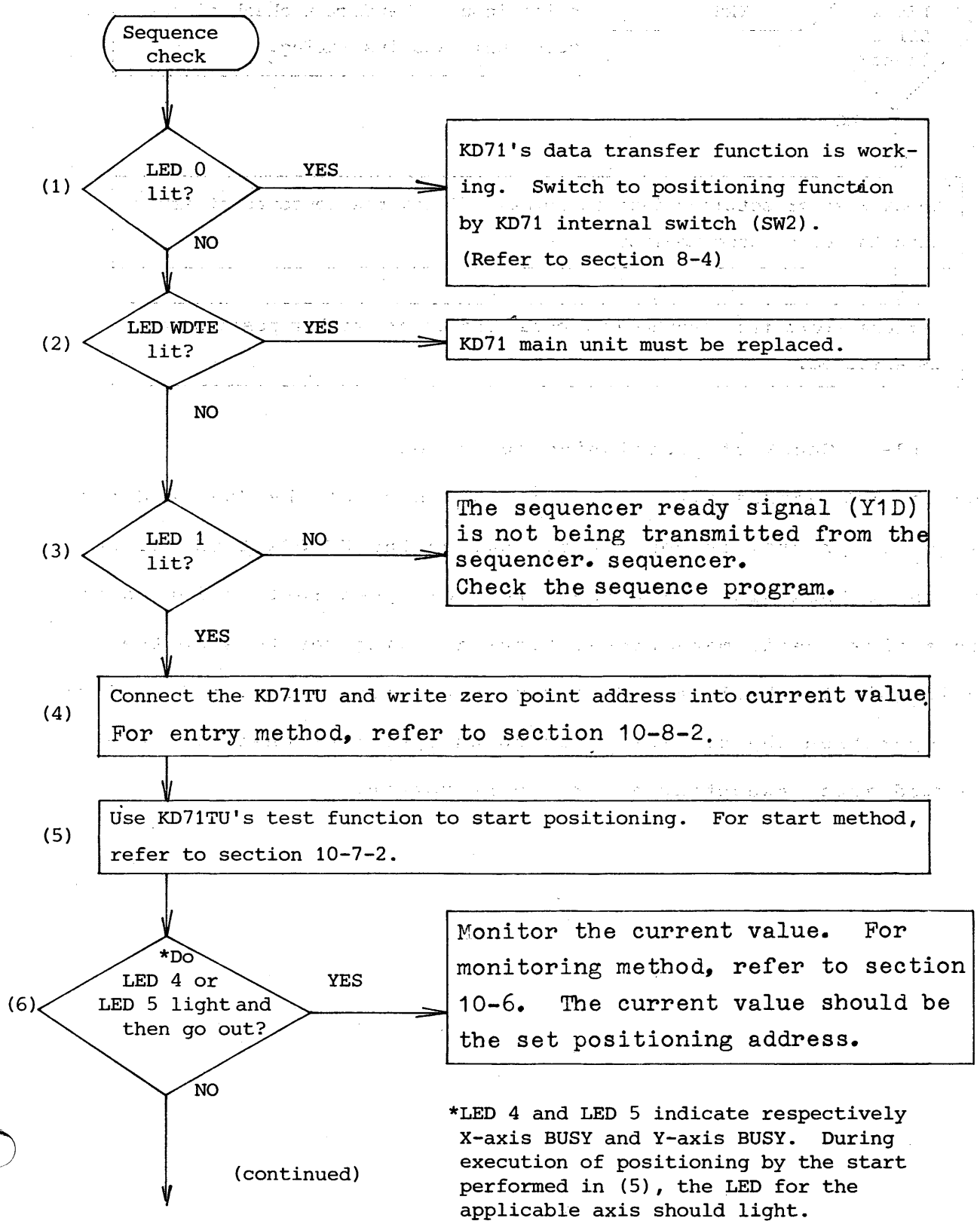


Fig. 11.10 Speed revision

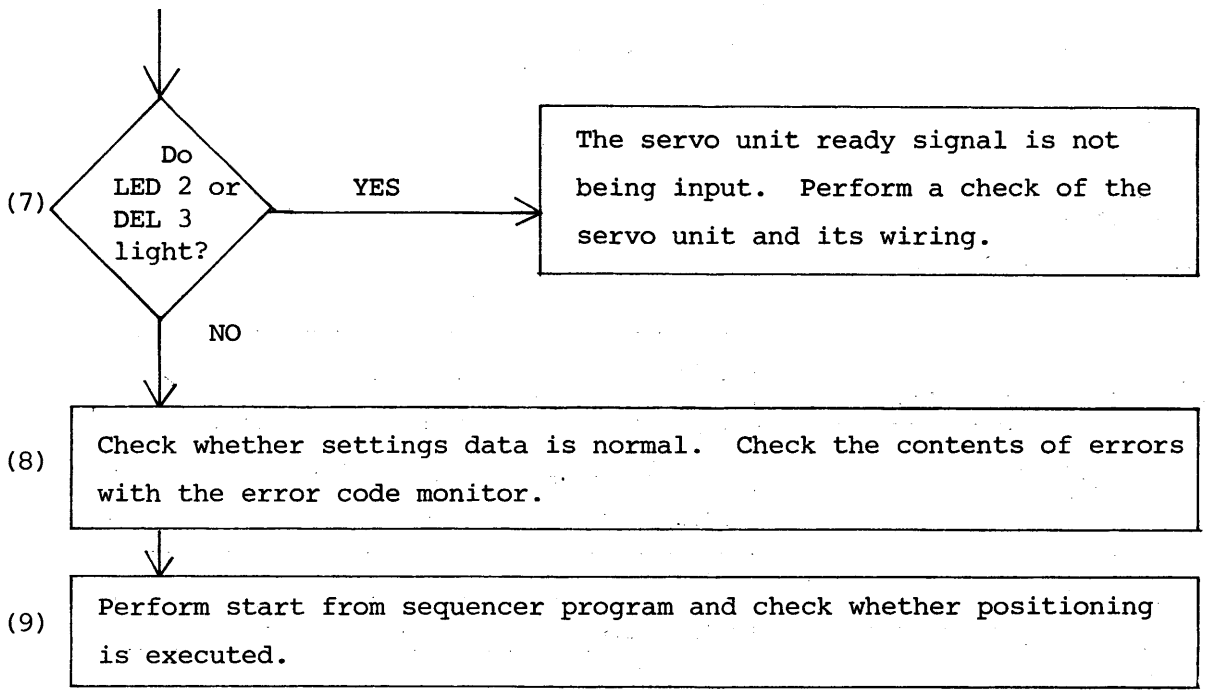
12. Trial run

12-1 Sequence checks

This section explains how sequence checks are performed without moving the machine. When the UNLOCK-LOCK switch on the KD71 is switched to the LOCK side, the positioning function can be checked while feed pulses for both X- and Y-axes are stopped.



*LED 4 and LED 5 indicate respectively X-axis BUSY and Y-axis BUSY. During execution of positioning by the start performed in (5), the LED for the applicable axis should light.



12-2 Check of positioning operation

By the procedures given in 12-1, the check of the KD71 and the sequence program is completed. Switch the UNLOCK-LOCK switch to the UNLOCK side. Set the parameter speed restriction value to a slow speed, make preparations allowing you to stop the unit quickly should any dangerous conditions arise, and perform an operation check. The positioning operation check is performed after executing a zero point return.

13. Error code displays and their rectification

Error code displays are the easiest means of discovering faulty conditions in the KD71. Check the contents of the error, and upon ascertaining the cause of the malfunction, remedy it.

13-1 Error code display

Error codes can be read form the KD71TU. For operating procedures, refer to section 10-6.

13-2 Error code chart

Error code	Division	Contents and remedy	
0	-	Normal	
1	KCPU write-in processing	No designation for parameter, zero point return data, positioning data, or status. With a plurality ON, assign a priority to the above data and perform write-in.	
2		During parameter write-in, sequencer ready signal (Y1D) is ON. Parameter write-in can be performed only when Y1D is OFF.	
3		X-axis	Parameter continuous write-in is faulty. When writing in speed restriction or stroke limit, Y-axis designation or data other than parameters was designated.
4			Zero point data cannot be written in during execution of zero point return.
5			Continuous write-in of zero point return data is faulty. When writing in zero point address, zero point return speed, or zero point creep speed, Y-axis designation or data other than zero point return data was designated.
6			Continuous write-in of positioning data is faulty. When writing in positioning address and speed, Y-axis designation or data other than positioning data was designated.
7		Y-axis	Continuous write-in of parameters is faulty.
8			Zero point data cannot be written in during execution of zero point return.
9			Continuous write-in of zero point return data is faulty.
10			Continuous write-in of positioning data is faulty.
11		No axis designation. Neither X-axis nor Y-axis designated. If X-axis and Y-axis are both designated, data will be processed as Y-axis data.	

Error code	Division	Contents and remedy	
12		X-axis current value continuous write-in is faulty. Write-in upper-order data and lower-order data continuously.	Current value write-in is in standby state. (Perform when BUSY signal is OFF)
13		Y-axis present value continuous write-in is faulty. Write-in upper-order data and lower-order data continuously.	
20	KCPU write-in processing (parameters)	Abnormal data type designation. Data type other than 1 ∿ 9.	
21		Accel/decel time outside of range 10 ∿ 999.	
22		Torque restriction value outside of range 10 ∿ 250.	
23		Backlash compensation outside of range 0 ∿ 255.	
24		Speed restriction continuous data write-in is faulty. Write-in upper-order and lower-order continuously.	
25		Speed restriction value in excess of 100000.	
26		Upper stroke limit continuous data write-in is faulty. Write-in upper-order and lower-order continuously.	
27		Lower stroke limit continuous data write-in is faulty. Write-in upper-order and lower-order continuously.	
30	Start processing	Does not start since STOP input is LOW at time of X-axis zero point return start.	
31		Does not start since STOP input is LOW at time of Y-axis zero point return start.	
32		X-axis start does not occur since STOP input is LOW.	
33		Y-axis start does not occur since STOP input is LOW.	
34		Interpolation start does not occur since X-axis or Y-axis STOP input is at LOW.	

Error code	Division	Contents and remedy
40	KCPU Write-in processing (zero point return data)	Data type designation faulty. Data type other than 1 ∿ 9.
41		Zero point return mode designation faulty. Mode designation other than 000, 010, 100, 101. (refer to section 7-2-1.)
42		Address continuous data write-in is faulty. Write in upper-order and lower-order data continuously.
43		Zero point return speed data write-in is faulty. Write in upper-order and lower-order data continuously.
44		Zero point return speed setting value exceeds 100000.
45		Creep speed continuous data write-in is faulty. Write in upper-order and lower-order data continuously.
46		Creep speed setting value exceeds 100000.
47		Torque restriction value outside of range 10 ∿ 250.
48		Dwell time setting value exceeds 999.
50	KCPU write-in processing (present value)	Faulty data type code. Data type other than 1 or 2.
51		Continuous data write-in is faulty. Write in upper-order, and lower-order data continuously.
53	KCPU write-in processing	KCPU write-in data is abnormal. — Receipt of data incapable of binary BCD conversion.
54	KCPU write-in processing	KCPU readout data is abnormal.
55		At rise of sequencer ready signal (U1D), either X- or Y-axis is in process of start.
56	Start processing	X-axis identical data No. start — Start is not possible when data No. identical to that of previous start is designated.
57		Y-axis identical data No. start
58		Interpolation identical data No. start

Error code	Division	Contents and remedy
60	KCPU write-in processing (positioning data)	Faulty data type code. Data type other than 1 ∿ 8.
61		Data No. exceeds 399.
62		Address continuous write-in is faulty. Write in data with upper-order and lower-order continuous.
63		No data number designation. At time of positioning data write-in, data number is written in first, followed by other data write-in.
64		Speed continuous write-in is faulty. Write in data with upper-order and lower-order continuous.
65		Speed preset value exceeds 100000.
66		Torque restriction value outside of range 10 ∿ 250.
67		Dwell time preset value exceeds 999.
68		Positioning pattern setting value other then 00, 01,11.
70	KCPU Readout processing	No axis designation. Neither X- nor Y-axis is designated. If both X- and Y-axes are designated, data will be processed as that of Y-axis.
71		No designation of parameters, zero point return data, positioning data, or status. With a plurality ON, assign an order of priority to above items and perform readout.
72		Abnormal parameter, data type code. Data type other than 1 ∿ 9.
73		Abnormal zero point return data, data type code. Data type other than 1 ∿ 9.
74		No designation of positioning data, data number. When performing readout of positioning data, readout data number and data type is designated.

Error code	Division	Contents and remedy
75		Abnormal data type code. Data type other than 1 ∿ 8.
76		Data number exceeds 399.
77		At time of status readout, data type other than 1 ∿ 4.
80	Speed revision processing	Speed preset value exeeds 9999.
81	Start processing	X-axis designation data number exceeds 399.
82		More than 10 change pattern preset data.
83		Different direction designation within change pattern setting data.
84		Y-axis preset data number exceeds 399.
85		Interpolation preset data number exceeds 399.
86		Non-matching pattern at time of interpolation start. During interpolation run, X-axis and Y-axis pattern designation must be a matching 00 or 01.
87		Exceeds range of stroke limit. Positioning data address must be lower than upper stroke limit and higher than lower stroke limit set by parameters.
88		At time of X-axis start, sequencer ready signal (Y1D) is OFF.
89		At time of Y-axis start, sequencer ready signal (Y1D) is OFF
90		At time of interpolation start, sequencer ready signal (Y1D) is OFF.
91	Speed revision processing	Speed revision not possible during interpolation start. Speed revision cannot be performed during interpolation run.

Error code	Division	Contents and remedy
93	Start processing	Pattern setting of data number 399 is other than 00. Positioning pattern for continuous positioning, change pattern setting cannot be set in data number 399.
94	Memory clear	Memory clear not possible during X-axis or Y-axis BUSY.
95	Start processing	At time of interpolation start, X-axis or Y-axis is BUSY.
96		At time of X-axis start, X-axis is BUSY.
97		At time of Y-axis start, Y-axis is BUSY.
98		At time or X-axis zero point return start, X-axis is BUSY.
99		At time of Y-axis zero point return start, Y-axis is BUSY.
110	KD71TU Write-in, readout processing	Transfer error. Data transfer error between KD71 and KD71TU. Check for proper connection at connector.
112		At time of parameter write-in sequencer ready signal (Y1D) is ON. Parameter write-in is possible only when Y1D is OFF.
113		Setting value lower limit error. Settings data is less than permissible values.
114		Setting value upper limit error. Settings data is greater than permissible values.
115	KD71TU Start processing	X-axis start not possible. Start not possible since STOP input is set at LOW.
116		Y-axis start not possible. Start not possible since STOP input is set at LOW.
117	Data transfer	DCPU ↔ KD71 data transfer not possible. Data transfer is possible when selector switch SW2-C is OFF.
118	KD71TU Start processing	X-axis start not possible. Start is not possible when X-axis is BUSY or when READY input is on HIGH.

Error code	Division	Contents and remedy	
119	KD71TU Present value monitor	Current value is outside of range 0 ∿ 999999. Perform zero point return or correct present value from KD71TU.	
120	KD71TU Start processing	Y-axis start not possible. Start is not possible when Y-axis is BUSY or when READY input is on HIGH.	
121		X-axis identical data number start.	Start is not possible when data No. identical to that of previous start is designated.
122		Y-axis identical data number start.	
123		Interpolation identical data number start.	
125	KD71TU Start processing	Sequencer ready signal (Y1D) is OFF.	

14. Safety measures

Safety measures are an important part of the use, and system design of the positioning unit KD71. Please observe the following precautions:

(1) Perform zero point return after turning on the power and when starting operations.

(2) Perform zero point return when the zero point return demand signal is output from the KD71.

(3) Be sure that the upper stroke limit and lower stroke limit values are set at appropriate values.

(4) Be sure that the parameter speed restriction value is set appropriately.

(5) Do not set JOG speed initially at a large value. Perform operations at a moderate speed.

(6) The speed for interpolation operation is set as explained in section 6-2. Accordingly, in order to operate at a speed lower than the preset speed of either axis, set both axes preset speed identically.

(7) Use a high-reliability contact for the limit switch in the near-point dog. If the near-point dog signal is not received during zero point return, movement will continue at zero point return speed.

(8) The STOP input signal is the stop signal for normal operating stops, and should not be used as an emergency stop signal.

(9) When checking for abnormal operations in the sequencer program, if an abnormality is detected, turn the sequencer ready signal (Y1D) OFF.

(10) Stops initiated by the stroke end signal from the limit switch attached at the end of the machine stroke, and stops initiated by emergency stop signal, should be confirmed on the drive unit side.

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