HITACHI PROGRAMMABLE CONTROLLER

EH-150

4 AXES PULSE POSITIONING CONTROL MODULE

EH-POS4
INSTRUCTION MANUAL

NJI-409DX

○ Warranty period and coverage

The warranty period is the shorter period either 18 months from the date of manufacture or 12 months from the date of installation.
However within the warranty period, the warranty will be void if the fault is due to;

(1) Incorrect use as directed in this manual and the application manual.
(2) Malfunction or failure of external other devices than this unit.
(3) Attempted repair by unauthorized personnel.
(4) Natural disasters.

The warranty is for the PLC only, any damage caused to third party equipment by malfunction of the PLC is not covered by the warranty.

○ Repair

Any examination or repair after the warranty period is not covered. And within the warranty period any repair and examination which results in information showing the fault was caused by any of the items mentioned above, the repair and examination cost are not covered. If you have any questions regarding the warranty please contact either your supplier or the local Hitachi Distributor. (Depending on failure part, examination might be impossible.)

○ Ordering parts or asking questions

When contacting us for repair, ordering parts or inquiring about other items, please have the following details ready before contacting the place of purchase.

(1) Model
(2) Manufacturing number (MFG no.)
(3) Details of the malfunction

Safety Precautions

Read this manual and related documents thoroughly before installing, operating, performing preventive maintenance or performing inspection, and be sure to use the unit correctly. Use this product after acquiring adequate knowledge of the unit, all safety information, and all cautionary information. Also, make sure this manual enters the possession of the chief person in charge of safety maintenance.
Safety caution items are classified as “Danger” and “Caution” in this document.

DANGER : Cases where if handled incorrectly a dangerous circumstance may be created, resulting in possible death or severe injury.

CAUTION : Cases where if handled incorrectly a dangerous circumstance may be created, resulting in possible minor to medium injury to the body, or only mechanical damage.

However, depending on the circumstances, items marked with CAUTION may result in major accidents.

In any case, they both contain important information, so please follow them closely.

Icons for prohibited items and required items are shown below:

: Indicates prohibited items (items that may not be performed). For example, when open flames are prohibited, is shown.

: Indicates required items (items that must be performed). For example, when grounding must be performed, is shown.

1. About installation

⚠ CAUTION

- Use this product in an environment as described in the catalog and this document.
  If this product is used in an environment subject to high temperature, high humidity, excessive dust, corrosive gases, vibration or shock, it may result in electric shock, fire or malfunction.
- Perform installation according to this manual.
  If installation is not performed adequately, it may result in dropping, malfunction or an operational error in the unit.
- Do not allow foreign objects such as wire chips to enter the unit.
  They may become the cause of fire, malfunction or failure.

2. About wiring

REQUIRED

- Always perform grounding (FE terminal).
  If grounding is not performed, there is a risk of electric shocks and malfunctions.

⚠ CAUTION

- Connect power supply that meets rating.
  If a power supply that does not meet rating is connected, fire may be caused.
- The wiring operation should be performed by a qualified personnel.
  If wiring is performed incorrectly, it may result in fire, damage, or electric shock.

3. Precautions when using the unit

⚠ DANGER

- Do not touch the terminals while the power is on.
  There is risk of electric shock.
- Structure the emergency stop circuit, interlock circuit, etc. outside the programmable controller (hereinafter referred to as PLC).
  Damage to the equipment or accidents may occur due to failure of the PLC.
  However, do not interlock the unit to external load via relay drive power supply of the relay output module.

⚠ CAUTION

- When performing program change, forced output, RUN, STOP, etc., while the unit is running, be sure to verify safety.
  Damage to the equipment or accidents may occur due to operation error.
- Supply power according to the power-up order.
  Damage to the equipment or accidents may occur due to malfunctions.

4. About preventive maintenance

DANGER
• Do not connect the ⊕, ⊖ of the battery in reverse. Also, do not charge, disassemble, heat, place in fire, or short circuit the battery. There is a risk of explosion or fire.

PROHIBITED
• Do not disassemble or modify the unit. These actions may result in fire, malfunction, or malfunction.

CAUTION
• Turn off the power supply before removing or attaching module/unit. Electric shock, malfunction or failure may result.

Table of Correction

No.	Contents	date	Manual No.
1	“15.1.2 Example program”, “15.1.3 Example program”, “15.4.1 Example program” and “15.4.2 Example program” are made the corrections.	04.04.2002	NJI-409AX
2	“15. Example program” and “Appendix 1.1 Example of wiring with Hitachi AD series servo” are made the corrections.	18.12.2002	NJI-409BX
3	“7.2.2 Speed change command” specifications are changed.	08.09.2003	NJI-409CX
4	“3.2 System Construction” applicable CPU module types are added.	30.06.2004	NJI-409DX

Table of Contents

Chapter 1 Introduction

1.1 Checking products

This instruction manual describes how properly operate the EH-POS4 (4 Axes Positioning Control Module), which is one of the special function module of EH-150 Programmable Logic Controller (PLC). Carefully read this manual to familiarize yourself with the procedures respectively of installation, operation, and maintenance and inspection.

Please be sure to read the related application manual, too.

Table 1.1 Reference Manual list

Manual No.	Document name
NJI-281*(X)	EH-150 application manual

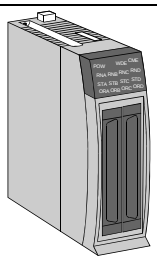
"*" means the revision of manual and up to A, B, C, … in order. Use the manual revision "H" or later.

⚠ Cautions

1) Use EH-CPU548, EH-CPU516, EH-CPU448, EH-CPU448A, EH-CPU308A or EH-CPU316A for CPU module. Do not use EH-CPU104, EH-CPU104A, EH-CPU208 and EH-CPU208A.
2) EH-POS4 is different from EH-POS, H-series positioning module POSIT-H, POSIT-2H, POSIT-A2H, POSH in detailed specifications. To port an user program for EH-POS4, read the both manuals carefully and understand the difference.
3) Read this manual carefully before using EH-POS4 to operate the module correctly.
4) The description in this manual may be changed without notice.

1.2 Accesaries

The following accessories are packed in the EH-POS4 module. Check each item after unpacking the module.

No.	Item name	Model	Appearance	Number of pieces	Remark
1	4-axes positioning module	EH-POS4		1	**(Caution)** **Use model EH-CPU548, EH-CPU516, EH-CPU448A, EH-CPU448, EH-CPU308A or EH-CPU 316A for CPU module.** **Do not use EH-CPU104, EH-CPU104A, EH-CPU208 and EH-CPU 208A.**
2	Instruction manual	NJI-411A(X):English		1	
		NJI-411A: Japanese		1	

Chapter 2 General description

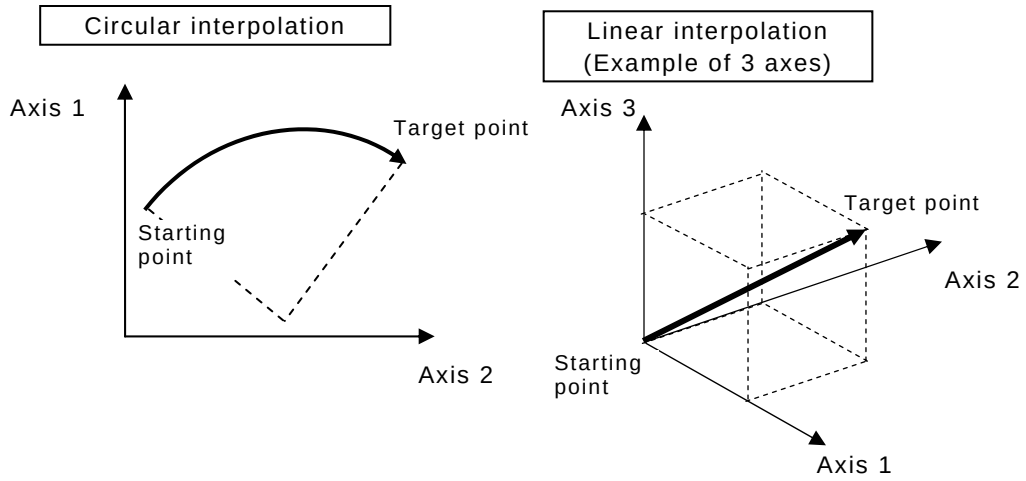
2.1 Feature of EH-POS4

(1) Independent operation and multiple axis operation.

EH-POS4 can start 1 up to 4 axes at the same time.

(2) Circular interpolation (2 axes) and Linear interpolation (maximum 4 axes)

The interpolation axes are selectable.

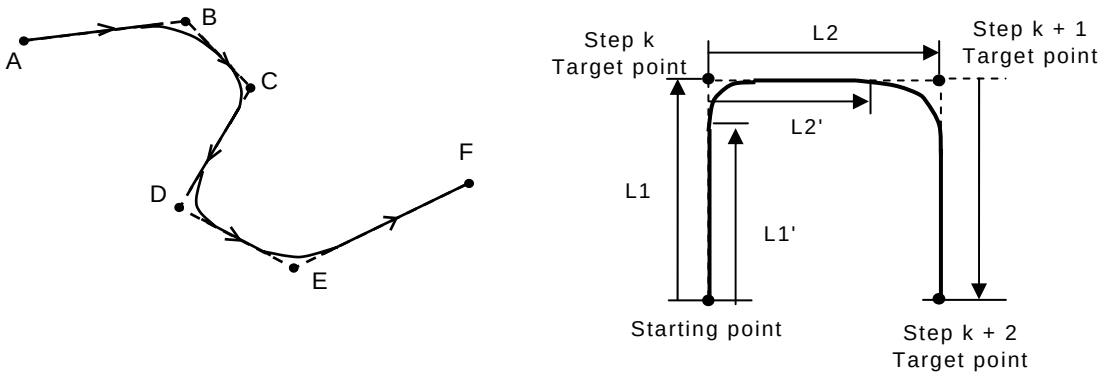


(3) Smoothing motion

1) Arch-motion function

The next step operation starts on the way to the target point.

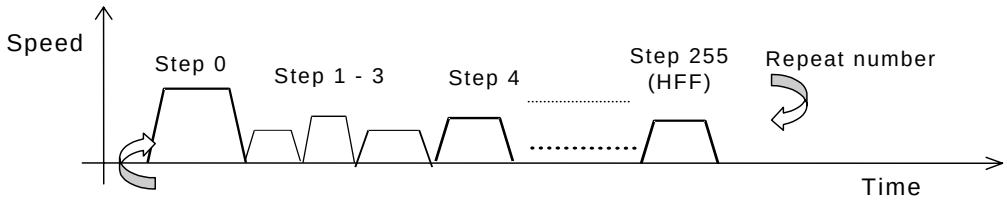
The ratio (L1'/L1, L2'/ L2) is variable by step.



(4) Multi-points continuous operation (cycle step operation)

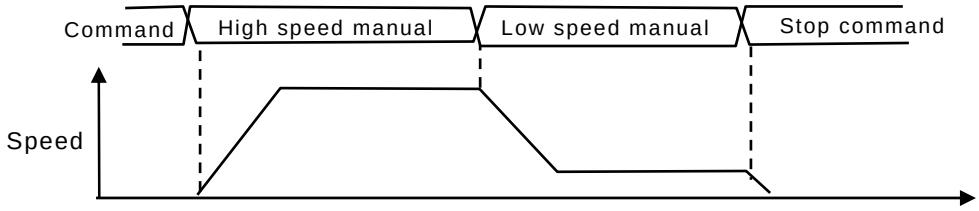
Multi-points (maximum 256 points) positioning is available continually.
Repeat number can be set up to 255.

(Example)



(5) Speed change on manual operation

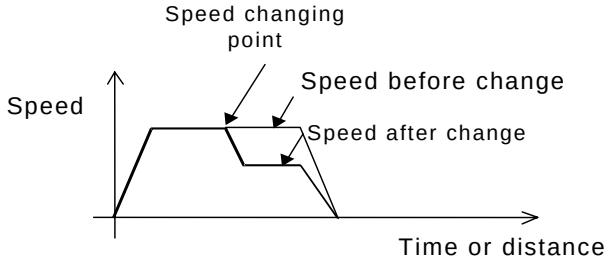
Speed change is available on manual operation.
(From high speed mode to low speed mode, or from low speed to high speed.)



(6) Speed change on running

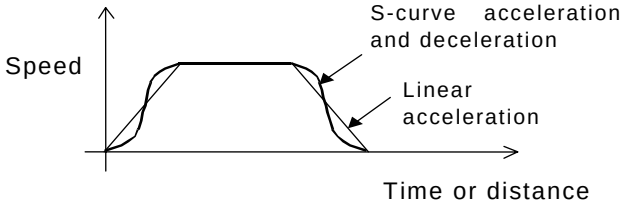
Speed change is available on automatic operation.

(Example)



(7) S-curve acceleration and deceleration

3 types S-curve acceleration and deceleration.



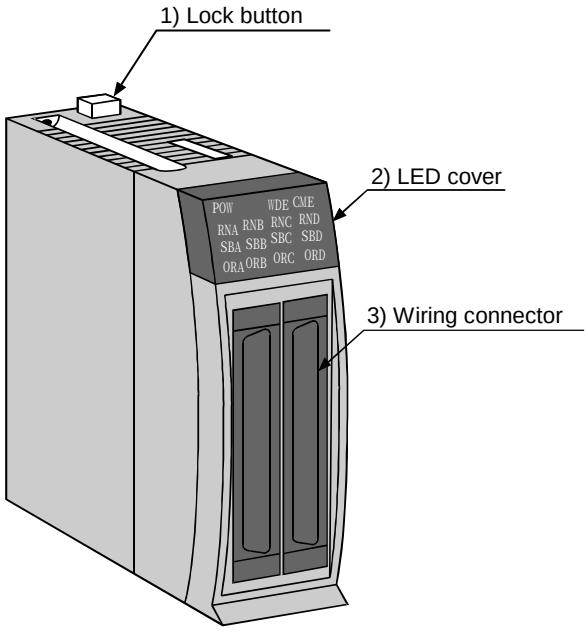
(8) ABS (absolute) encoder input

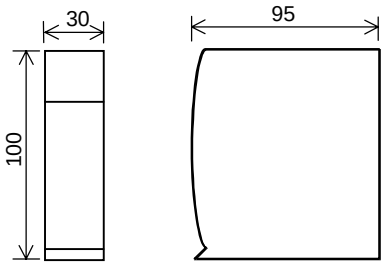
EH-POS4 can be connected to the servo amp with ABS encoder directly.
(Applied maker: AD series)

Chapter 3 System construction

3.1 Appearance and dimension

Name of Parts	Model	EH-POS4
	Weight	Approx. 0.18 kg
	Dimension(mm)	





NO.	Name	Function	Remarks
1)	Lock button	This is used when removing the module from the base unit. After it is installed to the base unit, the fixation can be reinforced using screw. In this case, use M4x10 mm screws.	
2)	LED cover	This indicates the status of this module.	
3)	Wiring connector	This is connector for pulse output and external control input.	Connector for cable: Fujitsu Takamisawa (Solder type) Socket: FCN-361J040-AU Cover : FCN-360C040-E (Solder less type) Housing : FCN-363J040 Contact : FCN-363J-AU Cover : FCN-360C040-E (Flat cable type) FCN-367J040-AU/F

3.2 System construction

The system configuration of EH-150 is shown below.
EH-POS4 can be mounted on any slot of a basic base or expansion unit.

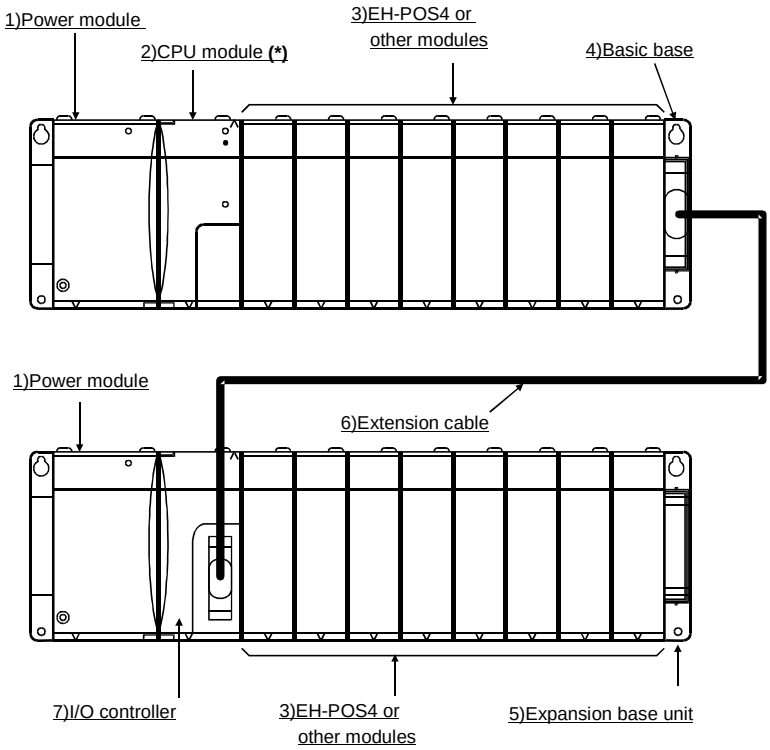


Figure 3.1 EH-150's system configuration

No.	Device name	Description of function
1)	Power module	EH-PSA or EH-PSD
2)	CPU module (*)	(*) EH-CPU548, 516, 448A, 448, 316A and 308A are available.
3)	Positioning module or other modules	Positioning module or other modules.
4)	Basic base unit	Base which CPU is mounted on.
5)	Expansion base unit	Base which CPU is not mounted on.
6)	Extension cable	Cable connected from Basic base and Expansion base.
7)	I/O controller	Interface of CPU module and I/O modules on Expansion base unit.

Chapter 4 Specification of function and performance

4.1 General specification

Item	Specification
Consumption current	5 V DC , 850 mA (supplied from Power module)
Operation temperature	0 to 55 °C
Storage temperature	–10 to 75 °C
Operation humidity	20 to 90 % RH (without condensation),
Storage humidity	10 to 90 % RH (without condensation)
Installation location	1000m or less above the sea
Operating atmosphere	Free from corrosive gas and dust
Cooling	Natural air cooling
Weight	Approx. 180 g
Dimension	30(W) x 100(H) x 95(D)
External power source	24 V DC, approx. 4.3 mA /point (for external input)

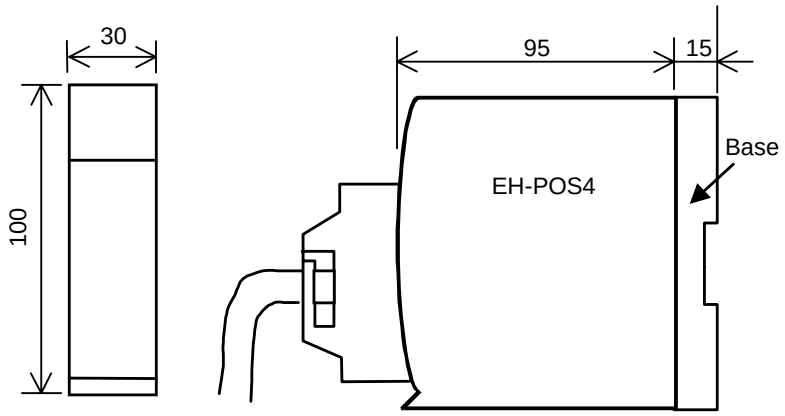


Figure 4.1 Dimension of EH-POS4

4.2 Functional specification

Item		Specification
Number of controlled axes		4
Number of interpolation axes		Linear interpolation : up to 4 axes Circular interpolation : 2 axes
Maximum speed		3.2768 M pulse/ s [Note 2]
Positioning data	Number of positioning points	Maximum 256 points/ axis (storage in the module)
	Setting method	1) Ladder Program 2) Positioning Data tool
Positioning	Positioning mode	1) Absolute mode 2) Absolute and Incremental 3) Incremental
	Positioning Unit	1) Pulse 2) μm 3) inch 4) degree
	Speed unit	1 pulse/ s – 3.2768M pulse/ s [Note 2] (Auto, Manual, Homing) μm /s , inch/s , degree/s (selectable by common parameter)
	Number of speed stage	Maximum 256 stages (in continuous operation)
	Acceleration and Deceleration	Linear S-curve (3 types)
	Acceleration and Deceleration time	1 up to 65 535 ms
	Backlash	0 - 65 535 pulses
	Operation range	- 2 147 483 648 up to + 2 147 483 647 pulses - 214 748 364.8 up to + 214 748 364.7 μm - 21 474.83648 up to + 21 474. 83647 inch - 21 474.83648 up to + 21 474.83647 degree
	Pulse train signal	1) 2 Pulse signal (CW pulse and CCW pulse) 2) Pulse and Direction signal (PLS and SIG) (Selectable by common parameter)
	Output method	Line driver
Homing		1) Free home position 2) Low speed homing 3) High speed homing 1 (Off edge stop) 4) High speed homing 2 (Phase Z input stop) 5) Absolute encoder homing
Applied servo amp in absolute homing		Hitachi AD series
Manual operation		Manual command
Teaching function		Teaching command
I/O assignment		Word 4W/4W
Operation on CPU stopping		Available

Note1: When CPU is turned "RUN" to "STOP" or "STOP" to "RUN", the servo motor stops.

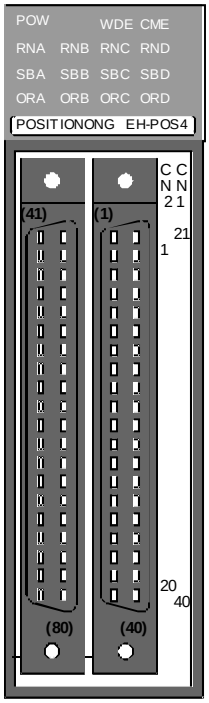
Note2: Maximum speed “3.2768Mpulse/s” is supported later hard were revision “02”. Hard were revision “01” are maximum speed is 1Mpulse/s.

4.3 Hardware Interface

Item			Specification
Output	Pulse & Sign		Line driver (SN75158(TI))
	"High" voltage		Minimum 2.4 V
	"Low" voltage		Maximum 0.4 V
Phase input	Phase Z input and Absolute encoder serial signal		Line driver (input impedance: 220 ohm)
Input	Input voltage		20.4 up to 28.8 V DC
	Input impedance		Approx. 5.6 k ohm
	Input current		Approx. 4.3 mA (24 V DC)
	Operation voltage	"ON" voltage	Minimum 15 V DC
		"OFF" voltage	Maximum 5 V DC
	Delay	"ON" to "OFF"	Maximum 1 ms
		"OFF" to "ON"	Maximum 1 ms
	Polarity		No
	isolation		Photo-coupler

(1) Connector (CN1, CN2)

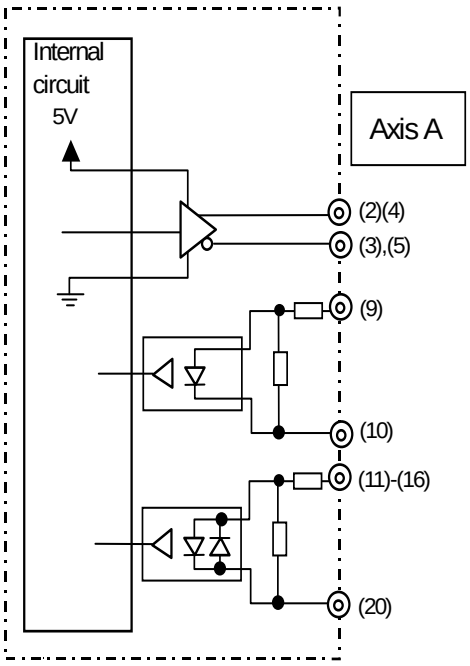
assignment



Pin assignment and signal

left(CN2)		right(CN1)		signal
Axis C	Axis D	Axis A	Axis B	
No.	No.	No.	No.	
(41)	(61)	(1)	(21)	N.C.
(42)	(62)	(2)	(22)	CW+
(43)	(63)	(3)	(23)	CW-
(44)	(64)	(4)	(24)	CCW+
(45)	(65)	(5)	(25)	CCW-
(46)	(66)	(6)	(26)	N.C.
(47)	(67)	(7)	(27)	N.C.
(48)	(68)	(8)	(28)	N.C.
(49)	(69)	(9)	(29)	Z-(PS-)
(50)	(70)	(10)	(30)	Z+(PS+)
(51)	(71)	(11)	(31)	SRDY
(52)	(72)	(12)	(32)	COIN
(53)	(73)	(13)	(33)	PORG
(54)	(74)	(14)	(34)	+ORUN
(55)	(75)	(15)	(35)	-ORUN
(56)	(76)	(16)	(36)	MODSEL
(57)	(77)	(17)	(37)	N.C.
(58)	(78)	(18)	(38)	N.C.
(59)	(79)	(19)	(39)	N.C.
(60)	(80)	(20)	(40)	COM(+24V)

Internal circuit



Same circuit about Axis B, C, D

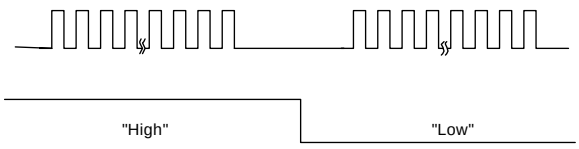
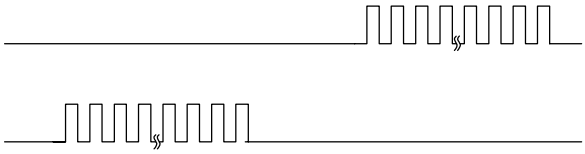
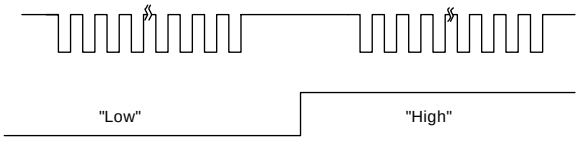
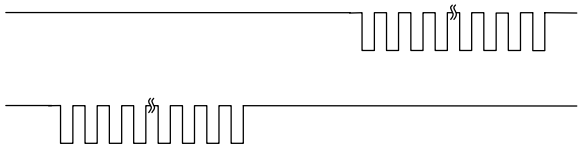
4.4 Input and output terminal

Axis C No.	Axis D No.	Axis A No.	Axis B No.	I/O	Symbol	Name	Remark
41	61	1	21				
42	62	2	22	Output	CW+	Pulse train output (CW pulse/ PLS)	Line driver
43	63	3	23		CW-		
44	64	4	24		CCW+	Pulse train output Or direction signal (CCW pulse/ SIG)	
45	65	5	25		CCW-		
46	66	6	26				
47	67	7	27				
48	68	8	28				
49	69	9	29	Input	Z-(PS-)	Phase Z input (Absolute encoder signal)	Phase Z output from servo Amp (Absolute encoder serial signal)
50	70	10	30		Z+(PS+)		
51	71	11	31		SRDY	Servo ready	Ready output from servo AMP
52	72	12	32		COIN	In position	Positioning complete signal
53	73	13	33		PORG	Origin signal	Origin limit switch
54	74	14	34		+ORUN	+ Overrun	Overrun for normal direction
55	75	15	35		-ORUN	- Overrun	Overrun for reversal direction
56	76	16	36		MODSEL	Control mode select	Control mode selective switch In speed and positioning mode
57	77	17	37				
58	78	18	38				
59	79	19	39				
60	80	20	40	Common	COM(+24V)	Input common	24 V DC or GND of external power source

4.5 Pulse train mode

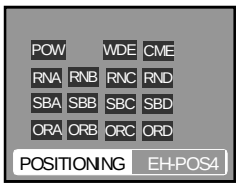
Pulse train mode is selected by Common parameter.
The modes are 4 modes, CW pulse/ CCW pulse and pulse (PLS)/ direction (SIG) ,those positive and negative logic.
The mode of each axis can be set independently.

Table 4.1 Pulse train mode

No.	Mode	Output signal	Forward direction(CCW) Reverse direction(CW)
(1)	Pulse(PLS) / Direction(SIG) mode (Positive logic)	PLS (CW) SIG (CCW)	
(2)	CW pulse / CCW pulse (positive logic)	CW pulse (CW) CCW pulse (CCW)	
(3)	Pulse(PLS) / Direction(SIG) mode (Negative logic)	PLS (CW) SIG (CCW)	
(4)	CW pulse / CCW pulse (Negative logic)	CW pulse (CW) CCW pulse (CCW)	

Note: The wave is the voltage of "CW-" to "CW+" or "CCW-" to "CCW+".

4.6 Name of LED

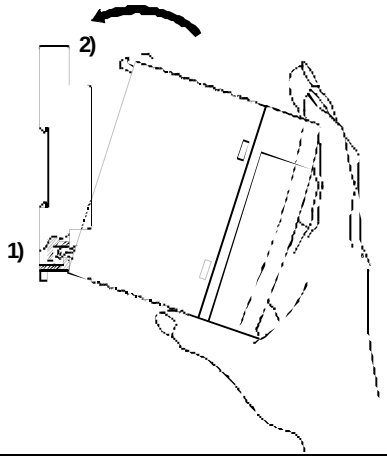
Appearance	Name	Signal	Contents	Color
	POW	Power source	Lighted when the module is valid	Yellow green
	RN*	RUN	Lighted in positioning	Yellow green
	SB*	Stand by	Lighted in stand by mode	Yellow green
	OR*	Overrun error	Lighted when overrun is occurred	Red
	CME	Command error	Lighted when command error is occurred	Red
	WDE	Watchdog error	Lighted when Watchdog error is occurred	Red

Note 1: *=A (Axis A), B (Axis B), C (Axis C), D (Axis D)

Note 2: All of the LEDs are lighted when power on.

Chapter 5 Installation and wiring

5.1 Installation

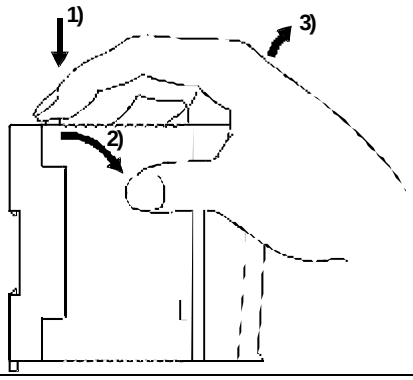


(1)Install the module.

1) Insert the hook at the lower section in the base.

2) Press in the upper side of the module until it clicks.

Note 1: After loading the module, check that it is firmly and exactly attached.



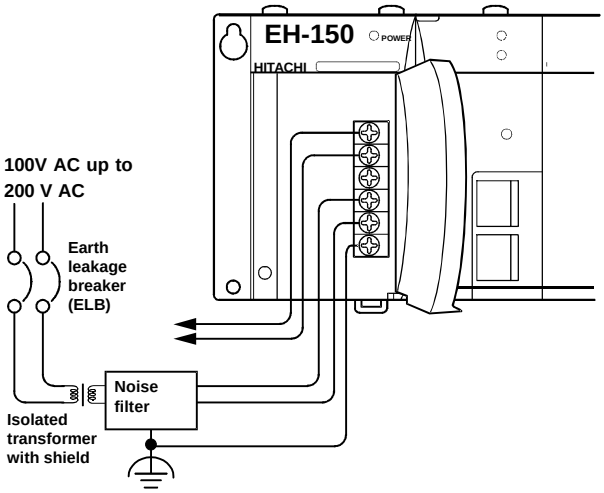
(2) Uninstall the module.

1) Push the lock button.

2) Under pushing the lock button, pull the upper part of the module.

3) Under bringing up, pull out the module.

5.2 Power wiring



(1) Use more than 2 mm^2 size cable for power source to avoid voltage drops.

(2) Use more than 2 mm^2 size cable for FE terminals and keep resistance less than 200 ohm.

Note: Avoid to join to the earth cable of the equipment that generates Noise.

(3) The screw size is M3. Tighten screws 0.05 N torque up to 0.08 N torque.

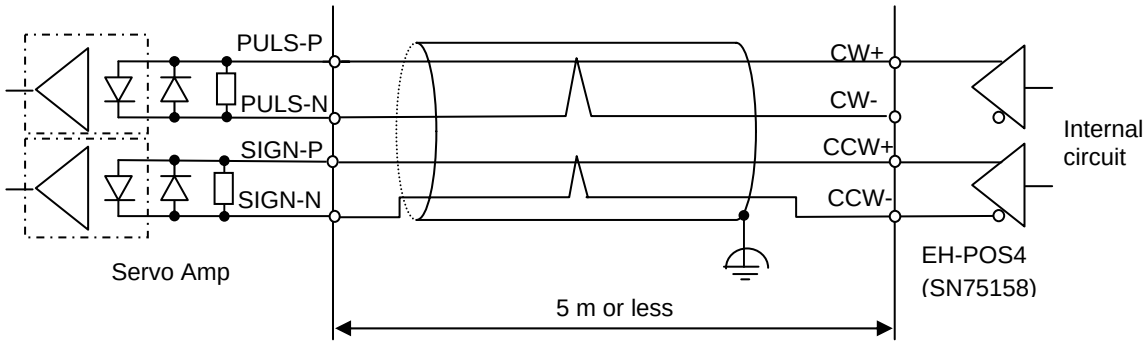
(4) Use the same power source for basic unit and expansion unit.

5.3 Wiring

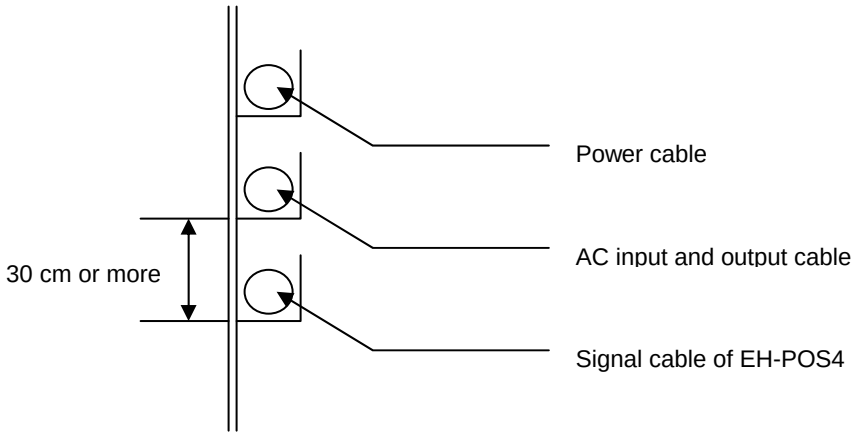
Please use the shield cable of more than AWG#28 size.
Please shorten the output cable as possible.

5.3.1 Wiring for the external output

(1) Pulse train output

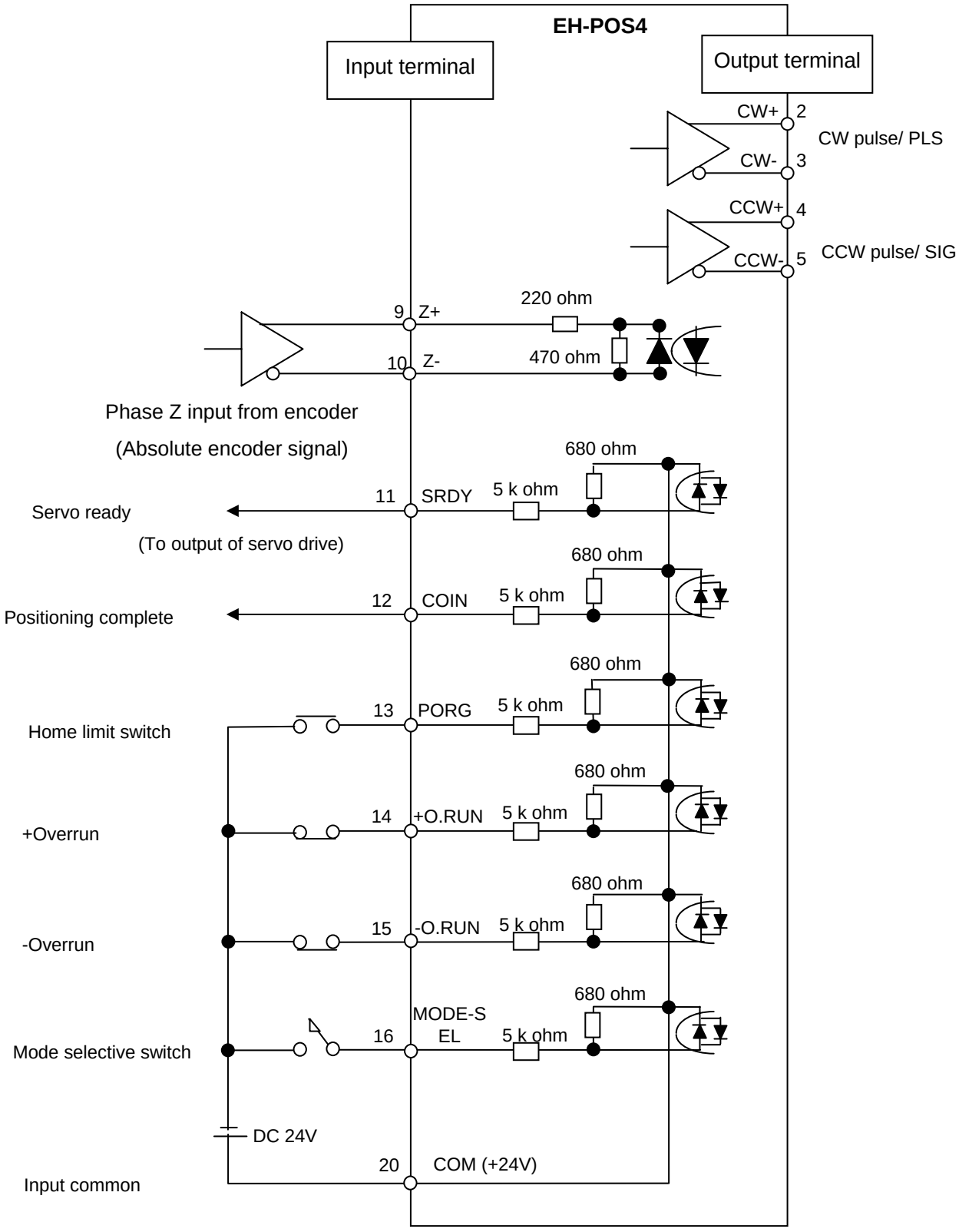


5.3.2 Precaution of wiring



⚠ Caution
1) Separate the signal cable of EH-POS4 from the power cable and AC signal cable. 2) For the safety, add the external interlock circuit for protection when the PLC system goes down.

5.3.3 Signal connection overview



Chapter 6 Positioning Data and Command

6.1 Positioning data

EH-POS4 needs Common parameter and Positioning data for operation.

6.1.1 Common parameter

Common parameter includes 16 data (19 words).

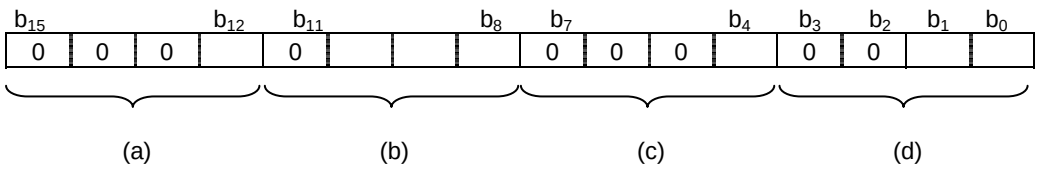
Set all data before the operations, because it is necessary for all operations (Homing, Manual operation, automatic operation). Common parameter is stored in the EEPROM (*) of EH-POS4.

At first of delivery, it is default value.

Parameter No.	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents	Default value Hex(Decimal)
1	1	Homing direction	Homing mode	Revolution polarity	Acceleration and deceleration mode		H0000
2	2	0	1) Speed scaling factor	2) Position scaling factor	3) unit	1), 2) x 1, x10, x100, x1000 3) Speed and position unit (pulse, um, inch, degree)	H0000
3	3	1) Pulse logic	2) +O.RUN Input mode	3) -O.RUN Input mode	4) SRDY/COIN Input mode	1) Pulse train (CW/ CCW or PLS/ SIG, Positive or Negative logic) 2), 3)O.RUN (Valid or Invalid, Positive or Negative logic) 4)SRDY/COIN(Valid or Invalid)	H0000
4	4	Pulses per a revolution				Number of the pulses per a revolution	H8000 (32 768)
5	5	Distance per a revolution				Moving quantity per a revolution	H8000 (32 768)
6	6	Limit speed				Upper limit value of speed	HFFFF (65 536)
7	7	Initial speed				Speed at starting to generate pulses	H0010 (16)
8	8	High speed				Speed of high speed manual operation and high speed homing	H0400 (1 024)
9	9	Low speed				Speed of low speed manual operation and low speed homing	H0050 (80)
10	10	Acceleration and deceleration time				Acceleration and deceleration time of manual operation and homing(unit: ms)	H01F4 (500)
11	11	Backlash				Backlash (unit: pulse)	H0000 (0)
12	12	Upper limit position value (Lower word)				Maximum position value in positive direction - 2 147 483 648 up to + 2 147 483 647	H7FFF FFFF (2 147 483 647)
	13	Upper limit position value (Upper word)					
13	14	Lower limit position value (Lower word)				Maximum position value in negative direction - 2 147 483 648 up to + 2 147 483 647	H8000 0000 (-2 147 483 648)
	15	Lower limit position value (Upper word)					
14	16	Home position value (Lower word)				Home position value - 2 147 483 648 up to + 2 147 483 647	H00000000 (0)
	17	Home position value (Upper word)					
15	18	Homing offset value (Lower word)				Offset value from home position - 2 147 483 648 up to + 2 147 483 647	H00000000 (0)
	19	Homing offset value (Upper word)					

(*): EEPROM can be rewrite minimum 100 000 times. (Stored period is 10 years .)

(1) Parameter No. 1



(a) Direction of Homing

b_{15}	b_{14}	b_{13}	b_{12}	Direction	Value (Hex)
0	0	0	0	Move to CW	H0***
0	0	0	1	Move to CCW	H1***

Note: In the case of the home position limit switch is active the motor move to the other direction
(In detail refer Chapter 8)
CCW: Counter clockwise at the load side view.
CW: Clockwise at the load side view.

(b) Homing mode

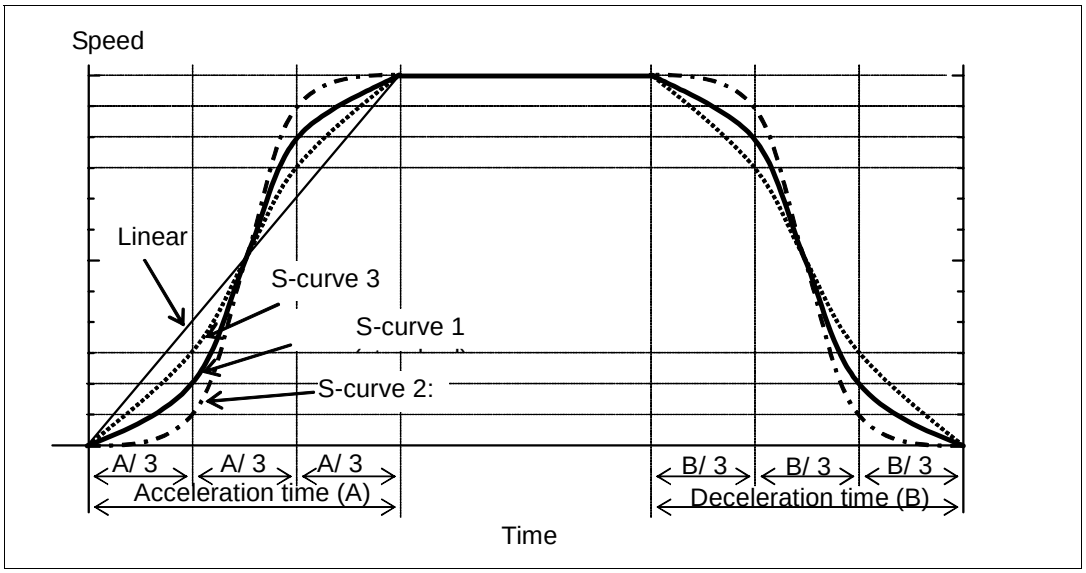
b_{11}	b_{10}	b_9	b_8	Mode		Value (Hex)
0	0	0	0	Free home position		H*0**
0	0	0	1	Low speed homing		H*1**
0	0	1	0	High speed homing 1 (OFF edge)		H*2**
0	0	1	1	High speed homing 2 (Z phase stop)		H*3**
0	1	0	0	Absolute encoder	Hitachi AD series (17 bit serial)	H*4**
0	1	0	1		Yaskawa Sigma 2 series (17 bit serial)	H*5**
0	1	1	0		Yaskawa Sigma 2 series (16 bit serial)	H*6**

(c) Polarity of revolution

b_7	b_6	b_5	b_4	Forward	Value (Hex)
0	0	0	0	CCW (Counter Clockwise)	H**0*
0	0	0	1	CW (Clockwise)	H**1*

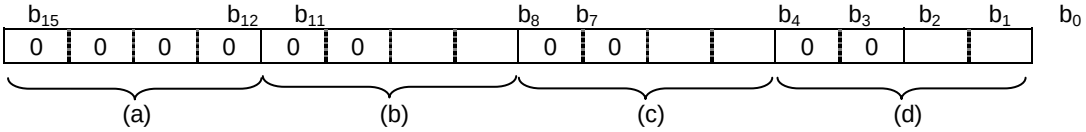
(d) Acceleration and deceleration mode

b_3	b_2	b_1	b_0	Mode	Value (Hex)
0	0	0	0	Linear acceleration and deceleration	H***0
0	0	0	1	S-curve 1	H***1
0	0	1	0	S-curve 2	H***2
0	0	1	1	S-curve 3	H***3



Note: This mode is valid in the positioning modes. In Homing operation, Speed changing operation on running, Continuous operation, Circular interpolation and Feed mode, acceleration and deceleration mode become linear mode.

(2) Parameter No. 2



(a) Always "0"

(b) Speed scaling factor

b_{11}	b_{10}	b_9	b_8	Scaling	Value (Hex)
0	0	0	0	X 1	H00**
0	0	0	1	X 10	H01**
0	0	1	0	X 100	H02**
0	0	1	1	X 1000	H03**

Note 1: About unit, refer (d).

Note 2: Set smaller value than 3.2768 M (pulse/ s) in conversion to pulse.

(c) Position scaling factor

b_7	b_6	b_5	b_4	Scaling	Value (Hex)
0	0	0	0	x 1	H0*0*
0	0	0	1	x 10	H0*1*
0	0	1	0	x 100	H0*2*
0	0	1	1	x 1000	H0*3*

Note: In case of Pulse mode scaling, Scaling is set to "x 1".

(d) Unit

b_3	b_2	b_1	b_0	Unit	Range	Scaling	Value (Hex)
0	0	0	0	pulse	- 2 147 483 648 up to + 2 147 483 647 pulses	1	H0**0
0	0	0	1	um	- 214 748 364.8 up to + 214 748 364.7 um	0.1 um	H0**1
0	0	1	0	inch	- 21 474.83648 up to + 21 474.83647 inch	0.00001 inch	H0**2
0	0	1	1	degree	- 21 474.83648 up to + 21 474.83647 degree	0.00001 degree	H0**3

[Example of setting scaling and unit]

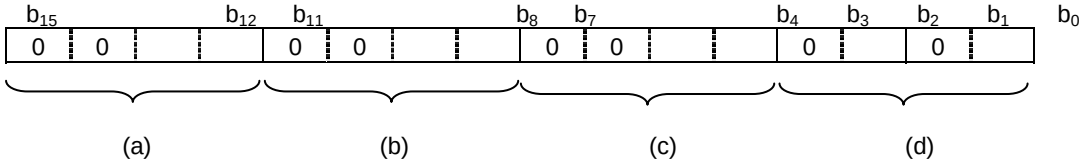
Basically EH-POS4 controls position and speed by pulse. So EH-POS4 converts the value set by the other units (um, inch, degree) to the number of pulses inside.

Formula of conversion

1) Position value per one pulse (Lp)

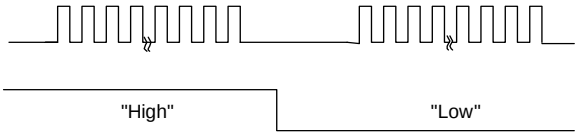
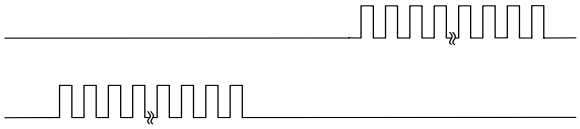
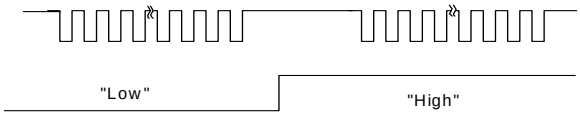
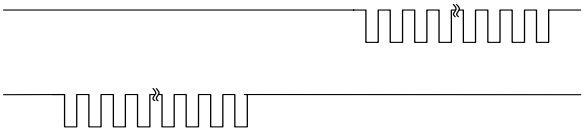
$$Lp = \frac{\text{Position value/ r (Parameter No. 5) x Position scaling factor (Parameter No. 2)}}{\text{Pulse/ r (Parameter No. 4)}}$$

(3) Parameter No. 3



(a) Pulse train mode

b_{15}	b_{14}	b_{13}	b_{12}	Mode	Value (Hex)
0	0	0	0	PLS / SIG (Positive logic)	H0***
0	0	0	1	CCW / CW pulse (Positive logic)	H1***
0	0	1	0	PLS / SIG (Negative logic)	H2***
0	0	1	1	CCW / CW pulse (Negative logic)	H3***

Mode	Signal	Forward / Reverse
1) PLS / SIG (Positive logic)	Pulse (PLS) Direction (SIG)	
2) CW/ CCW pulse (Positive logic)	CW pulse CCW pulse	
3) PLS / SIG (Negative logic)	Pulse (PLS) Direction (SIG)	
4) CW/ CCW pulse (Negative logic)	CW pulse CCW pulse	

Note: When Forward direction (Parameter No. 1) is CW, the movement of CW and CCW is converted.

(b) + O.RUN input mode

b_{11}	b_{10}	b_9	b_8	Contents	Value (Hex)
0	0	0	0	Input valid (When the input is "OFF ", "overrun" occurs.)	H*0**
0	0	0	1	Input valid (When the input is "ON ", "overrun" occurs.)	H*1**
0	0	1	0	Input invalid ("Overrun" doesn't occur.)	H*2**

(c) - O.RUN input mode

b_7	b_6	b_5	b_4	Contents	Value (Hex)
0	0	0	0	Input valid (When the input is "OFF ", "overrun" occurs.)	H**0*
0	0	0	1	Input valid (When the input is "ON ", "overrun" occurs.)	H**1*
0	0	1	0	Input invalid ("Overrun" doesn't occur.)	H**2*

(d) SRDY/ COIN input mode

b_3	b_2	b_1	b_0	Contents	Value (Hex)
0	*	0	0	"COIN" is valid (When the input is "ON", positioning completes)	H***0 H***4
0	*	0	1	"COIN" is invalid ("COIN" status is always "ON")	H***1 H***5
0	0	0	*	"SRDY" is valid (When the input is "ON", Servo ready)	H***0 H***1
0	1	0	*	"SRDY" is invalid ("SRDY" status is always "ON")	H***4 H***5

(4) Parameter No. 4 (pulses/ r)

This value is the number of pulses per one revolution of operating servo-motor.

When electrical gear function is enable, this value is changeable from the encoder pulses of the servo-motor.

(Example)

Encoder pulses of the servo-motor = 32 768 pulses

Electrical gear ratio: = 8:1

Output pulses which needs for EH-POS4 to move the servo-motor one revolution.

$$\frac{32\,768}{8} = 4\,096$$

⚠ Caution

Note 1: In case of absolute encoder mode, if this value is wrong, the home position value and the current position value shall be wrong.

(5) Parameter No. 5 (Position value/ r)

This is the work position value per one revolution of the servo-motor, when unit of position value or speed value is not pulse.

When this value becomes more than 65 536, please set Position scaling factor the suitable value.

(Example)

In the ball screw usage, the pitch is 10 mm per one revolution of the motor.

10 mm = 10 000.0 um. Setting value = 100 000 > 65 635 (impossible to set)

Set Position scaling factor "X 10". (Parameter No. 2 = H**11)

Parameter No. 5 = (100 000)/ (10) = 10 000 (H2710)

⚠ Caution

Note 1: Please set the ratio of "Parameter No. 4" and "Parameter No. 5" integer. If this value is not integer, the calculation error of position shall be increased.

(6) Parameter No. 6 (Speed limit value)

This is the upper limit of operating speed. In case of under, the error occurs and it can not be set and start the operation.

1) Initial speed (Parameter No. 7), High speed (Parameter No. 8), Low speed (Parameter No. 9) or automatic operation speed is more than this value.
2) This value is "0".
3) This value is more than 1M (pulse/ s).

(7) Parameter No. 7 (Initial speed)

This value is the initial value of manual operation and automatic operation.

Set smaller value than the speed value of manual operation, automatic operation.

(8) Parameter No. 8 (High speed)

This value is the speed value of High speed manual operation and High speed homing.

(9) Parameter No. 9 (Low speed)

This value is the speed value of Low speed manual operation, low speed and High speed homing.

(10) Parameter No. 10 (Acceleration and deceleration time)

This value is acceleration and deceleration time of manual operation and homing.

The time unit is "ms". Available range is 10 up to 65 535 (ms).

(11) Parameter No. 11 (Backlash)

This value is mechanical backlash.

Unit of this value is "pulse".

Note: In case of free home position and Absolute encoder homing, this value is invalid.

[Backlash calculation]

Backlash is calculated and generated output pulses when the operation direction changes.

Note: The calculation rule is different according to homing direction and homing mode.

1) Absolute mode in automatic operation

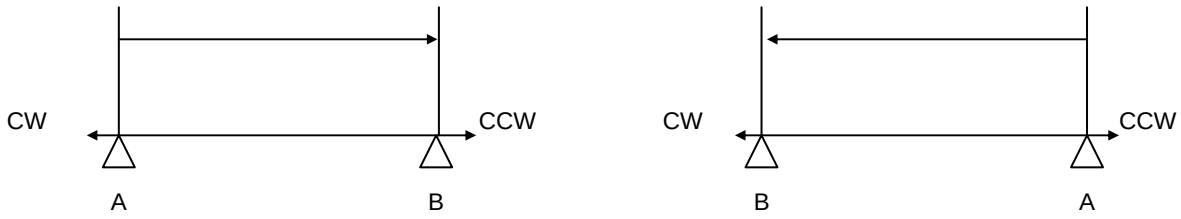
If A is smaller than B, in case of low speed homing and high speed homing 2, when positioning A to B, the current value after complete positioning to B is added backlash to the value of B.

In case of high speed homing 1, the current value after complete positioning to B is the value of B.

Otherwise if A is bigger than B, in case of high speed homing 1, the current value after complete positioning to B is added backlash to the value of B.

In case of low speed homing and high speed homing 2, the current value after complete positioning to B is the value of B.

[Positioning direction]



(a) A < B

Homing mode \ Homing direction	Current value (Pulse)	
	CW	CCW
Low speed homing	B + backlash	B
High speed homing 1	B	B + backlash
High speed homing 2	B + backlash	B

(b) A < B

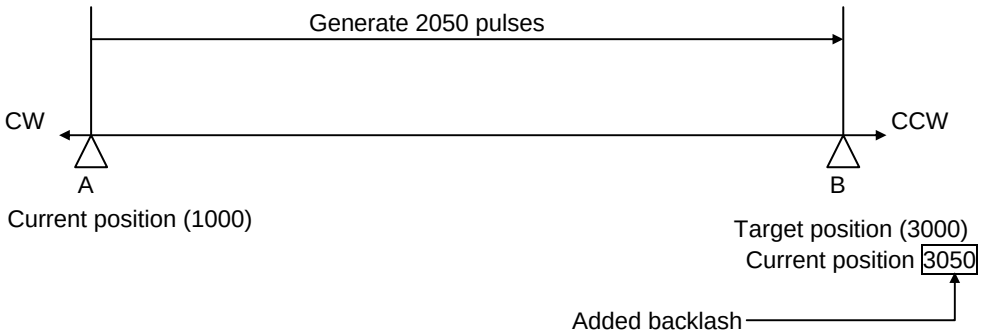
Homing mode \ Homing direction	Current value (Pulse)	
	CW	CCW
Low speed homing	B	B - backlash
High speed homing 1	B - backlash	B
High speed homing 2	B	B - backlash

1) Example of the case that homing direction is CW.

Example of Absolute mode

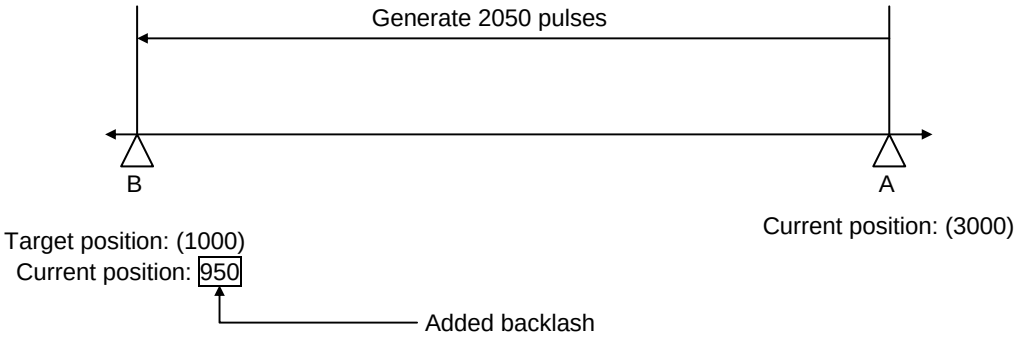
(1) Homing mode is Low speed homing.

"A" value = 1000 (Monitor value of current position)
"B" value = 3000 (Target position value)
Backlash = 50 (pulses)
After positioning A to B



(2) Homing mode is High speed homing 1.

"A" value = 3000 (Monitor value of current position)
"B" value = 1000 (Target position value)
Backlash = 50 (pulses)
After positioning A to B

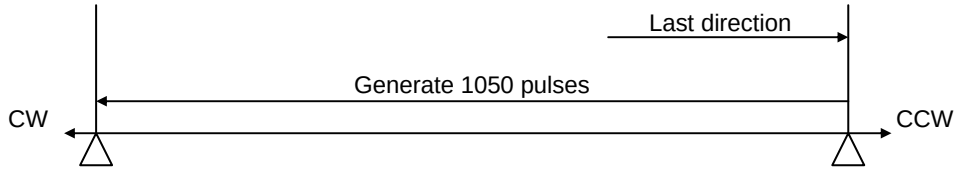


2) Example of incremental mode

When the positioning direction changes, EH-POS4 outputs the pulses added backlash to the target pulses. But if the positioning direction does not change, EH-POS4 does not add backlash.

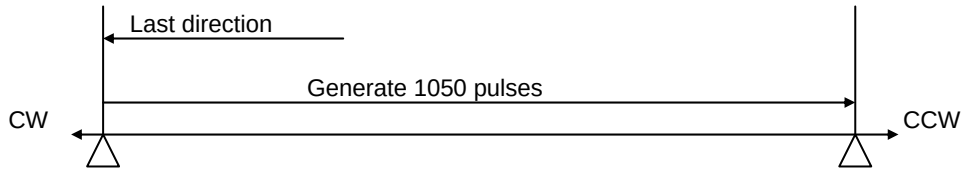
Example of incremental mode

(1) When the direction changes CCW to CW.
Target position : -1000
Backlash : 50



Target position: -1000 (HFFFF FC18)
Current position: -1050 (HFFFF FBE6)

(2) When the direction changes CW to CCW.
Target position : -1000
Backlash : 50



Target position: 1000
Current position: 1050

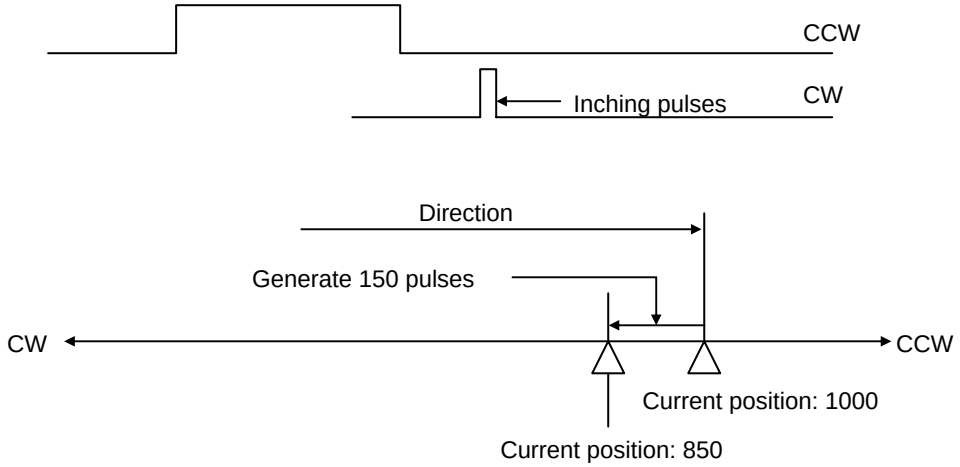
3) Example of manual operation

When the positioning direction changes, EH-POS4 outputs the pulses added backlash to the target pulses. But if the positioning direction does not change, EH-POS4 does not add backlash.

In case of inching operation, EH-POS4 outputs the pulses added backlash to inching pulses.

Example of manual operation

Backlash : 50
Inching pulses : 100
After stopped 1000 by CCW manual operation, reversing by inching operation.



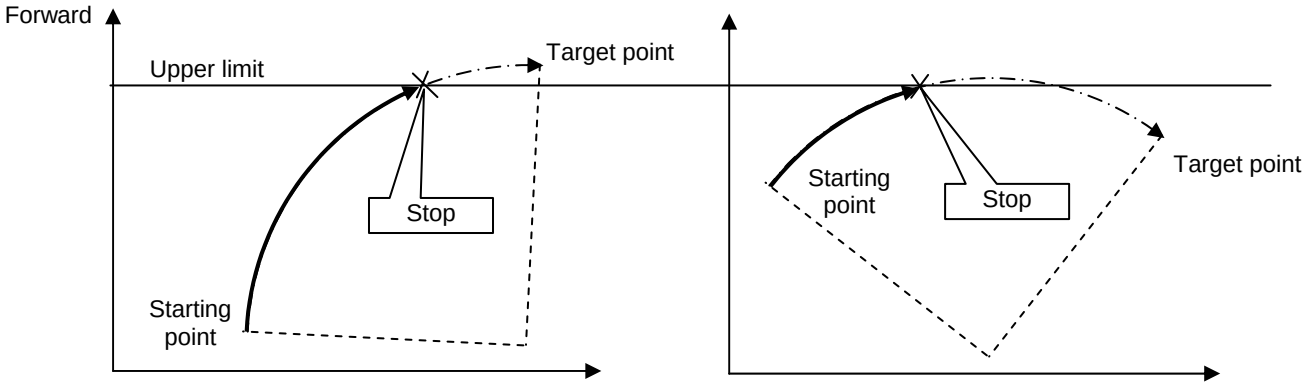
Note: In case of teaching mode

If it is set backlash, set the teaching point after stopped for the homing direction
The homing direction to homing mode is below.

Homing direction / Homing mode	Direction after stopped	
	CW	CCW
Low speed homing	CW	CCW
High speed homing 1	CCW	CW
High speed homing 2	CW	CCW

(12) Parameter No. 12 (Upper limit position value)

It is maximum position value that the work can move.
In case of manual operation, it can not move over this point for the positive direction.
In case of automatic operation, if it is started with the target value over this point, it can not start.
In case of circular interpolation, it stops when it reached at this point.

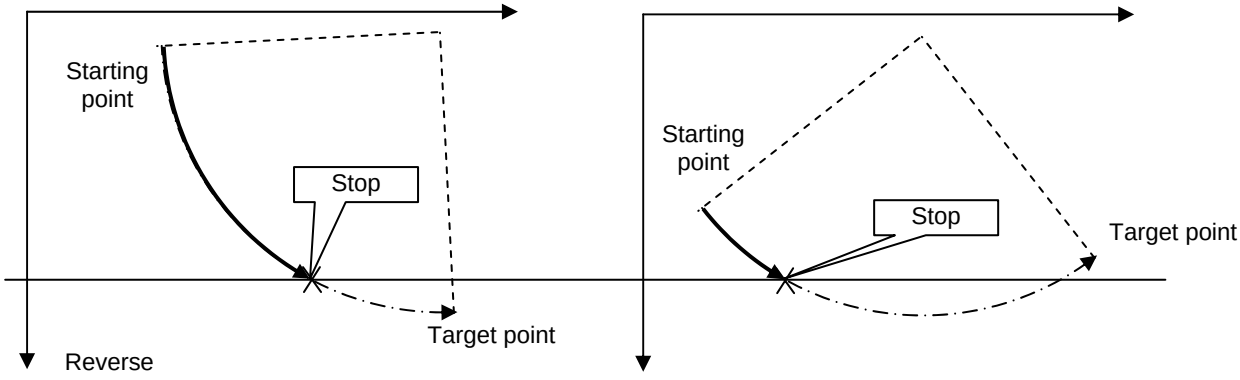


(Note of upper limit) positioning unit: um, inch and degree.

$$\frac{\text{(Upper limit) x (Scaling of positioning) x (Parameter No. 4)}}{\text{(Parameter No. 5)}} < 2\,147\,783\,648$$

(13) Parameter No. 13 (Lower limit position value)

It is minimum position value that the work can move.
In case of manual operation, it can not move over this point for the negative direction.
In case of automatic operation, if it is started with the target value over this point, it can not start.
In case of circular interpolation, it stops when it reached at this point.



(Note of upper limit) positioning unit: um, inch, degree

$$\frac{\text{(Lower limit) x (Scaling of positioning) x (Parameter No. 4)}}{\text{(Parameter No. 5)}} > -2\,147\,783\,649$$

Note

When the unit is um, inch or degree, it may occur the calculated error (about 200) to "Upper limit" or "Lower limit".

(Example)

Lower limit: HC000 0080

⇨ Target position: HC000 0070 (< lower limit, but it may not occur command error.)

Please set "lower limit" HC000 0270.

(14) Parameter No. 14 (home position value)

When "Homing" completed, the current position value becomes this value.
But in case of "Absolute encoder mode", this value is ignored.

(15) Parameter No. 15 (homing offset value)

After reaching at the hardware home position, EH-POS4 moves by this value.
This is the incremental value for the hardware home position, but the current value is the absolute value.
The moving direction is the sign of this value.
After this offset positioning, homing completes.

Note 1: If this value is over upper or lower limit, it stops at the hardware home position with the command error. If stopped on positioning to the offset point, the status of EH-POS4 becomes standby.
Note 2: In case of "Free origin" or "Absolute encoder homing", this value is ignored.
Note 3: The initial speed of this offset positioning is the value of "Low speed" (parameter No. 9). The speed is "High speed" (parameter No. 8).

6.1.2 Automatic positioning data

Automatic positioning data is constructed by 7 kinds of values per one step.
The maximum number of data is 256 steps. These data are stored in EEPROM of EH-POS4.

<table>
<tr><th rowspan="2">Data No.</th><th rowspan="2">Word No.</th><th colspan="4">MSB LSB</th><th rowspan="2">Contents</th></tr>
<tr><th>15 - 12</th><th>11 - 8</th><th>7 - 4</th><th>3 - 0</th></tr>
<tr><td>1</td><td>1</td><td colspan="4">Operation mode</td><td></td></tr>
<tr><td>2</td><td>2</td><td colspan="2">Arch-motion ratio</td><td colspan="2">Dwell time</td><td>Ratio(%) : 80 - 99 %
Dwell time (unit: 20 ms)</td></tr>
<tr><td>3</td><td>3</td><td colspan="4">Acceleration time</td><td>unit: ms (10 - 65 535)</td></tr>
<tr><td>4</td><td>4</td><td colspan="4">Deceleration time</td><td>unit: ms (10 - 65 535)</td></tr>
<tr><td>5</td><td>5</td><td colspan="4">Speed</td><td>pulse, um, inch, degree / s,</td></tr>
<tr><td rowspan="2">6</td><td>6</td><td colspan="4">Target positioning value (Lower word)</td><td rowspan="2">Positioning value of target point or turning point of continuous operation.
-2 147 483 647 to
+ 2 147 486 648</td></tr>
<tr><td>7</td><td colspan="4">Target positioning value (Upper word)</td></tr>
<tr><td rowspan="2">7</td><td>8</td><td colspan="4">Circular interpolation value (Lower word)</td><td rowspan="2">Passing point mode: Passing point value
Radius mode: radius value
Note: except to Circular interpolation mode, this value is ignored.</td></tr>
<tr><td>9</td><td colspan="4">Circular interpolation value (Upper word)</td></tr>
</table>

Note 1: Automatic positioning data are kept without the power source because those are stored in EEPROM.
Note 2: The maximum number to rewrite **EEPROM is 100 000 times,** the stored data can be kept ten years.
Note 3: In case of "Homing" and "Manual operation includes "Teaching mode", it is not necessary to set "Automatic positioning data", only "Common parameter" is necessary.

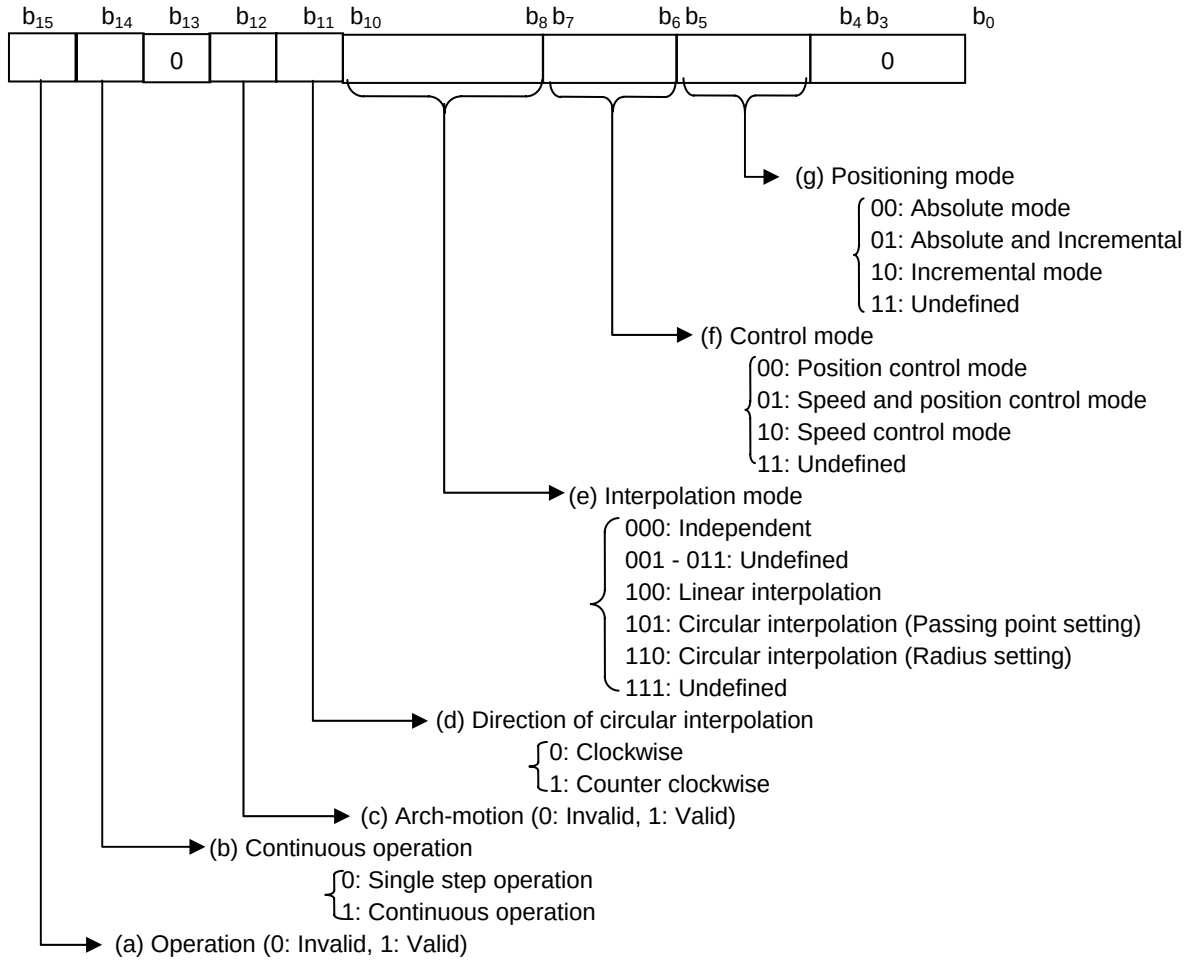
"Automatic positioning data" of each axis can be set at the same time.
If you set multiple axes data, set the data of each axis in order from "A axis" to "D axis".
If you set the data of each axis, set the data to "Data 1".

Area	Data address	MSB			LSB
		15 - 12	11 - 8	7 - 4	3 - 0
Command area	4	Setting command (H880X)			
	5	0	0	Step No. (H00 - HFF)	
	6 - 7	--			
Setting Data Area	1	Automatic operation mode 1			
	2	"Arch-motion" ratio 1 and Dwell 1			
	3	Acceleration time 1			
	4	Deceleration time 1			
	5	Speed 1			
	6	Target positioning value (Lower word) 1			
	7	Target positioning value (Upper word) 1			
	8	Circular interpolation value (Lower word) 1			
	9	Circular interpolation value (Upper word) 1			
	10	Automatic operation mode 2			
	11	"Arch-motion" ratio 2 and Dwell 2			
	12	Acceleration time 2			
	13	Deceleration time 2			
	14	Speed 2			
	15	Target positioning value (Lower word) 2			
	16	Target positioning value (Upper word) 2			
	17	Circular interpolation value (Lower word) 2			
	18	Circular interpolation value (Upper word) 2			
	19	Automatic operation mode 3			
	20	"Arch-motion" ratio 3 and Dwell 3			
	21	Acceleration time 3			
	22	Deceleration time 3			
	23	Speed 3			
	24	Target positioning value (Lower word) 3			
	25	Target positioning value (Upper word) 3			
	26	Circular interpolation value (Lower word) 3			
	27	Circular interpolation value (Upper word) 3			
	28	Automatic operation mode 4			
	29	"Arch-motion" ratio 4 and Dwell 4			
	30	Acceleration time 4			
	31	Deceleration time 4			
	32	Speed 4			
	33	Target positioning value (Lower word) 4			
	34	Target positioning value (Upper word) 4			
	35	Circular interpolation value (Lower word) 4			
	36	Circular interpolation value (Upper word) 4			

(Example)

If you set the automatic positioning data of axis A, axis C and axis D, set the data of axis A to data address 1 - 9, the data of axis B to data address 10 - 18, the data of axis D to data address 19 - 27. Then set HD to "X" of "Setting command".

(1) Operation mode (Data No. 1)



(a) Operation (b_{15})

When this bit is "1", this step operation starts. If this bit is "0", this step operation does not start and the command error occurs.

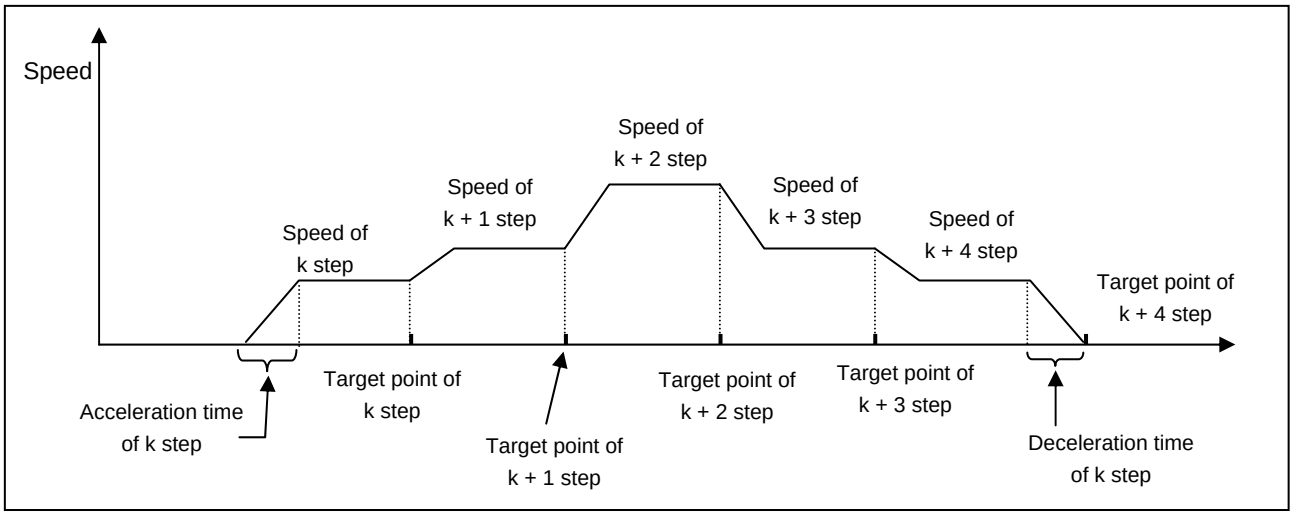
If there was any invalid step in "Cycle operation", it stops before that step.

(b) Continuous operation (b_{14})

When this bit is "1" and start "Step cycle operation", the motor drives continuously changing speed up to the last step like below.

The number of speed changing is maximum 256 steps.

[Example of starting from "k" step to "k + 4" step]



Note 1: When the automatic operation mode is different from other steps, the operation continues the mode of the last step and the command error (error code: H0030) occurs.

Note 2: When this bit is "1", it stops at the ending step of Starting command.

(c) Arch-motion (b_{12})

When the environment is below, "Arch-motion" function is valid.

1) This bit is "1".
2) Continuous operation
3) Linear interpolation of 2 axes
4) Automatic step cycle operation

In detail, refer "Chapter 11.3.1 Arch-motion function".

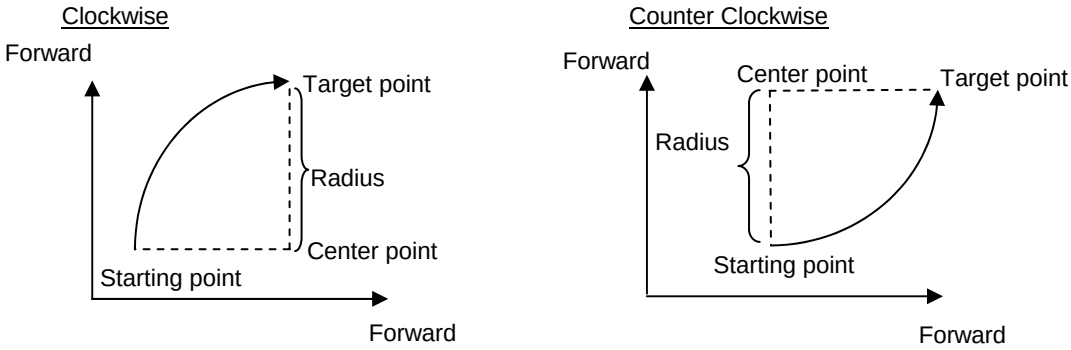
(d) Direction of Circular interpolation (b_{11})

When this bit is "0", it moves Clockwise.

When this bit is "1", it moves Counter Clockwise.

This bit is valid only in Radius setting.

[Direction]



(e) Interpolation mode (b_{10} b_9 b_8)

These bits indicate interpolation mode.

b_{10} , b_9 , b_8

0 , 0 , 0 : independent

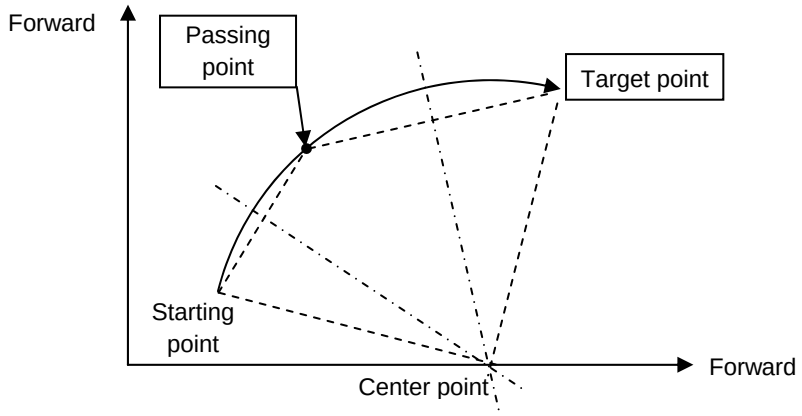
1 , 0 , 0 : Linear interpolation

1 , 0 , 1 : Circular interpolation (Passing point setting)

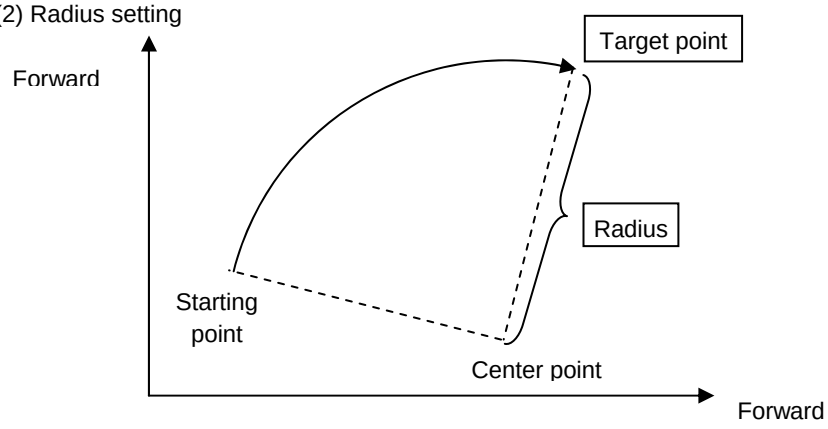
1 , 1 , 0 : Circular interpolation (Radius setting)

[Circular interpolation]

(1) Passing point setting



(2) Radius setting



(f) Control mode (b_7 b_6)

1) Positioning mode (b_7="0", b_6="0")

This mode is Positioning operation following to the positioning mode by "b_5, b_4".

2) Speed control and Positioning mode (b_7="0", b_6="1")

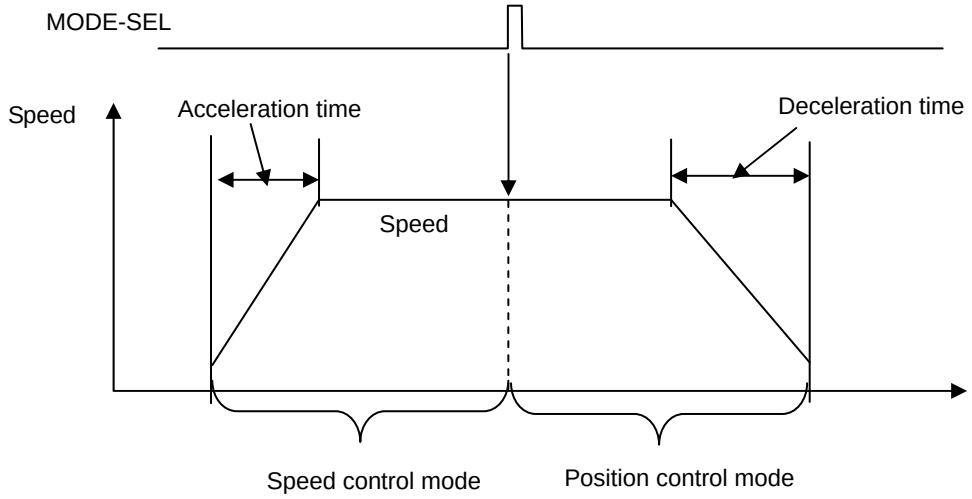
At starting, it moves by Speed control mode. After "MODE-SEL " input is "ON", it moves by Positioning control mode.

While it moves by Speed control mode, the current position value is "0".

Positioning method is Incremental respective of the (b_5, b_4) value.

The direction is following to the sign of "Target position value" (Data No. 6).

At starting, set "MODE-SEL" input "OFF".



3) Speed control mode (b_7="1", b_6="0")

It controls the motor speed only respective of "Target position value".

But the direction is following to the sign of "Target position value" (Data No. 6).

It stops by Stop commands, "Slow down stop command" or "Rapid stop command".

The current position value is always "0" respective of positioning method.

The running speed can be changed by "Speed change command"

Note

In case of "Speed control and Positioning mode" or "Speed control mode", "Interpolation operation" and "Continuous operation" are invalid.

In that case it move "Independent operation".

(g) Positioning mode (b_5, b_4)

This value sets the positioning mode of each step.

1) Absolute (b_5="0", b_4="0")

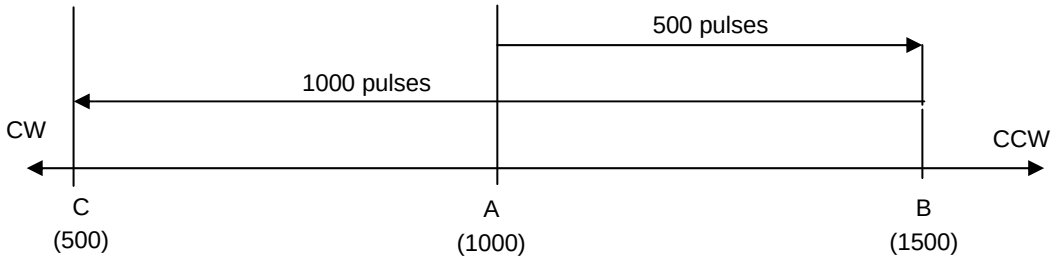
The current position value is the value of the absolute-coordinate.

The target position value indicates the absolute position.

Example of a positioning

Starting current position value (A): 1000 ⟶ First "Target position value" (B): 1500
⟶ Next "Target position value" (C): 500

Note: Without backlash



The value inside ( ) is the current position value of the absolute-coordinate.

2) Absolute and Increment (b_5="0", b_4="1")

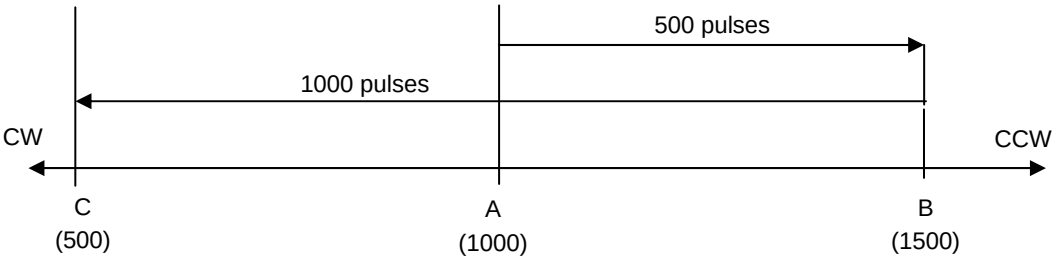
The current position value is the value of the absolute-coordinate.

The target position value indicates the incremental value.

Example of a positioning

Starting current position value (A): 1000 ⟶ First "Target position value" (B): 500
⟶ Next "Target position value" (C): -1000

Note: Without backlash



The value inside ( ) is the current position value of the absolute-coordinate.

3) Increment (b_9="1", b_8="0")

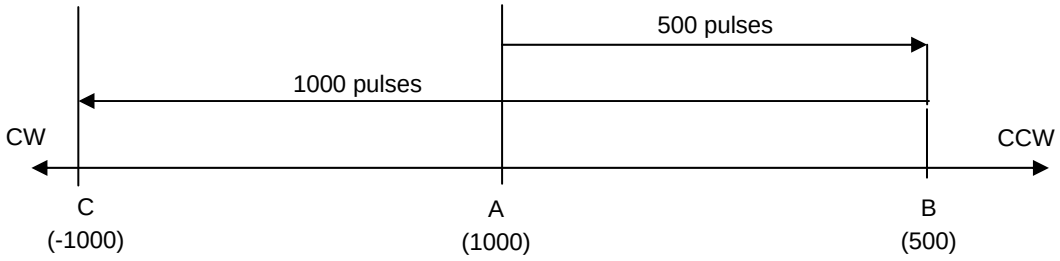
At starting it moves after set the current position value to "0".

The actual moving value is the value target position. In case of stopping by "Stop command", the actual moving value is the target position value too.

Example of a positioning

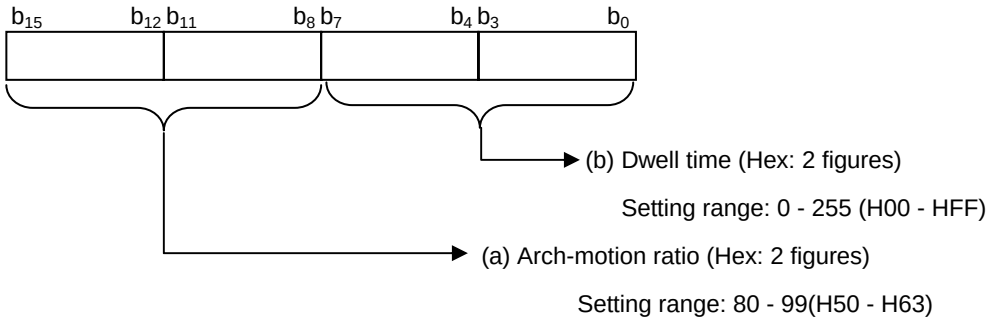
Starting current position value (A): 1000 ⟶ First "Target position value" (B): 500
⟶ Next "Target position value" (C): -1000

Note: Without backlash



The value inside ( ) is the current position value of the absolute-coordinate.

(2) Arch-motion ratio and Dwell time (Data No. 2)



(a) Arch-motion ratio (b_{15} - b_8)

This value is the starting position value of "Arch-motion".

[Arch-motion]

In case of linear interpolation and continuous operation, it moves smoothly to the "Target position" of the ending step, passing near the "Target position" of other step on the way.

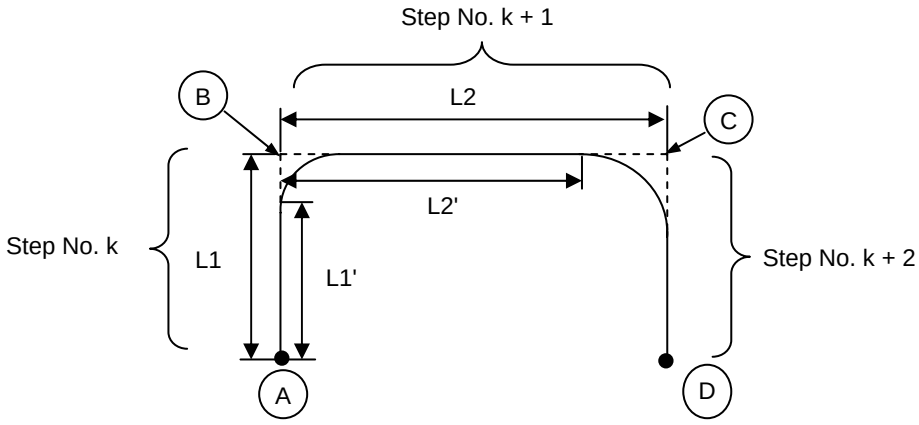
(Example)

In case of moving from (A), (B), (C) to (D)

Automatic positioning data are set "Linear interpolation", "Arch-motion" and "Continuous operation".

"Arch-motion ratio" of the steps are set (L1'/L1), (L2'/L2).

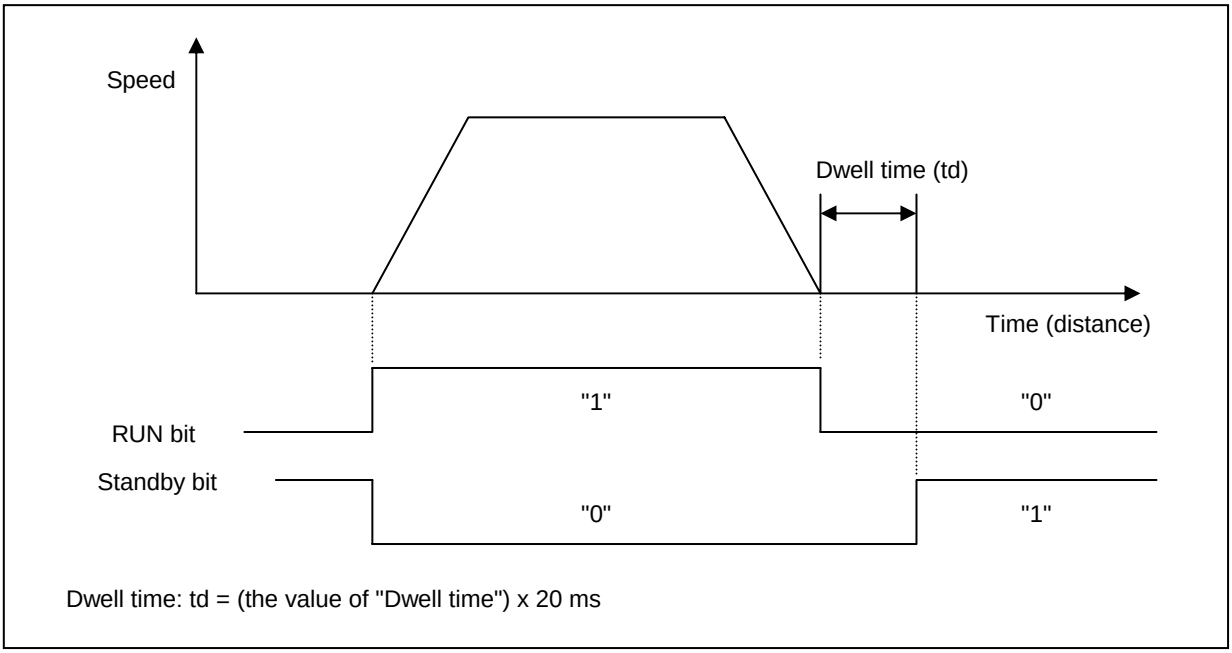
Set "Automatic step cycle operation" command to EH-POS4, then the starting step number is "k" and the ending step number is "k + 2".



(b) Dwell time (b_7 - b_0)

The lower 8 bit value of "Data No, 2" is "Dwell time". The value range is 0 - 255 (H00 - HFF).
The unit of value is "20 ms", so "Dwell time" range is 0 - 5100 ms.
"Dwell time" indicates the time from the completion of positioning ("COIN" input is "ON") until standby.

About "RUN" bit and "Standby" bit timing of "Status register", show below.



Dwell time: td = (the value of "Dwell time") x 20 ms

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The value of "Acceleration time" and "Deceleration time" can be set different from each other.
The unit of value is "ms" and the available range of "Acceleration time" or "Deceleration time" is 10 - 65 535 ms.

Note: If the wrong value was set, it moves as the value is 10 ms and command error (H0011 or H0012) occurs.
In detail, show "Chapter 13 Error code".

(4) Speed value (Data No. 5)

This value is speed of each step.
This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).
The range of this value is 1 - 65535 (HFFFF).
Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).
If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

(5) Target position value (Data No. 6)

This value is the positioning value of each step.
This value is following to Common parameter No. 2 (Unit, Position value scaling factor).
The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).
Set this value less than "Upper limit Position value" (Parameter No. 12) and more than "Lower limit Position value" (Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.
The meaning of this value is different following to "Positioning mode". Refer "6.1.2 (1) Automatic positioning mode ".

(6) Circular interpolation value (Data No. 7)

This value is the supplement value of "Circular interpolation".
In case of "Passing point setting", this value is the passing point on the way.
In case of "Radius setting", this value is the radius of circle. (Note)

Note: The radius value of the former axis following to alphabets is valid.

6.2 Register construction and operation data

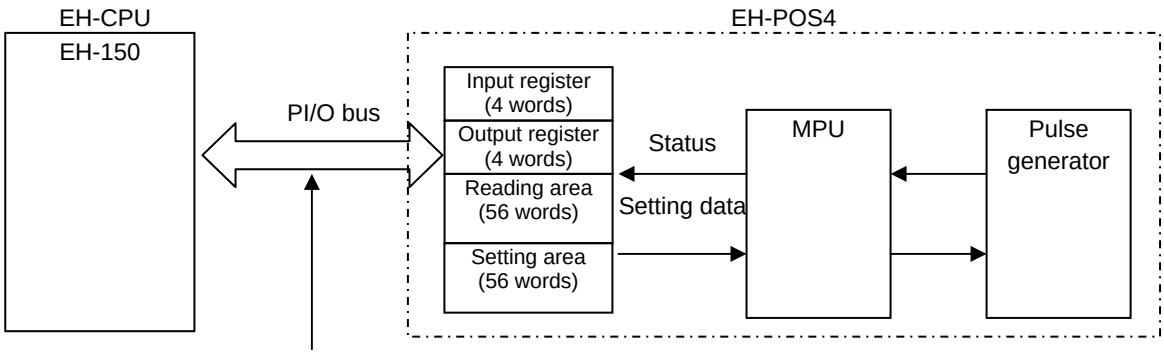
6.2.1 I/O assignment

I/O assignment of EH-POS4 is “Word 4W/4W”.
In detail about I/O assignment, refer the instruction manual of EH-150.

6.2.2 I/O register construction

EH-POS4 has the areas for the communication from EH-CPU to EH-POS4 to set the operation data and commands and to monitor the status of EH-POS4.

These areas are construct of 4 word input registers, 4 word input registers, 56 word reading area and 56 word setting area.



Control command: Start and stop operations
Setting command: Set the operation data
Reading command: Read the data of EH-POS4

Figure 6.2.2.1 Input and output registers

1) Input registers of 4 words (WX0**0 - WX0**3) can be read by user program.
2) Output registers of 4 words (WY0**4 - WY0**7) can be written by user program.
3) Reading area of 56 words in EH-POS4 can be read by special “FUN 200” instruction. (Note 1)
4) Setting area of 56 words in EH-POS4 can be written by special “FUN 200” instruction. (Note 1)

Note 1: In detail refer “Chapter 16 Programming”

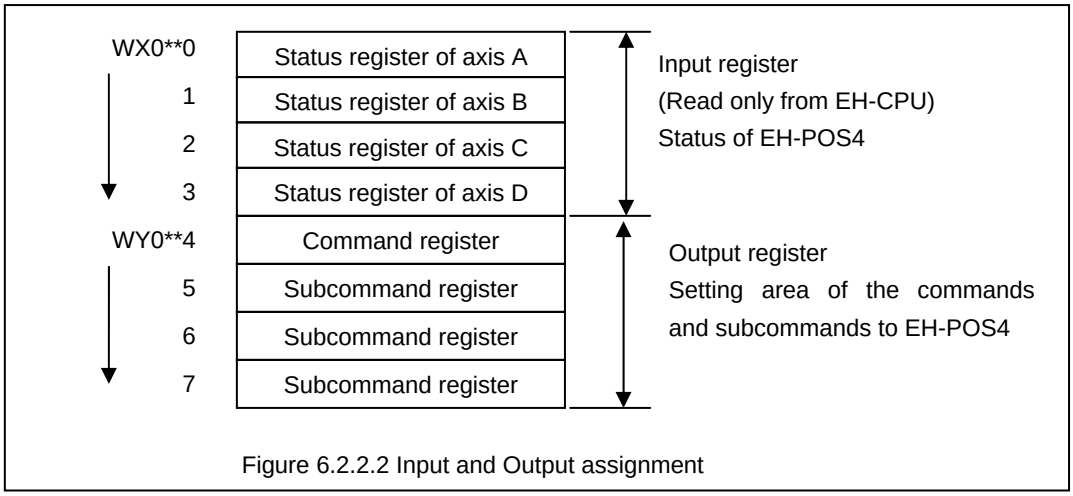
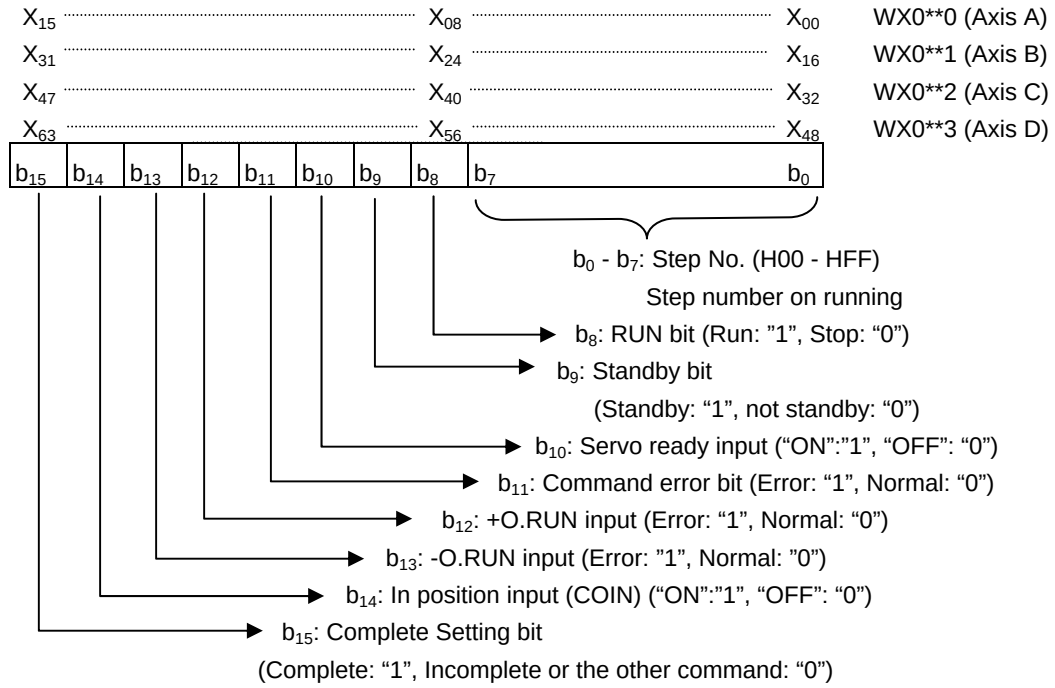


Figure 6.2.2.2 Input and Output assignment

6.2.3 Status registers

Status register is 16 bits register each axis.
Show the bit assignment of status registers.

(1) Bit assignment of Status registers (WX0**0 - 3)



Note: Default value is all “0”. (at Power on reset)

Table 5.2 Bit contents of Status register

Bit No.	Name	Contents
b_0 - b_7	Step No. (Note 1)	1) Step number on running. (Note 2) 2) Step number before stop on stopping.
b_8	RUN bit	“1” in generating pulses
b_9	Standby bit	1) “Homing” complete 2) “Automatic operation” complete (Including “Dwell time”) 3) “Manual operation” complete (Note 3) — “1” 4) Power on reset 5) Over run error, Servo ready error 6) On running (until in position) — “0”
b_{10}	Servo ready bit	“1”: SRD input is “ON”, “0”: “OFF”.
b_{11}	Command error bit	“1”: Command error [Clear timing] 1) Write the correct command or another command, but the error code is kept in the error code registers of reading area. 2) Write Initial command. The error codes of all axes clear too. In detail refer “Chapter 14 Error code”.
b_{12}	+O.RUN	“1”: Over run for forward, “0”: Clear over run.
b_{13}	-O.RUN	“1”: Over run for reverse, “0”: Clear over run.
b_{14}	Complete in position	”1”: “COIN” ON, ”0”: “COIN” OFF
b_{15}	Complete setting bit	“1”: Complete setting command or reading command “0”: Write another command or Initial command

Note 1: When write the reading command of input and output configuration, this changes input and output configuration.

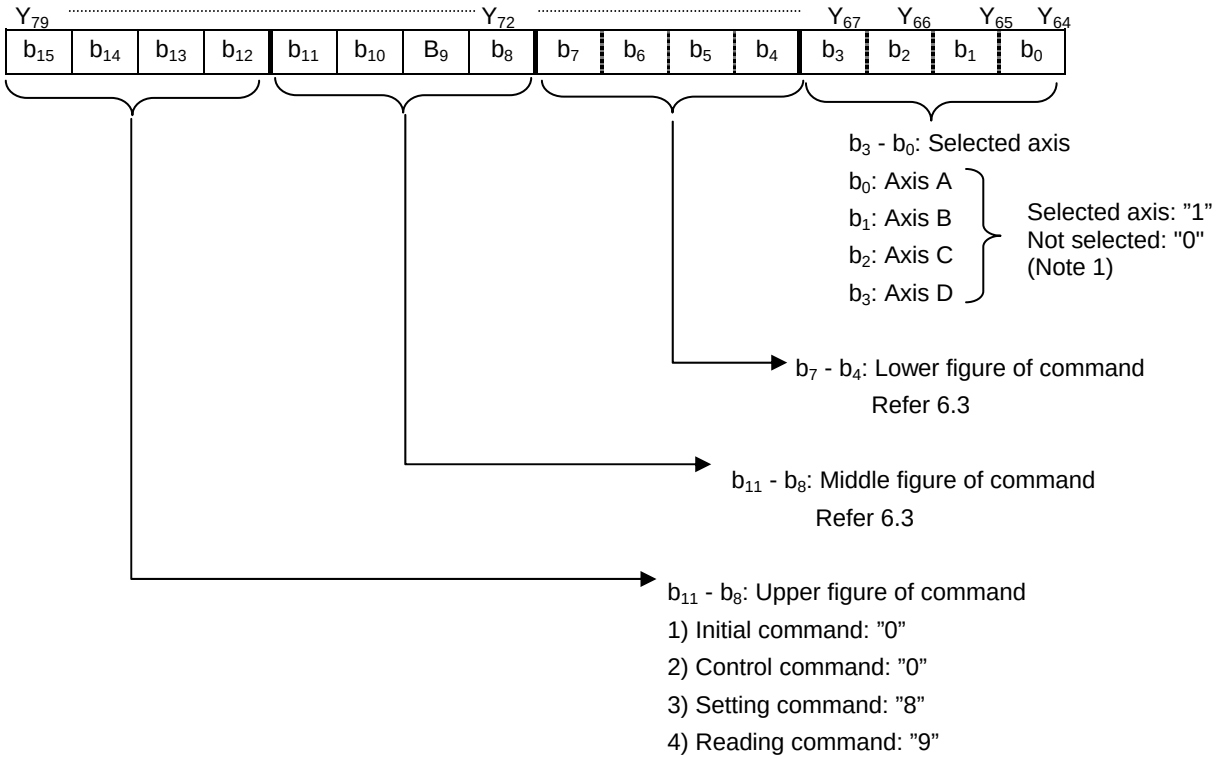
Note 2: In case of continuous operation, this value may be different from the real running step No.

Note 3: In case standby before starting.

6.2.4 Command registers (Setting registers)

(1) Bit construction of command register

The bit construction of command register (WY0**4) is bellow.



Note 1: When b_3 - b_0 are all "0”, it doesn't occurs command error, but doesn't start.

Note 2: At power on reset, b_{15} - b_0 are all "0”.

6.3 Command

Setting the commands to Command registers, EH-POS4 can start the operations, set Common parameter and Positioning data and read the data.

No.	Name	Contents
1	Initial command	Clear Command error bit, Complete setting bit and Error codes.
2	Control command	Start and stop the operation.
3	Setting command	Setting Common parameter and Positioning data.
4	Reading command	Reading Common parameter and Positioning data.

6.3.1 Control command

The list of Control commands is bellow.

Control command is constructed of Control Command (which is set to Command register (WY0**4)) and Subcommands which are set to output registers (WY0**5 - 7).

In detail of the operations, refer "Chapter 8 - 12".

Table 6.3.1.1 List of Control commands

No.	Command data	Subcommand data			Name	Contents
	WY0**4	WY0**5	WY0**6	WY0**7		
1	H010*(Note 1)	--------	--------	--------	Homing	Start homing
2	H02X*				Manual operation	
	H020*	--------	--------	--------	High speed operation (Forward)	Move forward at High speed (Parameter No. 8). Stop by Stop command.
	H021*	--------	--------	--------	Low speed operation (Forward)	Move forward at Low speed (Parameter No. 9). Stop by Stop command.
	H022*	Number of pulses	--------	--------	Inching operation (Forward)	Generate the forward pulses of subcommand per one command.
	H028*	--------	--------	--------	High speed operation (Reverse)	Move reverse at High speed (Parameter No. 8). Stop by Stop command.
	H029*	--------	--------	--------	Low speed operation (Reverse)	Move reverse at Low speed (Parameter No. 9). Stop by Stop command.
	H02A*	Number of pulses	--------	--------	Inching operation (Reverse)	Generate the reverse pulses of subcommand per one command.
3	H030*	Step No.	--------	--------	Automatic step operation	One step operation by Step data of subcommand.
4	H040*	--------	--------	--------	Direct automatic operation	One independent operation by the direct data of setting data area. (Note 2)
5	H05X*	--------	--------	--------	Interpolation	
	H050*	--------	--------	--------	Direct linear interpolation	One linear interpolation positioning by the direct data of setting data area. (Note 2)
	H051*	-------	--------	--------	Direct circular interpolation	One circular interpolation positioning by the direct data of setting data area. (Note 2)
6	H060*	Starting step No.	End step No.	Repeat number	Automatic step cycle operation	Continuous operation from the starting step No. to the ending step No. at times of the repeat number
7	H07X*				Stop	
	H070*	--------	--------	--------	Slowdown stop	Stop with deceleration.
	H07F*	--------	--------	--------	Rapid stop	Stop without deceleration.

Note 1: * indicates the operation axes. In detail, refer "6.2".

Note 2: In detail of setting data, refer "Table 6.3.1.2 List of the setting data assignment".

Setting data are valid only at once and not stored in EEPROM of EH-POS4.

Table 6.3.1.2 List of the setting data assignment

	Data No.	Direct automatic operation	Direct linear interpolation	Direct circular interpolation
Command register	WY0**4	H040*	H050*	H051*
	WY0**5	--------	--------	--------
	WY0**6	--------	--------	--------
	WY0**7	--------	--------	--------
Setting area	1	Automatic operation data 1	Automatic operation data 1	Automatic operation data 1
	2	Dwell time 1	Dwell time 1	Dwell time 1
	3	Acceleration time 1	Acceleration time 1	Acceleration time 1
	4	Deceleration time 1	Deceleration time 1	Deceleration time 1
	5	Speed 1	Speed 1	Speed 1
	6	Target position value 1	Target position value 1	Target position value 1
	7			
	8	Automatic operation data 2	Target position value 2	Circular interpolation value 1
	9	Dwell time 2		
	10	Acceleration time 2	Target position value 3	Target position value 2
	11	Deceleration time 2		
	12	Speed 2	Target position value 4	Circular interpolation value 2
	13	Target position value 2		
	14		--------	--------
	15	Automatic operation data 3	--------	--------
	16	Dwell time 3	--------	--------
	17	Acceleration time 3	--------	--------
	18	Deceleration time 3	--------	--------
	19	Speed 3	--------	--------
	20	Target position value 3	--------	--------
	21		--------	--------
	22	Automatic operation data 4	--------	--------
	23	Dwell time 4	--------	--------
	24	Acceleration time 4	--------	--------
	25	Deceleration time 4	--------	--------
	26	Speed 4	--------	--------
	27	Target position value 4	--------	--------
	28		--------	--------

----: don't care.

(a) Slow down stop command

When it is set Slow down stop command (H070* (*: the operation axis) to Command register, it gets slow down by Acceleration and Deceleration mode in Deceleration time (Refer 6.1) and stops.

Table 6.3.1.3 Behavior of Slow down stop

		On running	Stop (Note 1)	Status after stop
On homing (Note 2)		Slow down in Deceleration time (Parameter No. 10) to Initial speed and stop. (Note 3)	ignored	Not standby
Manual operation	High or Low speed	The same as the above	The same as the above	Status before Manual operation
	Inching	The same as the above	The same as the above	The same as the above
Automatic step operation		Slow down in Deceleration time (Data No. 4) to Initial speed and stop.	The same as the above	Standby
Direct automatic operation (interpolation)		The same as the above	The same as the above	The same as the above

Note 1: Since pulse stop to standby.
Note 2: Incase of Free home position and Absolute encoder homing, this command becomes invalid.
Note 3: In case of Low speed homing, it stops pulses without slow down as well as Rapid stop.
Note 4: In case of interpolation operation, this command for one axis makes all axes of interpolation stop.

(b) Rapid stop command

When it is set Rapid stop command (H07F* (*: the operation axis) to Command register, it stops pulses immediately.

This command is valid in running. If it is getting slow down, this command is valid and stops pulses immediately.

Table 6.3.1.4 Behavior of Rapid stop

		On running	Stop (Note 1)	Status after stop
On homing (Note 2)		Stop pulses immediately.	ignored	Not standby
Manual operation	High or Low speed	The same as the above	The same as the above	Status before Manual operation
	Inching	The same as the above	The same as the above	The same as the above
Automatic step operation		The same as the above	The same as the above	Standby
Direct automatic operation (interpolation)		The same as the above	The same as the above	The same as the above

Note 1: In case of free home position and Absolute encoder homing, this command becomes invalid.
Note 2: In case of interpolation operation, this command for one axis makes all axes of interpolation stop.

6.3.2 Setting command

The list of the setting commands is bellow.

Setting command is constructed of Setting Command (which is set to Command register (WY0**4)) and Subcommands which are set to output registers (WY0**5 - 7).

Table 6.3.2.1 List of Setting commands

No.	Command data	Subcommand data			Name	Contents
	WY0**4	WY0**5	WY0**6	WY0**7		
1	H810*	Parameter value	--------	--------	I/O configuration	1) Pulse train mode 2) O.RUN input made 3) SRDY/COIN input mode
2	H830*	--------	--------	--------	Speed change	Change speed on running. (Note 4)
3	H880*	Step No.	--------	--------	Positioning step data	Set positioning step data in the setting area to EH-POS4 as the step selected by subcommand (WY0**5).
4	H890*	Step No.	--------	--------	Teaching	Set the current position value to the target position value as the step selected by subcommand (WY0**5).
5	H8D0*	--------	--------	--------	Common parameter	Set the value of Setting area to Common parameter.
6	H8DF*	--------	--------	--------	Default Parameter	Set the value of Setting area to Common parameter.
7	H8F0*	--------	--------	--------	Current position value	Set the value of Setting area to current position value. (Note 5)

Note 1: ---- don't care

Note 2: In detail "Table 6.3.2.2".

Note 3: Be careful of the number to rewrite the above data. EEPROM for stored data can be rewrite maximum 100 000 times.

Note 4: "Speed change" is invalid in case of interpolation and continuous operation.

Note 5: " Current position value change" is only valid in standby.

The assignment of the setting data is bellow.
In detail about Common parameter and Automatic positioning data, refer "6.1 Positioning data".

Table 6.3.2.2 List of the setting data assignment

	Data No.	Speed change	Setting Automatic positioning data	Setting Common parameter	Current position value change
Command register	WY0**4	H830X	H880X	H8D0X	H8F0X
	WY0**5	--------	Step No.	--------	--------
	WY0**6	--------	--------	--------	--------
	WY0**7	--------	--------	--------	--------
Setting area	1	Speed 1	Operation mode (Data No. 1) 1	Parameter No. 1	Current position value 1
	2	Speed 2	Arch-motion ratio and Dwell time 1 (Data No. 2)	Parameter No. 2	Current position value 2
	3	Speed 3	Acceleration time 1 (Data No. 3)	Parameter No. 3	Current position value 3
	4	Speed 4	Deceleration time 1 (Data No. 4)	Parameter No. 4	Current position value 4
	5	--------	Speed 1 (Data No. 4)	Parameter No. 5	--------
	6	--------	Target position value 1 (Lower word) (Data No. 5)	Parameter No. 6	--------
	7	--------	Target position value 1 (Upper word) (Data No. 5)	Parameter No. 7	--------
	8	--------	Circular interpolation value 1 (Lower word) (Data No. 6)	Parameter No. 8	--------
	9	--------	Circular interpolation value 1(Upper word) (Data No. 6)	Parameter No. 9	--------
	10	--------	Automatic positioning data 2	Parameter No. 10	--------
	11	--------		Parameter No. 11	--------
	12	--------		Parameter No. 12 (Lower word)	--------
	13	--------		Parameter No. 12 (Upper word)	--------
	14	--------		Parameter No. 13 (Lower word)	--------
	15	--------		Parameter No. 13 (Upper word)	--------
	16	--------		Parameter No. 14 (Lower word)	--------
	17	--------		Parameter No. 14 (Upper word)	--------
	18	--------		Parameter No. 15 (Lower word)	--------
	19	--------	Automatic positioning data 3	Parameter No. 15 (Upper word)	--------
	20	--------		--------	--------
	21	--------		--------	--------
	22	--------		--------	--------
	23	--------		--------	--------
	24	--------		--------	--------
	25	--------		--------	--------
	26	--------		--------	--------
	27	--------		--------	--------
	28 - 36	--------	Automatic positioning data 4	--------	--------

Note 1: ------ don't care.
Note 2: Fill the setting data of each axis in order.
(Example)
Command: H880D (D: Selected axes are "Axis A", "Axis C" and "Axis D".
Data 1 is "Axis A". Data 2 is "Axis C". Data 3 is "Axis D".

6.3.3 Reading command

The list of Reading commands is bellow.

Setting command is constructed of Reading Command (which is set to Command register (WY0**4)) and Subcommands which are set to output registers (WY0**5 - 7).

Table 6.3.3.1 List of Reading command

No.	Command data	Subcommand data			Name	Contents
	WY0**4	WY0**5	WY0**6	WY0**7		
1	H9100	--------	--------	--------	I/O setting	Read and indicate the current I/O setting on the lower byte of the status register.
2	H980*	Step No.	--------	--------	Positioning step data	Read and indicate the positioning step data on the reading area.
3	H9D0*	--------	--------	--------	Common parameter	Read and indicate Common parameter on the reading area.
4	H9F00	--------	--------	--------	Latched current position value	Indicate the latched current position value on the reading area. (Note 1)

Note 1: The current value always indicated on the reading area is 32 bit size. But it is renewed by word (16 bit) size at once. So the lower and upper word of this value may not become the simultaneous value.

The data assignment of Reading area is bellow.

Table 6.3.2 List of Reading data assignment

<table>
<tr><th rowspan="2"></th><th rowspan="2">Data No.</th><th colspan="4">Assignment</th><th rowspan="2">Contents</th></tr>
<tr><th>I/O configuration</th><th>Positioning step data</th><th>Common parameter</th><th>Latched current position value</th></tr>
<tr><td rowspan="4">Command register</td><td>WY0**4</td><td>H9100</td><td>H980*</td><td>H9D0*</td><td>H9F00</td><td></td></tr>
<tr><td>WY0**5</td><td>----</td><td>Step No.</td><td>----</td><td>----</td><td></td></tr>
<tr><td>WY0**6</td><td>----</td><td>----</td><td>----</td><td>----</td><td></td></tr>
<tr><td>WY0**7</td><td>----</td><td>----</td><td>----</td><td>----</td><td></td></tr>
<tr><td rowspan="50">Reading area</td><td>1</td><td colspan="4">I/O configuration A, B Upper byte Lower byte
Axis B | Axis A</td><td rowspan="2">Indicate always</td></tr>
<tr><td>2</td><td colspan="4">I/O configuration C, D Upper byte Lower byte
Axis D | Axis C</td></tr>
<tr><td>3</td><td colspan="4">Error code of axis A</td><td rowspan="4">Indicate always
In detail of error code, refer " Chapter 13".</td></tr>
<tr><td>4</td><td colspan="4">Error code of axis B</td></tr>
<tr><td>5</td><td colspan="4">Error code of axis C</td></tr>
<tr><td>6</td><td colspan="4">Error code of axis D</td></tr>
<tr><td>7</td><td colspan="4">Current position value of axis A (Lower word)</td><td rowspan="8">Indicate always</td></tr>
<tr><td>8</td><td colspan="4">Current position value of axis A (Upper word)</td></tr>
<tr><td>9</td><td colspan="4">Current position value of axis B (Lower word)</td></tr>
<tr><td>10</td><td colspan="4">Current position value of axis B (Upper word)</td></tr>
<tr><td>11</td><td colspan="4">Current position value of axis C (Lower word)</td></tr>
<tr><td>12</td><td colspan="4">Current position value of axis C (Upper word)</td></tr>
<tr><td>13</td><td colspan="4">Current position value of axis D (Lower word)</td></tr>
<tr><td>14</td><td colspan="4">Current position value of axis D (Upper word)</td></tr>
<tr><td>15</td><td rowspan="24">----</td><td rowspan="10">Automatic positioning data 1 (total 9 words)</td><td rowspan="16">Common parameter No. 1 - 16 (total 19 words)</td><td>Current position value of axis A (Lower)</td><td rowspan="24">Indicate following to Reading commands.</td></tr>
<tr><td>16</td><td>Current position value of axis A (Upper)</td></tr>
<tr><td>17</td><td>Current position value of axis B (Lower)</td></tr>
<tr><td>18</td><td>Current position value of axis B (Upper)</td></tr>
<tr><td>19</td><td>Current position value of axis C (Lower)</td></tr>
<tr><td>20</td><td>Current position value of axis C (Upper)</td></tr>
<tr><td>21</td><td>Current position value of Axis D axis (Lower)</td></tr>
<tr><td>22</td><td>Current position value of axis D (Upper)</td></tr>
<tr><td>23</td><td rowspan="15">----</td></tr>
<tr><td>24 - 32</td><td>Automatic positioning data 2 (total 9 words)</td></tr>
<tr><td>33 - 41</td><td>Automatic positioning data 3 (total 9 words)</td></tr>
<tr><td>42 - 50</td><td>Automatic positioning data 4 (total 9 words)</td><td>----</td></tr>
</table>

6.4 Data assignment for commands

6.4.1 Data table of for Control commands

	Data No.	Homing	Manual operation						Automatic step operation	Direct positioning operation	Direct linear interpolation positioning	Direct circular interpolation positioning	Automatic step cycle operation	Stop	
			High speed forward	Low speed forward	Inching forward	High speed reverse	Low speed reverse	Inching reverse						Slow down stop	Rapid stop
Command register	WY0**4	H010*	H020*	H021*	H022*	H028*	H029*	H02A*	H030*	H040*	H050*	H051*	H060*	H070*	H07F*
	WY0**5	----	----	----	Pulses	----	----	Pulses	Step No.	----	----	----	Starting step	----	----
	WY0**6	----	----	----	----	----	----	----	----	----	----	----	Ending step	----	----
	WY0**7	----	----	----	----	----	----	----	----	----	----	----	Repeat No.	----	----
Setting area	1	----	----	----	----	----	----	----	----	Operation mode 1	Operation mode 1	Operation mode 1	----	----	----
	2	----	----	----	----	----	----	----	----	Dwell time 1	Dwell time 1	Dwell time 1	----	----	----
	3	----	----	----	----	----	----	----	----	Accel. time 1	Accel. time 1	Accel. time 1	----	----	----
	4	----	----	----	----	----	----	----	----	Decel. time 1	Decel. time 1	Decel. time 1	----	----	----
	5	----	----	----	----	----	----	----	----	Speed 1	Speed 1	Speed 1	----	----	----
	6	----	----	----	----	----	----	----	----	Target position 1	Target position 1	Target position 1	----	----	----
	7	----	----	----	----	----	----	----	----				----	----	----
	8	----	----	----	----	----	----	----	----	Operation mode 2	Target position 2	Circular interpolation 1	----	----	----
	9	----	----	----	----	----	----	----	----	Dwell time 2			----	----	----
	10	----	----	----	----	----	----	----	----	Accel. time 2	Target position 3	Target position 2	----	----	----
	11	----	----	----	----	----	----	----	----	Decel. time 2			----	----	----
	12	----	----	----	----	----	----	----	----	Speed 2	Target position 4	Circular interpolation 2	----	----	----
	13	----	----	----	----	----	----	----	----	Target position 2			----	----	----
	14	----	----	----	----	----	----	----	----		----	----	----	----	----
	15	----	----	----	----	----	----	----	----	Operation mode 3	----	----	----	----	----
	16	----	----	----	----	----	----	----	----	Dwell time 3	----	----	----	----	----
	17	----	----	----	----	----	----	----	----	Accel. time 3	----	----	----	----	----
	18	----	----	----	----	----	----	----	----	Decel. time 3	----	----	----	----	----
	19	----	----	----	----	----	----	----	----	Speed 3	----	----	----	----	----
	20	----	----	----	----	----	----	----	----	Target position 3	----	----	----	----	----
	21	----	----	----	----	----	----	----	----		----	----	----	----	----
	22	----	----	----	----	----	----	----	----	Operation mode 4	----	----	----	----	----
	23	----	----	----	----	----	----	----	----	Dwell time 4	----	----	----	----	----
	24	----	----	----	----	----	----	----	----	Accel. time 4	----	----	----	----	----
	25	----	----	----	----	----	----	----	----	Decel. time 4	----	----	----	----	----
	26	----	----	----	----	----	----	----	----	Speed 4	----	----	----	----	----
	27	----	----	----	----	----	----	----	----	Target position 4	----	----	----	----	----
	28	----	----	----	----	----	----	----	----		----	----	----	----	----

--------: don't care

6.4.2 Data table for Setting command

	Data No.	I/O Setting	Speed change	Positioning step data	Teaching	Common parameter	Default parameter	Current position value change
Command register	WY0**4	H810*	H830*	H880*	H890*	H8D0*	H8DF*	H8F0*
	WY0**5	parameter	----	Step No.	Step No.	----	----	----
	WY0**6	----	----	----	----	----	----	----
	WY0**7	----	----	----	----	----	----	----
Setting area	1	----	Speed 1	Operation mode	----	Parameter No. 1 (Homing mode etc.)	----	Current position 1
	2	----	Speed 2	Arch-motion ratio and Dwell time	----	Parameter No. 2 (Scaling etc.)	----	Current position 2
	3	----	Speed 3	Acceleration time	----	Parameter No. 3 (Pulse logic etc.)	----	Current position 3
	4	----	Speed 4	Deceleration time	----	Parameter No. 4 (Pulses /r)	----	Current position 4
	5	----	----	Speed	----	Parameter No. 5 (Position value /r)	----	----
	6	----	----	Target position	----	Parameter No. 6 (Speed limit value)	----	----
	7	----	----		----	Parameter No. 7 (Initial speed)	----	----
	8	----	----	Circular interpolation value	----	Parameter No. 8 (High speed)	----	----
	9	----	----		----	Parameter No. 9 (Low speed)	----	----
	10	----	----	(Note 1)	----	Parameter No. 10 (acceleration and deceleration time)	----	----
	11	----	----		----	Parameter No. 11 (Backlash)	----	----
	12	----	----		----	Parameter No. 12 (Positioning Upper limit)	----	----
	13	----	----		----		----	----
	14	----	----		----	Parameter No. 13 (Positioning Lower limit)	----	----
	15	----	----		----		----	----
	16	----	----		----	Parameter No. 14 (Home position value)	----	----
	17	----	----		----		----	----
	18	----	----		----	Parameter No. 15 (Homing offset value)	----	----
	19	----	----		----		----	----

Note 1: In case of more than 2 axes, set the data per the number of axes.

Chapter 7 Setting and reading Positioning data

7.1 Timing of setting and reading Positioning data

Timing of setting and reading data by the program is bellow.

7.1.1 Flowchart of setting Positioning data

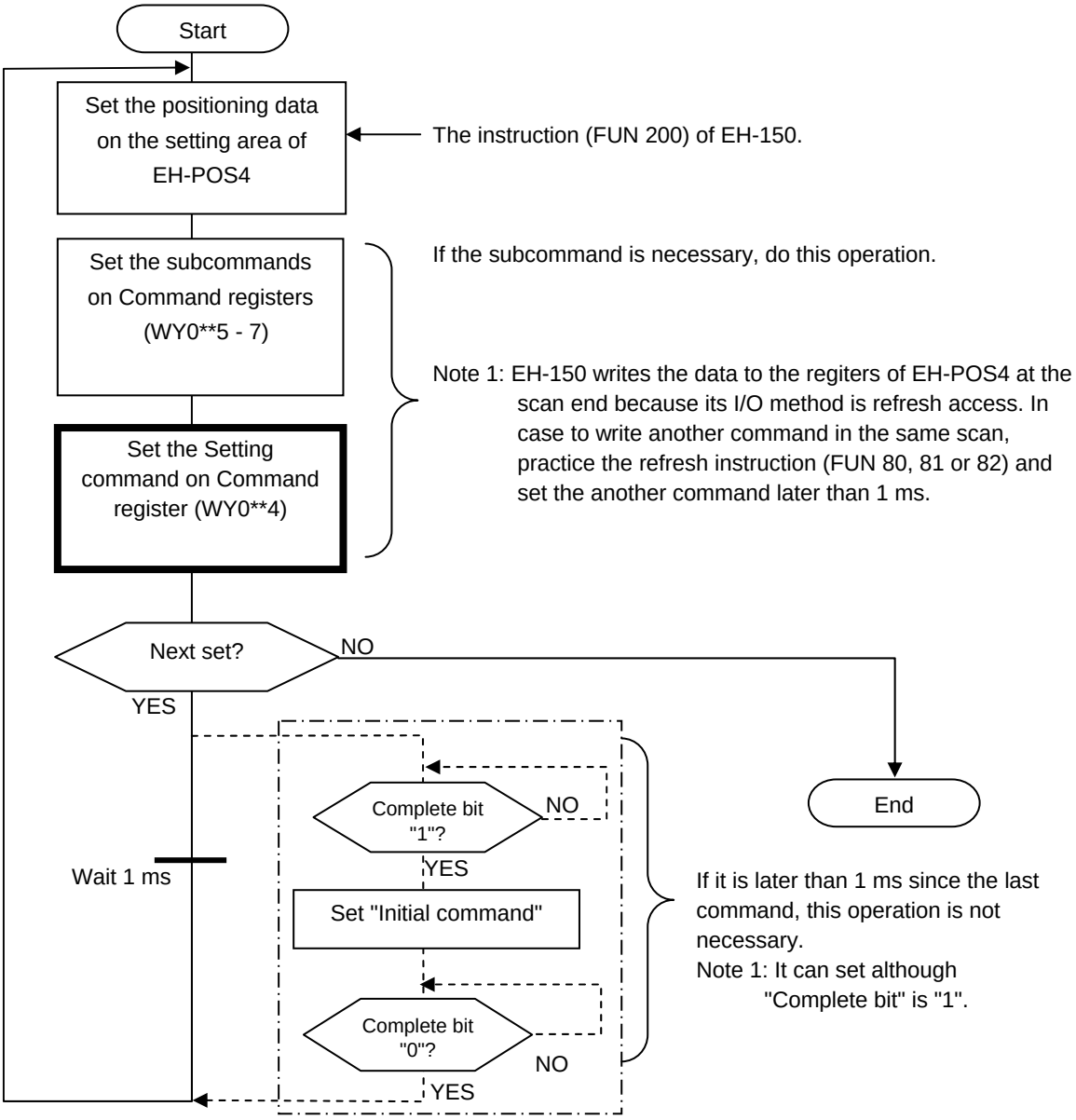
At first set the positioning data on teh settion area of EH-POS4 by the instruction (FUN 200) of Eh-150. (In detail of FUN 200, refer the instruction manual oh EH-150.)

Next If the subcommand is necessary, set the subcommand. At last set Setting command.

When the setting operation is complete, "Complete bit" of the applicable axis, which is " b_{15}" of Status regiter, become "1".

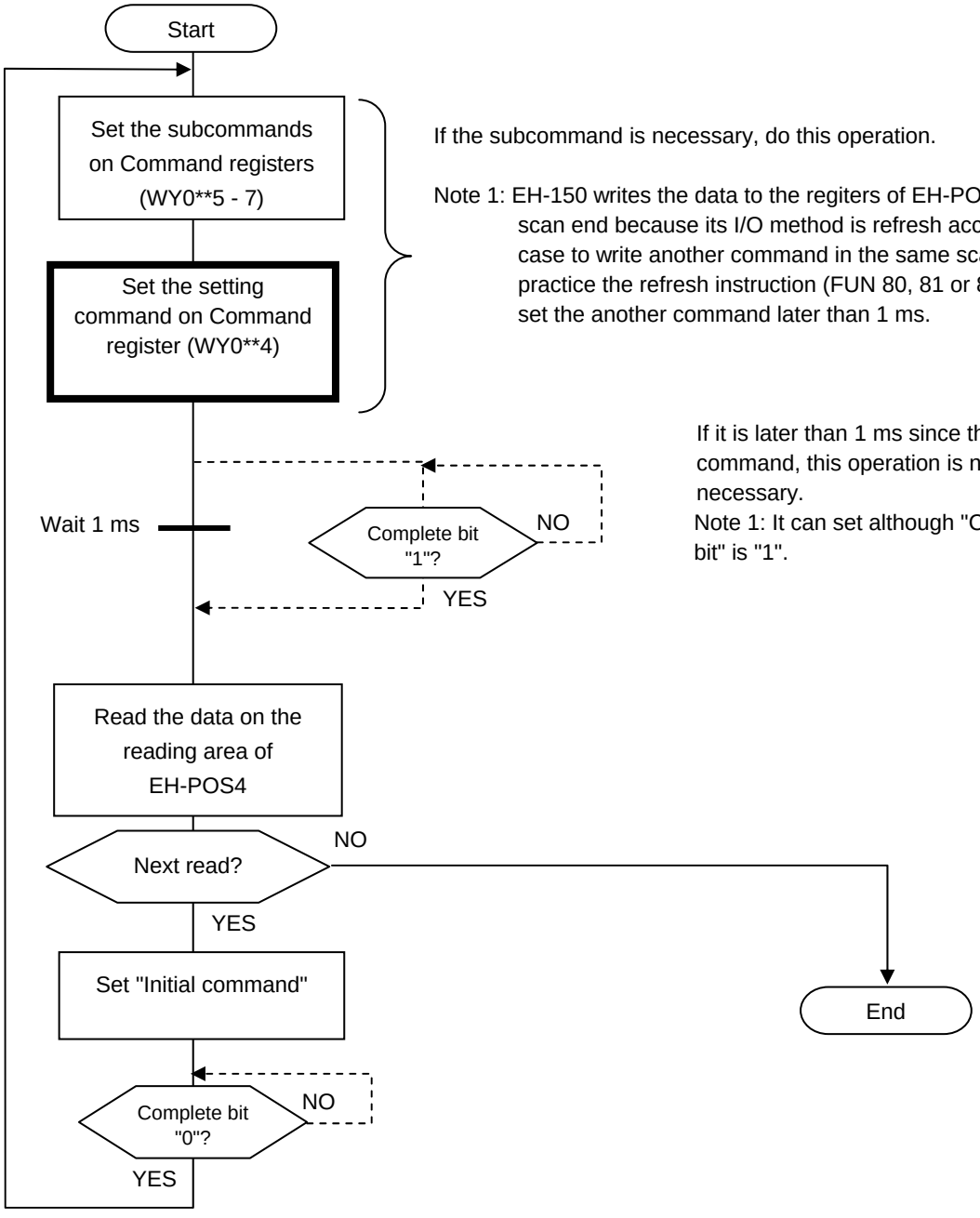
In order to clear "Complete bit", set Initial command or set "Control command".

The flowchart of this protocol is bellow.



7.1.2 Flowchart of reading Positioning data

At first If the subcommand is necessary, set the subcommand. Next set the "Reading command".
When the reading operation is complete, "Complete bit" of the applicable axis, which is " b_{15}" of Status regiter, become "1". Then it can read the data by the instruction (FUN 200) of Eh-150. (In detail of FUN 200, refer the instruction manual oh EH-150.)
In order to clear "Complete bit", set Initial command or set "Control command".
The flowchart of this protocol is bellow.



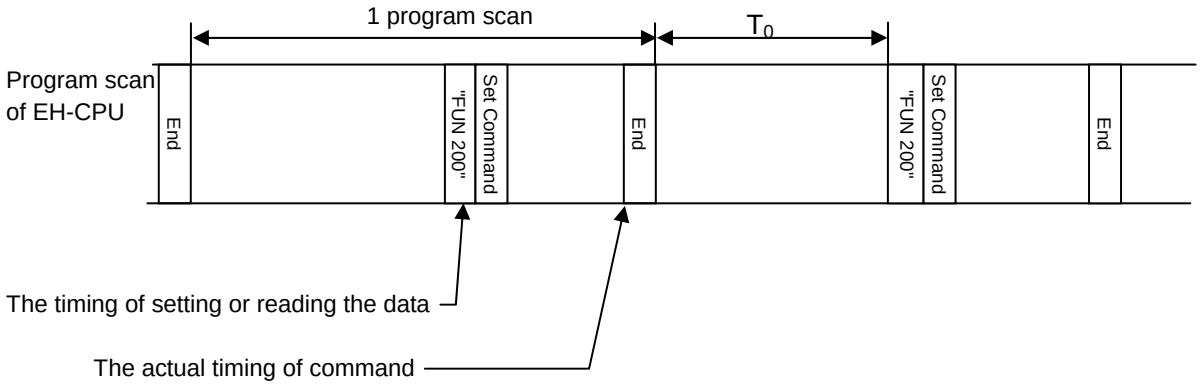
7.1.3 Timing of setting Positioning data

Actual timing of setting "Positioning data" to the register of EH-POS4 is bellow.

(1) Usual timing

I/O access method of EH-150 is refresh. So usually it practices to write the command and subcommands to Command registers (WY0**4 - 7) or read status registers (WX0**0 - 3) at the scan end.

But it practices to write the positioning data to the setting area or read the data from the reading area of EH-POS4 at the timing of "FUN 200".

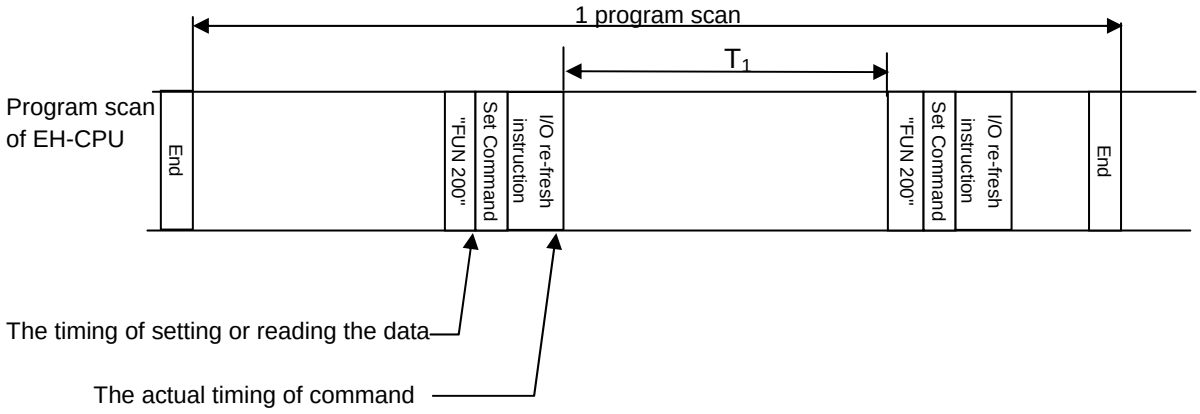


(EH-POS4 starts the operation of the command from this timing.)

Note: When T_0 > 1 ms, it is possible to write or set the next command.

(2) Timing in case of using the I/O refresh instructions

In this case, it is possible to set several commands in a program scan.



(EH-POS4 starts the operation of the command from this timing.)

Note 1: When T_1 > 1 ms, it is possible to write or set the next command.

Note 2: I/O re-fresh instructions of EH-150

1) FUN 80 (s): Re-fresh all I/O.
2) FUN 81 (s): Re-fresh all inputs or all outputs selectively.
3) FUN 82 (s): Re-fresh the I/O of the selective slot by "s".

7.2 Setting command

I/O logic setting, Common parameter and Automatic positioning data are set to the EEPROM of EH-POS4 by the setting commands.

The data stored in the EEPROM is kept although turn off power.

7.2.1 I/O logic setting command

This command selects the external I/O logic (Pulse logic, O.RUN input polarity, valid or invalid selection of SRD and COIN input).

When the value "H810*" is written to the command register (WY0**4), this command will do.

At same time, the setting contents are saved in Common parameter No.3.

If multiple axes are selected, it set the same contents to the selected axes.

[Setting command]

WY0**4 (Command)	8	1	0	*
WY0**5 (Subcommand)	Pulse logic	+O.RUN input	-O.RUN input	SRDY/ COIN

*: Selected axes

In detail, refer "6.1.1".

[Example]

In case of the selected axes are bellow.

b_3	b_2	b_1	b_0	
1	0	1	1	Selected axis A, B and D

The "Parameter No. 3" value of axis A, axis B and axis D changes to Subcommand.

The "Parameter No. 3" value not selected is kept before value.

[Response data]

The contents which are set by this command is indicated on the lower byte of status register (Wx0**0 - 3)

	b_{15}		b_7 b_0
WX0**0	1	Note 1	Setting of axis A or 0 (Note 2)
WX0**1	1	Note 1	Setting of axis B or 0 (Note 2)
WX0**2	0	Note 1	0
WX0**3	1	Note 1	Setting of axis D or 0 (Note 2)

Note 1: Kept the last value.

Note 2: In detail, refer bellow.

b_7	b_6	b_5	b_4	b_3	B_2	b_1	b_0	Contents
0	0	*	*	*	*	*	*	Pulses and Direction signal (Positive logic)
0	1	*	*	*	*	*	*	CCW and CW pulses (Positive logic)
1	0	*	*	*	*	*	*	Pulses and Direction signal (Negative logic)
1	1	*	*	*	*	*	*	CCW and CW pulses (Negative logic)
*	*	0	0	*	*	*	*	When +O.RUN input is "OFF", the command error occurs.
*	*	0	1	*	*	*	*	When +O.RUN input is "ON", the command error occurs
*	*	1	0	*	*	*	*	+O.RUN input is invalid.
*	*	*	*	0	0	*	*	When -O.RUN input is "OFF", the command error occurs.
*	*	*	*	0	1	*	*	When -O.RUN input is "ON", the command error occurs
*	*	*	*	1	0	*	*	-O.RUN input is invalid.
*	*	*	*	*	*	0	*	When SRD input is "ON", the servo is ready.
*	*	*	*	*	*	1	*	SRD input is invalid.
*	*	*	*	*	*	*	0	When COIN input is "ON", In position completes.
*	*	*	*	*	*	*	1	COIN input is invalid.

*: 0 or 1

Note 3: If the selected axes value is "0", the command is invalid.

7.2.2 Speed change command

This command changes speed on running.
When the value "H830*" is written to the command register (WY0**4), this command will do.
Change value is applied in order from axis A to axis D.

[Setting command]

WY0**4 (Command)

8	3	0	*

*: Selected axes

Setting area

Word 1	Speed change value 1
Word 2	Speed change value 2
Word 3	Speed change value 3
Word 4	Speed change value 4

[Example]
In case of the selected axes are bellow.

b_3	b_2	b_1	b_0
1	1	0	1

Selected axis A, C and D

In this case, **Axis A: Speed change value 1, axis C: Speed change value 2, axis D: Speed change value 3.**

[Response data]

	b_{15}		b_7 b_0
WX0**0	1	Note 1	Note 1
WX0**1	0	Note 1	Note 1
WX0**2	1	Note 1	Note 1
WX0**3	1	Note 1	Note 1

Note 1: Kept the last value.
Note 2: If the selected axes are stopping, this command is invalid for stopping axis.
Note 3: This change value is temporary value, so it doesn't influence the stored data.
Note 4: If the selected axes value is "0", this command is invalid.

7.2.3 Automatic positioning data setting command

This command sets the automatic positioning data by a step.

When the value "H880*" s written to the command register (WY0**4) with "step No." which is set to the subcommand register (WY0**5), this command will do.

The Positioning value in the setting area is applied in order from axis A to axis D.

Table 7.1 List of Automatic positioning data

Data No.	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents
1	1	Automatic operation mode				Note 1
2	2	Arch-motion ratio and Dwell time				1)Arch-motion starting distance ratio 2)Dwell time (unit: 20 ms)
3	3	Acceleration time				Unit: ms
4	4	Deceleration time				Unit: ms
5	5	Speed				Speed value (Note 2)
6	6	Target position value (Lower word)				Target positioning point or speed changing point of continuous operation -2 147 483 647 to +2 147 486 648
	7	Target position value (Upper word)				
7	8	Circular interpolation value (Lower word)				Passing point mode: passing point position value Radius mode: Radius value (Note 2)
	9	Circular interpolation value (Upper word)				

Note 1: In detail, refer "6.1.2"

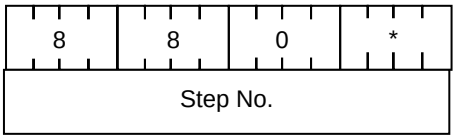
Note 2: In detail about unit, refer Parameter No. 2 of "6.1.1".

Note 3: Invalid except Circular interpolation.

[Setting command]

WY0**4 (Command)

WY0**5 (Subcommand)



*: Selected axes

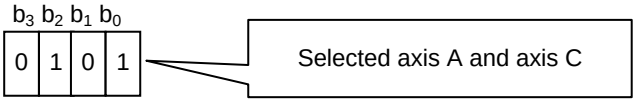
[Setting area]

Setting area Word No.	Word No.	Contents
1 - 9	Data No. 1 - 9	Automatic positioning data 1 (Note 1)
10 - 18	Data No. 1 - 9	Automatic positioning data 2 (Note 1)
19 - 27	Data No. 1 - 9	Automatic positioning data 3 (Note 1)
28 - 37	Data No. 1 - 9	Automatic positioning data 4 (Note 1)

Note 1: About the assignment of Automatic positioning data, refer "Table 7.1"

[Example]

In case of the selected axes are bellow and "Step No." is H3F (63).



In this case, "**Automatic positioning data 1" are set to "Automatic positioning data" in the 63rd step of axis A and "Automatic positioning data 2" are set to " Automatic positioning data" in the 63rd step of axis C.**

[Response data]

(Example)

	b_{15}	b_{14} ... b_0
WX0**0	1	(Note 1)
WX0**1	0	(Note 1)
WX0**2	1	(Note 1)
WX0**3	0	(Note 1)

Note 1: Kept the last value.

Note 2: If "Step No." is over than H100 (256), the command error occurs and will not complete.

Note 3: Only Automatic positioning data of the selected "step No." change. The other step data will not change.

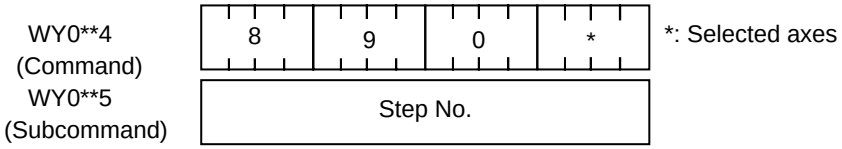
Note 4: If the selected axes value is "0", this command is invalid.

7.2.4 Teaching command

This command sets the current position value to "Target position value" of selected "step No.". When the value "H890*" is written to the command register (WY0**4) with "step No." which is set to the subcommand register (WY0**5), this command will do.

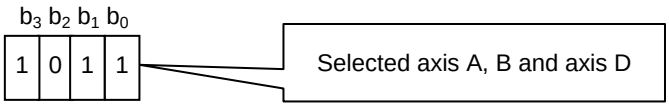
"Teaching" is possible for multiple axes at once.

[Setting command]



[Example]

In case of the selected axes are bellow and "Step No." is H3F (63).



In this case, **the current position value of axis A is set to "Target position value" in the 63rd step of axis A, the current position value of axis B is set to "Target position value" in the 63rd step of axis B and the current position value of axis D is set to "Target position value" in the 63rd step of axis D**

[Response data]

	b_{15}	b_7 ... b_0	
WX0**0	1	Note 1	(Note 1)
WX0**1	0	Note 1	(Note 1)
WX0**2	1	Note 1	(Note 1)
WX0**3	1	Note 1	(Note 1)

Note 1: Kept the last value.

Note 2: If the selected axes are running, this command is invalid for the running axis.

Note 3: This command is valid for only selected axis and invalid for the other axes.

Note 4: If the selected axes value is "0", this command is invalid.

7.2.5 Common parameter setting command

This command sets "Common parameter" of the selected axis.
When the value "H8D0*" is written to the command register (WY0**4), this command will do.
If multiple axes are selected, it set the same contents to the selected axes.

[Setting command]

WY0**4 (Command)

8	D	0	*

*: Selected axes

(Assignment of setting area)

Setting area Word No.	Parameter No	Contents
1	No. 1	Homing mode, Direction, Acceleration and Deceleration mode
2	No. 2	Scaling and unit
3	No. 3	I/O logic setting
4	No. 4	Pulses per a revolution
5	No. 5	Distance per a revolution
6	No. 6	Limit speed
7	No. 7	Initial speed
8	No. 8	High speed
9	No. 9	Low speed
10	No. 10	Acceleration and deceleration time
11	No. 11	Backlash
12	No. 12	Upper limit position value (Lower word)
13	No. 13	Upper limit position value (Upper word)
14	No. 14	Lower limit position value (Lower word)
15	No. 15	Lower limit position value (Upper word)
16	No. 16	Home position value (Lower word)
17	No. 17	Home position value (Upper word)
18	No. 18	Homing offset value (Lower word)
19	No. 19	Homing offset value (Upper word)

[Example]

In case of the selected axes are bellow.

0	0	1	1

Selected axis A and axis B

In this case, the above data value are set to "Common parameter" of axis A and axis B at once.

[Response data]

	b_{15} b_{14}	b_0
WX0**0	1	(Note 1)
WX0**1	1	(Note 1)
WX0**2	0	(Note 1)
WX0**3	0	(Note 1)

Note 1: Kept the last data.
Note 2: If Setting data are wrong. The command error occurs and will not complete.
In detail of command error, refer "Chapter 13 Error codes".
Note 3: This command is valid for only selected axis and invalid for the other axes.
Note 4: If the selected axes value is "0", this command is invalid.

7.2.6 Common parameter default setting command

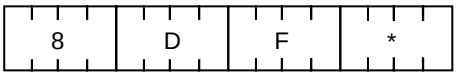
This command sets the default value to "Common parameter" of the selected axis. About the default value refer "6.1".

When the value "H8DF*" is written to the command register (WY0**4), this command will do.

If multiple axes are selected, it set the same parameter to the selected axes at once.

[Setting command]

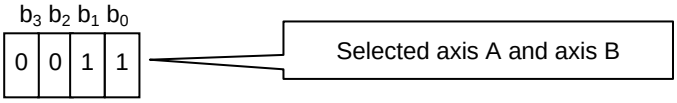
WY0**4 (Command)



*: Selected axes

[Example]

In case of the selected axes are bellow.



In this case, the default value is set to "Common parameter" of axis A and axis B at once.

[Response]

	b_{15}	b_{14} ... b_0
WX0**0	1	(Note 1)
WX0**1	1	(Note 1)
WX0**2	0	(Note 1)
WX0**3	0	(Note 1)

Note 1: Kept the last value.

Note 2: If the selected axes value is "0", this command is invalid.

7.2.7 Current position value setting command

This command changes "Current position value" of the selected axis to the value in the setting area.
When the value "H8F0*" is written to the command register (WY0**4), this command will do.
If multiple axes are selected, it set the applied value in the setting area to the selected axes at once.
This command is valid at only standby.

[Setting command]

WY0**4
(Command)

8	F	0	*

*: Selected axes

[Setting area]

Setting area Word No.	Contents
1 - 2	Current position value 1
3 - 4	Current position value 2
5 - 6	Current position value 3
6 - 7	Current position value 4

[Example]

In case of the selected axes are bellow.

b_3	b_2	b_1	b_0
1	1	1	1

Selected all axes

In this case, "Current position value 1" is set to axis A, "Current position value 2" is set to axis B, "Current position value 3" is set to axis C and "Current position value 4" is set to axis D at once.

[Response data]

	b_{15}	b_{14} ... b_0
WX0**0	1	(Note 1)
WX0**1	1	(Note 1)
WX0**2	1	(Note 1)
WX0**3	1	(Note 1)

Note 1: Kept the last value.
Note 2: If the selected axes value is "0", this command is invalid.

7.3 Reading command

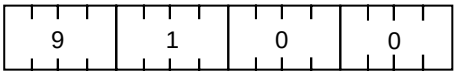
7.3.1 I/O logic reading command

This command read "I.O logic setting" (Pulse logic, O.RUN input polarity, valid or invalid selection of SRD and COIN input) of "Common parameter".

When the value "H910*" is written to the command register (WY0**4), this command will do.

[Command]

WY0**4 (Command)



[Response data]

Response data are set in the low byte of each Status register "WX0**0 - 3".

	b_{15}		b_7 ... b_0
WX0**0	1	(Note 1)	I/O logic of axis A (Note 2)
WX0**1	1	(Note 1)	I/O logic of axis B (Note 2)
WX0**2	1	(Note 1)	I/O logic of axis C (Note 2)
WX0**3	1	(Note 1)	I/O logic of axis D (Note 2)

Note 1: Kept the last value.

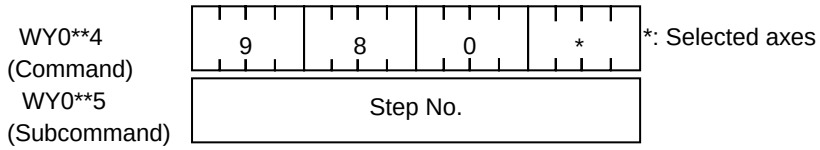
Note 2: In detail, refer "7.2.1 I/O logic setting command".

7.3.2 Positioning data reading command

This command read "Automatic positioning data" of each step and the selected axes.

When the value "H980*" is written to the command register (WY0**4) with "step No." which is set to the subcommand register (WY0**5), this command will do.

[Command]



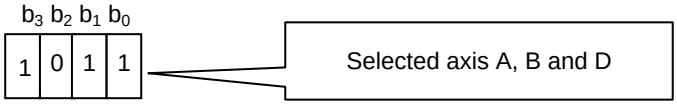
[Reading area]

Reading area Word No.	Contents
1 - 14	Full time indication area
15 - 23	Automatic positioning data 1 (Note 1)
24 - 32	Automatic positioning data 2 (Note 2)
33 - 41	Automatic positioning data 3 (Note 3)
42 - 50	Automatic positioning data 4 (Note 4)

Note 1: About the assignment of data, refer "7.2.2 Automatic positioning data Table 7.1".

[Example]

In case of the selected axes are bellow and "Step No." is H3F (63).



In this case, "Automatic positioning data 1" are set to "Automatic positioning data" in the 63_{rd} step of axis A. "Automatic positioning data 2" are set to "Automatic positioning data" in the 63_{rd} step of axis B . "Automatic positioning data 3" are set to " Automatic positioning data" in the 63_{rd} step of axis D.

[Response data]

	b_{15}		b_7 b_0
WX0**0	1	(Note 1)	Reading step No.
WX0**1	1	(Note 1)	Reading step No.
WX0**2	0	(Note 1)	(Note 1)
WX0**3	1	(Note 1)	Reading step No.

Note 1: Kept the last data.

Note 2: If "Step No." is over than H100 (256), the command error occurs and will not complete.

Note 3: If the selected axes value is "0", this command is invalid.

7.3.3 Common parameter reading command

This command read "Common parameter" of the selected axis.
When the value "H9D0*" is written to the command register (WY0**4), this command will do.
If multple axes are selected, only the axis of the lowest bit is valid.

[Command]

WY0**4
(Command)

9	D	0	*

*: Selected axis.

[Reading area]

Reading area Word No.	Contents
1 - 14	Full time indication area
15 - 33	Common parameter (Note 1)

Note 1: About the assignment of data, refer "6.1.1 Common parameter".

[Example]

In case of the selected axes are bellow.

b_3	b_2	b_1	b_0
1	0	1	0

Selected axis B

In this case, "Common parameter" of axis B is read.

[Response data]

	b_{15}	b_{14} ... b_0
WX0**0	0	(Note 1)
WX0**1	1	(Note 1)
WX0**2	0	(Note 1)
WX0**3	0	(Note 1)

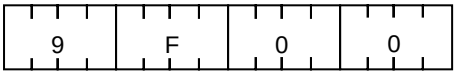
Note 1: Kept the last value.
Note 2: If the selected axes value is "0", this command is invalid.

7.3.4 Latched current position reading command

"Current position value" is always indicated in "Full time indication area". This current value indicated in "Full time indication area" is 32 bit size. But it is renewed by word (16 bit) size at once. So the lower and upper word of this value may not become the simultaneous value.

[Command]

WY0**4
(Command)



[Reading area]

Reading area Word No.	Contents
1 - 14	Full time indication area
15 - 16	Latched current position value of axis A
17 - 18	Latched current position value of axis B
19 - 20	Latched current position value of axis C
21 - 22	Latched current position value of axis D

[Response data]

	b_{15}	b_{14} ~ b_0
WX0**0	1	(Note 1)
WX0**1	1	(Note 1)
WX0**2	1	(Note 1)
WX0**3	1	(Note 1)

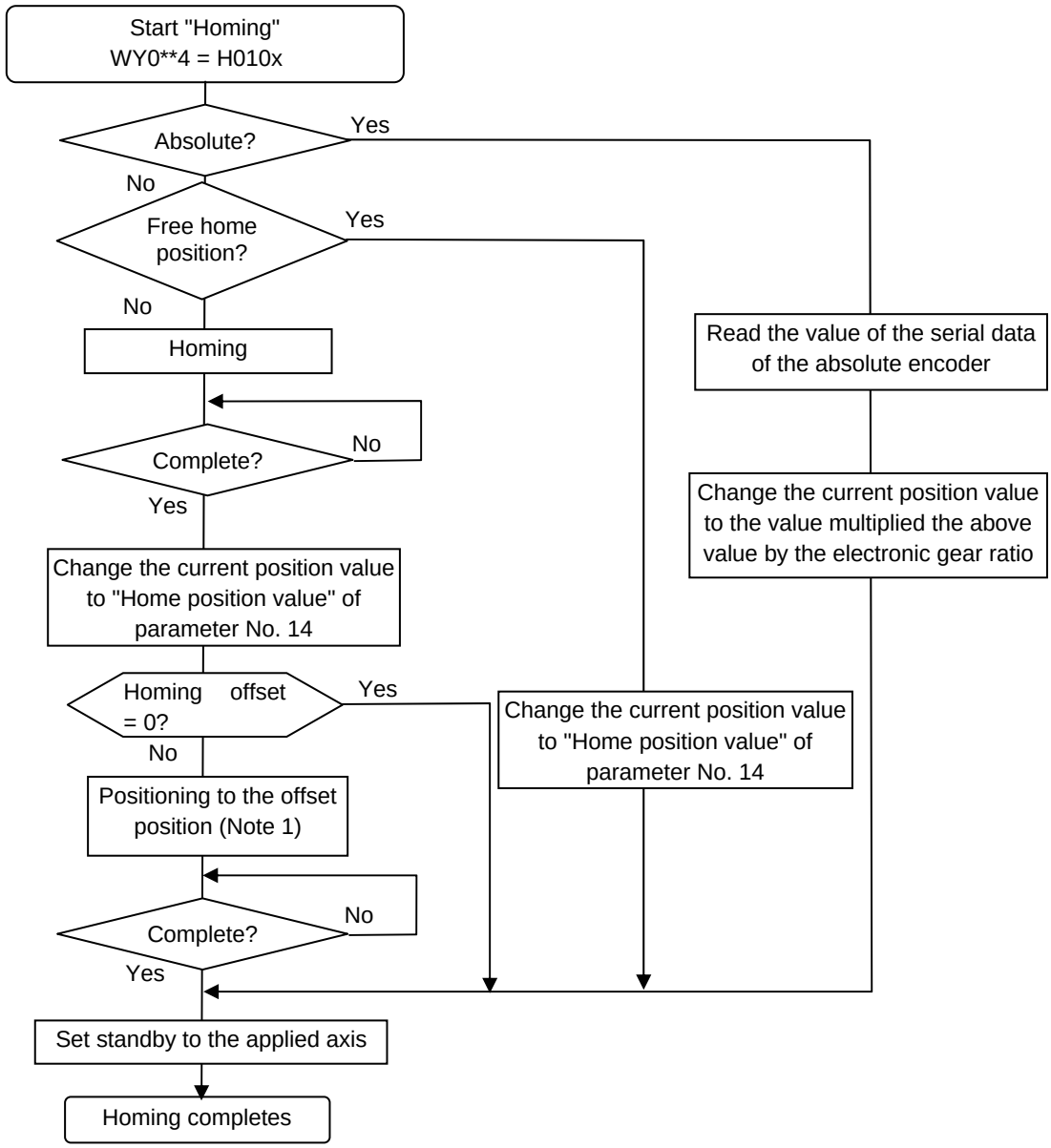
Note 1: Kept the last value.

Chapter 8 Homing

Homing starts by Homing command (H010X) set to the command register (WY0**4).
Homing mode can be selected by Common parameter No. 1. (In detail, refer "6.1.1 Common parameter")

NO.	Homing mode			Common parameter No. 1	
				CW	CCW
1	Free home position			H00**	
2	Low speed homing			H01**	H11**
3	High speed homing 1 ("OFF" edged)			H02**	H12**
4	High speed homing 2 (Phase Z stop)			H03**	H13**
5	Absolute encoder homing	Hitachi	AD series (17 bit type)	H*4**	
		Yaskawa	Sigma 2 series (17 bit type)	H*5**	
			Sigma 2 series (16 bit type)	H*6**	

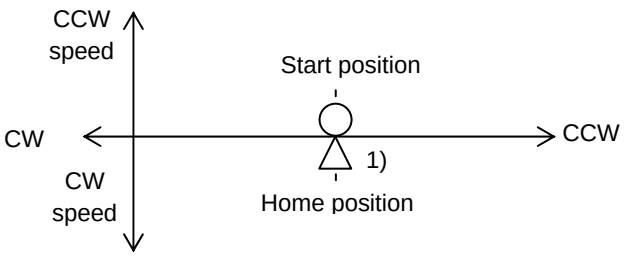
When Homing is complete, the current position value becomes "Home position value" of Common parameter No. 14 except "Absolute encoder homing". Then the applied axis of EH-POS4 becomes standby.
The following flowchart is the general flowchart of "Homing".



8.1 Free Home position

When the value of Parameter No. 1 is "H*0**", "Homing mode" is selected to "Free home position".

(1) Explanation of the movement



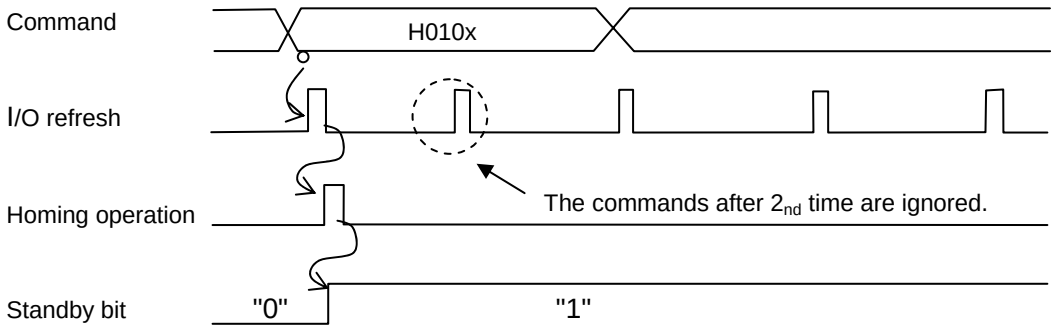
1) Set "Homing command"(H010x x: applied axes) to the command register.

The current position value changes to the Home position value (Parameter No. 14) and "Homing " is complete.

Note 1: In this case, "Backlash" of Common parameter is invalid.
Note 2: In this case, "Direction of Homing" of Common parameter is invalid.

(2) Timing

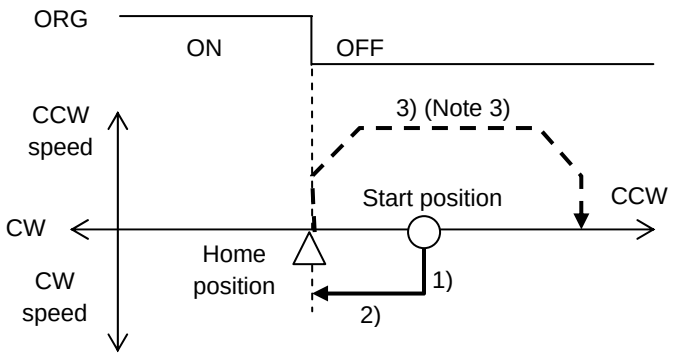
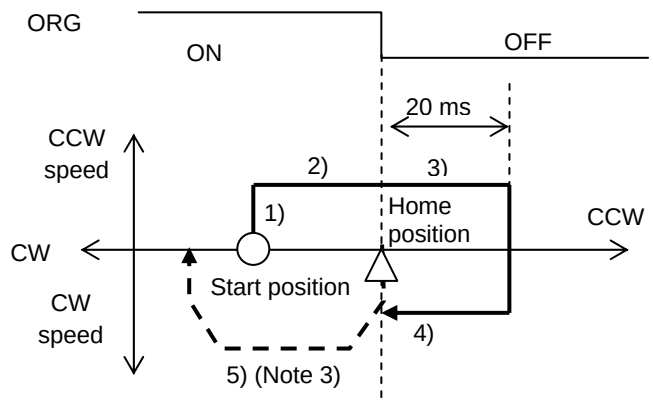
The timing from setting the command to standby is bellow.



8.2 Low speed homing

When the value of Parameter No. 1 is "H01**" or "H11**", "Homing mode" is selected to "Low speed homing".

(1) In case that the value of Parameter No. 1 is "H01**" (the homing direction is CW.)

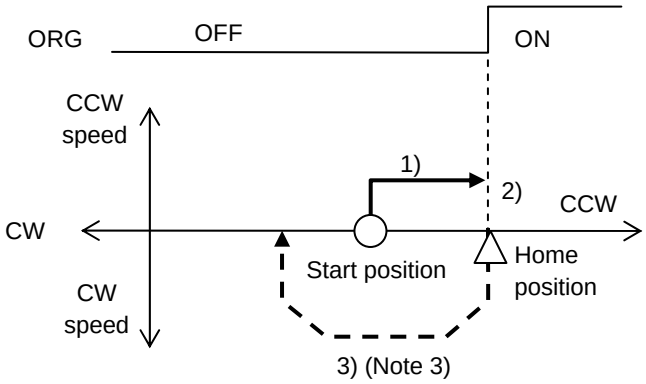
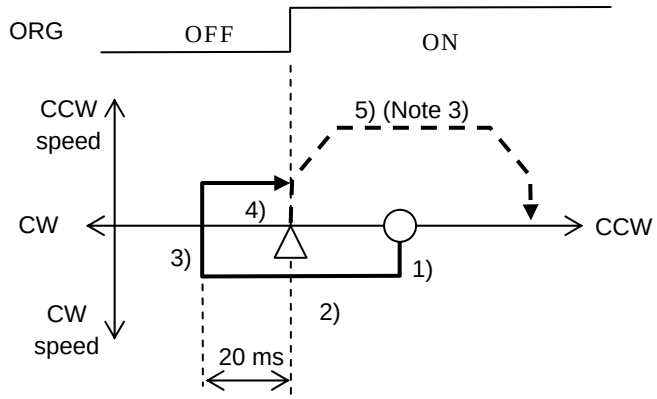
In case that "ORG" is "OFF" at start. (Note 1) 	1) Start Low speed homing by the command (H010x, x: applied axes) 2) Moving for CW direction by Low speed (parameter No. 9), it stops at "ORG" ON edge point. 3) When "Homing offset value" is not "0", Setting the initial speed "Low speed" (parameter No. 9) and the positioning starts for "Homing offset position" (parameter No. 15) by "High speed" (parameter No. 8). But in case that "Homing offset position" is "0", Homing is complete at the point of "2)".
In case that "ORG" is "ON" at start. (Note 2) 	1) Start Low speed homing by the command (H010x, x: applied axes) 2) Move for CCW direction by Low speed (parameter No. 9), it stops at "ORG" ON edge point. 3) Moving in 20 ms after "OFF" edge point of "ORG" and then it stops. 4) Reversing for CW direction, it stops at "ON" edge of "ORG. 5) When "Homing offset value" is not "0", setting the initial speed "Low speed" and the positioning starts for "Homing offset position" by "High speed" . But in case that "Homing offset position" is "0", Homing is complete at the point of "4)".

Note 1: This example is the case that the forward direction of "Revolution polarity" (parameter No. 1) is CCW and "Homing offset value" is positive, or case that the forward direction of "Revolution polarity" (parameter No. 1) is CW and "Homing offset value" is negative.

Note 2: This example is the case that the forward direction of "Revolution polarity" (parameter No. 1) is CCW and "Homing offset value" is negative, or case that the forward direction of "Revolution polarity" (parameter No. 1) is CW and "Homing offset value" is positive.

Note 3: When the stop command is set on moving for the offset position, the applied axes become standby.

(2) In case that the value of Parameter No. 1 is "H11**" (the homing direction is CCW.)

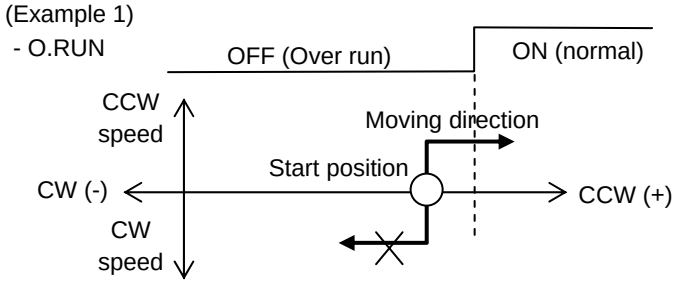
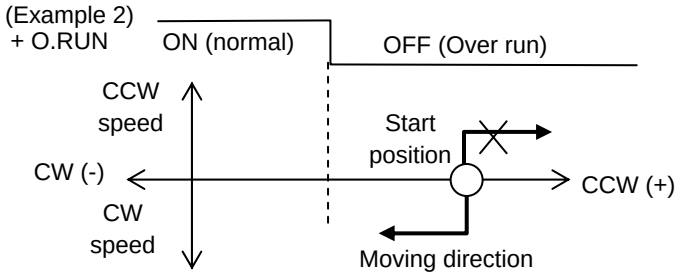
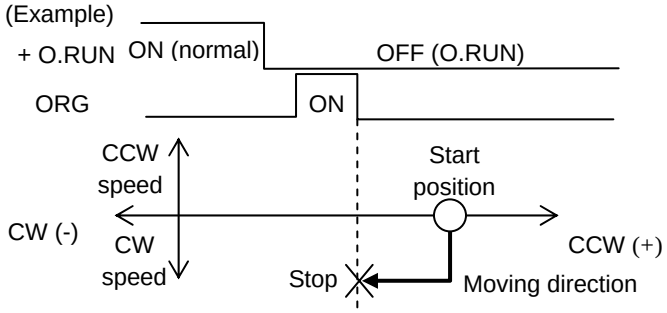
In case that "ORG" is "OFF" at start. (Note 1) 	1) Low speed homing starts by the command (H010x, x: applied axes) 2) Moving for CCW direction by "Low speed" (parameter No. 9), it stops at "ORG" ON edge point. 3) When "Homing offset value" is not "0", Setting the initial speed "Low speed" and the positioning starts for "Homing offset position" by "High speed". But in case that "Homing offset position" is "0", Homing is complete at the point of "2)".
In case that "ORG" is "ON" at start. (Note 2) 	1) Low speed homing starts by the command (H010x, x: applied axes) 2) Move for CW direction by "Low speed" (parameter No. 9), it stops at "ORG" "ON" edge point. 3) Moving in 20 ms after "OFF" edge point of "ORG" and then it stops. 4) Reversing for CW direction, it stops at "ON" edge of "ORG. 5) When "Homing offset value" is not "0", setting the initial speed "Low speed" and the positioning starts for "Homing offset position" by "High speed". But in case that "Homing offset position" is "0", Homing is complete at the point of "4)".

Note 1: This example is the case that the forward direction of "Revolution polarity" (parameter No. 1) is CW and "Homing offset value" is positive, or case that the forward direction of "Revolution polarity" (parameter No. 1) is CCW and "Homing offset value" is negative.

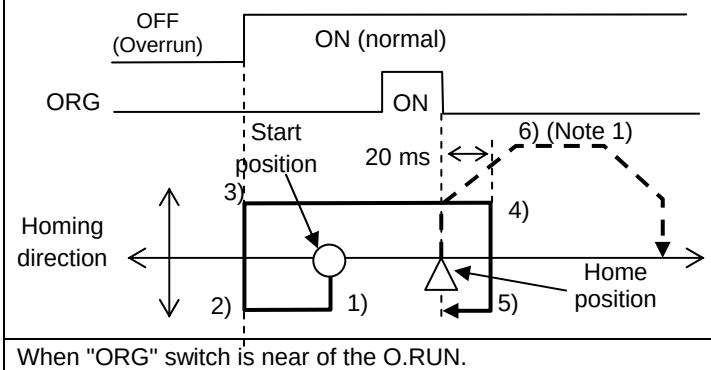
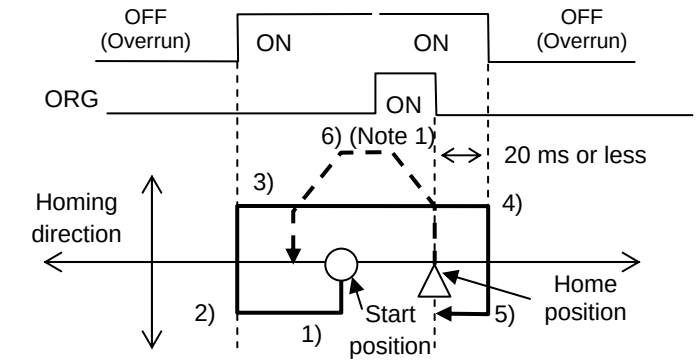
Note 2: This example is the case that the forward direction of "Revolution polarity" (parameter No. 1) is CW and "Homing offset value" is negative, or case that the forward direction of "Revolution polarity" (parameter No. 1) is CCW and "Homing offset value" is positive.

Note 3: When the stop command is set on moving for the offset position, the applied axis becomes standby.

(3) In case that "Over run" occurs at start of "Homing".

In case that "Over run" occurs at starting Homing. (Example 1)  (Example 2)  	Move for the direction to recover O.RUN error in spite of "Homing direction" of parameter No. 1. (Example 1) If "Homing direction" is CW and forward of "Revolution polarity" is CCW like the left figure, homing starts to move CCW in spite of "Homing direction". (Example 2) If "Homing direction" is CCW and forward of "Revolution polarity" is CCW like the left figure, homing starts to move CW in spite of "Homing direction".
In case that "ORG" is in "O.RUN" (Example)  	(Example) Stop at "ON" edge of "ORG" and the command error occurs. But the applied axis should not be standby, Note: Set the "ORG" switch between "+O.RUN" and "-O.RUN".

(4) In case that "Over run" occurs in "Homing"

"Over run" occurs because there is no inputs of "ORG" switch for "Homing direction".  	1) "Homing" starts for the homing direction by "Low speed". 2) Stop by "O.RUN" input. 3) Reverse the direction and move to "OFF" edge of "ORG". 4) Stop 20 ms after "OFF" edge of "ORG" switch. 5) Reverse again and stop at "ON" edge of "ORG" switch. 6) When "Homing offset value" is not "0", the offset positioning starts for "Homing offset position" by "High speed".
When "ORG" switch is near of the O.RUN.  	1) "Homing" starts for the homing direction by "Low speed". 2) Stop by "O.RUN" input. 3) Reverse the direction and move to "OFF" edge of "ORG". 4) Stop 20 ms after "OFF" edge of "ORG" switch. 5) Reverse again and stop at "ON" edge of "ORG" switch. 6) When "Homing offset value" is not "0", the offset positioning starts for "Homing offset position" by "High speed".

Note 1: When the stop command is set on moving for the offset position, the applied axes become standby.

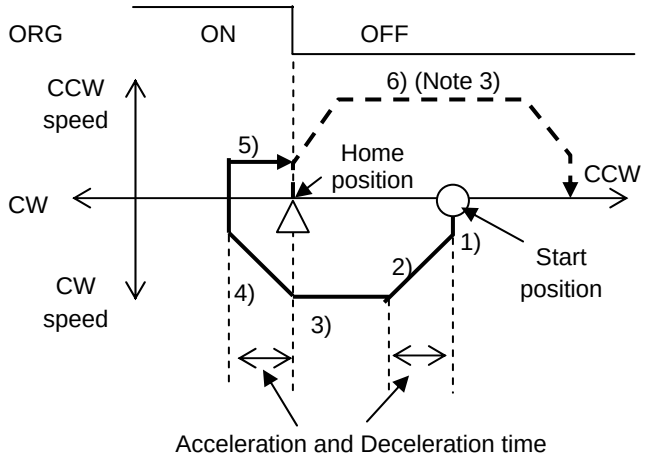
8.3 High speed homing 1(OFF edge stop)

When the value of Parameter No. 1 is "H02**" or "H12**", "Homing mode" is selected to "High speed homing 1 ("OFF" edge stop)".

The current position value of Home position changes "Home position value" (parameter No. 14)

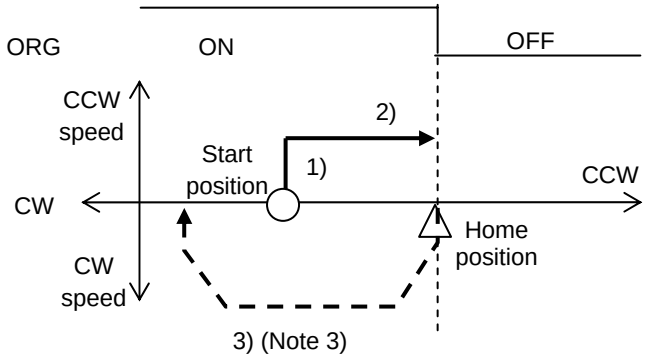
(1) In case that the value of Parameter No. 1 is "H02**" (the homing direction is CCW.)

(Example) "ORG" switch is "OFF" at start (Note 1)



1) "High speed homing 1" starts by the command (H010x, x: applied axes)
2) Setting the initial speed "Low speed", move for CW direction by "High speed" (parameter No. 9) with the acceleration ratio calculated by " Acceleration and Deceleration time".
3) Move to "ON" edge of "ORG" by "High speed".
4) Slow down to "Low speed" by the deceleration ratio and stop.
5) Reverse for CCW and move to "OFF" edge of "ORG" and stop by "Low speed".
6) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed". But in case that "Homing offset position" is "0", Homing is complete at the point of "5)".

(Example) "ORG" switch is "ON" at start (Note 2)



1) "High speed homing 1" starts by the command (H010x, x: applied axes)
2) Move to "OFF" edge of "ORG" by "Low speed" and stop.
3) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed". But in case that "Homing offset position" is "0", Homing is complete at the point of "2)".

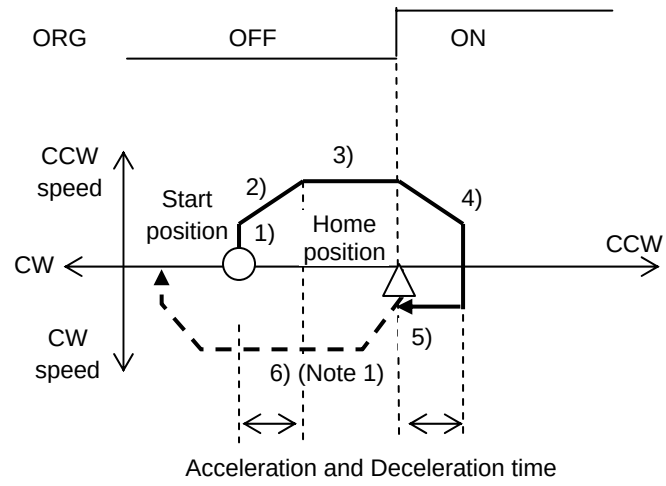
Note 1: This example is the case that the forward direction of "Revolution polarity" (parameter No. 1) is CCW and "Homing offset value" is positive, or case that the forward direction of "Revolution polarity" (parameter No. 1) is CW and "Homing offset value" is negative.

Note 2: This example is the case that the forward direction of "Revolution polarity" (parameter No. 1) is CCW and "Homing offset value" is negative, or case that the forward direction of "Revolution polarity" (parameter No. 1) is CW and "Homing offset value" is positive.

Note 3: When the stop command is set on moving for the offset position, the applied axis becomes standby.

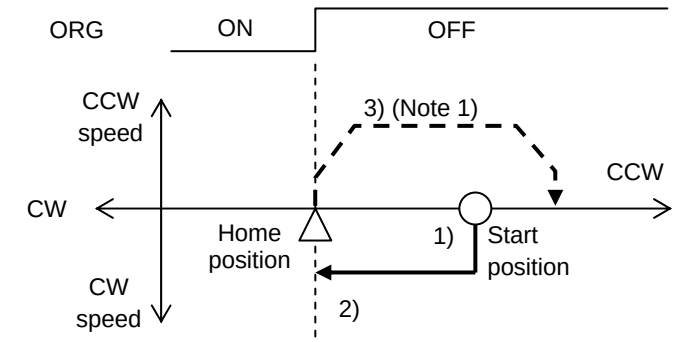
(2) In case that the value of Parameter No. 1 is "H12**" (the homing direction is CCW.)

(Example) "ORG" switch is "OFF" at start



1) "High speed homing 1" starts by the command (H010x, x: applied axes)
2) Setting the initial speed "Low speed", move for CCW direction by "High speed" (parameter No. 9) with the acceleration ratio calculated by " Acceleration and Deceleration time".
3) Move to "ON" edge of "ORG" by "High speed".
4) Slow down to "Low speed" by the deceleration ratio and stop.
5) Reverse for CW and move to "OFF" edge of "ORG" and stop by "Low speed".
6) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed". But in case that "Homing offset position" is "0", Homing is complete at the point of "5)".

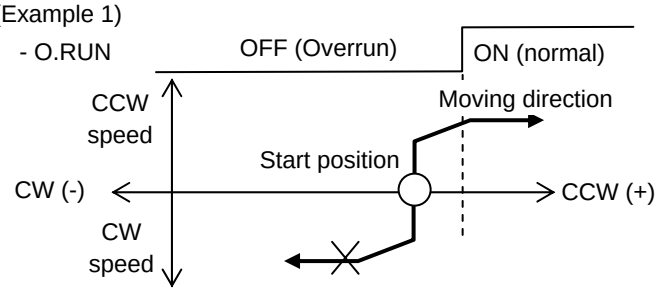
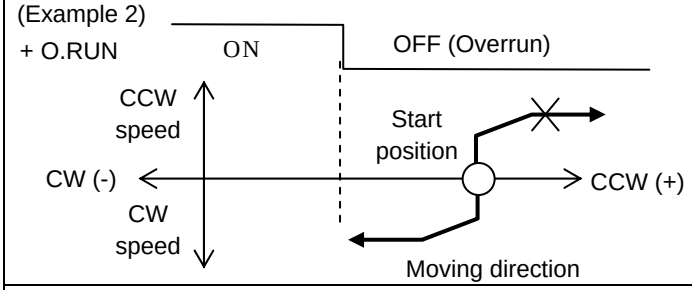
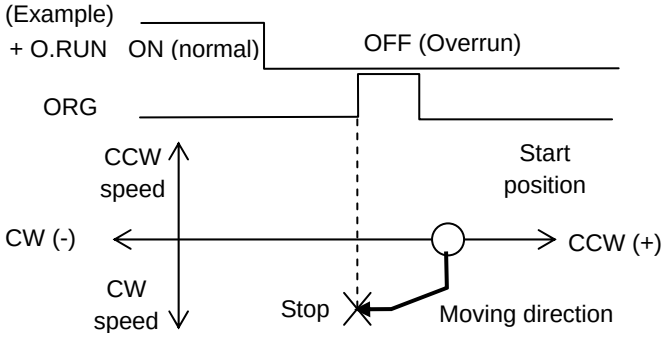
(Example) "ORG" switch is "ON" at start



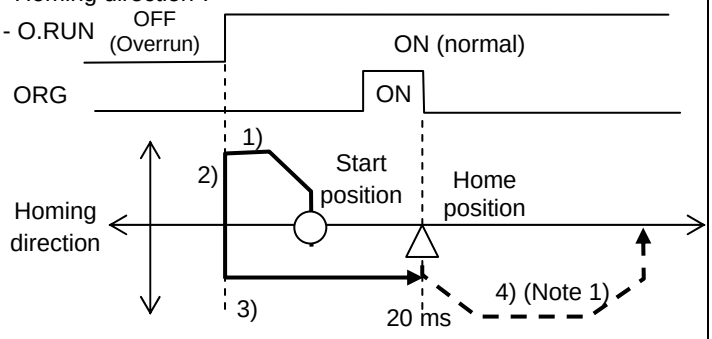
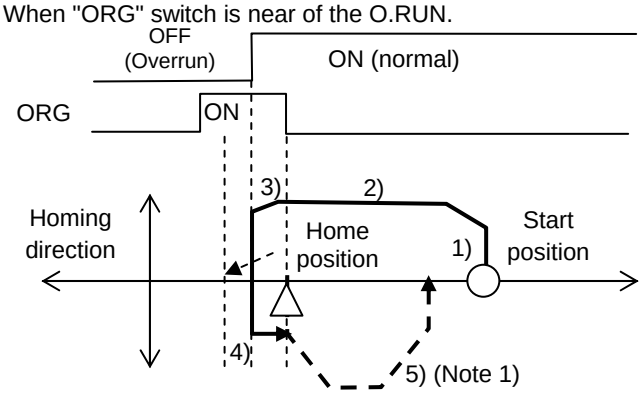
1) "High speed homing 1" starts by the command (H010x, x: applied axes)
2) Move to "OFF" edge of "ORG" by "Low speed" and stop.
3) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed" . But in case that "Homing offset position" is "0", Homing is complete at the point of "2)".

Note 1: When the stop command is set on moving for the offset position, the applied axis becomes standby.

(3) In case that "Over run" occurs at start of "Homing".

In case that "Over run" occurs at starting Homing. (Example 1)  (Example 2) 	Move for the direction to recover O.RUN error in spite of "Homing direction" of parameter No. 1. (Example 1) If "Homing direction" is CW and forward of "Revolution polarity" is CCW like the left figure, homing starts to move CCW in spite of "Homing direction". (Example 2) If "Homing direction" is CCW and forward of "Revolution polarity" is CCW like the left figure, homing starts to move CW in spite of "Homing direction".
In case that "ORG" is in "O.RUN" (Example) 	(Example) It stops at "ON" edge of "ORG" and the command error occurs. But the applied axis should not be standby, Note: Set the "ORG" switch between "+O.RUN" and "-O.RUN".

(4) In case that "Over run" occurs in "Homing"

"Over run" occurs because there is no inputs of "ORG" switch for "Homing direction". 	1) "Homing" starts for the homing direction by "High speed". 2) Stop by "O.RUN" input. 3) Reverse the direction and move to "OFF" edge of "ORG". 4) When "Homing offset value" is not "0", the offset positioning starts for "Homing offset position" by "High speed".
When "ORG" switch is near of the O.RUN. 	1) "Homing" starts for the homing direction by "High speed". 2) Move to "ON" edge of "ORG". 3) Slow down from "ON" edge of "ORG". 4) Stop at "O.RUN" and reverse. 5) When "Homing offset value" is not "0", the offset positioning starts for "Homing offset position" by "High speed".

Note 1: When the stop command is set on moving for the offset position, the applied axis becomes standby.

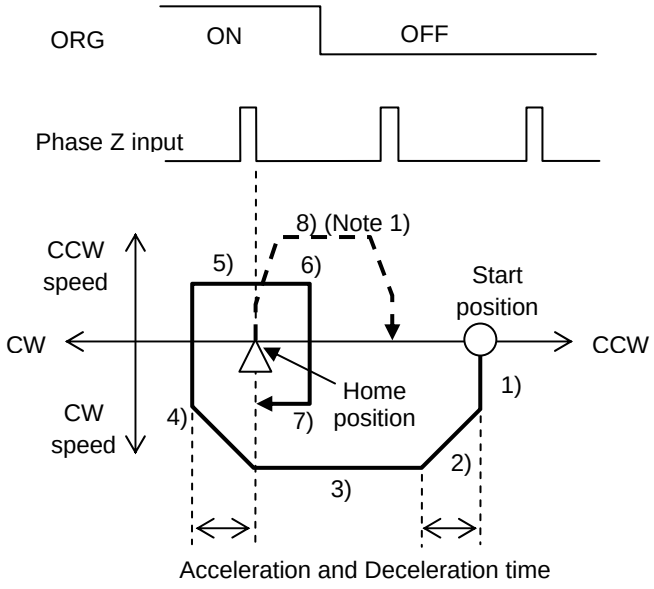
8. 4 High speed homing 2 (Phase Z stop)

When the value of Parameter No. 1 is "H03**" or "H13**", "Homing mode" is selected to "High speed homing 2 (Phase Z stop)".

The current position value of Home position changes "Home position value" (parameter No. 14)

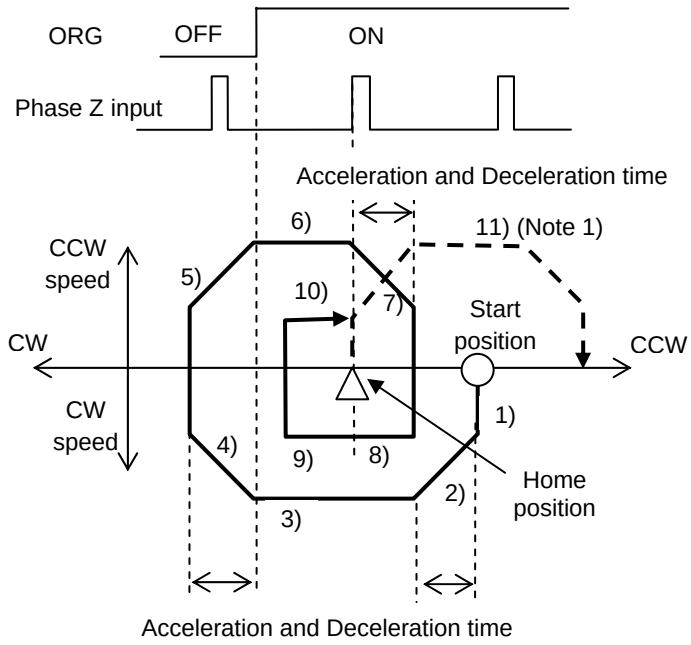
(1) In case that the value of Parameter No. 1 is "H03**" (the homing direction is CW.)

(Example) "ORG" switch is "OFF" at start



1) "High speed homing 2" starts by the command (H010x, x: applied axes)
2) Setting the initial speed "Low speed", move for CW direction by "High speed" (parameter No. 9) with the acceleration ratio calculated by " Acceleration and Deceleration time".
3) Move to the first phase Z input after "ON" edge of "ORG" by "High speed".
4) Slow down to "Low speed" and stop.
5) Reverse for CCW and move to the next phase Z input.
6) Generate 10 pulses after the next phase Z input and stop.
7) Reverse again and generate pulses of 20 ms interval and stop at the next phase Z input.
8) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed".

(Example) "ORG" switch is "ON" at start

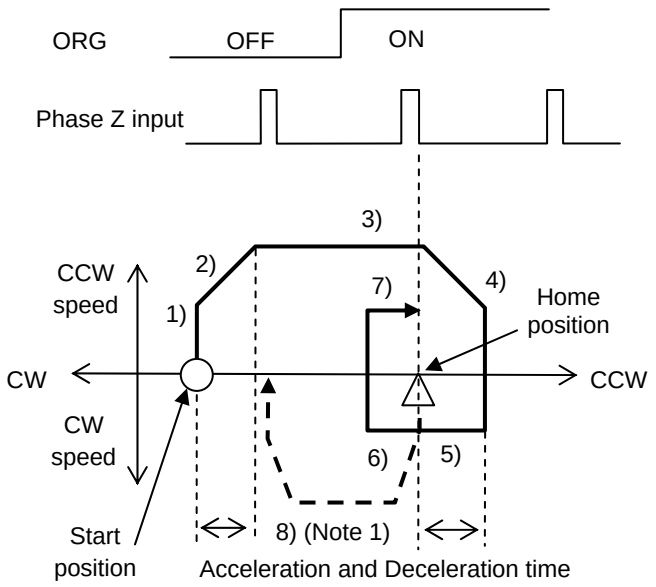


1) "High speed homing 2" starts by the command (H010x, x: applied axes)
2) Setting the initial speed "Low speed", move for CW direction by "High speed" with the acceleration ratio calculated by " Acceleration and Deceleration time".
3) Move to "OFF" edge of "ORG" by "High speed".
4) Slow down to "Low speed" and stop.
5) Reverse for CCW and accelerate to "High speed" by the acceleration ratio.
6) Move to the next phase Z input by "High speed".
7) Slow down to "Low speed" and stop.
8) Reverse for CW and move to the next phase Z input by "Low speed"
9) Generate 10 pulses after the next phase Z input and stop.
10) Reverse again and generate pulses of 20 ms interval and stop at the next phase Z input.
11) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed".

Note 1: When the stop command is set on moving for the offset position, the applied axis becomes standby.

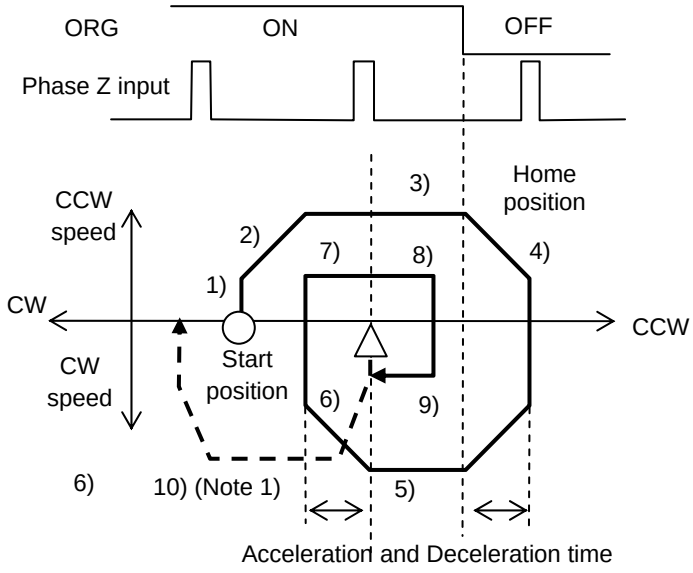
(2) In case that the value of Parameter No. 1 is "H13**" (the homing direction is CCW.)

(Example) "ORG" switch is "OFF" at start



1) "High speed homing 2" starts by the command (H010x, x: applied axes)
2) Setting the initial speed "Low speed", move for CCW direction by "High speed" with the acceleration ratio calculated by " Acceleration and Deceleration time".
3) Move to the first phase Z input after "ON" edge of "ORG" by "High speed".
4) Slow down to "Low speed" and stop.
5) Reverse for CW and move to the next phase Z input by "Low speed" and stop after generating 10 pulses.
6) Reverse again and generate pulses 20 ms interval and stop at the next phase Z input.
7) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed".

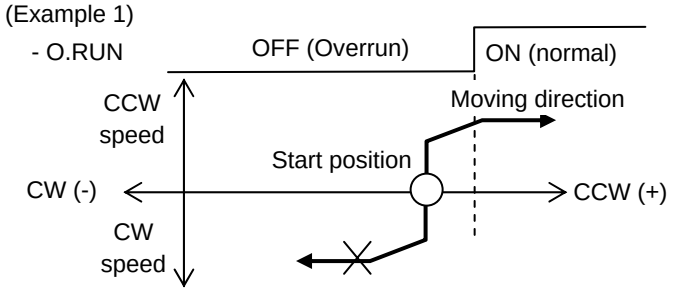
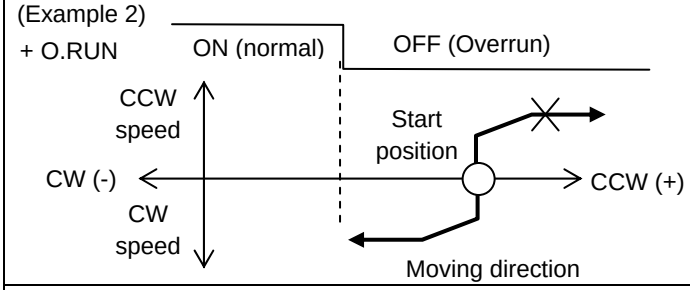
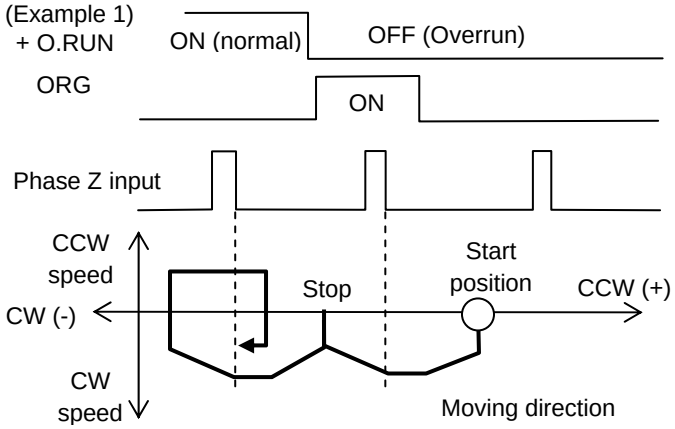
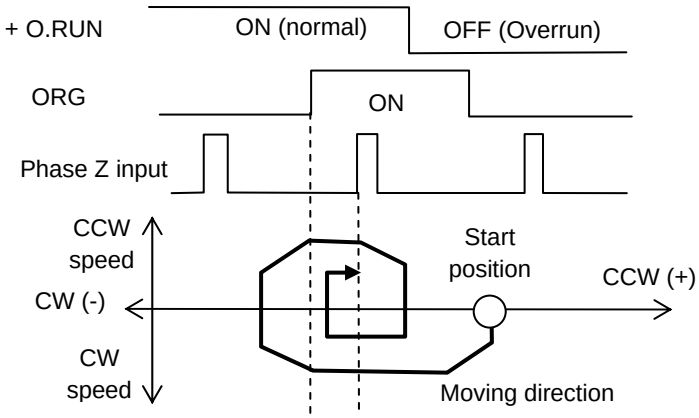
(Example) "ORG" switch is "ON" at start



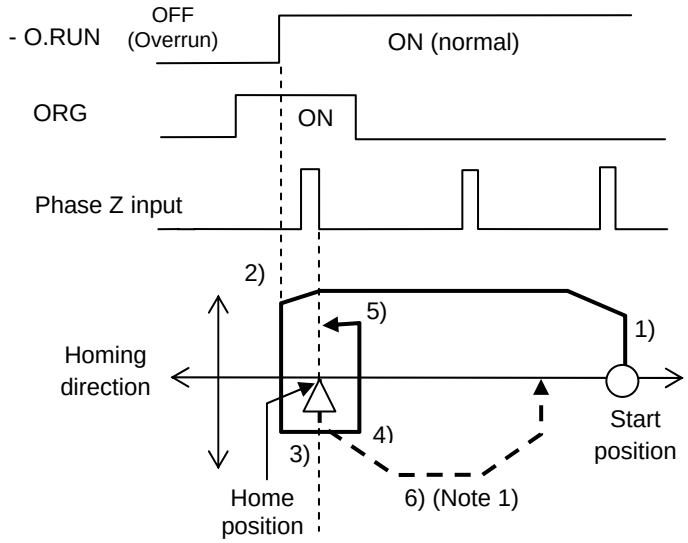
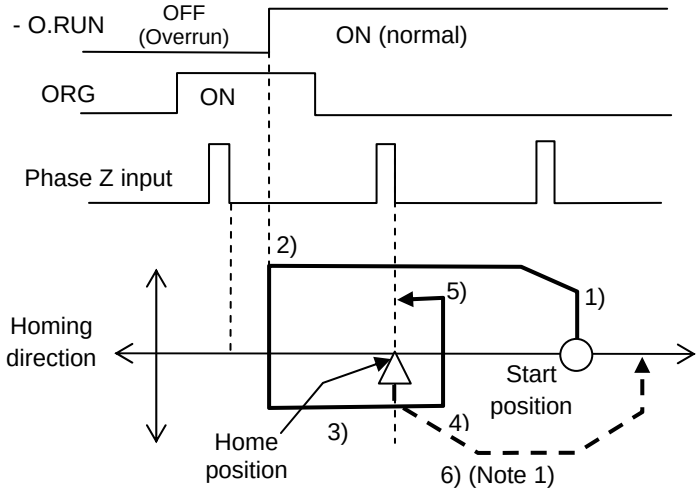
1) "High speed homing 2" starts by the command (H010x, x: applied axes)
2) Setting the initial speed "Low speed", move for CCW direction by "High speed" with the acceleration ratio calculated by " Acceleration and Deceleration time".
3) Move to "OFF" edge of "ORG" by "High speed".
4) Slow down to "Low speed" and stop.
5) Reverse for CW and move to the first phase Z input by "High speed".
6) Slow down to "Low speed" and stop.
7) Reverse again and move to the next phase Z input by "Low speed".
8) After phase Z input, generate 10 pulses.
9) Reverse again and generate pulses of 20 ms interval and stop at the next phase Z input.
10) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed".

Note 1: When the stop command is set on moving for the offset position, the applied axis becomes standby.

(3) In case that "Overrun" occurs at start of "Homing".

In case that "Overrun" occurs at starting Homing. (Example 1)  (Example 2)  	Move for the direction to recover O.RUN error in spite of "Homing direction" of parameter No. 1. (Example 1) If "Homing direction" is CW and forward of "Revolution polarity" is CCW like the left figure, homing starts to move CCW in spite of "Homing direction". (Example 2) If "Homing direction" is CCW and forward of "Revolution polarity" is CCW like the left figure, homing starts to move CW in spite of "Homing direction".
In case that "ORG" is in "O.RUN". (Example 1)  (Example 2)  	(Example 1) Homing direction: CW Stop at the "ON" edge of phase Z input. If it is still "O.RUN", move to CW until "O.RUN" input becomes normal and stop at the next phase Z input. Then "Homing" will be complete. (Example 2) Homing direction: CCW Stop after slow down at the "OFF" edge of "ORG" and reverse. Stop at the first phase Z input and "Homing" completes. If it is still "O.RUN", move to CW until "O.RUN" input becomes normal. Note: Set the "ORG" switch between "+O.RUN" and "-O.RUN".

(4) In case that "Over run" occurs in "Homing"

"Over run" occurs because there is no inputs of "ORG" switch for "Homing direction".  	1) "Homing" starts for the homing direction by "High speed". 2) Stop by "O.RUN" input. 3) Reverse the direction and move to the next phase Z input by "Low speed". 4) After phase Z input, generate 10 pulses. 5) Reverse again and generate pulses of 20 ms interval and stop at the next phase Z input. 6) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed".
When "ORG" switch is near of the O.RUN  	1) "Homing" starts for the homing direction by "High speed". 2) Stop by "O.RUN" input. 3) Reverse the direction and move to the next phase Z input by "Low speed". 4) After phase Z input, generate 10 pulses. 5) Reverse again and generate pulses of 20 ms interval and stop at the next phase Z input. 6) When "Homing offset value" is not "0", the positioning starts for "Homing offset position" by "High speed"

Note 1: When the stop command is set on moving for the offset position, the applied axis becomes standby.

8. 5 Absolute encoder homing

When the value of Parameter No. 1 is "H04**" , "Homing mode" is selected to "Absolute encoder homing".
The current position value of Home position changes the absolute position value that is read from the servo amplifier.

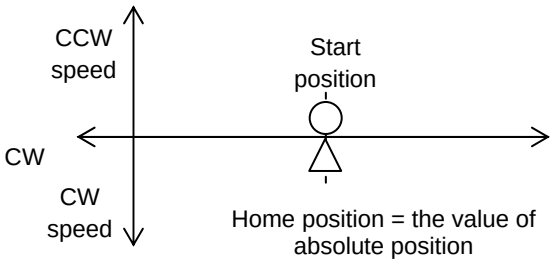


Table 8.1 List of the applied servo series

Vendor	Contents		Common parameter No. 1
Hitachi	AD series	17 bit absolute serial encoder type (32 768 pulses/ r)	H04**
Yaskawa	Sigma 2 series	17 bit absolute serial encoder type (32 768 pulses/ r)	H05**
		17 bit absolute serial encoder type (32 768 pulses/ r)	H06**

Chapter 9 Manual operation

"Manual operation" starts by the control commands (H020x, H021x, H022x, H028x, H029x, H02Ax, x: applied axes) written to the command register (WY0**4).

This operation needs only "Common parameter" and does not need "Automatic positioning data".

"Manual operation" is construct of 3 modes, "High speed manual", " Low speed manual" and "Inching", or the forward operation and reverse operation of each mode.

Note 1: "Manual operation" is available without standby.
Note 2: "Manual operation" is always "Absolute mode".

No.	Manual mode	Control command	
		Forward	Reverse
1	High speed manual	H020x	H028x
2	Low speed manual	H021x	H029x
3	Inching	H022x	H02Ax
4	Slow down stop	H070x	
5	Rapid stop	H07Fx	

x: applied axes

9.1 High speed manual

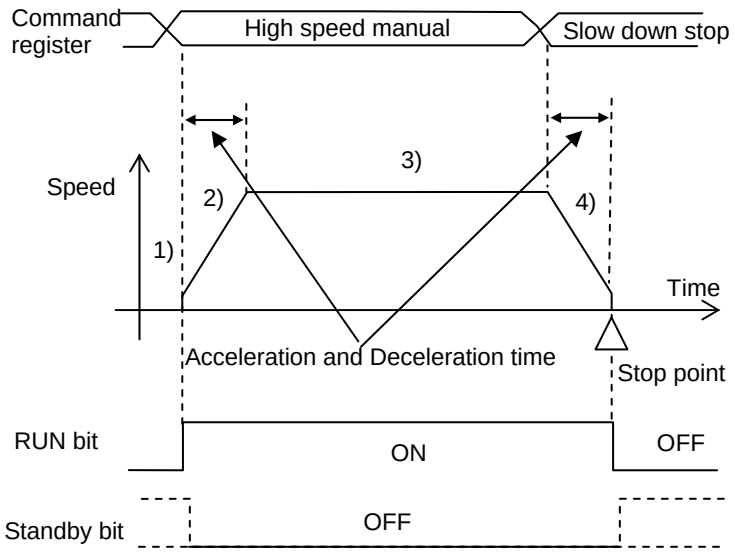
When the command value is set "H020x (forward)" or "H028x (reverse)" (x: applied axes), the applied axes start with the value of "Initial speed (parameter No. 7)", "High speed (parameter No. 8)" and "Acceleration and Deceleration time (parameter No. 10)".

The operation stops by "Stop command" ("Slow down stop" or "Rapid stop").

(1) Operation

When the command of "Low speed manual " on this operation, the speed change to the value of "Low speed (parameter No. 9)" by the deceleration ratio of "High speed manual".

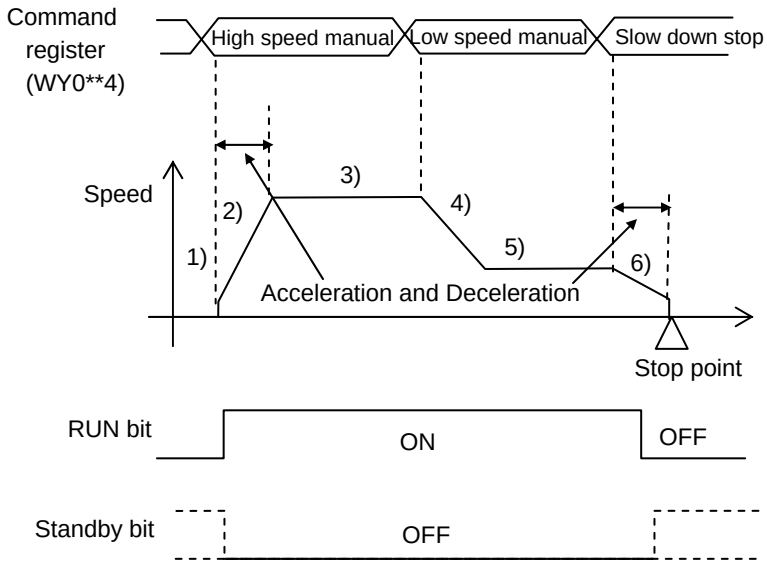
Example of "High speed manual"



1) Start "High speed manual" by setting the command (H020x or H028x).
2) Accelerate to "High speed" by "Initial speed" and "Acceleration and Deceleration time" of "Common parameter".
3) Move at "High speed".
4) Decelerate by "Slow down stop" command (H070x) and stop

Note: When reached at "Upper limit position" or "Lower limit position", stop as above.

In case that "Low speed manual" starts on "High speed manual" running



1) Start "High speed manual" by setting the command (H020x or H028x).
2) Accelerate to "High speed" by "Initial speed" and "Acceleration and Deceleration time" of "Common parameter".
3) Move at "High speed".
4) Decelerate by "Low speed manual" command at the ratio of 6).
5) Move at "Low speed".
6) Decelerate by "Slow down stop" command (H070x) and stop

9.2 Low speed manual

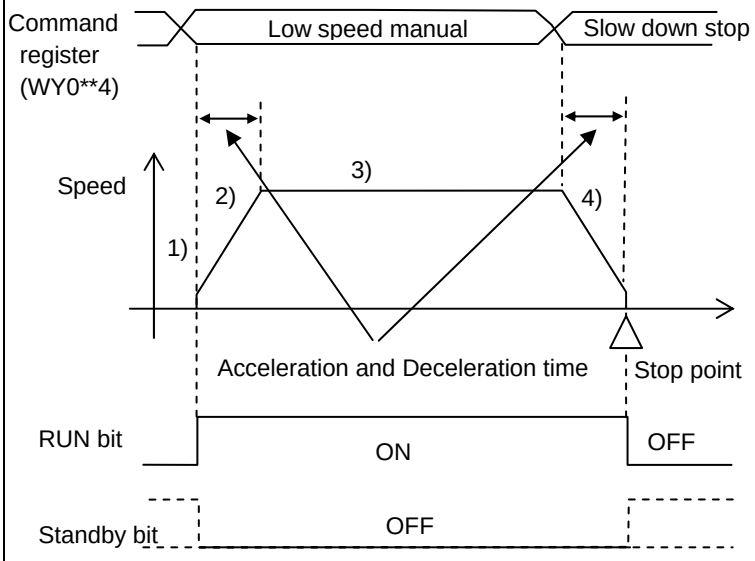
When the command value is set "H021x (forward)" or "H029x (reverse)" (x: applied axes), the applied axes start with the value of "Initial speed (parameter No. 7)", "Low speed (parameter No. 9)" and "Acceleration and Deceleration time (parameter No. 10)".

The operation stops by "Stop command" ("Slow down stop" or "Rapid stop").

(1) Operation

When the command of "High speed manual " on this operation, the speed change to the value of "High speed (parameter No. 8)" by the deceleration ratio of "Low speed manual".

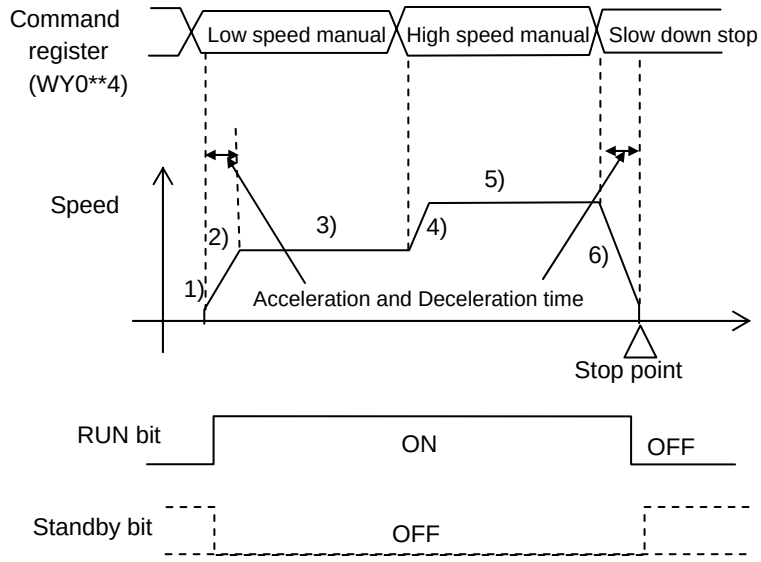
Example of "Low speed manual"



1) Start "Low speed manual" by setting the command (H021x or H029x).
2) Accelerate to "Low speed" by "Initial speed" and "Acceleration and Deceleration time" of "Common parameter".
3) Move at "Low speed".
4) Decelerate by "Slow down stop" command (H070x) and stop.

Note: When reached at "Upper limit position" or "Lower limit position", stop as above.

In case that "High speed manual" starts on "Low speed manual" running



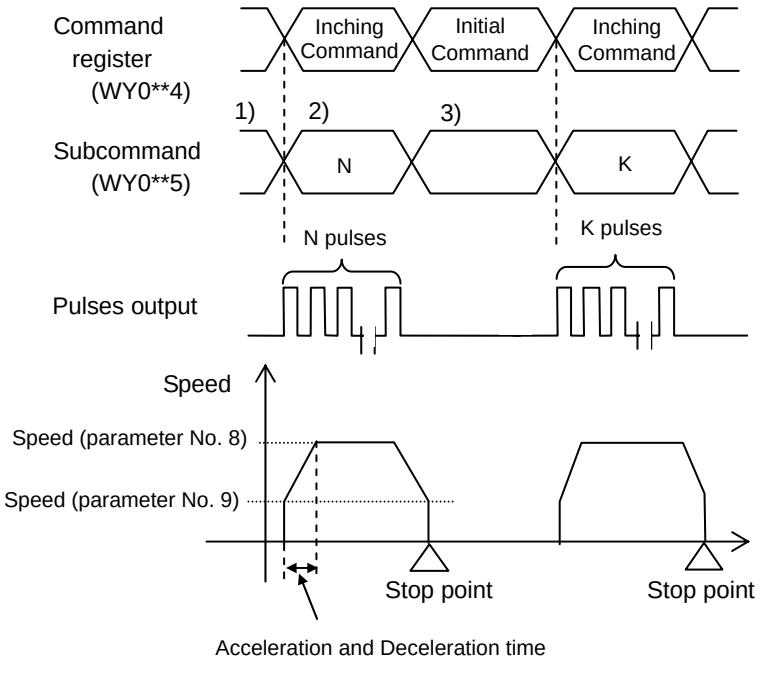
1) Start "Low speed manual" by setting the command (H021x or H029x).
2) Accelerate to "Low speed" by "Initial speed" and "Acceleration and Deceleration time" of "Common parameter".
3) Move at "Low speed".
4) Accelerate by "High speed manual" command at the ratio of 6).
5) Move at "High speed".
6) Decelerate by "Slow down stop" command (H070x) and stop.

9.3 Inching operation

When the command value is set "H022x (forward)" or "H02Ax (reverse)" (x: applied axes), the applied axes start with the value of "Low speed " as "Initial speed", "High speed" as speed and "Acceleration and Deceleration time (parameter No. 10)". The axes operate the positioning of the pulses set on the subcommand value (WY0**5).

Set the Initial command (H0000) or "Stop command" ("Slow down stop" or "Rapid stop") to start the next operation.

The current value is indicated the value calculated with the position scaling value (Parameter No. 2).



1) Set the pulse number N to the subcommand register (WY0**5) and the command (H022x or H02Ax) to the command register.
2) Generate N pulses.
3) Set the initial command or stop command to start the next operation.
4) Set the next operation (k pulses positioning).

Chapter 10 Automatic step operation

Automatic step operation can do the independent and interpolation positioning according to setting of "Operation mode".

This operation moves by "Common parameter" and "Automatic positioning data" which are already stored in the memory of EH-POS4. About setting those data, refer "6.1 Positioning data" and "Chapter 7 Setting and Reading positioning data".

Automatic operation can start at standby. If the applied axis isn't standby, make the axis start "Homing".

When the control command (H030x, x: applied axis) is set to the command register (WY0**4) with the step number of the subcommand (WY0**5), start Automatic step operation.

The table of the Automatic step data is bellow. In detail refer "6.1.2 Automatic positioning data".

Data No.	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents
1	1	Operation mode				
2	2	Ratio of arch-motion and Dwell				1) Ratio (%) (Note 1) 2) Dwell time (Unit: 20 ms)
3	3	Acceleration time				Unit: ms 10 ms - 65.535 s (HFFFF)
4	4	Deceleration time				Unit: ms 10 ms - 65.535 s (HFFFF)
5	5	Speed				Speed value (Note 2) 1 - 65 535(HFFFF)
6	6	Target position value (Lower word)				Positioning value of target point or turning point of continuous operation (Note 2) -2,147,483,648(H80000000) - +2,147,483,647(H7FFFFFFF)
	7	Target position value (Upper word)				
7	8	Circular interpolation value (Lower word)				Passing point mode: Passing position value (Note 2) Radius mode: Radius value Note: Except circular interpolation mode, this value is ignored.
	9	Circular interpolation value (Upper word)				

Note 1: 80 % - 99 % (H50 - H63)

Note 2: Applied unit is selected by the value of Common parameter No. 2 (Unit: pulse, um/s, inch/s, degree/s) and scaling.

[Example of the combination of the operation modes]

Independent no axis -	---------	Linear interpolation (2 - 4 axes)
Independent 1 axis	----------	Linear interpolation (2 - 3 axes)
Independent 2 axes	----------	Linear interpolation (2 axes)
Independent no axis	----------	Circular interpolation (2 axes)
Independent 1 axis	----------	Circular interpolation (2 axes)
Independent 2 axes	----------	Circular interpolation (2 axes)
Linear interpolation 2 axes	----------	Linear interpolation (2 axes) (Note 1)
Linear interpolation 2 axes	----------	Circular interpolation (2 axes) (Note 1)

Note 1: This combination can not start at the same time.

10.1 Indepedent step operation

When the standby bit (status register WX0**0 - 3, b9) of the applied axis is "1", after the automatic step operation command (H030x, x: applied axis, A: 1, B: 2, C: 4, D: 8) is set to the command register (WY0**4), single axis step operation starts. When the standby bit is "0", the operation does not start.

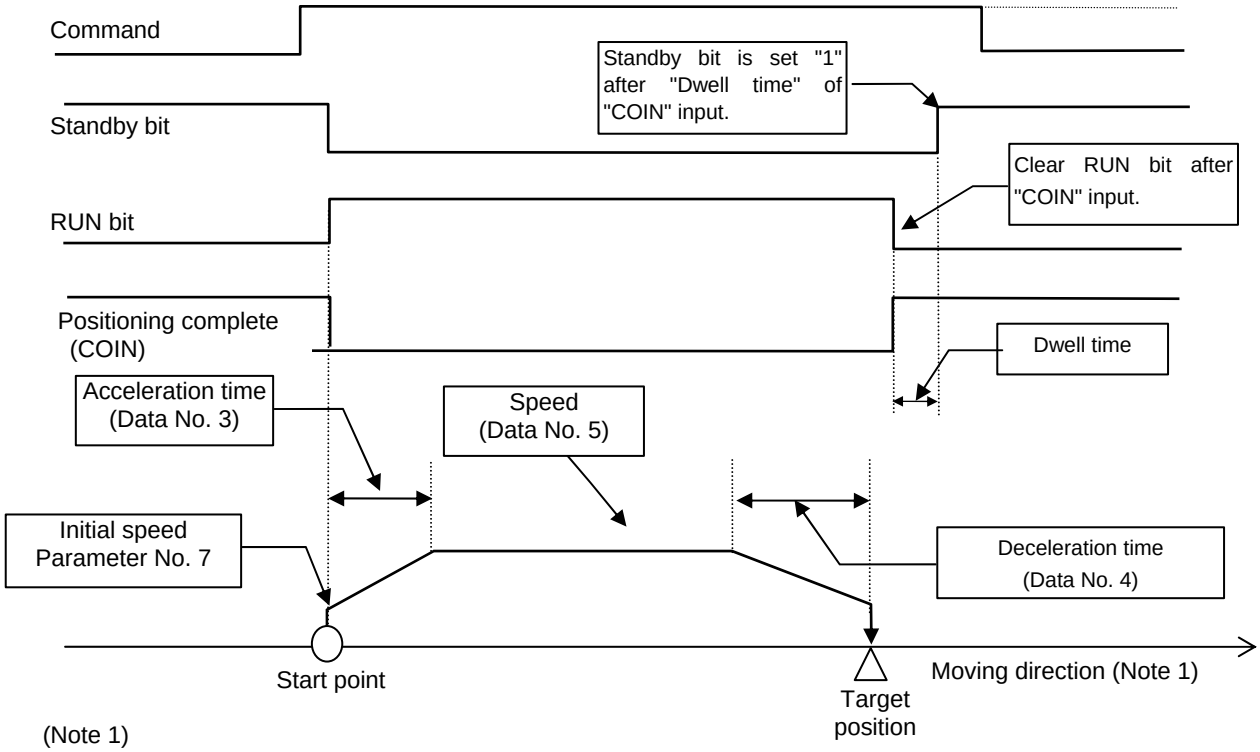
After generating the pulses applied to the target position value, the operation stops and completes.

The timing of each signal is bellow.

[Register]

WY0**4	Command (H030x)
WY0**5	Starting step No. (0- 255)
WY0**6	don't care
WY0**7	don't care

[Timing of signal]



(Note 1)

The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

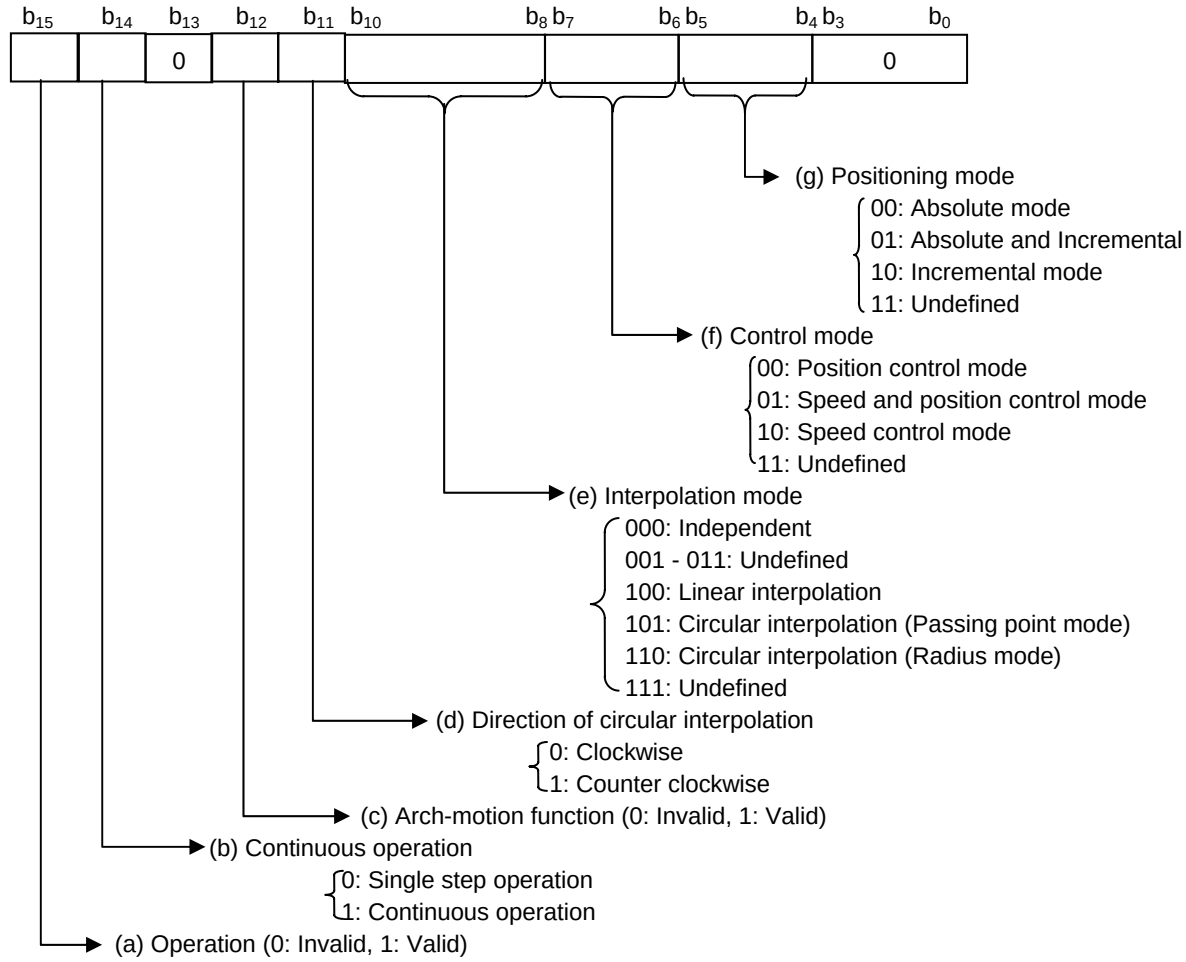
(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

The following describes about Automatic positioning data of this operation.

(1) Operation mode (Data No. 1)



(a) Operation (b_{15})

When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})

In case of this operation, this bit is ignored. This operation moves to the target position of the applied step whose number is set to the subcommand register (WY0**5) in spite of this bit. About the continuous operation, refer "Chapter 11 Automatic cycle operation"

(c) Arch-motion function (b_{12})

In case of this operation, this bit is ignored. This bit is only valid in case of the linear interpolation of 2 - 4 axes and Automatic cycle operation.

About Arch-motion function, refer "11.3.1 Arch-motion function".

(d) Direction of circular interpolation (b_{11})

In case of this operation, this bit is ignored.

About Circular interpolation, refer "10.4 Circular interpolation".

(e) Interpolation mode (b_{10} - b_8)

In case of this operation, set these bits all "0" (000).

About Interpolation operation, refer "10.3 Linear interpolation" and "10.4 Circular interpolation".

(f) Control mode (b_7 - b_6)

Each mode is selectable. In detail, refer "6.1.2 Positioning data".

(g) Positioning mode (b_5 - b_4)

Each mode is selectable. But in case that "Control mode" is "Speed mode", this mode is selected "Incremental mode" in spite of these value. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms.
So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

Note: If the wrong value was set, it moves as the value is 10 ms and command error (H0011 or H0012) occurs. In detail, show "Chapter 13 Error code".

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).
The range of this value is 1 - 65535 (HFFFF).
Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).
If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).
The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).
Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

In case of this operation, this value is ignored. About Circular interpolation, refer "10.4 Circular interpolation", "11.4 Continuous circular interpolation" and "12.4 Circular interpolation".

10.2 Multiple axes step operation (simultinuous starting)

When the standby bits (status register WX0**0 - 3, b9) of the applied axes are "1", after the automatic step operation command (H030x, x: multiple applied axes) is set to the command register (WY0**4), the applied axes step operation starts at the same time. The operation of the axis whose standby bit is "0" does not start.

After generating the pulses applied to the target position value, the operation of each axis stops and completes.

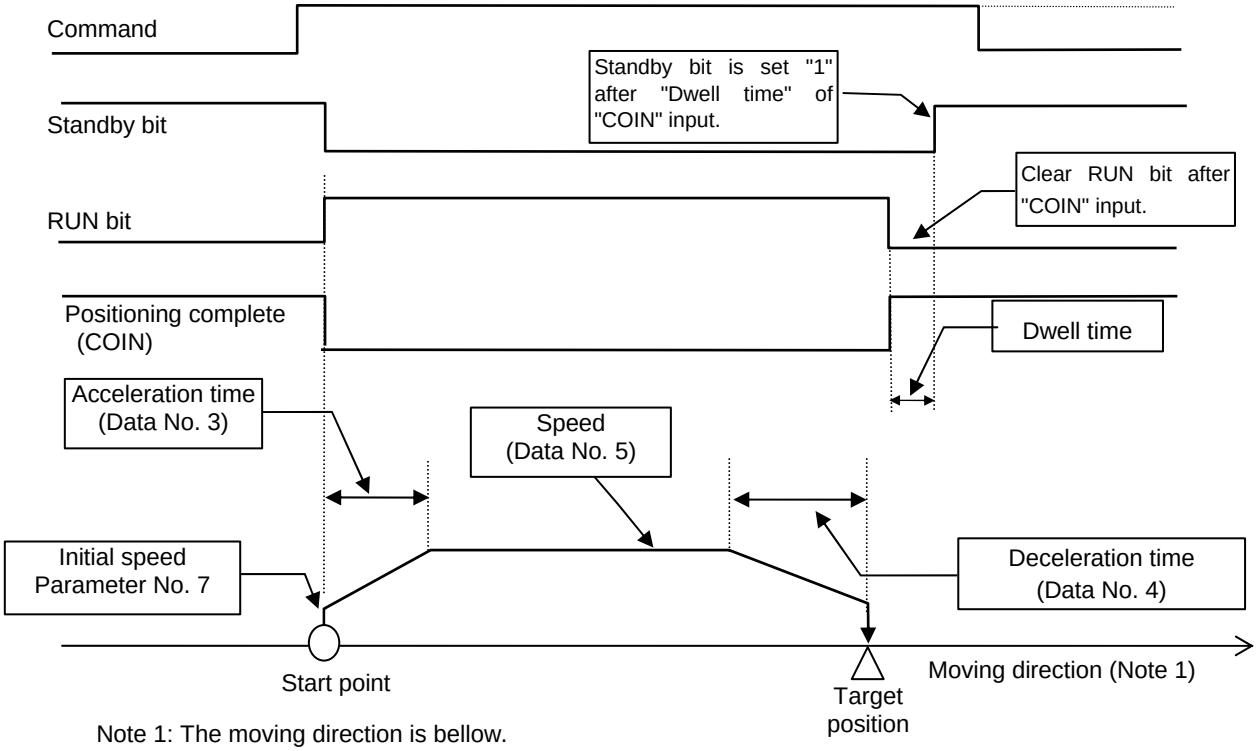
The applied axes are selected by the combination of b_0 - b_3 (b_0: axis A, b_1: axis B, b_2: axis C, b_3: axis D).

The timing of each signal is bellow.

[Register]

WY0**4	Command (H030x)
WY0**5	Starting step No. (0 - 255)
WY0**6	don't care
WT0**7	don't care

[Timing of signal]



Note 1: The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

Automatic positioning data of this operation is same as "10.1 Independent step operation"

10.3 Linear interpolation step operation

When the standby bit (status register WX0**0 - 3, b9) of the applied axes are "1", after Automatic step operation command (H030x, x: applied axes) is set to the command register (WY0**4), the applied axes step operation starts at the same time. If the standby bits of the applied axes are not "1", the operation of all of the applied axes do not start.

After generating the pulses applied to the target position value, the operation of the applied axes stops and completes. Set the same value of "Operation mode" to the applied axes.

The applied axes are selected by the combination of b_0 - b_3 (b_0: axis A, b_1: axis B, b_2: axis C, b_3: axis D).

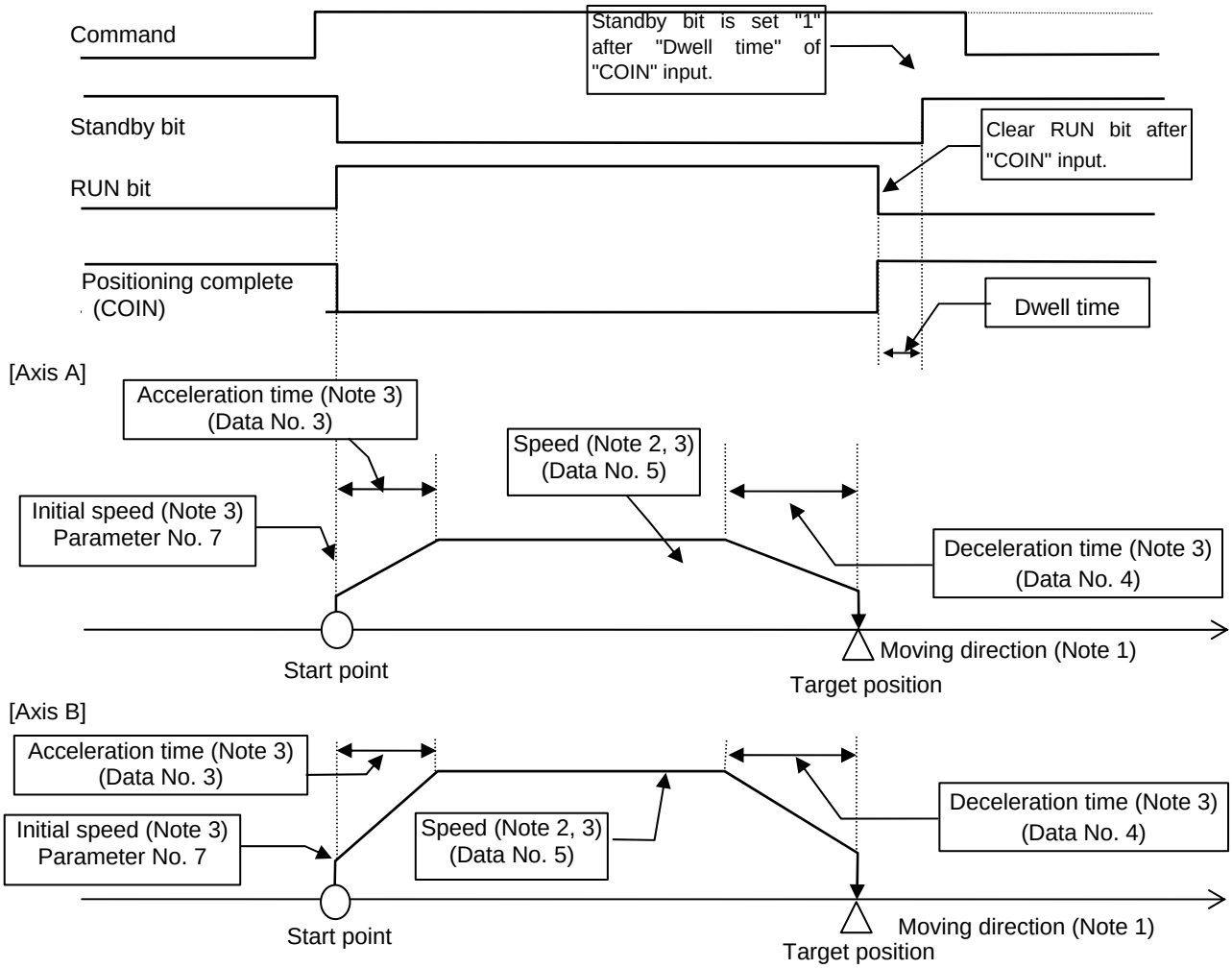
The timing of each signal is bellow.

[Register]

WY0**4	Command (H030x)
WY0**5	Starting step No. (0 - 255)
WY0**6	don't care
WT0**7	don't care

[Timing of signal]

In case of linear interpolation of axis A and B



Note 1: The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

Note 2: Speed change command in this operation is ignored and the command error occurs. But the operation continues.

Note 3: The speed value of each axis may be different from the setting value. Refer the following.

[The operation value of linear interpolation]

The basic axis of linear interpolation is the one whose value of "speed value/ transfer value " is smaller than the ones of the other axes.

If the value is same as another one, the basic axis is the one whose value of transfer value is smaller than the other one.

The acceleration time and the deceleration time of all applied axes become the ones of the basic axis.

The calculation formula of speed is bellow.

$$\text{"Speed value " of one axis} = \frac{\text{"Speed value of the basic axis" x "Transfer value of one axis"}}{\text{" Transfer value of the basic axis"}}$$

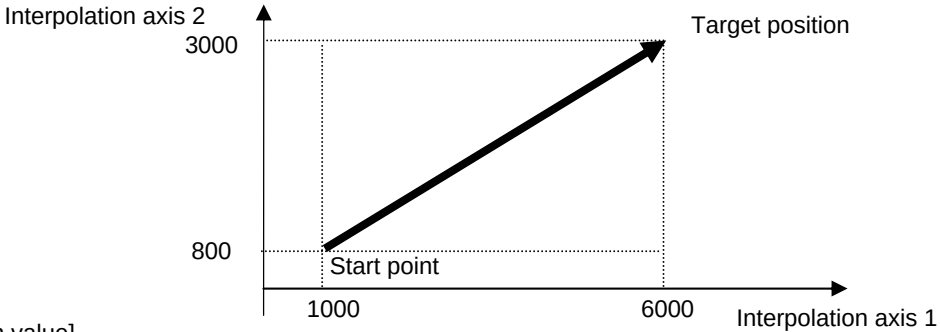
[Example] Linear interpolation of 4 axes

	axis	Initial speed	Acceleration time	Deceleration time	Speed	Target position	Current position	Speed / Transfer value
Setting value	A	100	200 ms	100 ms	1000	25000	5000	0.05
	B	200	100 ms	150 ms	600	10000	8000	0.3
	C	300	150 ms	150 ms	2000	50000	0	0.04
	D	400	200 ms	300 ms	3000	80000	-20000	0.03
Interpolation value	A	80	200 ms	300 ms	600	25000	5000	0.03
	B	8	200 ms	300 ms	60	10000	8000	0.03
	C	200	200 ms	300 ms	1500	50000	0	0.03
	D	400	200 ms	300 ms	3000	80000	-20000	0.03

: The basic axis

Example of 2 axis linear interpolation

Move from the current position (1000, 800) to the target position (6000, 3000) by linear interpolation.

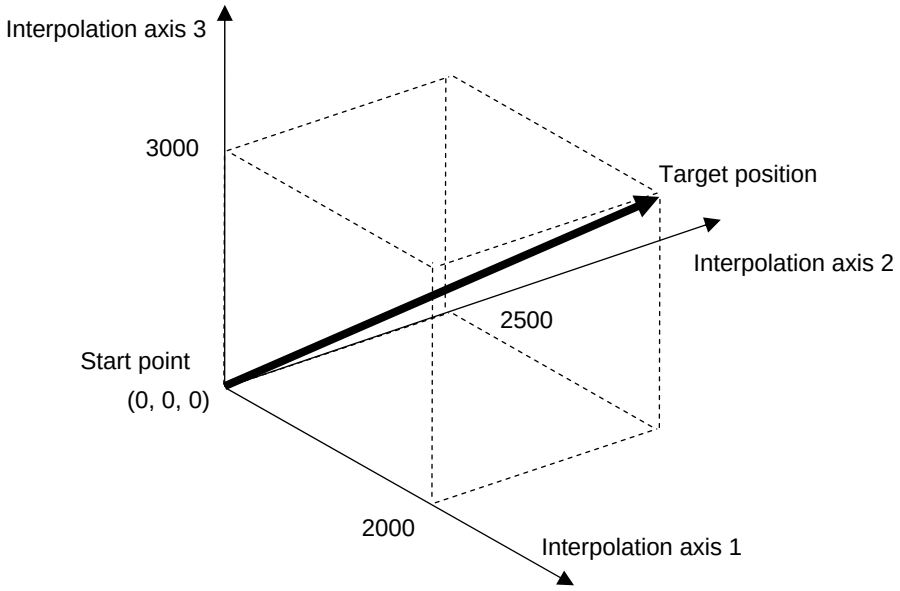


[Interpolation value]

Data No.	Word No.	Contents	Interpolation axis 1		Interpolation axis 2	
			Setting value	Run value	Setting value	Run value
1	1	Operation mode	H8400	--	H8400	--
2	2	Arch-motion ratio/ Dwell time	H0000	--	H0000	--
3	3	Acceleration time	H0064	H0064	H03E8	H0064
4	4	Deceleration time	H01F4	H01F4	H03E8	H01F4
5	5	Speed value	H1000	H1000	H1500	H0500
6	6	Target position value (Lower word)	H6000	--	H3000	--
	7	Target position value (Upper word)	H0000	--	H0000	--
7	8	Circular interpolation value (Lower word)	H0000	--	H0000	--
	9	Circular interpolation value (Upper word)	H0000	--	H0000	--

Example of 3 axis linear interpolation

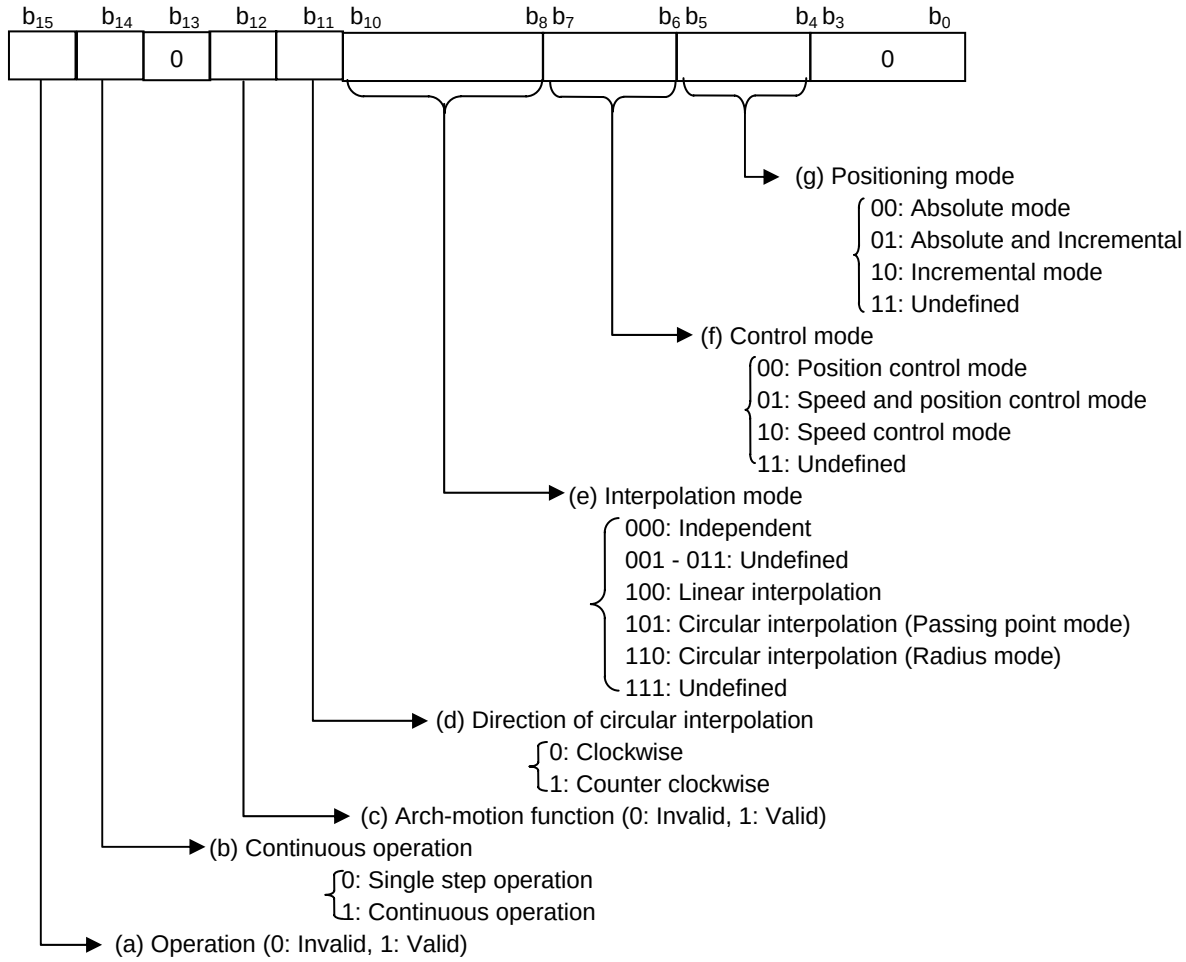
Move from the current position (0, 0, 0) to the target position (2000, 2500, 3000) by linear interpolation.



[Interpolation value]

Data No.	Word No.	Contents	Interpolation axis 1		Interpolation axis 2		Interpolation axis 3	
			Setting value	Run value	Setting value	Run value	Setting value	Run value
1	1	Operation mode	H8400	--	H8400	--	H8400	--
2	2	Arch-motion ratio /Dwell time	H0000	--	H0000	--	H0000	--
3	3	Acceleration time	H0064	H0032	H03E8	H0032	H0032	H0032
4	4	Deceleration time	H01F4	H0064	H03E8	H0064	H0064	H0064
5	5	Speed value	H1000	H0400	H1500	H0500	H0600	H0600
6	6	Target position value (Lower word)	H07D0 (2000)	--	H09C4 (2500)	--	H0BB8 (3000)	--
	7	Target position value (Upper word)	H0000	--	H0000	--	H0000	--
7	8	Circular interpolation value (Lower word)	H0000	--	H0000	--	H0000	--
	9	Circular interpolation value (Upper word)	H0000	--	H0000	--	H0000	--

The following describes about Linear interpolation positioning data of this operation.
(1) Operation mode (Data No. 1)



(a) Operation (b_{15})
When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})
In case of this operation, this bit is ignored. This operation moves to the target position of the applied step whose number is set to the subcommand register (WY0**5) in spite of this bit. About the continuous operation, refer "Chapter 11 Automatic cycle operation"

(c) Arch-motion function (b_{12})
In case of this operation, this bit is ignored. This bit is only valid in case of the linear interpolation of 2 - 4 axes and Automatic cycle operation.
About Arch-motion function, refer "11.3.1 Arch-motion function".

(d) Direction of circular interpolation (b_{11})
In case of this operation, this bit is ignored.
About Circular interpolation, refer "10.4 Circular interpolation".

(e) Interpolation mode (b_{10} - b_8)
Set "100" to b_{10} - b_8.

(f) Control mode (b_7 - b_6)
"00" (Positioning mode) is only valid. In detail, refer "6.1.2 Positioning data".

(g) Positioning mode (b_5 - b_4)

Each mode is selectable. But set the same value to all of the applied axes. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

The applied axis value of the real operation becomes the one of the basic axis.

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).

The range of this value is 1 - 65535 (HFFFF).

Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).

If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

This value may be different from the value of the real operation because of the calculation for interpolation.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).

The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).

Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

In case of this operation, this value is ignored. About Circular interpolation, refer "10.4 Circular interpolation", "11.4 Continuous circular interpolation" and "12.4 Circular interpolation".

10.4 Circular interpolation

When the standby bit (status register WX0**0 - 3, b9) of the applied axes are "1", after Automatic step operation command (H030x, x: applied axes) is set to the command register (WY0**4), the applied axes step operation starts at the same time. If the standby bits of the applied axes are not "1", the operation of all of the applied axes do not start.

During the circular interpolation, the other group of circular interpolation cannot start.

After generating the pulses applied to the target position value, the operation of the applied axes stops and completes. Set the same value of "Operation mode" to the applied axes.

The applied axes are selected by the combination of b_0 - b_3 (b_0: axis A, b_1: axis B, b_2: axis C, b_3: axis D).

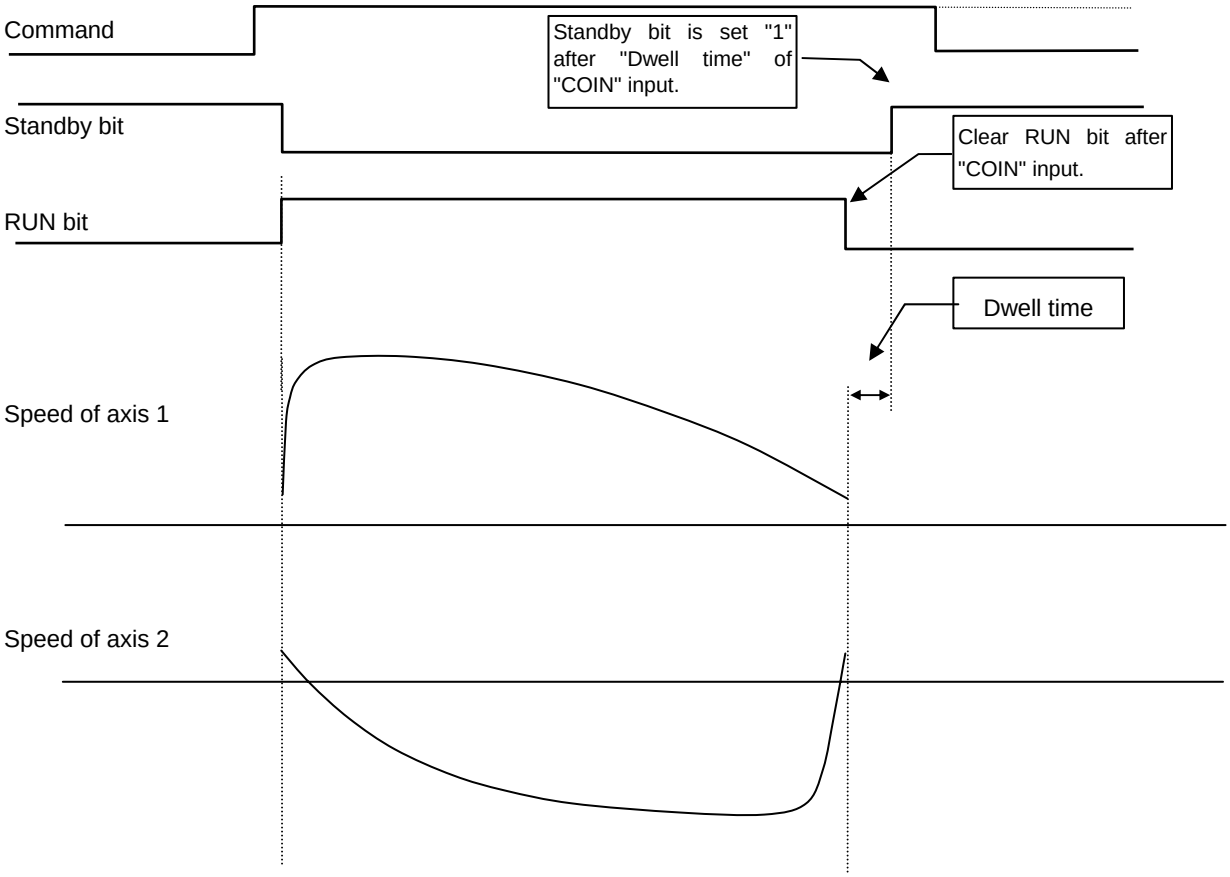
The timing of each signal is bellow.

[Register]

WY0**4	Command (H030x)
WY0**5	Starting step No. (0 - 255)
WY0**6	don't care
WT0**7	don't care

[Timing of signal]

In case of Circular interpolation of axis A and B



Note 1: Set two axes for Circular interpolation. If the number of circular interpolation isn't two, the command error occurs and the operation does not start.

Note 2: The current position value change (H8F0*) or Speed change (830*) is invalid during running, but Stop commands are valid.

[Interpolation value]

The speed value of Circular interpolation is the value of the former axis whose order is A, B, C to D. This value is compose of 2 axis value.

(Example) Circular interpolation of axis A and axis B

	Axis	Acceleration time	Deceleration time	Speed value	Target position value	Current position value
Setting value	A	200 ms	100 ms	1000	25000	5000
	B	100 ms	150 ms	600	10000	8000

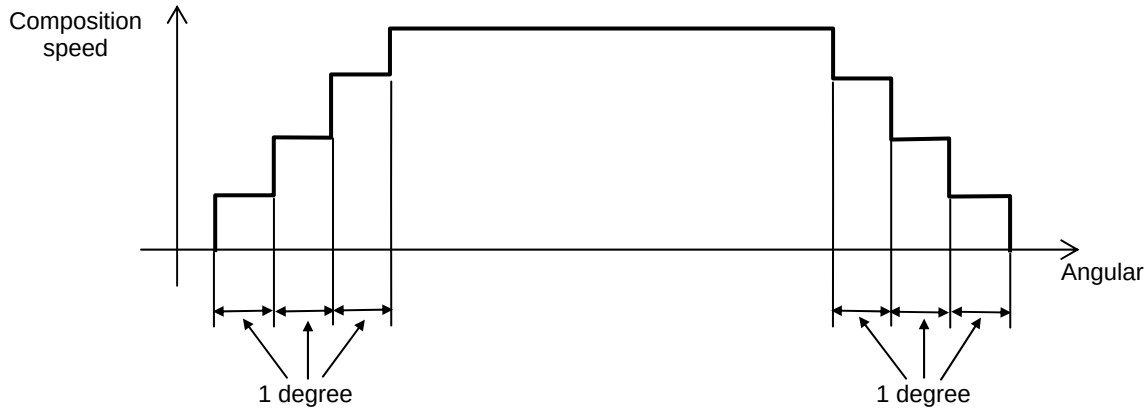
The speed value of this operation is "1000" (which is the value of the former axis, axis A)
In case of Radius setting, the radius value of this operation is the value of axis A too.

	axis	Acceleration time	Deceleration time	Speed value	Target position value	Current position value
Actual operation value		-- (Note 1)	-- (Note 1)	1000	--	--

The speed value is taken apart to each axis speed.

Note 1: Actual acceleration and Deceleration time are different from the setting value. Acceleration and Deceleration are 4 steps by a degree.

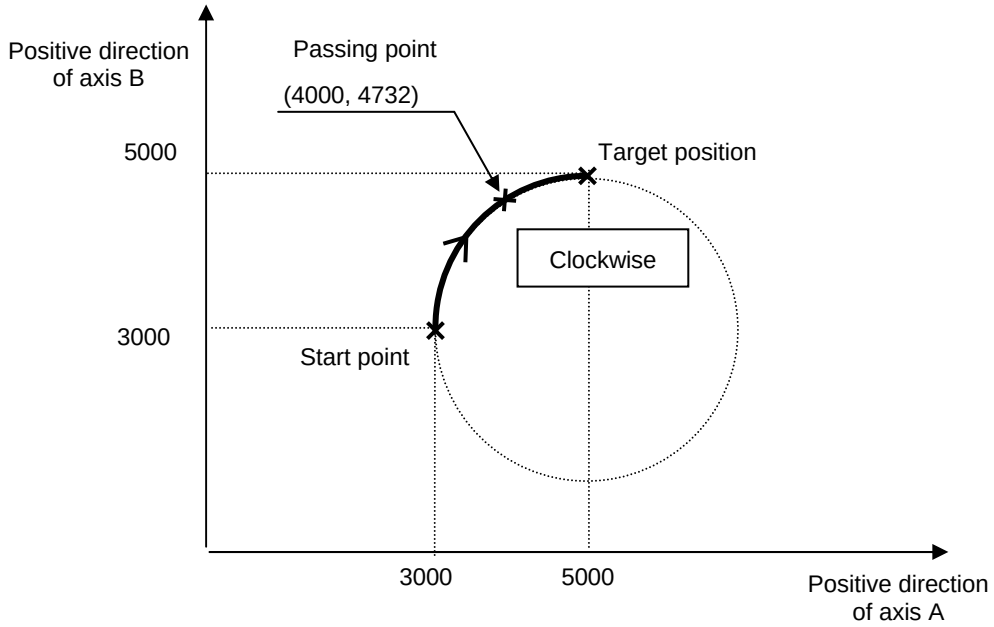
[Acceleration and Deceleration]



10.4.1 Passing point setting

(Example)

The following operation is Circular interpolation of axis A and axis B from "Start point" (3000, 3000) to "Target position" through "passing point" (4000, 4732).



[Interpolation value]

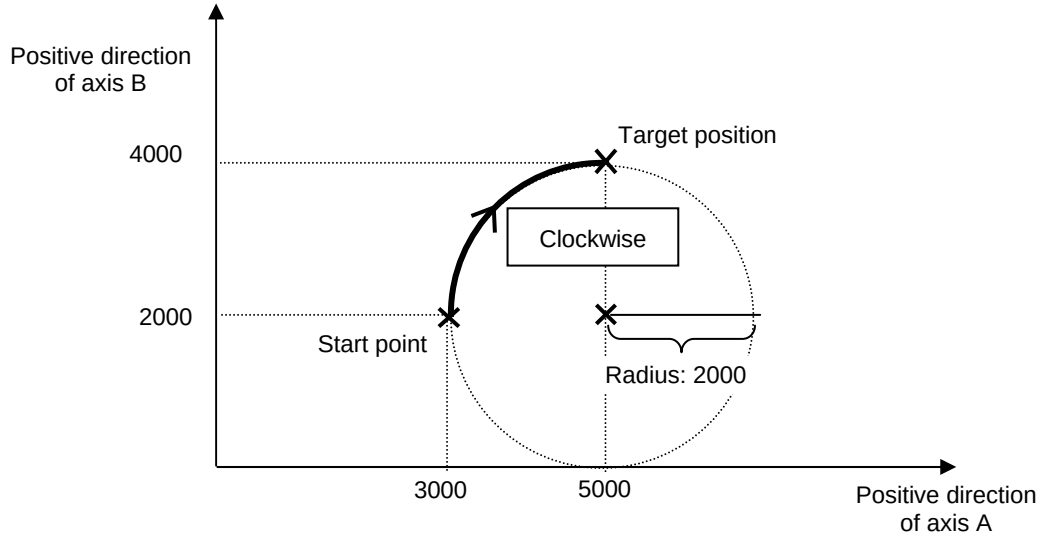
Data No.	Word No.	Contents	Axis A setting	Axis B setting	Actual operation value (Composition value)
1	1	Operation mode	H8500	H8500	--
2	2	Arch-motion ratio/ Dwell time	H0000	H0000	--
3	3	Acceleration time	H0064	H01F4	--
4	4	Deceleration time	H01F4	H0032	--
5	5	Speed value	H1000	H2000	H1000
6	6	Target position value (Lower word)	H1388 (500)	H1388 (5000)	--
	7	Target position value (Upper word)	H0000	H0000	--
7	8	Circular interpolation value (Lower word)	H0FA0 (4000)	H127C (4732)	--
	9	Circular interpolation value (Upper word)	H0000	H0000	--

Note: Interpolation axes can be applied freely.

10.4.2 Radius setting

[Example]

The following operation is Circular interpolation of axis A and axis B from "Start point" (2000, 3000) to "Target position" (5000, 4000) with the Radius value.



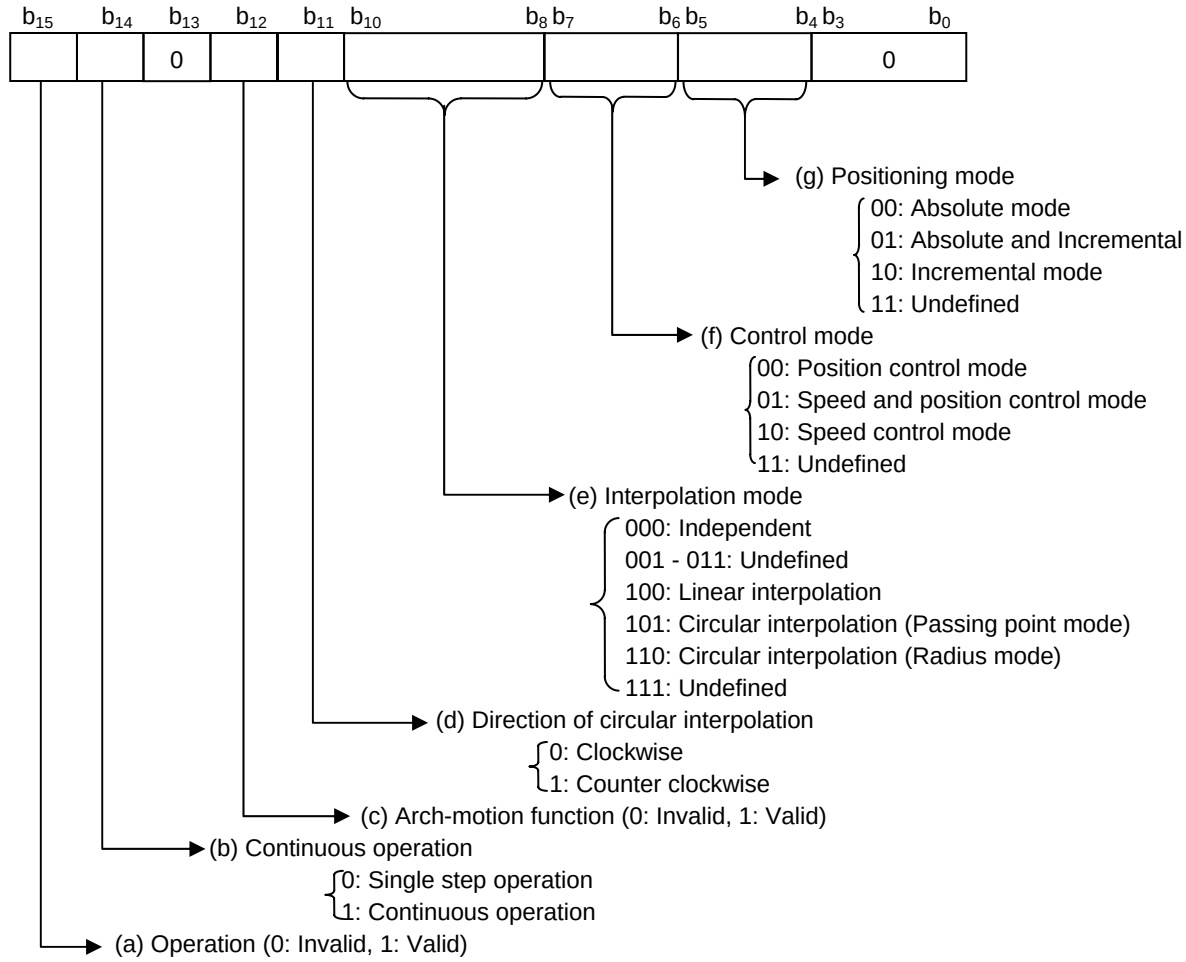
[Interpolation value]

Data No.	Word No.	Contents	Axis A setting	Axis B setting	Actual operation value (Composition value)
1	1	Operation mode	H8600	H8600	--
2	2	Arch-motion ratio/Dwell time	H0000	H0000	--
3	3	Acceleration time	H0064	H01F4	--
4	4	Deceleration time	H01F4	H0032	--
5	5	Speed value	H1000	H2000	H1000
6	6	Target position value (Lower word)	H1388 (5000)	H0FA0 (4000)	--
	7	Target position value (Upper word)	H0000	H0000	--
7	8	Circular interpolation value (Lower word)	H07D0 (2000)	H05DC (1500)	H07D0 (2000)
	9	Circular interpolation value (Upper word)	H0000	H0000	H0000

Note: Interpolation axes can be applied freely.

The following describes about Circular interpolation positioning data of this operation.

(1) Operation mode (Data No. 1)



(a) Operation (b_{15})

When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})

In case of this operation, this bit is ignored. This operation moves to the target position of the applied step whose number is set to the subcommand register (WY0**5) in spite of this bit. About the continuous operation, refer "Chapter 11 Automatic cycle operation"

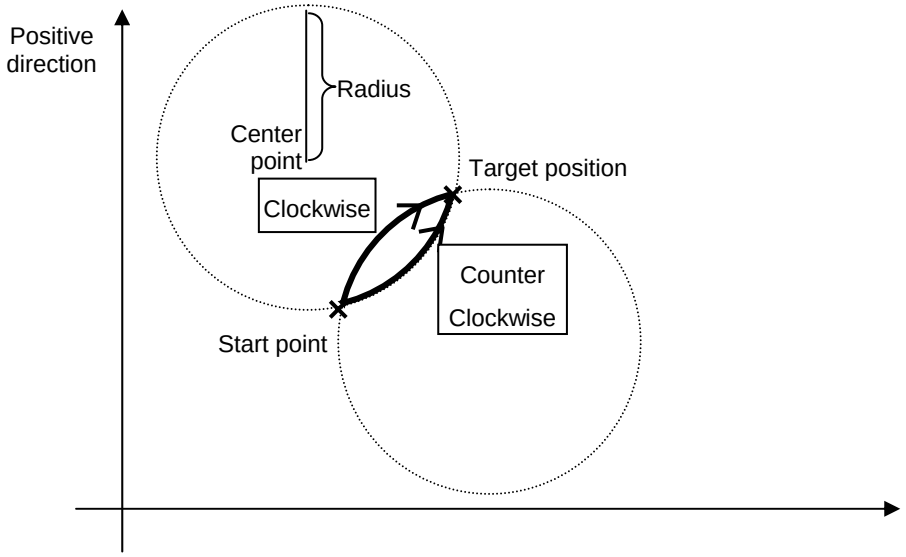
(c) Arch-motion function (b_{12})

In case of this operation, this bit is ignored. This bit is only valid in case of the linear interpolation of 2 - 4 axes and Automatic cycle operation.

About Arch-motion function, refer "11.3.1 Arch-motion function".

(d) Direction of circular interpolation (b_{11})

In case of this operation, set "0"(Clockwise) or "1" (Counter Clockwise) to this bit.



Note: The shorter arc is always selected.

(e) Interpolation mode (b_{10} - b_8)

Set "101" (Passing point setting) or "110" (Radius setting) to b_{10} - b_8.

(f) Control mode (b_7 - b_6)

"00" (Positioning mode) is only valid. In detail, refer "6.1.2 Positioning data".

(g) Positioning mode (b_5 - b_4)

Each mode is selectable. But set the same value to all of the applied axes. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

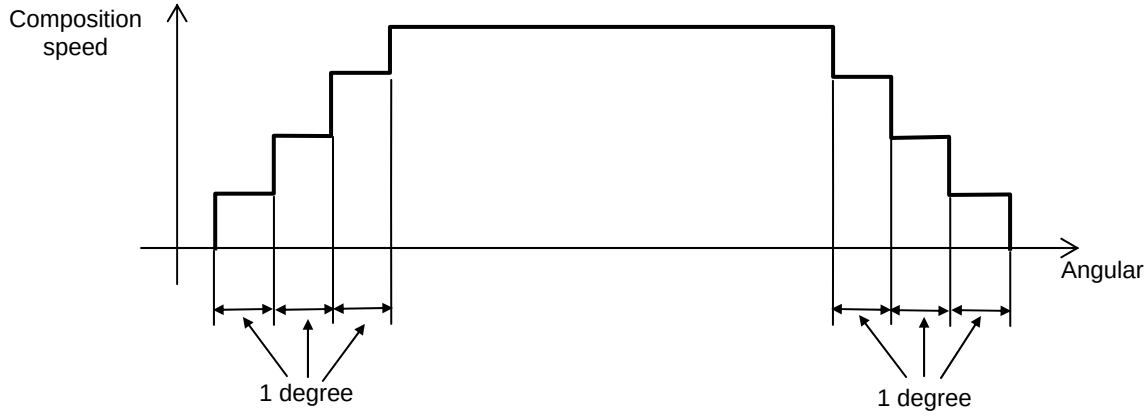
The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

In case of this operation, this value is ignored. But set the value more than "10".

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

[Acceleration and Deceleration]



(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).
The range of this value is 1 - 65535 (HFFFF).
Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).
I f the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.
This value may be different from the value of the real operation because of the calculation for interpolation.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).
The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).
Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

Set the position value of "Passing point" or the Radius value.
In case of Radius value, the value of the former axis is valid. (For example of the interpolation axis A and axis B, the value of axis A is valid.)

Chapter 11 Automatic cycle step operation

In Automatic cycle step operation, it moves from the start step of the subcommand (WY0**5) to the end step of the subcommand (WY0**6) automatically. The operation mode of the steps of the applied axis can be selected by each axis.

In this operation it moves following to Common parameter and Automatic positioning data stored inside memory.

In detail, refer "6.1 Positioning data" and "Chapter 7 Setting and Reading positioning data".

Automatic cycle step operation can start at standby. If the applied axis isn't standby, make the axis start "Homing".

When the control command (H060x, x: applied axis) is set to the command register (WY04) with the start step number of the subcommand (WY0**5) and the end step number of the subcommand (WY0**6) and the repeat number of the subcommand (WY0**7), start Automatic cycle step operation.**

About Positioning data, refer "6.1.2 Positioning data".

(1) Example of the combination of the operation modes

Independent no axis -	---------	Linear interpolation (2 - 4 axes)
Independent 1 axis	----------	Linear interpolation (2 - 3 axes)
Independent 2 axes	----------	Linear interpolation (2 axes)
Independent no axis	----------	Circular interpolation (2 axes)
Independent 1 axis	----------	Circular interpolation (2 axes)
Independent 2 axes	----------	Circular interpolation (2 axes)
Linear interpolation 2 axes	----------	Linear interpolation (2 axes) (Note 1)
Linear interpolation 2 axes	----------	Circular interpolation (2 axes) (Note 1)

Note 1: This combination can not start at the same time.

(2) About "Continuous operation"

Don't change "Continuous operation" setting value of each step during Automatic cycle step operation. So it is able to change from "Single step operation" to " Continuous operation" or the opposite case too. In this case, it stops at the step of "Single step operation".

[Example]

Start step number: 0
End step number: 4
Repeat number: 1

	Step No.	0	1	2	3	4	Contents
E-1	Continuos / single	Continuos	Continuos	single	Continuos	Continuos	Stop when the operation of Step No. 2 completes. It is not able to change from "Single step operation" to "Continuous operation".
	Interpolation of axis A	Linear	Circular	Linear	Linear	Linear	
	Interpolation of axis B	Linear	Circular	Linear	Linear	Linear	
	Status	Start and Run	Run	Run and Slow down stop	--	--	
E-2	Continuos / single	Continuos	Continuos	Continuos	Continuos	Continuos	Stop when the operation of Step No. 1 completes. It is not able to change from "Independent operation" to "Interpolation operation".
	Interpolation of axis A	Independent	Independent	Linear	Linear	Linear	
	Interpolation of axis B	Independent	Independent	Linear	Linear	Linear	
	Status	Start and Run	Run and Slow down stop	--	--	--	

	Step No.	0	1	2	3	4	Contents
E-3	Continuos / single	Continuos	Continuos	Continuos	Continuos	Continuos	It is able to change from " Interpolation operation" to " Independent operation".
	Interpolation of axis A	Linear	Linear	Independent	Independent	Independent	
	Interpolation of axis B	Linear	Linear	Independent	Independent	Independent	
	Status	Start and Run	Run	Run	Run	Run and Slow down stop	
E-4	Continuos / single	Continuos	Continuos	Continuos	Continuos	Continuos	Stop when the operation of Step No. 1 completes. It is not able to change the axis number of interpolation on the cycle operation.
	Interpolation of axis A	Linear	Linear	Linear	Linear	Linear	
	Interpolation of axis B	Linear	Linear	Linear	Linear	Linear	
	Interpolation of axis C	Linear	Linear	Independent	Independent	Independent	
	Status	Start and Run	Run and Slow down stop	--	--	--	
E-5	Continuos / single	Continuos	single	Continuos	Continuos	Continuos	Same as example 4.
	Interpolation of axis A	Linear	Linear	Linear	Linear	Linear	
	Interpolation of axis B	Linear	Linear	Linear	Linear	Linear	
	Interpolation of axis C	Linear	Linear	Independent	Independent	Independent	
	Status	Start and Run	Run and Slow down stop	--	--	--	

11.1 Continuous start of Step operation

In this operation each step operation is following to the data of "Chapter 10 Automatic step operation".

When the command (H060x , x: applied axes) is set to the command register (WY0**4), this operation starts from the start step of the subcommand (WY0**5) to the end step of the subcommand (WY0*6*) and repeats the times of the subcommand (WY0**7). If WY0**7 is "0", the operation continues until "Stop command".

One step operation completes, then the next step operation starts automatically.

The following is the timing of this operation.

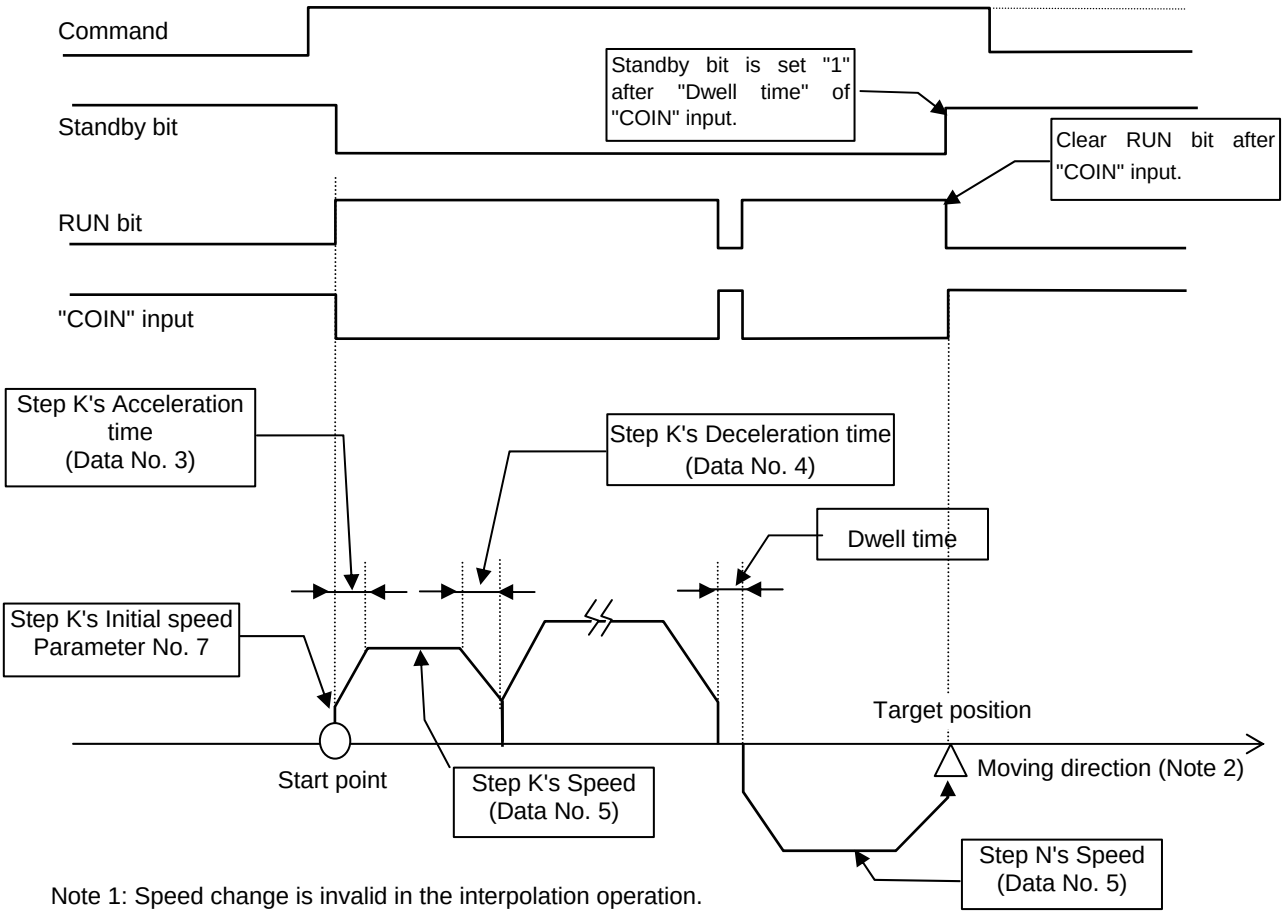
Note 1: When the standby bit (b9 of the status register) is "0", the applied axis doesn't start.

[Register]

WY0**4	Command (H060x)
WY0**5	Start step No.(0 - 255)
WY0**6	End step No. (0 - 255)
WY0**7	Repeat number (0 - 65535) (Note 2)

Note 2: The step number on running is indicated on the lower byte of status register.

[Timing] In case of the operation from step K to step N



Note 1: Speed change is invalid in the interpolation operation.

Note 2: The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

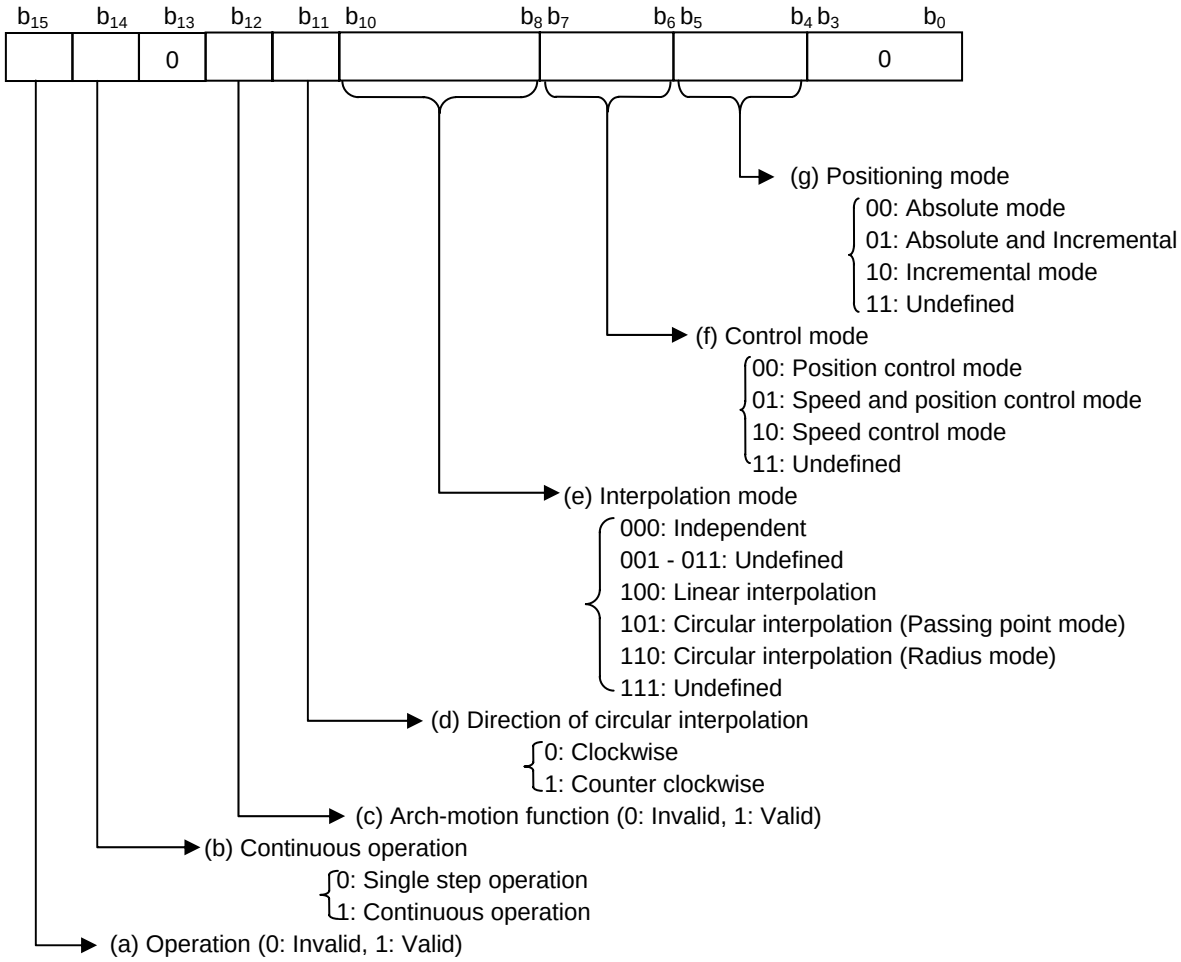
(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

* CW direction set to "Forward" on Common parameter No.1, above becomes an opposite direction.

The following describes about Automatic positioning data of this operation.
(1) Operation mode (Data No. 1)



(a) Operation (b_{15})
When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})
In case of this operation, set "0".
About the continuous operation, refer "11.2 Multiple stage speed operation" or after.

(c) Arch-motion function (b_{12})
In case of this operation, set "0".
About Arch-motion function, refer "11.3.1 Arch-motion function".

(d) Direction of circular interpolation (b_{11})
In case of Circular interpolation, set "0"(Clockwise) or "1" (Counter Clockwise) to this bit.
About Circular interpolation, refer "10.4 Circular interpolation".

(e) Interpolation mode (b_{10} - b_8)
Each mode is selectable. In detail, refer "6.1.2 Positioning data".
About Interpolation operation, refer "10.3 Linear interpolation" and "10.4 Circular interpolation".

(f) Control mode (b_7 - b_6)
In case of this operation, set these bits all "0" (00).

(g) Positioning mode (b_5 - b_4)
Each mode is selectable. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

In case of Circular interpolation, this value is ignored.

About Acceleration and Deceleration of Circular interpolation, refer "10.4 Circular interpolation".

Note: If the wrong value was set, it moves as the value is 10 ms and command error (H0011 or H0012) occurs. In detail, show "Chapter 13 Error code".

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).

The range of this value is 1 - 65535 (HFFFF).

Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).

If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).

The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).

Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

Incase of Circular interpolation, set the position value of "Passing point" or the Radius value.

In case of Radius value, the value of the former axis is valid. (For example of the interpolation axis A and axis B, the value of axis A is valid.)

Except Circular interpolation, this value is ignored.

11.2 Multiple stage speed operation

When the command (H060x , x: applied axes) is set to the command register (WY0**4), this operation starts from the start step of the subcommand (WY0**5) to the end step of the subcommand (WY0*6*) and repeats the times of the subcommand (WY0**7). If WY0**7 is "0", the operation continues until "Stop command".

In this operation the value of the target position of one step is the speed change point to the next step.

In case that the direction of one step operation is different from the one of the next step, one step positioning completes and the next step operation starts for the other direction without stopping automatically.

The following is the timing of this operation.

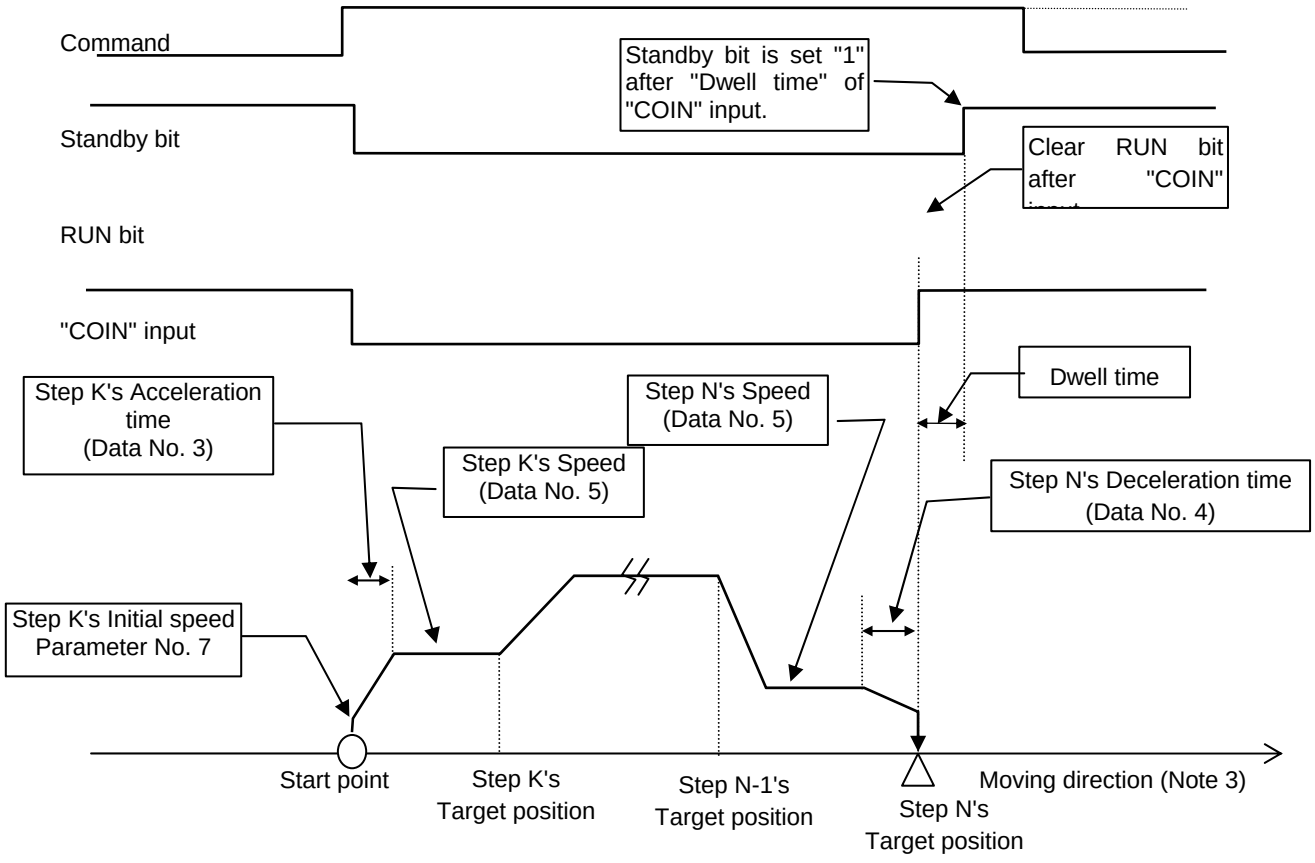
Note 1: When the standby bit (b9 of the status register) is "0", the applied axis doesn't start.

[Register]

WY0**4	Command (H060x)
WY0**5	Start step No.(0 - 255)
WY0**6	End step No. (0 - 255)
WY0**7	Repeat number (0 - 65535) (Note 2)

Note 2: The step number on running is indicated on the lower byte of status register.

[Timing] In case of the operation from step K to step N



Note 3: The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

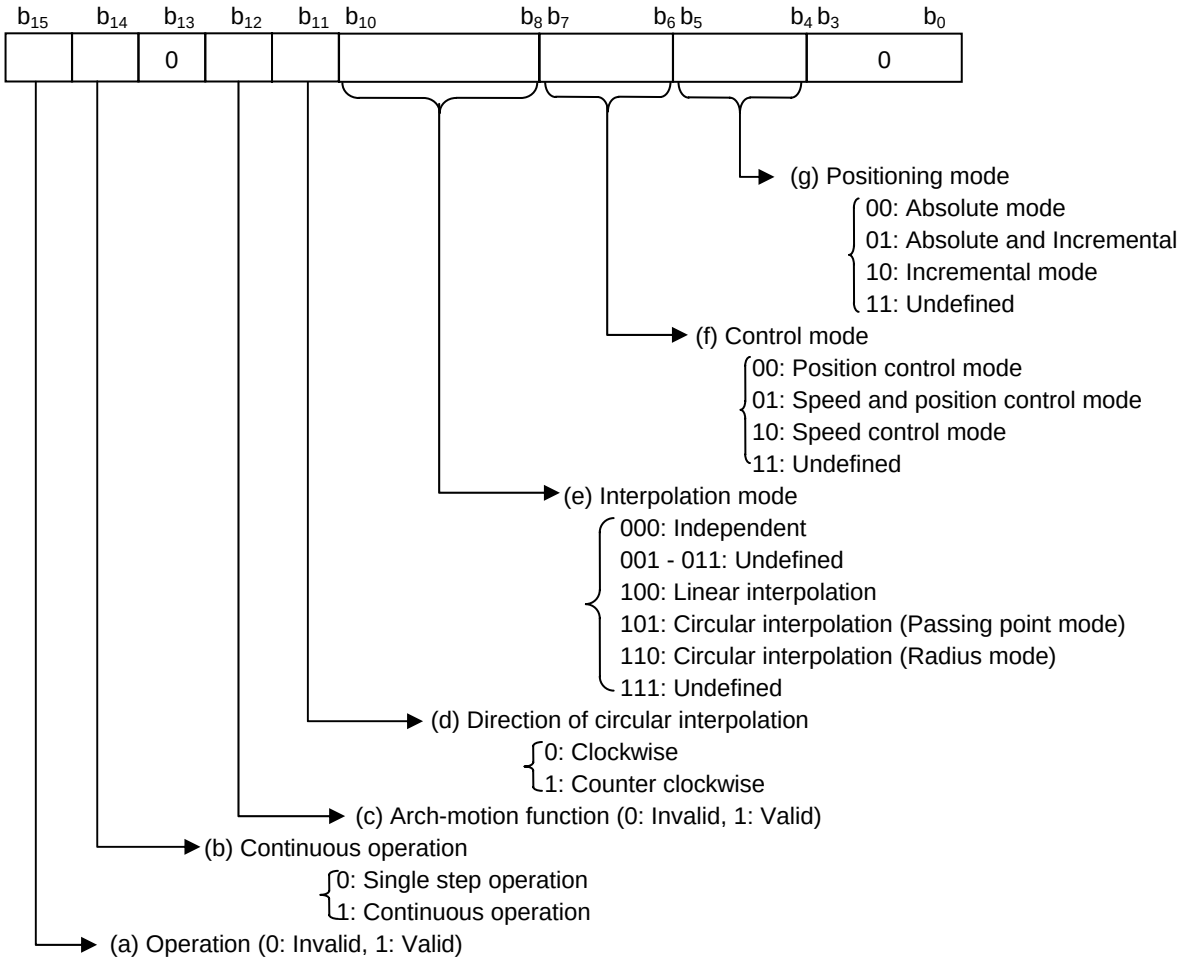
Note 4: The acceleration and deceleration ratio between each step is the same one of the start step.

Note 5: Speed change command in this operation is ignored and the command error occurs.

But the operation continues.

The following describes about the Automatic positioning data of this operation.

(1) Operation mode (Data No. 1)



(a) Operation (b_{15})

When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})

In case of this operation, set "1".

(c) Arch-motion function (b_{12})

In case of this operation, this bit is ignored. This bit is only valid in case of the linear interpolation of 2 - 4 axes and Automatic cycle operation.

About Arch-motion function, refer "11.3.1 Arch-motion function".

(d) Direction of circular interpolation (b_{11})

In case of this operation, this bit is ignored.

About Circular interpolation, refer "10.4 Circular interpolation".

(e) Interpolation mode (b_{10} - b_8)

Set "000" to b_{10} - b_8.

(f) Control mode (b_7 - b_6)

"00" (Positioning mode) is only valid. In detail, refer "6.1.2 Positioning data".

(g) Positioning mode (b_5 - b_4)

Each mode is selectable. But set the same value to all of the applied axes. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

The range of this value is 0 - 255 (HFF) and Unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

The applied axis value of the real operation becomes the one of the basic axis.

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).

The range of this value is 1 - 65535 (HFFFF).

Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).

If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

This value may be different from the value of the real operation because of the calculation for interpolation.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).

The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).

Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

In case of this operation, this value is ignored. About Circular interpolation, refer "10.4 Circular interpolation", "11.4 Continuous circular interpolation" and "12.4 Circular interpolation".

11.3 Continuous linear interpolation operation

When the command (H060x , x: applied axes) is set to the command register (WY0**4), this operation starts from the start step of the subcommand (WY0**5) to the end step of the subcommand (WY0*6*) and repeats the times of the subcommand (WY0**7). If WY0**7 is "0", the operation continues until "Stop command".

If the continuous operation bit is "1" in this operation, the value of the target position of one step is the speed change point to the next step.

In case that the direction of one step operation is different from the one of the next step, one step positioning completes and the next step operation starts for the other direction without stopping automatically.

The following is the timing of this operation.

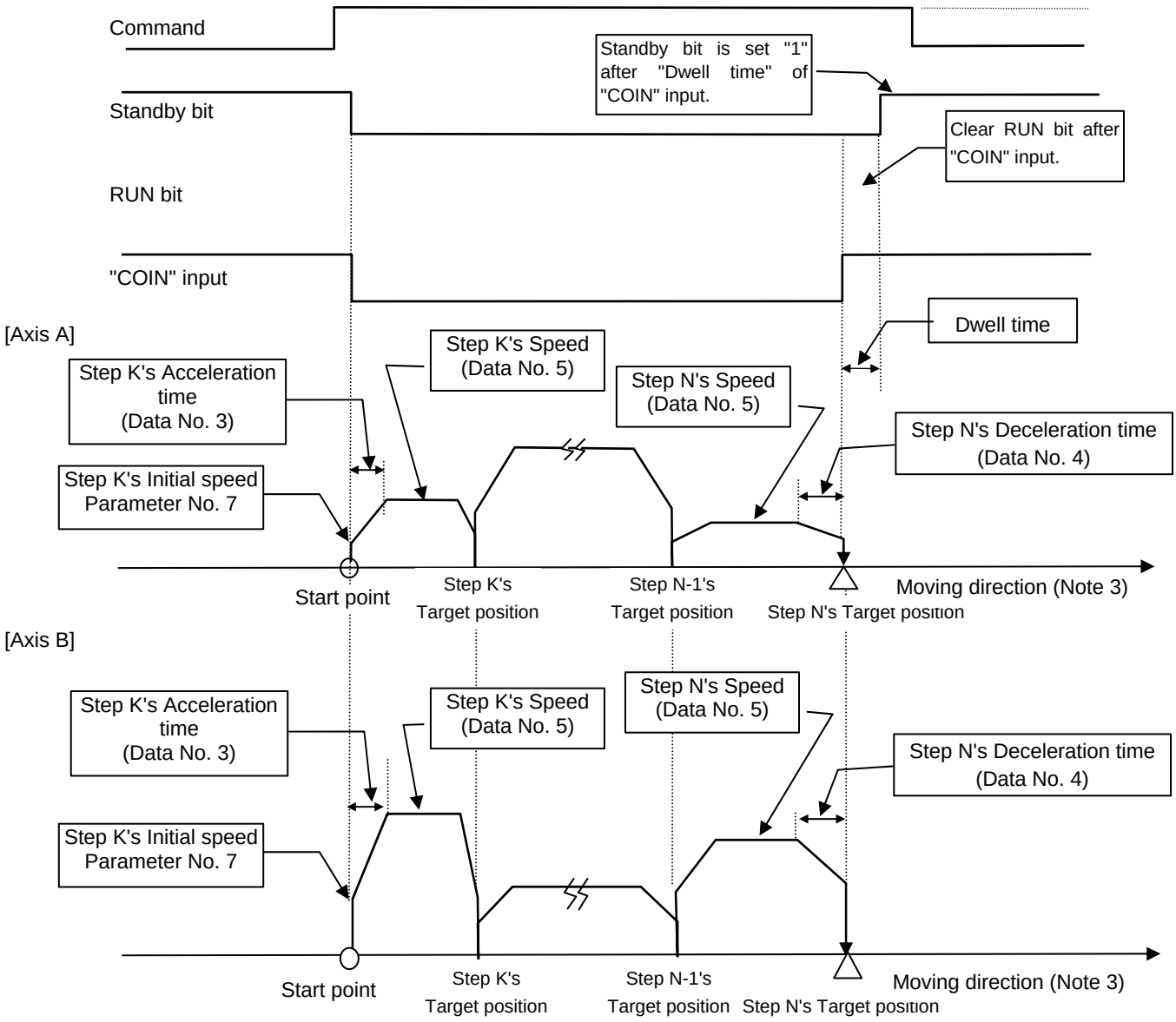
Note 1: When the standby bit (b9 of the status register) is "0", the applied axis doesn't start.

[Register]

WY0**4	Command (H060x)
WY0**5	Start step No.(0 - 255)
WY0**6	End step No. (0 - 255)
WY0**7	Repeat number (0 - 65535) (Note 2)

Note 2: The step number on running is indicated on the lower byte of status register.

[Timing] In case of the operation from step K to step N



Note 3: The moving direction is bellow.
(1) Absolute mode
1) Target position value > Current position value: Forward
2) Target position value < Current position value: Reverse
(2) Incremental mode
1) Target position value is positive: Forward
2) Target position value is negative: Reverse
Note 4: The acceleration and deceleration ratio between each step is the same one of the start step.
Note 5: Speed change command in this operation is ignored and the command error occurs.
But the operation continues.
Note 6: Actual initial speed and speed are changed by the distance ratio of the applied axis and the basic axis.

The example is bellow.

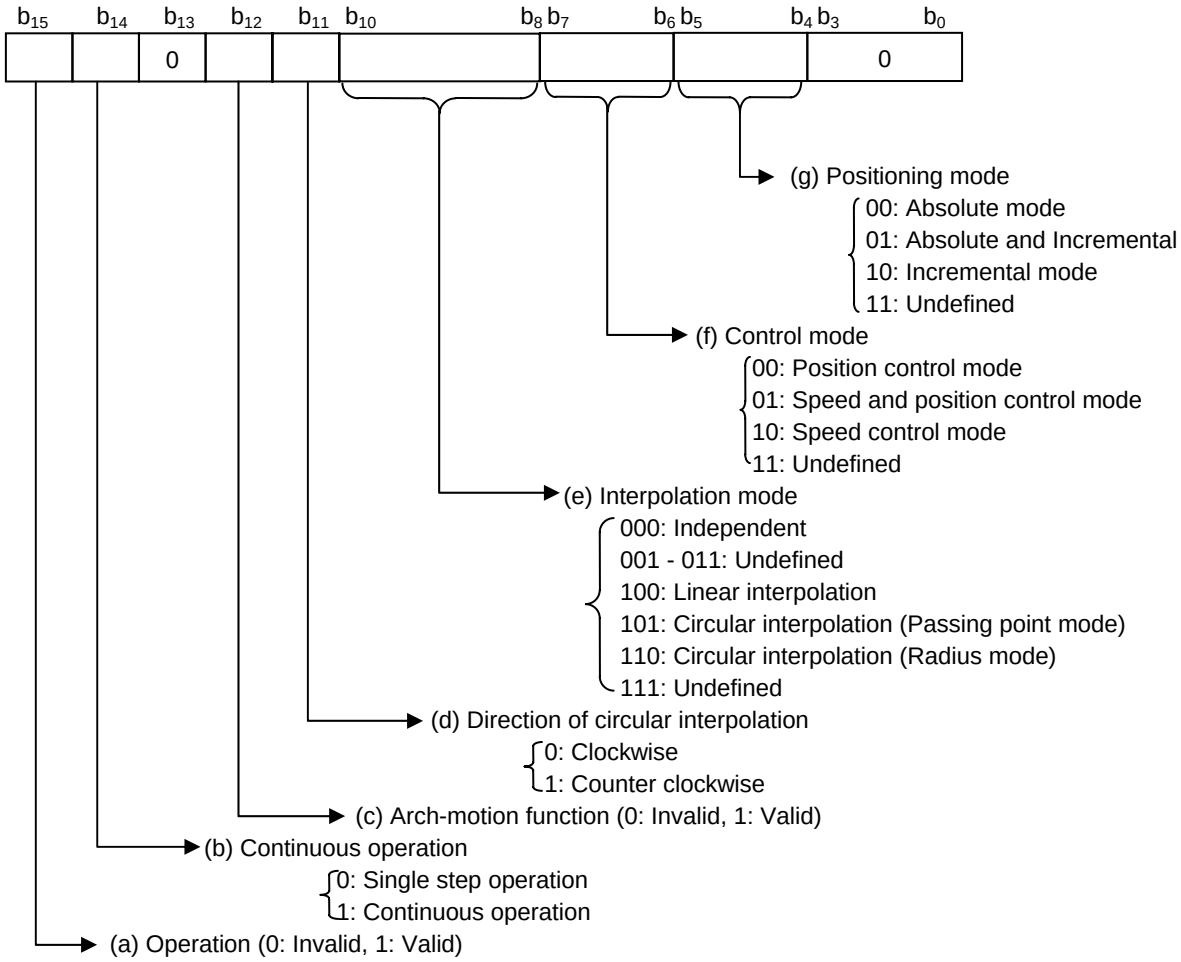
[Interpolation value]
The basic axis is the smallest axis for the value of "speed / distance".
If the value is same, the basic axis is longer one. Acceleration and deceleration are the ones of the basic axis.

[Example]
Setting data

	Axis	Initial speed	Acceleration time	Deceleration time	Speed	Target position	Current position	Speed / distance
Setting data	A	100	200 ms	100 ms	1000	25000	5000	0.05
	B	150	100 ms	150 ms	600	10000	8000	0.3
	C	100	150 ms	150 ms	2000	50000	0	0.04
	D	200	200 ms	300 ms	3000	80000	-20000	0.03
Interpolation data	A	40	200 ms	300 ms	600	25000	5000	0.03
	B	3	200 ms	300 ms	60	10000	8000	0.03
	C	100	200 ms	300 ms	1500	50000	0	0.03
	D	200	200 ms	300 ms	3000	80000	-20000	0.03

D is the basic axis

The following describes about the Automatic positioning data of this operation.
(1) Operation mode (Data No. 1)



(a) Operation (b_{15})
When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})
In case of this operation, set "1".

(c) Arch-motion function (b_{12})
In case that this bit is "1", Arch-motion function is valid.
In detail, refer "11.3.1 Arch-motion function".

(d) Direction of circular interpolation (b_{11})
In case of this operation, this bit is ignored.
About Circular interpolation, refer "10.4 Circular interpolation".

(e) Interpolation mode (b_{10} - b_8)
Set "100" to b_{10} - b_8.

(f) Control mode (b_7 - b_6)
"00" (Positioning mode) is only valid. In detail, refer "6.1.2 Positioning data".

(g) Positioning mode (b_5 - b_4)
Each mode is selectable. But set the same value to all of the applied axes. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of Arch-motion mode only, this value is valid.
The range of this value is 80 - 99 (H50 - H63), Unit is %.

2) Dwell time

The range of this value is 0 - 255 (HFF) and Unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).
The applied axis value of the real operation becomes the one of the basic axis.

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).
The range of this value is 1 - 65535 (HFFFF).
Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).
If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.
This value may be different from the value of the real operation because of the calculation for interpolation.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).
The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).
Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

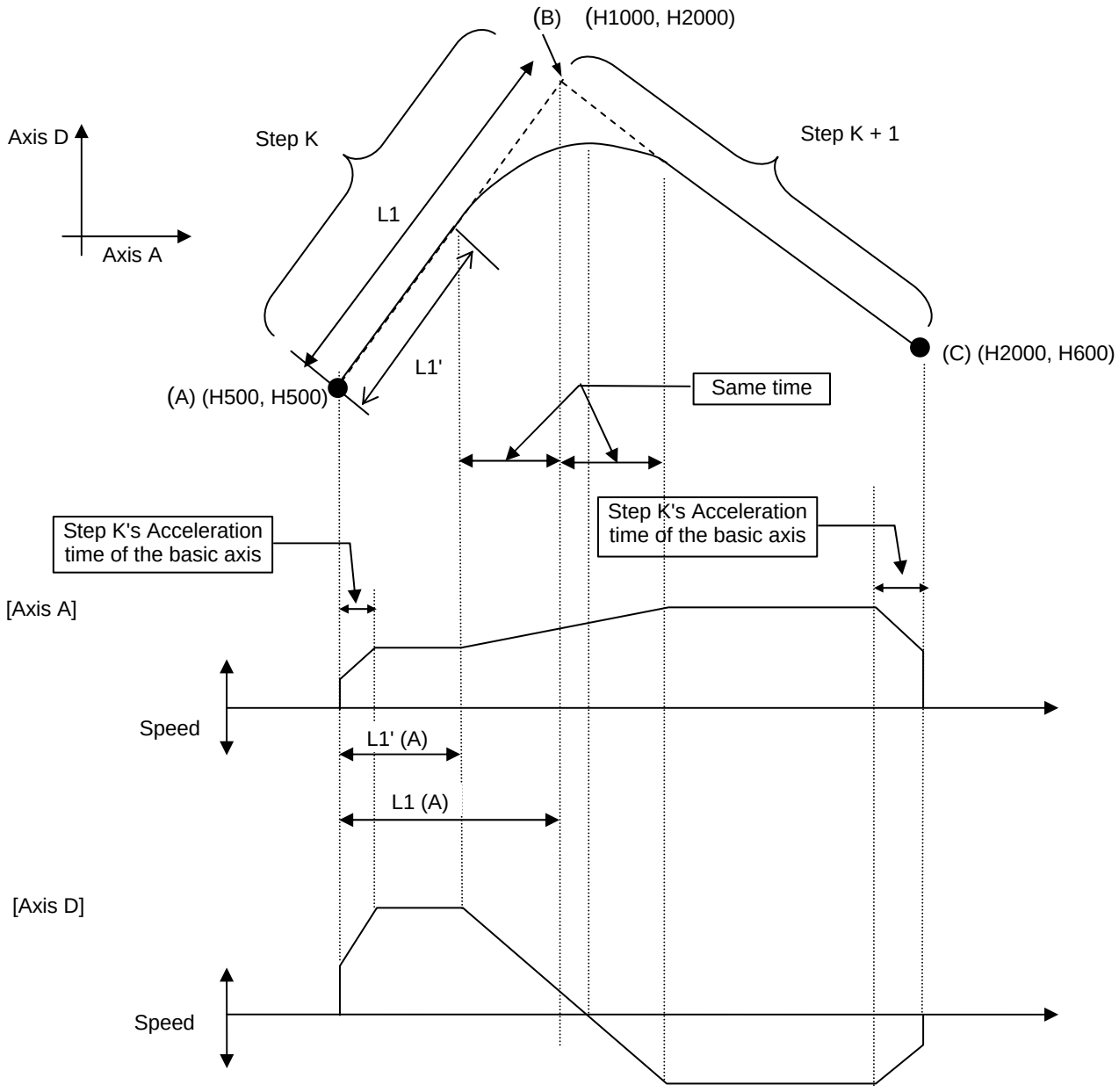
In case of this operation, this value is ignored. About Circular interpolation, refer "10.4 Circular interpolation", "11.4 Continuous circular interpolation" and "12.4 Circular interpolation".

11.3.1Arch-motion function

Arch-motion function is selectable in the linear interpolation and continuous operation. This function makes smooth movement between the positioning points.

In this operation the applied axes moves the next step on the way following to the arch-motion ratio. (Positioning data No. 2)

[Example] The applied axes are 2 axes. Arch-motion is valid. Linear interpolation is selected.
Linear interpolation operation moves from (A) passing (B) to (C).



Note 1: L1 (A) and L1' (A) are the components of axis A for the distance L1 and L1'.

[Example of interpolation data]

Data No.			1	2	3	4	5	6		7	
Word No.			8	9	A	B	C	D	E	F	10
Contents			Operation mode	Arch-motion ratio and Dwell	Acceleration time	Deceleration time	Speed	Target position		Circular interpolation	
								Lower	Upper	Lower	Upper
Step 0	Axis A	Setting	HE400	H0000	H0064	H0032	H1000	H1000	H0000	H0000	H0000
		Interpolation	--	--	H01F4	(Note 1)	H0500	--	--	--	--
	Axis B	Setting	HE400	H0000	H01F4	H0064	H1500	H2000	H0000	H0000	H0000
		Interpolation	--	--	H01F4	(Note 1)	H1500	--	--	--	--
Step 1	Axis A	Setting	HE400	H0000	H0032	H0064	H1500	H2000	H0000	H0000	H0000
		Interpolation	--	--	H0032	H0064	H1500	--	--	--	--
	Axis B	Setting	HE400	H0000	H0064	H0032	H1000	H0600	H0000	H0000	H0000
		Interpolation	--	--	H0032	H0064	H03FD	--	--	--	--

[ ] is the basic axis

11.4 Continuous circular interpolation

When the command (H060x , x: applied axes) is set to the command register (WY0**4), this operation starts from the start step of the subcommand (WY0**5) to the end step of the subcommand (WY0*6*) and repeats the times of the subcommand (WY0**7). If WY0**7 is "0", the operation continues until "Stop command".

If the continuous operation bit is "1" in this operation, the value of the target position of one step is the speed change point to the next step.

In case that the direction of one step operation is different from the one of the next step, one step positioning completes and the next step operation starts for the other direction without stopping automatically.

The following is the timing of this operation.

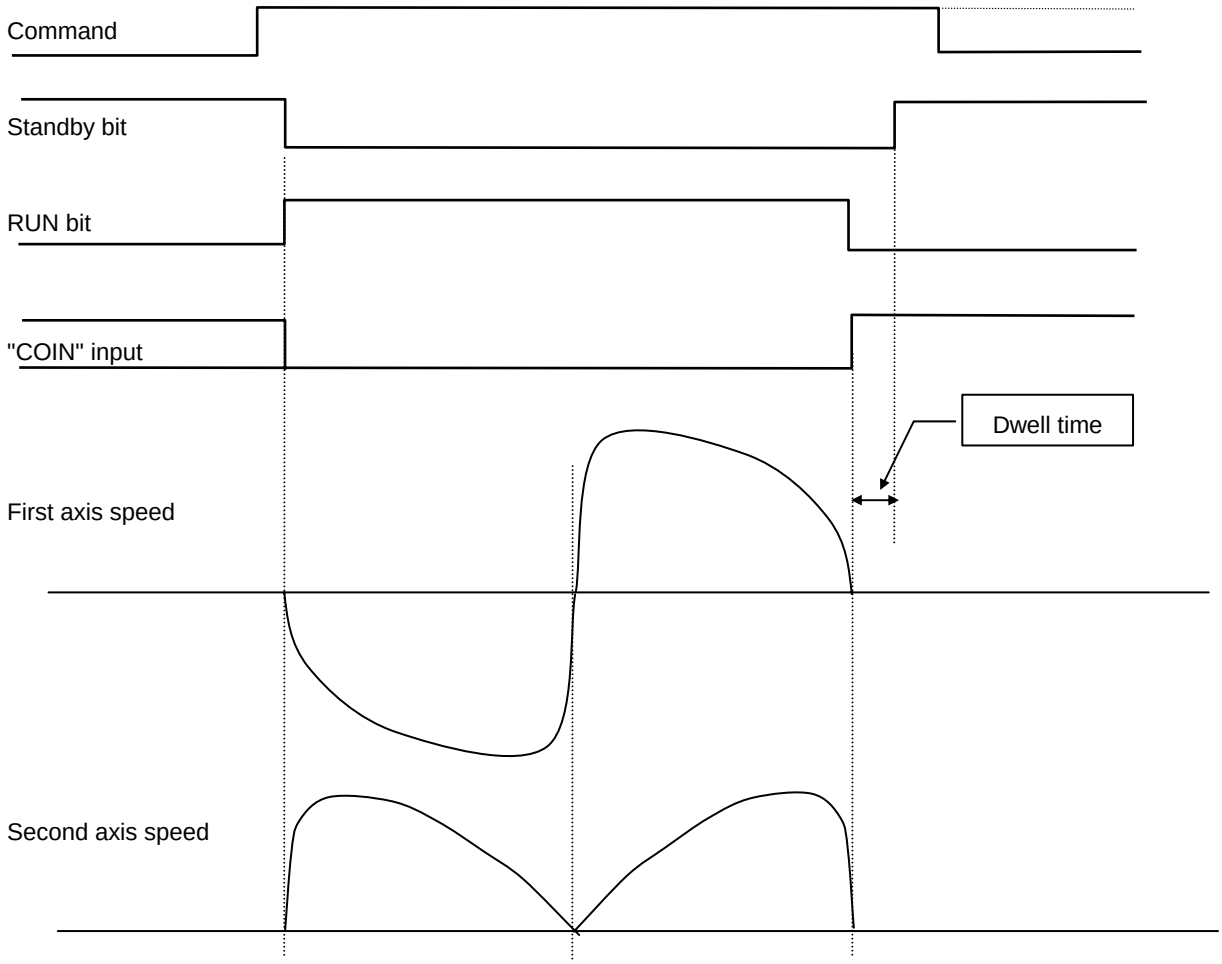
Note 1: When the standby bit (b9 of the status register) is "0", the applied axis doesn't start.
Note 2: In this operation, set the same value of the operation mode to the applied axes.
Note 3: During the circular interpolation, the other group of circular interpolation cannot start.

[Register]

WY0**4	Command (H060x)
WY0**5	Start step No.(0 - 255)
WY0**6	End step No. (0 - 255)
WY0**7	Repeat number (0 - 65535) (Note 2)

Note 3: The step number on running is indicated on the lower byte of status register.

[Timing]



Note 4: The number of circular interpolation axes is 2 axes. If the number isn't 2 axes, the command error occurs and it can not start.

Note 5: Speed change command in this operation is ignored and the command error occurs. But the operation continues.

[Interpolation value of Circular interpolation]

The speed value of Circular interpolation is the one of the former axis in order to A - D, The speed value of each axis is the component of this value. The acceleration time and the deceleration time are the ones of the former axis too.

[Example] The example of the circular interpolation between axis A and B indicates bellow.

Setting Value

	Axis	Acceleration time	Deceleration time	Speed	Target position	Interpolation value	Current position
Setting value	A	200 ms	100 ms	1000	25000	20000	5000
	B	100 ms	150 ms	600	10000	11000	8000

1) In case of passing point setting

	Axis	Acceleration time	Deceleration time	Speed	Target position	Passing point	Current position
Actual value	A	200 ms	100 ms	--	25000	20000	5000
	B	200 ms	100 ms	--	10000	11000	8000
Composite value		--	--	1000	--	--	--

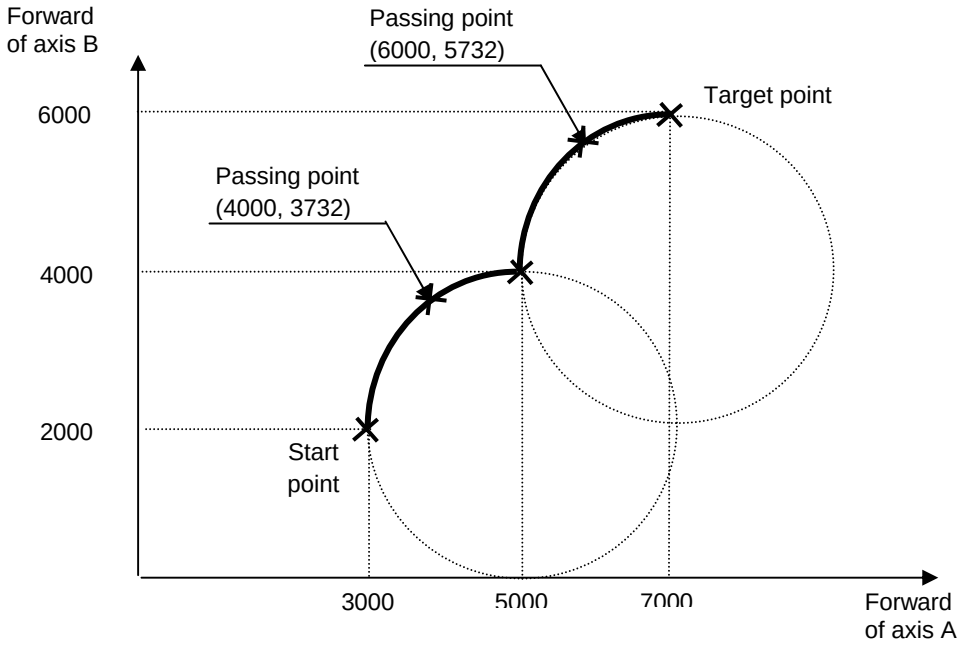
2) In case of Radius setting

	Axis	Acceleration time	Deceleration time	Speed	Target position	Radius value	Current position
Actual value	A	200 ms	100 ms	--	25000	20000	5000
	B	200 ms	100 ms	--	10000	20000	8000
Composite value		--	--	1000	--	20000	--

11.4.1 Passing point setting

[Example]

Selecting axis A and B, the following is the example to move from the start point (3000, 2000) to the target position (5000, 4000) passing the setting point (4000, 3732) and continue to move to the next target point (7000, 6000) passing the next setting point (6000, 5732).



(Actual value)

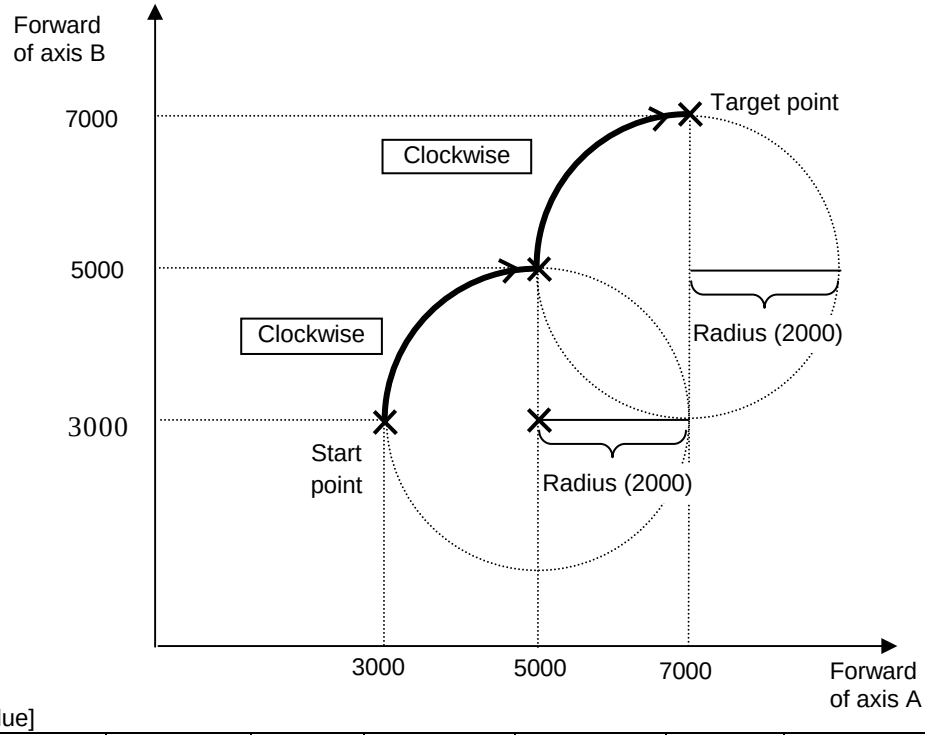
Data No.			1	2	3	4	5	6		7	
Word No.			8	9	A	B	C	D	E	F	10
Contents			Operation mode	Dwell	Acceleration time	Deceleration time	Speed	Target position		Interpolation value	
								Lower word	Upper word	Lower word	Upper word
Step 0	Setting value	Axis A	HC500	H0000	H0064	H01F4	H1000	H1388 (5000)	H0000	H0FA0 (4000)	H0000
		Axis B	HC500	H0000	H01F4	H0032	H2000	H0FA0 (4000)	H0000	H0E94 (3732)	H0000
	Actual value		--	--	H0064	H01F4	H1000	The value of each axis			
Step 1	Setting value	Axis A	HC500	H0000	H0100	H0200	H1500	H1B58 (7000)	H0000	H1770 (6000)	H0000
		Axis B	HC500	H0000	H03E8	H01F4	H1000	H1770 (6000)	H0000	H1664 (5732)	H0000
	Actual value		--	--	H0100	H0200	H1500	The value of each axis			

Note 1: The applied axes can be selected freely.

11.4.2 Radius setting

[Example]

Selecting axis A and B, the following is the example to move from the start point (3000, 3000) to the target position (5000, 5000) with the radius value (2000) and continue to move to the next target point (7000, 7000) with the radius value (2000).



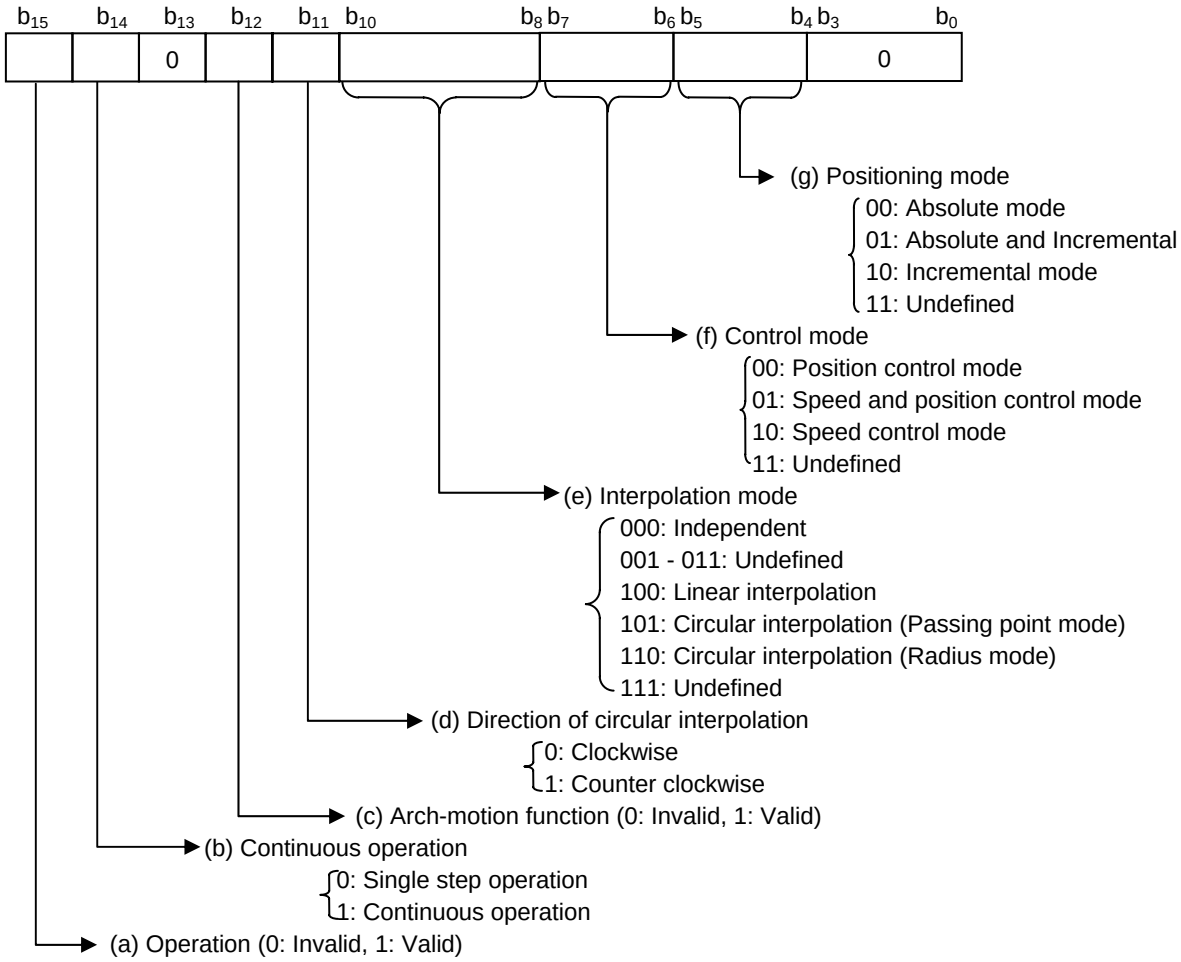
[Actual value]

Data No.			1	2	3	4	5	6		7	
Word No.			8	9	A	B	C	D	E	F	10
Contents			Operation mode	Dwell	Acceleration time	Deceleration time	Speed	Target position		Interpolation value	
								Lower word	Upper word	Lower word	Upper word
Step 0	Setting value	Axis A	HC600	H0000	H0064	H01F4	H1000	H1388 (5000)	H0000	H07D0 (2000)	H0000
		Axis B	HC600	H0000	H01F4	H0032	H2000	H1388 (5000)	H0000	H1388 (5000)	H0000
	Actual value		--	--	H0064	H01F4	H1000	The value of each axis		H07D0 (2000)	H0000
Step 1	Setting value	Axis A	HC600	H0000	H0100	H0200	H1500	H1B58 (7000)	H0000	H07D0 (2000)	H0000
		Axis B	HC600	H0000	H03E8	H01F4	H1000	H1B58 (7000)	H0000	H1388 (5000)	H0000
	Actual value		--	--	H0100	H0200	H1500	The value of each axis		H07D0 (2000)	H0000

Note 1: The applied axes can be selected freely.

Note 2: ▭ is the basic axis.

The following describes about the Automatic positioning data of this operation.
(1) Operation mode (Data No. 1)



(a) Operation (b_{15})
When the data are valid, set "1"(valid). If this bit is "0", the command error occurs and the operation does not start.

(b) Continuous operation (b_{14})
In case of this operation, set "1".

(c) Arch-motion function (b_{12})
In case of this operation, set "0".

(d) Direction of circular interpolation (b_{11})
In case of this operation, set "0"(Clockwise) or "1" (Counter Clockwise) to this bit.
In detail, refer "10.4 Circular interpolation".

(e) Interpolation mode (b_{10} - b_8)
Set "101" or "110" to b_{10} - b_8.

(f) Control mode (b_7 - b_6)
"00" (Positioning mode) is only valid. In detail, refer "6.1.2 Positioning data".

(g) Positioning mode (b_5 - b_4)
Each mode is selectable. But set the same value to all of the applied axes. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is invalid.

2) Dwell time

The range of this value is 0 - 255 (HFF) and Unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

In case of this operation, this value is ignored. But set the value more than "10".
The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).
In detail, refer "10.4 Circular interpolation".

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).
The range of this value is 1 - 65535 (HFFFF).
Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).
If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.
This value may be different from the value of the real operation because of the calculation for interpolation.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).
The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).
Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

Set the position value of "Passing point" or the Radius value.
In case of Radius value, the value of the former axis is valid. (For example of the interpolation axis A and axis B, the value of axis A is valid.)

Chapter 12 Direct positioning operation

Direct positioning operation can move one time without storing the positioning data to the memory (EEPROM). But the continuous operation like the step cycle operation can not do.
Direct positioning operation can do “Single axis operation” (H040x), “Multiple axes operation” (H040x), “Linear interpolation operation”(H050x), “Circular interpolation operation”(H051x).
Direct positioning operation is triggered it needs to be standby. In the case that a corresponding axis is not standby, please make homing ("Chapter 8 Homing) at first.
Direct positioning operation can start with setting up to control command H040x, H050x or, H051x (x: axis appointment) in command register (WYrus4) and operation data in setting area at condition of standby.

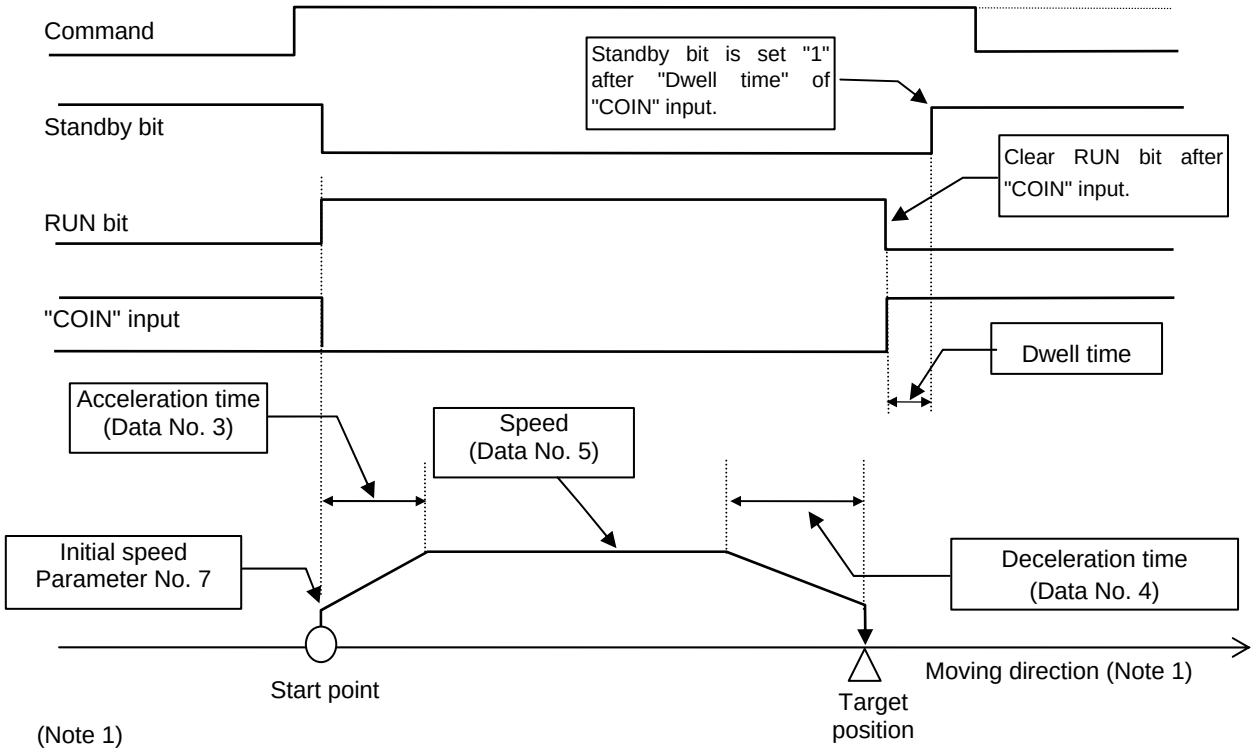
12.1 Single axis operation

At first set the direct positioning data. When the standby bit (status register WX0**0 - 3, b9) of the applied axis is "1", after the automatic step operation command (H040x, x: applied axis, A: 1, B: 2, C: 4, D: 8) is set to the command register (WY0**4), single axis direct positioning starts. When the standby bit is "0", the operation does not start.
After generating the pulses applied to the target position value, the operation stops and completes.
The timing of each signal is bellow.

[Register]

WY0**4	Command (H040x)
WY0**5	don't care
WY0**6	don't care
WY0**7	don't care

[Timing]



(Note 1)
The moving direction is bellow.
(1) Absolute mode
1) Target position value > Current position value: Forward
2) Target position value < Current position value: Reverse
(2) Incremental mode
1) Target position value is positive: Forward
2) Target position value is negative: Reverse
* CW direction set to "Forward" on Common parameter No.1, above becomes an opposite direction.

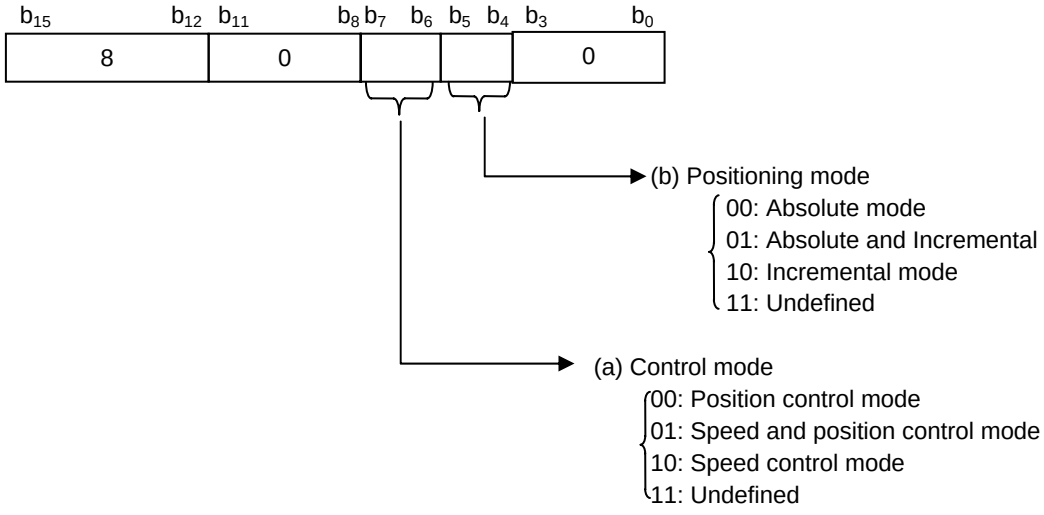
[Direct positioning data]

Area	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents
Command register	WY0**4	H040x (x: applied axis)				Direct positioning control command
	WY0**5	--				--
	WY0**6	--				--
	WY0**7	--				--
Setting area 1	1	Operation mode				--
	2	Dwell time (Lower byte) (Note 1)				Unit: 20 ms
	3	Acceleration time				Unit: ms
	4	Deceleration time				Unit: ms
	5	Speed value				About unit and scaling, refer "6.1 Common parameter".
	6	Target position (Lower word)				About unit and scaling, refer "6.1 Common parameter". Range: -2 147 483 648 to + 2 147 486 647
	7	Target position (Upper word)				

Note 1: In this case, the upper byte is invalid.

[Positioning data]

(1) Operation mode



(a) Control mode (b_7 - b_6)

Each mode is selectable. In detail, refer "6.1.2 Positioning data".

(b) Positioning mode (b_5 - b_4)

Each mode is selectable. But in case that "Control mode" is "Speed mode", this mode is selected "Incremental mode" in spite of these value. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

Note: If the wrong value was set, it moves as the value is 10 ms and command error (H0011 or H0012) occurs. In detail, show "Chapter 13 Error code".

(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).

The range of this value is 1 - 65535 (HFFFF).

Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).

If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).

The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).

Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

12.2 Multiple axes operation

At first set the direct positioning data. When the standby bits (status register WX0**0 - 3, b9) of the applied axes are "1", after the automatic step operation command (H040x, x: applied axis, A: 1, B: 2, C: 4, D: 8) is set to the command register (WY0**4), multiple axes direct positioning start. When the standby bit is "0", the operation does not start.

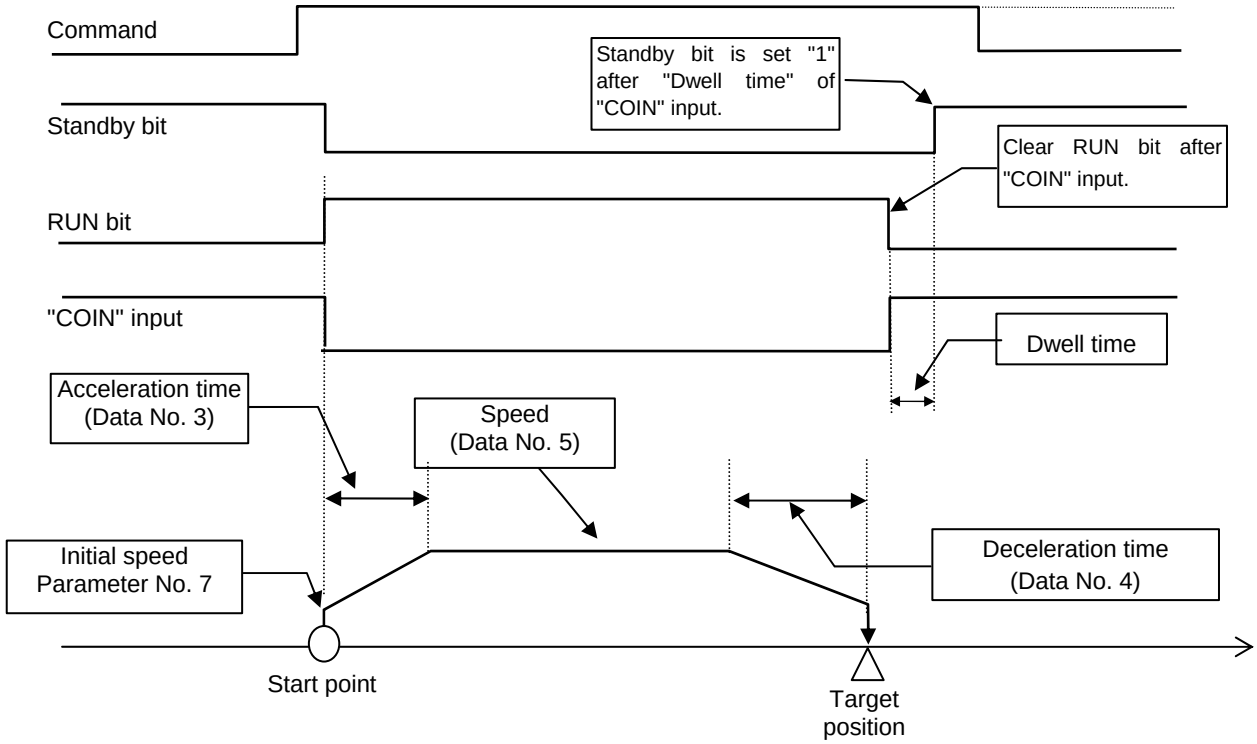
After generating the pulses applied to the target position value, the operation stops and completes.

The timing of each signal is bellow.

[Register]

WY0**4	Command (H040x)
WY0**5	don't care
WY0**6	don't care
WY0**7	don't care

[Timing]



(Note 1)

The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

* CW direction set to "Forward" on Common parameter No.1, above becomes an opposite direction.

(Note 2)

About Speed change, refer "6.3.2 Setting command".

The following table is the positioning data list setting at start.
Set the data to the data area in order of the applied axes.
[Example]
(1) In case of axis A and C, axis A: the first axis data area, axis C: the second axis data area.
(2) Incase of axis B and C, axis B: the first axis data area, axis C: the second axis data area.

Area	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents
Command register	WY0**4	H040x (x: applied axis)				Direct positioning control command
	WY0**5	--				--
	WY0**6	--				--
	WY0**7	--				--
Setting area 1	1	Operation mode 1				--
	2	Dwell time 1 (Lower byte) (Note 1)				Unit: 20 ms
	3	Acceleration time 1				Unit: ms
	4	Deceleration time 1				Unit: ms
	5	Speed value 1				About unit and scaling, refer "6.1 Common parameter".
	6	Target position 1 (Lower word)				About unit and scaling, refer "6.1 Common parameter". Range: -2 147 483 648 to + 2 147 486 647
	7	Target position 1 (Upper word)				
Setting area 2	8	Operation mode 2				--
	9	Dwell time 2 (Lower byte) (Note 1)				Unit: 20 ms
	10	Acceleration time 2				Unit: ms
	11	Deceleration time 2				Unit: ms
	12	Speed value 2				About unit and scaling, refer "6.1 Common parameter".
	13	Target position 2 (Lower word)				About unit and scaling, refer "6.1 Common parameter". Range: -2 147 483 648 to + 2 147 486 647
	14	Target position 2 (Upper word)				
Setting area 3	15 - 21	The positioning data of the third axis				--
Setting area 4	22 - 28	The positioning data of the fourth axis				--

Note 1: In this case, the upper byte is invalid.

[Positioning data]

The data of this operation are the same as "Single axis direct operation".
In detail, refer "12.1 Single axis direct operation

12.3 Linear interpolation

At first set the direct linear interpolation data. When the standby bits (status register WX0**0 - 3, b9) of the applied axes are "1", after the direct linear interpolation command (H050x, x: applied axis, A: 1, B: 2, C: 4, D: 8) is set to the command register (WY0**4), the direct positioning start. When the standby bits are "0", the operation does not start.

After generating the pulses applied to the target position value, the operation stops and completes.

The timing of each signal is bellow.

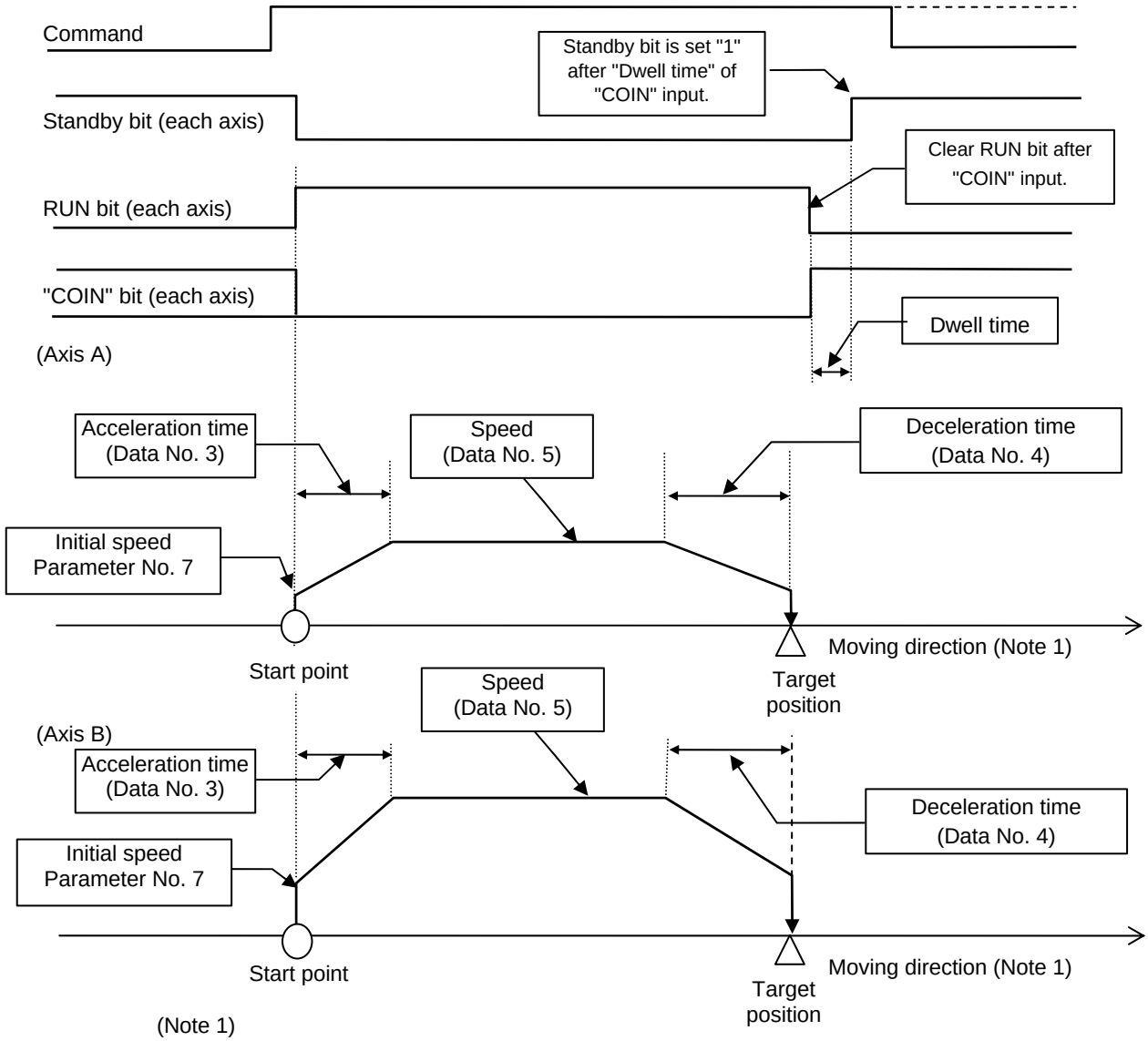
Set the same value to the operation mode of the applied axes.

[Register]

WY0**4	Command (H050x)
WY0**5	don't care
WY0**6	don't care
WY0**7	don't care

[Timing]

The example of the linear interpolation of axis A and B is bellow.



(Note 1)

The moving direction is bellow.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

* CW direction set to "Forward" on Common parameter No.1, above becomes an opposite direction.

[The operation value of linear interpolation]
In detail, refer "10.3 Linear interpolation step operation".

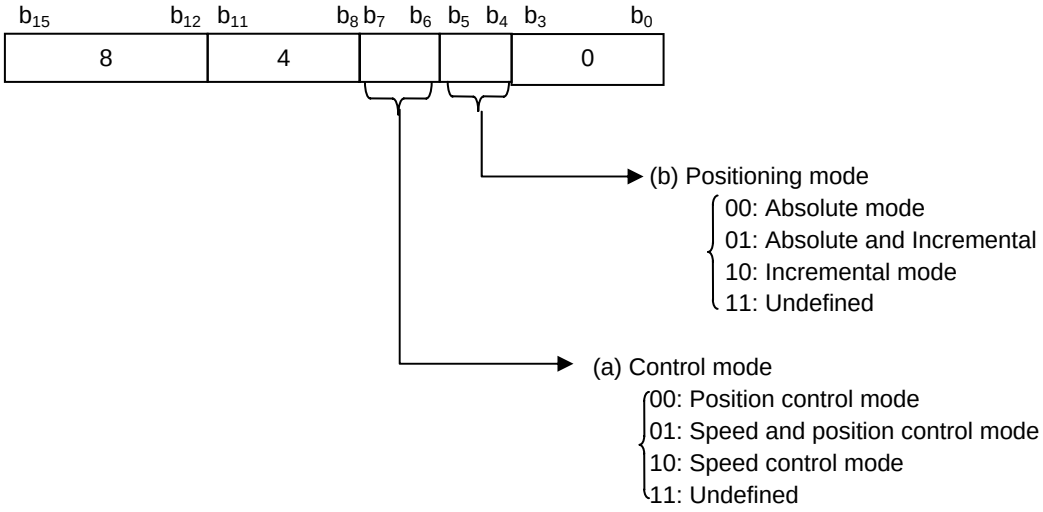
[Direct linear interpolation data]
The following table is the positioning data list setting at start.
Set the data to the data area in order of the applied axes.
[Example]
(1) In case of axis A and C, axis A: the first axis data area, axis C: the second axis data area.
(2) Incase of axis B and C, axis B: the first axis data area, axis C: the second axis data area.

Area	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents
Command register	WY0**4	H050x (x: applied axes)				
	WY0**5	--				--
	WY0**6	--				--
	WY0**7	--				--
Setting area 1	1	Operation mode				
	2	Dwell time (Lower byte) (Note 1)				Unit: 20 ms
	3	Acceleration time				Unit: ms
	4	Deceleration time				Unit: ms
	5	Speed value				About unit and scaling, refer "6.1 Common parameter".
	6	Target position 1 (Lower word)				About unit and scaling, refer "6.1 Common parameter". Range: -2 147 483 648 to + 2 147 486 647
	7	Target position 1 (Upper word)				
Setting area 2	8 - 9	Target position 2 (the second axis value)				The same as the above
Setting area 3	10 - 11	Target position 3 (the third axis value)				The same as the above
Setting area 4	12 - 13	Target position 4 (the fourth axis value)				The same as the above

Note 1: In this case, the upper byte is invalid.

[Positioning data]

(1) Operation mode



(a) Control mode (b_7 - b_6)

Each mode is selectable. In detail, refer "6.1.2 Positioning data".

(b) Positioning mode (b_5 - b_4)

Each mode is selectable. But in case that "Control mode" is "Speed mode", this mode is selected "Incremental mode" in spite of these value. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored. Set "H00".

2) Dwell time

The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

Note: If the wrong value was set, it moves as the value is 10 ms and command error (H0011 or H0012) occurs. In detail, show "Chapter 13 Error code".

(4) Speed value (Data No. 5)

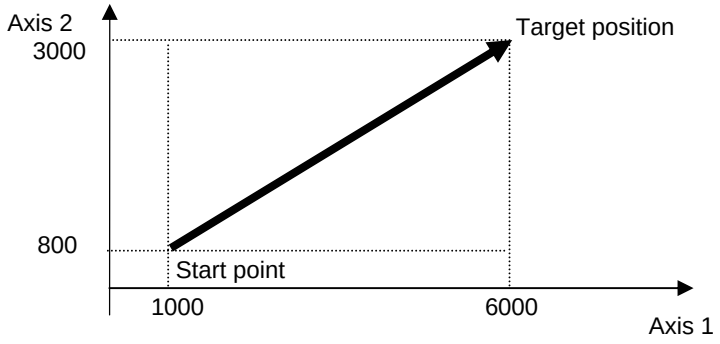
This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).
The range of this value is 1 - 65535 (HFFFF).
Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).
If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).
The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).
Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

Example of 2 axis interpolation

The following is the example of the interpolation operation from the start point (1000, 800) to the target position (6000, 3000).



[Interpolation data]

Area	Word No.	Contents	Setting value
Setting area	1	Operation mode	H8400
	2	Dwell time	H0000
	3	Acceleration time	H0064
	4	Deceleration time	H01F4
	5	Speed value	H1000
	6	Target position 1 (Lower word)	H1770 (6000)
	7	Target position 1 (Upper word)	H0000
	8	Target position 2 (Lower word)	H0BB8 (3000)
	9	Target position 2 (Upper word)	H0000

Interpolation

Actual speed after interpolation calculation

Contents	The value of each axis
Speed of axis 1	H1000 (4096)
Speed of axis 2	H070A (1802)

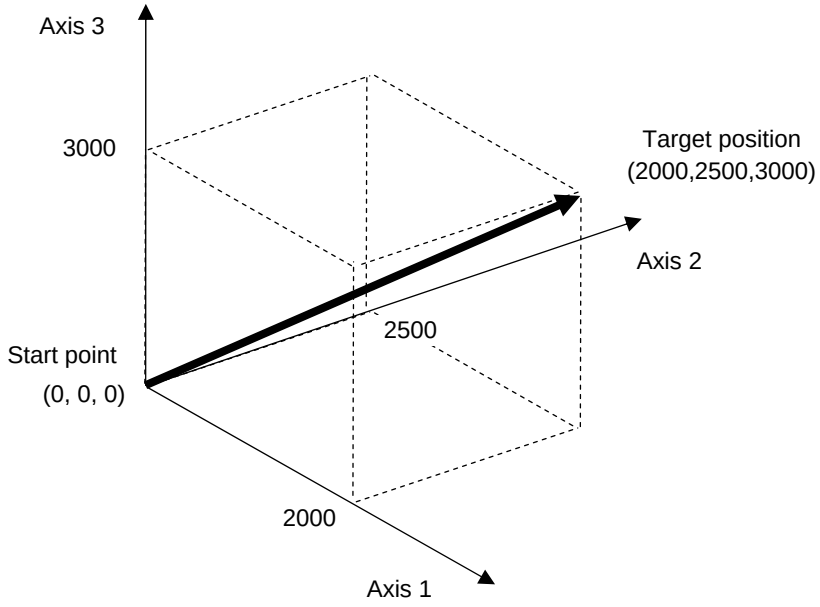
Note 1: The interpolation axes can be selectable freely.

Note 2: The actual operation value is the value in the right table. (The initial speed becomes the interpolation value too.

Note 3: In this case, the basic axis is Axis 1.

Example of 3 axis interpolation

The following is the example of the interpolation operation from the start point (0, 0, 0) to the target position (2000, 2500, 3000)



[Interpolation data]

Area	Word No.	Contents	Setting value
Setting area	1	Operation mode	H8400
	2	Dwell time	H0000
	3	Acceleration time	H0064
	4	Deceleration time	H01F4
	5	Speed value	H1000
	6	Target position 1 (Lower word)	H07D0 (2000)
	7	Target position 1 (Upper word)	H0000
	8	Target position 2 (Lower word)	H09C4 (2500)
	9	Target position 2 (Upper word)	H0000
	10	Target position 3 (Lower word)	H0BB8 (3000)
	11	Target position 3 (Upper word)	H0000

Interpolation

Actual speed after interpolation calculation

Contents	The value of each axis
Speed of axis 1	H0AAA (2730)
Speed of axis 2	H0D55 (3413)
Speed of axis 3	H1000 (4096)

Note 1: The interpolation axes can be selectable freely.

Note 2: The actual operation value is the value in the right table. (The initial speed becomes the interpolation value too.

Note 3: In this case, the basic axis is Axis 3.

12.4 Circular interpolation

At first set the direct circular interpolation data. When the standby bits (status register WX0**0 - 3, b9) of the applied axes are "1", after the direct circular interpolation command (H051x, x: applied axis, A: 1, B: 2, C: 4, D: 8) is set to the command register (WY0**4), the direct positioning start. When the standby bits are "0", the operation does not start.

After generating the pulses applied to the target position value, the operation stops and completes.

The timing of each signal is bellow.

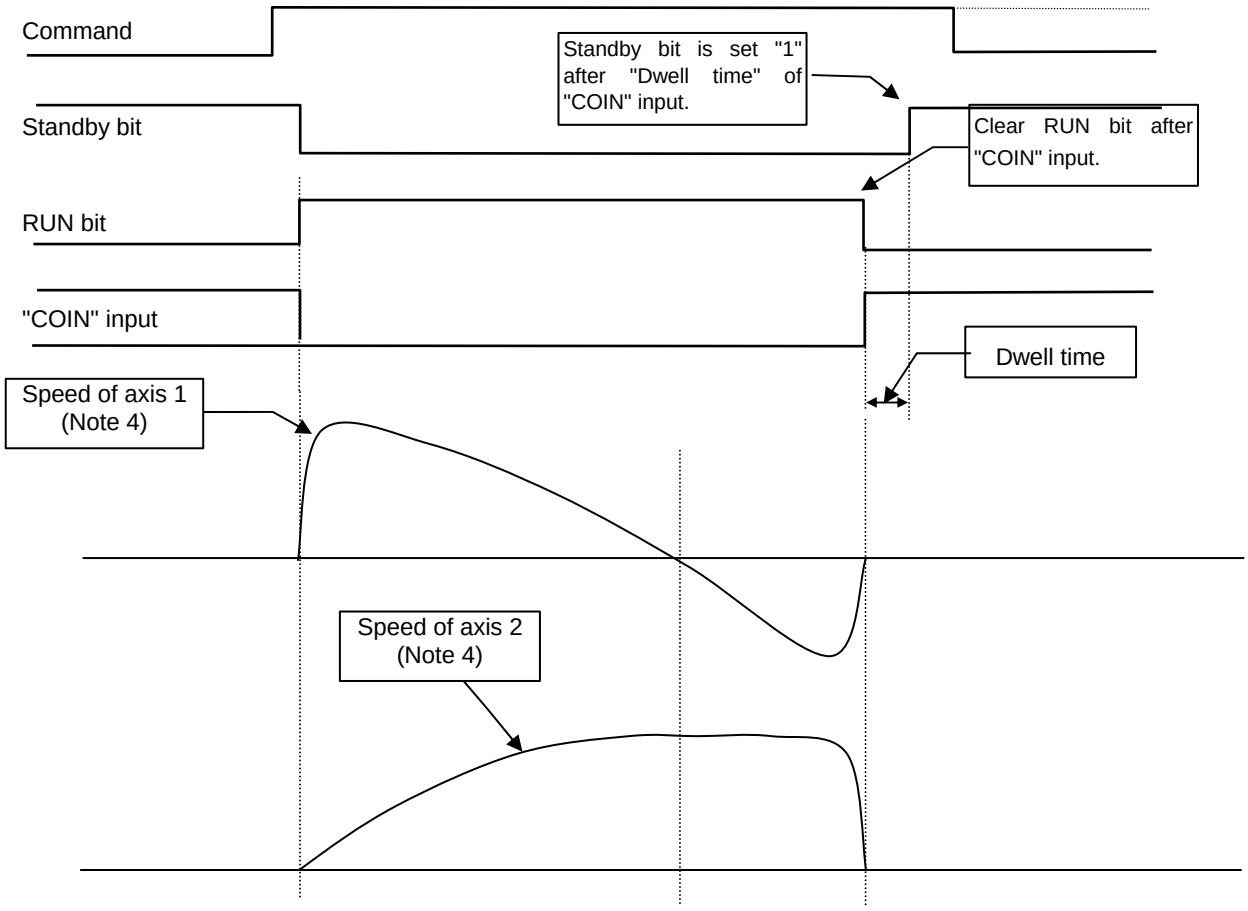
Set the same value to the operation mode of the applied axes.

[Register]

WY0**4	Command (H051x)
WY0**5	don't care
WY0**6	don't care
WY0**7	don't care

[Timing]

The example of the circular interpolation of axis A and B is bellow.



Note 1: The number of circular interpolation axes is 2 axes. Except 2 axes the command error occurs.

Note 2: On running Speed change is invalid.

Note 3: The moving direction is bellow. But it may differ from the following circular locus.

(1) Absolute mode

1) Target position value > Current position value: Forward

2) Target position value < Current position value: Reverse

(2) Incremental mode

1) Target position value is positive: Forward

2) Target position value is negative: Reverse

* CW direction set to "Forward" on Common parameter No.1, above becomes an opposite direction.

Note 4: It is not possible the speed of each axis to set up. The dissolution speed of the synthesis speed (setting data No. 5) of 2 actual axes becomes the speed of each axis.

[Direct circular interpolation data]

The following table is the positioning data list setting at start.

Set the data to the data area in order of the applied axes.

[Example]

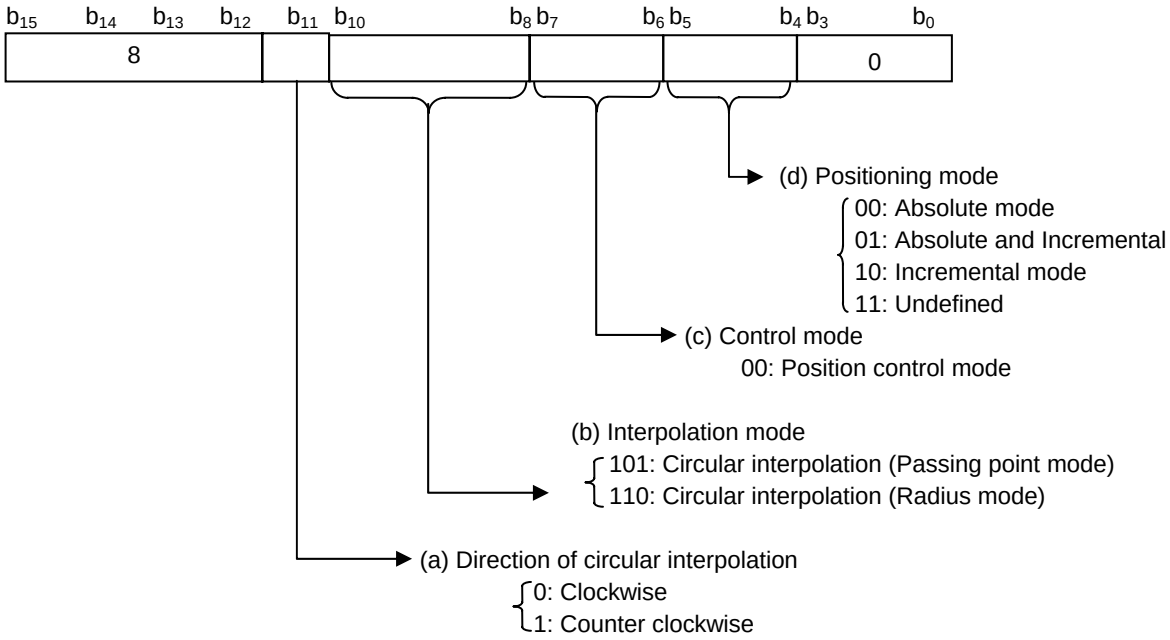
(1) In case of axis A and C, axis A: the first axis data area, axis C: the second axis data area.

(2) Incase of axis B and C, axis B: the first axis data area, axis C: the second axis data area.

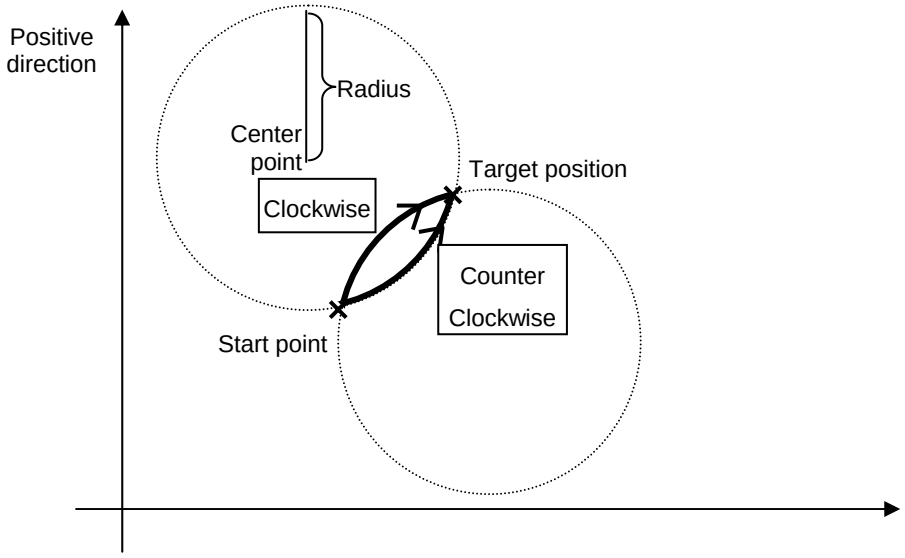
Area	Word No.	MSB 15 - 12	11 - 8	7 - 4	LSB 3 - 0	Contents
Command register	WY0**4	H051x (x: applied axes)				
	WY0**5	--				--
	WY0**6	--				--
	WY0**7	--				--
Setting area 1	1	Operation mode				
	2	Dwell time (Lower byte) (Note 1)				Unit: 20 ms
	3	Acceleration time				Unit: ms
	4	Deceleration time				Unit: ms
	5	Speed value				About unit and scaling, refer "6.1 Common parameter".
	6	Target position 1 (Lower word)				About unit and scaling, refer "6.1 Common parameter". Range: -2 147 483 648 to + 2 147 486 647
	7	Target position 1 (Upper word)				
	8	Circular interpolation value 1 (Lower word)				The same as the above
	9	Circular interpolation value 1 (Upper word)				
Setting area 2	10 - 11	Target position 2 (the second axis value)				The same as the above
	12 - 13	Circular interpolation value 2 (the second axis value)				The same as the above

Note 1: In this case, the upper byte is invalid.

The following describes about Circular interpolation positioning data of this operation.
(1) Operation mode (Data No. 1)



(a) Direction of circular interpolation (b_{11})
In case of this operation, set "0"(Clockwise) or "1" (Counter Clockwise) to this bit.



Note: The shorter arc is always selected.

(b) Interpolation mode (b_{10} - b_8)
Set "101" (Passing point setting) or "110" (Radius setting) to b_{10} - b_8.

(c) Control mode (b_7 - b_6)
"00" (Positioning mode) is only valid. In detail, refer "6.1.2 Positioning data".

(d) Positioning mode (b_5 - b_4)
Each mode is selectable. But set the same value to all of the applied axes. In detail, refer "6.1.2 Positioning data".

(2) Arch-motion ratio and Dwell time (Data No. 2)

1) Arch-motion ratio

In case of this operation, this value is ignored.

2) Dwell time

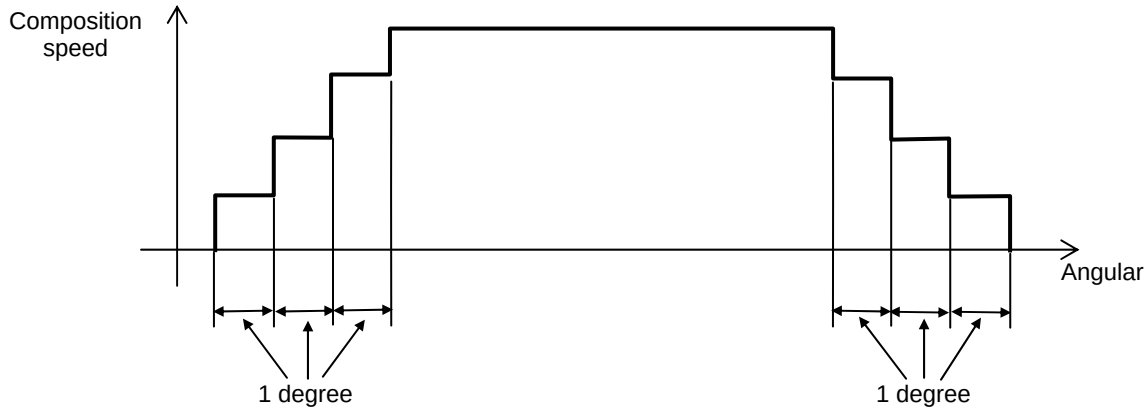
The range of this value is 0 - 255 (HFF) and unit of this value is 20 ms. So the range of Dwell time is 0 - 5100 ms.

(3) Acceleration time and Deceleration time (Data No. 3 and 4)

In case of this operation, this value is ignored. But set the value more than "10".

The available range of Acceleration time and Deceleration time is 10 - 65535 ms (H000A - HFFFF).

[Acceleration and Deceleration]



(4) Speed value (Data No. 5)

This value is following to "Common parameter No. 2 (Unit, Speed scaling factor).

The range of this value is 1 - 65535 (HFFFF).

Set this value less than "Upper limit speed"(Parameter No. 6) and more than "Initial speed" Parameter No. 7).

If the setting value was less than "Initial speed", it can move, but the command error (Error code: H0014) occurs.

This value may be different from the value of the real operation because of the calculation for interpolation.

(5) Target position value (Data No. 6)

This value is following to Common parameter No. 2 (Unit, Position value scaling factor).

The range of this value is -2 147 483 648 up to + 2 147 483 647 (H8000 000 - H7FFF FFFF).

Set this value less than "Upper limit Position value"(Parameter No. 12) and more than "Lower limit Position value" Parameter No. 13). If the setting value was out of this, it can not move and the command error (Error code: H0017) occurs.

(6) Circular interpolation value (Data No. 7)

Set the position value of "Passing point" or the Radius value.

In case of Radius value, the value of the former axis is valid. (For example of the interpolation axis A and axis B, the value of axis A is valid.)

12.4.1 Passing point settig

In detail, refer "10.4.1 Passing point setting".

12.4.2 Radius setting

In detail, refer "10.4.2 Radius setting".

Chapter 13 Error codes

The following is the list of error codes always indicated in each axis reading area.

	Error code	Phenomenon	Contents	RUN	Indication	
					LED	Status
Control command	H0001	On running it received another control command except stop commands. But on running manual operation, it is possible to change from “Low speed” to “High speed” or from “High speed” to “Low speed”.	The received command is ignored and the running operation continues.	OK	ON	Command error
	H0002	Not standby except “Homing” and “Manual operation”.	Not move. (Note 1)	NG	ON	Command error
	H0003	Undefined control command (H0***)	Not move.	NG	ON	Command error
	H0010	The operation mode of the step in the subcommand is invalid.	Not move. (Note 1)	NG	ON	Command error
	--	In continuous operation the control mode isn’t Positioning mode.	Move as positioning mode.	OK	OFF	No error
	--	Arch-motion mode is valid, but not continuous mode.	Move as single step operation.	OK	OFF	No error
	--	Arch-motion mode is valid and circular interpolation.	Move as circular interpolation.	OK	OFF	No error
	--	Arch-motion mode is valid, but not positioning mode.	Move as positioning mode.	OK	OFF	No error
	--	Undefined control mode	Move as positioning mode.	OK	OFF	No error
	--	Control mode is “Speed” or “Speed and positioning”, but not incremental mode.	Move as the applied mode	OK	OFF	No error
	--	Undefined positioning mode	Move as absolute mode.	OK	OFF	No error
	H0011	The acceleration time of Automatic step operation is less than 10 ms.	Accelerate in 10 ms.	OK	ON	Command error
	H0012	The deceleration time of Automatic step operation is less than 10 ms.	Decelerate in 10 ms.	OK	ON	Command error
	H0013	The speed value of Automatic step operation is “0”.	Not move.(Note 1)	NG	ON	Command error
	H0014	The speed of Automatic step operation is less than Initial speed.	Not move.(Note 1)	OK	ON	Command error
	H0015	The speed of Automatic step operation is less than Upper limit speed.	Not move.(Note 1)	NG	ON	Command error
	H0016	The step number of Automatic step operation is more than 256.	Not move.(Note 1)	NG	ON	Command error
	H0017	The target position value of Automatic step operation is out of the range.	Not move.(Note 1)	NG	ON	Command error
	H0018	In “Speed and Positioning mode” the deceleration time is less than the time during positioning.	Decelerate by the maximum deceleration ratio.	OK	ON	Command error
	H0019	At start of “Speed and positioning”, "MODE -SEL" input is "ON".	Not move.(Note 1)	NG	ON	Command error
	H001A	Interpolation mode is undefined.	Not move.(Note 1)	NG	ON	Command error
	H001B	Arch -motion ratio is out of range.	When the value is more than 100%, Not move.	NG	ON	Command error
	H0023	"Low speed" value is bigger than "High speed" value.	Move as "High speed" value.	OK	ON	Command error
	H0024	During slow down by phase Z input in "High speed homing 2", phase Z pulse inputs again.	After slow down, reversing and stop at the next Z phase pulse.	OK	ON	Command error
	H0025	In "Absolute encoder homing", the serial signal of the absolute encoder data doesn't input while one second.	Will not be standby.	NG	ON	Command error
	H0027	Acceleration and Deceleration time of Common parameter is smaller than 10 ms (minimum time)	Move by 10 ms as "Acceleration or Deceleration time".	OK	ON	Command error

	Error code	Phenomenon	Contents	RUN	Indication	
					LED	Status
Control command	H0029	In "Manual operation", make move to out of the limit range which is set by Common parameter.	Stop at the limit position with standby.	NG	ON	Command error
	H002A	"High speed" value is smaller than "Initial speed".	Move by the value of "High speed" as "Initial speed".	OK	ON	Command error
	H002B	"Low speed" value is smaller than "Initial speed".	Move by the value of "Low speed" as "Initial speed".	OK	ON	Command error
	H0031	There is a step without interpolation in cycle interpolation operation.	Move up to the applied step and stop.	--	ON	Command error
	H0032	There is an invalid step in the cycle operation.	Move up to the applied step and stop.	--	ON	Command error
	H0033	Simultaneously triggered linear interpolation and circular interpolation.	Not move. (Note 1)	NG	ON	Command error
	H0034	Linear interpolation or circular interpolation step after independent operation in cyclic operation.	Linear interpolation or circular interpolation step is ignored.	--	ON	Command error
	H0035	The moving route of Circular interpolation is out of range.	Move up to the limit position and stop.	--	ON	Command error
	H0036	The number of interpolation is 1 axis.	Not move.(Note 1)	NG	ON	Command error
	H0037	The number of Circular interpolation is bigger than 3.	Not move.(Note 1)	NG	ON	Command error
	H0038	In continuous cycle step operation, the number of interpolation is different from other steps.	Move up to the applied step and stop.	NG	ON	Command error
	H0039	Invalid circular interpolation value. 1) Passing point is start point or target point. 2) Radius value is smaller than the half value of the distance between start and target point. 3) Radius value is negative.	Not move.(Note 1)	NG	ON	Command error
	H003A	During circular interpolation, the other group of circular interpolation start.	The other group doesn't move.	NG	ON	Command error
	H003B	In case of continuous mode, positioning mode isn't absolute mode.	Not move.(Note 1)	NG	ON	Command error
Setting command (Common parameter)	H8001	Undefined Homing direction	Not store in memory.	--	ON	Command error
	H8002	Undefined Homing mode	Not store in memory.	--	ON	Command error
	H8003	Undefined Revolution polarity	Not store in memory.	--	ON	Command error
	H8005	Undefined Acceleration and Deceleration mode	Not store in memory.	--	ON	Command error
	H8006	Undefined Speed scaling factor	Not store in memory.	--	ON	Command error
	H8007	Undefined Position value scaling factor	Not store in memory.	--	ON	Command error
	H8008	Undefined Position unit	Not store in memory.	--	ON	Command error
	H8009	Undefined Pulse logic	Not store in memory.	--	ON	Command error
	H800A	Undefined O.RUN input mode	Not store in memory.	--	ON	Command error
	H800B	Undefined SRDY/COIN input mode	Not store in memory.	--	ON	Command error
	H800C	Pulse/r or Position value/r is 0	Not store in memory.	--	ON	Command error

	Error code	Phenomenon	Contents	RUN	Indication	
					LED	Status
Setting command	H800D	Speed limit value is bigger than 1 M pulses/s.	Not store in memory.	--	ON	Command error
	H800E	The value of speed parameter (Limit speed, Initial speed, High speed or Low speed) is 0. Or the value is bigger than Limit speed.	Not store in memory.	--	ON	Command error
	H800F	Upper or Lower limit position value is out of range.	Not store in memory.	--	ON	Command error
	H8010	Common parameters are uncertain value in EEPROM.	If do not cure and set up to parameters, start command is ignored (Note2)	NG	ON	Command error
	H8101	Undefined Setting command (H8***)	Not store in memory.	--	ON	Command error
	H8102	The step number is bigger than 256.	Not store in memory.	--	ON	Command error
	H8103	The speed value of Change speed command is bigger than Limit speed.	Operation continue by the former speed	--	ON	Command error
	H8104	The speed value of Change speed command is 0.	Slow down stop	--	ON	Command error
	H8105	The applied axis to change the current position isn't standby.	Not store in memory.	--	ON	Command error
Reading command	H9001	Undefined Reading command (H9***)	Not practice	--	ON	Command error
	H9002	The step number is bigger than 256.	Not practice	--	ON	Command error
External input	H1001	"+ O.RUN" occurs (Note 3)	Not move forward. But in Homing it can start. On running forward it stops.	NG	ON	Command error
	H1002	"- O.RUN" occurs (Note 3)	Not move reverse. But in Homing it can start. On running reverse Pulses stop.	NG	ON	Command error
	H1003	"SRD" input is "OFF" (Note 3)	Not move. On running pulses stop.	NG	ON	Command error

Note 1: In case of interpolation, not only the error axis stops but also the other axes with the applied axes stop.

Note2: If H8010 error is occurs, cure and set up to parameters of the axis that corresponds.
Reset after parameter, and please confirm that there is not an error.
If H8010 error is occurs even 1 axis, all axis stops. Also, all the axes are not triggered.
(All axis is occurs “H8010” error)

Note3: If H100* error is occurs even 1 axis, all interpolation axis stops in Linear interpolation or circular interpolation mode. Also, all the axes are not triggered. In the case of 2 axis pairs operation start of time-difference, pairs axis stops.

Chapter 14 Trouble shooting

In case of some troubles concerned with EH-pos4, please deal with the trouble according to the following description.

The troubles are mainly 5 types as bellow.

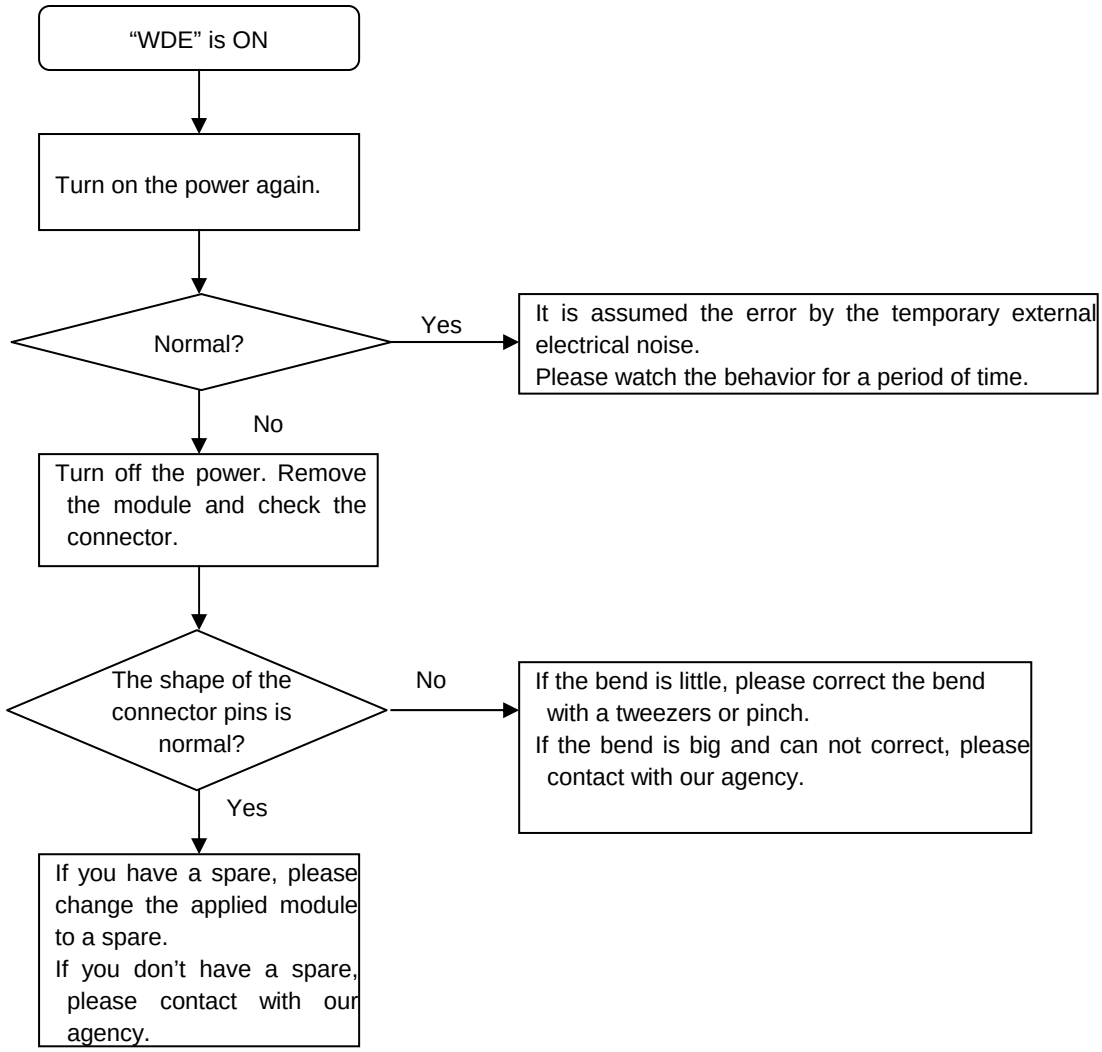
(1) Trouble indicated on the front LED of EH-POS4.
(2) Trouble indicated of the status registers (WX0** - 3).
(3) Error code indicated in the reading area.
(4) Error code of EH-CPU.
(5) Abnormal behavior of the motor without errors of EH-POS4 or EH-CPU.

14.1 Error indicated on LED

LED	Error or function	Contents	Recovery operation	Light
POW	Power lamp	1) No power 2) The module isn't installed on the base unit correctly.	1) Turn on the power of EH-150. 2) Install the module on the base correctly with care of the connection.	OFF
WDE	Watch dog timer error	1) Micro processor of the module trouble	1) Turn on again. (Refer 14.2)	ON
OR* (*: A, B, C, D)	Overrun error	1) The applied axis is overrun. (In case that the "Over run" setting of Common parameter of the applied axis is valid.)	1) Release the over run by manual operation and start homing again. 2) In case that the "Over run" input is invalid, set the "Over run" setting of Common parameter of the applied axis to the invalid setting. (Refer "6.1.1 Common parameter) 3) Check the polarity of the over run input.	ON
CME	Command error	1) Command error occurs.	1) Check the error code and Deal with the error according to the error code. (Refer "Chapter 13 Error codes")	ON

Note 1: LED turn on during the power on reset temporary, but it is normal.

14.1.1 Operational flowchart of the case that “WDE” occurs



14.1.2 Operation of the case that “OR*” occurs

(1) Check the polarity

Please check the polarity of the over run input and the setting of Common parameter.
If they are unmatched, please change either polarity.

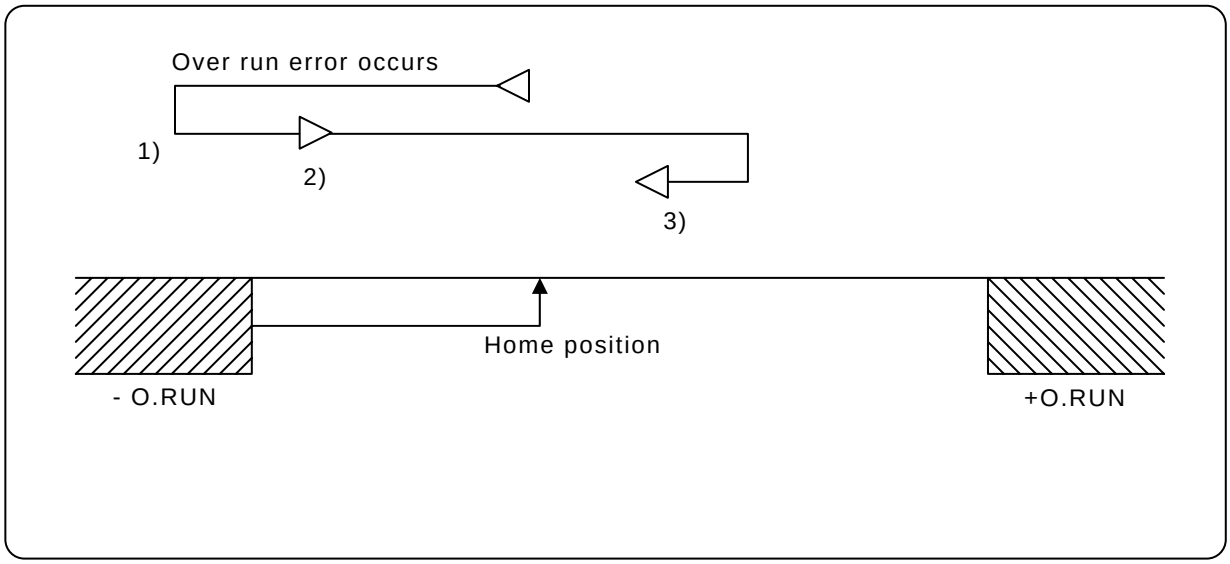
(2) In case that the over run occurs actually.

Please do the following operation for recovery.

[Example] In case of the recovery of “- O.RUN”

1) Please move forward by manual operation.
2) Please check the release of “O.RUN”. If “O.RUN” is released, LED of “OR*” is OFF.
3) Please start “Homing”.
4) After “Homing”, the normal operation can start.

The recovery of -O.RUN



Note: In case of +O.RUN, the direction is reverse of above.

14.2 Error indicated in the status register

The value of Status register (WX0**0) (WX0**1) (WX0**2) (WX0**3)	Name	Contents	Recovery operation
H*8** H*9** H*A** H*C** H*D** H*E**	Command error	Command error occurs (Note 1)	Please refer “Chapter 13 Error code”.
H1*** H3*** H5*** H7*** H9*** HB*** HD*** HF***	+ O.RUN	1) “+O.RUN” occurs. 2) The polarity of “O.RUN” input is wrong. 3) No input of O.RUN when the setting of “O.RUN” is the setting that “O.RUN” is “OFF”.	Please see “14.1.2”
H2*** H3*** H6*** H7*** HA*** HB*** HE*** HF***	- O.RUN	1) “-O.RUN” occurs. 2) The polarity of “O.RUN” input is wrong. 3) No input of O.RUN when the setting of “O.RUN” is the setting that “O.RUN” is “OFF”.	

Note 1: The error code in the reading area is kept without the Initial command even if the error was released.

14.3 Error of EH-CPU

If the watch dog time error occurs in EH-POS4, “Module error” occurs in EH-CPU.
In detail, please refer the instruction manual of EH-CPU.

14.4 Abnormal behavior of the motor

No.	Check item	Contents
1	Is I/O assignment right?	The I/O assignment of EH-POS4 is “4W/4W”. If this setting is wrong, the error occurs in EH-CPU or EH-POS4 can not activate.
2	Is wiring right?	Check which the pulse output of EH-POS4 is connected with the pulse input of the applied servo driver.
3	Does the setting of the pulse output of EH-POS4 match with the setting of the pulse input of the applied servo-driver ?	If the pulse output logic of EH-POS4 doesn’t match with the pulse input logic of the applied servo driver, it may occur like the following phenomena. 1) Servo-motor moves only for the same direction. 2) The error occurs in the applied servo driver. 3) The applied motor repeats moving forward and reverse minutely.
4	Is the applied servo driver ready?	Please make the applied servo driver ready according to the manual of one self.
5	Is it “Servo ON”?	Please make it “Servo ON”.
6	Does the applied servo driver inhibit pulse input (Pulse input is enable)?	Please make it permit pulse input (Pulse train input enable).
7	Does the applied servo driver inhibit to move (rotate)?	Please make it permit to move (rotate).
8	Is the parameter of the applied servo driver right?	Please make it set the right parameter.
9	Is the applied axis of EH-POS4 standby at start?	Please make it standby by executing Homing.
10	Is the connection right? Is the shape of the connector pins normal?	Please check the connection and the connector pins.
11	In Manual operation or Automatic operation, the indication of the current position value changes, but it doesn’t generate pulses.	In case that No. 1, 2, 9 are right, it seems that EH-POS4. Please contact with our agency.
12	The applied motor moves, but it doesn’t stop Homing (Low speed or High speed homing).	1) Please check the switch of home position. 2) Please check the Z phase pulse of Servo driver. 3) Please check the common parameter.

Note 1: In case that EH-POS4 is connected with the pulse motor, the servo driver of above description means the stepping motor driver.

14.5 Operation trouble and the treatment

No.	Phenomenon	Check item	Contents
1	Although motor works homing (low speed, high speed 1, high speed 2) does not stop or completing.	・Is home position LS correct ? ・Is it make amplifier side Z phase input mode? (In the case of high speed homing 2) ・Is the setting of the common parameter correct?	Please check the input signal (+/-O. RUN, starting point LS, Z phase input). Please check "6.1.1 Common parameter" and "Chapter 8 Homing".
2	After motor action, motor becomes just as RUN condition although it is stopping.	・Is the COIN signal (the INPOSITION signal) connected? (When it is effective COIN signal setting (common parameter No. 3))	Please check COIN input signal line from servo amplifier. Please check whether INPOSITION signal is output from servo amplifier correctly. (In the case that COIN signal line is connected.)

Chapter 15 Programming

This chapter describes about the example program of EH-POS4.
These programs are described about the usage of commands mainly. So they don't include the program controlling "Servo ON or OFF", "Servo alarm reset" and so on.
The I/O assignment of these programs is the case that EH-POS4 is installed on the "0" slot of EH-150.

15.1 Notice on Programming

Keep these notes on programming.

15.1.1 Command timing

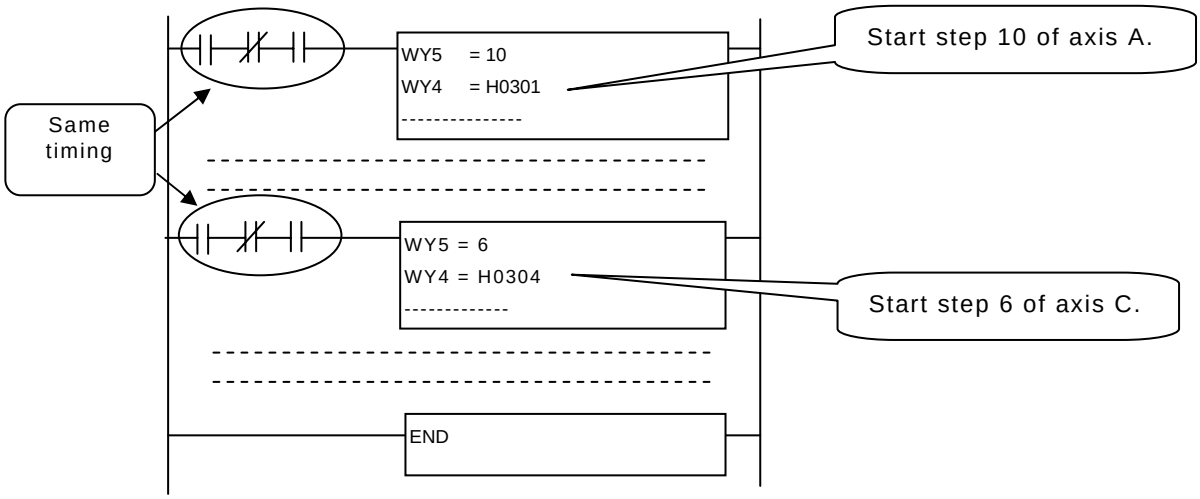
(1) Command before I/O refreshes.

The I/O access method of EH-150 is refresh type. Usually Status registers (WX0**0 - 3) and Command registers (WY0**4 - 7) of EH-POS4 are refreshed at program scan end as well as the other external I/O.

So when it practices the other command in the same scan, the later command is valid but the former commands are ignored.

[Example]

In case of the following program, axis A doesn't start, but the step 6 operation of axis C starts.



Note 1: In case of all commands, only the nearest command is valid, but the former commands are invalid.

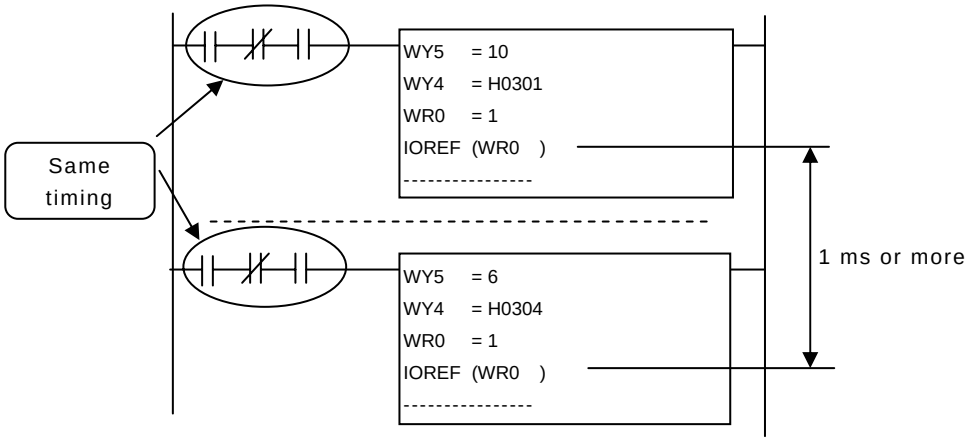
(2) Notice of using the refresh instructions

EH-150 has the three refresh instructions (FUN80(s): ALREF(s), FUN81(s): IOREF(s)).
Using these instructions, it is possible to refresh the external I/O multiple times in a program scan.
So it is possible to write the multiple commands to EH-POS4 in a program scan.

Write the command to EH-POS4 after 1 ms or more from the last command.

If the interval is 1 ms or less, the last command may not do.

[Example]

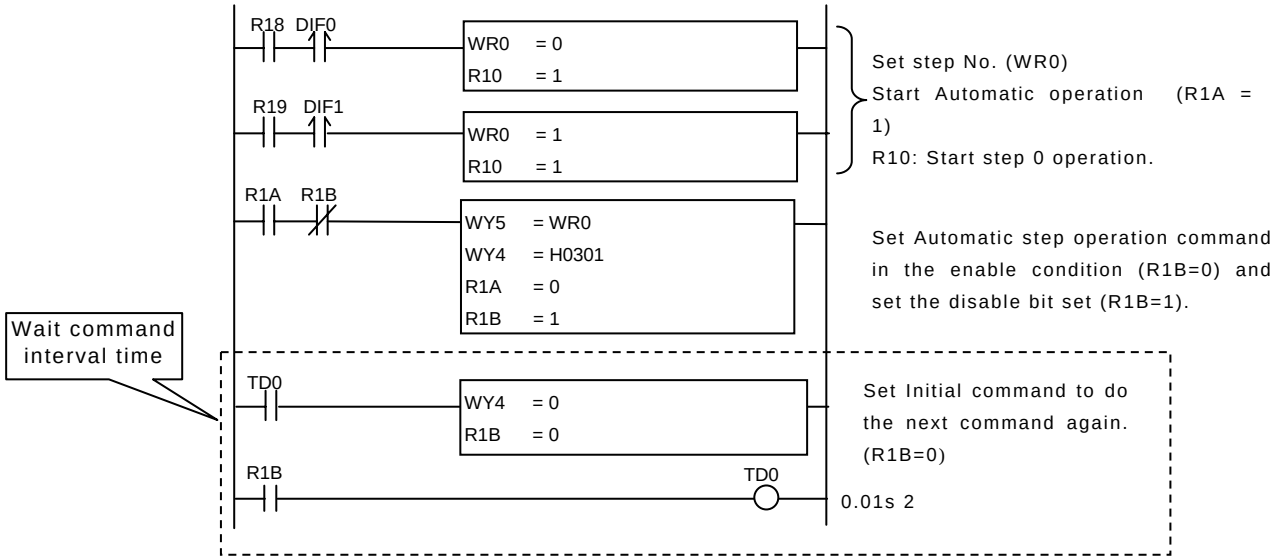


15.1.2 Operation of the same command

In order to do the same commands, write Initial command between the commands.

[Example]

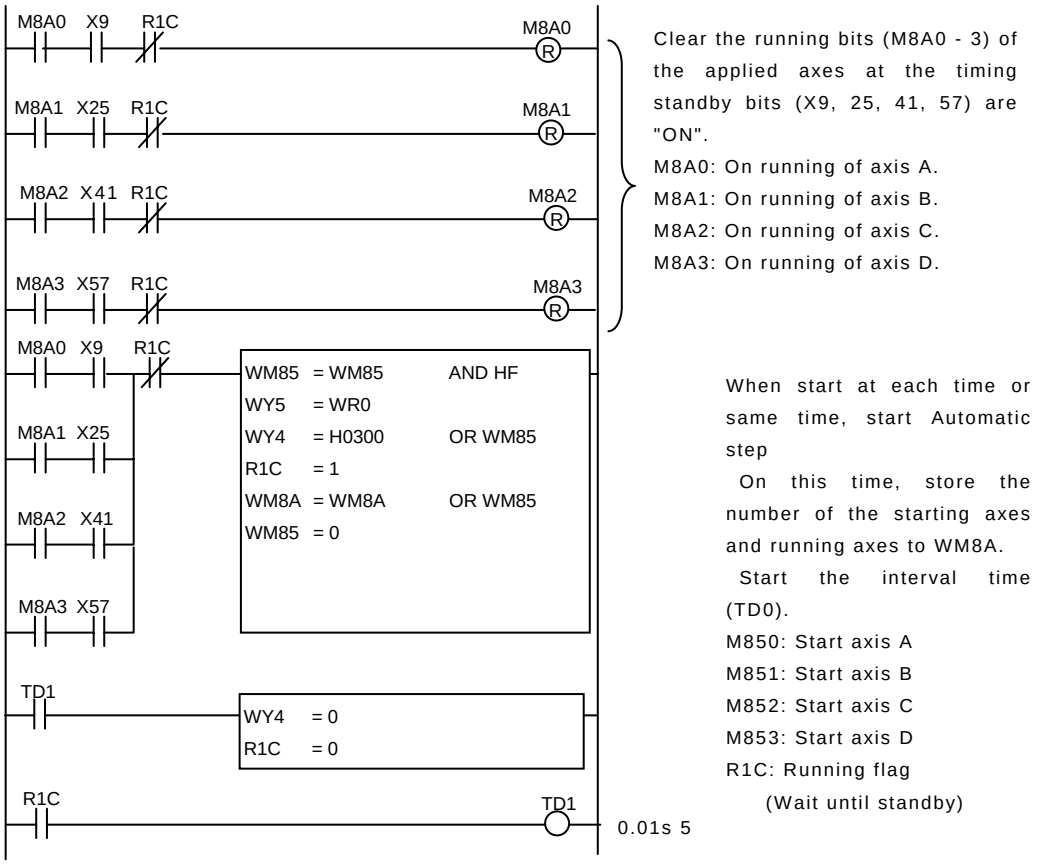
In case of starting 1 step operation after step 0 operation completes.
(In case of axis A)



15.1.3 Starting multiple axes at the same time

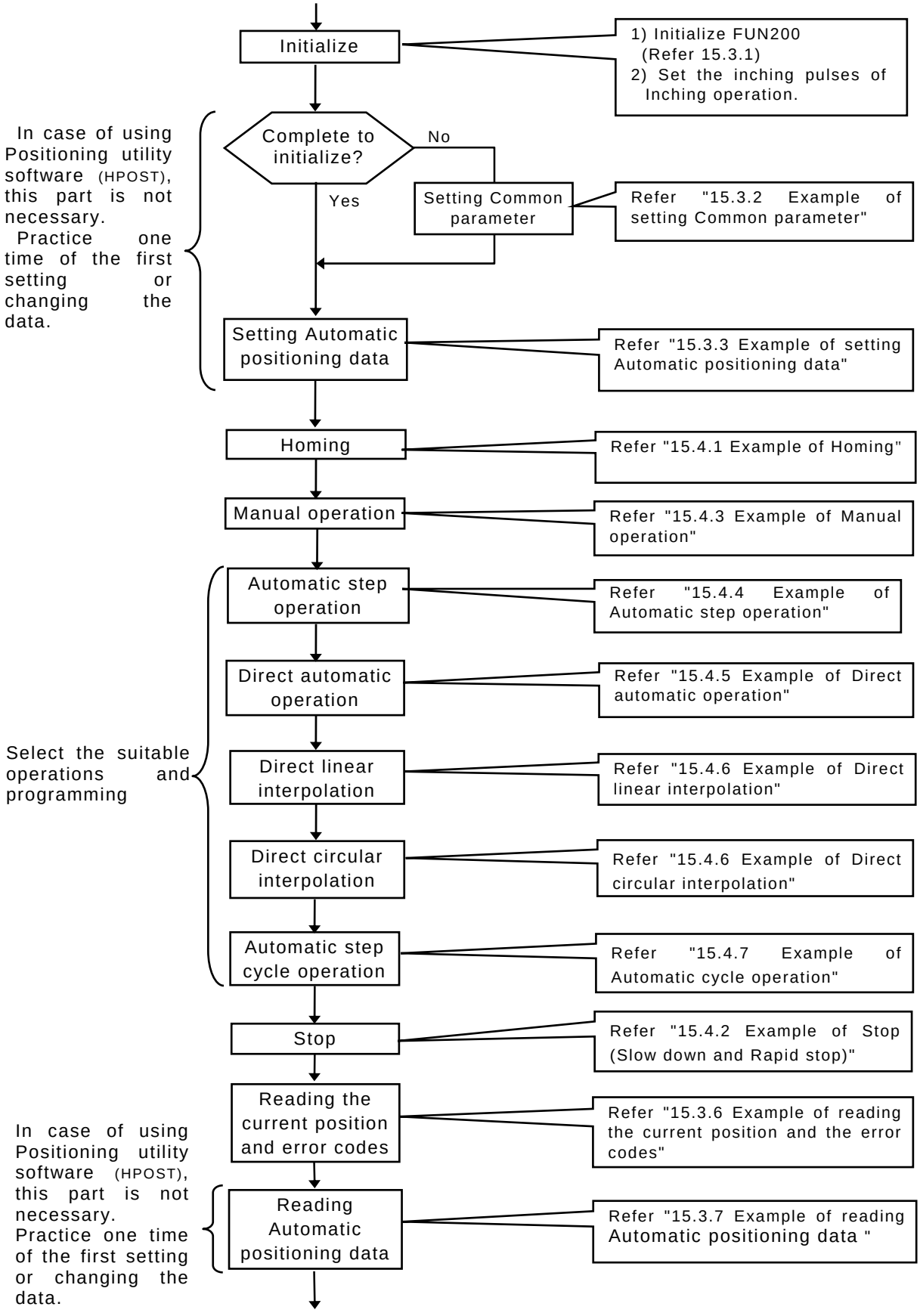
Show the example to start Automatic step operation of the multiple axes at the same time. But it can not start the different step between the axes at the same time.

[Example]



15.2 Construction of Programming

The typical example of operating EH-POS4.



15.3 Setting and Reading programming

15.3.1 Usage of FUN200

The following is described about FUN200 (which is the special instruction for data setting and reading.

FUN200 transfers the data of the internal outputs from EH-CPU to the setting area (maximum 56 words) of EH-POS4 and the data of the reading area (maximum 56 words) from EH-POS4 to the internal outputs of EH-CPU. (Note 1)

In case of EH-POS4, it is necessary to set 2 kinds for reading and setting.

(It is possible to use multiple instructions by changing "s parameter".

In detail, refer "Instruction manual of EH-CPU (NJI-280*, *: after "C").

Note 1: EH-CPU448, 308A and 316A can be applied.

[Example]

(1) Memory assignment

Memory table of this FUN200 example program is bellow.

1) FUN200 for setting

Table 16.1 List of "s" parameter

"s" parameter No.	Internal outputs No.	Contents	Remark
s	WM0	Error code of FUN200	
s+1	WM1	Area for system software	Don't use
s+2	WM2	Area for system software	Don't use
s+3	WM3	Function selection of FUN200	Setting: H0004
s+4	WM4	Slot assignment of EH-POS4 H u s 0 0 "u": Unit No. "s": Slot No.	IN case of "0" slot in basic base. H 0000 IN case of "4" slot in basic base. H 0400
s+5	WM5	Real address of starting flag bit	Set by "ADRIO" instruction.
s+6	WM6	Real head address of the setting data area of EH-CPU	Set by "ADRIO" instruction.
s+7	WM7	Number of setting data	Set 36 normally.

Note: Set "s" parameter before FUN200. Normally set at the first scan.

Table 16.2 List of starting flag bits

Internal output No.	Name	Contents
R0	Starting flag	1: Start FUN200
R1	Complete flag	1: Complete to transfer setting data from EH-CPU to EH-POS4.
R2	Incomplete flag	1: Error occurs in running FUN200 by the errors of EH-POS4 or another module.

Table 16.3 Setting data area

Internal output No.	Contents	Remark
WM10 - WM33	Setting data setting to EH-POS4	Set the data to this area before starting FUN200 (R0 = 1)

2) FUN200 for reading

Table 16.4 List of "s parameter" area

"s" parameter No.	Internal output No.	Contents	Remark
s	WM8	Error code of FUN200	
s+1	WM9	Area for system software	Don't use
s+2	WMA	Area for system software	Don't use
s+3	WMB	Function selection of FUN200	Reading: H0002
s+4	WMC	Slot assignment of EH-POS4 H u s 0 0 "u": Unit No. "s": Slot No.	In case of "0" slot in basic base H0000 In case of "4" slot in basic base H0400
s+5	WMD	Real address of starting flag bit	Set by "ADRIO" instruction.
s+6	WME	Real head address of the transfer data area of EH-CPU	Set by "ADRIO" instruction.
s+7	WMF	Number of setting data	Set 50 normally.

Note: Set "s" parameter before FUN200. Normally set at the first scan.

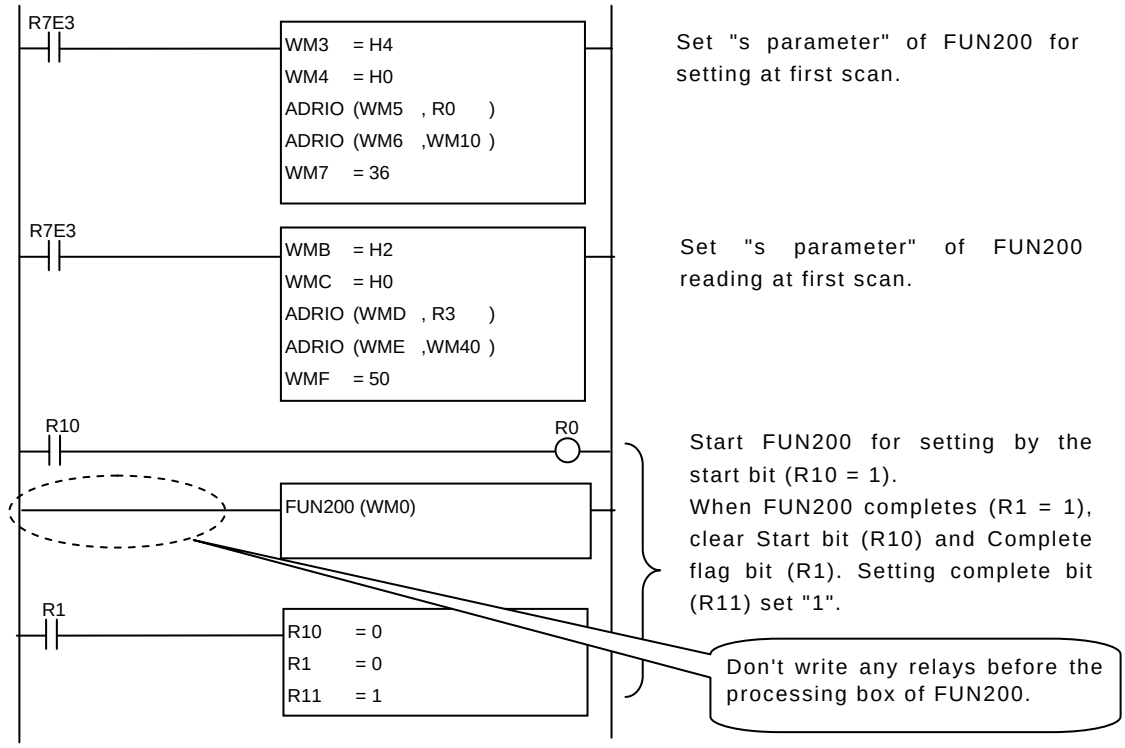
Table 16.5 List of starting flag bits

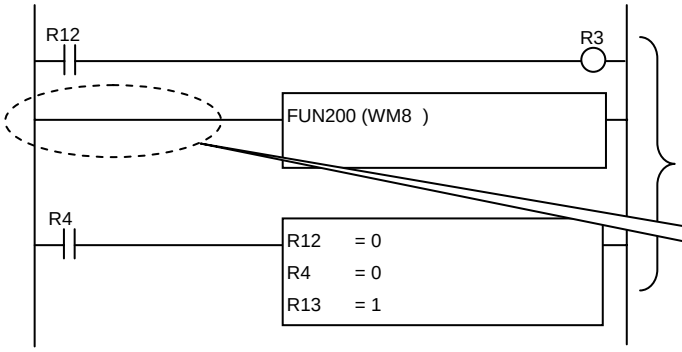
Internal output No.	Name	Contents
R3	Starting flag	1: Start FUN200
R4	Complete flag	1: Complete to transfer reading data from EH-POS4 to EH-CPU.
R5	Incomplete flag	1: Error occurs in running FUN200 by the errors of EH-POS4 or another module.

Table 16.6 Setting data area

Internal output No.	Contents	Remark
WM40 - WM71	Setting data reading from EH-POS4	When Complete flag becomes "1", reading data from EH-POS4 are set in this area.

[Example]





Start FUN200 for reading by the start bit (R12 = 1).
When FUN200 completes (R4 = 1), clear Start bit (R12) and Complete flag bit (R4).Setting complete bit (R13) set "1".

Don't write any relays before the processing box of FUN200.

15.3.2 Common parameter

The following describes the example to set the every axis Common parameter to EH-POS4 by Ladder diagram.

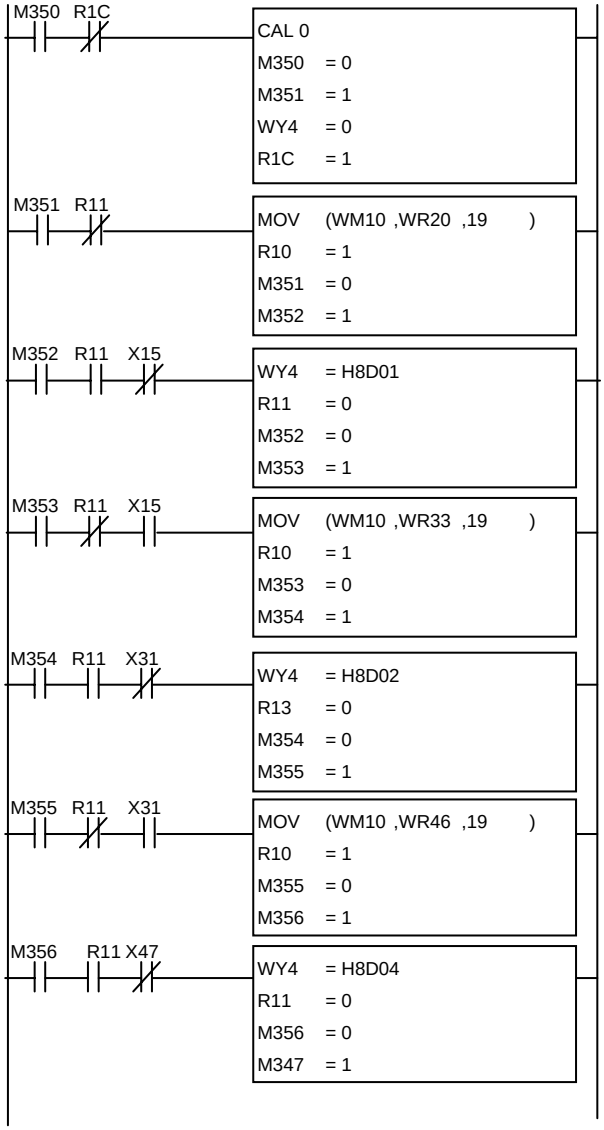
This is the example to set in order of A axis Common parameter set in WR20 - 32, B axis one set in WR33 - 45, C axis one set in WR46 - 58 and D axis one is set in WR59 - 4B.

Note: Setting data is example.

In case of using "Positioning utility software (HPOST)", this program isn't necessary.

[Example]

When set M350 "1", set the every axis Common parameter. Set in order "A axis", "B axis", "C axis, "D axis". M359 becomes "1" after complete.



Set the value of Common parameter in "CAL0"

Set the value of axis A Common parameter to the setting area of FUN200 and start FUN200 (R10=1).

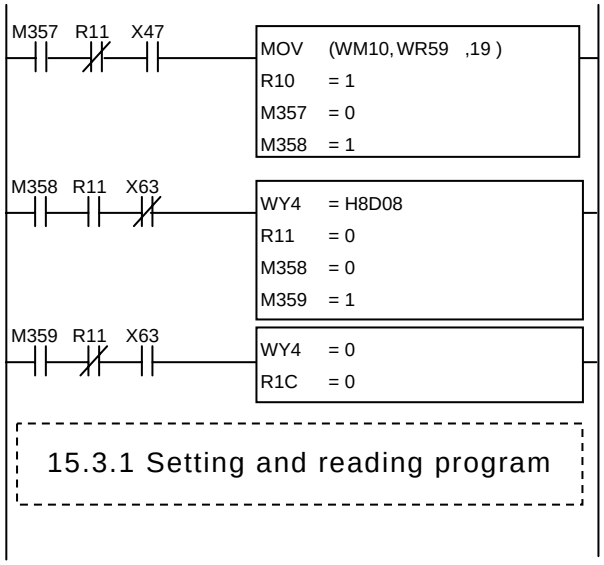
Set axis A's Setting Common parameter command (H8D01) to the command register (WY4) of EH-POS4 after FUN200 (R1 =1).

After axis A's setting complete, set the value of axis B's Common parameter to the setting area of FUN200 and start FUN200 (R10=1).

Set axis B's Setting Common parameter command (H8D02) to the command register (WY4) of EH-POS4 after FUN200 (R11=1).

After axis B's setting complete, set the value of axis C's Common parameter to the setting area of FUN200 and start FUN200 (R10=1).

Set axis C's Setting Common parameter command (H8D04) to the command register (WY4) of EH-POS4 after FUN200 (R11=1).

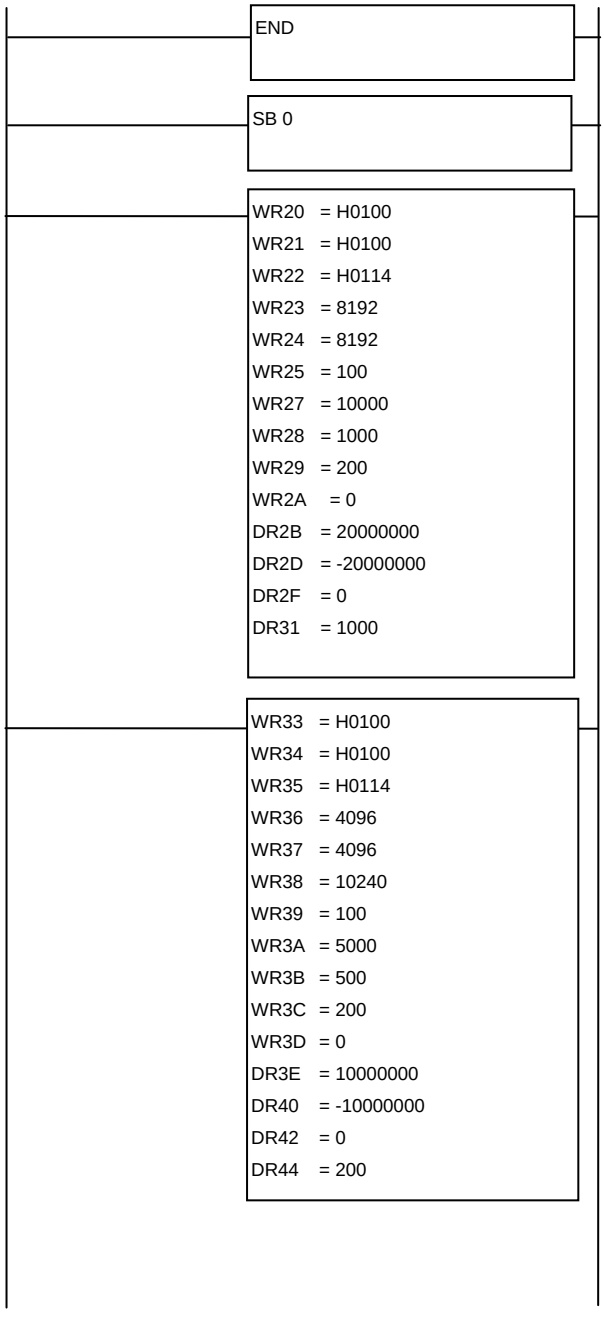


15.3.1 Setting and reading program

After axis C's setting complete, set the value of axis D's Common parameter to the setting area of FUN200 and start FUN200 (R10=1).

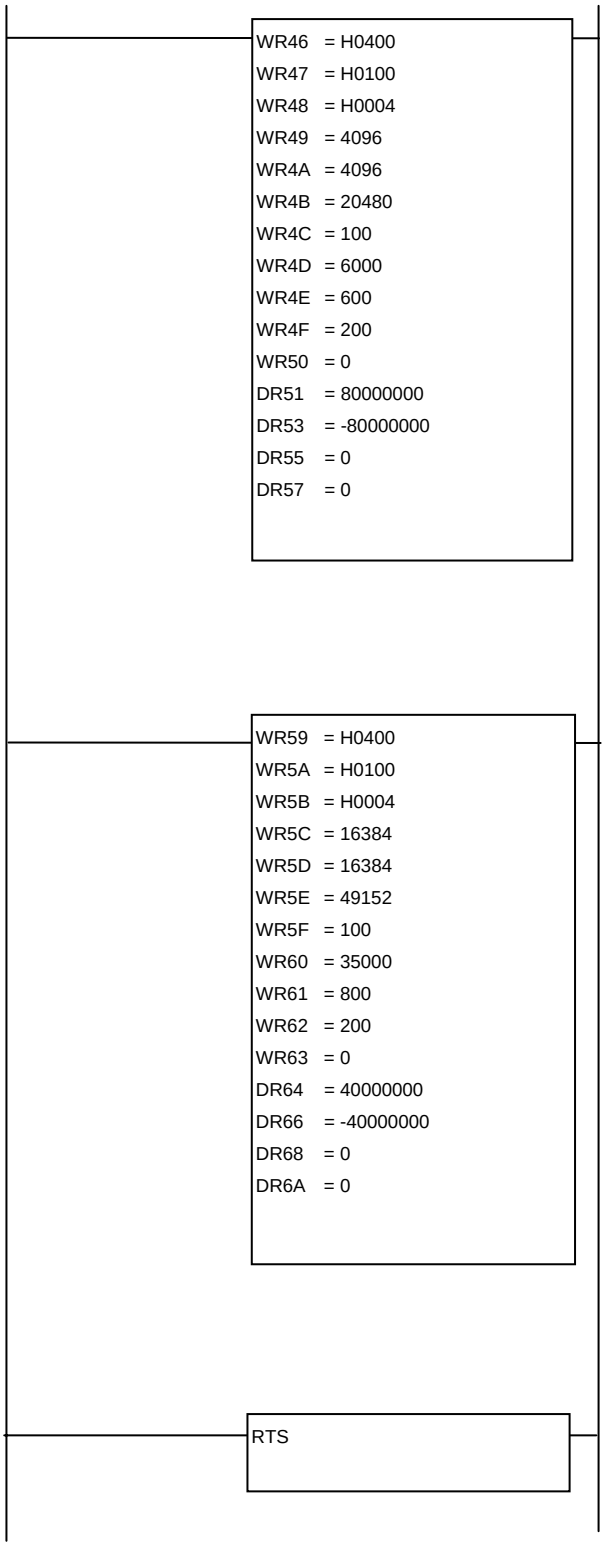
Set axis D's Setting Common parameter command (H8D08) to the command register (WY4) of EH-POS4 after FUN200 (R11=1).

After axis D's setting complete, set Initial command and clear all axis Complete bits.



Set the value of axis A's Common parameter. (Change the following from the default value.)
WR20: Low speed homing
WR21: Speed scaling x10
WR22: O.RUN inputs is valid and normally "OFF". SRD is invalid
WR23 - WR24: 8192 pulses / revolution
WR25: Upper limited speed 307k pulses/s (2250 rpm)
WR26: Initial speed 1k pulses/s
WR27: High speed 100k pulses/s
WR28: Low speed 10k pulses/s
WR29: Acceleration and Deceleration time 200 ms
WR2A: Backlash 0
DR2B: Upper limited position 20M pulses
DR2D: Lower limited position -20M pulses
DR2F: Homing position 0
DR31: Homing offset 1000 pulses

Set the value of axis B's Common parameter. (Change the following from the default value.)
WR33: Low speed homing
WR34: Speed scaling x10
WR35: O.RUN inputs is valid and normally "OFF". SRD is invalid
WR36 - WR37: 4096 pulses / revolution
WR38: Upper limited speed 102k pulses/s (1500 rpm)
WR39: Initial speed 1k pulses/s
WR3A: High speed 50k pulses/s
WR3B: Low speed 5k pulses/s
WR3C: Acceleration and Deceleration time 200 ms
WR3D: Backlash 0
DR3E: Upper limited position 10M pulses
DR40: Lower limited position -10M pulses
DR42: Homing position 0
DR44: Homing offset 200 pulses



Set the value of axis C's Common parameter. (Change the following from the default value.)
WR46: Absolute encoder Homing
WR47: Speed scaling x10
WR48: O.RUN inputs is valid and normally "ON". SRD is invalid
WR49 - WR4A: 40968 pulses/r
WR4B: Upper limited speed 204.8k pulses/s (3000 rpm)
WR4C: Initial speed 1k pulses/s
WR4D: High speed 100k pulses/s
WR4E: Low speed 10k pulses/s
WR4F: Acceleration and Deceleration time 200 ms
WR50: Backlash 0
DR51: Upper limited position 20M pulses
DR53: Lower limited position -20M pulses
DR55: Homing position 0
DR57: Homing offset 0

Set the value of axis C's Common parameter. (Change the following from the default value.)
WR59: Absolute encoder Homing
WR5A: Speed scaling x10
WR5B: O.RUN inputs is valid and normally "ON". SRD is invalid
WR5C - WR5D: 16384 pulses/r
WR5E: Upper limited speed 492k pulses/s (1800 rpm)
WR5F: Initial speed 1k Pulses/s
WR60: High speed 350k pulses/s
WR61: Low speed 8k pulses/s
WR62: Acceleration and Deceleration time 200 ms
WR63: Backlash 0
DR64: Upper limited position 40M pulses
DR66: Lower limited position -40M pulses
DR68: Homing position 0
DR6A: Homing offset 0

Note: Positioning utility software (HPOST) can set and read Common parameter and Automatic positioning data. It can save those data as CSV file format.

15.3.3 Automatic positioning data

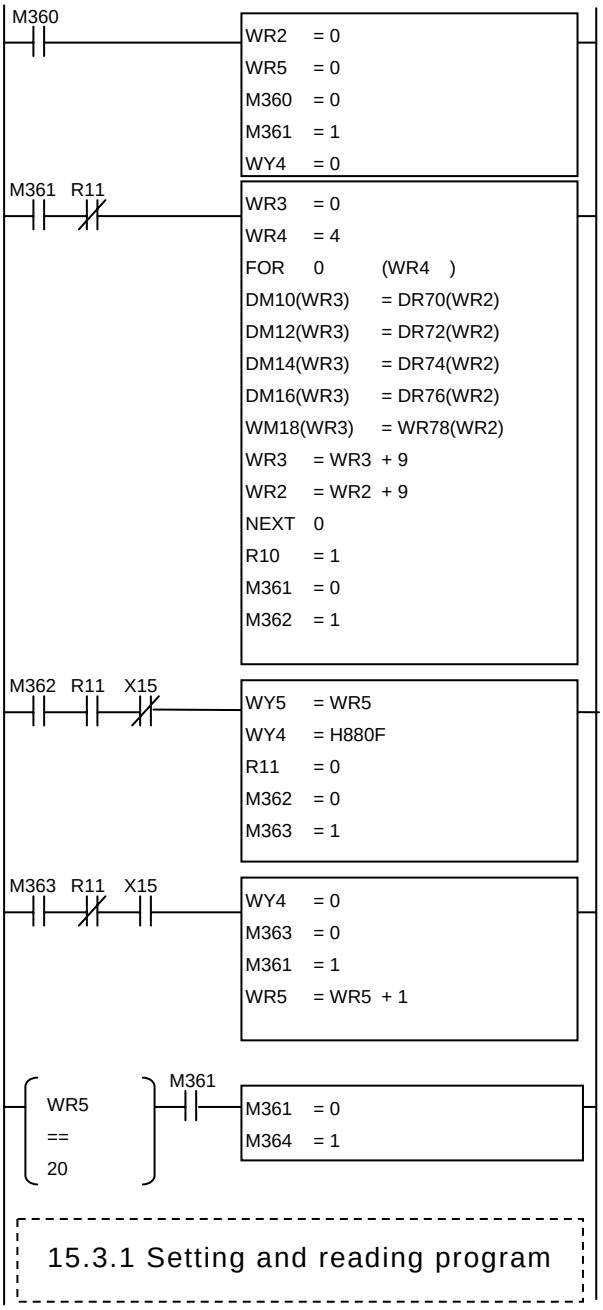
The following describes the example to set the automatic positioning data of all axes from step 0 to step 19 by ladder diagram.

The automatic positioning data are set in the retentive data memory area (WR70 - 33F) previously.

In case of using Positioning utility software (HPOST), this program is not necessary.

[Example]

When set "1" to M360, setting the data starts. When setting completes, M364 will be "1".



At first, clear the address counter (WR2) of the setting data and the step counter (WR5).

Write the positioning step data of 4 axes (36 words = 9 words x 4) on the setting area of FUN200 and start FUN200 (R10=1).
WR3: The address counter in the setting area of FUN200.

Set the step No. (WR5), set Setting command of 4 axes to the command register (WY4).

When setting completes (Complete flag: X15=1), set Initial command.
Renew the step No. (WR5) and start the next step.

When the step No. (WR5) comes up to 20, set "1" to the complete bit (M364) and this operation completes.

Note: Positioning utility software (HPOST) can set and read Common parameter and Automatic positioning data. It can save those data as CSV file format.

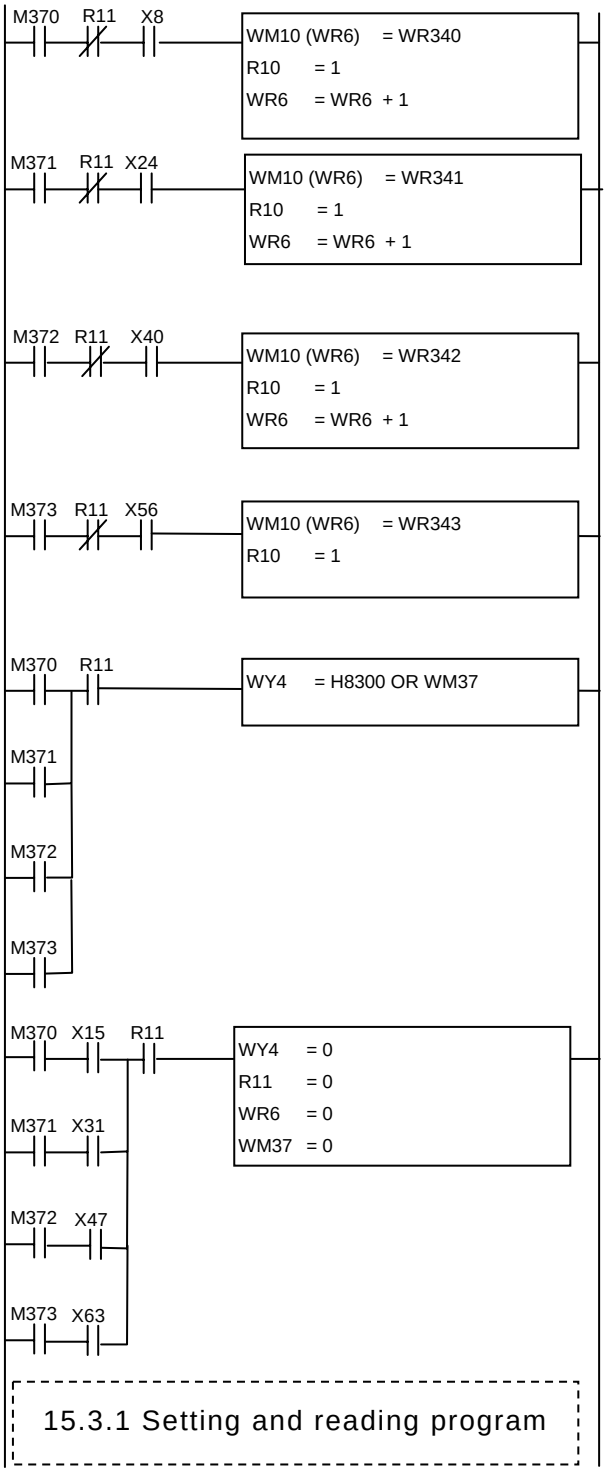
15.3.4 Speed change

The following describe the example to change the speed on running.

In this case of the example, the changing speed values of axis A, axis B, axis C and axis D are already set in WR340, WR341, WR342 and WR343.

[Example]

The following program changes the speed of each axis or all axes at the same time.



When the speed change bit (M370) of axis A is set, set the changing speed value to the head address (WM10) of the setting area and start FUN200 (R10 = 1).

When the speed change bit (M371) of axis B is set, set the changing speed value to the next address and start FUN200 (R10 = 1).

When the speed change bit (M372) of axis C is set. Set the changing speed value to the next address and start FUN200 (R10 = 1).

When the speed change bit (M373) of axis C is set. Set the changing speed value to the next address and start FUN200 (R10 = 1).

Set Speed change command of applied axes to the command register (WY4).

When Complete flag (X15, X31, X47 or X63) becomes "1", set Initial command. (Clear Complete flag at the same time.) Clear the setting counter (WR6) and speed change bits (M370 - 373) too.

This example is the case that the applied axes are not fixed previously in the scan.
If those are fixed, it is possible to simplify this program because the address of the setting area can be fixed.

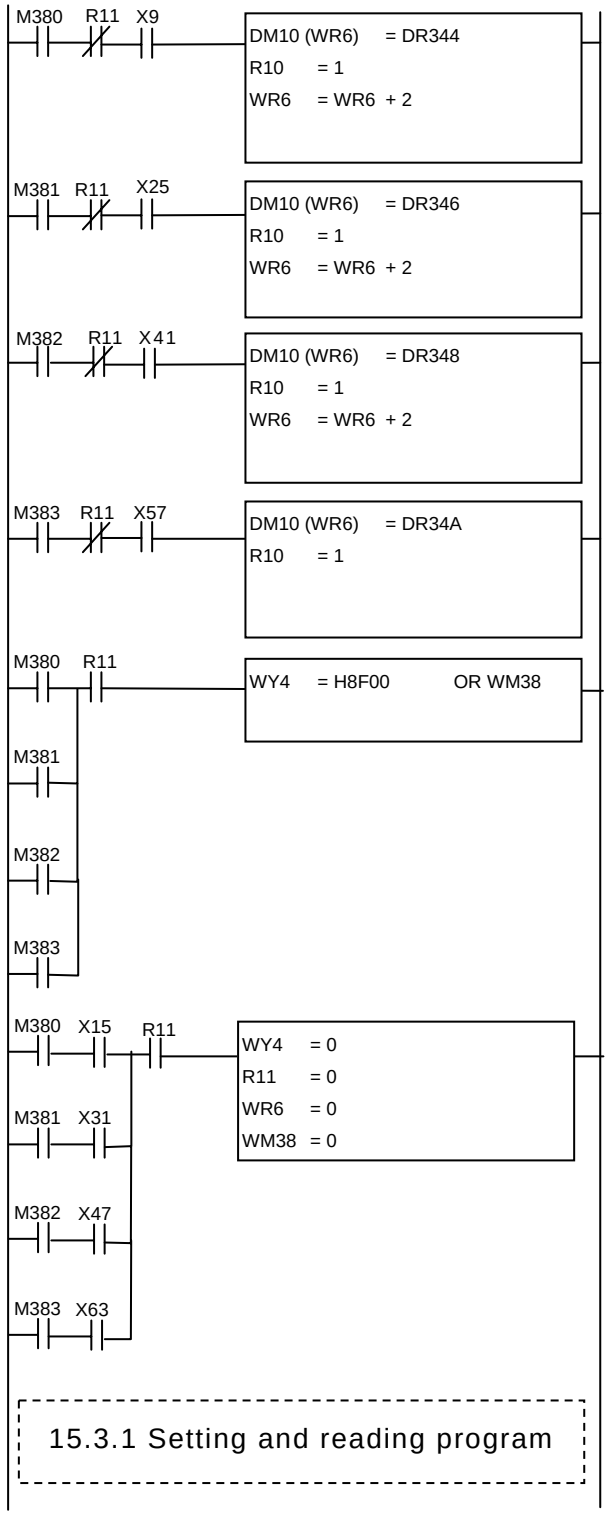
15.3.5 Current position change

The following describe the example to change the current position value on stopping. (Note 1)
In this case of the example, the changing current position values of axis A, axis B, axis C and axis D are already set in DR344, DR346, DR348 and DR34A.

Note 1: If this command is set on running, this command will not do and the command error occurs.

[Example]

The following program changes the current position value of each axis or all axes at the same time.



When the current position change bit (M380) of axis A is set, set the changing position value to the head address (DM10) of the setting area and start FUN200 (R10 = 1).

When the current position change bit (M381) of axis B is set, set the changing position value to the next address of the setting area and start FUN200 (R10 = 1).

When the current position change bit (M382) of axis C is set, set the changing position value to the next address of the setting area and start FUN200 (R10 = 1).

When the current position change bit (M383) of axis D is set, set the changing position value to the next address of the setting area and start FUN200 (R10 = 1).

Set Current position change command of applied axes to the command register (WY4).

When Complete flag (X15, X31, X47 or X63) becomes "1", set Initial command. (Clear Complete flag at the same time.) Clear the setting counter (WR6) and speed change bits (M380 - 383) too.

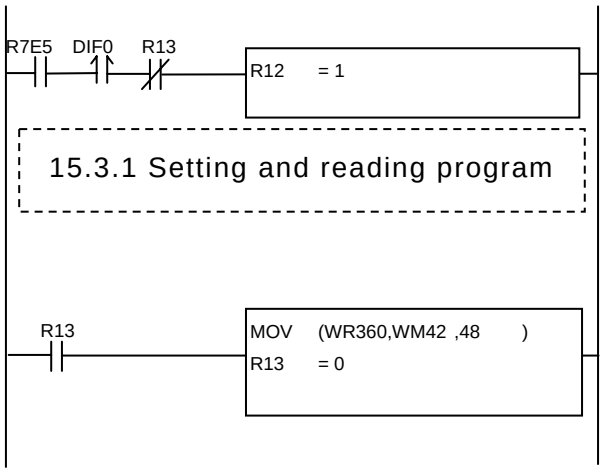
This example is the case that the applied axes are not fixed previously in the scan.
If those are fixed, it is possible to simplify this program because the address of the setting area can be fixed.

15.3.6 Reading Current position value and Command error

Current position value and Command error are always indicated in the reading area of EH-POS4. So they can be read by FUN200 freely.

[Example]

The following program transfers the error codes to the internal outputs (axis A: WR360, axis B: WR361, axis C: WR362, axis D: WR363) and transfers Current position values to the internal outputs (axis A: DR364, axis B: DR366, axis C: DR368, axis D: DR36A) at every 20 ms.



Start FUN200 (R12 = 1) at the "ON" edge timing of R7E5 (20 ms clock)

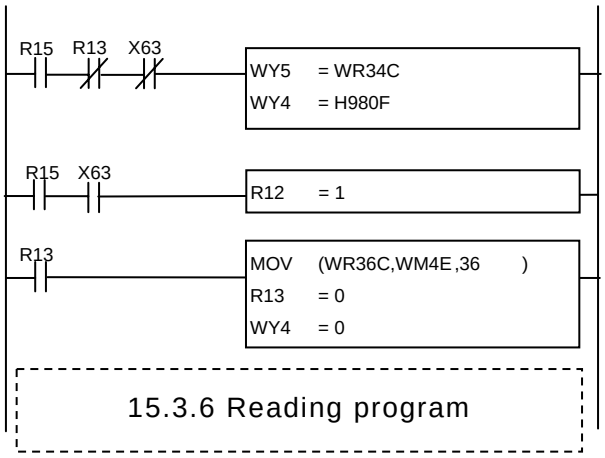
After FUN200 completes, transfer the error codes and current position values of all axes to the area (WR360 - 36B).

15.3.7 Reading the automatic positioning data

The automatic positioning data stored in EH-POS4 can be read by the positioning data reading command.

[Example]

The following program transfers the specified automatic step data of all axes to the area (WR36C -38F).



When the reading bit (R15) of the automatic positioning data is "1", set the reading command to the command register (WY4) with subcommand (WY5).

After Complete bit (X63) is "1", start FUN200 (R12 = 1).

After FUN200 completes, transfer the data to the area (WR36C - 38F)

Note: Positioning utility software (HPOST) can set and read Common parameter and Automatic positioning data. It can save those data as CSV file format.

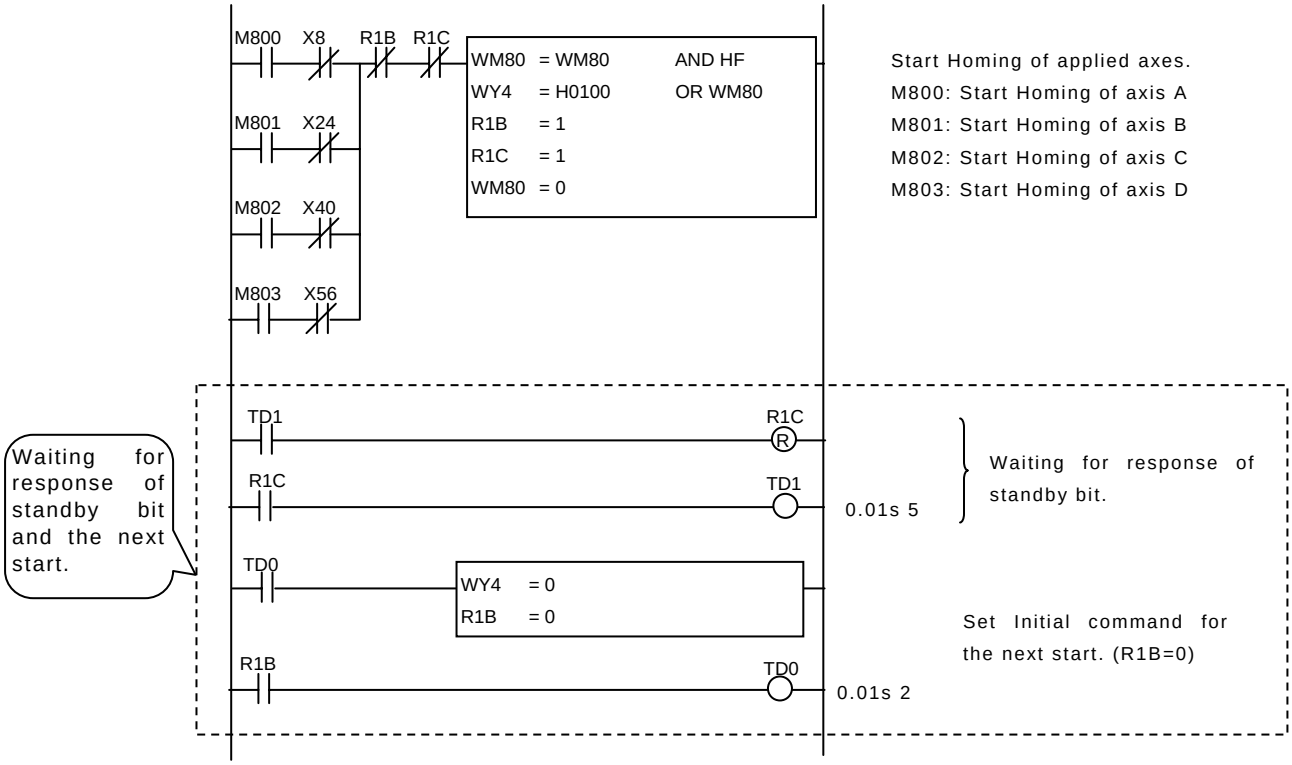
15.4 Programming to start operation

15.4.1 Homing

The program is described the program to start Homing.

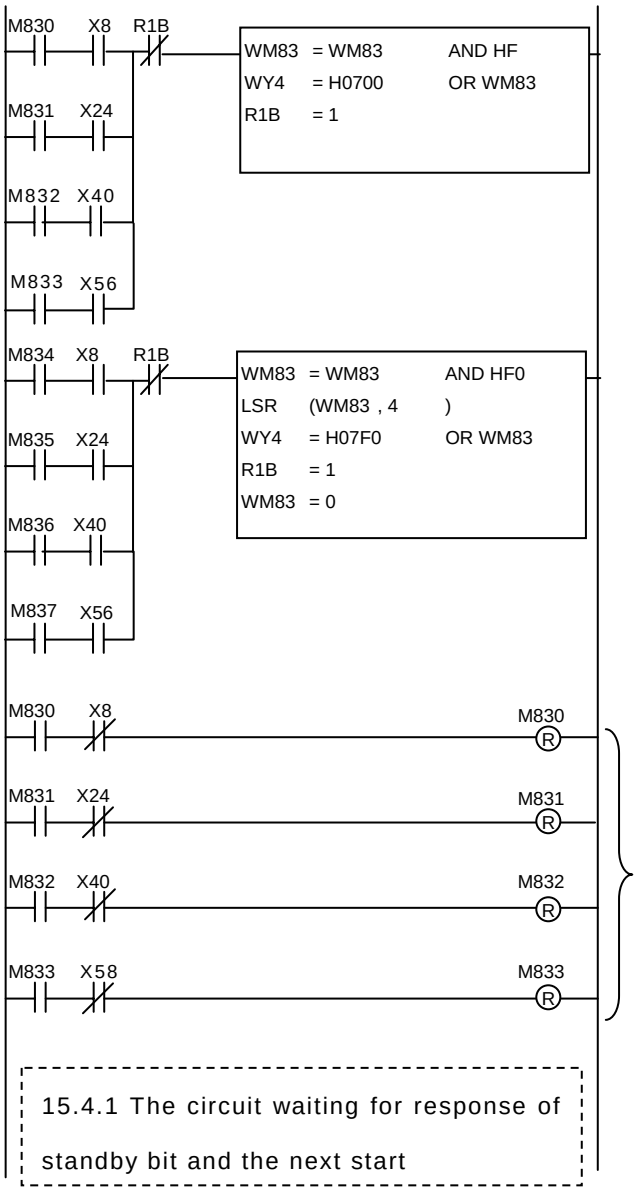
[Example]

The following program is the example to start Homing of each axis independently or multiple axes at the same time.



15.4.2 Stop (Slow down stop, Rapid stop)

The program is described the program to slow down and stop or stop rapidly on running.



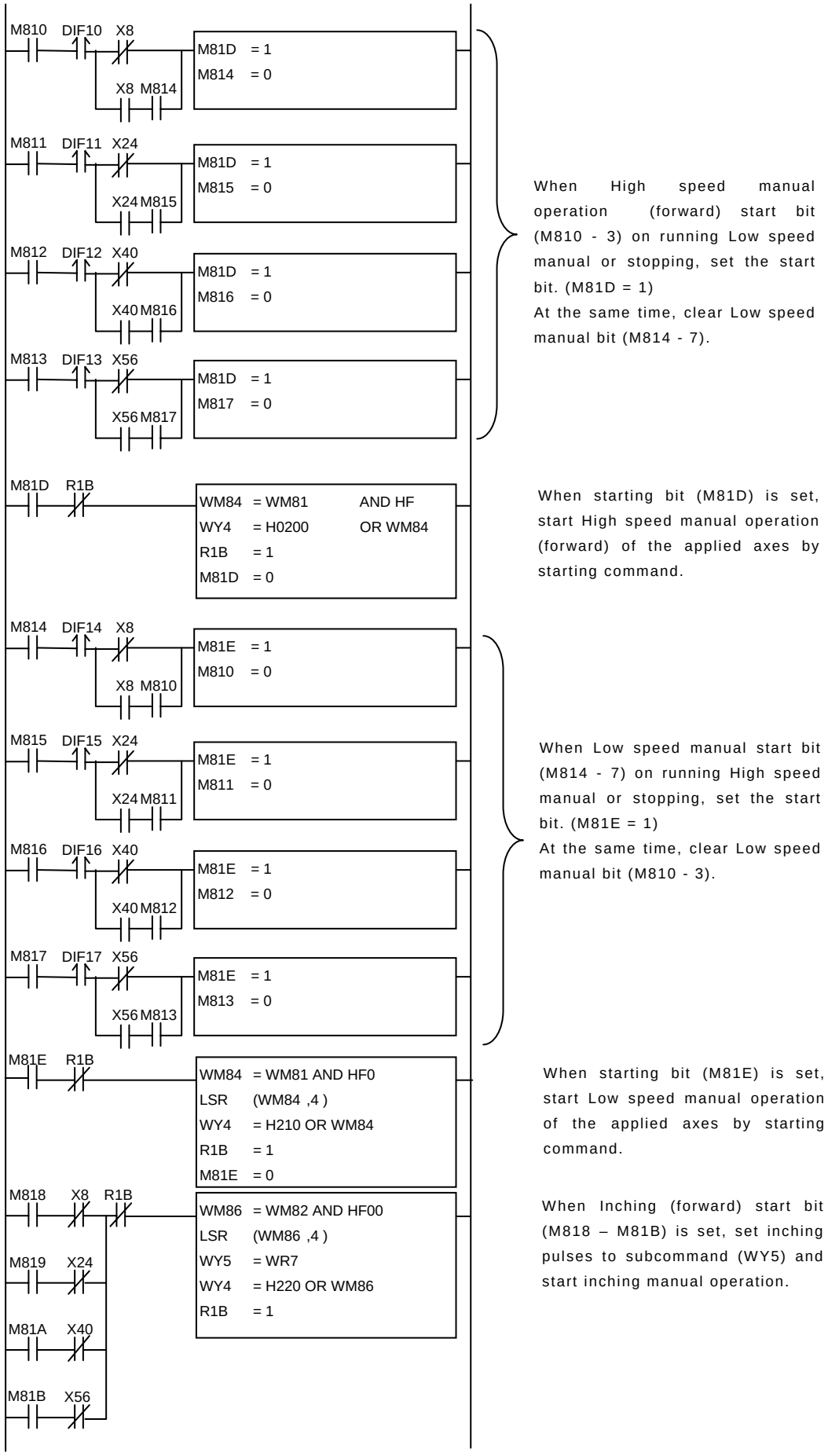
Stop after slow down applied to stop bit (M830 - 3) on running. (X8, X24, X40, X56=1).
M830: Slow down stop of axis A
M831: Slow down stop of axis B
M832: Slow down stop of axis C
M833: Slow down stop of axis D

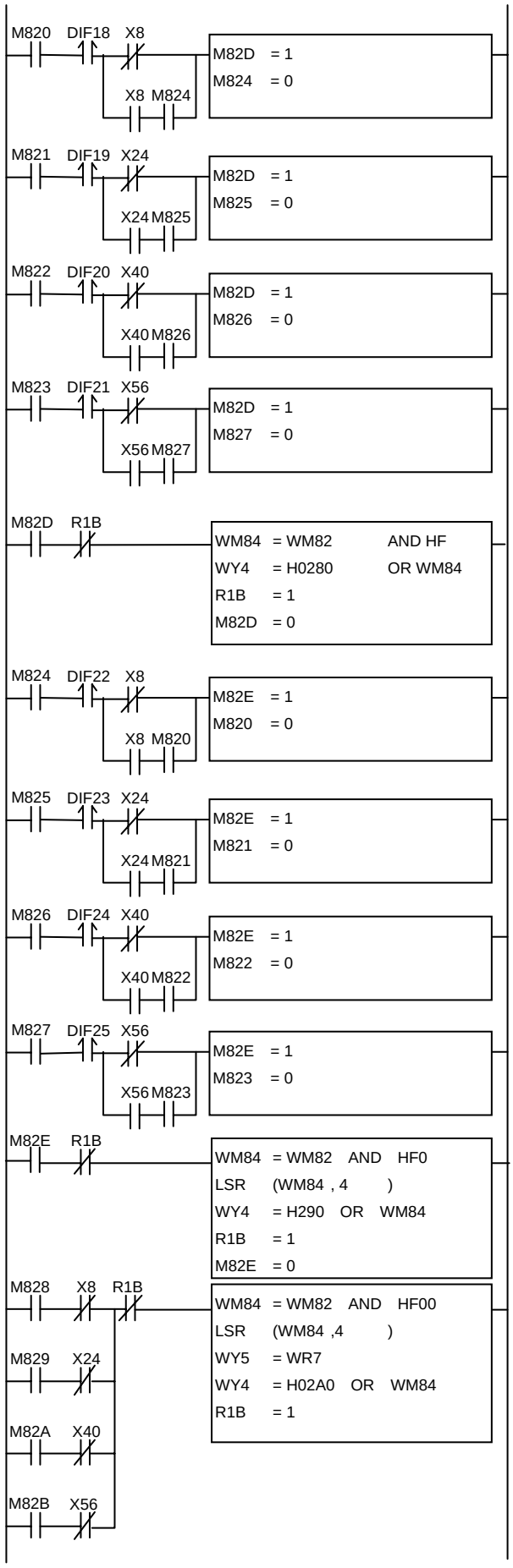
Stop rapidly applied to stop bit (M834 - 7) on running. (X8, X24, X40, X56=1).
M834: Rapid stop of axis A
M835: Rapid stop of axis B
M836: Rapid stop of axis C
M837: Rapid stop of axis D

Clear the axis bit (M830 - 3) that already become standby.

15.4.3 Manual operation

[Example]





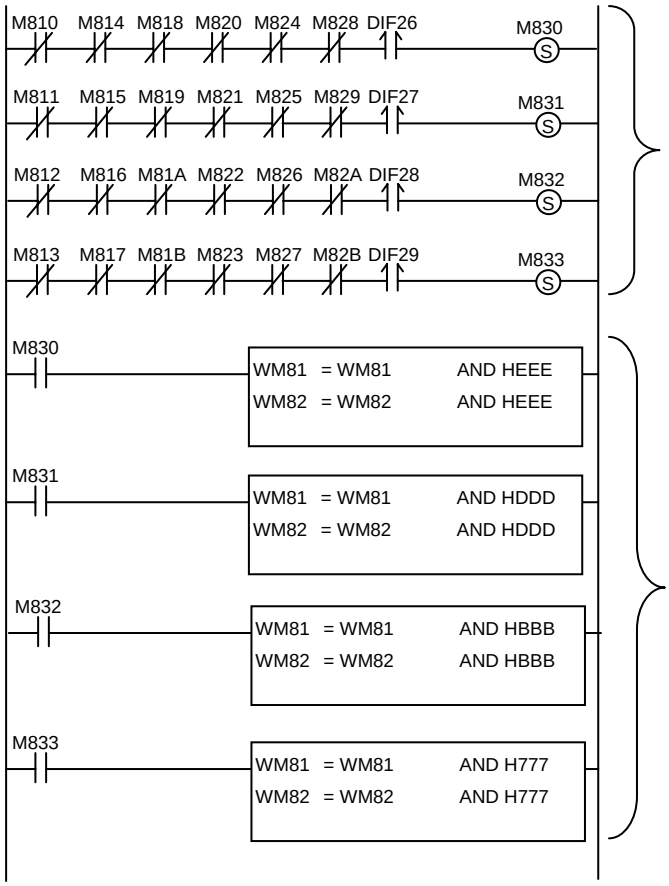
When High speed manual operation (reverse) start bit (M820 - 3) on running Low speed manual or stopping, set the start bit. (M82D = 1)
At the same time, clear Low speed manual bit (M824 - 7).

When starting bit (M82D) is set, start High speed manual operation (reverse) of the applied axes by starting command.

When Low speed manual start bit (M824 - 7) on running High speed manual or stopping, set the start bit. (M82E = 1)
At the same time, clear Low speed manual bit (M820 - 3).

When starting bit (M82E) is set, start Low speed manual operation of the applied axes by starting command.

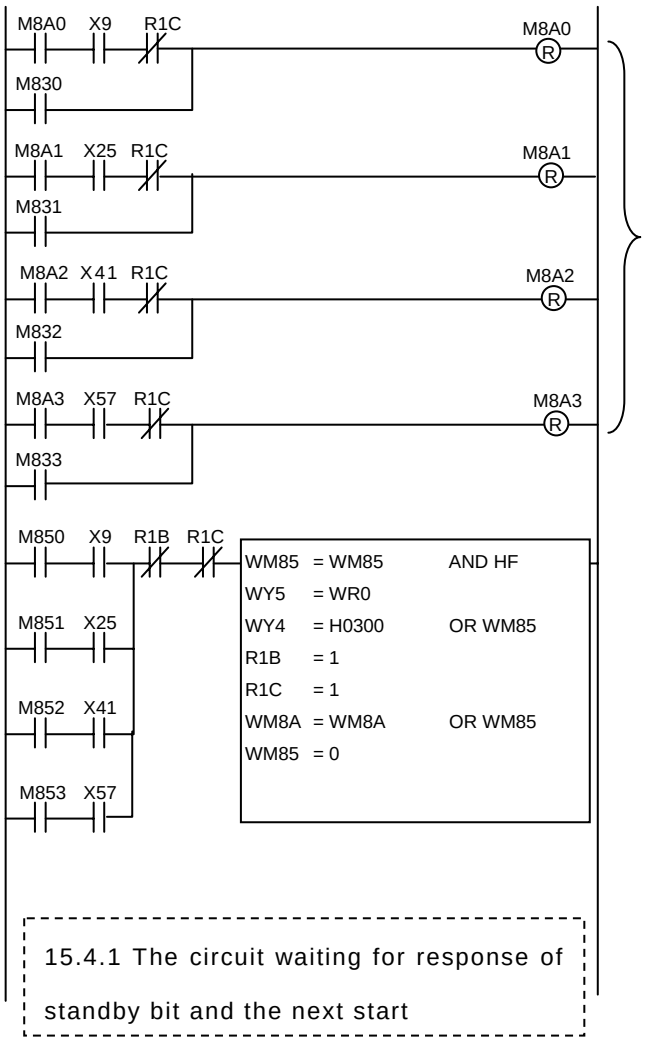
When Inching (reverse) start bit (M828 - B) is set, set inching pulses to subcommand (WY5) and start inching manual operation.


M810 M814 M818 M820 M824 M828 DIF26 M830
M811 M815 M819 M821 M825 M829 DIF27 M831
M812 M816 M81A M822 M826 M82A DIF28 M832
M813 M817 M81B M823 M827 M82B DIF29 M833
S
When the start bit of each axis (=0), set the slow down stop bit (M830 - 3) to "1".
M830
WM81 = WM81 AND HEEE
WM82 = WM82 AND HEEE
M831
WM81 = WM81 AND HDDD
WM82 = WM82 AND HDDD
M832
WM81 = WM81 AND HBBB
WM82 = WM82 AND HBBB
M833
WM81 = WM81 AND H777
WM82 = WM82 AND H777
When the stop bit (M830 - 3) of each axis (=1), clear the manual operation bits of the applied axes.

15.4.4 Automatic step operation

The following program is the example to start the automatic step operation of each axis independently or multiple axes at the same time.

[Example]



When the running bits (M8A0 - 3) and the standby bits (X9,25,41,57), clear the running bits of the applied bits.
M8A0: On running of axis A
M8A1: On running of axis B
M8A2: On running of axis C
M8A3: On running of axis D

When the start bits (M850 - 3) of each axis or multiple axes are set "1" at the same time, start the automatic step operations of applied axes and store the axes number to WM8A and start TD0 for adjustment of continuous operation.
M850: Axis A starts
M851: Axis B starts
M852: Axis C starts
M853: Axis D starts
R1B: Running flag
R1C: Standby waiting flag

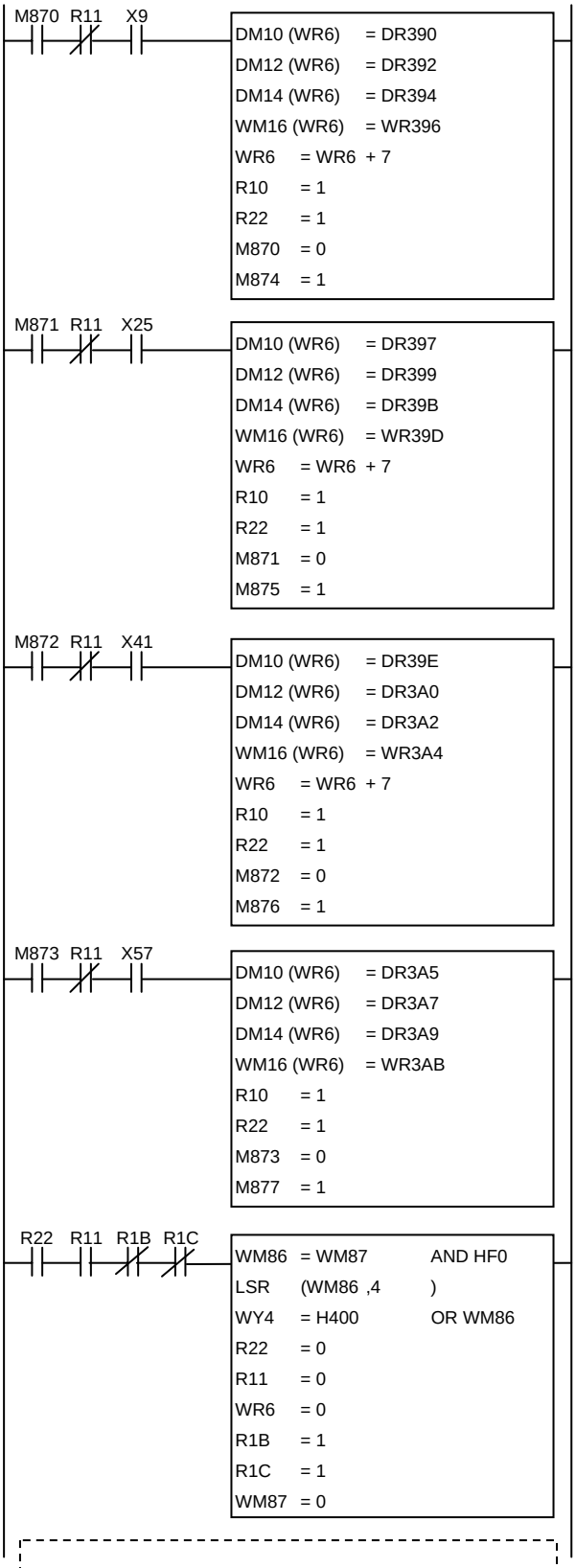
Note: When the number of the steps of the starting axes are different from each other, it doesn't start the operation.

15.4.5 Direct automatic operation

The following program is the example to start the direct automatic operation of each axis independently or multiple axes at the same time.

[Example]

In case of setting the starting bits of multiple axes in the same scan, the applied axes starts at the same time.



If axis A starting bit (M870) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct automatic operation bit (R22) "1" and clear M870 and set the running bit (M874) "1".

If axis B starting bit (M871) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct automatic operation bit (R22) "1" and clear M871 and set the running bit (M875) "1".

If axis C starting bit (M872) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct automatic operation bit (R22) "1" and clear M872 and set the running bit (M876) "1".

If axis D starting bit (M873) is set, set the positioning data to the setting area of FUN200 (WM10 -) and start FUN200 (R10=1).
Then set Direct automatic operation bit (R22) "1" and clear M873 and set the running bit (M877) "1".

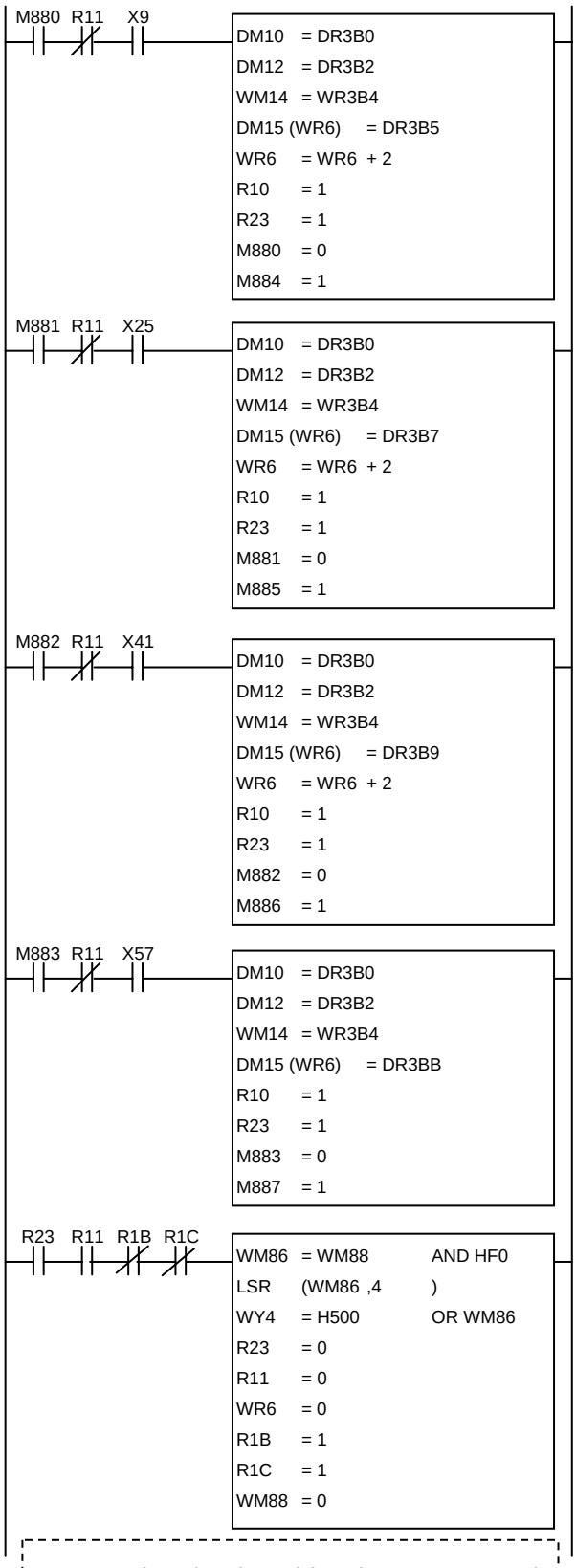
When FUN200 is complete (R11=1), set the Direct automatic command to the command register (WY4) with the applied axes bits, clear the running flags (M874-7).

15.4.1 The circuit waiting for response of standby bit and the next start

15.4.6 Direct linear interpolation

The following program is the example to start the Direct linear interpolation from 2 to 4 axes.
In this case the positioning data are WR3B0 - WR3BC.

[Example]



If axis A starting bit (M880) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct linear interpolation bit (R23) "1" and clear M880 and set the running bit (M884) "1".

If axis B starting bit (M881) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct linear interpolation bit (R23) "1" and clear M881 and set the running bit (M885) "1".

If axis C starting bit (M882) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct linear interpolation bit (R23) "1" and clear M882 and set the running bit (M886) "1".

If axis D starting bit (M883) is set, set the positioning data to the setting area of FUN200 (WM10 -) and start FUN200 (R10=1).
Then set Direct linear interpolation bit (R23) "1" and clear M883 and set the running bit (M887) "1".

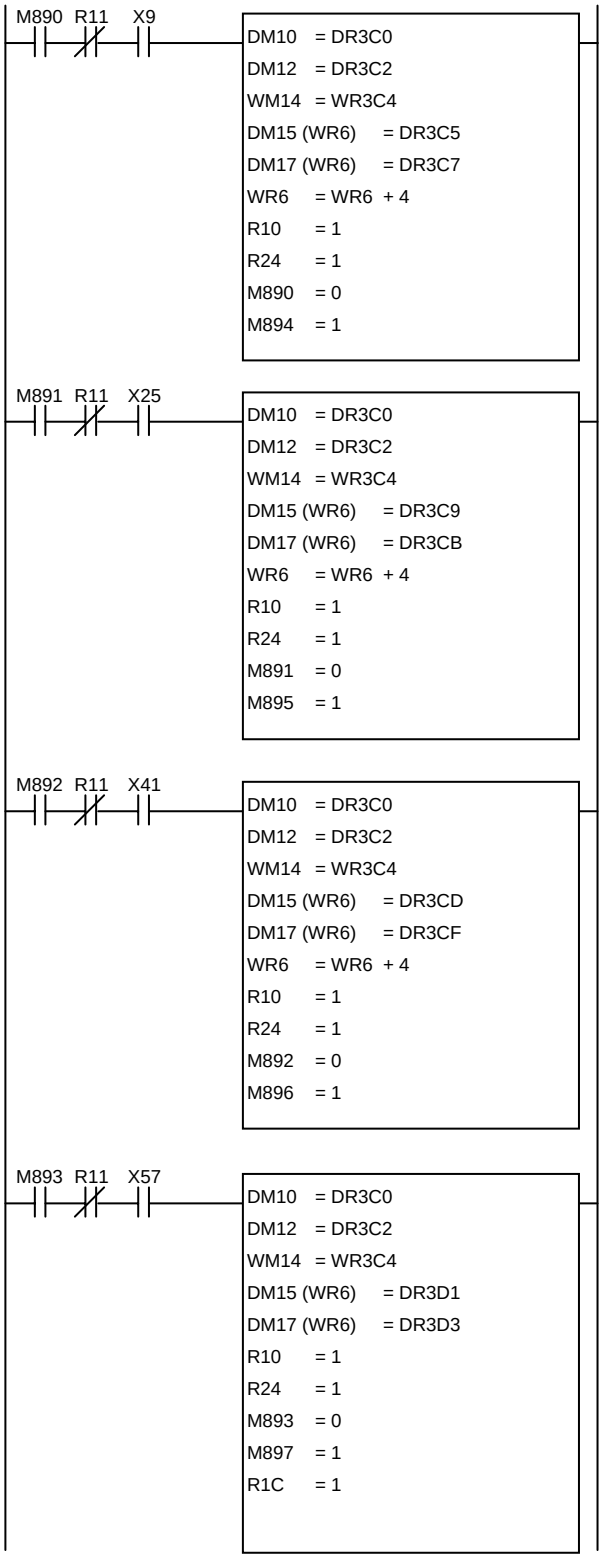
When FUN200 is complete (R11=1), set the Direct linear interpolation command to the command register (WY4) with the applied axes bits, clear the running flags (M884- 7).

15.4.1 The circuit waiting for response of standby bit and the next start

15.4.7 Direct circular interpolation

The following program is the example to start the Direct circular interpolation.
The positioning data are WR3C0 - WR3CC.

[Example]

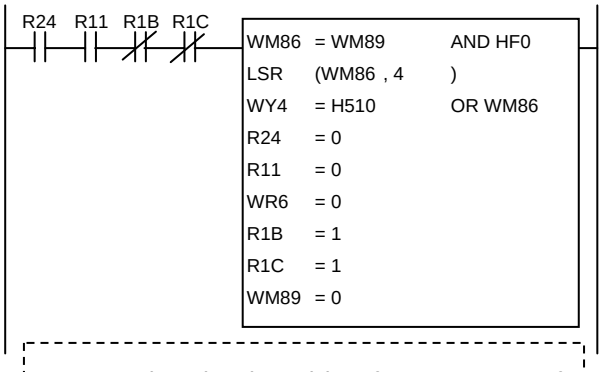


If axis A starting bit (M890) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct circular interpolation bit (R24) "1" and clear M890 and set the running bit (M894) "1".

If axis B starting bit (M891) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct circular interpolation bit (R24) "1" and clear M891 and set the running bit (M895) "1".

If axis C starting bit (M892) is set, set the positioning data to the setting area of FUN200 (WM10 -) and renew the address counter of the setting data of another axis and start FUN200 (R10=1). Then set Direct circular interpolation bit (R24) "1" and clear M892 and set the running bit (M896) "1".

If axis D starting bit (M893) is set, set the positioning data to the setting area of FUN200 (WM10 -) and start FUN200 (R10=1).
Then set Direct circular interpolation bit (R24) "1" and clear M893 and set the running bit (M897) "1".



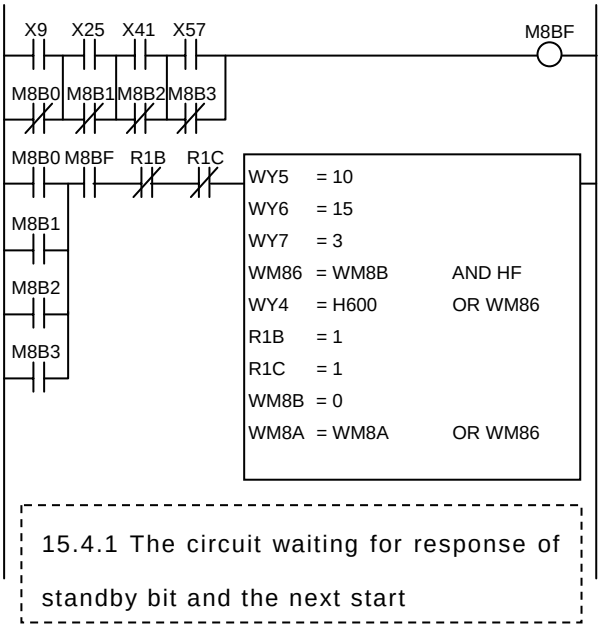
When FUN200 is complete (R11=1), set the Direct circular interpolation command to the command register (WY4) with the applied axes bits, clear the running flags (M894- 7).

15.4.1 The circuit waiting for response of standby bit and the next start

15.4.8 Automatic cycle operation

The following program is the example to start Automatic cycle operation of the specified axes.
This example is the operation that repeats the step operations from No. 10 to No. 15 three times.

[Example]



When the standby bits (X9, X25, X41, X57) of the applied axes, "M8BF" is "1".

When the Cycle starting bits are set (M8B0 - M8B3=1), set the starting step number to the subcommand register (WY5) and the ending step number to the subcommand register (WY6) and the repeat number to the subcommand register (WY7). Then set Automatic cycle operation command to command register (WY4).

15.5 Using memory table for the example

The following tables represent the using memory (internal outputs) in the above example programs.

[Whole internal outputs of all examples]

(1) Bit type internal outputs : R0 - R1C
(2) Bit/Word shared internal outputs : WM0 - WM8B
(3) Word type internal outputs : WR0 - WR3D4

In detail of using memory of each program, refer the followings.

15.5.1 Using memory of setting and reading program

The following table is the using memory of the program in "15.3.2 - 15.3.7".

(1) Common parameter setting program (program "15.3.2")

Table 15.7 Using internal outputs table of common parameter setting program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	M358	Set common parameter setting command of axis D
R11	Complete setting data of FUN200		
M350	Reading common parameter data (set by user)	M359	Waiting complete to set
M351	Setting the data of axis A to FUN200	WR20 - WR32	Common parameter value of axis A (set by user)
M352	Set common parameter setting command of axis A		
M353	Setting the data of axis B to FUN200	WR33 - WR45	Common parameter value of axis B (set by user)
M354	Set common parameter setting command of axis B		
M355	Setting the data of axis C to FUN200	WR46 - WR58	Common parameter value of axis C (set by user)
M356	Set common parameter setting command of axis C		
M357	Setting the data of axis D to FUN200	WR59 - WR6B	Common parameter value of axis D (set by user)

(2) Automatic positioning data (program "15.3.3")

Table 15.8 Using internal outputs table of Automatic positioning data setting program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	WR2	Address counter of the positioning data memory
R11	Complete setting data of FUN200	WR3	Address counter of the setting data area of FUN200
M360	Start to set the automatic position data. (set by user)	WR4	The repeat value of the axes
M361	Setting the positioning data to the setting area of FUN200	WR5	Setting step number counter
M362	Set automatic positioning data setting command	WR70 - WR33F	The positioning data area of step number from 0 to 19. There are stored in order from axis A to D of step "0", axis A to D of step "1". (set by user)
M363	Clear complete bits		
M364	Complete of setting all of the step data.		

(3) Speed change (program "15.3.4")

Table 15.9 Using internal outputs table of Speed change program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	WR6	Address counter of the setting data area of FUN200
R11	Complete setting data of FUN200		
M370	Speed change of axis A (set by user)	WR340	Speed value of axis A (set by user)
M371	Speed change of axis B (set by user)	WR341	Speed value of axis B (set by user)
M372	Speed change of axis C (set by user)	WR342	Speed value of axis C (set by user)
M373	Speed change of axis D (set by user)	WR343	Speed value of axis D (set by user)

(4) Current position change (program "15.3.5")

Table 15.10 Using internal outputs table of Current position change program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	WR6	Address counter of the setting data area of FUN200
R11	Complete setting data of FUN200		
M380	Current position change of axis A (set by user)	DR344	Current position value of axis A (set by user)
M381	Current position change of axis B (set by user)	DR346	Current position value of axis B (set by user)
M382	Current position change of axis C (set by user)	DR348	Current position value of axis C (set by user)
M383	Current position change of axis D (set by user)	DR34A	Current position value of axis D (set by user)

(5) Reading Current position and Command error (program "15.3.6")

Table 15.11 Using internal outputs table of Reading Current position and Command error program

I/O No.	Contents	I/O No.	Contents
R12	Start reading data of FUN200	WR360 - WR38F	Reading data transferred address
R13	Complete reading data of FUN200		

(6) Reading the automatic position data (program "15.3.7")

Table 15.12 Using internal outputs table of Reading the automatic position data program

I/O No.	Contents	I/O No.	Contents
R12	Start reading data of FUN200	WR34C	Step number for reading
R13	Complete reading data of FUN200	WR36C - WR38F	Step data of all axes
R15	Starting bit of Reading the automatic positioning data		

15.5.2 Using internal outputs of starting the operation

The following table is the using memory of the program in "15.4.1 - 15.4.8".

(1) Homing (program "15.4.1")

Table 15.13 Using internal outputs table of Homing program

I/O No.	Contents	I/O No.	Contents
R1B	Waiting bit for next operation	TD0	Interval time until next operation (10 ms - 20 ms)
R1C	Waiting bit for standby	TD1	Interval time until standby (40 ms - 50 ms)
M800	Start Homing of axis A (set by user)		
M801	Start Homing of axis B (set by user)		
M802	Start Homing of axis C (set by user)		
M803	Start Homing of axis D (set by user)		

(2) Slow dawn stop and Rapid stop (program "15.4.2")

Table 15.14 Using internal outputs table of Stop program

I/O No.	Contents	I/O No.	Contents
R1B	Waiting bit for next operation	M834	Rapid stop of axis A (set by user)
M830	Slow down stop of axis A (set by user)	M835	Rapid stop of axis B (set by user)
M831	Slow down stop of axis B (set by user)	M836	Rapid stop of axis C (set by user)
M832	Slow down stop of axis C (set by user)	M837	Rapid stop of axis D (set by user)
M833	Slow down stop of axis D (set by user)		

(3) Manual operation (program "15.4.3)

Table 15.15 Using internal outputs table of Manual operation program

I/O No.	Contents	I/O No.	Contents
R1B	Waiting bit for next operation	M820	High speed manual bit of axis A reverse (set by user)
M810	High speed manual bit of axis A forward (set by user)	M821	High speed manual bit of axis B reverse (set by user)
M811	High speed manual bit of axis B forward (set by user)	M822	High speed manual bit of axis C reverse (set by user)
M812	High speed manual bit of axis C forward (set by user)	M823	High speed manual bit of axis D reverse (set by user)
M813	High speed manual bit of axis D forward (set by user)	M824	Low speed manual bit of axis A reverse (set by user)
M814	Low speed manual bit of axis A forward (set by user)	M825	Low speed manual bit of axis B reverse (set by user)
M815	Low speed manual bit of axis B forward (set by user)	M826	Low speed manual bit of axis C reverse (set by user)
M816	Low speed manual bit of axis C forward (set by user)	M827	Low speed manual bit of axis D reverse (set by user)
M817	Low speed manual bit of axis D forward (set by user)	M828	Inching bit of axis A reverse (set by user)
M818	Inching bit of axis A forward (set by user)	M829	Inching bit of axis B reverse (set by user)
M819	Inching bit of axis B forward (set by user)	M82A	Inching bit of axis C reverse (set by user)
M81A	Inching bit of axis C forward (set by user)	M82B	Inching bit of axis D reverse (set by user)
M81B	Inching bit of axis D forward (set by user)	M82D	Start High speed manual operation reverse (set by user)
M81D	Start High speed manual operation forward	M82E	Start Low speed manual operation reverse (set by user)
M81E	Start Low speed manual operation forward (set by user)	WR7	Pulse number of inching (set by user)
		WM84	Applied axes in case of speed switching
		WM86	Applied axes at the start command

(4) Automatic step operation (program "15.4.4")

Table 15.16 Using internal outputs table of Automatic step operation program

I/O No.	Contents	I/O No.	Contents
R1B	Waiting bit for next operation	M8A0	On running of axis A
R1C	Waiting bit for standby	M8A1	On running of axis B
M850	Start axis A (set by user)	M8A2	On running of axis C
M851	Start axis B (set by user)	M8A3	On running of axis D
M852	Start axis C (set by user)	WR0	Starting step number (set by user)
M853	Start axis D (set by user)		

(5) Direct automatic operation (program "15.4.5")

Table 15.17 Using internal outputs table of Direct automatic operation program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	WM86	Applied axes at the start command
R11	Complete setting data of FUN200	WR6	Address counter of the setting data area of FUN200
R1B	Waiting bit for next operation	WR390 - WR396	Positioning data of axis A (set by user)
R1C	Waiting bit for standby		
M870	Start axis A (set by user)		
M871	Start axis B (set by user)	WR397 - WR39D	Positioning data of axis B (set by user)
M872	Start axis C (set by user)		
M873	Start axis D (set by user)		
M874	Set the start command of axis A	WR39E - WR3A4	Positioning data of axis C (set by user)
M875	Set the start command of axis B		
M876	Set the start command of axis C		
M877	Set the start command of axis D	WR3A5 - WR3AB	Positioning data of axis D (set by user)

(6) Direct linear interpolation (program "15.4.6")

Table 15.18 Using internal outputs table of Direct linear interpolation program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	WM86	Applied axes at the start command
R11	Complete setting data of FUN200	WR6	Address counter of the setting data area of FUN200
R1B	Waiting bit for next operation	DR3B0	Operation mode and Dwell time (set by user)
R1C	Waiting bit for standby	DR3B2	Acceleration and Deceleration time (set by user)
M880	Start axis A (set by user)	WR3B4	Speed (set by user)
M881	Start axis B (set by user)	DR3B5	Target position value of axis A (set by user)
M882	Start axis C (set by user)	DR3B7	Target position value of axis B (set by user)
M883	Start axis D (set by user)	DR3B9	Target position value of axis C (set by user)
M884	Set the start command of axis A	DR3BB	Target position value of axis D (set by user)
M885	Set the start command of axis B		
M886	Set the start command of axis C		
M887	Set the start command of axis D		

(7) Direct circular interpolation (program "15.4.7")

Table 15.19 List of internal outputs used in Direct circular interpolation program

I/O No.	Contents	I/O No.	Contents
R10	Start setting data of FUN200	WM86	Applied axes at the start command
R11	Complete setting data of FUN200	WR6	Address counter of the setting data area of FUN200
R1B	Waiting bit for next operation	DR3C0	Operation mode and Dwell time (set by user)
R1C	Waiting bit for standby	DR3C2	Acceleration and Deceleration time (set by user)
M890	Start axis A (set by user)	WR3C4	Speed (set by user)
M891	Start axis B (set by user)	DR3C5	Target position value of axis A (set by user)
M892	Start axis C (set by user)	DR3C7	Circular interpolation value of axis A (set by user)
M893	Start axis D (set by user)	DR3C9	Target position value of axis B (set by user)
M894	Set the start command of axis A	DR3CB	Circular interpolation value of axis B (set by user)
M895	Set the start command of axis B	DR3CD	Target position value of axis C (set by user)
M896	Set the start command of axis C	DR3CF	Circular interpolation value of axis C (set by user)
M897	Set the start command of axis D	DR3D1	Target position value of axis D (set by user)
		DR3D3	Circular interpolation value of axis D (set by user)

(8) Automatic cycle operation ("15.4.8")

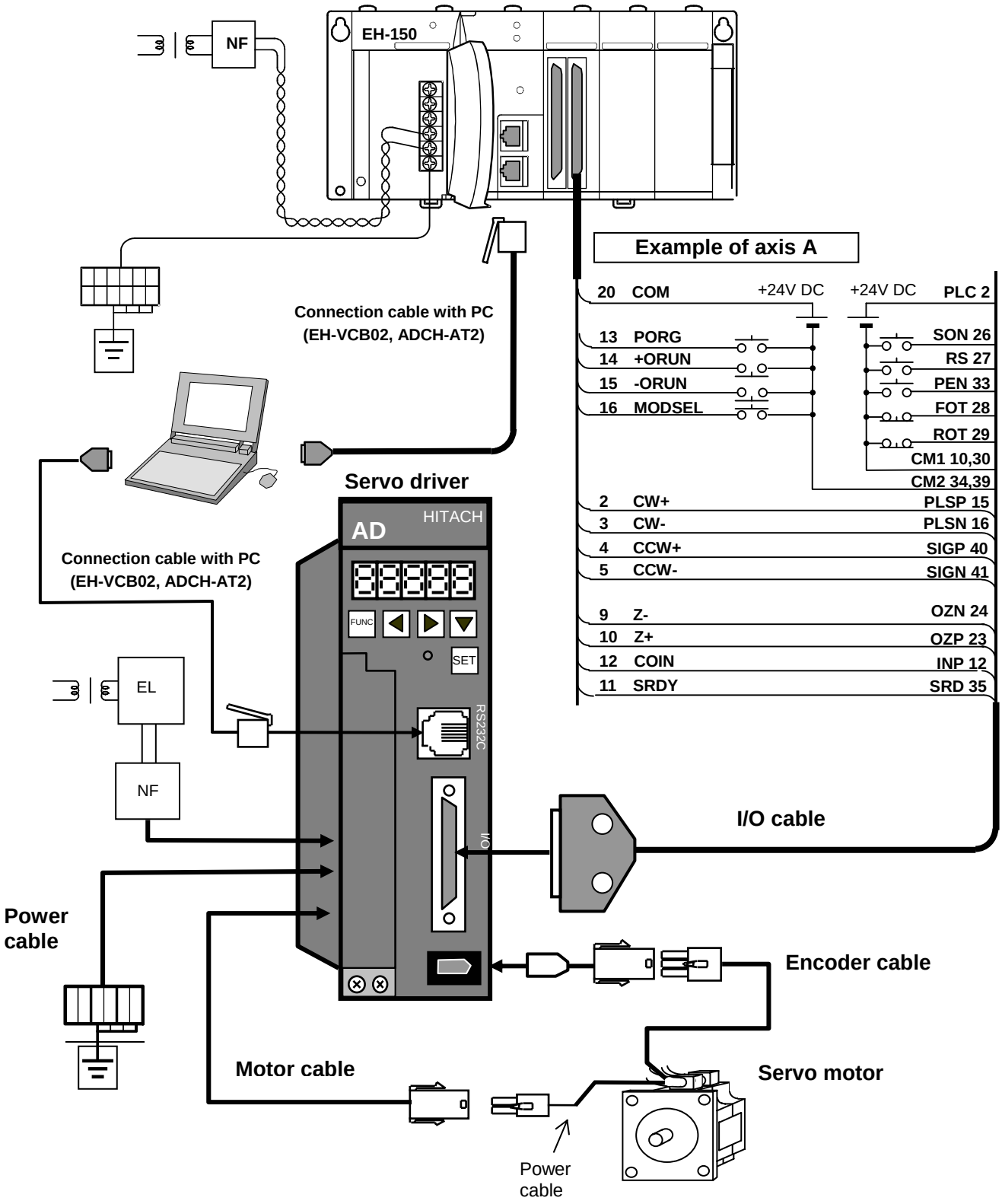
Table 15.20 List of internal outputs used in Automatic cycle operation program

I/O No.	Contents	I/O No.	Contents
R1B	Waiting bit for next operation	WM86	Applied axes at the start command
R1C	Waiting bit for standby		
M8B0	Start axis A (set by user)		
M8B1	Start axis B (set by user)		
M8B2	Start axis C (set by user)		
M8B3	Start axis D (set by user)		
M8B4	Set the start command of axis A		
M8B5	Set the start command of axis B		
M8B6	Set the start command of axis C		
M8B7	Set the start command of axis D		
M8BF	Standby of the applied axes		

Appendix 1 Example of wiring

Appendix 1.1 Example of wiring with Hitachi AD series servo

Appendix 1.1.1 In case of Incremental encoder type



Appendix 1.1.2 In case absolute encoder type

Wiring of absolute type is same as incremental type.

Appendix 1.1.3 Setting of EH-POS4 and AD series driver

Set the parameter to EH-POS4 and AD series servo driver as following. If the setting is wrong, the servo system does not active normally although the wiring is right.

About other parameters of the driver, refer the manual of AD series.

[In case of incremental encoder type]

	Setting item	Setting value	Remark
EH-POS4	Homing mode Common parameter No. 1	1) Free home position: H*0** 2) Low speed homing: H*1** 3) High speed homing 1: H*2** 4) High speed homing 2: H*3**	Set the other mode except Absolute encoder mode (H*4** - H*6**)
	Pulse logic Common parameter No. 3	1) Pulse and direction (Positive logic) H0*** 2) CW/CCW pulses (Positive logic) H1**	Set the parameter of AD series driver 1) FA-11: -P-S 2) FA-11: r-F
	SRDY/ COIN input mode Common parameter No. 3	1) SRDY/COIN both valid H***5	Note: In detail refer "6.1.1 Common parameter "
	Pulses / revolution Common parameter No. 3	1) Calculation $\frac{\text{FA-13}}{\text{FA-12}}$ X 32 768	Set the value less than 65535 and the Integer value (the error of calculation occurs)
AD Series driver	Control mode [FA-00]	1) [P-S]	MOD terminal = OFF
	Pulse train input mode [FA-11]	1) Pulse and direction [-P-S] 2) CW/CCW pulses [r-F]	Adapt this value to the setting of EH-POS4
	Electrical gear 1) numerator: [FA-12] 2) denominator: [FA-13]	Free	Note: In detail refer "6.1.1 Common parameter "
	Direction of motor forward run [FA-14]	1) Direction [CC]	Set the direction by Common parameter No. 1. If select the direction by the parameter of the driver, set "H**0* " to Common parameter No. 1
	Encoder type selection [FA-80]	1) Incremental encoder [inC]	
	Input terminal polarity setting [FC-01]	1) SON bit 0: 0 2) RS bit 1: 0 3) FOT bit 4: 0 4) ROT bit 5: 0 5) PEN bit 12: 0	In detail, refer the manual of AD series driver.
	Output terminal polarity setting [FC-02]	1) INP bit 2: 0 2) SRD bit 0: 0	
	Phase Z output selection [FC-12]	1) Phase Z output [1PLS]	

[In case of absolute encoder type]

	Setting item	Setting value	Remark
EH-POS4	**Homing mode Common parameter** No. 1	**1) absolute encoder homing H*4****	
	Pulse logic Common parameter No. 3	1) Pulse and direction (Positive logic) H0*** 2) CW/CCW pulses (Positive logic) H1**	Set the parameter of AD series driver 1) FA-11: -P-S 2) FA-11: r-F
	SRDY/ COIN input mode Common parameter No. 3	1) SRDY/COIN both valid H***5	Note: In detail refer "6.1.1 Common parameter "
	Pulses / revolution Common parameter No. 3	1) Calculation $\frac{\text{FA-13}}{\text{FA-12}}$ X 32 768	Set the value less than 65535 and the Integer value (the error of calculation occurs)
AD Series driver	Control mode [FA-00]	1) [P-S]	MOD terminal = OFF
	Pulse train input mode [FA-11]	1) Pulse and direction [-P-S] 2) CW/CCW pulses [r-F]	Adapt this value to the setting of EH-POS4
	Electrical gear 1) numerator: [FA-12] 2) denominator: [FA-13]	Free	Note: In detail refer "6.1.1 Common parameter "
	Direction of motor forward run [FA-14]	1) Direction [CC]	Set the direction by Common parameter No. 1 of EH-POS4. If select the direction by the parameter of the driver, set "H**0* " to Common parameter No. 1
	Encoder type selection [FA-80]	**1) absolute type [ABS]**	
	Input terminal polarity setting [FC-01]	1) SON bit 0: 0 2) RS bit 1: 0 3) FOT bit 4: 0 4) ROT bit 5: 0 5) PEN bit 12: 0	In detail, refer the manual of AD series driver.
	Output terminal polarity setting [FC-02]	1) INP bit 2: 0 2) SRD bit 0: 0	
	Phase Z output selection [FC-12]	**1) Absolute 17 bit serial data [nCunt]**	

The setting items in bold face are different from "Incremental encoder type".