XGB Positioning

- XBMS/XBC-H/XBC-SU type Built-in Positioning
- XBF-PD02A

- Contents -

1. Specifications

1.1 General Specifications

<table>
<tr><th>No.</th><th>Item</th><th colspan="5">Specification</th><th>Reference</th></tr>
<tr><td>1</td><td>Ambient Temp.</td><td colspan="5">0 ~ 55 °C</td><td></td></tr>
<tr><td>2</td><td>Storage Temp.</td><td colspan="5">-25 ~ +70 °C</td><td></td></tr>
<tr><td>3</td><td>Ambient Humidity</td><td colspan="5">5 ~ 95 %RH, Non-Condensing</td><td></td></tr>
<tr><td>4</td><td>Storage Humidity</td><td colspan="5">5 ~ 95 %RH, Non-Condensing</td><td></td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibration</td><td colspan="4">Occasional vibration</td><td>-</td><td></td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Times</td><td rowspan="8">IEC61131-2</td></tr>
<tr><td>10 < f < 57 Hz</td><td>-</td><td>0.075 mm</td><td rowspan="5">10 times each direction (X,Y and Z)</td></tr>
<tr><td>57 < f < 150 Hz</td><td>9.8 m/s^2 (1 G)</td><td>-</td></tr>
<tr><td colspan="3">Continuous vibration</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Amplitude</td></tr>
<tr><td>10 < f < 57 Hz</td><td>-</td><td>0.0375 mm</td></tr>
<tr><td>57 < f < 150 Hz</td><td>4.9m/s^2(0.5 G)</td><td>-</td></tr>
<tr><td>6</td><td>Shock</td><td colspan="5">• Peak acceleration : 147 m/s2 (15 G)
• Duration : 11 ms
• Half-sine, 3 times each direction per each axis</td><td>IEC61131-2</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Impulse Noise</td><td>Square wave impulse noise</td><td colspan="3">AC ±1,500 V
DC ±900 V</td><td>LSIS standard</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="3">Voltage: 4 kV (Contact discharge)</td><td>IEC61131-2
IEC61000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="3">27 ~ 500 MHz, 10V/m</td><td>IEC61131-2
IEC61000-4-3</td></tr>
</table>

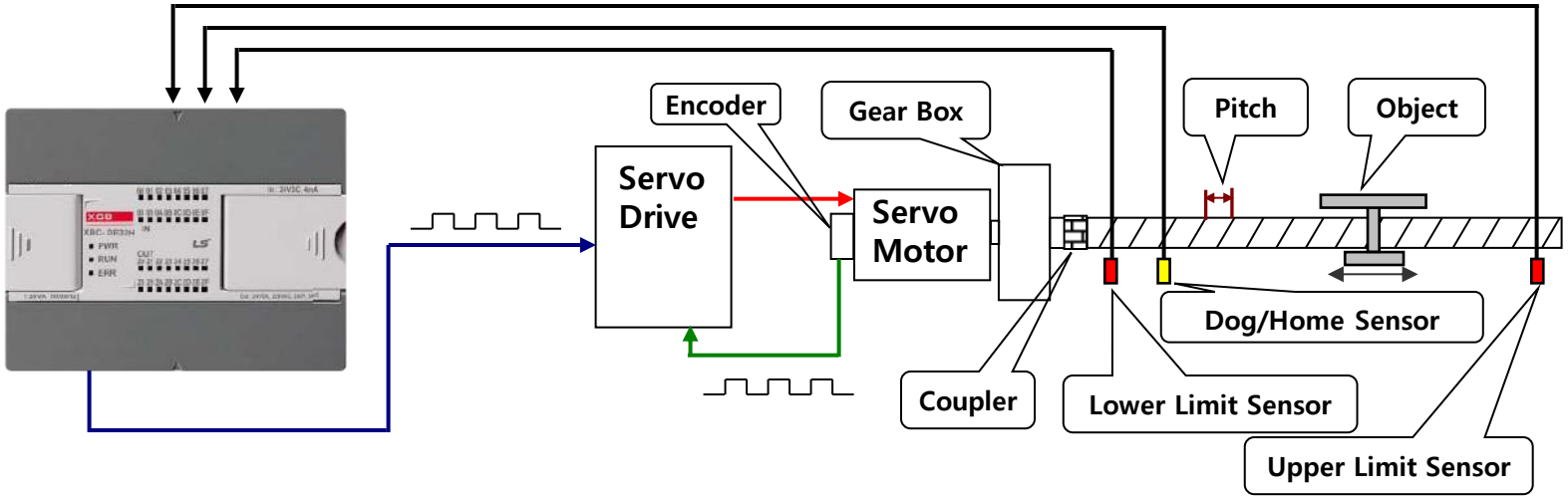
1.2 Positioning Specifications

Item	Specification				Remarks
	XBM*	XBC-S/SU*	XBC-H*	XBF-PD02A	
Max. Pulse Output	100 kpps			2 Mpps	
Channels	2 Ch.				
Output Pulse Type	Pulse & Direction		Pulse & Direction, CW/CCW		
Pulse Signal Level	DC 5~24V Open Collector			Line Drive	
Control Unit	Pulse				
Position Range	-2,147,483,648 ~ 2,147,483,647 Pulse				
Speed Range	0 ~ 100 kpps			0 ~ 2 Mpps	
Control Method	Position Control, Speed Control, Position/Speed Switching, Speed/Position Switching				
Interpolation	Linear Interpolation			Linear, Circular	2 Axis
Predefined Position Data	30	80		150	
Coordination System	Absolute/Incremental Coordination system				
Acc./Dec. type	Trapezoidal Acceleration/deceleration				
Acc./Dec. time	1 ~ 10,000 ms			1 ~ 65,535 ms	
External Interface	High Limit, Low Limit, Dog, Home				
External Encoder(MPG)	X			O(200 kpps)	

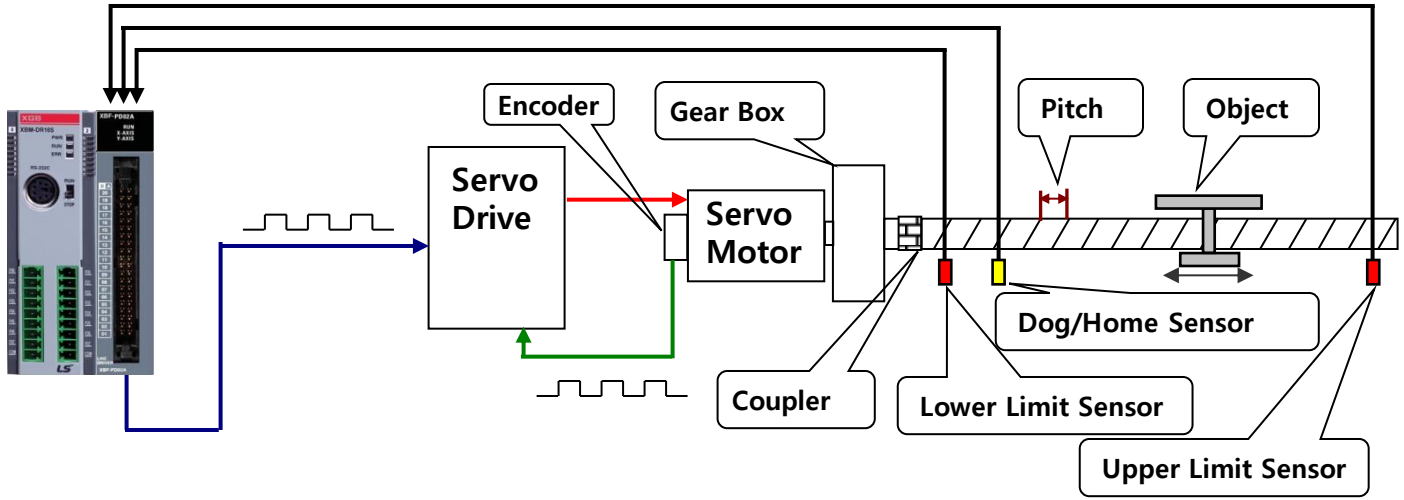
* Built-in Positioning function is available in transistor output type only.

2.1 Position Control System

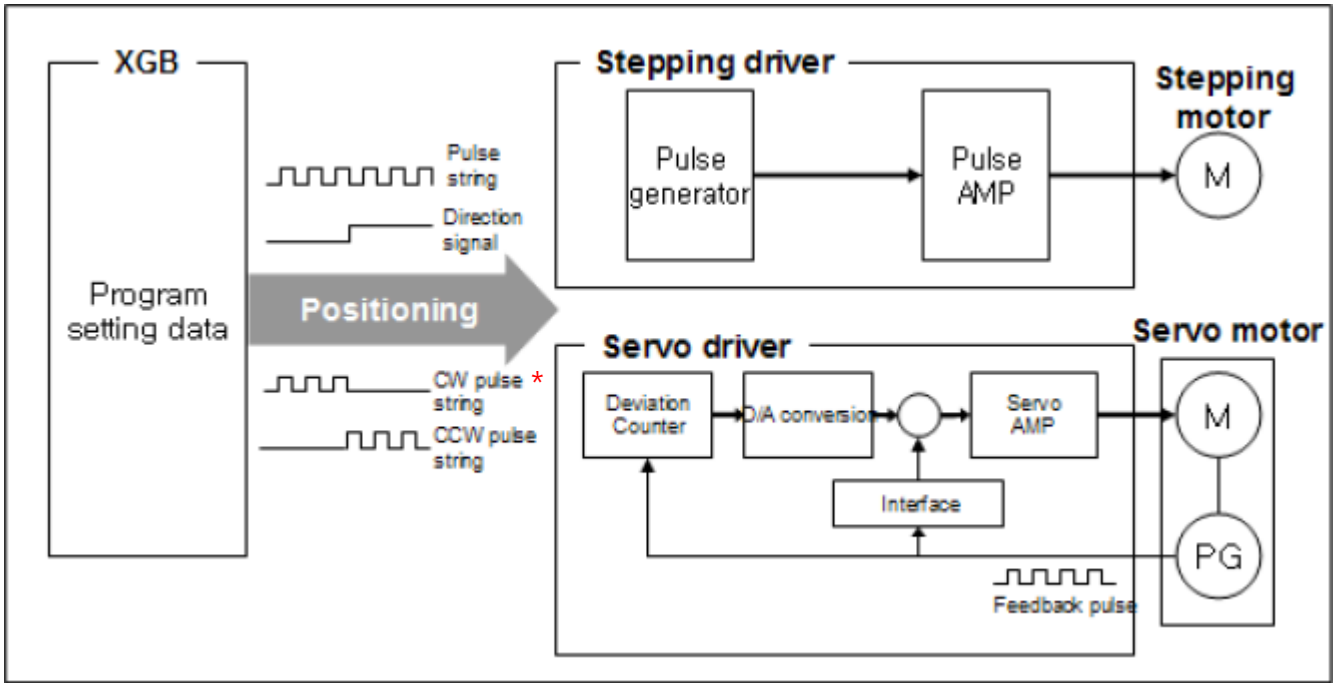
2.1.1 Built-in Position Control System Configuration



2.1.2 XBF-PD02A Position Control System Configuration



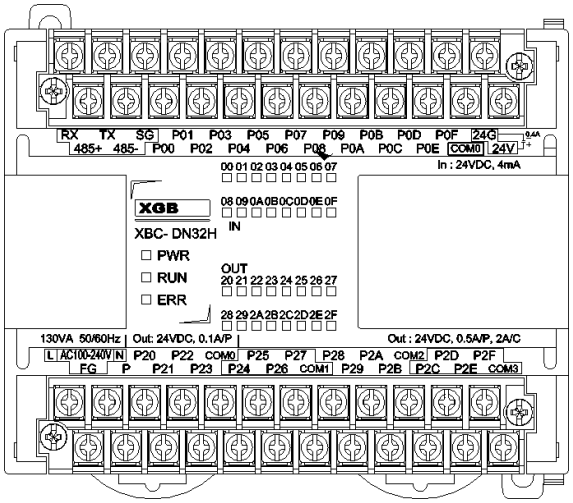
2.1.3 Position Control System Block Diagram



* CW/CCW pulse output is available in XBC-H type only.

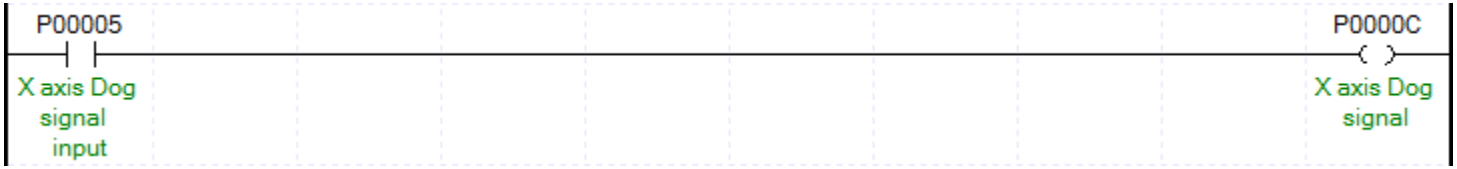
2.2 I/O Assignment for Positioning Function

2.2.1 XBCH/S/SU type PLC I/O Assignment



Input			Output		
Signal	Axis	Address	Signal	Axis	Address
Lower Limit	X Axis	P008	Pulse (CW)*2)	X Axis	P020/P040*3)
	Y Axis	P00A		Y Axis	P021/P041*3)
Upper Limit	X Axis	P009	Direction (CCW)*2)	X Axis	P022/P042*3)
	Y Axis	P00B		Y Axis	P023//P043*3)
Dog	X Axis	P00C*1)	-	-	-
	Y Axis	P00E*1)	-	-	-
Origin	X Axis	P00D*1)	-	-	-
	Y Axis	P00F*1)	-	-	-

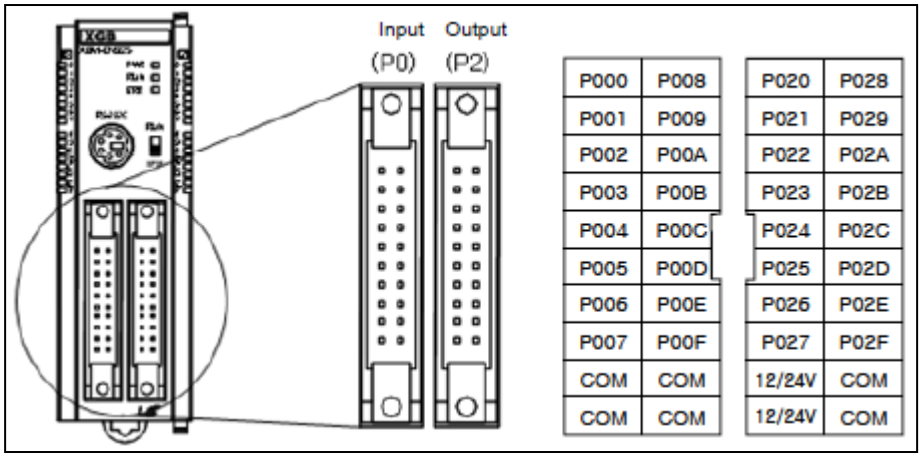
*1) Because 20 points XBC-S/SU PLC has 12 input points whose address is P000 ~ P00B, P00C ~ P00F must be controlled by program as below. (In case that Dog signal of X axis is connected to P00005 input point.)

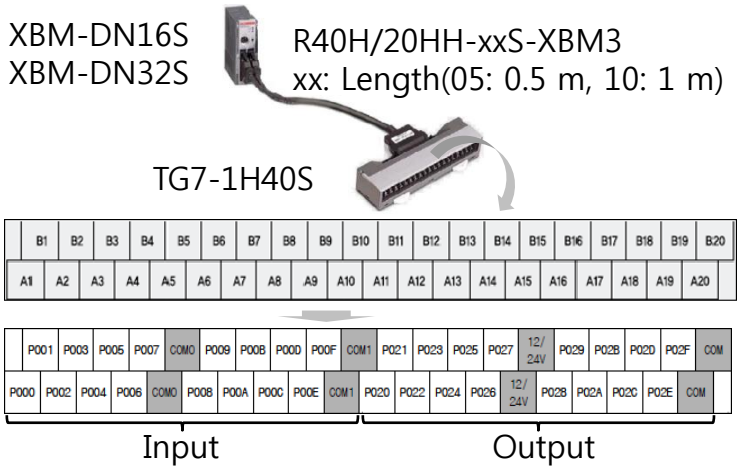


*2) CW/CCW pulse output is available in XBC-H type only.

*3) The addresses P020 ~ P023 are XBCH type PLC addresses and P040 ~ P033 are XBCS/SU type PLC addresses.

2.2.2 XBMS type PLC I/O Assignment



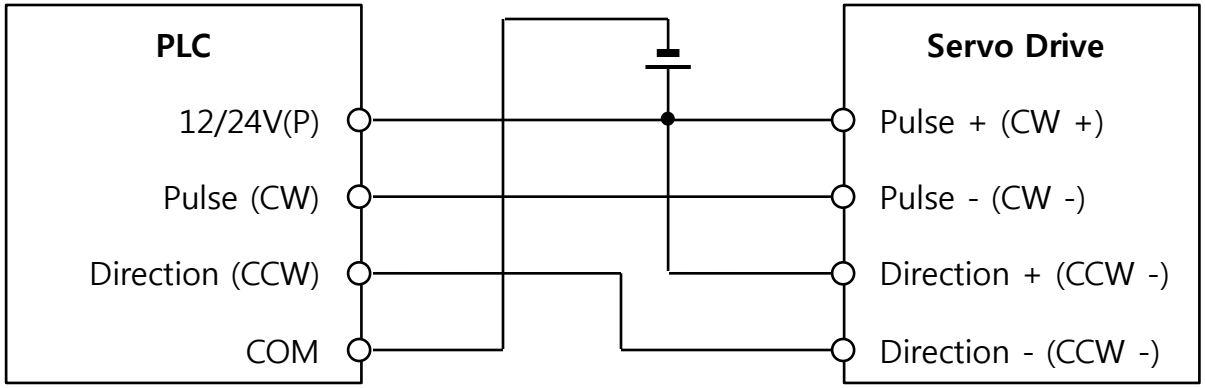


Input				Output			
Signal	Axis	Address	Terminal	Signal	Axis	Address	Terminal
Lower Limit	X Axis	P000	A1	Pulse	X Axis	P020	A11
	Y Axis	P002	A2		Y Axis	P021	B11
Upper Limit	X Axis	P001	B1	Direction	X Axis	P022	A12
	Y Axis	P003	B2		Y Axis	P023	B12
Dog	X Axis	P004	A3	-	-	-	-
	Y Axis	P006	A4	-	-	-	-
Origin	X Axis	P005	B3	-	-	-	-
	Y Axis	P007	B4	-	-	-	-

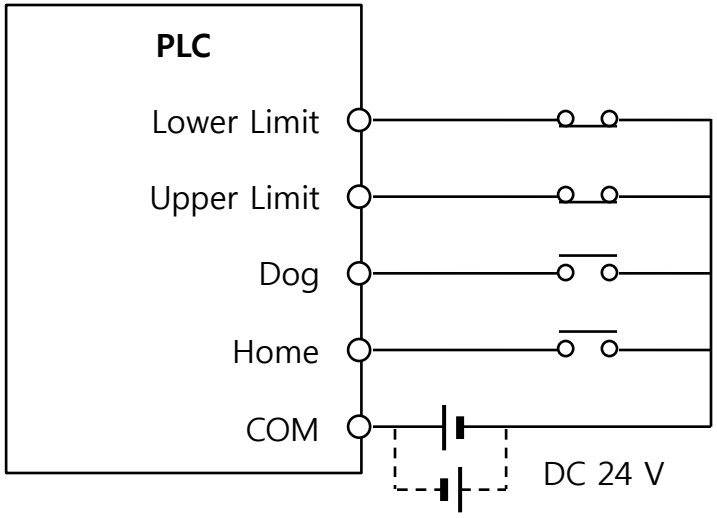
* Because input signals for positioning overlap with built in high speed counter input, built in high speed counter function is restricted when built in positioning function is used.

2.3 Wiring for built-in positioning function

2.3.1 Wiring between PLC and Servo Drive



2.3.2 Wiring between PLC and Sensors

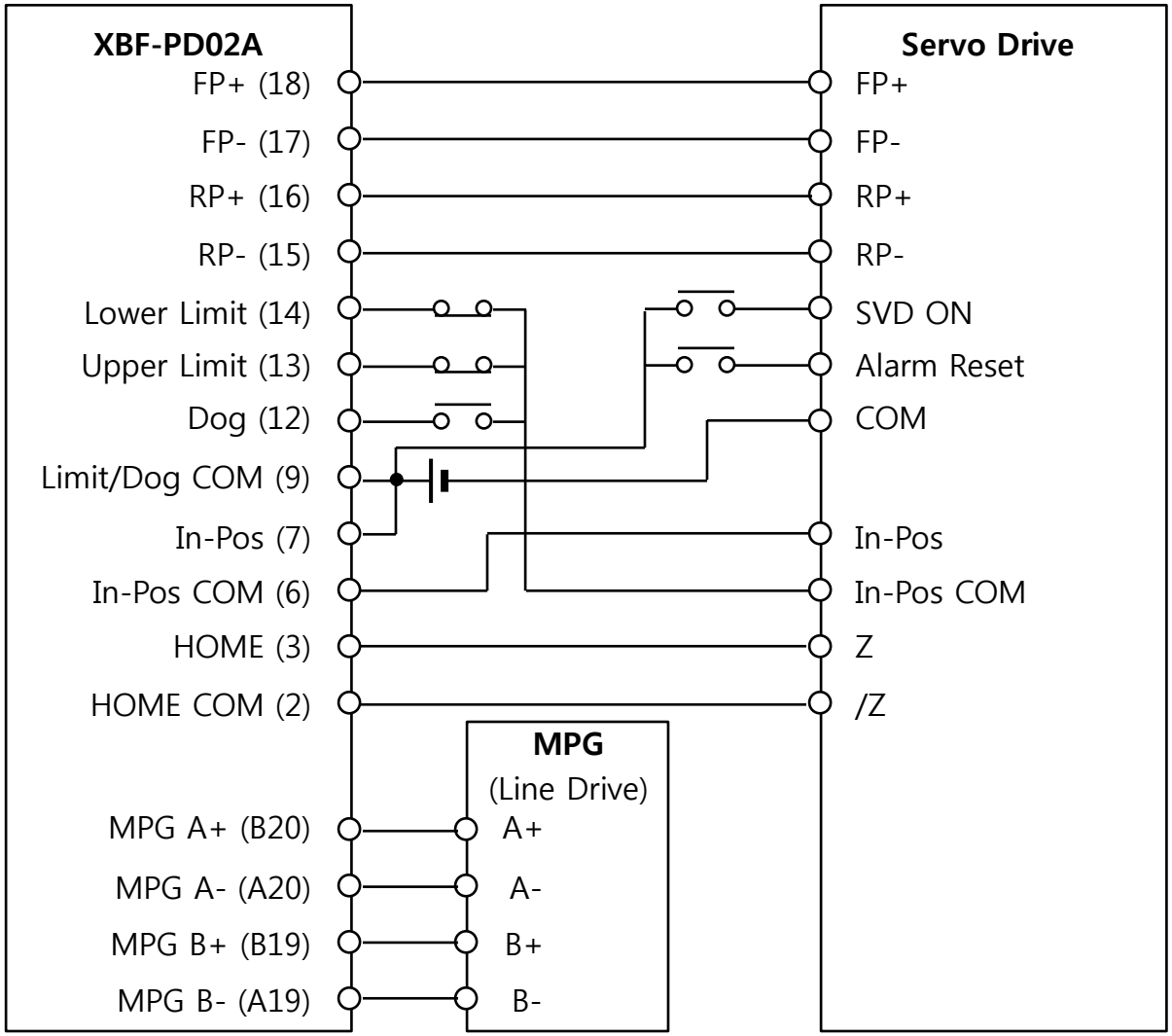


2.4 Wiring for XBF-PD02A positioning module

2.4.1 Pin Assignment of XBF-PD02A

Pin no. Y	Pin no. X	Signal Name		Signal direction positioning-external	Action condition
B20		MPG A+	Manual pulse generator/Encoder A+	←	
A20		MPG A-	Manual pulse generator/Encoder A-	←	
B19		MPG B+	Manual pulse generator/Encoder B+	←	
A19		MPG B-	Manual pulse generator/Encoder B-	←	
B18	A18	FP+	Pulse output (Differential Motion +)	→	
B17	A17	FP-	Pulse output (Differential Motion -)	→	
B16	A16	RP+	Pulse sign (Differential Motion +)	→	
B15	A15	RP-	Pulse sign (Differential Motion -)	→	
B14	A14	OV+	Upper limit	←	⌐
B13	A13	OV-	Lower limit	←	⌐
B12	A12	DOG	DOG	←	⌐
B11	A11	NC	Not used	-	
B10	A10	NC			
B9	A9	COM	Common (OV+, OV-, DOG)	-	
B8	A8	NC	Not used	-	
B7	A7	INP	In-Position Signal	←	⌐¬
B6	A6	INP COM	Common (INP)	-	
B5	A5	CLR	Deviation counter clear signal	→	
B4	A4	CLR COM	Common (CLR)	-	
B3	A3	HOME	Home(+5V)	←	⌐
B2	A2	COM HOME	Common (Home)	-	
B1	A1	NC	Not used	-	

2.4.2 Wiring between XBF-PD02A and Servo Drive



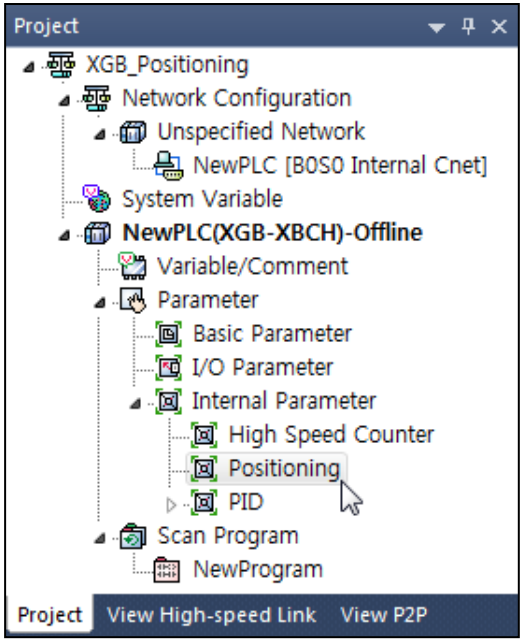
* Above diagram is simplified wiring diagram explains wiring between XBF-PD02A and servo drive. For more detail, refer to XBF-PD02A and servo drive manuals.

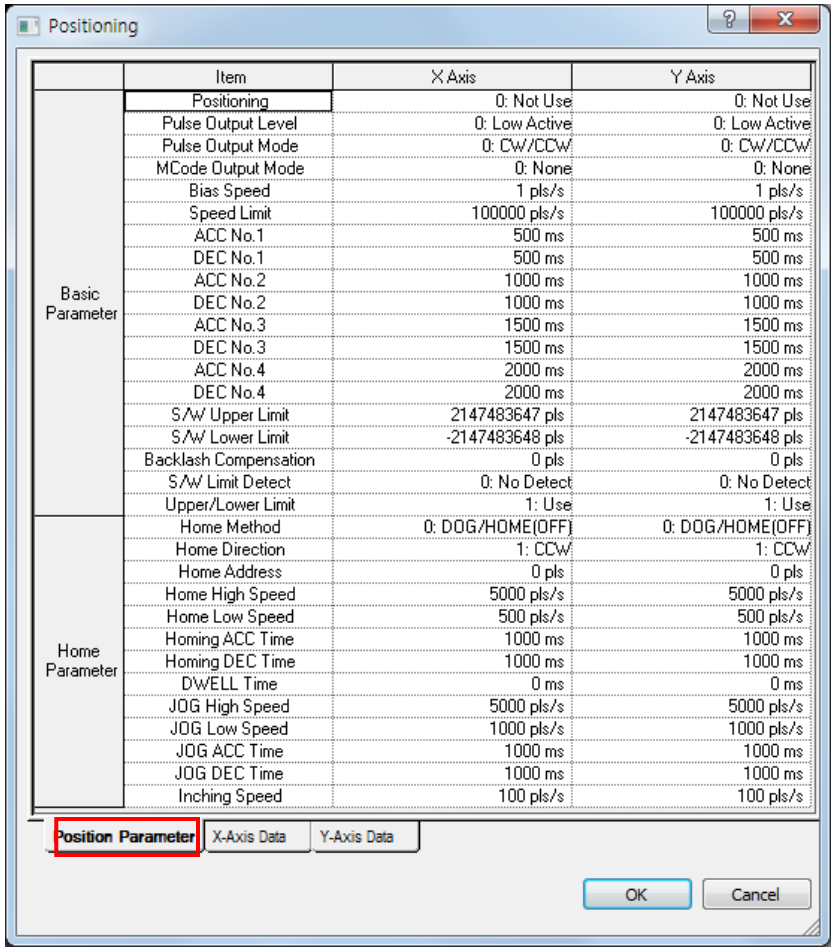
3.1 Built-in Positioning Parameter

Parameters for built-in positioning function can be set up in project window of XG5000.

When 'Positioning' in 'Internal Parameter' of XG5000 Project window is double clicked, Positioning window will be displayed.

Positioning parameters composed of Basic and Home parameter can be edited in 'Positioning Parameter' tab of Positioning window.





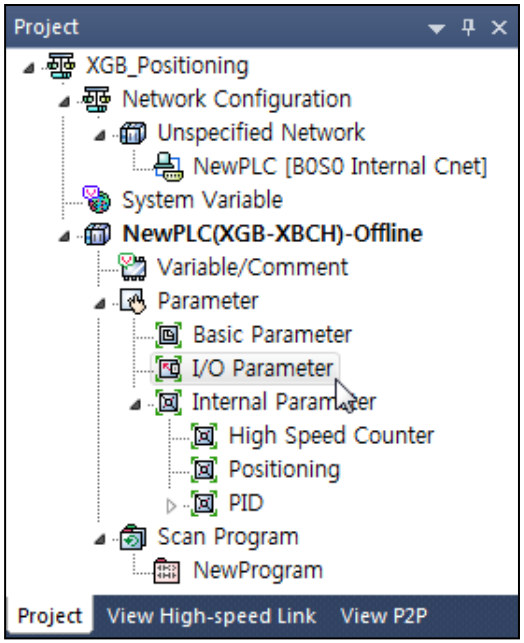
3.2 Positioning Module Parameter

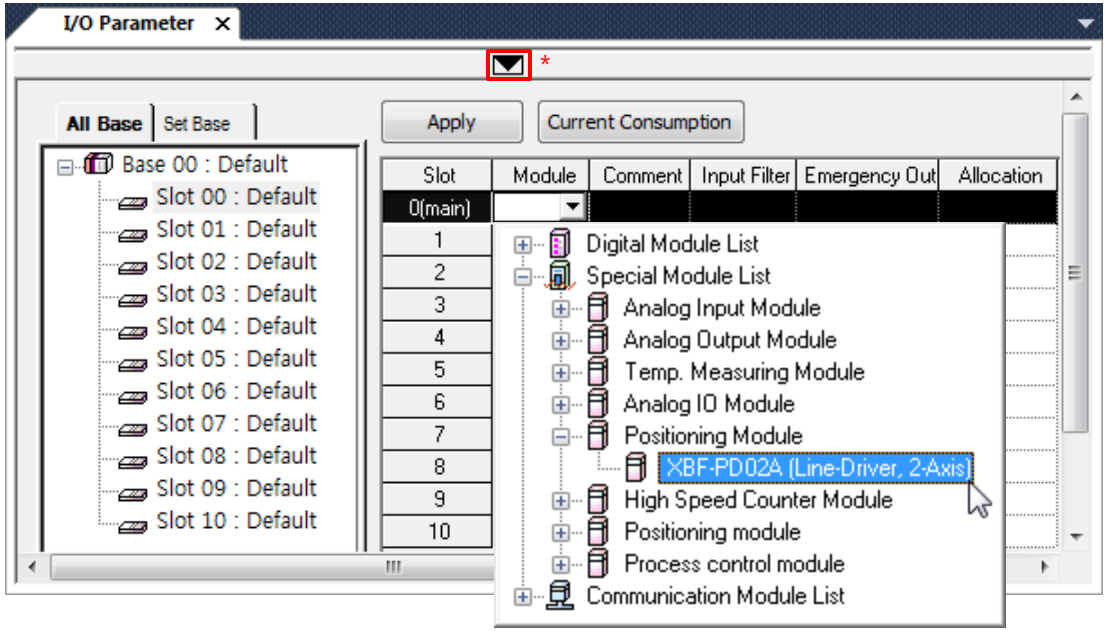
Parameters for positioning module can be set up in I/O Parameter. Prior to setting up positioning parameters, module must be registered.

3.2.1 Module Registration

1) Offline Module Registration

① Double click 'I/O Parameter and I/O Parameter window will be displayed.
In I/O Parameter, Module column of slot in which positioning module will be attached is clicked, module list will be displayed. Expand Special Module List and Positioning Module and 'XBF-PD02A can be selected.

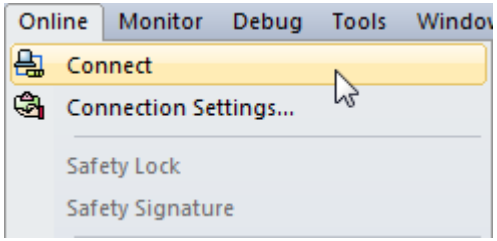




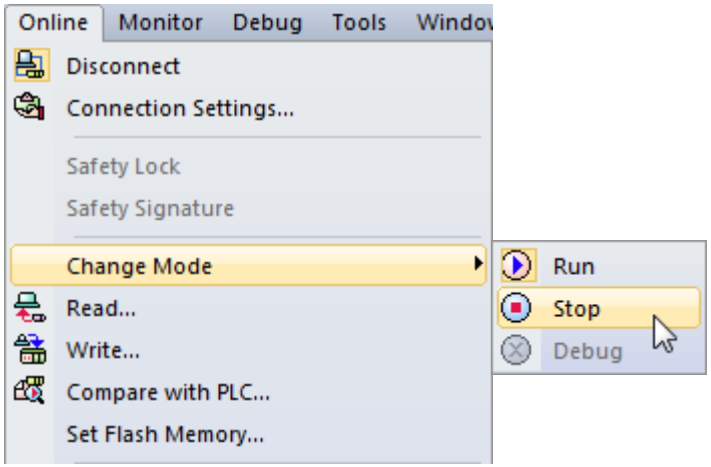
* If triangle button towards bottom direction(▼) is clicked, the PLC and modules' image will be displayed together.

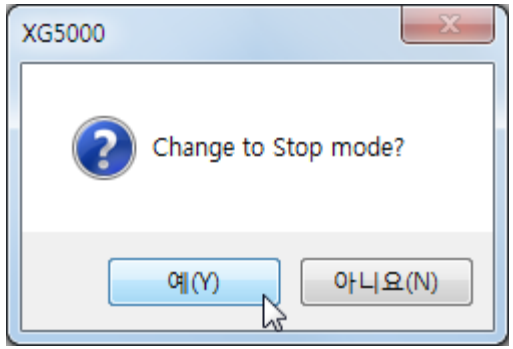
2) Online Module Registration (I/O synchronization)

① Connect XG5000 and PLC by selecting 'Connect' in 'Online' menu.



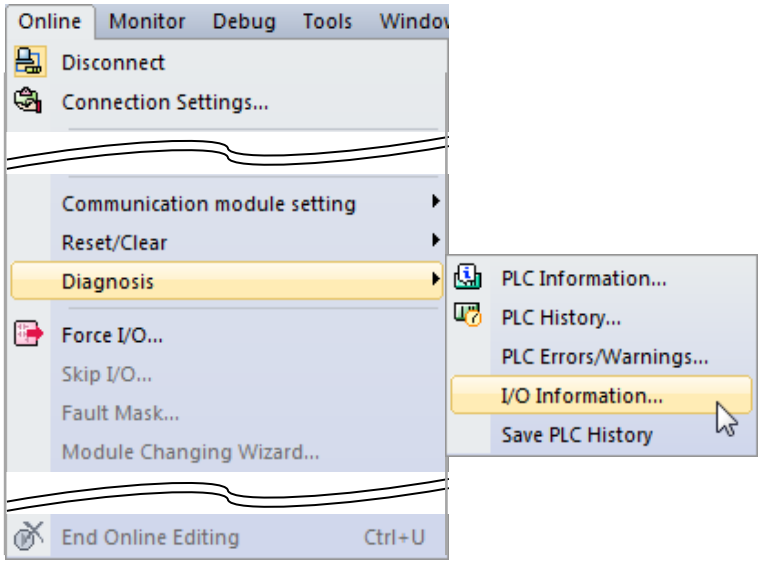
② I/O synchronization is available when PLC is STOP mode. If PLC is RUN mode, change the mode to stop by selecting 'Stop' in 'Change Mode' command in 'Online' menu.

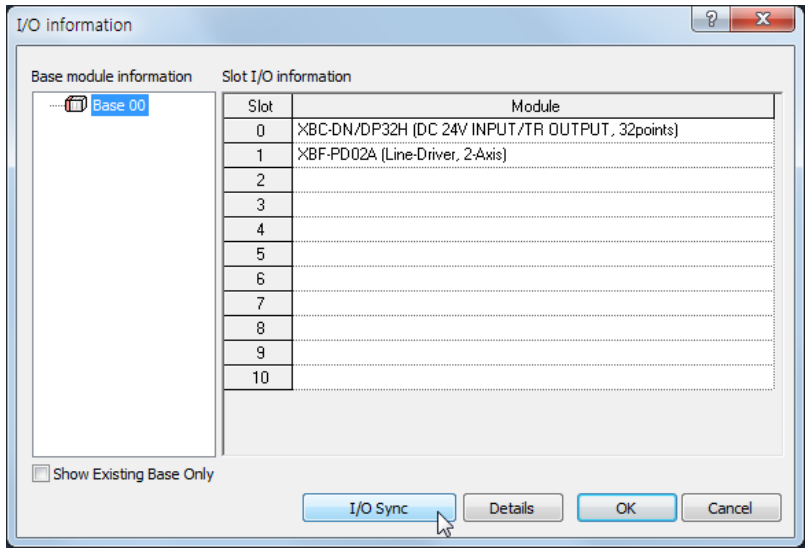




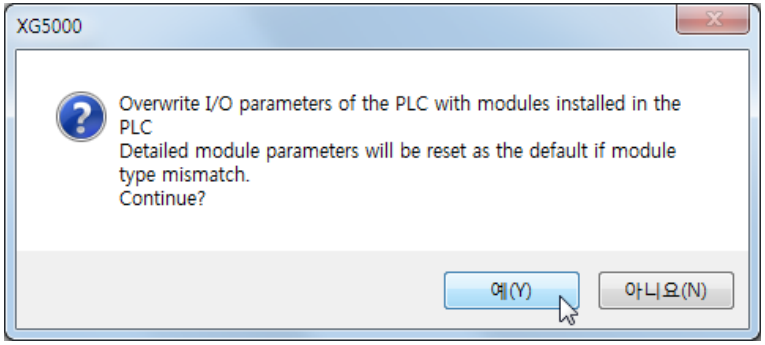
* To establish connection between XG5000 and PLC, communication settings may be required. For communication settings refer to XG5000 manual.

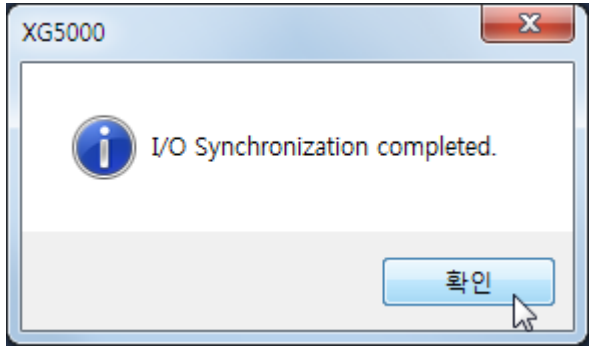
③ When Online menu, Diagnosis command, I/O Information item is selected, 'I/O Information' window will be displayed.
In 'I/O Information' window, modules attached in PLC will be listed up.
'I/O Sync' button in 'I/O Information' window is clicked, a message window below will be displayed.





④ In message window, 'Yes' button is clicked, and 'OK' button is clicked in next message window, the modules listed up in 'I/O Information' window will be registered in I/O Parameter.

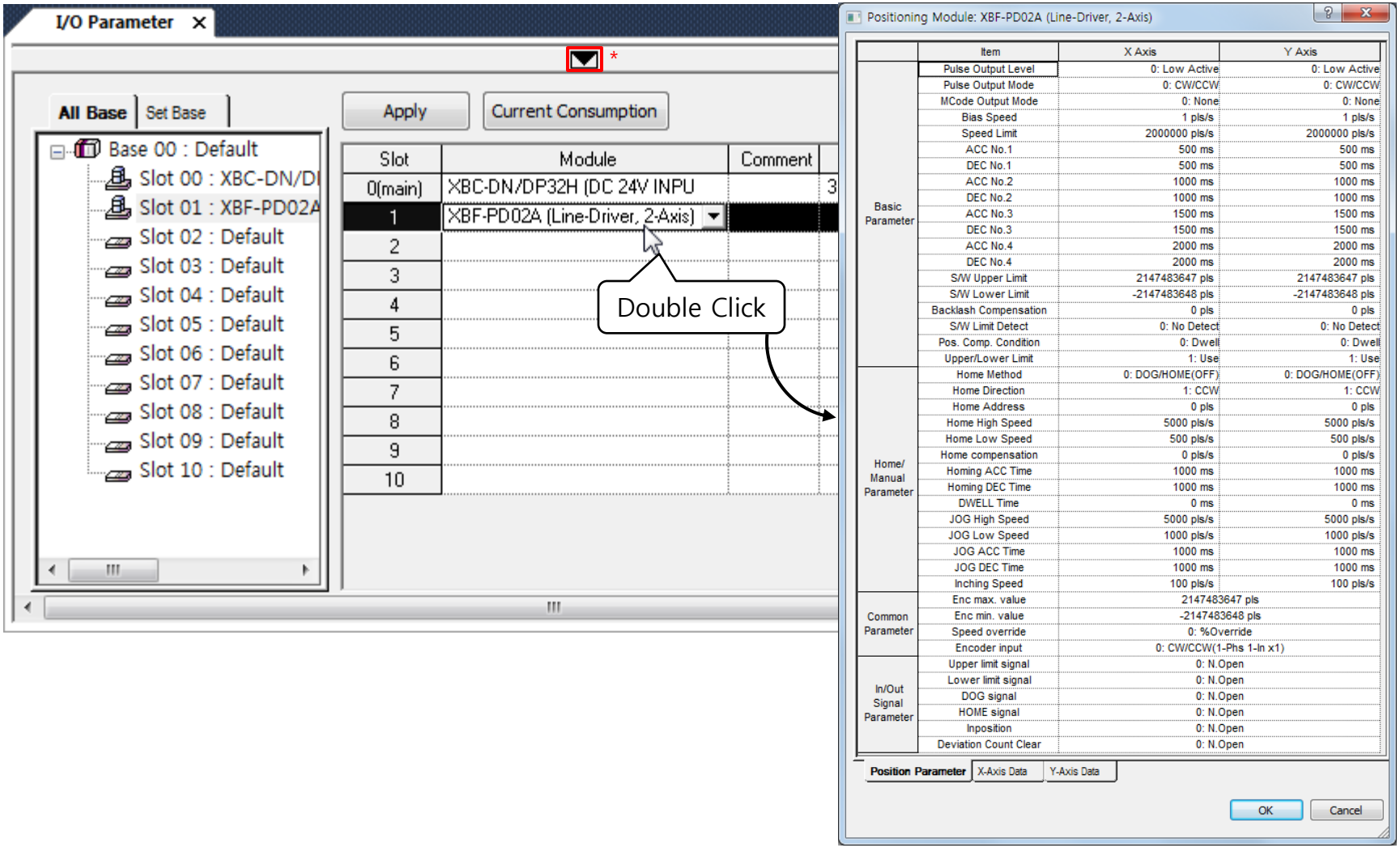




* If PLC is RUN mode, 'I/O Sync' button in 'I/O Information' window will be disabled and cannot be selectable.

3) Check I/O Parameter

When module is registered in I/O Parameter and a module is selected, parameter setting window will be displayed.



* If triangle button towards bottom direction(▼) is clicked, the PLC and modules' image will be displayed together.

3.3 Positioning Parameters

Built-in positioning parameters are divided into 2 groups named Basic Parameter and Home Parameter and positioning module parameters are divided into 4 groups named Basic, Home/Manual, Common, In/Out Signal Parameter.

3.3.1 Basic Parameter

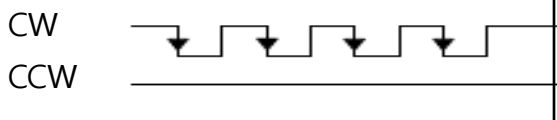
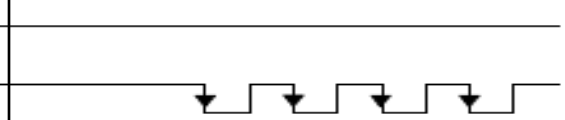
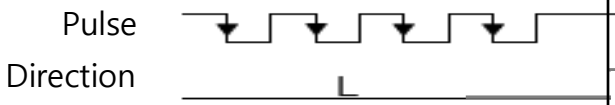
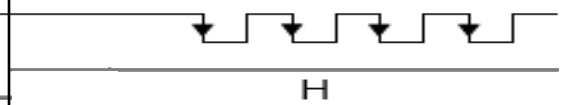
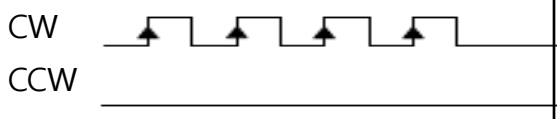
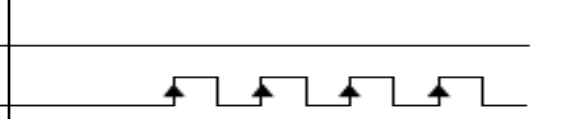
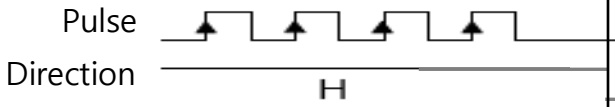
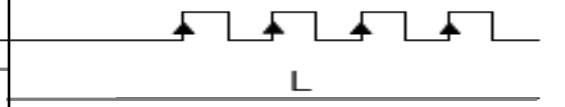
Parameters regarding pulse level and mode, acceleration and deceleration time and so on are assigned in Basic Parameter.

	Item	X Axis	Y Axis
Basic Parameter	Positioning	0: Not Use	0: Not Use
	Pulse Output Level	0: Low Active	0: Low Active
	Pulse Output Mode	0: CW/CCW	0: CW/CCW
	MCode Output Mode	0: None	0: None
	Bias Speed	1 pls/s	1 pls/s
	Speed Limit	100000 pls/s	100000 pls/s
	ACC No.1	500 ms	500 ms
	DEC No.1	500 ms	500 ms
	ACC No.2	1000 ms	1000 ms
	DEC No.2	1000 ms	1000 ms
	ACC No.3	1500 ms	1500 ms
	DEC No.3	1500 ms	1500 ms
	ACC No.4	2000 ms	2000 ms
	DEC No.4	2000 ms	2000 ms
	S/W Upper Limit	2147483647 pls	2147483647 pls
	S/W Lower Limit	-2147483648 pls	-2147483648 pls
	Backlash Compensation	0 pls	0 pls
	S/W Limit Detect	0: No Detect	0: No Detect
	Upper/Lower Limit	1: Use	1: Use

① Positioning(Built-in only): Use or not is decided. If 'Not Use' is selected, I/O points used in positioning function can be used as general I/O points.

② Pulse Output Level: One of the two choices, Low Active and High Active, can be selected.

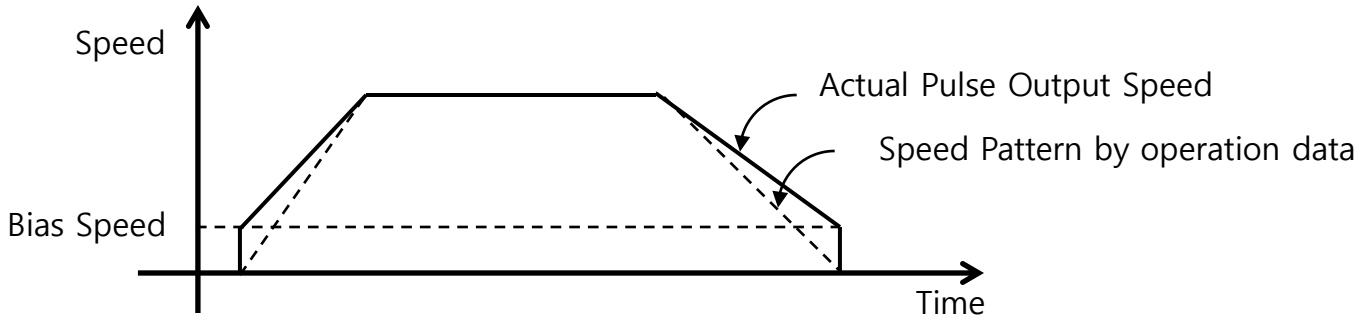
③ Pulse Output Mode: One of the two choices, CW/CCW and Pulse/Direction can be selected in XBCH type built-in positioning function and XBF-PD02A positioning module and Pulse/Direction is fixed in XBMS and XBCS type positioning function parameter. The characteristics of each mode and level is depicted below.

Level	Mode	Forward Rotation	Reverse Rotation
Low Active	CW/CCW*		
	Pulse/Direction		
High Active	CW/CCW*		
	Pulse/Direction		

* CW/CCW mode is available in XBC-H built-in positioning function and XBF-PD02A positioning module.

④ M Code Output Mode: Every movement may have one code called M code. Positioning function will output the assigned M code at start or completion of every movement.
M code will be output at the start of a movement when 'With' is assigned and M code will be output at the completion of a movement when 'After' is selected in 'M code Output Mode', respectively.
By monitoring the M Code, user can recognize which movement is executing when 'With' is selected, and which movement is completed when 'After' is selected.

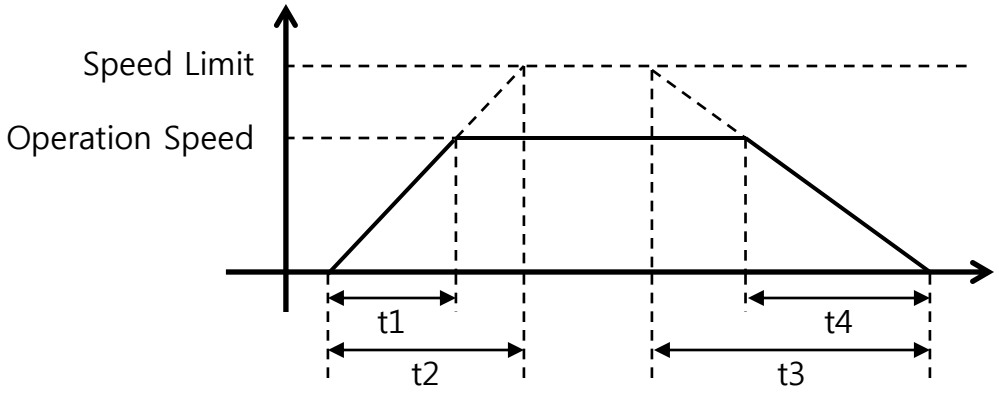
⑤ Bias Speed can be regarded as minimum pulse output speed.
Generally, bias speed is used for increasing stability at start and stop by increasing torque at low speed, but too much bias speed can be the cause of instability or impact at start and stop.



⑥ Speed Limit can be regarded as maximum pulse output speed. Available range for speed limit is 1 ~ 100,000pps for built-in positioning function and 1 ~ 2,000,000pps for XBF-PD02A. Speed limit can be restricted by mechanical and/or electrical limitations.

⑦ ACC No.1 ~ ACC No.4(Acceleration time): Acceleration time is time to increase speed from 0 speed to speed limit and the actual acceleration time for a movement is time ratio operation speed to speed limit. Available range for each acceleration time is 1 ~ 10,000ms for built-in positioning function and 1 ~ 65,535ms for XBF-PD02A. Acceleration time number for an operation is assigned in axis data or DST instruction.

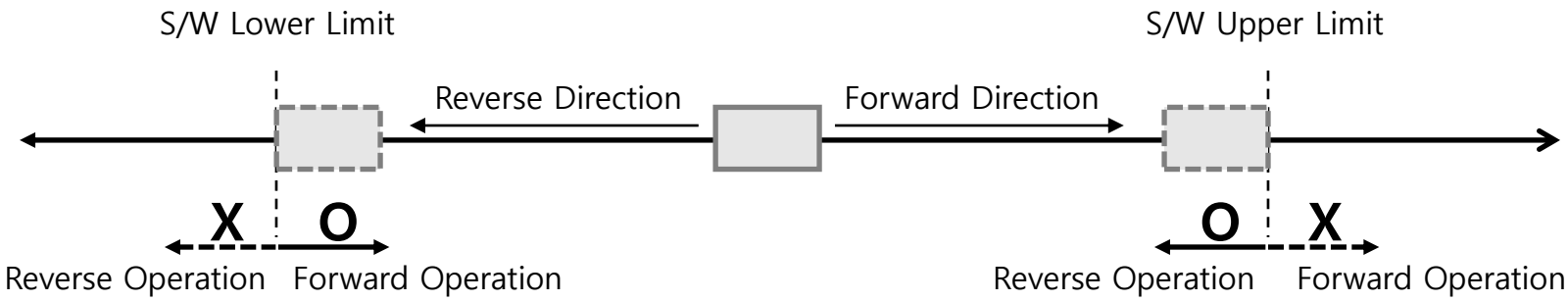
⑧ DEC No.1 ~ DEC No.4(Deceleration time): Deceleration time is time to decrease speed from speed limit to 0 speed and the actual acceleration time for a movement is time ratio operation speed to speed limit. Available range for each acceleration time is 1 ~ 10,000ms for built-in positioning function and 1 ~ 65,535ms for XBF-PD02A. Deceleration time number for an operation is assigned in axis data or DST instruction.



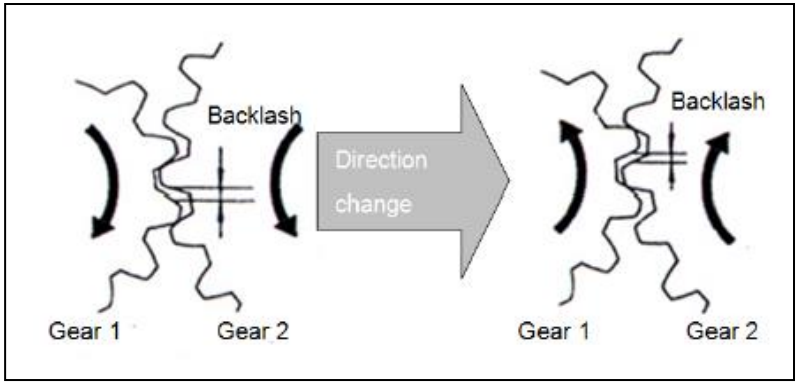
t1: Acceleration time
t2: Actual acceleration time of the operation
t3: Deceleration time
t4: Actual deceleration time of the operation

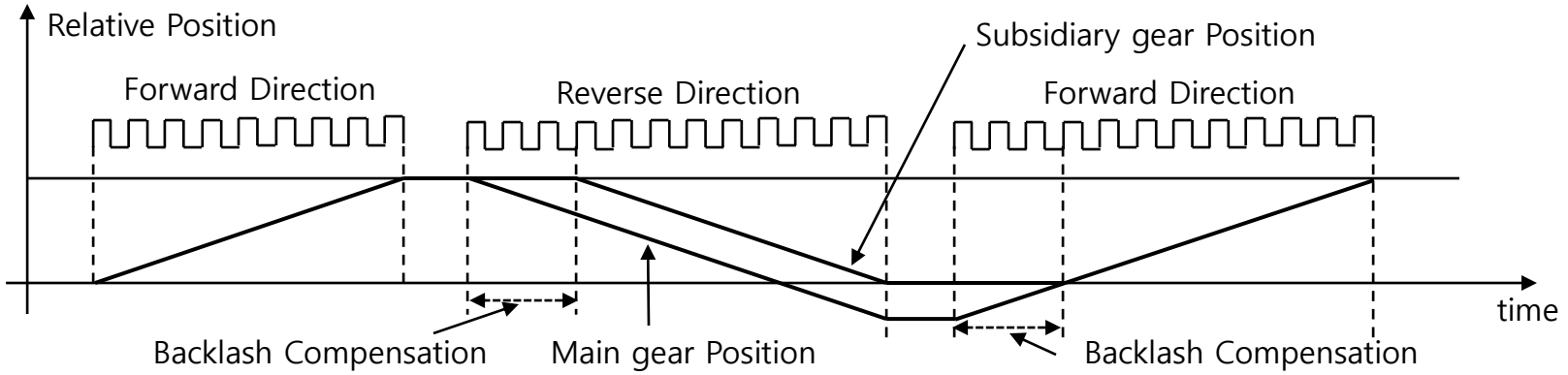
⑨ S/W(software) Upper/Lower Limit: Available range for S/W upper or lower limit is -2147483648 ~ 2147483647 and upper limit must be larger than lower limit. S/W Limit Detect is selected, software upper or lower limit error will occur and the system will be stopped when current position is out of the range assigned in S/W Lower Limit and S/W Upper Limit.

When software limit error occurs, object must be moved into position between lower and upper limit using positioning operation. If positioning operation is executed toward out of S/W upper or Lower Limit, error will occur again right after operation is executing.



⑩ Backlash Compensation*: Backlash is the tolerance that the machine does not work when the rotation direction is changed If backlash exist in machine, because subsidiary gear will not rotate when main gear rotate in backlash section, main gear must rotate more angle corresponding to backlash when rotation direction is change to recover the backlash. Available range for 'Backlash Compensation' is 0 ~ 65,535 pulse.





⑪ Upper/Lower Limit: Use or not use of upper and lower limit can be assigned. When 'Not Use' is selected, limit signal input points for built-in positioning function can be used as general digital input points.

* The amount of Backlash compensation is mechanical specification of gear box or ball screw. Refer to specification of gear box or ball screw when backlash Compensation is assigned.

⑫ Pos. Comp. Condition(Positioning Completion Condition, PD02A only): It decides the condition that positioning completion signal is turned on.

- Dwell: Positioning completion signal will be turned on when dwell time elapse after module makes all pulses appropriate to movement.
- Inposition: It is available when inposition output signal of servo drive is connected to positioning module. When 'Inposition' is assigned in this item, positioning completion signal will be turned on when 'Inposition' signal turned on after starting a movement.
- Dwell and Inposition: Positioning completion signal will be turned on when dwell and inposition conditions together are satisfied.
- Dwell or Inposition: Positioning completion signal will be turned on when one or more of the two conditions, dwell and inposition conditions, are satisfied.

3.3.2 Home/Manual Parameter

Parameters regarding Homing and manual operation such as jog and inching operation are assigned in Home/Manual Parameter.

Home/ Manual Parameter	Home Method	0: DOG/HOME(OFF)	0: DOG/HOME(OFF)
	Home Direction	1: CCW	1: CCW
	Home Address	0 pls	0 pls
	Home High Speed	5000 pls/s	5000 pls/s
	Home Low Speed	500 pls/s	500 pls/s
	Home compensation	0 pls/s	0 pls/s
	Homing ACC Time	1000 ms	1000 ms
	Homing DEC Time	1000 ms	1000 ms
	DWELL Time	0 ms	0 ms
	JOG High Speed	5000 pls/s	5000 pls/s
	JOG Low Speed	1000 pls/s	1000 pls/s
	JOG ACC Time	1000 ms	1000 ms
	JOG DEC Time	1000 ms	1000 ms
	Inching Speed	100 pls/s	100 pls/s

① Home Method: It must be assigned after considering sensors regarding homing operation.

- DOG/HOME(OFF): Home position will be decided by checking Dog and Home signal. Dog and Hone signal must be connected to use DOG/HOME(OFF) method.

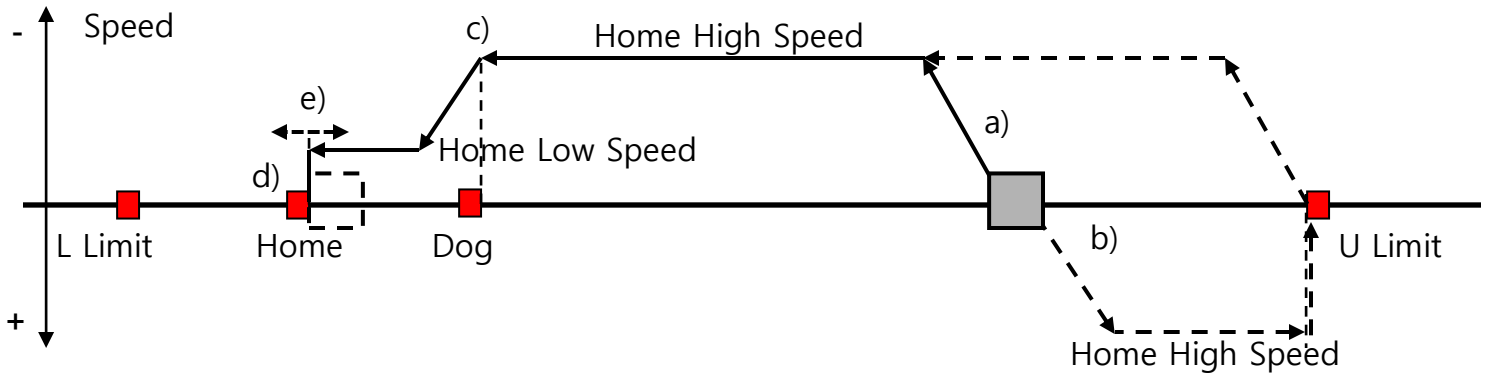
a) When Homing operation is executed, object will move to the direction assigned in Home Direction parameter with Home High Speed. Homing ACC/DEC time will be applied when acceleration or deceleration is executed.

b) If wrong Home Direction is assigned, and the object meets limit sensor prior to Dog sensor, the object will change its moving direction after sudden stop.

c) When object meets Dog sensor, speed will be decreased to Home Low Speed.

d) When Home signal is turned on while the object is moving with Home Low Speed, the object stops and the stop point will be Home position and its position will be Home Address.

e) If XBF-PD02A is used and Home Compensation is assigned, the object will stop after moving the length appropriate to Home Compensation with Home Low Speed and the position will be Home Address.

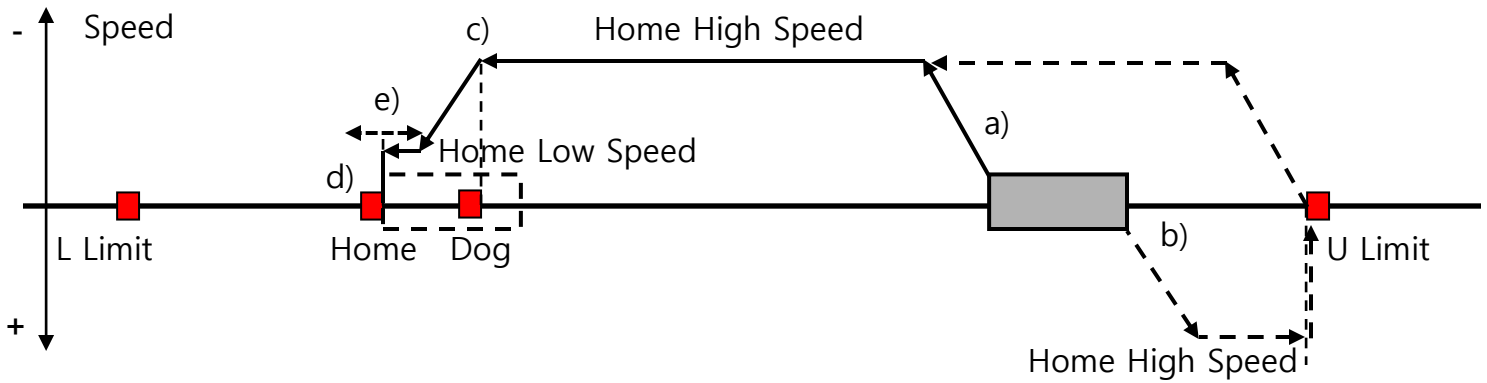


* When Z phase of encoder is used as Home signal, turning on of Home signal while the object is moving with Home High Speed or decelerating will be ignored.

* Dog signal must be turned off when Home signal is turned on. If the length between Home and Dog is too short to decrease operation speed from Home High Speed to Home Low Speed, so, Home signal is turned on while speed decreasing, or Dog signal is turned on, Home position can not be decided.

- DOG/HOME(ON): Home position will be decided by checking Dog and Home signal. Dog and Hone signal must be connected to use DOG/HOME(ON) method.

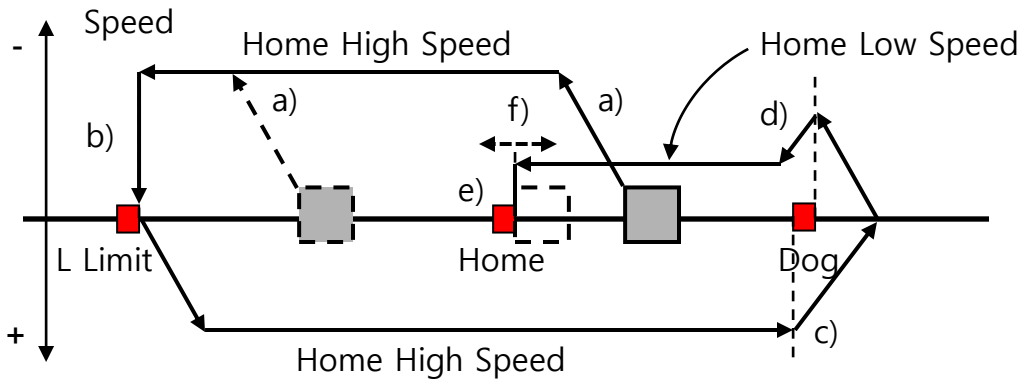
a) When Homing operation is executed, object will move to the direction assigned in Home Direction parameter with Home High Speed. Homing ACC/DEC time will be applied when acceleration or deceleration is executed.
b) If wrong Home Direction is assigned, and the object meets limit sensor prior to Dog sensor, the object will change its moving direction after sudden stop.
c) When object meets Dog sensor, speed will be decreased to Home Low Speed.
d) When Home signal is turned on While the object is moving with Home Low Speed, the object will stop and the stop point will be Home position and its position will be Home Address.
e) If XBF-PD02A is used and Home Compensation is assigned, the object will stop after moving the length appropriate to Home Compensation with Home Low Speed and the position will be Home Address.



* When Z phase of encoder is used as Home signal, turning on of Home signal while the object is moving with Home High Speed or decelerating will be ignored.
* Dog signal must be turned on when Home signal is turned on. If the length between Home and Dog is so long that Dog signal is turned off when Home signal is turned on, Home position can not be decided.

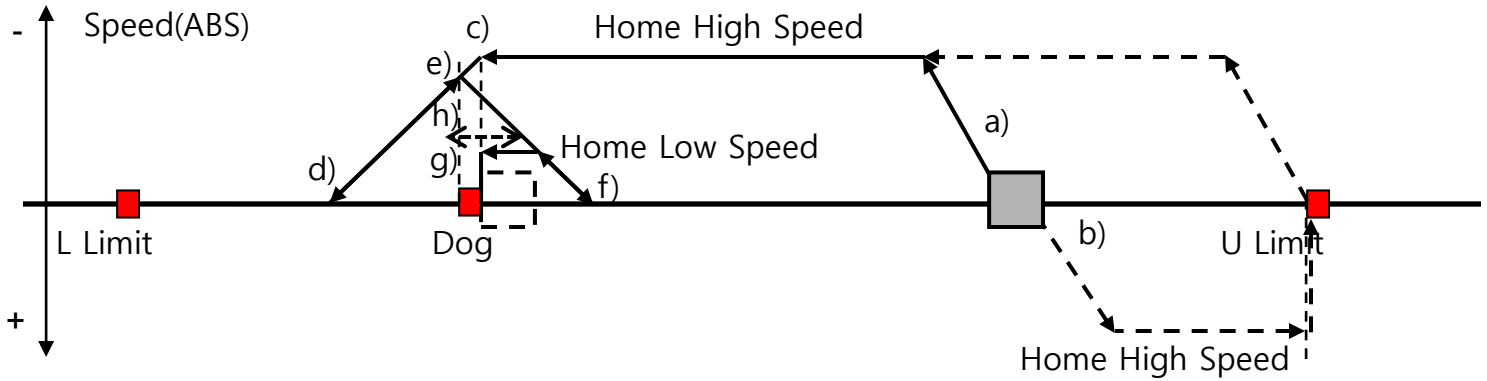
* Remarks: If Homing operation is executed when homing method using Home and Dog sensors is used and object is between L Limit and Home or Dog sensor.

a) When Homing operation is executed, object will move to the direction assigned in Home Direction parameter with Home High Speed. Homing ACC/DEC time will be applied when acceleration or deceleration is executed.
b) If the object meets limit sensor prior to Dog sensor, the object will change its moving direction after sudden stop.
c) When the object meets Dog sensor, the object will change moving direction after deceleration and stop.
d) The object meets Dog sensor again, the speed will be decreased to Home Low Speed.
e) When Home signal is turned on while the object is moving with Home Low Speed, the object will stop and the stop point will be Home position and its position will be Home Address.
f) If XBF-PD02A is used and Home Compensation is assigned, the object will stop after moving the length appropriate to Home Compensation with Home Low Speed and the position will be Home Address.



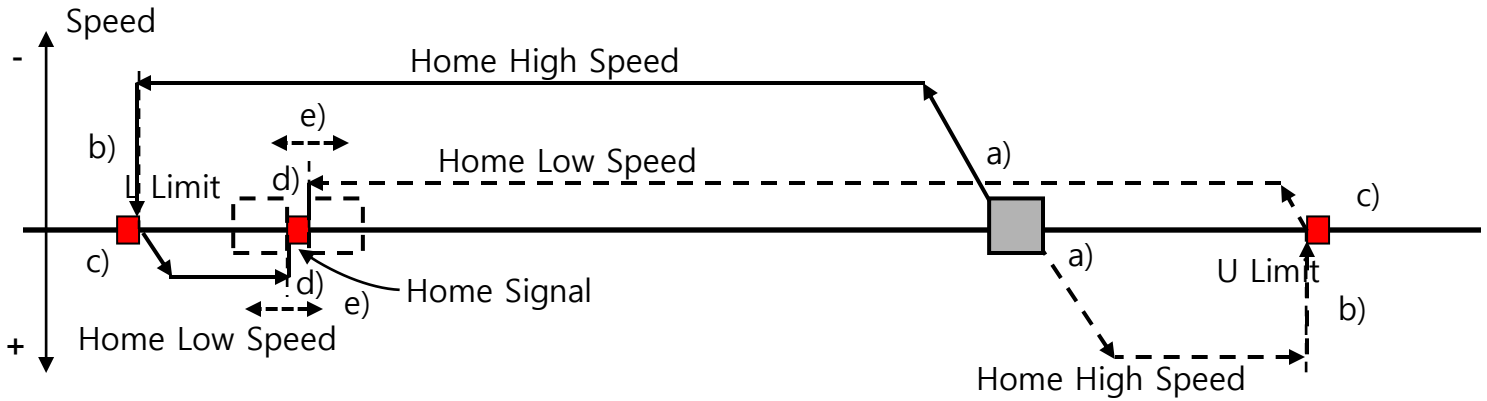
- DOG: Home position will be decided by checking Dog signal. Dog signal position will be Home position.

a) When Homing operation is executed, object will move to the direction assigned in Home Direction parameter with Home High Speed. Homing ACC/DEC time will be applied when acceleration or deceleration is executed.
b) If wrong Home Direction is assigned, and the object meets limit sensor prior to Dog sensor, the object will change its moving direction after sudden stop.
c) When object meets Dog sensor, the object will decelerate and stop.
d) The object will move to opposite direction.
e) Again Dog signal is turned on, the object will decelerate and stop again.
f) Again, the object will change its moving direction. At this moment, moving speed will be Home Low Speed.
g) When Dog signal is turned on again, the object will stop and the stop point will be Home position and its position will be Home Address.
h) If XBF-PD02A is used and Home Compensation is assigned, the object will stop after moving the length appropriate to Home Compensation with Home Low Speed and the position will be Home Address.



- U.L. Limit/Home(XBF-PD02A only): Home position will be decided by checking Upper/Lower Limit and Home signals. Upper/Lower Limit and Home signals must be connected to positioning module to use U.L. Limit/Home method.

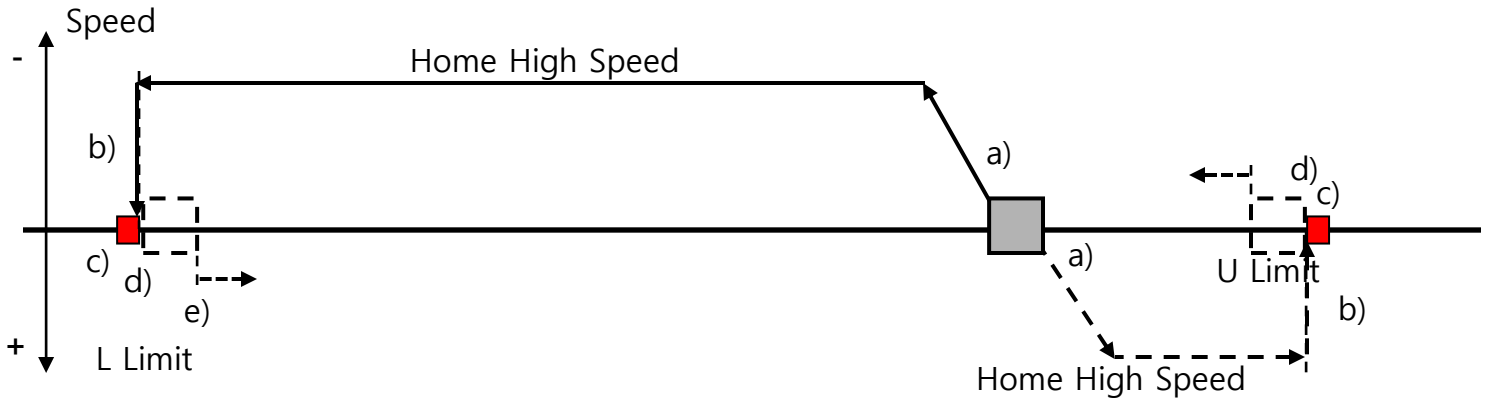
a) When Homing operation is executed, object will move to the direction assigned in Home Direction parameter with Home High Speed. Homing ACC/DEC time will be applied when acceleration or deceleration is executed.
b) When the object meets limit sensor, the object will change its moving direction after sudden stop.
c) The object will move to opposite direction. At this time, moving speed will be Home Low Speed.
d) When Home signal is turned on while the object is moving with Home Low Speed, the object will stop and the stop point will be Home position and its position will be Home Address.
e) If Home Compensation is assigned, the object will stop after moving the length appropriate to Home Compensation with Home Low Speed and the position will be Home Address.



* Depending on Home direction, home position is different.

- U.L. Limit(XBF-PD02A only): Home position will be decided by checking Upper/Lower Limit signal.
  Upper/Lower Limit signal must be connected to positioning module to use U.L. Limit/Home method.

  a) When Homing operation is executed, object will move to the direction assigned in Home Direction parameter with Home High Speed. Homing ACC/DEC time will be applied when acceleration or deceleration is executed.
  b) When the object meets limit sensor, the object will change its moving direction after sudden stop.
  c) The object will move to opposite direction until limit signal is turned off. At this time, maximum moving speed will be Home Low Speed.
  d) When Limit signal is turned off, the object will stop and the stop point will be Home position and its position will be Home Address.
  e) If Home Compensation is assigned, the object will stop after moving the length appropriate to Home Compensation with Home Low Speed and the position will be Home Address.



* Depending on Home direction, home position is different.
* When U.L Limit homing method is used, widening the spaces between Limit sensor and object using Home Compensation function is strongly recommended to evade Lower or Upper Limit error when object is home position.

② Home Direction: It assigns the moving direction when homing operation is executed. If wrong direction is assigned and the object meets limit sensor prior to expected sensor such as Dog signal, the object will change its moving direction after sudden stop.

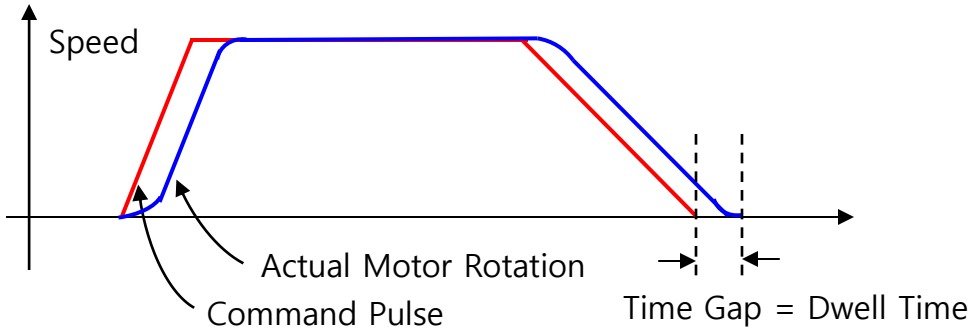
③ Home Address: When homing operation is completed, the position is the number assigned in Home Address.

④ Home High/Low Speed: When homing operation is executed, object will move to Home direction with Home High Speed and decrease the speed to Home Low Speed when 1st homing supplementary sensor or signal. 2nd condition is satisfied while the object is moving with Home Low Speed, the object will stop and the stop position will be home position.
If the object meets Upper or Lower Limit sensor prior to expected 1st sensor due to assigning wrong Home Direction, the object will change the direction only, not the speed.

⑤ Home Compensation(XBF-PD02A only): After deciding home position by sensor or signal, the object will move the length appropriate to Home Compensation when Home Compensation is assigned. For example, when sensor is used for homing function, home position is assigned by sensor, the home position is always at the side point of sensor. If center of sensor is expected for home position, Home Compensation can be used.
Especially, Lower/Upper Limit is assigned in Home Method, widening the spaces between Limit sensor and object using Home Compensation function is strongly recommended to evade Lower or Upper Limit error when object is home position.

⑥ Homing ACC/DEC Time: It assigns acceleration and deceleration time applied while homing operation is executed. But Homing DEC time will not be applied when the object meets limit sensor while homing operation is executing because the object will stop as fast as possible.(sudden stop)

⑦ DWELL Time: Because servo motor will rotate delayed by some time compared to command pulse, although positioning completes making all pulses appropriate the total movement, motor will still rotate. When DWELL time is assigned, Positioning Completion signal will be turn on after completion of making all pulses and lapse of DWELL time.



⑧ JOG High/Low Speed: The speed used when jog operation is executed. Jog High and Low speed can be selected by setting or resetting a bit for each axis when jog operation starts. Jog operation can be executed prior to deciding home position, but in this case position will not be refreshed although the object moves. But, the position will be refreshed when jog operation is executed after home position is decided.

⑨ JOG ACC/DEC Time: Acceleration and deceleration time applied when accelerate or decelerate when jog operation is executed.

⑩ Inching Speed: Inching operation is to move user assigned length prior to deciding Home position. When inching operation is executed before home position is decided, position will not be refreshed although the object moves like jog operation.

3.3.3 Common Parameter(XBF-PD02A only)

1 channel of 200 kpps high speed counter is embodied. Basically, ±5V line drive type encoder and 5V open collector type encoder can be connected. Parameters regarding high speed counter and speed override function can be assigned in Common parameter of XBF- PD02A positioning module.

Common Parameter	Enc max. value	2147483647 pls
	Enc min. value	-2147483648 pls
	Speed override	0: %Override
	Encoder input	0: CW/CCW(1-Phs 1-In x1)

① Enc max./min. value: Basically, the high speed counter embodied in XBF-PD02A is ring counter of which counter value range is Enc min. value ~ Enc max. value. At initial, the counter value will be Enc min. value and the value will be increased or decreased when encoder connected to embodied in high speed counter rotate and generates pulses, depending on the rotation direction.

② Speed override: The function that changing operation speed while an operation is executing is speed override. When speed override is executed, changing rate(%) compared to current operation speed or speed to operate(Spd. Override) can be given. Speed override function can be executed while constant speed movement is executed. In other words, speed override function cannot be executed while acceleration or deceleration is executing.

③ Encoder input: Input signal for embodied high speed counter is assigned in Encoder input parameter. CW/CCW, Pulse & Direction, Phase type pulse can be connected and counted. When CW/CCW or Pulse & Direction type pulse is connected, counting will be executed at rising edge of pulse(meaning x1 at the end of choice), and Phase type pulse is connected, counting will be executed at every edge, rising and falling edge of A, B phase.(meaning x4 at the end of choice)

3.3.4 In/Out Signal Parameter(XBF-PD02A only)

Supplementary input and output digital signals' operation sequence, normal open or close, can be assigned in In/Out Signal Parameter. By setting In/Out Signal Parameter, wiring can be reduced. For example, Generally, Upper and Lower limit signals use normal close sequence because these signals are concerned with safety function. But in a rotating mechanical structure like a washing drum, Upper and Lower limit signal will be leaved out. If normal close sequence is fixed, wire must be connected so that the current flow. In this case by setting normal open in Upper and Lower limit signal, wiring can be leaved out.

In/Out Signal Parameter	Upper limit signal	1: N.Close
	Lower limit signal	1: N.Close
	DOG signal	0: N.Open
	HOME signal	0: N.Open
	Inposition	0: N.Open
	Deviation Count Clear	0: N.Open

3.4 Storage and Modification of Positioning Parameters

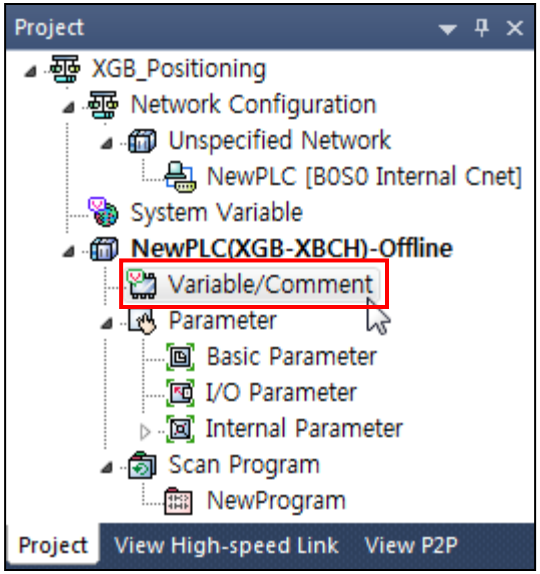
Parameters for built-in positioning will be stored in flash memory and copied to some K device in CPU data memory named positioning flags and parameters for positioning module will be stored in flash memory in positioning module and copied execution RAM memory of positioning module.

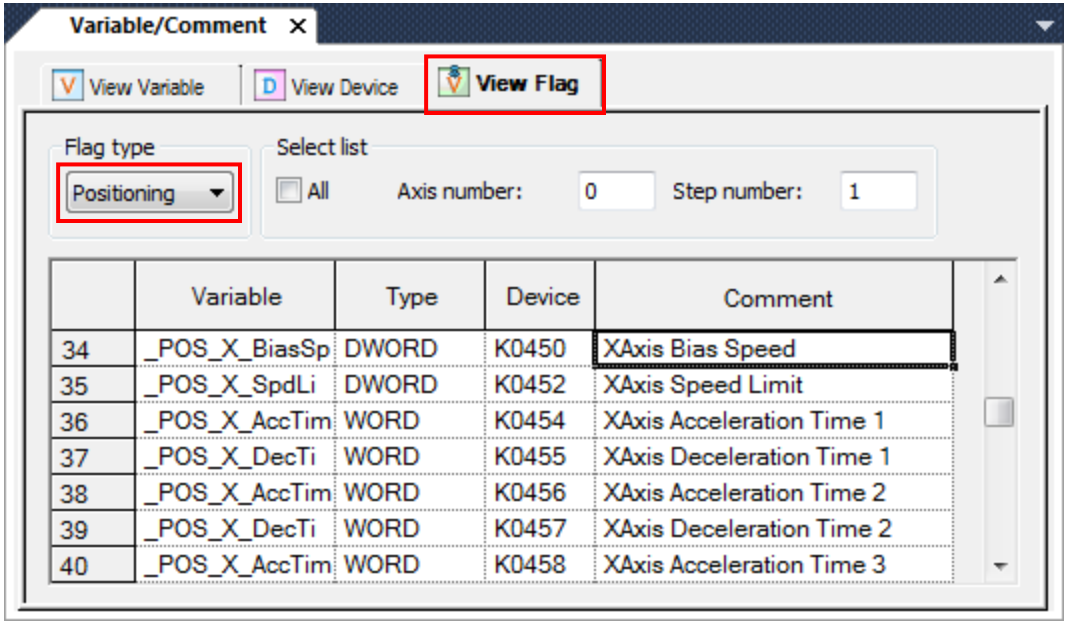
Parameters can be modified by program. When parameters are modified in program, the modified parameters must be stored in flash memory with WRT instruction not to be cleared when PLC is reset.

3.4.1 Storage of Built-in Positioning Parameter

Parameters for built-in positioning will be stored in flash memory and copied to positioning flags configured in K device. In program, parameter data can be accessed easily with predefined variable named positioning flag in XG5000.

When 'Variable/Comment' is double clicked in Project window, 'Variable/Comment' window will be displayed. In the 'Variable/Comment' window, 'View Flag' tab is selected and 'Positioning' is selected in Flag type, built-in positioning parameters will be listed up.



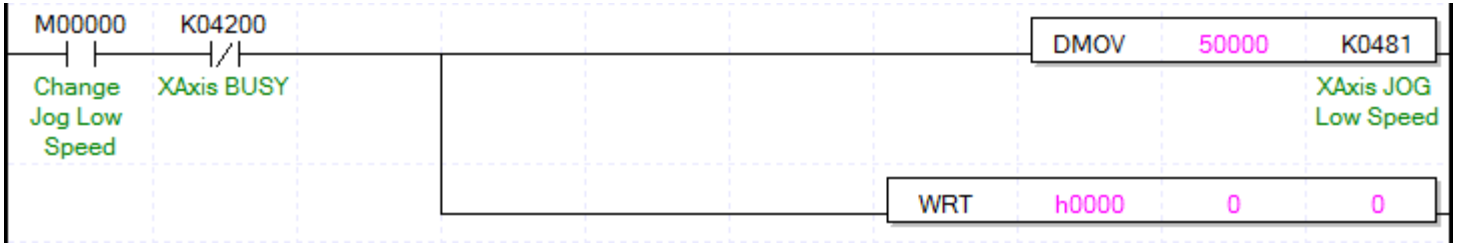


3.4.2 Modification of Built-in Positioning Parameter

Because built-in positioning parameters are stored in CPU data memory area, parameter data can be changed with MOV or DMOV instruction depending on the size of parameter data. Because parameter stored in flash memory will be copied again when PLC is reset and although, K device is latch area, the data in K device can be cleared when the back up power (super capacitor) is exhausted, it is safe to store the modified data into flash memory. WRT* instruction is used to store the modified parameter into flash memory.

If parameter data is changed while operation is executing, an error will occur. Not to make error, busy signal must be referred to when parameter is changed.

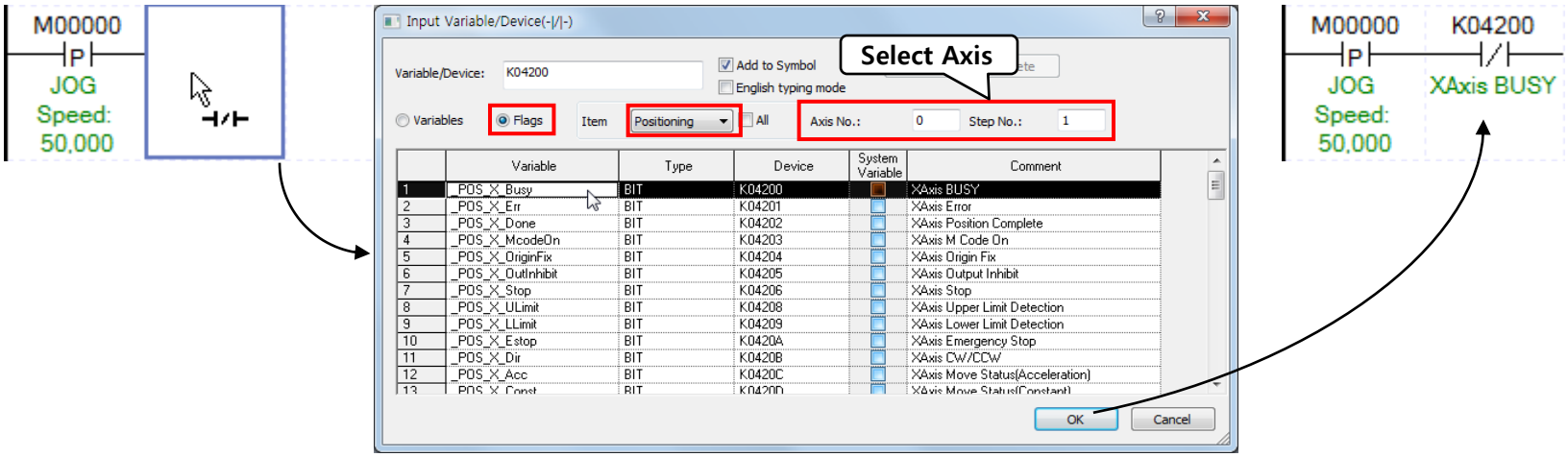
The program below changes X axis Jog Low Speed when M00000 bit is turned on.



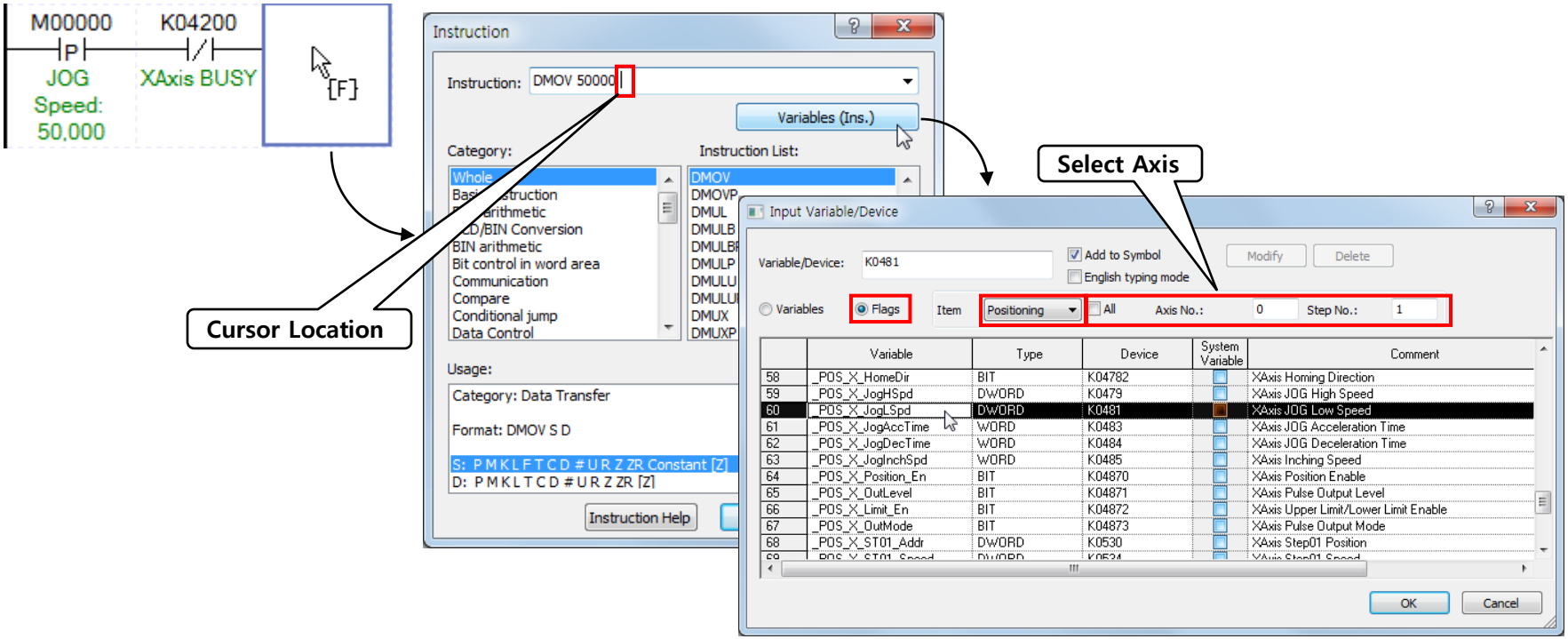
* Because frequently writing to flash memory can cause reduction of flash memory life time, it is recommended to execute WRT instruction one time after setting all data to be modified when more than one data is to be modified.

1) Finding Built-in Positioning Flag and Parameter on program editing.

① Bit Flag: Register ladder symbol in program and 'Input Variable/Device' window will be displayed. In 'Input Variable/Device' window, select 'Flags' and 'Positioning' and parameters and data for built-in positioning will be listed up. In the list, parameter or data to be used is selectable. Selected parameter or data will be used variable for the ladder symbol.



② Built-in positioning data or parameter is used with instruction, call a instruction by registering a function({F}), type an instruction, click 'Variable(Ins)' button when cursor is located at the position where positioning parameter or data is expected and 'Input Variable/Device' window will be displayed. In 'Input Variable/Device' window, select 'Flags' and 'Positioning', then data or parameter will be listed up. In the list, data or parameter used with instruction can be selected. Selected positioning data or parameter will be registered with instruction.



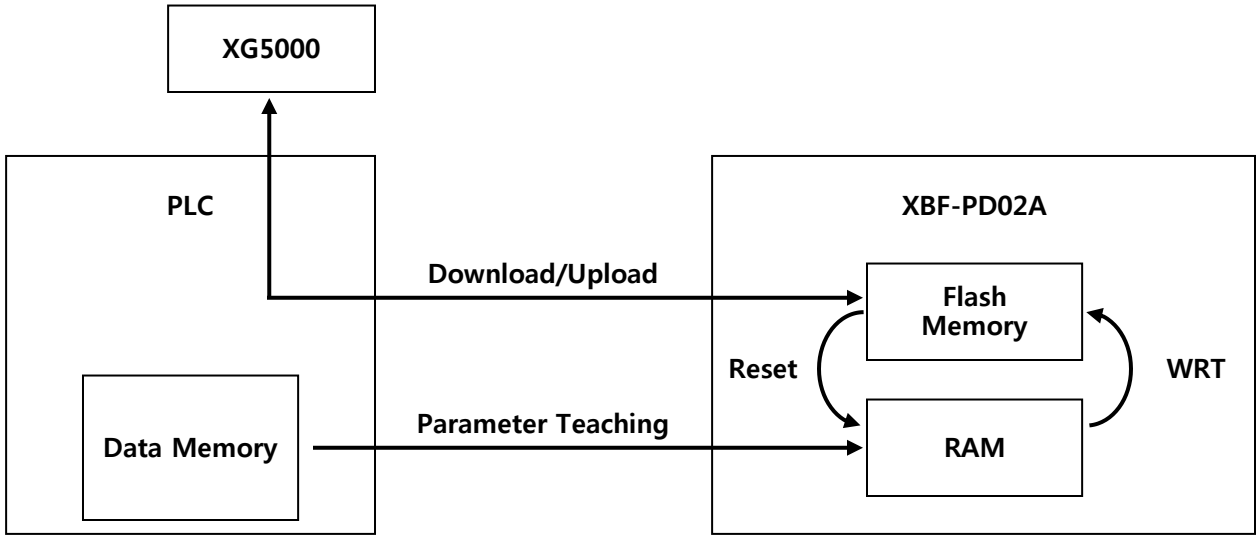
3.4.3 Storage and modification of XBF-PD02A Positioning Parameter

Different from built-in positioning function, parameters for positioning module will be stored in flash memory in positioning module. Because the parameter is stored in flash memory, the data will be reserved when PLC power is turned off.

When parameter is to be modified by program, parameter teaching instructions(TBP: Teaching Basic Parameter, THP: Teaching Home/Manual Parameter, TCP: Teaching Parameter, TSP: Teaching Signal Parameter) must be used.

If more than one parameters are to be modified, one instruction modifying parameter must be executed at a PLC scan.

When parameter teaching instructions are used, the transferred data will be stored in RAM area of positioning module, the data will be cleared when PLC is reset. Not to clear the written data when PLC is reset, the data must be written to flash memory with WRT instruction. Because the writing time of flash memory used in the module is limited to 100,000 times, too often execution of WRT instruction can cause breakdown of flash memory.

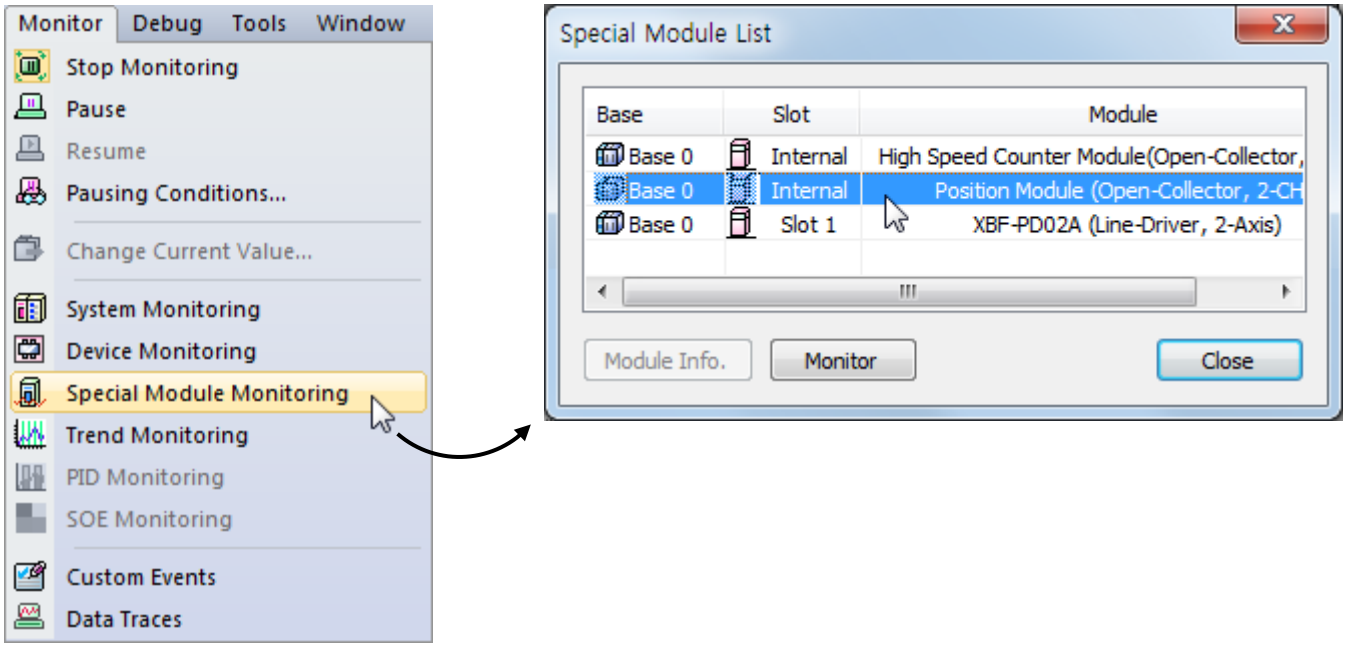


3.5 Trial Run

When setting and downloading parameter is completed, positioning function can be tried with 'Special Module Monitoring' command in 'Monitor' menu of XG5000.

3.5.1 Special Module Monitoring

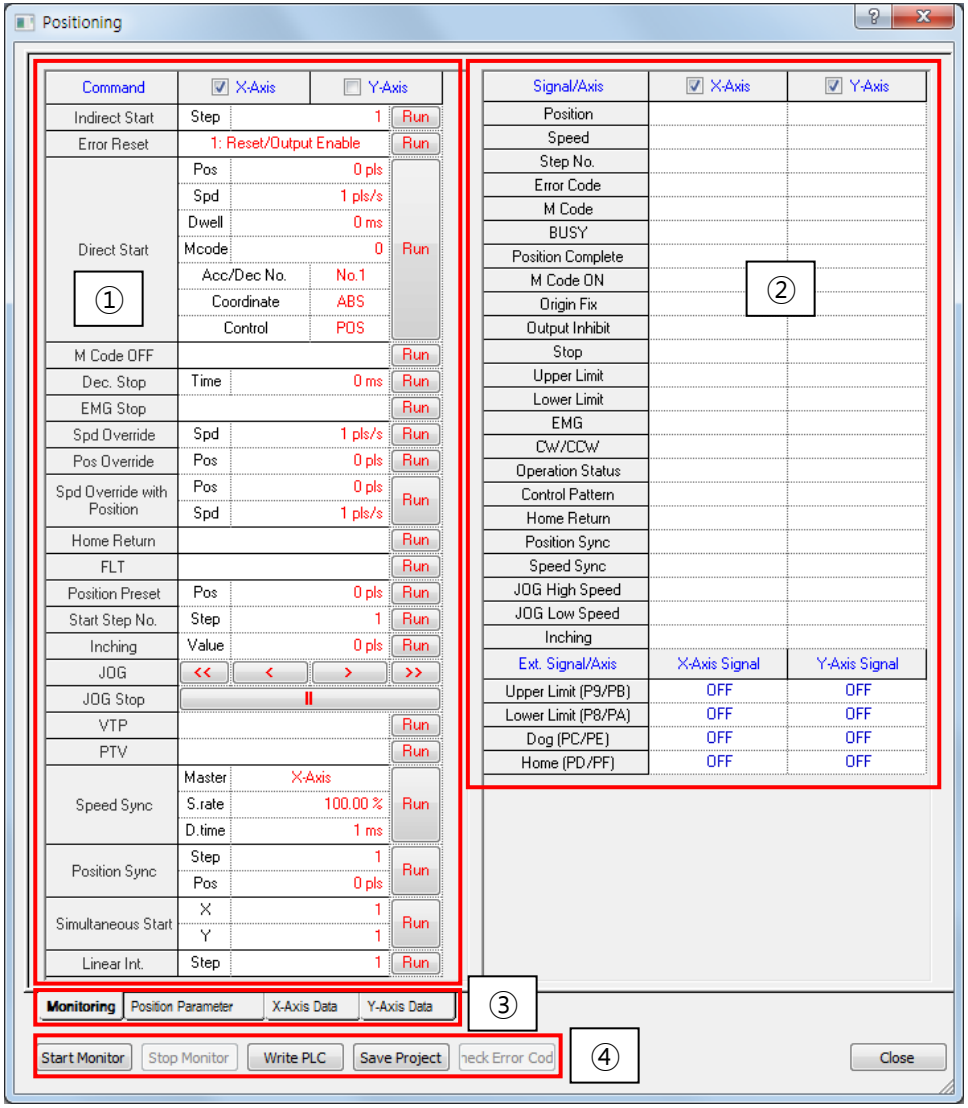
'Special Module Monitoring' command is selected in 'Monitor' menu, 'Special Module List' window will be displayed and all built-in special function and special module will be listed up in the 'Special Module List' window. A function or module is selected(double click), the monitoring/operating window appropriate to selected module will be displayed.



* Special module monitoring is available when XG5000 and PLC are connected.

3.5.2 Special Module Monitoring window for Positioning

Special module monitoring window for positioning is composed of 4 parts.



① Command window: Positioning operations can be given in command window. Because 1 axis can be operated in this window, axis to be operated(X-axis or Y-axis) must be selected prior to operation.

② Status and I/O signal monitoring window: The status of each axis and I/O signal will be displayed.

③ Tabs: Monitoring and trial run can be executed in Monitoring tab. Parameters and data can be modified when each tab is selected. When parameter or data is modified in special module monitoring window, 'Write PLC' or 'Save Project' button must be selected to download or save modified parameter or data.

④ Operating buttons: 'Start' button must be clicked to start monitoring or trial operation.

4. Program 1

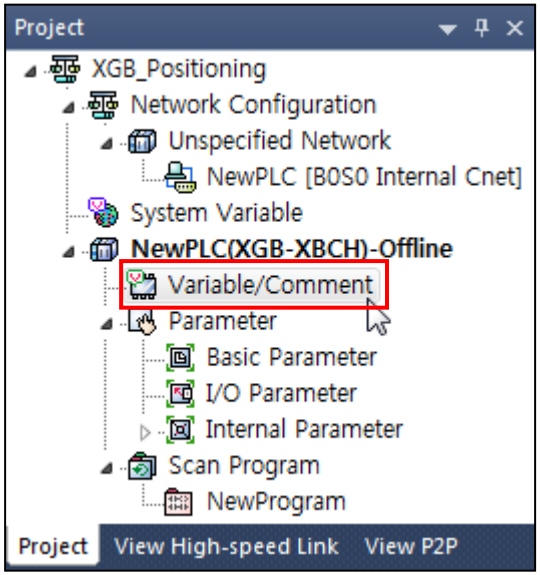
In this chapter, positioning programs which do not use predefined data in data list will be introduced. Positioning operations can be executed without assigned data are jog, inching, homing and direct start.

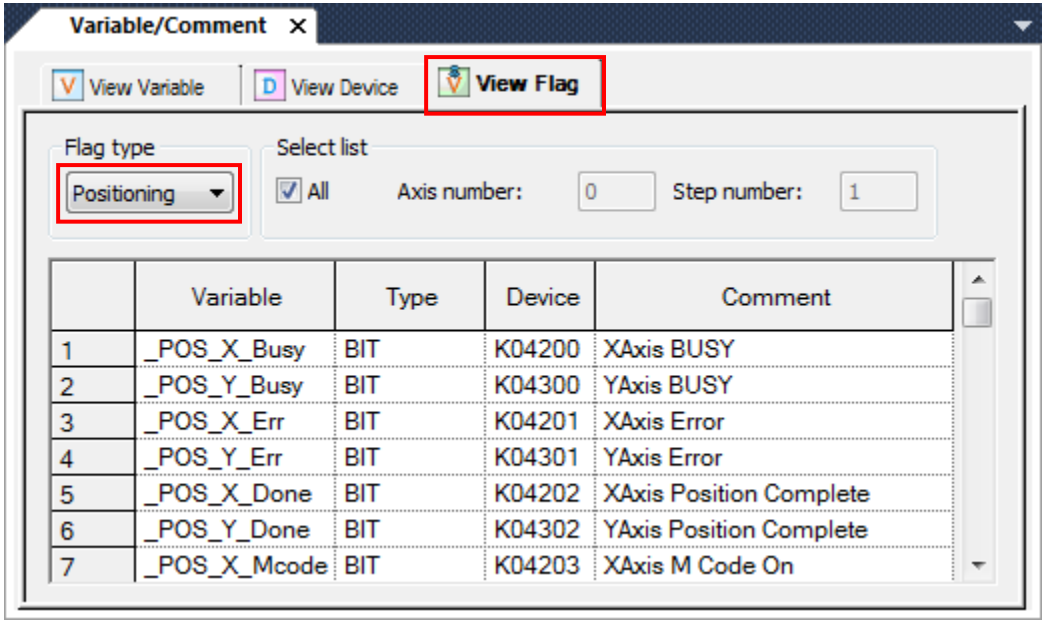
4.1 Positioning Data Monitoring

Prior to execution of positioning operations, CPU must know the status of positioning by monitoring positioning status data. When built-in positioning is used, positioning parameters and status data is stored in K area of CPU data memory and can be accessed with predefined variable named 'Positioning Flag'. And XBF-PD02A is used, basically, all data is stored in positioning module and the data must be stored in CPU data memory so that CPU can use. SRD instruction must be used to read the positioning status data.

4.1.1 Built-in Positioning Data Monitoring

Built-in positioning flag can be seen in Variable/Comment window.





	Variable	Type	Device	Comment
1	_POS_X_Busy	BIT	K04200	XAxis BUSY
2	_POS_Y_Busy	BIT	K04300	YAxis BUSY
3	_POS_X_Err	BIT	K04201	XAxis Error
4	_POS_Y_Err	BIT	K04301	YAxis Error
5	_POS_X_Done	BIT	K04202	XAxis Position Complete
6	_POS_Y_Done	BIT	K04302	YAxis Position Complete
7	_POS_X_Mcode	BIT	K04203	XAxis M Code On

4.1.2 XBF-PD02A Positioning module Data Monitoring

SRD instruction must be used to read XBF-PD02A positioning module. Because SRD instruction is executed, the status and data of 1 axis is read, if 2 axis are used, SRD instruction must be edited 2 times and each SRD instruction uses continuous 13 words data memory to store the read data. The contents read by SRD instruction is listed up below.

No.	Address*1)		Contents
	X	Y	
0	140	180	Module Status 1
1	141	181	Module Status 2
2	142	182	Axis Information
3	143	183	I/O Signal Status
4	144	184	Current Position
5	145	185	
6	146	186	Current Speed
7	147	187	
8	148	188	Step Number
9	149	189	M Code
10	14A	18A	Error Code
11	14B	18B	High Speed Counter Value*2)
12	14C	18C	

*1) The address is module memory address and can be used in GET or GETP instruction to read each data.
*2) Because only 1 high speed counter channel is embodied, the same data is read regardless of axis.

① Module Status 1(Module Status Information)

Bit	Information	Bit	Information	Bit	Information	Bit	Information
0	Busy	4	Home Position Decision	8	Upper Limit Detection	C	Accelerating
1	Error	5	-	9	Lower Limit Detection	D	Constant Speed
2	Positioning Completion	6	Stop State	A	Emergency Stop State	E	Decelerating
3	M Code	7	-	B	Direction 0: Forward, 1: Reverse)	F	Dwell State

② Module Status 2(Executing Operation Information)

Bit	Information	Bit	Information	Bit	Information	Bit	Information
0	Position Control	4	Circular Interpolation	8	Low Speed Jog	C	-
1	Speed Control	5	Homing	9	High Speed Jog	D	-
2	Linear Interpolation	6	Position Sync.	A	Inching	E	-
3	-	7	Speed Sync.	B	-	F	-

③ Axis Information

Bit	Information	Bit	Information	Bit	Information	Bit	Information
0	Main Axis: X	4	-	8	-	C	-
1	Main Axis: Y	5	-	9	-	D	-
2	Main Axis: HSC	6	-	A	-	E	-
3	Axis State(0: Sub, 1: Main)	7	-	B	-	F	-

④ I/O Signal Status

Bit	Information	Bit	Information	Bit	Information	Bit	Information
0	-	4	Upper Limit	8	-	C	Inposition
1	-	5	Lower Limit	9	-	D	Deviation Counter Clear
2	-	6	Origin	A	-	E	-
3	-	7	Dog	B	-	F	-

4.2 Positioning Instructions

4.2.1 Positioning Instruction List

The instruction list below is used for positioning.

Instruction	Operation	Operands
ORG	Home Position Setting	Slot, Axis
FLT	Floating Home Position Setting	Slot, Axis
DST	Direct Start	Slot, Axis, Position, Speed, Dwell Time, M Code, Control Word
IST	Indirect Start	Slot, Axis, Step
LIN	Linear Interpolation	Slot, Axis, Step, Axes
CIN*	Circular Interpolation	Slot, Axis, Step, Axes
SST	Simultaneous Start	Slot, Axis, X Step, Y Step, Z Step, Axes
VTP	Velocity to Position Control Switching	Slot, Axis
PTV	Position to Velocity Control Switching	Slot, Axis
STP	Stop	Slot, Axis, Deceleration Time
SSP	Position Synchronization	Slot, Axis, Main Axis Position, Step, Main Axis
SSS	Speed Synchronization	Slot, Axis, Main Axis Rate, Sub Axis Rate, Main Axis
SOR	Speed Override	Slot, Axis, Speed
POR	Position Override	Slot, Axis, Position
PSO	Position assigned Speed Override	Slot, Axis, Position, Speed
INCH	Inching Operation	Slot, Axis, Amount to Move
SNS	Changing Step Number	Slot, Axis, Step
SRS*	Changing Repeat Step Number	Slot, Axis, Step

* XBF-PD02A Only

4. Program 1

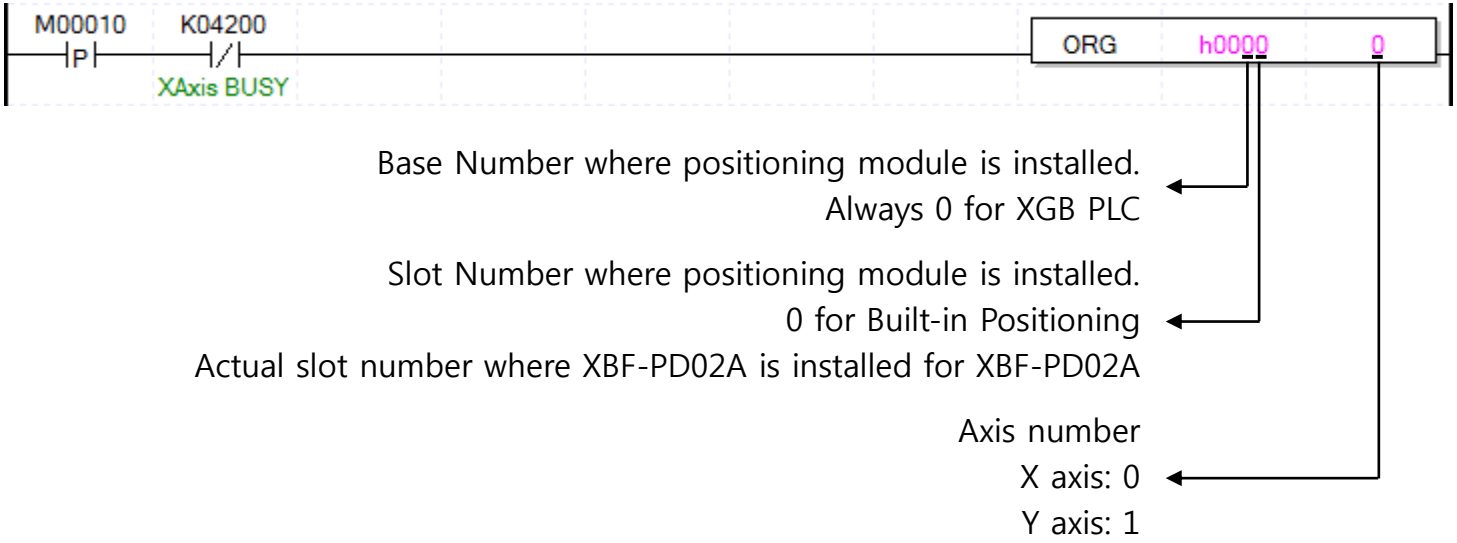
Instruction	No.	Reference
MOF	Resetting M Code(M Code Off)	Slot, Axis, Step
PRS	Current Position Preset	Slot, Axis, Position
EPRS*	Encoder Preset	Slot, Axis, Value
EMG	Emergency Stop	Slot, Axis
CLR	Error Clear	Slot, Axis, Pulse Output Disable/Enable
WRT	Parameter/Data Write	Slot, Axis, Axes
PWM**	Pulse Width Modulation	Slot, Axis, Period, Off Duty Ratio
SRD*	Status Read	Slot, Axis, Device to store
TEA*	Teaching	Slot, Axis, Data, Step, RAM/ROM, Position/Speed
TEAA*	Array Teaching	Slot, Axis, Step, RAM/ROM, Position/Speed, Number of Data
TWR*	Setting Multiple Teaching Data	Slot, Axis, Data, Number of Data
TBP*	Teaching Basic Parameter	Slot, Axis, Data, Item to be Changed
THP*	Teaching Home/Manual Parameter	Slot, Axis, Data, Item to be Changed
TSP*	Teaching Signal Parameter	Slot, Axis, Data, Item to be Changed
TCP*	Teaching Common Parameter	Slot, Axis, Data, Item to be Changed
TMD*	Teaching Operation Data	Slot, Axis, Data, Item to be Changed, Step

* XBF-PD02A Only
* * Built-in Positioning only

4.2.2 Common Items in Positioning Instructions

All positioning instructions, slot and axis must be assigned. Here, the way how to assign slot and axis number is explained with ORG instruction.

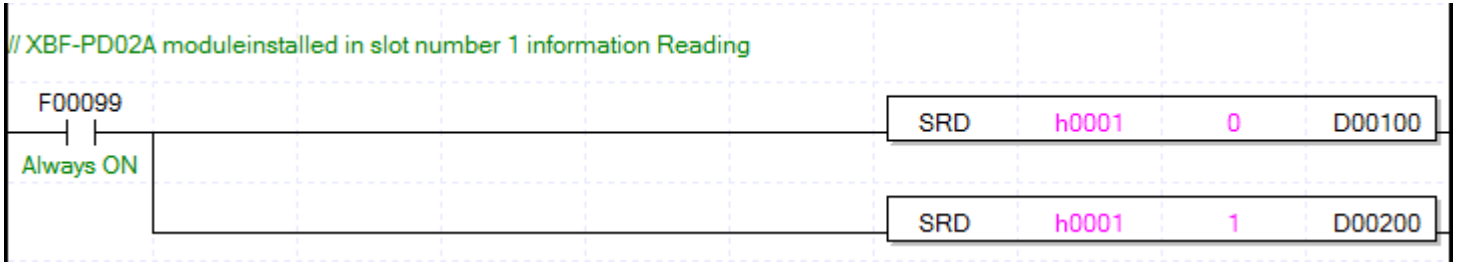
When slot number is assigned using hexadecimal number is convenient because 3rd digit is base number and 4th digit is slot number when slot number is assigned with hexadecimal number.



4.3 Basic Program

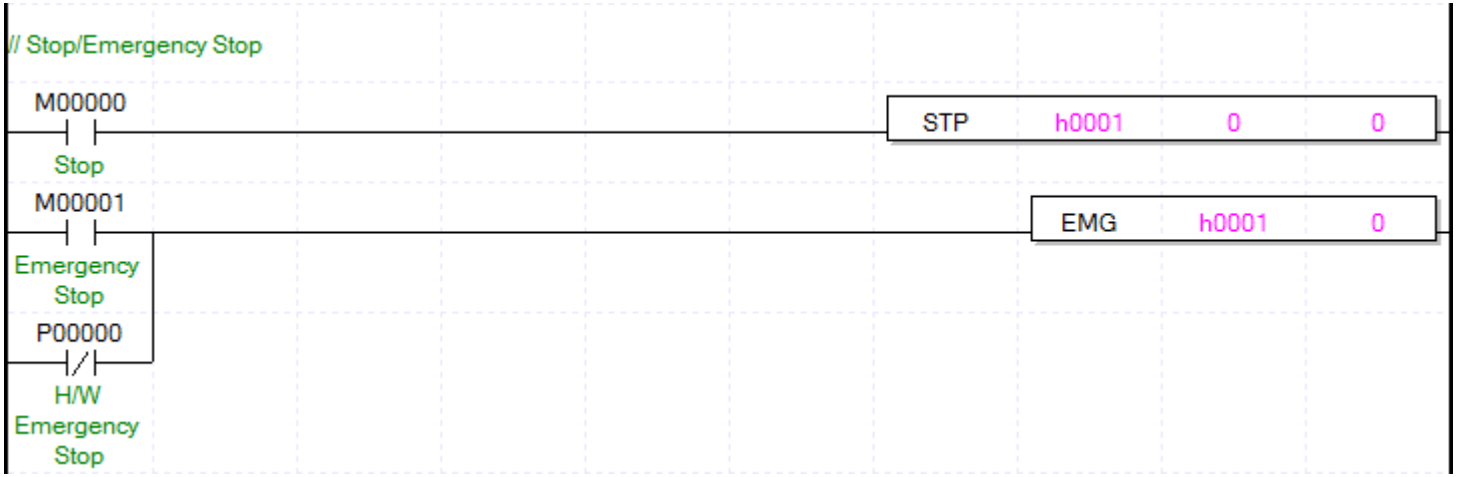
4.3.1 Status Reading(XBF-PD02A only)

Reading module information must be executed always and because each axis information is composed of 13 words data, 13 words data memory must be secured to store the read data.(Refer to paragraph 4.1.2)



4.3.2 Stop/Emergency Stop

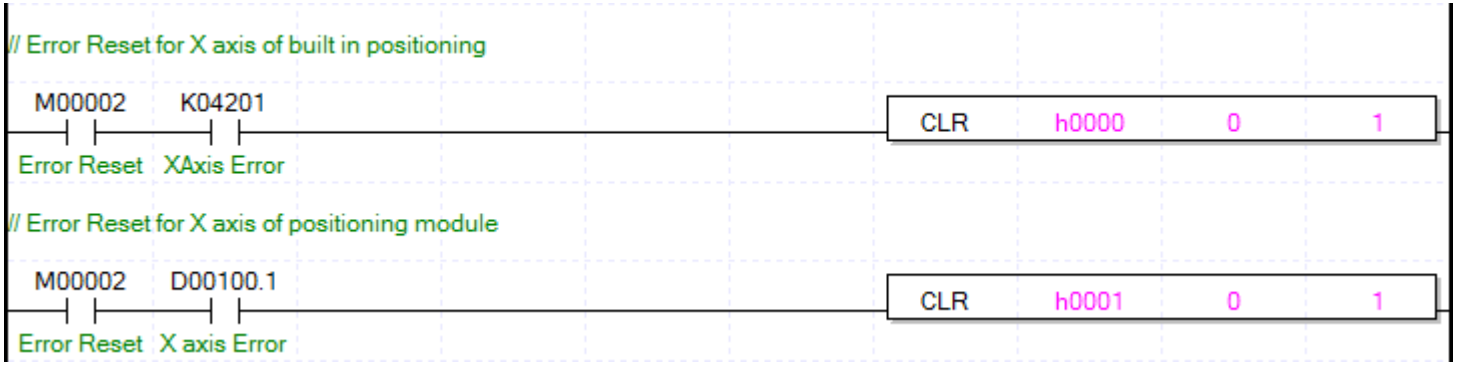
Prior to programming other functions, programming stop or emergency stop function is recommended because stop or emergency function must be executed when the system runs by mistake. Using just command without any condition is recommendable for stop and emergency function. Especially, emergency stop case, using 2 commends, software(HMI) and hardware with normal closed sequence is recommendable.



4.3.3 Error Reset*

When error occurs in positioning, error must be reset to execute positioning. When some kinds of error such as emergency stop, upper or lower limit error and so on, occurs, pulse output will be disabled. When pulse output is disabled and error is reset, another error will occur(pulse output disabled error) will occur when an positioning operation is executed. So, error disabling pulse output occurs, pulse output must be enabled. Pulse output will be enabled when error reset instruction is executed with last operand 1.

It is recommendable that error reset instruction is executed when axis is error state. Error state can be monitored by checking error flag which is stored in positioning flag for built-in positioning and read data by SRD instruction for XBF-PD02A module. Refer to paragraph 4.1 for finding error information.

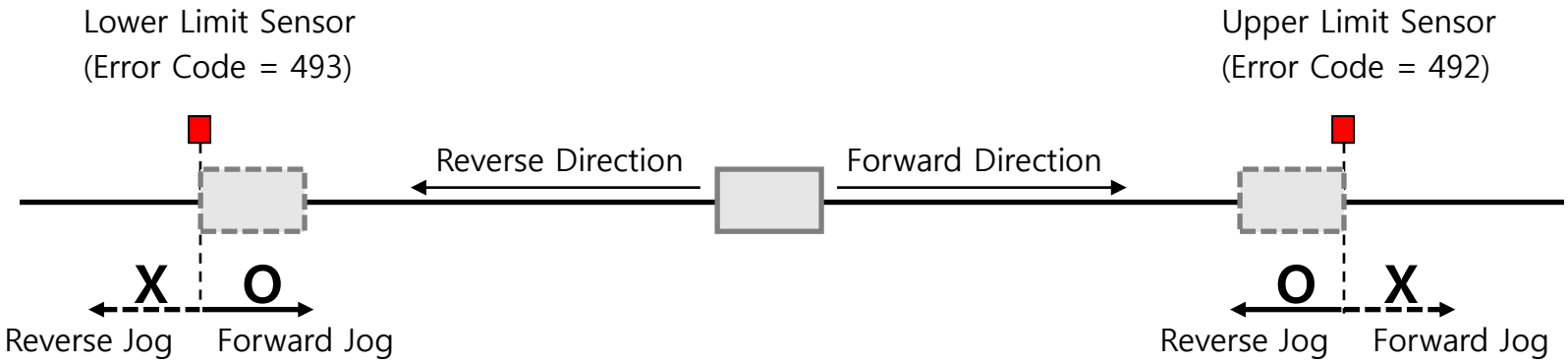


* Error reset here means resetting error in positioning axis. If error occurs in servo drive, servo drive error must be reset with the way to reset servo drive error. Generally, servo drive error can be reset by turning on an input signal of servo drive named error reset.

4.3.4 Jog Operation

Jog operation can be executed prior to setting home position and configured with controlling 3 bits, forward, reverse jog operation and jog high or low speed selection.

When error occurs, general positioning operations cannot be executed. When upper or lower limit error occurs, because although, error reset instruction is executed when upper or lower sensor is turned on, error will not be reset. Because the only available operation at the upper or lower limit error state is jog operation, object must move not to be sensed by upper or lower limit sensor so that error can be reset using jog operation.



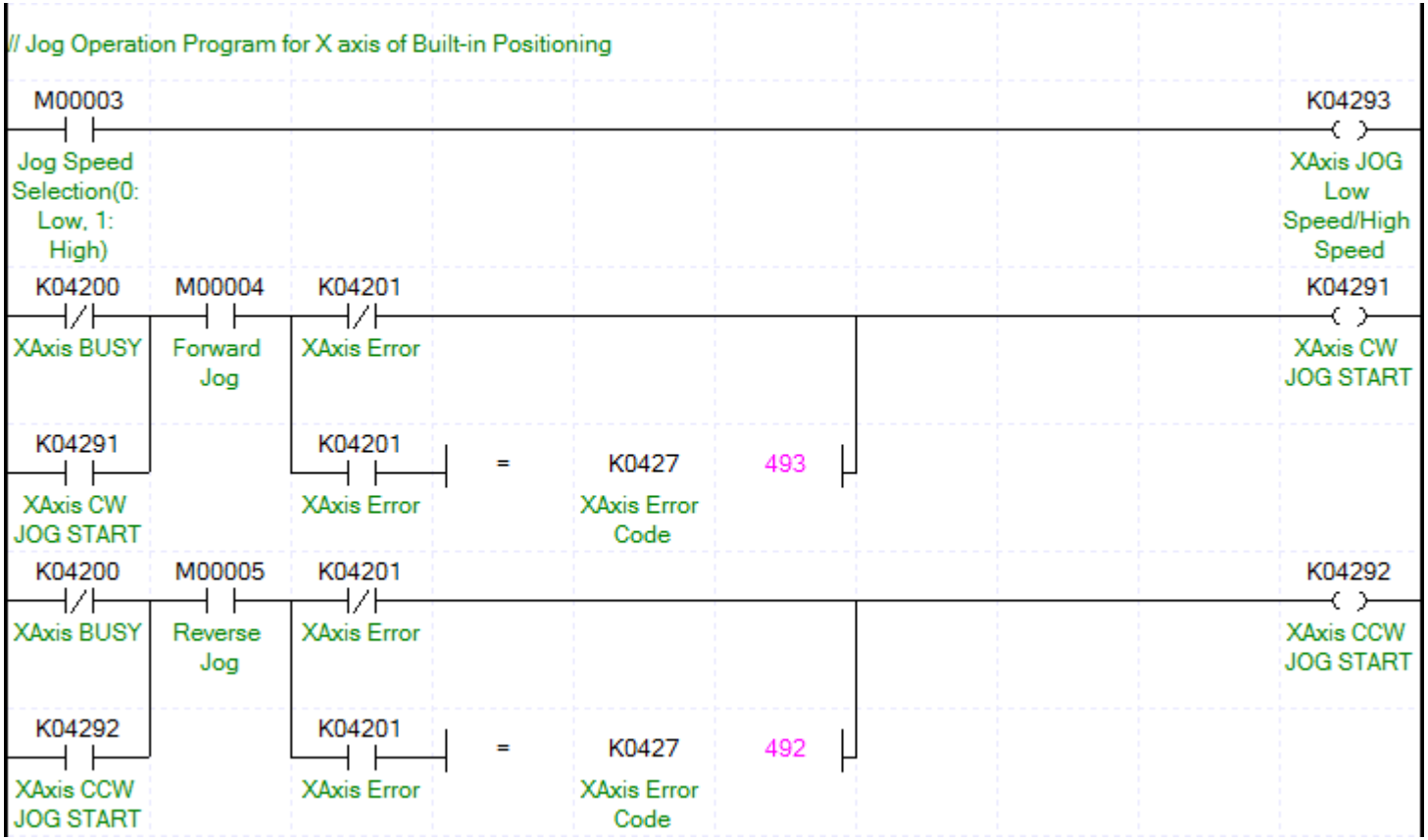
1) Parameters affecting Jog Operation

Parameters affecting jog operation are JOG High Speed, JOG Low Speed, JOG ACC Time and JOG DEC Time included in Home/Manual parameter. Jog speed can be selected by turning on(high speed) or off(low speed) of jog speed selection bit and JOG ACC/DEC times are acceleration and deceleration time applied when jog operation is accelerating and decelerating, respectively.

JOG High Speed	5000 pls/s	5000 pls/s
JOG Low Speed	1000 pls/s	1000 pls/s
JOG ACC Time	1000 ms	1000 ms
JOG DEC Time	1000 ms	1000 ms

2) General Jog Operation Program for Built-in Positioning

Jog operation is composed turning on or off of 3 bits and must be executed when positioning is not busy state. As explained previous page, jog operation can be executed when upper or lower limit error occurs considering direction.

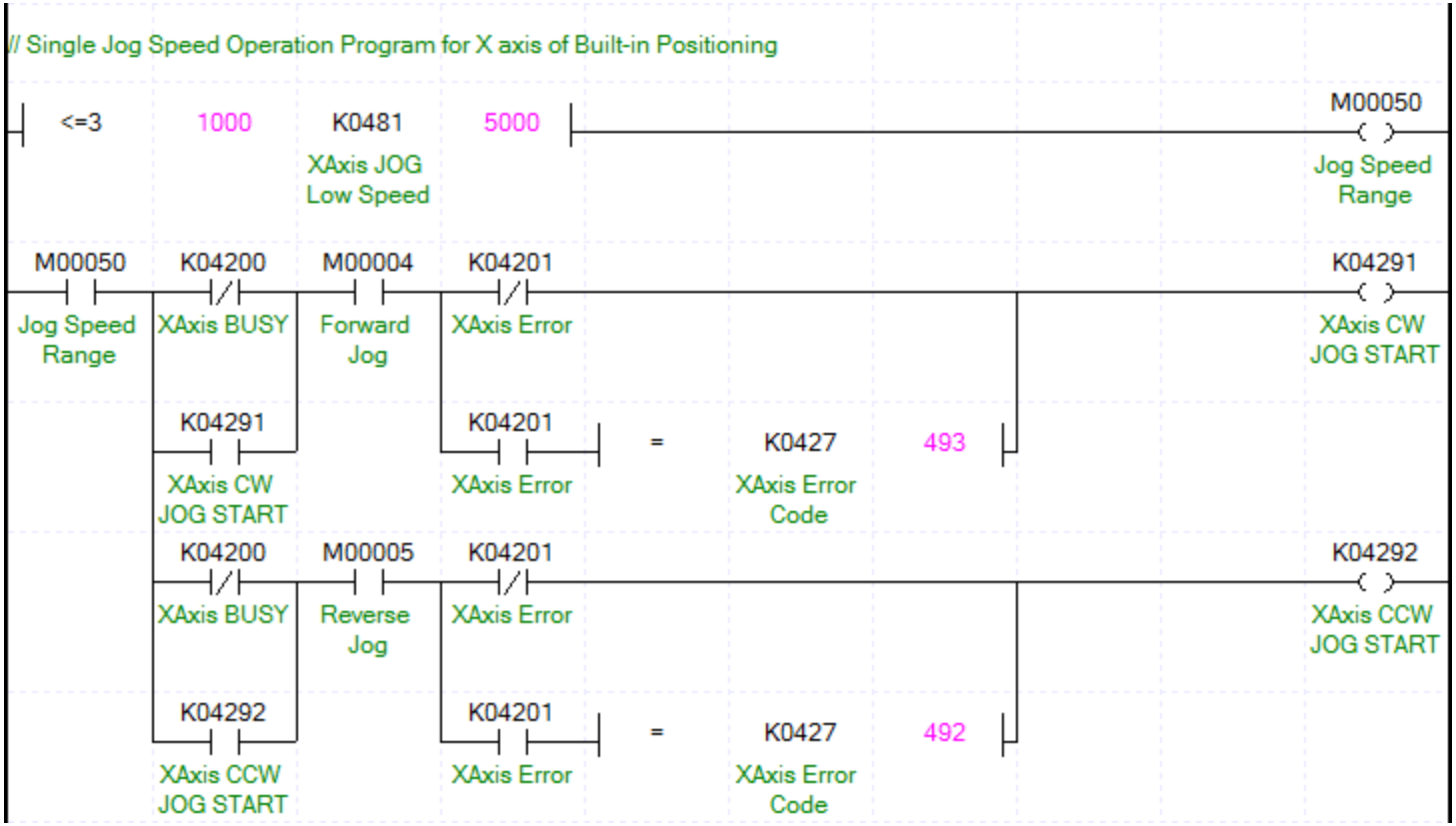


* K devices used in program above are positioning flags.

3) Adjustable Single Speed Jog Operation Program for Built-in Positioning

If single jog speed which is assigned and can be modified by HMI is used, it is recommendable to set the same value for Speed Limit and Jog High Speed in parameter and Jog speed given by HMI is stored in the storage for Jog Low Speed, K481, K521 for X and Y axis and the data size is double word(32 bits), respectively. To do so, jog speed selection program is needless.

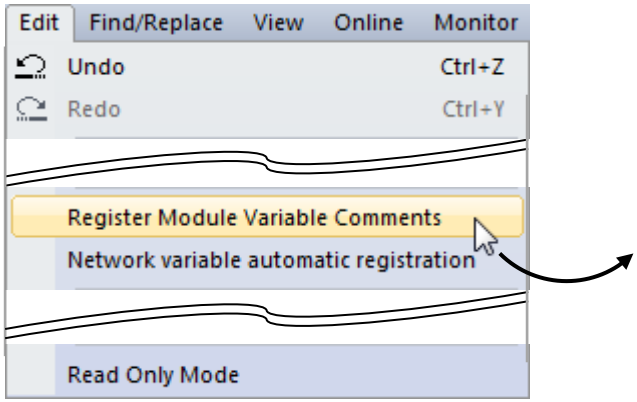
Because positioning parameters are stored in K area(Latch area), the setting value will not be cleared when the PLC is reset. If the jog speed must be in a certain range, the input data can be limited by HMI function or comparison instruction.

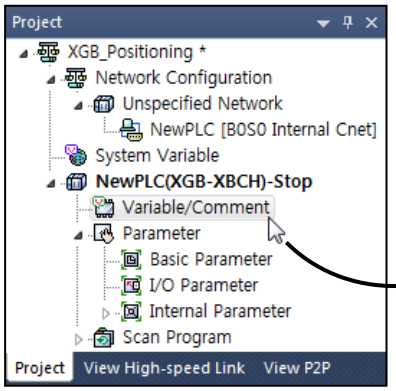


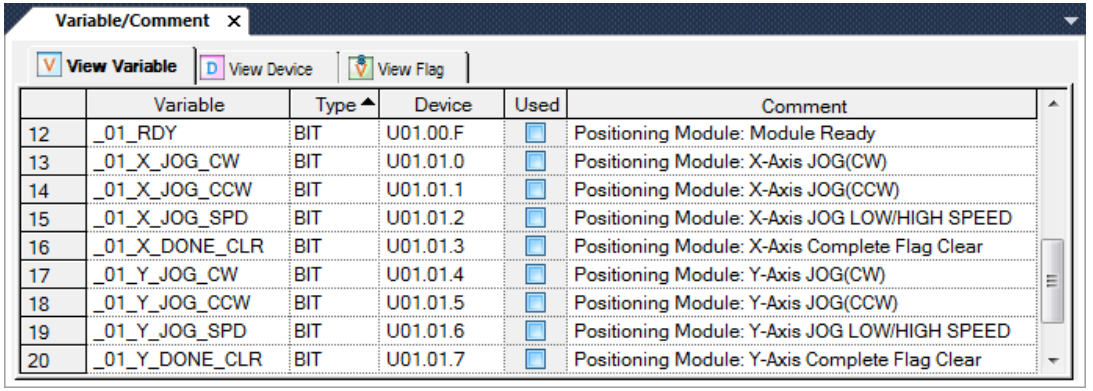
* K devices used in program above are positioning flags.

4) Register Module Variable and Comment for XBF-PD02A

XGT series PLC including XGB series, use special device, named U device, for data exchange between CPU and special modules. U devices assigned to module is dependent on module type and slot where module is installed.
When 'Register Module Variable and Comment' command in 'Edit' menu is executed after I/O Parameter is registered (Refer to phrase 3.2.1), XG5000 will assign U device for modules registered in I/O Parameter.
Because XBF-PD02A module is a kind of special module used with XGB series PLC and U device is used for data exchange with CPU, U device will be assigned when 'Register Module Variable and Comment' command in 'Edit' menu is executed after module is registered in I/O Parameter. U devices assigned each special module can be checked in 'Variable/Comment' window after execution of 'Register Module Variable and Comment' command.



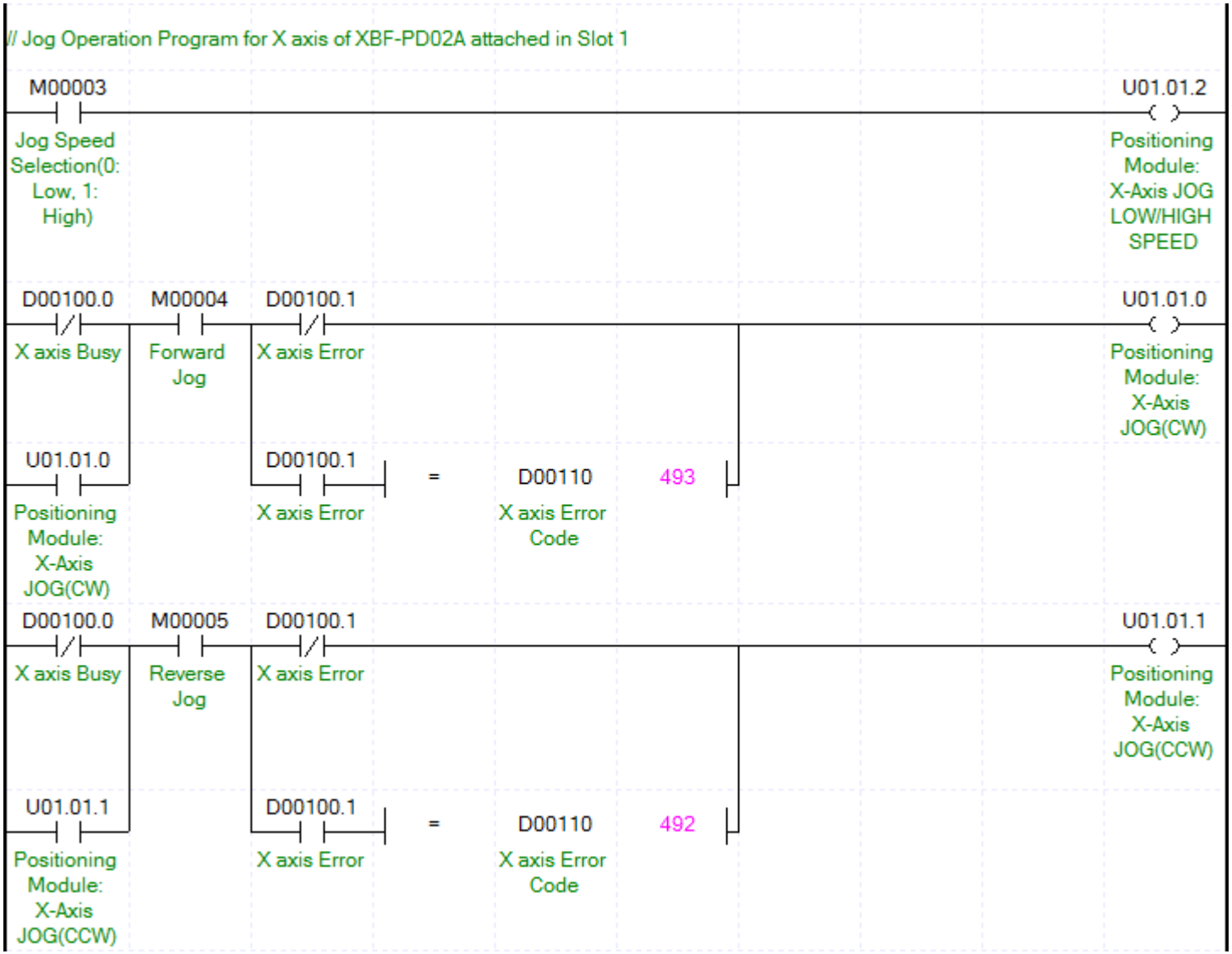




	Variable	Type	Device	Used	Comment
12	_01_RDY	BIT	U01.00.F		Positioning Module: Module Ready
13	_01_X_JOG_CW	BIT	U01.01.0		Positioning Module: X-Axis JOG(CW)
14	_01_X_JOG_CCW	BIT	U01.01.1		Positioning Module: X-Axis JOG(CCW)
15	_01_X_JOG_SPD	BIT	U01.01.2		Positioning Module: X-Axis JOG LOW/HIGH SPEED
16	_01_X_DONE_CLR	BIT	U01.01.3		Positioning Module: X-Axis Complete Flag Clear
17	_01_Y_JOG_CW	BIT	U01.01.4		Positioning Module: Y-Axis JOG(CW)
18	_01_Y_JOG_CCW	BIT	U01.01.5		Positioning Module: Y-Axis JOG(CCW)
19	_01_Y_JOG_SPD	BIT	U01.01.6		Positioning Module: Y-Axis JOG LOW/HIGH SPEED
20	_01_Y_DONE_CLR	BIT	U01.01.7		Positioning Module: Y-Axis Complete Flag Clear

5) Jog Operation Program for XBF-PD02A

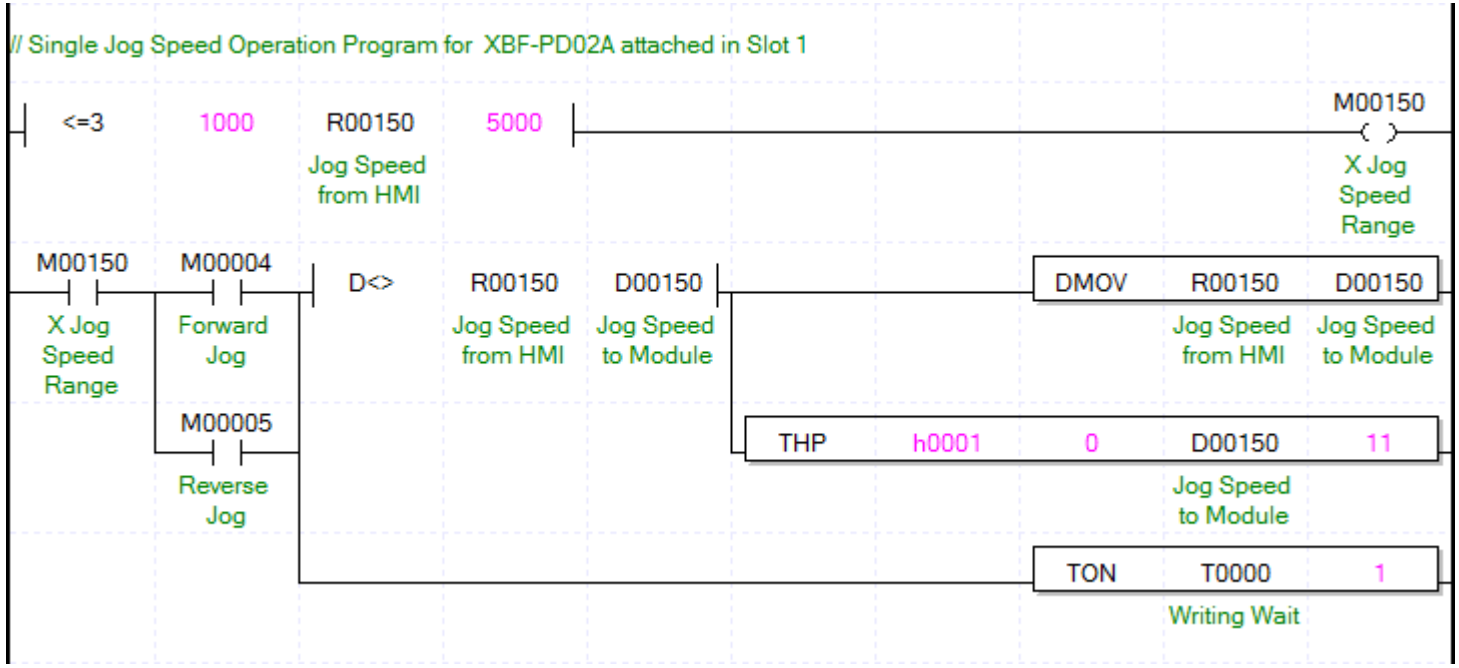
The same logical conditions used in built-in positioning jog operation are used.



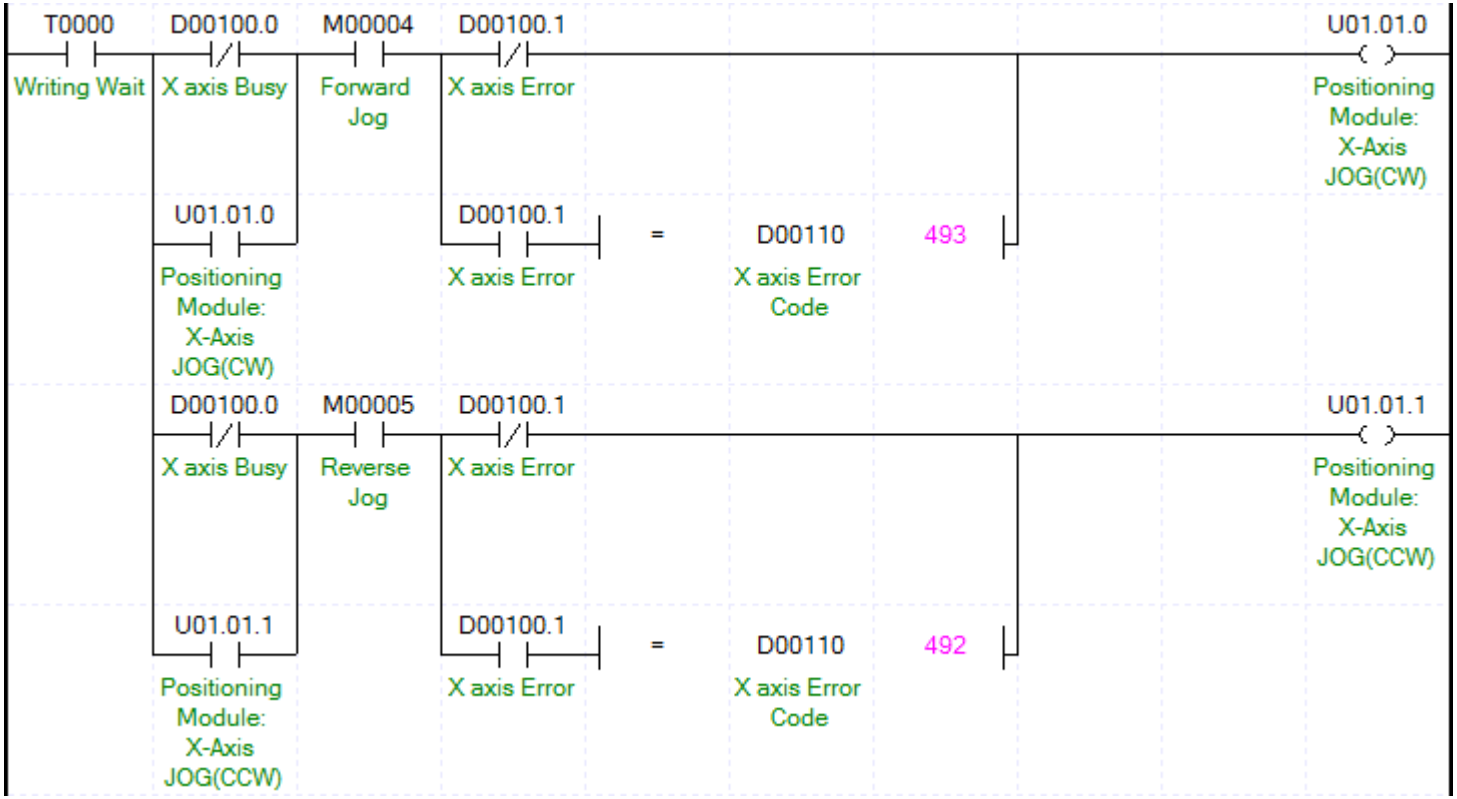
6) Adjustable Single Speed Jog Operation Program for XBF-PD02A

Like built-in positioning, if single jog speed which is assigned and can be modified by HMI is used, it is recommendable to set the same value for Speed Limit and Jog High Speed in parameter.

But, different form built-in positioning, because HMI cannot access positioning module directly, jog speed must be stored in latch area, not to be cleared when PLC is reset and transferred to module with 'THP' instruction when jog speed is changed. Because transferring jog speed takes some time, waiting time is need between writing and jog operation.

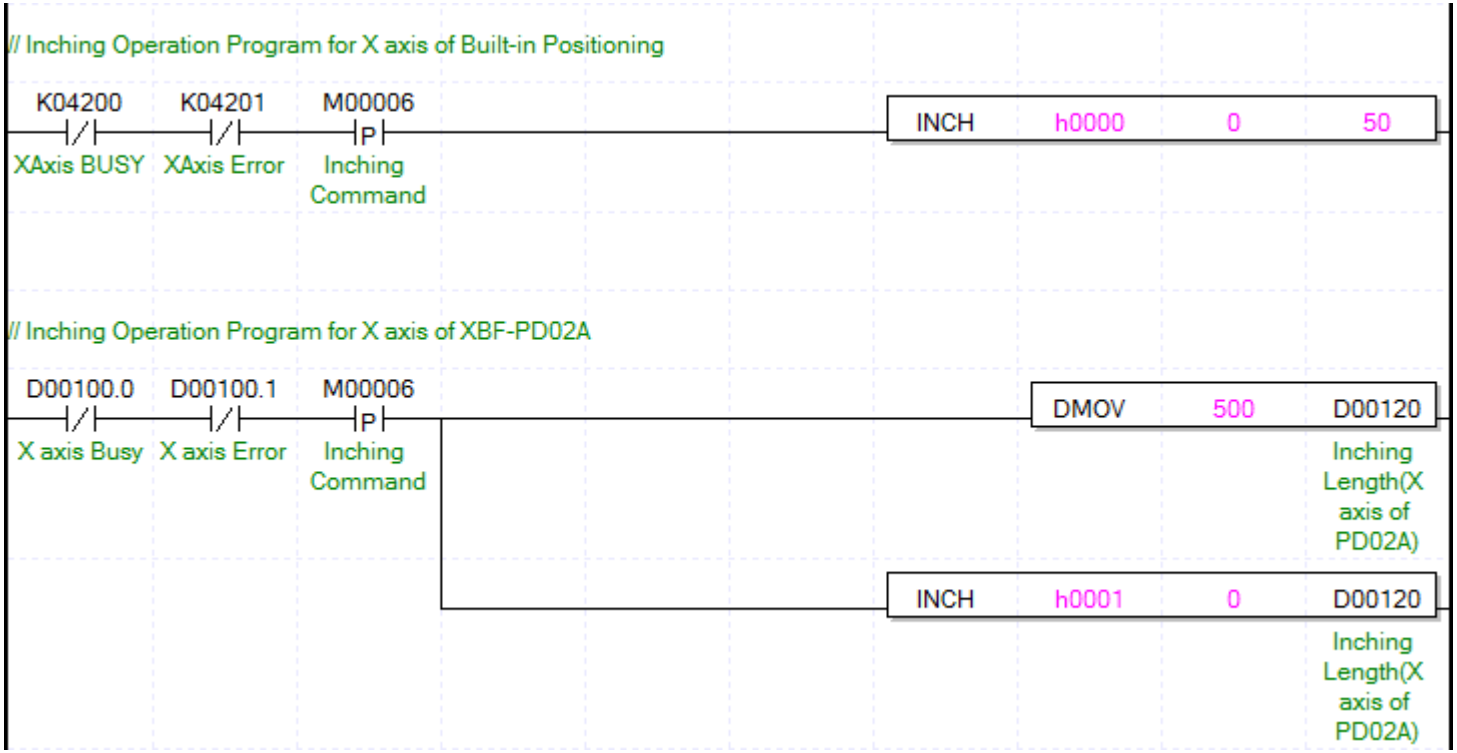


4. Program 1


T0000
Writing Wait
D00100.0
X axis Busy
M00004
Forward Jog
D00100.1
X axis Error
U01.01.0
Positioning Module: X-Axis JOG(CW)
U01.01.0
Positioning Module: X-Axis JOG(CW)
D00100.1
X axis Error
=
D00110
X axis Error Code
493
D00100.0
X axis Busy
M00005
Reverse Jog
D00100.1
X axis Error
U01.01.1
Positioning Module: X-Axis JOG(CCW)
U01.01.1
Positioning Module: X-Axis JOG(CCW)
D00100.1
X axis Error
=
D00110
X axis Error Code
492

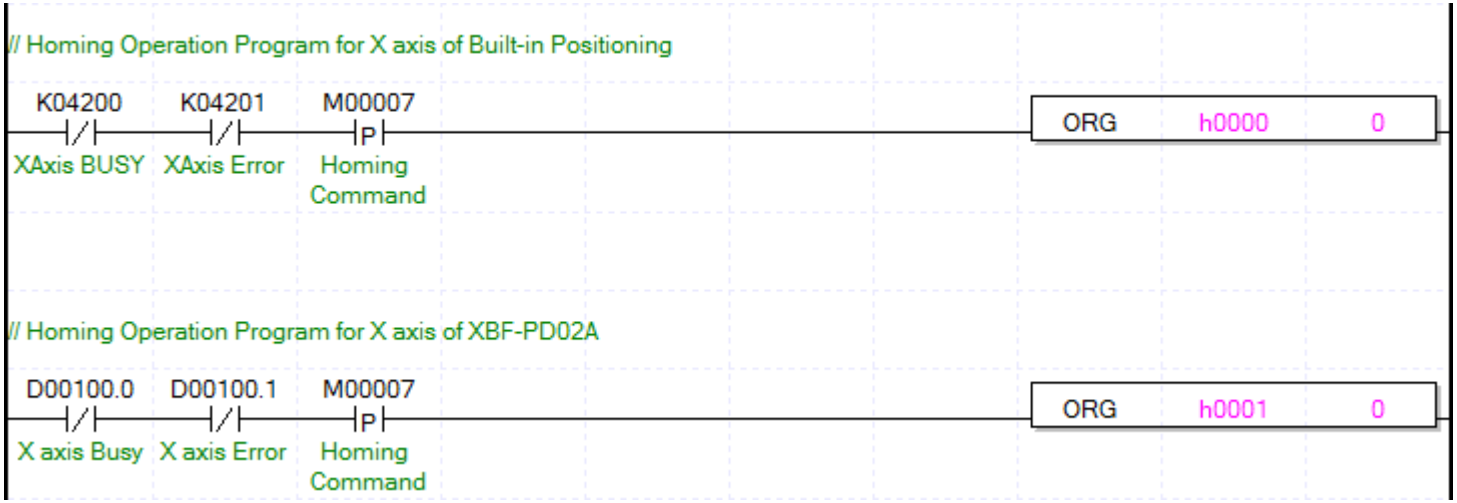
4.3.5 Inching Operation

Inching operation can be used for moving object user assigned length prior to setting home position. Parameter for Inching operation is Inching Speed included in Home/Manual parameter and the object will move with inching speed. JOG ACC/DEC Time will be applied when acceleration and deceleration is executing. Positive(forward direction) or negative (reverse direction) length to move is given in inching instruction with constant number or double word size device. Inching operation can be executed when positioning is normal(no error) and not busy state and edge command is recommended not to execute operation twice at a command.



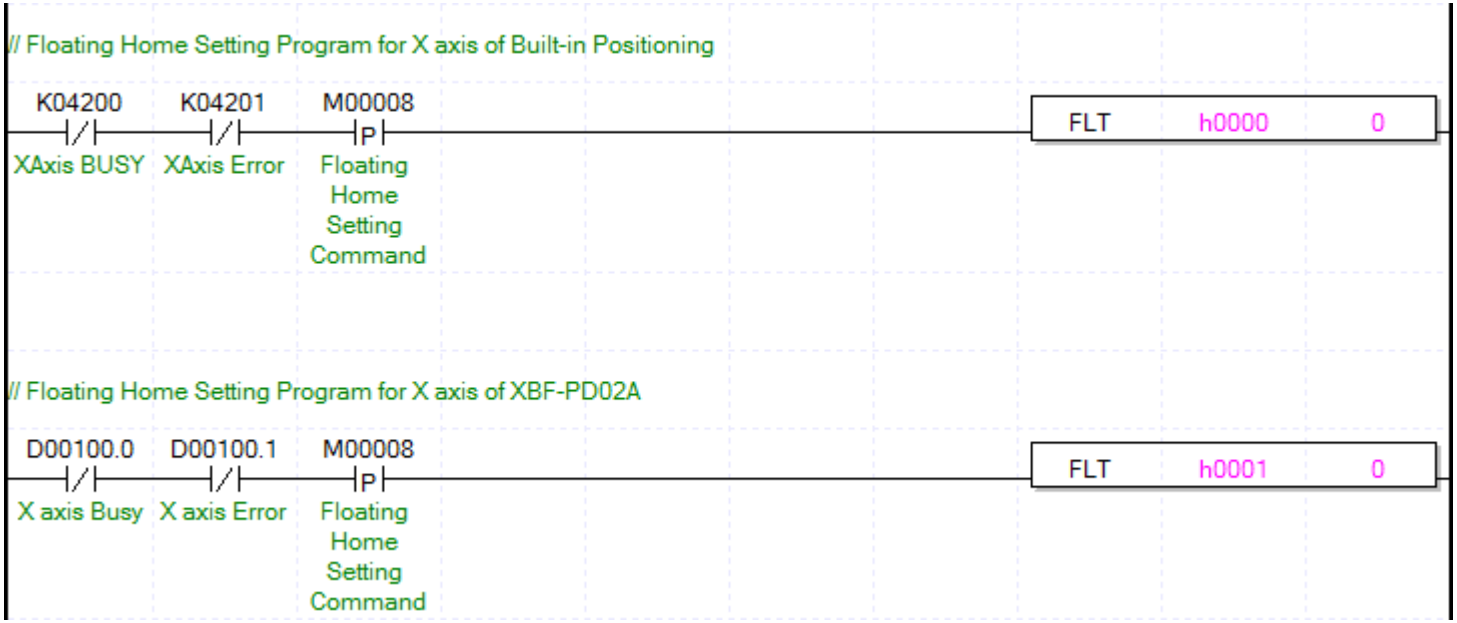
4.3.6 Homing Operation

All operations except jog and inching operation can be executed when home position is decided. When ORG instruction is Executed, object will find home position with the method and moving speed assigned in Home Parameter.
Homing instruction can be executed when positioning is normal(no error) and not busy state and edge command is recommended not to execute operation twice at a command. When homing instruction is executed successfully, origin fix flag will be turned on.



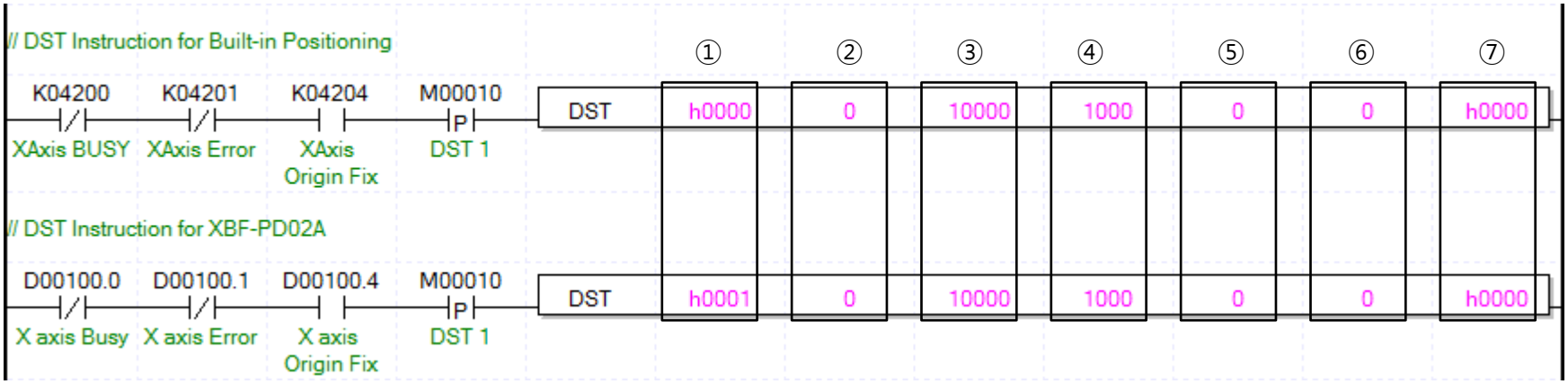
4.3.7 Floating Home Set

Floating home setting is used when specific home position is not necessary. Different from homing operation, the current position where FLT instruction is executed will be home position without moving to home direction. Floating home setting function is available for drum or conveyer speed control application where fixed home position is not necessary.



4.3.8 DST(Direct Start) Instruction

DST instruction can be used for positioning without predefined data. Target position or quantity to move and speed to move is given in the instruction.



1) Operands of DST Instruction

① Base and slot number. Always h0000 for built-in positioning and h000n for XBF-PD02A where n is slot number where module is attached.

② Axis number. 0 for X axis and 1 for Y axis.

③ Target Position/Quantity to move when absolute/relative coordination system is selected and available range and unit are -2,147,483,648 ~ 2,147,483,647 pulse.

④ Speed to move. Available range and unit are 1 ~ Speed Limit parameter pps(Pulse per Second).

⑤ Dwell Time. Time gab between command and actual operation of servo motor. Available range and unit are 0 ~ 50,000ms for built-in positioning and 0 ~ 65,535ms for XBF-PD02A.

⑥ M Code. Each operation can have operation number called M Code. Depending on M Code Mode selection, With or After, in Basic Parameter, assigned M code will be stored in M Code, 9th word of read data by SRD instruction.

⑦ Control Word. It assigns control method, coordination system, acceleration and deceleration speed.

- Control Word for Built-in Positioning

Bit No.	F ~ 7	6	5	4	3 ~ 1	0
Setting Item	Not Use	Acc./Dec. Time		Coordination System	Not Use	Control Method
Meaning	Always 0	00: Acc./Dec. Time 1 01: Acc./Dec. Time 2 10: Acc./Dec. Time 3 11: Acc./Dec. Time 4		0: Absolute 1: Relative	Always 0	**0: Position Control** **1: Speed Control**

- Control Word for XBF-PD02A

Bit No.	F ~ C	B	A	9	8	7 ~ 5	4	3 ~ 1	0
Setting Item	Not Use	Dec. Time		Acc. Time		Not Use	Coordination System	Not Use	Control Method
Meaning	Always 0	00: Dec. Time 1 01: Dec. Time 2 10: Dec. Time 3 11: Dec .Time 4		00: Acc. Time 1 01: Acc. Time 2 10: Acc. Time 3 11: Acc. Time 4		Always 0	0: Absolute 1: Relative	Always 0	**0: Position Control** **1: Speed Control**

Ex1) Setting value for position control using Acc./Dec. time 1 and absolute coordination system is h0000 for both positioning.

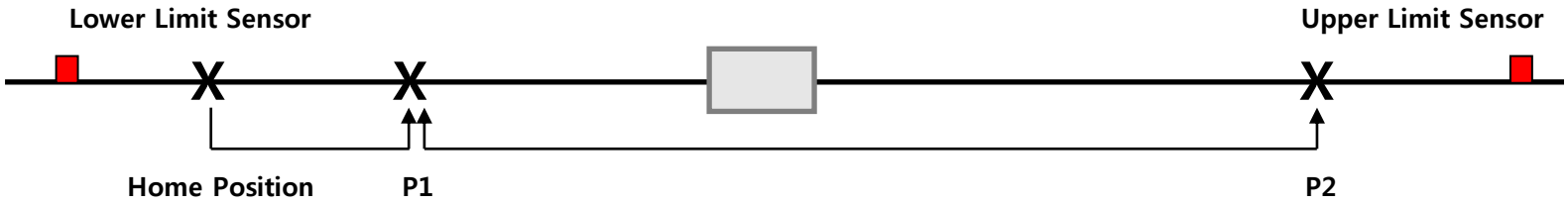
Ex2) Setting values for speed control using Acc./Dec. time 2 and relative coordination system are h0031 for built-in positioning and h0511 for XBF-PD02A.

4.4 Application Program with DST Instruction

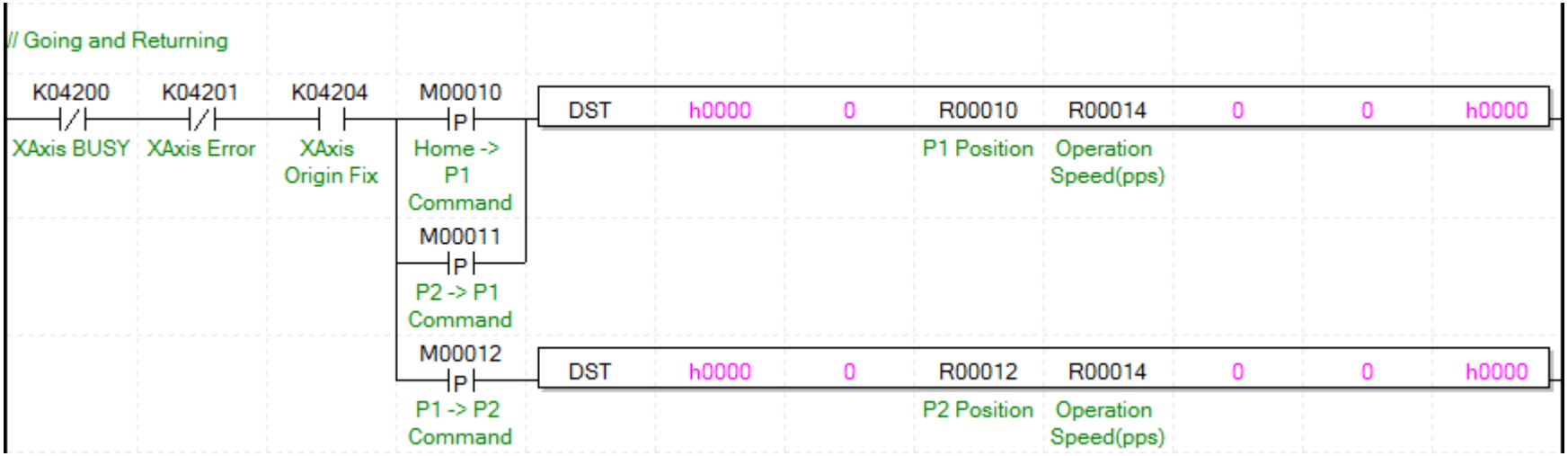
In this paragraph, some simple, widely used positioning programs using DST instruction will be introduced. For simplicity, instructions explained in previous paragraph will be omitted as long as special application or explanation is not needed. XBC-H type built-in positioning is assumed for all programs while there is no additional comments.

4.4.1 Going and Returning System

1) System Overview

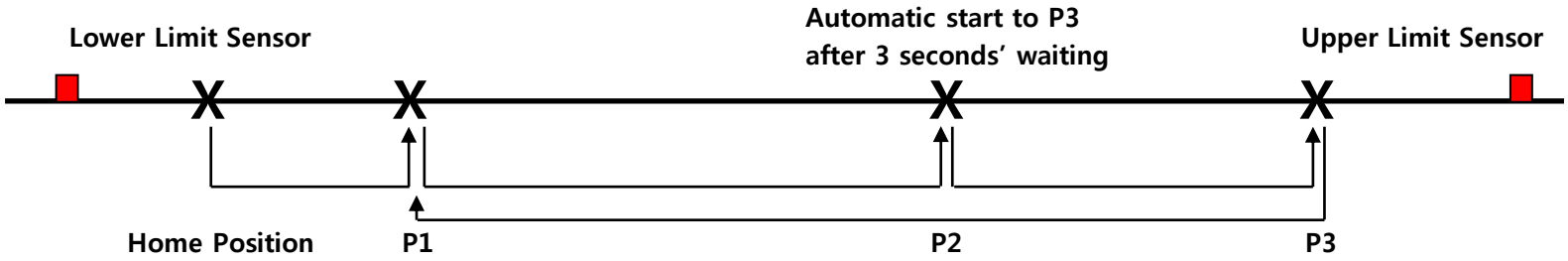


2) Program

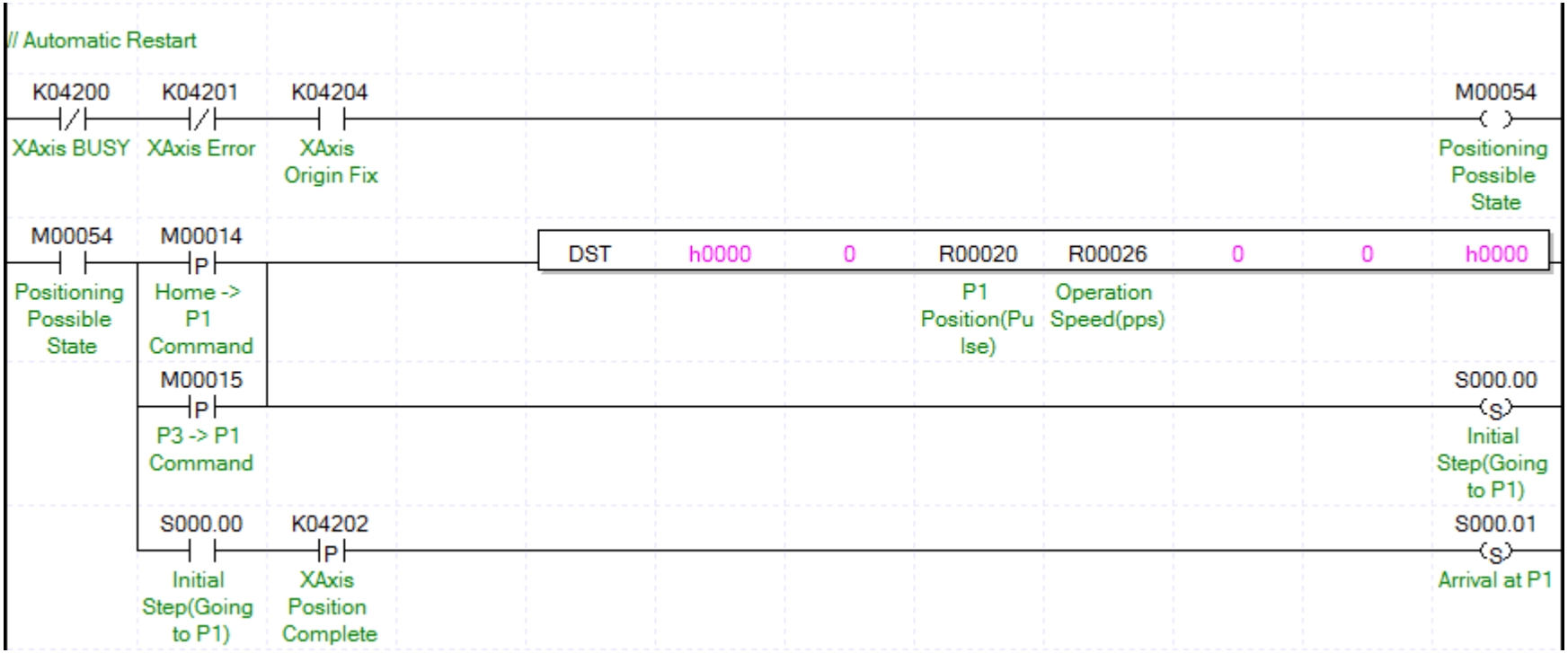


4.4.2 Automatic start to next position

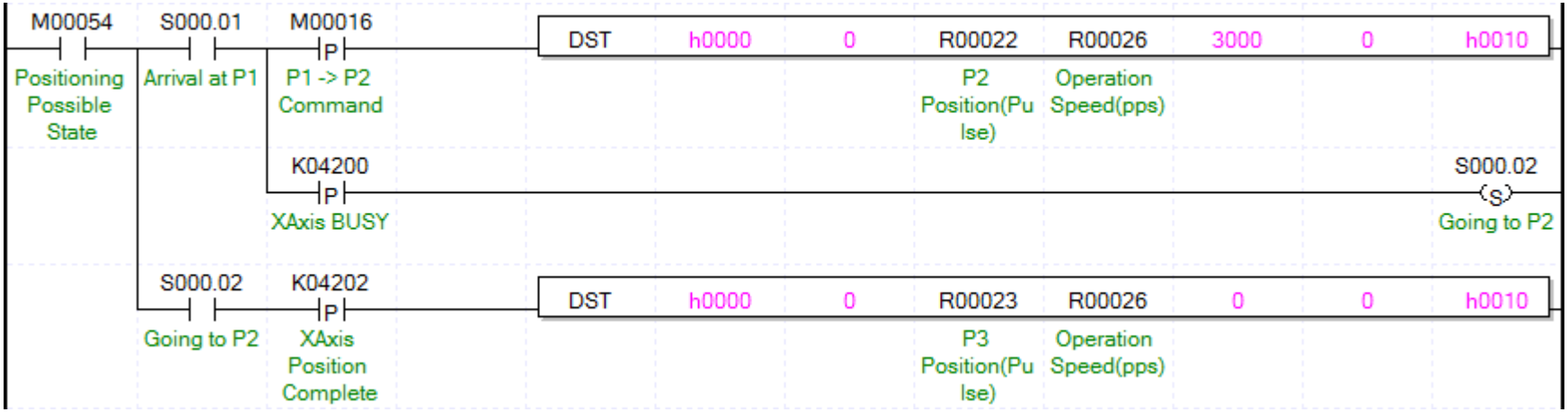
1) System Overview



2) Program

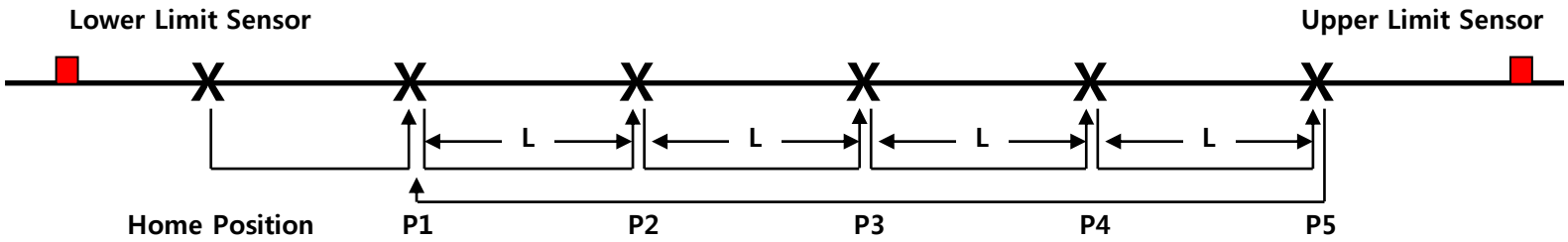


4. Program 1

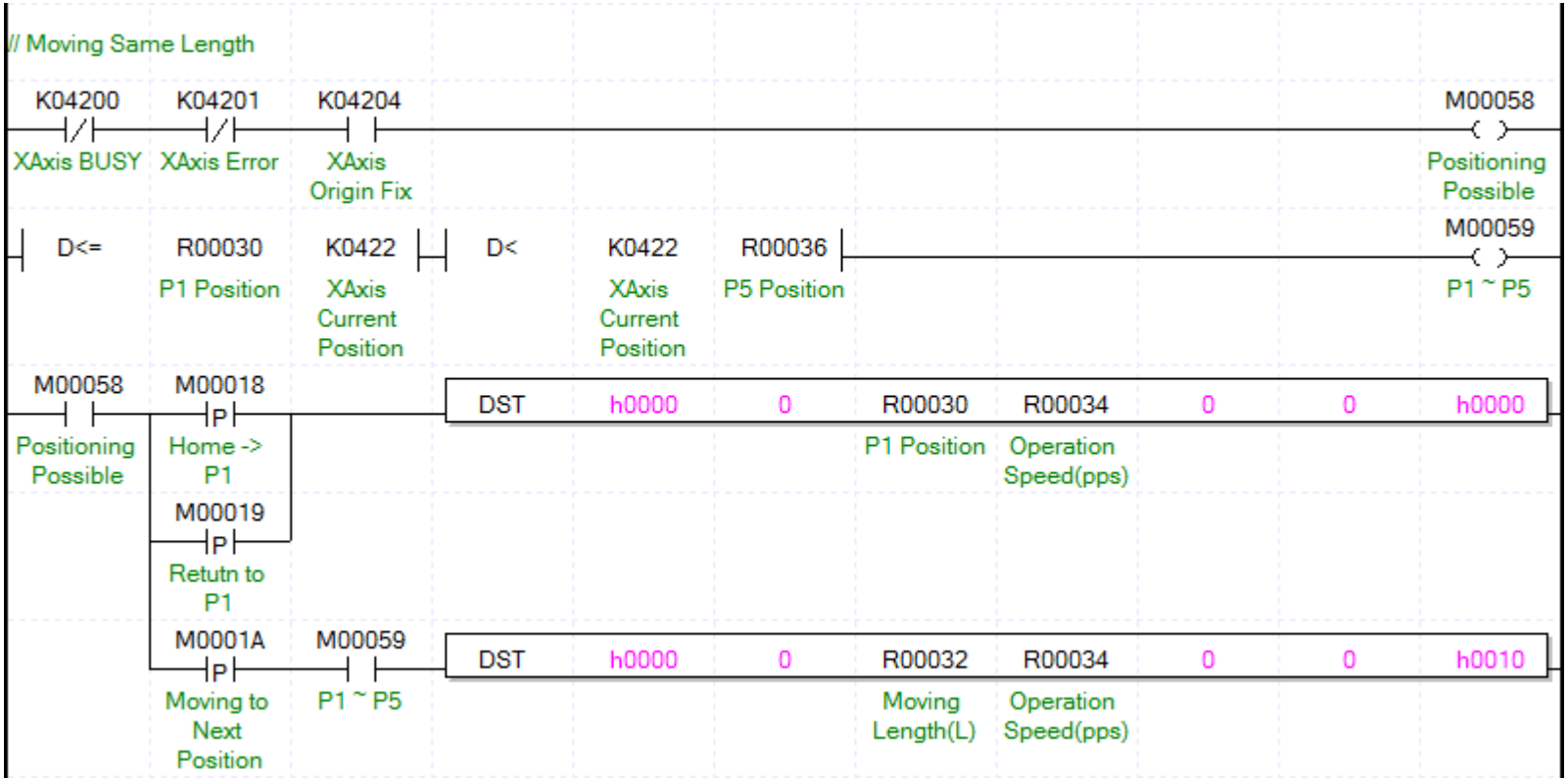

M00054
Positioning Possible State
S000.01
Arrival at P1
M00016
P
P1 -> P2 Command
DST
h0000
0
R00022
P2 Position(Pulse)
R00026
Operation Speed(pps)
3000
0
h0010
K04200
P
XAxis BUSY
S000.02
S
Going to P2
S000.02
Going to P2
K04202
P
XAxis Position Complete
DST
h0000
0
R00023
P3 Position(Pulse)
R00026
Operation Speed(pps)
0
0
h0010

4.4.3 Moving Same Length

1) System Overview



2) Program

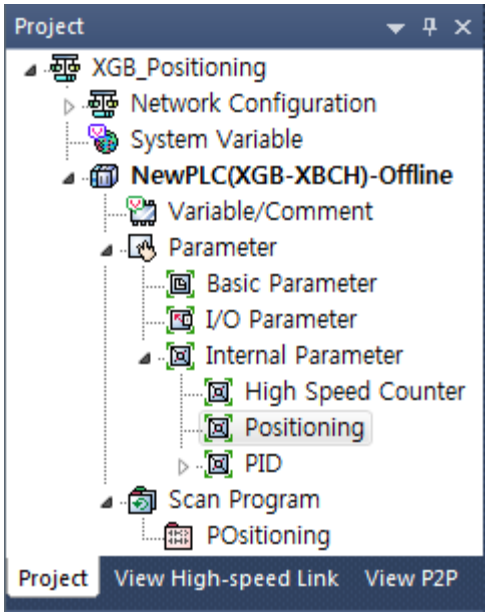


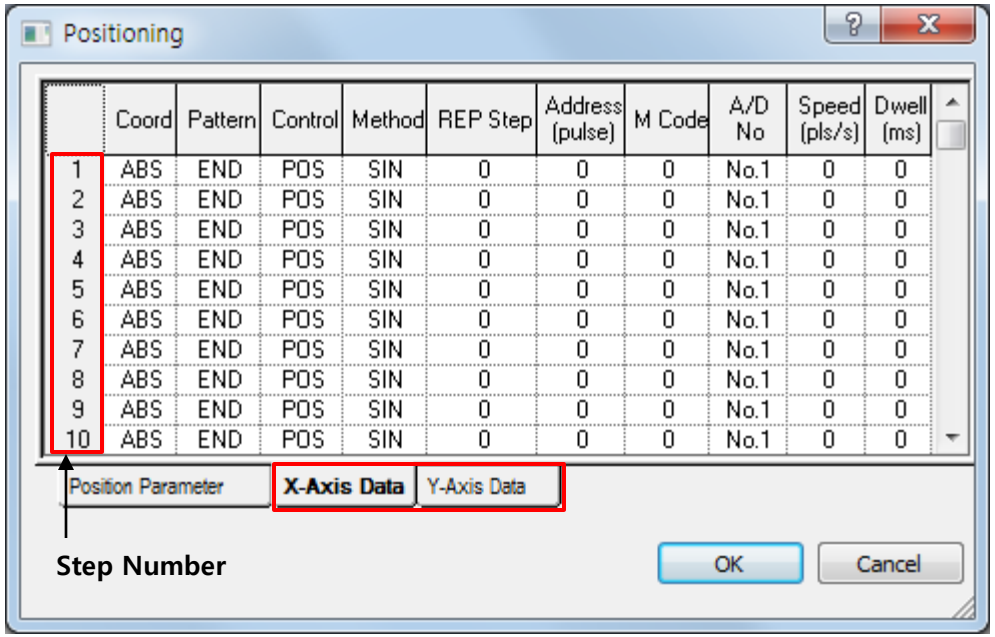
5.1 Positioning Data

In chapter 5, direction start with DST instruction is explained. When direct start is used, items needed for positioning are given in instruction. Items for positioning can be assigned in data list and execution of assigned data is indirect start. Each set of data is step and can be executed with IST(indirect start) instruction. Step to be executed can be assigned in IST instruction with step number. All data in the data list can be modified with TMD instruction.

5.2 Built-in Positioning Data

Data for built-in positioning function can be set up in project window of XG5000.
When 'Positioning' in 'Internal Parameter' of XG5000 Project window is double clicked, Positioning window will be displayed.
Positioning data for X and Y axis are can be edited in X-Axis Data or Y-Axis Data tab.
Maximum number of data is different depending on main unit type. Maximum data number is 30 for XBMS PLC is, 80 for XBCS or XBCH PLC.





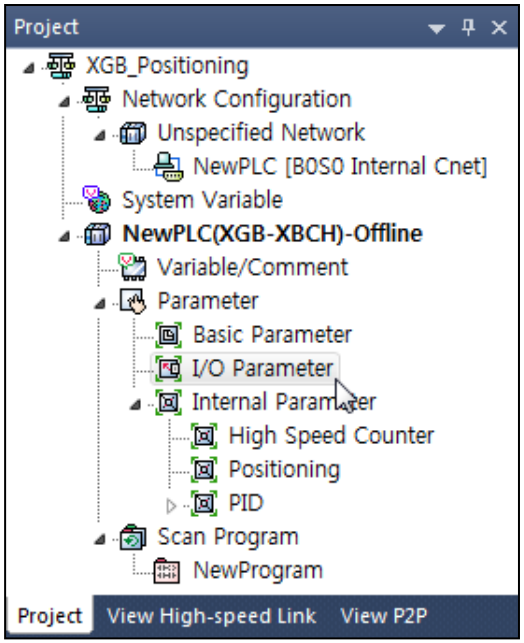
5.3 Positioning Module Data

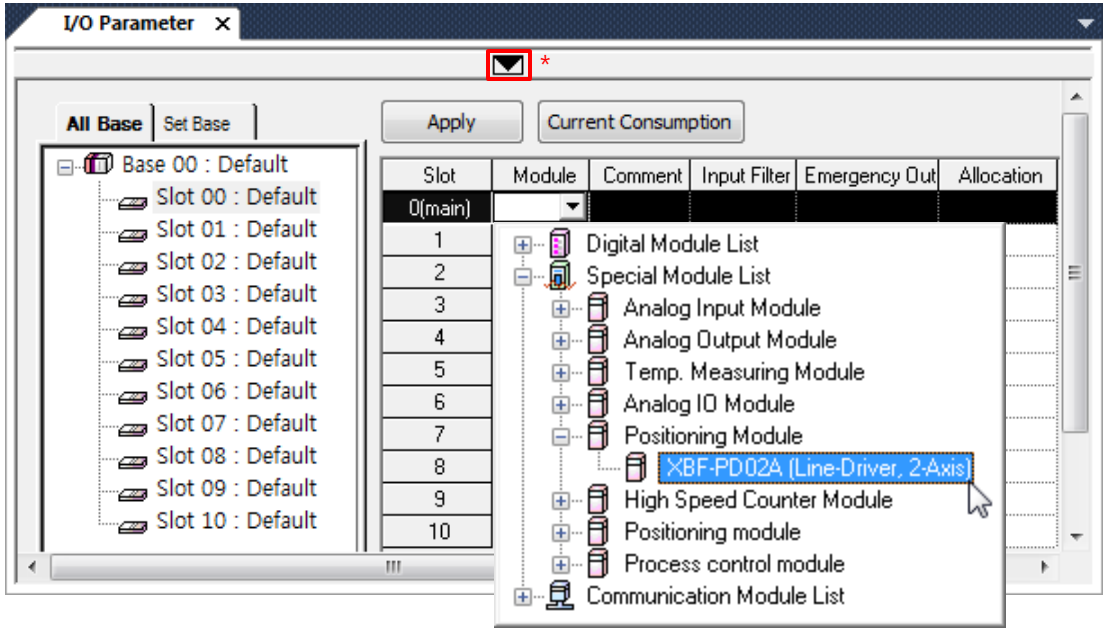
Data for positioning module can be set up in I/O Parameter. Prior to setting up positioning parameters, module must be registered.

5.3.1 Module Registration

1) Offline Module Registration

① Double click 'I/O Parameter and I/O Parameter window will be displayed.
In I/O Parameter, Module column of slot in which positioning module will be attached is clicked, module list will be displayed. Expand Special Module List and Positioning Module and 'XBF-PD02A can be selected.

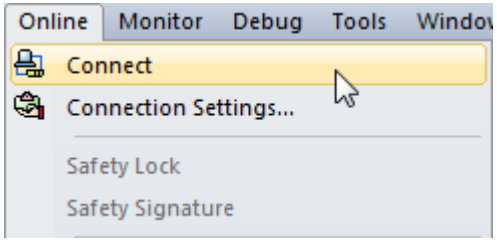




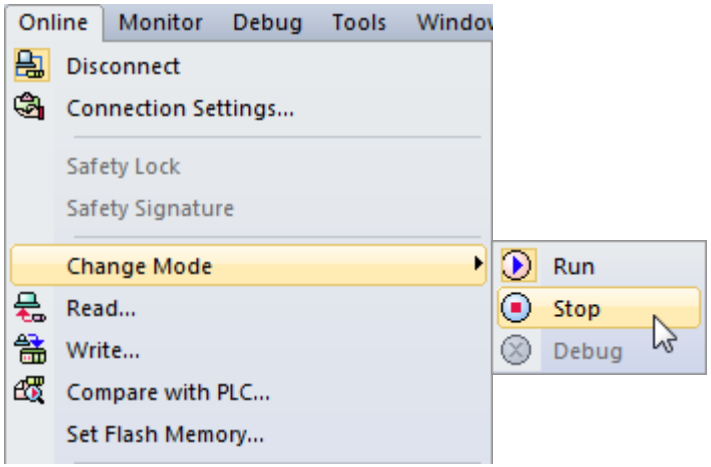
* If triangle button towards bottom direction(▼) is clicked, the PLC and modules' image will be displayed together.

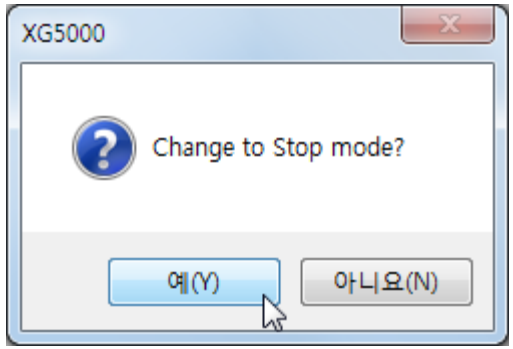
2) Online Module Registration (I/O synchronization)

① Connect XG5000 and PLC by selecting 'Connect' in 'Online' menu.



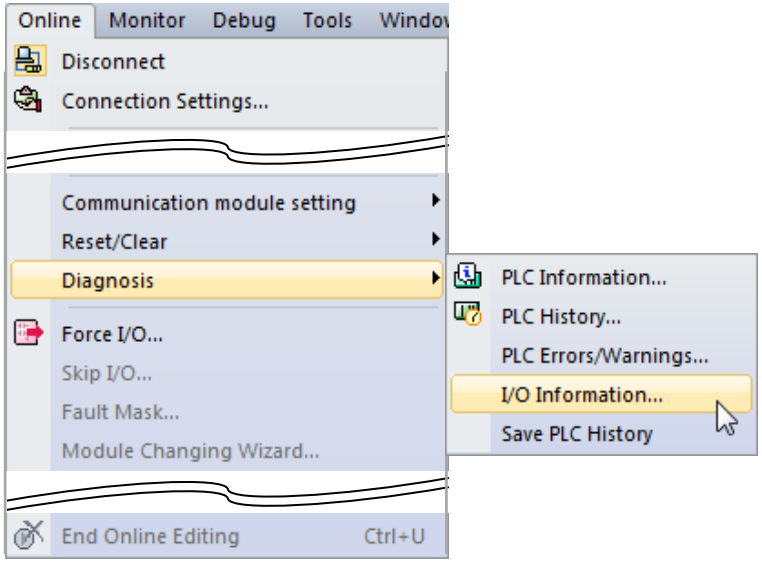
② I/O synchronization is available when PLC is STOP mode. If PLC is RUN mode, change the mode to stop by selecting 'Stop' in 'Change Mode' command in 'Online' menu.

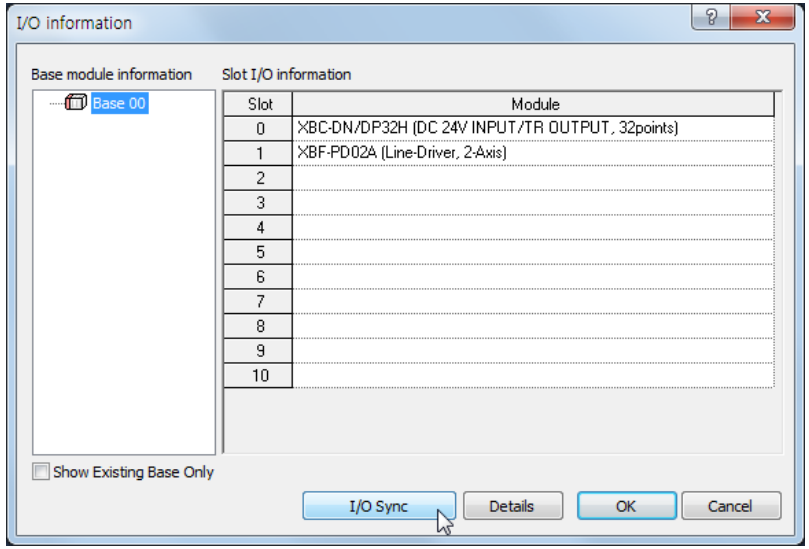




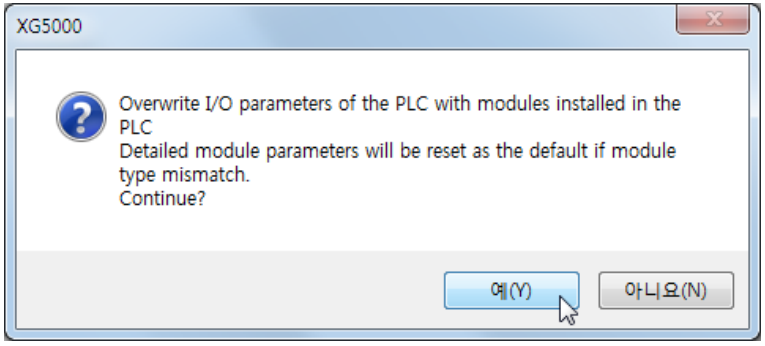
* To establish connection between XG5000 and PLC, communication settings may be required. For communication settings refer to XG5000 manual

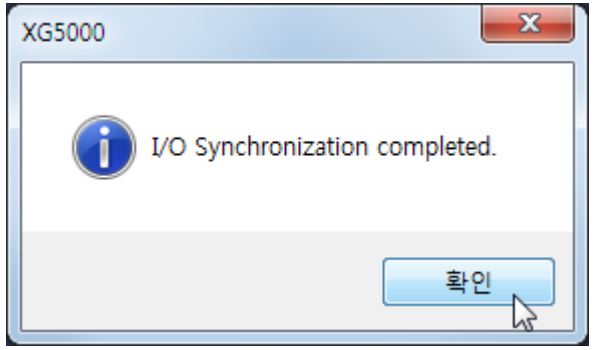
③ When Online menu, Diagnosis command, I/O Information item is selected, 'I/O Information' window will be displayed.
In 'I/O Information' window, modules attached in PLC will be listed up.
'I/O Sync' button in 'I/O Information' window is clicked, a message window below will be displayed.





④ In message window, 'Yes' button is clicked, and 'OK' button is clicked in next message window, the modules listed up in 'I/O Information' window will be registered in I/O Parameter.

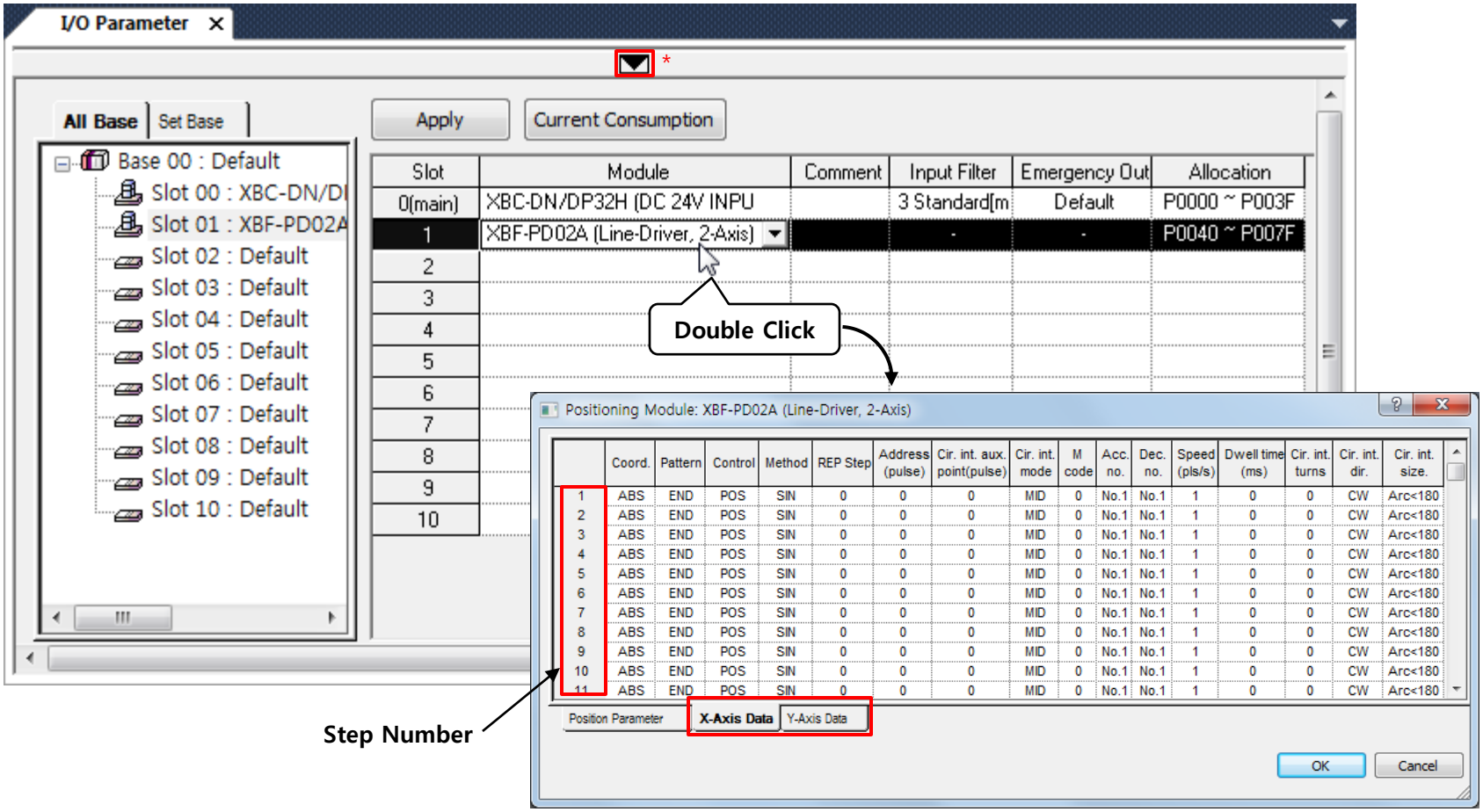




* If PLC is RUN mode, 'I/O Sync' button in 'I/O Information' window will be disabled and cannot be selectable.

3) Check I/O Parameter

When module is registered in I/O Parameter and a module is selected, parameter setting window will be displayed. Data can be edited in X-Axis Data or Y-Axis Data tab.



* If triangle button towards bottom direction(▼) is clicked, the PLC and modules' image will be displayed together.

5.4 Data Items

5.4.1 Common Data Items for Built-in positioning and XBF-PD02A

1) Coord.(Coordination System)

① ABS: Absolute coordination system will be applied. ABS is selected, Address(6th item in data table) is target position to stop.

② INC: Incremental or relative coordination system will be applied. INC is selected, Address(6th item in data table) is pulse number to move.

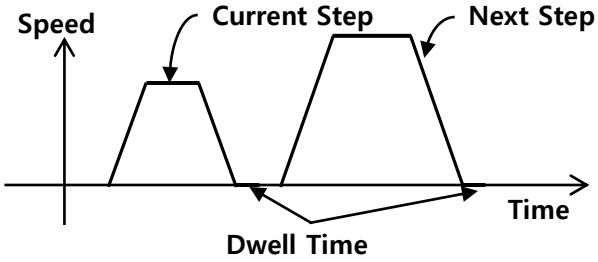
2) Pattern

Pattern item decides how to connect the next step when an execution is completed.

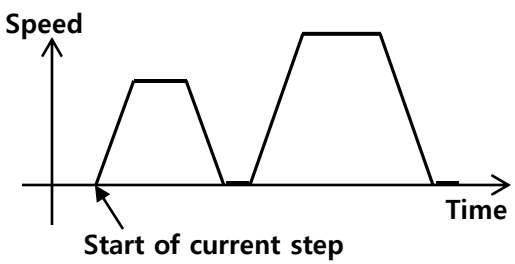
① END: The next step will not be executed. Operation will be stopped after current step is executed.

② KEEP: The next step will be automatically executed after current step is executed. After execution of acceleration, constant speed, deceleration and stop assigned in current step, the next step will be executed automatically.

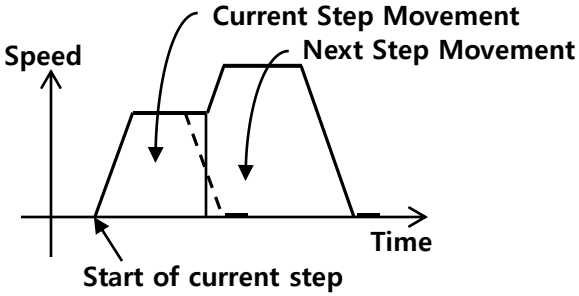
③ Cont.(Continuous): The next step will be automatically executed after current step is executed like KEEP. But connection method is different. Acceleration and constant speed movement will be executed until the object arrives at the target position of this step and the speed will be changed to the speed assigned in next step. The object will stop when arrived at the target position assigned in next step.



Step time and speed pattern for each step



Keep Operation



Continuous Operation

3) Control

① POS(Position): The object will move to destination position decided by assigned coordination system and address by execution of acceleration, constant speed and deceleration and stop when the current position is equal to destination position.

② SPD(Speed): Speed control controls acceleration and constant speed movement. To stop the positioning executing speed control, STP instruction must be executed. Coordination system and address in the data list will be referred to decide direction, forward or reverse.

4) Method and REP Step(Repeat Step)

Positioning manages a step number. The step number managed by positioning(current step) can be monitored by the positioning flag, _POS_X_CurStep or _POS_Y_CurStep for X and Y axis, respectively, for built in positioning and 9th word data, Step number, in positioning data read by SRD instruction for XBF-PD02A. The initial step number managed by the positioning is 1.

① SIN(Single): When a step is executing, the current step is the step number currently executed and the execution is completed, the current step number will be increased by 1. SIN is assigned in Method, REP Step item is not used.

② REP(Repeat): When a step is executing, the current step is the step number currently executed and the execution is completed, the step number will be the number assigned in REP Step. REP Step can be modified with SRS instruction.

5) Address(Pulse)

Absolute coordination system is selected, Address item is destination position to stop from home position in pulse unit and incremental coordination system is selected, it is pulse number to move. Available address range is -2,147,483,648 ~ 2,147,483,647 pulse. If address is 0 and the positioning is executed, positioning completed signal will not be turned on.

* To execute a step, IST instruction must be executed. The last operand of IST instruction is step number to be executed and if IST instruction is executed with 0 for the step number, the step number stored in current step will be executed.

6) M Code

Each data can have unique movement code. Assigned M code will be stored in positioning flag, _POS_X_Mcode and _POS _Y_Mcode for X and Y axis, respectively, for built-in positioning and 10th word(M Code) in data read by SRD instruction for XBF-PD02A. M code will be stored when positioning is start or completed depending on M Code output mode, With or After. If M code is composed 2 components, M code bit and M code number. M code bit will be turned on when M code is output and positioning commend is executed when M code bit is turned on, error will occur. To prevent occurring error, M code bit must be turned off with MOF instruction.

7) A/D No.(Acceleration and Deceleration Number), Acc. No.(Acceleration Number), Dec. No.(Deceleration Number)

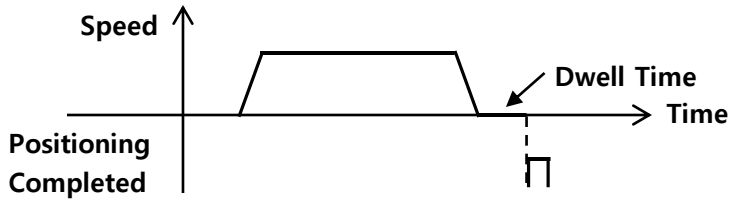
Acceleration and/or deceleration number assigned in parameter is selected. Built-in positioning case, same number of acceleration and deceleration is selectable and XBF-PD02A case, different number can be selectable. When acceleration and/or deceleration time is selected, it must be considered that because acceleration and deceleration time is time to increase the speed from 0 to speed limit in parameter and decrease the speed from speed limit to 0, respectively actual acceleration and deceleration time is shorter than time assigned in acceleration and deceleration time parameter.

8) Speed

Moving speed is given in Speed item and its unit is pps(Pulse pre second). Available address range is 1 ~ speed limit in parameter and the maximum value for speed limit is 100,000 and 2,000,000 for built-in positioning and XBF-PD02A, respectively.

9) Dwell

Dwell time is waiting time after completion of pulse output so that servo motor can arrive at command position. When Dwell time is assigned, positioning completed signal will be turned on after dwell time than all pulses output.



5.4.2 Data Items for XBF-PD02A only

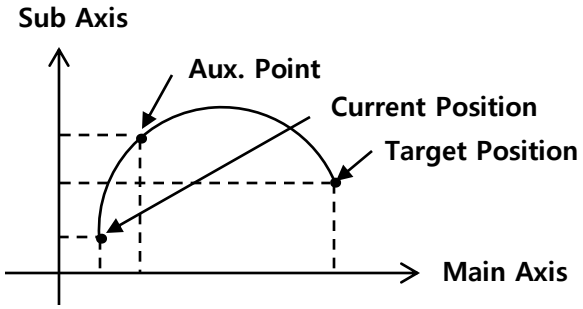
Because XBF-PD02A supports circular interpolation function, not supported by built-in positioning, data items regarding circular interpolation are required. Simply, circular interpolation function is drawing circle or arc with 2 axis' combination. If current and target positions are not equal, arc will be drawn and equal, circle will be drawn.
Speed is to be set in main axis data and is need not to assign in subordinate axis. Speed assigned in main axis data is composite speed and actual main and subordinate axis speed will be calculated by positioning module.

1) Cir. int. Aux. Point.(Circular Interpolation Auxiliary Point)

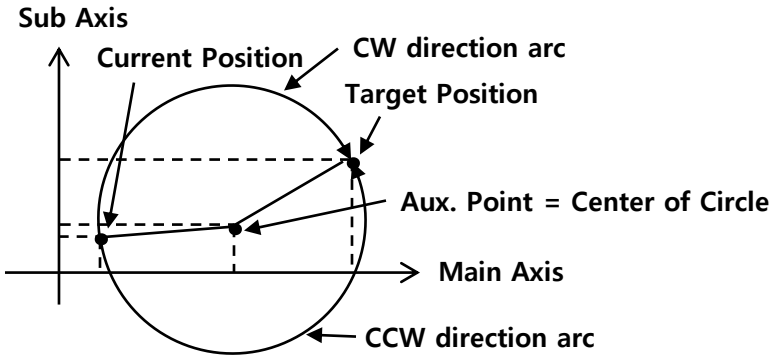
It assigns the auxiliary point position. The meaning of auxiliary point is different depending on circular interpolation mode. If MID(middle) is assigned in Cir. Int. Mode(circular interpolation mode, 8th data item) auxiliary point must be on the circle or arc to draw. And Center is assigned in circular interpolation mode, the auxiliary point will be the center or the circle or arc to draw. Radius is assigned in circular interpolation mode, circular interpolation auxiliary point of main axis is not point position but length or radius in pulse. In this case, circular interpolation point is needless to be assigned.

2) Cir. int. Mode(Circular Interpolation Mode)

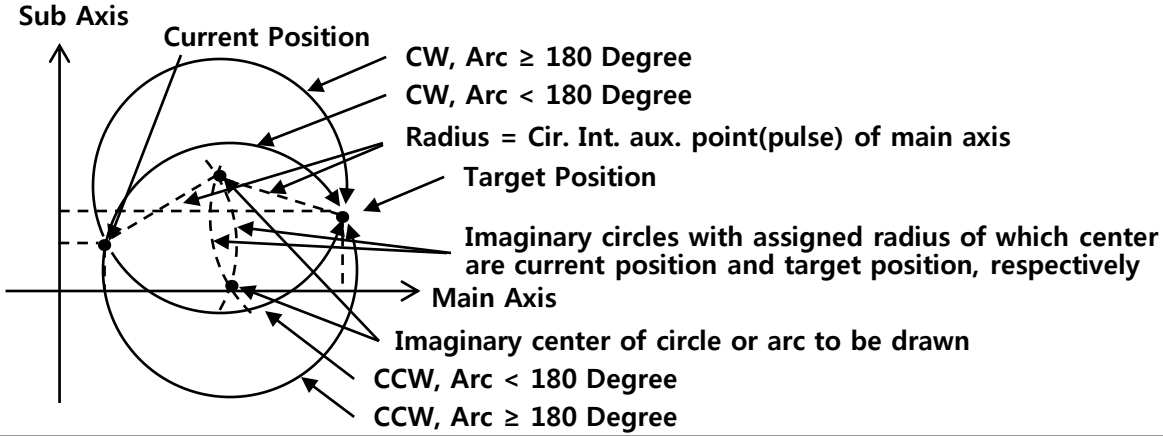
① MID(middle): To use middle mode, circular interpolation auxiliary position must be on the circle or arc to draw. If auxiliary point is not on the circle or arc to draw, error will occur when circulation interpolation is executed.



② Center: To use Center mode, circular interpolation auxiliary position must be the center of the circle or arc to draw. Center mode is used, Cir. int. dir.(Circle interpolation direction) is referred to because two arcs can be drawn when center, and two points are given. If the length from current position to aux. position and from target position to aux. position is different, error will occur when circular interpolation is executed.



③ Radius: Radius mode is used, circular interpolation auxiliary point of main axis is not point position but length or radius in pulse. In this case, circular interpolation point is needless to be assigned in subordinate axis. Circular interpolation direction and size are referred to because totally four circle or arc can be drawn without other condition.
If radius shorter than half of length from current to target position is given, error will occur because imaginary circle center cannot be decided in this case.



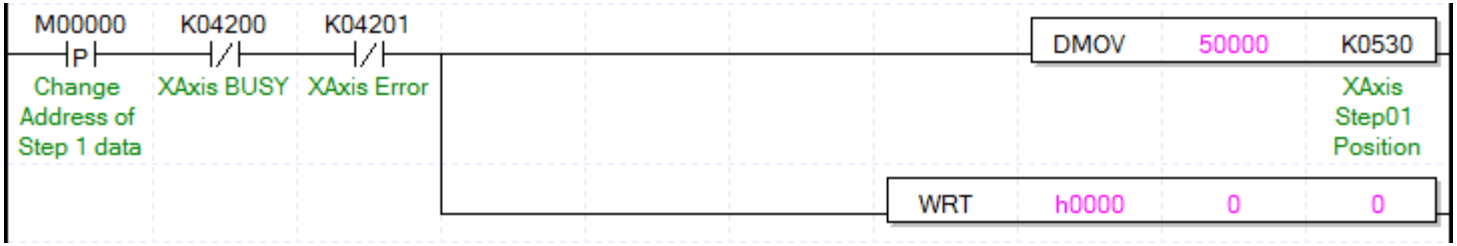
5.5 Modification of Data in Program.

Predefined data can be modified in program. Built-in positioning case, data are stored in positioning flags configured in K device, MOV or DMOV instruction can be used to modify positioning data depending on the size of data to be modified. But, XBF-PD02A case, Instructions TEA, TWR, TEAA are used to modify address or operation speed and TMD instruction must be used to modify data other than address and speed.

5.5.1 Modification of Built-in positioning Data

Like built-in positioning parameter, built-in positioning data can be accessed with positioning flags. Operating data can be modified by changing data in positioning flag in K device, the data will be overwritten by the data in flash memory when the PLC is reset. To store the modified data into flash memory, WRT instruction must be executed after modification of operating data in positioning flag.

If data is changed while operation is executing, error will occur. To prevent error, busy state must be referred to when operating data is modified.



① Base and slot number where XBF-PD02A is attached.
② Axis number: 0 for X axis, 1 for Y axis.
③ Data to be transmitted. When device is assigned, it charges double word(32 bits).
④ Step number to be modified.
⑤ Teaching item. 0 for address, 1 for speed.
⑥ Transmitted data Storage. 0 for RAM, 1 for flash memory(ROM).

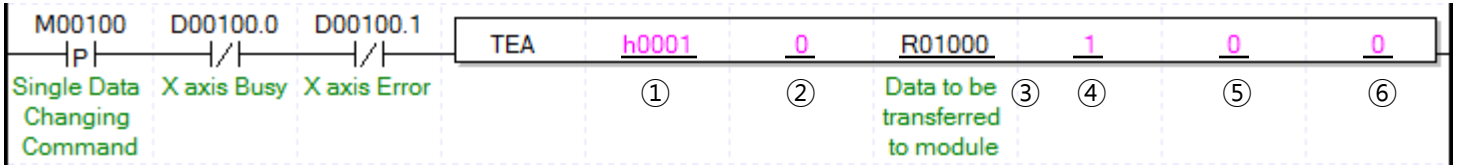
5.5.2 Modification of XBF-PD02A Data

Different from built-in positioning data, XBF-PD02A case, the modified data must be transferred to positioning module. TEA instruction is available to change address or speed of a step, TWR and TEAA instructions are available to change address or speed in continuous multiple, max. 16, steps. TWR and TEAA instructions must be used by pair. TEA or TEAA instruction case, the data storage in module can be selected between RAM or Flash memory(ROM).

To modify the data other than address or speed, TMD instruction must be used. Because the data transferred to module by TMD instruction will be stored in RAM area, the data will be cleared at PLC reset. To store the data permanently, the data must be stored in flash memory in the positioning module with WRT instruction. Because too often writing to flash memory can cause the breakdown of flash memory, it is recommended to stored the data must not be cleared only into flash memory. For example, if address is to be modified, if the address data can be stored in latch device, the data will not be cleared when PLC is reset. In this case, the address data need not to be stored in flash memory.

If data is changed while operation is executing, error will occur. To prevent error, busy state which, 0th bit in the 1st word data read by SRD instruction, must be referred to when operating data is modified.

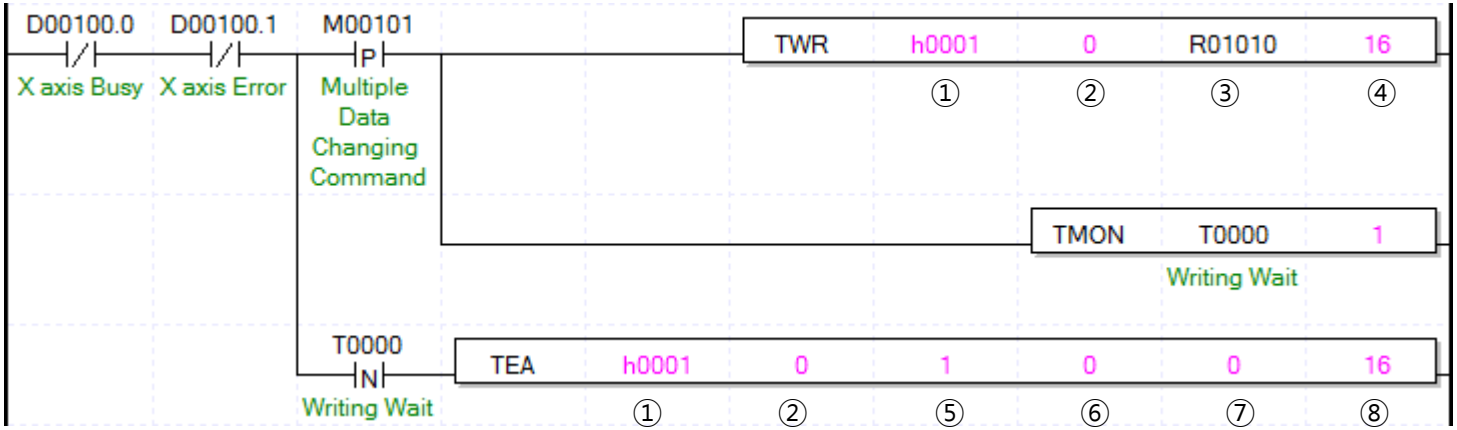
1) Modification of Address or Speed of a Step.



① Base and slot number where XBF-PD02A is attached.
② Axis number: 0 for X axis, 1 for Y axis.
③ Data to be transmitted. When device is assigned, it charges double word(32 bits).
④ Step number to be modified.
⑤ Teaching item. 0 for address, 1 for speed.
⑥ Transmitted data Storage. 0 for RAM, 1 for flash memory(ROM).

2) Modification of Address or Speed of Continuous Multiple steps.

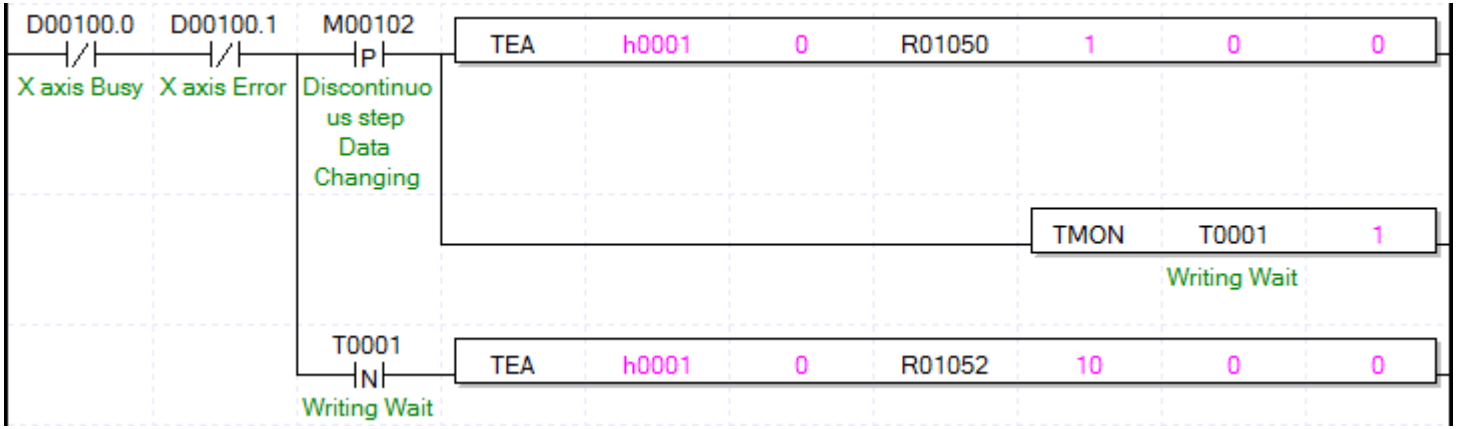
When address or speed of continuous multiple steps are to be modified, TWR and TEAA instructions must be used. There must be a short time gap between execution time of the two instructions.



① Base and slot number where XBF-PD02A is attached.
② Axis number: 0 for X axis, 1 for Y axis.
③ Data to be transmitted. Because one data charges double word(32 bits), total device size is 2 X number assigned in ④.
④ Number of steps of which address or speed will be modified.
⑤ Starting step number to be modified.
⑥ Transmitted data Storage. 0 for RAM, 1 for flash memory(ROM).
⑦ Teaching item. 0 for address, 1 for speed.
⑧ Number of data to be modified. It may or may not equal to the number assigned in ④.

3) Modification of Address or Speed of Discontinuous steps.

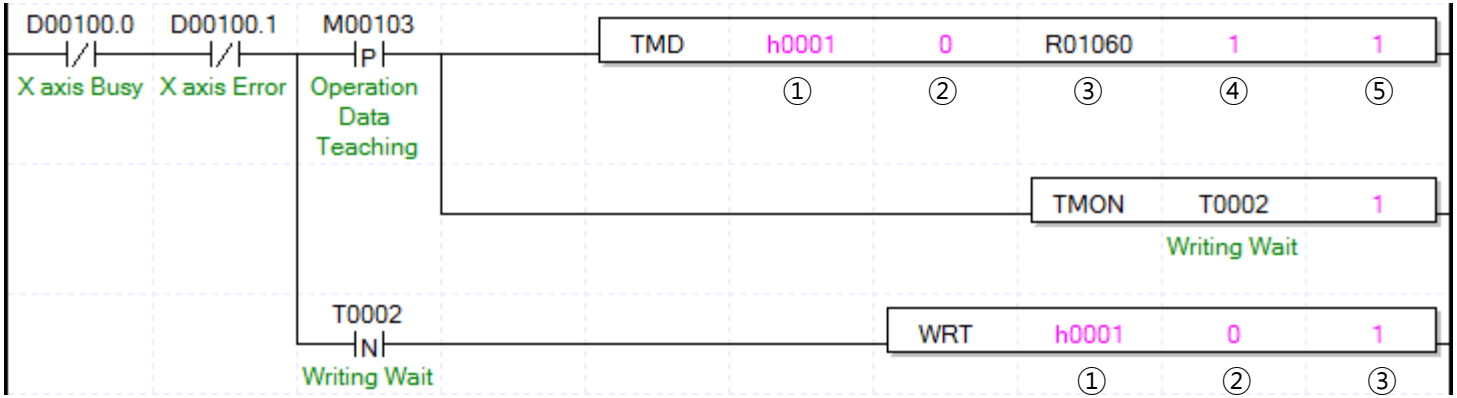
When address or speed of discontinuous steps are to be modified, TEA instruction can be used. And there must be some time gap between execution time.



4) Modification of Data other than Address or Speed.

When data item other than address or speed, TMD instruction must be executed and if more than one items in the same step are to be modified, TMD instruction must be used multiple times and there must be a short time gap between execution time.

If the modified data is to be stored into flash memory, WRT instruction must be executed.



① Base and slot number where XBF-PD02A is attached.

② Axis number: 0 for X axis, 1 for Y axis.

③ Data to be transmitted. When device is assigned, it charges double word(32 bits).

④ Teaching item. Refer to table below.

⑤ Step number to be modified.

Value	Item	Data Range
1	Address	-2,147,483,648 ~ 2,147,483,647 [pulse]
2	Cir. Int. aux. point	
3	Speed	1 ~ 2,000,000 [pulse/s]
4	Dwell time	0 ~ 65,535[ms]

5. Data

Value	Item	Data Range
5	M code number	0 ~ 65,535
6	Cir. Int. turns	0 ~ 65,535
7	Operation method	0:single, 1:repeat
8	Control method	0:position control, 1:speed control
9	Operation pattern	0:End, 1:Keep, 2:CONT
10	Coordinate	0:Absolute, 1:Incremental
11	Cir. Int. size	0:Arc<180, 1:Arc>=180
12	Acc. no.	0 ~ 3
13	Dec. no.	0 ~ 3
14	Cir. Int. mode	0:MID, 1:CENTER, 2:RADIUS
15	Cir. Int. direction	0:CW, 1:CCW
16	Repeat step number	1~150

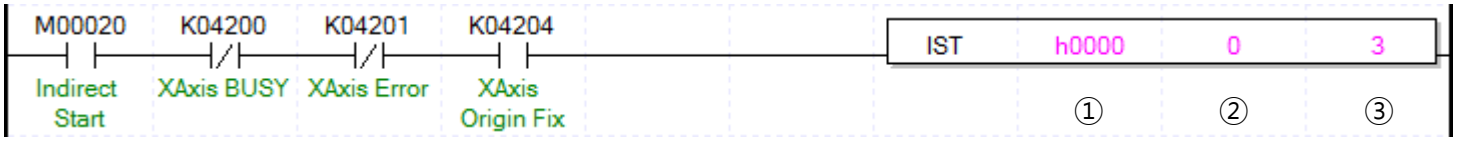
6. Program 2

In this chapter, positioning programs which use predefined data will be introduced. Indirect start instruction, IST, will be used to execute predefined data for single axis positioning. And operations more than 2 axis are combined such as linear or circular interpolation must use data list.
Positioning status and data monitoring is available, which is explained in chapter 4.

6.1 Indirect Start Instruction (IST)

IST instruction is used for execution of a data assigned in data list. With the last operand named step number, a data to be executed is selected. If 0 is assigned in step number of IST instruction, the current step number managed by positioning will be executed. If 0 is assigned in step number of IST instruction, the current step number managed by positioning will be executed.

1) Operands of IST Instruction



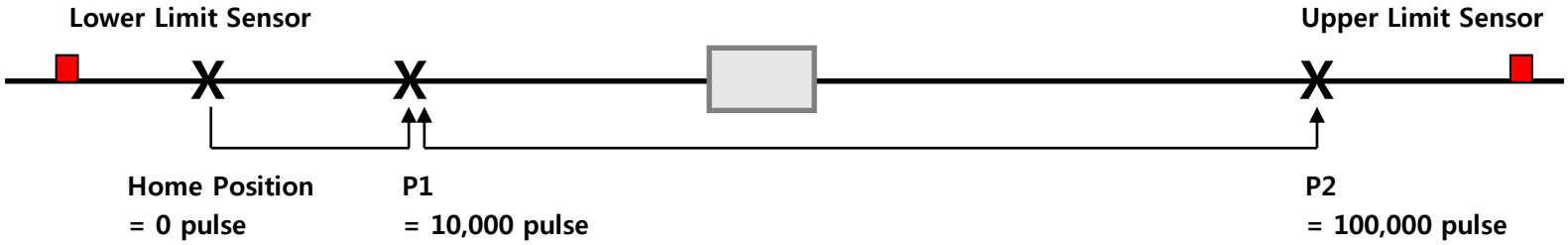
① Base and slot number where XBF-PD02A is attached.
② Axis number: 0 for X axis, 1 for Y axis.
③ Step number to be executed. If device is to be assigned, 1 word will be changed.

6.2 Application Program with IST Instruction

In this paragraph, some simple, widely used positioning programs using IST instruction will be introduced. For simplicity, instructions explained in chapter 4 and teaching instruction which are indispensable for positioning system will be omitted as long as special application or explanation is not needed. XBC-H type built-in positioning is assumed for all programs while there is no additional comments.

6.2.1 Going and Returning System

1) System Overview

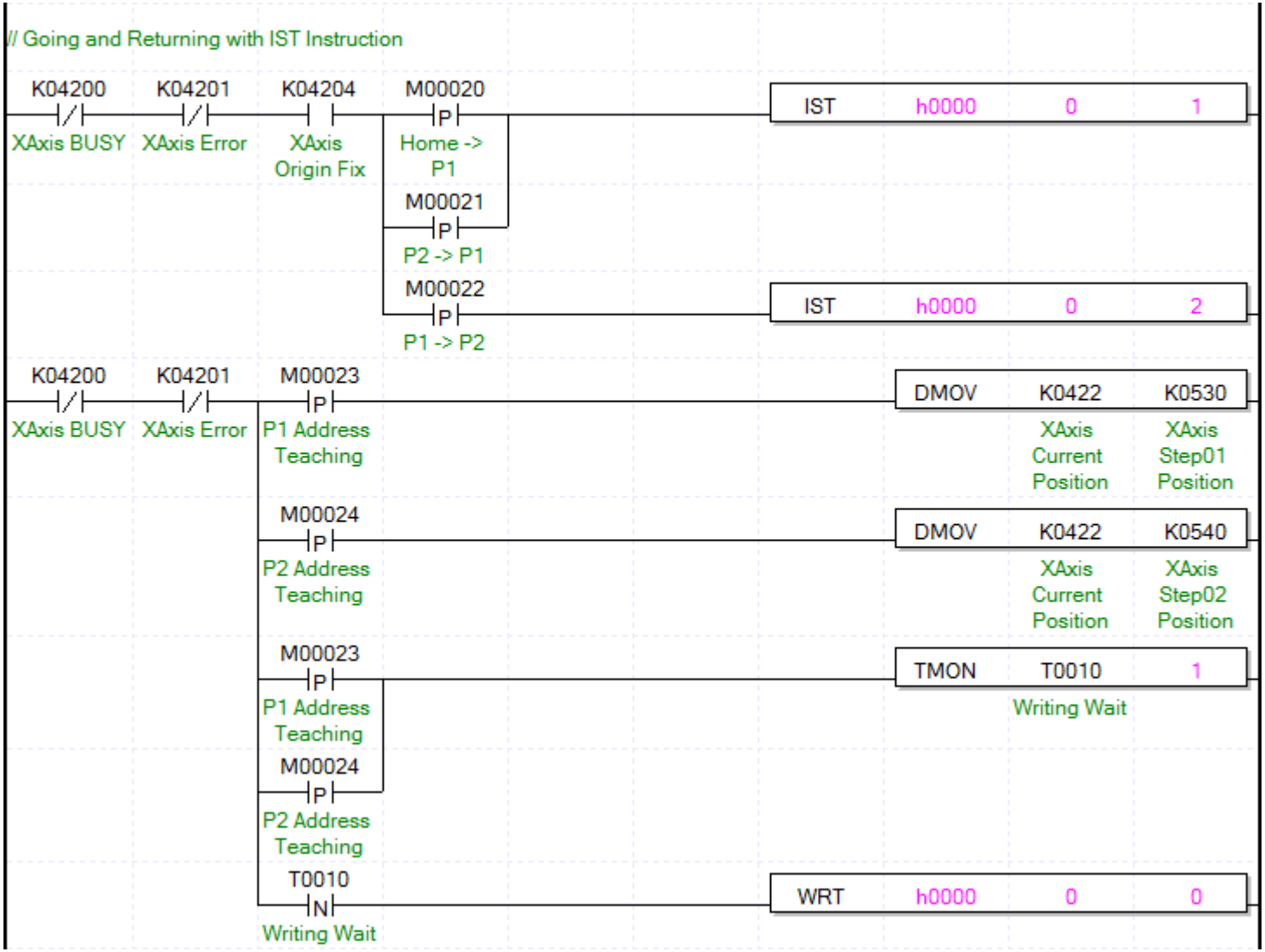


2) Data Setting

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
1	ABS	END	POS	SIN	0	10000	0	No.1	50000	0
2	ABS	END	POS	SIN	0	100000	0	No.1	50000	0

6. Program 2

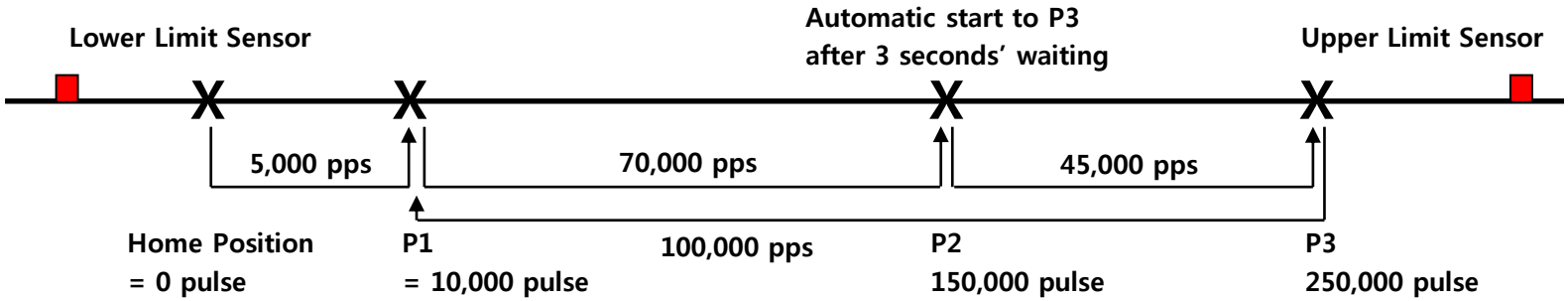
3) Program



* In actual system, exact position data can be acquired by checking current position when the object is moved to the exact position with jog and inching operation after home position setting.

6.2.2 Automatic start to next position

1) System Overview

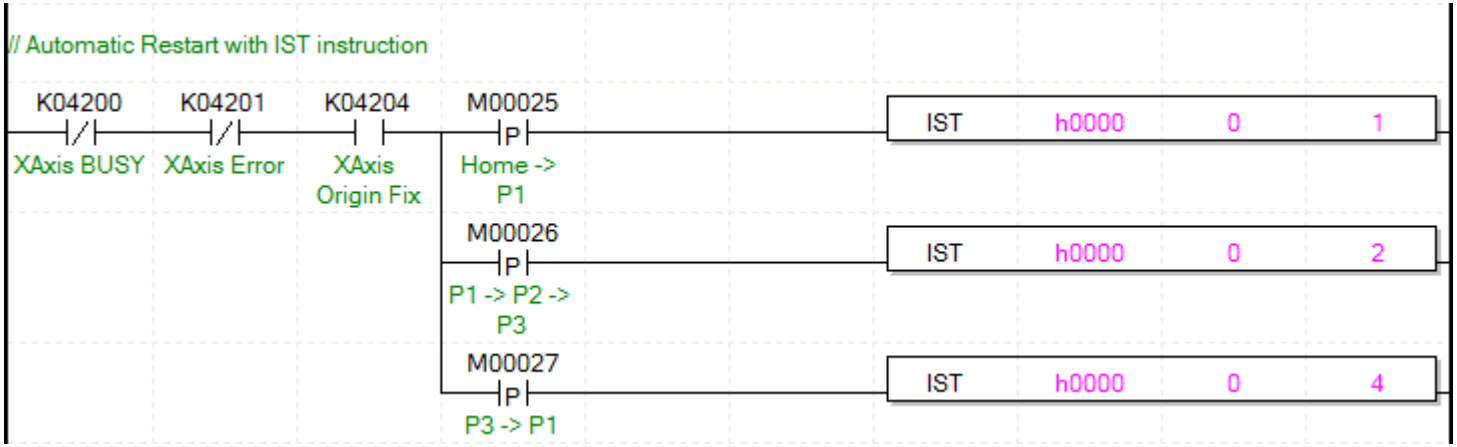


2) Data Setting

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
1	ABS	END	POS	SIN	0	10000	0	No.1	5000	0
2	ABS	KEEP	POS	SIN	0	150000	0	No.1	70000	3000
3	ABS	END	POS	SIN	0	250000	0	No.1	45000	0
4	ABS	END	POS	SIN	0	10000	0	No.1	100000	0

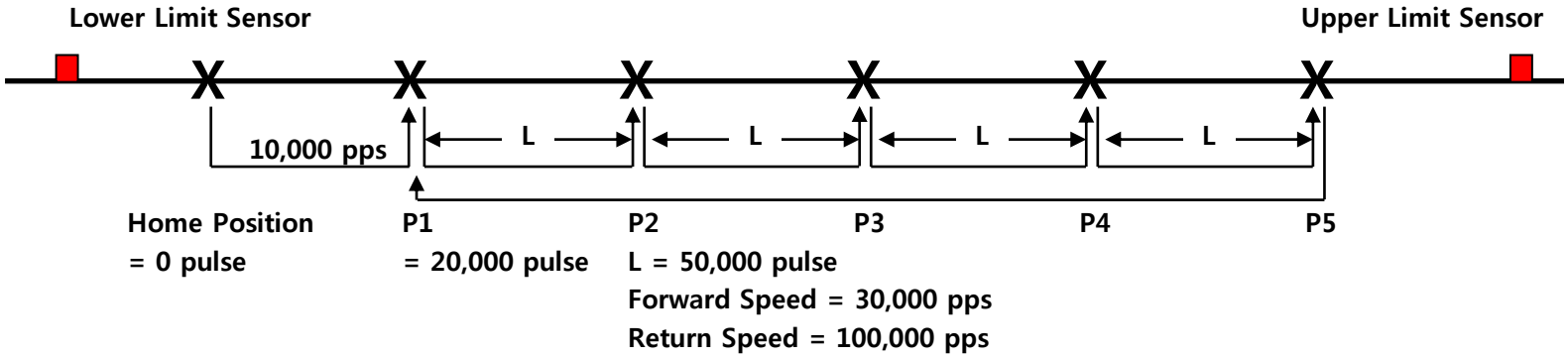
6. Program 2

3) Program



6.2.3 Moving Same Length

1) System Overview

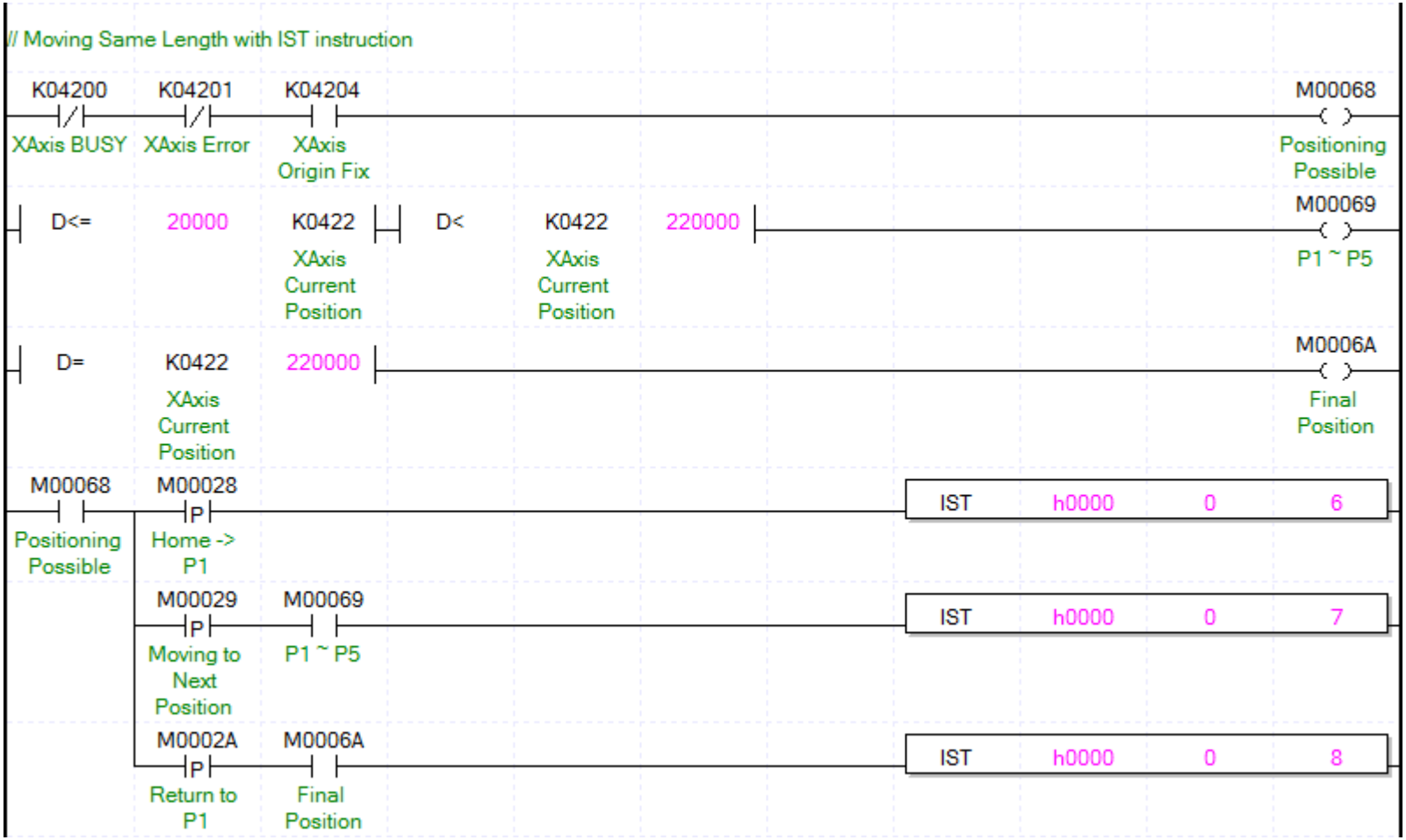


2) Data Setting

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
6	ABS	END	POS	SIN	0	20000	0	No.1	10000	0
7	INC	END	POS	SIN	0	50000	0	No.1	30000	0
8	ABS	END	POS	SIN	0	20000	0	No.1	100000	0

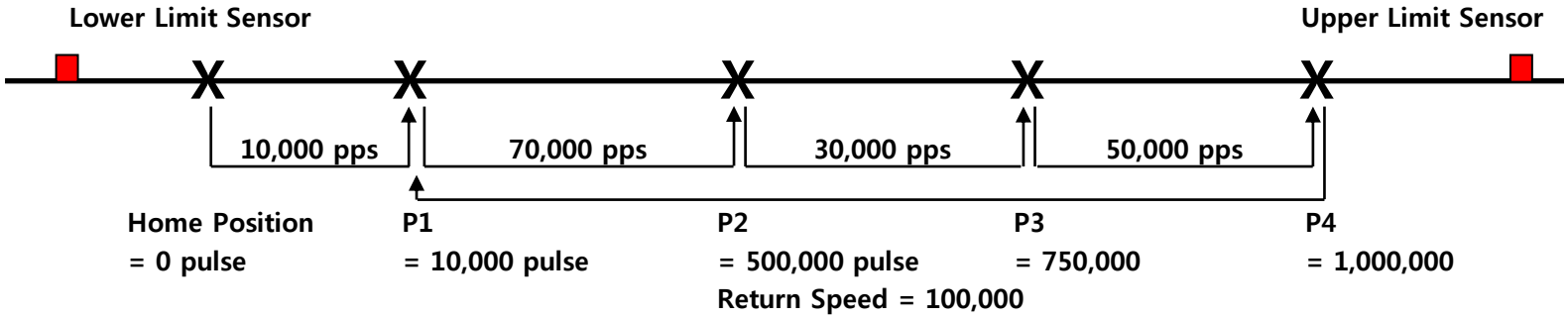
6. Program 2

3) Program



6.2.4 Speed Changing while Positioning is executing

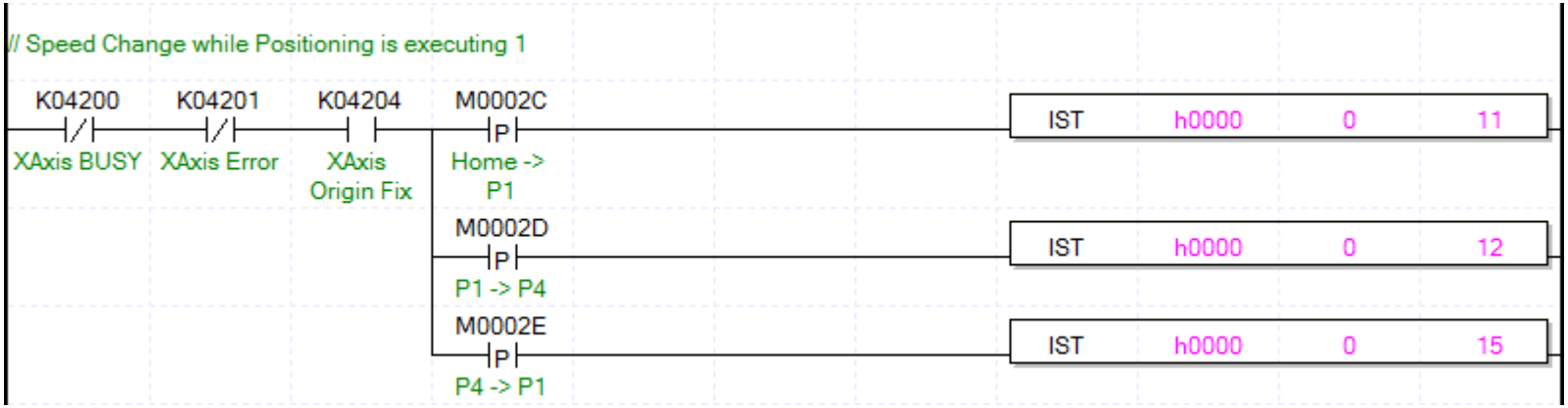
1) System Overview



2) Data Setting 1: Using Multiple Steps

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
11	ABS	END	POS	SIN	0	10000	0	No.1	10000	0
12	ABS	CONT	POS	SIN	0	500000	0	No.1	70000	0
13	ABS	CONT	POS	SIN	0	750000	0	No.1	30000	0
14	ABS	END	POS	SIN	0	1000000	0	No.1	50000	0
15	ABS	END	POS	SIN	0	10000	0	No.1	100000	0

3) Program 1

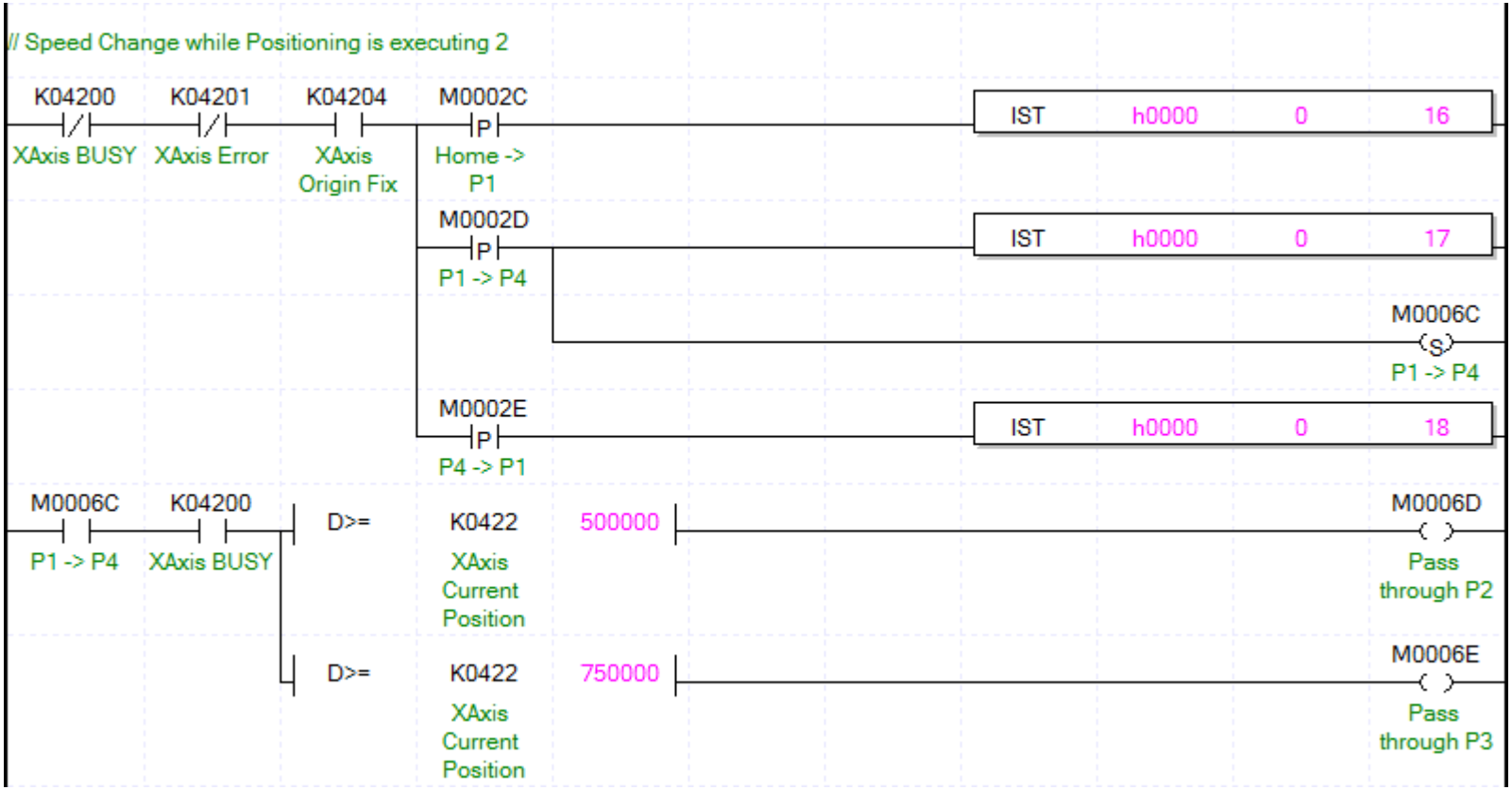


6. Program 2

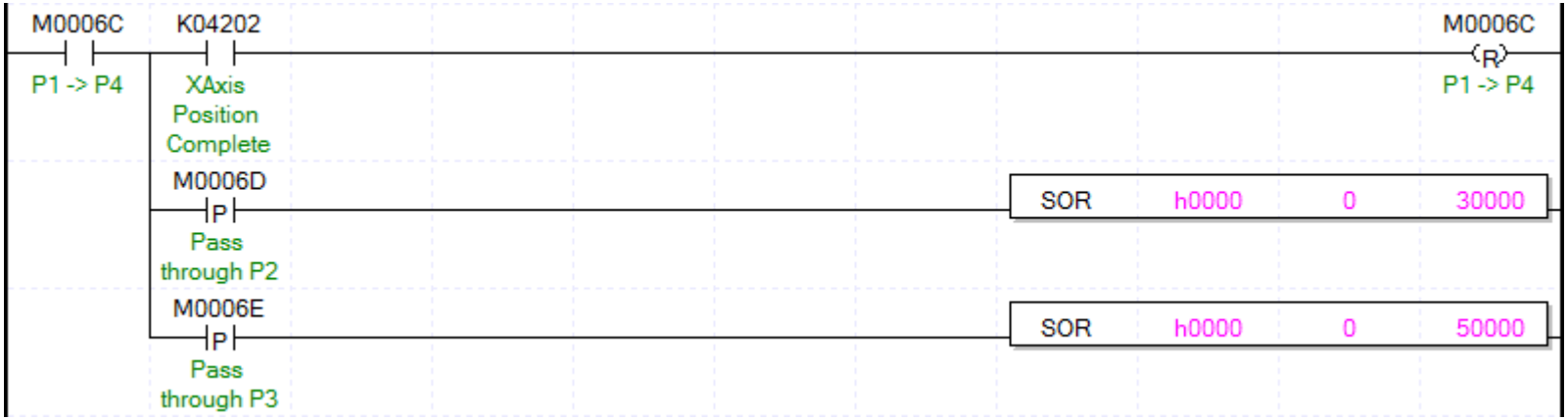
4) Data Setting 2: Using Single Step and Speed Override

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
16	ABS	END	POS	SIN	0	10000	0	No.1	10000	0
17	ABS	END	POS	SIN	0	1000000	0	No.1	70000	0
18	ABS	END	POS	SIN	0	10000	0	No.1	100000	0

5) Program 2



6. Program 2


M0006C
P1 -> P4
K04202
XAxis
Position
Complete
M0006C
R
P1 -> P4
M0006D
P
Pass
through P2
SOR
h0000
0
30000
M0006E
P
Pass
through P3
SOR
h0000
0
50000

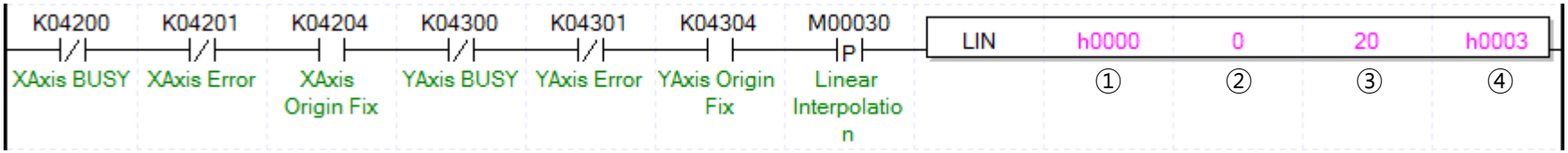
6.3 Application Program with Multiple Axis

In this paragraph, some simple, widely used positioning programs using multiple axis such as linear or circular interpolation will be introduced.

6.3.1 Linear Interpolation

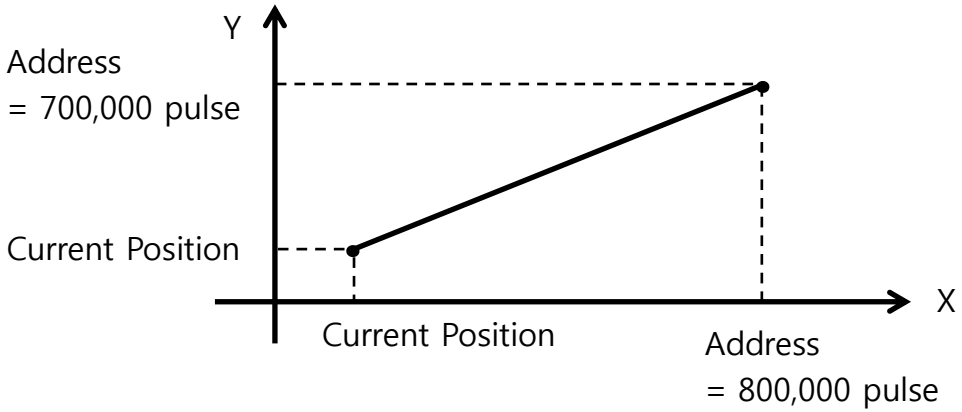
Linear interpolation is positioning operation that draws a straight line from the point designated by current positions to the point designated by target positions of 2 axis participate in linear interpolation operation. Linear interpolation operation is main and subordinate axis structured operation and main axis keeps the speed assigned in data and the subordinate axis speed will be calculated automatically. Linear interpolation data for axis data participate in linear interpolation operation must be assigned in same step number.

1) Linear Interpolation Instruction - LIN



① Base and slot number where XBF-PD02A is attached.
② Main axis number: 0 for X axis, 1 for Y axis.
③ Step number where linear interpolation data is assigned. In this example, linear interpolation data must be assigned in 20th step of X and Y axis data.
④ Axis participate in linear interpolation. Always h0003 for built-in and XBF-PD02A. Bit 0 On: X axis, Bit 1 On: Y axis

2) Linear Interpolation Example



3) Data Setting

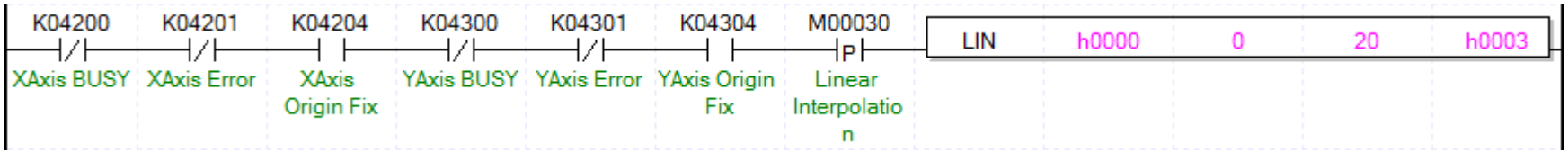
① X axis(main axis) data. Address and speed must be assigned for main axis.

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
20	ABS	END	POS	SIN	0	800000	0	No.1	50000	0

② Y axis(subordinate axis) data. Speed is needless to be assigned for subordinate axis because the subordinate axis speed will be calculated automatically to make a straight line.

	Coord	Pattern	Control	Method	REP Step	Address (pulse)	M Code	A/D No	Speed (pls/s)	Dwell (ms)
20	ABS	END	POS	SIN	0	700000	0	No.1	0	0

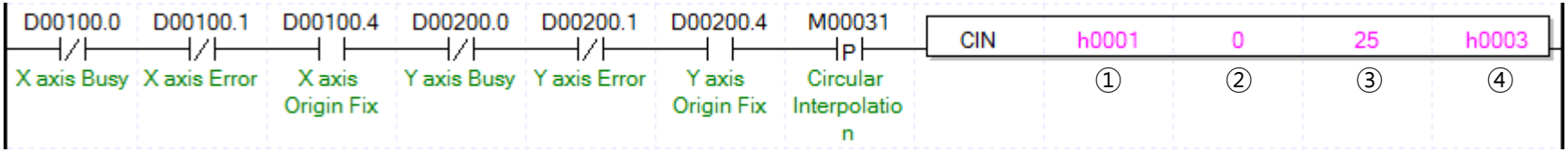
4) Program



6.3.2 Circular Interpolation(XBF-PD02A Only)

Circular interpolation is positioning operation that draws an arc from the point designated by current positions to the point designated by target positions of 2 axis participate in circular interpolation operation. If target position is equal to current position and circular interpolation is executed, a circle will be drawn. Because limitless number of arc can be drawn when only 2 points are given, one more item such as a point in a arc, center of circle or radius of circle must be given to define unique circle. For more detail, refer to phrase 5.4.2.

1) Circular Interpolation Instruction - CIN



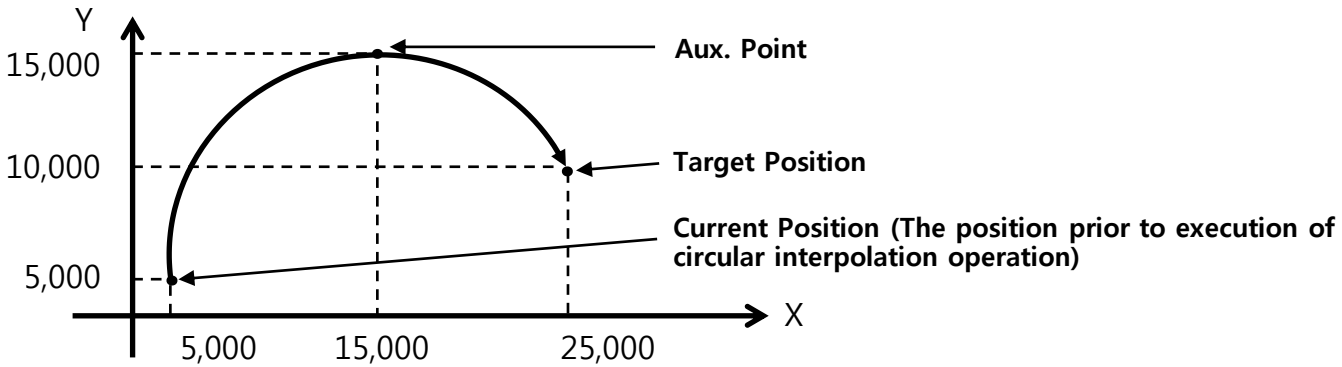
① Base and slot number where XBF-PD02A is attached.

② Main axis number: 0 for X axis, 1 for Y axis.

③ Step number where circular interpolation data is assigned. In this example, circular interpolation data must be assigned in 25th step of X and Y axis data.

④ Axis participate in linear interpolation. Always h0003 for built-in and XBF-PD02A. Bit 0 On: X axis, Bit 1 On: Y axis

2) Circular Interpolation Example 1 –MID Mode



3) Data Setting

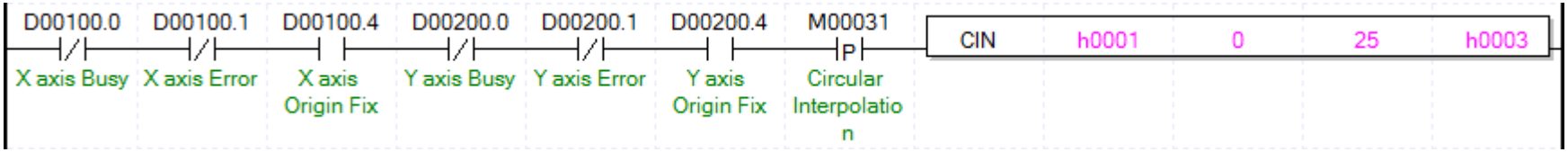
① X axis(main axis) data. Address and speed must be assigned for main axis. Speed assigned in main axis data is composite speed and actual main and subordinate axis speed will be calculated by positioning module.

	Coord.	Pattern	Control	Method	REP Step	Address (pulse)	Cir. int. aux. point(pulse)	Cir. int. mode	M code	Acc. no.	Dec. no.	Speed (pls/s)	Dwell time (ms)	Cir. int. turns	Cir. int. dir.	Cir. int. size.
25	ABS	END	POS	SIN	0	25000	15000	MID	0	No.1	No.1	50000	0	0	CW	Arc<180

② Y axis(subordinate axis) data. Speed is needless to be assigned for subordinate axis.

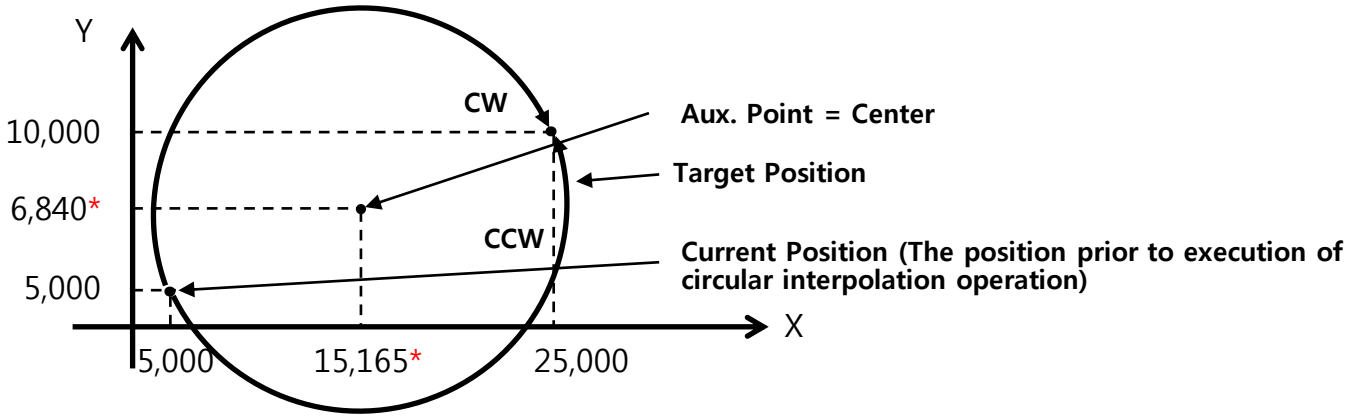
	Coord.	Pattern	Control	Method	REP Step	Address (pulse)	Cir. int. aux. point(pulse)	Cir. int. mode	M code	Acc. no.	Dec. no.	Speed (pls/s)	Dwell time (ms)	Cir. int. turns	Cir. int. dir.	Cir. int. size.
25	ABS	END	POS	SIN	0	10000	15000	MID	0	No.1	No.1	1	0	0	CW	Arc<180

4) Program



* Prior to execution of circulation interpolation operation, it is assumed that X and Y is located at 5,000 pulse position, respectively.

5) Circular Interpolation Example 2 – Center Mode



6) Data Setting

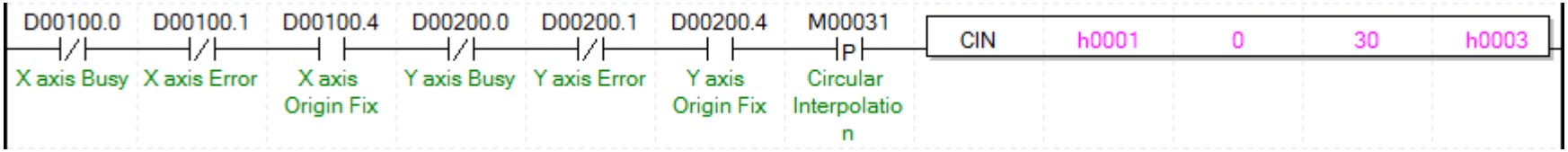
① X axis(main axis) data. Address and speed must be assigned for main axis. Speed assigned in main axis data is composite speed and actual main and subordinate axis speed will be calculated by positioning module.

	Coord.	Pattern	Control	Method	REP Step	Address (pulse)	Cir. int. aux. point(pulse)	Cir. int. mode	M code	Acc. no.	Dec. no.	Speed (pls/s)	Dwell time (ms)	Cir. int. turns	Cir. int. dir.	Cir. int. size.
30	ABS	END	POS	SIN	0	25000	15165	CENTER	0	No.1	No.1	50000	0	0	CW	Arc<180

② Y axis(subordinate axis) data. Speed is needless to be assigned for subordinate axis.

	Coord.	Pattern	Control	Method	REP Step	Address (pulse)	Cir. int. aux. point(pulse)	Cir. int. mode	M code	Acc. no.	Dec. no.	Speed (pls/s)	Dwell time (ms)	Cir. int. turns	Cir. int. dir.	Cir. int. size.
30	ABS	END	POS	SIN	0	10000	6840	CENTER	0	No.1	No.1	1	0	0	CW	Arc<180

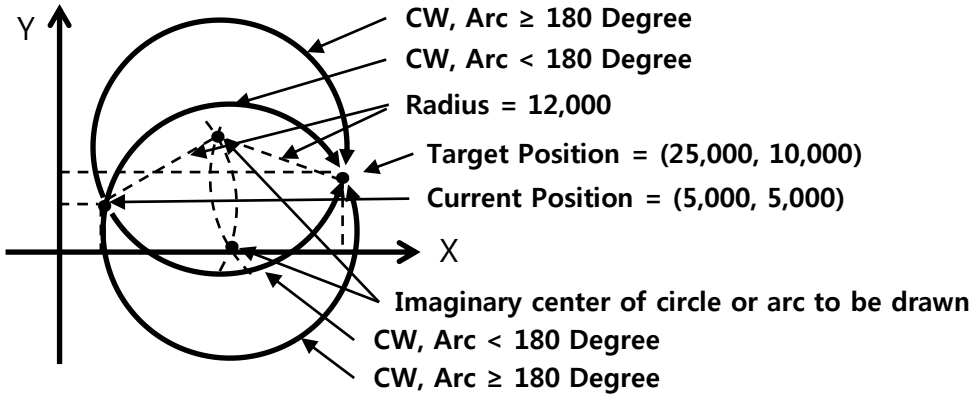
7) Program



* Prior to execution of circulation interpolation operation, it is assumed that X and Y is located at 5,000 pulse position, respectively.

* Exact data can be obtained CAD tool.

5) Circular Interpolation Example 3 – Radius Mode



6) Data Setting

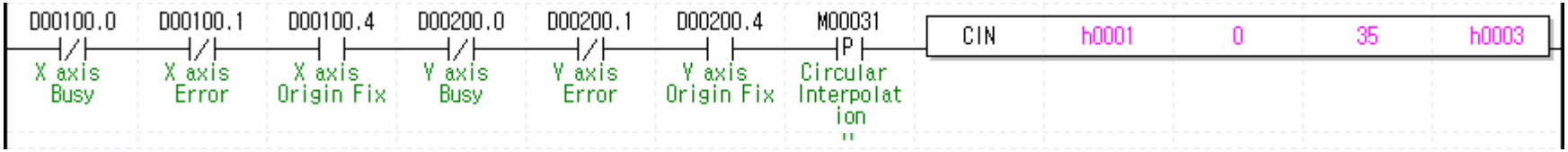
① X axis(main axis) data. Address and speed must be assigned for main axis. Speed assigned in main axis data is composite speed and actual main and subordinate axis speed will be calculated by positioning module.

	Coord.	Pattern	Control	Method	REP Step	Address (pulse)	Cir. int. aux. point(pulse)	Cir. int. mode	M code	Acc. no.	Dec. no.	Speed (pls/s)	Dwell time (ms)	Cir. int. turns	Cir. int. dir.	Cir. int. size.
35	ABS	END	POS	SIN	0	25000	12000	RADIUS	0	No.1	No.1	50000	0	0	CW	Arc<180

② Y axis(subordinate axis) data. Speed is needless to be assigned for subordinate axis.

	Coord.	Pattern	Control	Method	REP Step	Address (pulse)	Cir. int. aux. point(pulse)	Cir. int. mode	M code	Acc. no.	Dec. no.	Speed (pls/s)	Dwell time (ms)	Cir. int. turns	Cir. int. dir.	Cir. int. size.
35	ABS	END	POS	SIN	0	10000	0	MID	0	No.1	No.1	1	0	0	CW	Arc<180

7) Program



* Prior to execution of circulation interpolation operation, it is assumed that X and Y is located at 5,000 pulse position, respectively.

* Exact data can be obtained CAD tool.