LX3V-4PG

User manual

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1. Introduction

The LX3V-4PG is pulse generator unit which has four channels. Each channel can control positioning of an axis independently. It works by sending specified quantity of pulses (200 kHz maximum) to Server controller or step motors.

The LX3V-4PG is an extension module of LX3V series PLC, which transfers data with the PLC using the FROM/TO instructions.

There are two versions for LX3V-4PG, one is LX3V-4PGA (Advanced), and the other is LX3V-4PGB (Basic). Please get more detail from [BFM description]

Warnings:
Make sure power is Cut off before installation/disassembly of the unit or connection of wires onto the unit, to prevent electric shock or product damage.

2. Dimensions

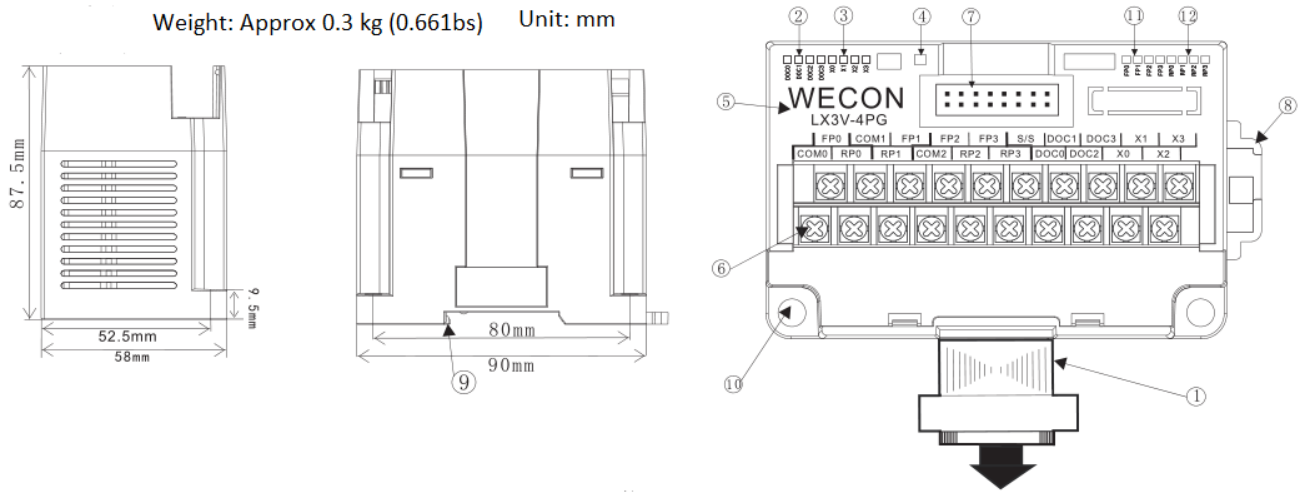
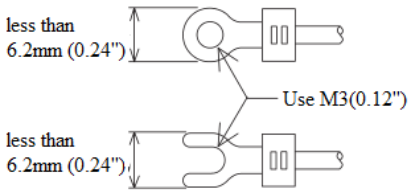


Figure 2-1

①Extension cable and connector
②Com LED: Light when communicating
③Power LED: Light when connect to 24V
④State LED: Light when normal condition
⑤Module name
⑥Analog signal output terminal

⑦Extension module interface
⑧DIN rail mounting slot
⑨DIN rail hook
⑩Mounting holes (ϕ4.5)

2.1 Crimp terminations



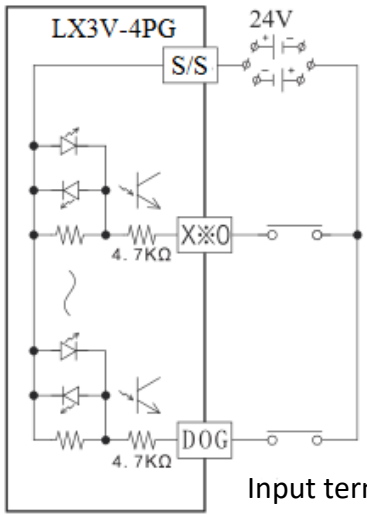
- Please use crimp terminals as indicated on the graph.
- The tightening torque should be applied 5 to 8 Kg.cm.
- Other terminals should be empty but only wiring terminals mention in this manual.

2.2 Terminals Definition

Terminal	Instruction	Terminal	Instruction	Terminal	Instruction
COM0	Common terminal for channel 1	FP2	Channel 3 outputs pulses	S/S	Common terminal for X and DOG, it supports NPN/PNP type.
FP0	Channel 1 outputs pulses	RP2	Channel 3 outputs direction		
RP0	Channel 1 outputs direction	FP3	Channel 4 outputs pulses	DOG 3	Home position return: Channel 4 near point signal input
COM1	Common terminal for channel 2	RP3	Channel 4 outputs direction	X 0	Channel 1 interrupt signal input
FP1	Channel 2 outputs pulses	DOG 0	Home position return: Channel 1 near point signal input	X 1	Channel 2 interrupt signal input
RP1	Channel 2 outputs direction	DOG 1	Home position return: Channel 2 near point signal input	X 2	Channel 3 interrupt signal input
COM 2	Common terminal for channel 3 and 4	DOG 2	Home position return: Channel 3 near point signal input	X 3	Channel 4 interrupt signal input

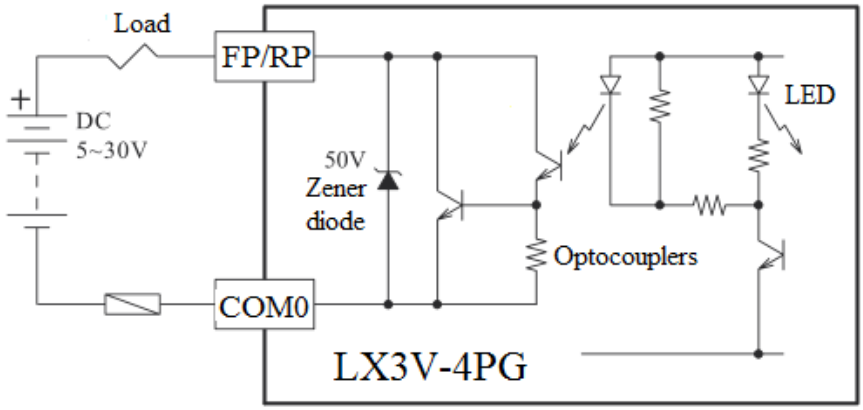
3. Input and output Specification

3.1 Input specification

LX3V-4PG input specification			
X input and DOG input	 This is NPN type, if you want to PNP type, please connect S/S to 24V negative electrode, and X connects to positive electrode. Input terminal: X0-X3, DOG0-DOG3		
Input signal voltage	DC V 24 ±10%	Input signal type	Contact input, NPN and PNP
Input signal current	5 mA /DC24V	Circuit insulation	Optocouples insulation
Input ON current	3.5 mA / DC24 V	Input action	LED turns on, when input ON
Input OFF current	Less than 1.5 mA		

3.2 Output specification

Output circuit
Output: FP0-3: High-speed pulse output; Electrical parameters: Same as PLC high speed output (Y0-Y1); PR0-3: Normal output direction; Electrical parameters: Same as PLC normal output (from Y4);



Items		Transistor output
Models		LX3V series PLC
External power supply		DC 5~30V
Circuit insulation		Optocouplers insulation
Action		LED turns on when optocoupler works.
Maximum load	Resistance	0.5A/ each point, 0.8A/ four points (0.3A/each point in FP terminal)
	Inductance	12W/DC24V (7.2W/DC24V in FP terminal)
	Lamp	0.9W/DC24V (0.9W/DC24V in FP terminal)
Leakage current		0.1mA/DC30V
Minimum load		DC5V2mA
Response time	Input current (ON)	5us less than 0.2ms (FP terminal)
	Input current (OFF)	5us less than 0.2ms (FP terminal)
Output type		NPN signal

4. Function description

4.1 BFM list

BFM								Latched	Operation	Register name	B15	B14	B13	B12	B11	B10	Default	Range
CH1		CH2		CH3		CH4												
H16	L16	H16	L16	H16	L16	H16	L16											
0		40		80		120		X	R/W	Pulse rate	Unit : PLUSE/ REV (Pulse/ Revolution) [1]						2000	1-32,767

2	1	42	41	82	81	122	121	X	R/W	Feed rate	Unit: it set by b2-b0 of BFM#3 [1]			1000	1-9 99, 999
3		43		83		123		X	R/W	Parameters	--	DOG input polarity	S-type acceleration and deceleration [3]	Home position return direction	0	0-5
5	4	45	44	85	84	125	124	X	R/W	Maximum speed)	The unit value depends on the system of units set in the BFM #3 b1 and b0				100KHz	10Hz-200,000Hz
6		46		86		126		X	R/W	Bias speed	The unit value depends on the system of units set in the BFM #3 b1 and b0				0Hz	0Hz -10,000 Hz
8	7	48	47	88	87	128	127	X	R/W	JOG speed	The unit value depends on the system of units set in the BFM #3 b1 and b0				10KHz	10Hz-100,000Hz
10	9	50	49	90	89	130	129	X	R/W	Home position return speed (high speed	The unit value depends on the system of units set in the BFM #3 b1 and b0				50KHz	1Hz -100,000Hz
11		51		91		131		X	R/W	Home position return speed (creep speed)	The unit value is depending on the system of units set in the BFM #3 b1 and b0				1KHz	0Hz -10,000 Hz
12		52		92		132		X	R/W	Reserved	--				--	--
14	1	54	5	94	93	13	13	O	R/W	Home	The unit value depends on the system of				0	-99

	3		3			4	3			position	units set in the BFM #3 b1 and b0		9,999-999,999
15		55		95		135		X	R/W	Acceleration time	Time from the bias speed Accelerating to the maximum speed.	100 ms	20-32000 ms
16		56		96		136		X	R/W	Deceleration time	Time from the maximum Deceleration to the bias speed.	100 ms	20-32000 ms
18	17	58	57	98	97	138	137	X	R/W	Set position (I)	The unit value depends on the system of units set in the BFM #3 b1 and b0	0	-999,999-999,999
20	19	60	59	100	99	140	139	X	R/W	Operating speed (I)	The unit value depends on the system of units set in the BFM #3 b1 and b0	10Hz	10Hz-200,000Hz
22	21	62	61	102	101	142	141	X	R/W	Set position (II)	The unit value is depending on the system of units set in the BFM #3 b1 and b0	0	-999,999-999,999
24	23	64	63	104	103	144	143	X	R/W	Operating speed (II)	The unit value is depending on the system of units set in the BFM #3 b1 and b0	10Hz	10Hz-200,000Hz
25		65		105		145		X	R/W	Operating mode	-	Variable speed - Two-speed positi	--	--

									d operation start		on start		
27	26	67	66	107	106	147	146	O	R/W	Current position	The unit value is depending on the system of units set in the BFM #3 b1 and b0		
28		68		108		148		X	R/W	Status flag	--	Interrupt signal	--	--
29		69		109		149		X	R	Error code	--		--	--
30		70		110		150		X	R	Model code	LX3V-4PGB: 5110; LX3V-4PGA: 5120; [5]		K5110	
31		71		111		151		X	R	Version code			K13301	--
32		72		112		152		X	R	Reserved	--		--	
33		73		113		153		X	R	Reserved				
34		74		114		154		X	R	Reserved				
35		75		115		155		X	R	Reserved				
36		76		116		156		X	R	Reserved				
37		77		117		157		X	R	Reserved				
38		78		118		158		X	R	Reserved				
39		79		119		159		X	R	Reserved				

BFM List	**CH1**	3	25	28
	CH2	43	65	68
	CH3	83	105	108
	CH4	123	145	148
Device name		Parameters	Operating mode	Flags
b9		Rotation direction	Interrupt single speed positioning start[3]	CLR signal
b8		--	Single speed positioning start	Positioning completed flag
b7		--	Relative /absolute position	Error flag
b6		Interrupt signal input polarity[3]	Home position return start	Current position value overflow
b5		Positioning data multiple 10^0~10^3	JOG- operation	--
b4			JOG+ operation	DOG signal

b3		Forward pulse stop	Stop signal
b2		Reverse pulse stop	Home position return completed
b1	System units: motor systems, mechanical systems, combined systems.	STOP	Reverse rotation/ Forward rotation
b0		Error reset	Ready/Busy

Note:

Symbol remarks: O means power-off save type; X means power-off non-save type; R means read only; W means read and write.

[1] Unit is um/R, mdeg/R or 10-4 inch/R.

[2] Unit is PLS, um/R, mdeg/R or 10-4 inch depending on the system of units set in the BFM #3 b1 and b0.

[3] S-type acceleration and deceleration interrupt single speed positioning and two-speed positioning are available in advanced version.

[4] When there are more than one bits set on in BFM #25 b6~b4, b12~b8, the operation will not be executed.

[5] "5110" (basic): it has JOG, single speed positioning, home position return and speed change; "5120" (advanced): it has all functions.

4.2 BFM instruction

4.2.1 System of Units and Parameter Setting

1) [BFM #0] Pulse rate

This is the count of input pulses what the motor needs to rotate 1 revolution. It is not the count of encoder pulses that generates by motor when it rotates 1 revolution. (The pulse speed is different value according with the electronic gear ratio.) The BFM #0 is not required to be set when the motor system of units is selected.

2) [BFMs #2 and #1] Feed rate

b1 (distance specification) = 1 to 999,999 um/R

b2 (angle specification) = 1 to 999,999 mdeg/R

b3 (distance specification) = 1 to 999,999x10-4 inch/R

This is the machine feeding distance while the motor rotates by 1 revolution. One of B1, B2 and

B3 could be selected, the unit could be um/R, mdeg/R and 10-4 inch/R. The BFMs #2 and #1 are not required to be set when the motor system of units is selected.

3) [BFM #3] Parameters (b0 to b15)

- System of units (b1, b0)

b1	b0	System of units	Remarks
0	0	Motor system	Units based on pulses
0	1	Machine system	Units based on lengths and angles
1	0	Combined system	Units based on lengths and angles for position units based on HZ for speed
1	1		

The table below shows the units for position and speed in accordance with the setting of the BFMs #2 and #1

	Selection of feed rate	Motor system	Machine system	Combined system
Position data*1	Unit 1	PLS	um	
	Unit 2	PLS	mdeg	
	Unit 3	PLS	10^{-4} inch	
Speed data*2	Unit 1	Hz		cm / min
	Unit 2	Hz		10 deg /min
	Unit 3	Hz		inch / min

*1 position data: HP, P (I), P (II), CP.

*2 speed data: Vmax, Vbia, Vjog, Vrt, V (I), V (II).

- Multiplication of position data (b5, b4)

b5	b6	Multiplication
0	0	10^0
0	1	10^1
1	0	10^2
1	1	10^3

The position data HP, P (I), P (II) and CP will be multiplied by the value shown in the table on the left.

Example: When the value of the set position P(I) is 123 and the BFM #3 (b5, b4) is (1, 1), the actual position (or travel) becomes as follows:

Motor system units	123 * 10^3=123,000 (pulses)
Machine system units	123*10^3=123,000 (um, mdeg, 10^{-4}inch)
Combined system units	=123 (mm,deg, 10^{-1}inch)

- Rotation direction (b9)

When b9 = 0: The current position (CP) value increases with a forward pulse (FP).
When b9 = 1: The current position (CP) value decreases with a forward pulse (FP).
This bit is used for the initialized setting. The change of rotation direction is not active when the positioning works.

- The direction of home position return (b10)

When b10 = 0: The current position (CP) value decreases during return to the home position.
When b10 = 1: The current position (CP) value increases during return to the home position.

- S-type acceleration and deceleration(b11)

When b11=0, the acceleration is constant during the process of accelerating and decelerating for positioning, the curve of speed is trapezoidal.
When b11=1, the curve of speed is S-type during the process of accelerating and decelerating for positioning.

- DOG input polarity (b12)

When b12 = 0: The DOG (near point signal) is turned on when the workpiece is approaching the home position.
When b12 = 1: The DOG (near point signal) is turned off when the workpiece is approaching the home position.

4.2.2 Speed Data and Positioning Data

1) [BFMs #5 and #4] Maximum speed V_{max}

Motor system and combined system: 1 to 200,000 Hz
This is the setting of maximum speed. Make sure that the bias speed (BFM #6), the JOG speed (BFMs #7 and #8), the speed of home position return (BFMs #9 and #10), the creep speed (BFM #11), the operating speed (I) (BFMs #19 and #20) and the operating speed (II) (BFMs #23 and #24) should be equal to or less than the maximum speed. The degree of acceleration/deceleration is determined by this maximum speed, the bias speed (BFM #6), the acceleration time (BFM #15) and the deceleration time (BFM#16).

2) [BFM #6] Bias speed V_{bia}

The range is 0 to 10,000Hz
This is the bias speed for start. When the LX3V-4PG and the stepper motor works together, it is necessary to set a value while considering the resonance area and the self-start frequency of the stepper motor

3) [BFMs #8 and #7] JOG speed V_{JOG}

The range is 1 to 100,000Hz

This is the speed for manual forward/reverse (JOG+/JOG-). It should be between the bias speed V_{bia} and the maximum speed V_{max}

4) [BFMs #10 and #9] The speed of home position return (high speed) V_{RT}

The range is 10 to 100,000Hz

This is the speed (high speed) for returning to home position. It should be between the bias speed V_{bia} and the maximum speed V_{max}.

5) [BFM #11] The speed of home position return (creep) V_{CR}

This is the speed (extremely slow speed) after the ear point signal (DOG) for returning to home position. It is instantaneous velocity before stopping at home position. Slower speed could get high precision of home positioning.

6) [BFMs#14 and #13] Home position HP

Motor system: 0 to ±999,999 PLS. Machine system and combined system: 0 to ±999,999

This is the position of home position return, when return actions completes, the value is written to the current position (BFMs #26 and #27).

7) [BFM #15] Acceleration time T_a

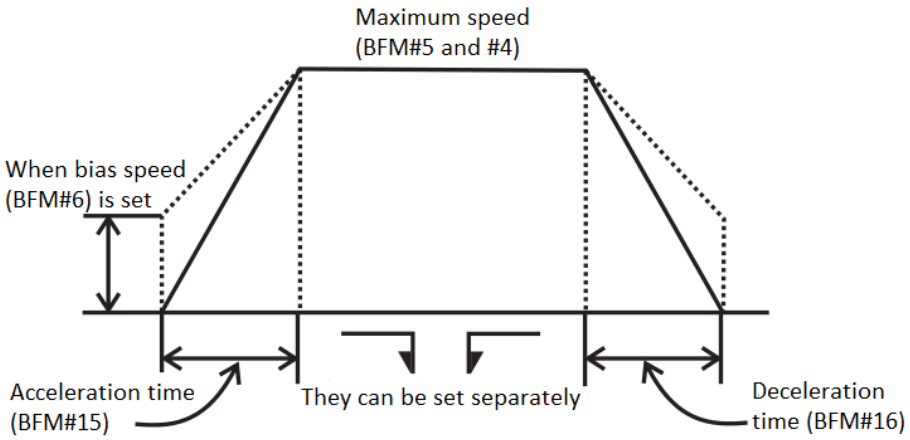
The range is 20 to 32,000 ms

This is accelerating time from the bias speed (BFM #6) to the maximum speed (BFMs #5 and #4).

8) [BFM #16] Deceleration time T_d

The range is 20 to 32,000 ms

This is the decelerating time between the bias speed (BFM#6) and the maximum speed (BFMs #5 and #4).



9) [BFMs#18 and #17] Set position (I) P (I)

Motor system: 0 to ±999,999 PLS. Machine system and combined system: 0 to ±999,999

This is the target position or the travel distance for operation. When the absolute position is used, the rotation direction is determined in accordance with the absolute value of the set position based on the current position (BFMs #26 and #27). When the relative position is used, the rotation direction is determined by the sign of the set position.

10) [BFMs #20 and #19] Operating speed (I) V (I)

The range is 10 to 100,000 Hz.

This is the actual operating speed within the range between the bias speed V_{bia} and the maximum speed V_{max}. In variable speed operation and external command positioning operation, forward rotation or reverse rotation is performed in accordance with the sign (positive or negative) of this set speed.

11) [BFMs #22 and #21] Set position (II) P (II)

Motor system: 0 to ±999,999 PLS. Machine system and combined system: 0 to ±999,999

This is the set position for the second speed in two-speed positioning operation.

12) [BFMs #24 and #23] Operating speed (II) V (II)

The range is 1 to 200,000Hz

This is the second operating speed in two-speed positioning operation.

13) [BFMs #27 and #26] Current position CP

Motor system: -2,147,483,648 to +2,147,483,647 Hz. Machine system and combined system: -2,147,483,648 to +2,147,483,647

The current position data is automatically written here.

4.2.3 Position Data, Home Position and Current Position

The position data includes the following: HP: Home position, P (I): Set position (I), P(II): Set position (II) and CP: Current position.

When the operation of returning to the machine home position is completed, the home position HP (BFMs #14 and #13) value is automatically written to the current position CP (BFMs #27 and #26).

The set positions P(I) and P(II) can be treated as absolute positions (distance from the current position CP = 0) or relative positions (travel from the current stop position) as described later.

4.2.4 Operation Command

[BFM #25] Operation command (b0 to b11, b12)

After data is written to the BFMs #0 to #24, write the BFM #25 (b0 to b12) as follows.

[b0] When b0 = 1: The error flag (BFM #28 b7) is reset.

[b1] When b1 = 0→1: Stop, if this bit is changed from 0 to 1 in positioning mode, the machine is decelerated and stopped.

[b2] When b2 = 1: Forward pulse stop, the forward pulse is immediate stopped in the forward limit position.

[b3] When b3 = 1: Reverse pulse stop, the reverse pulse is immediate stopped in the reverse limit position.

[b4] When b4 = 1: JOG+ operation, when b4 continues to be 1 for less than 300ms, one forward pulse is generated. When b4 continues to be 1 for 300 ms or more, continuous forward pulses are generated.

[b5] When b5 = 1: JOG- operation, when b5 continues to be 1 for less than 300ms, one reverse pulse is generated. When b5 continues to be 1 for 300 ms or more, continuous reverse pulses are generated.

[b6] When b6 = 0→1: Home position return start, the machine starts to return to the home position, and is stopped at the machine home position when the DOG input (near point signal) is given.

[b7] When b7 = 0: Absolute position. When b7 = 1: Relative position. The relative or absolute position is specified in accordance with the b7 status (1 or 0). (This bit is valid while operation is performed using b8, b9 or b10.)

[b8] When b8 = 0→1: Single-speed positioning operation is performed.

[b9] When b9 = 0→1: Interrupt single-speed positioning operation is performed.

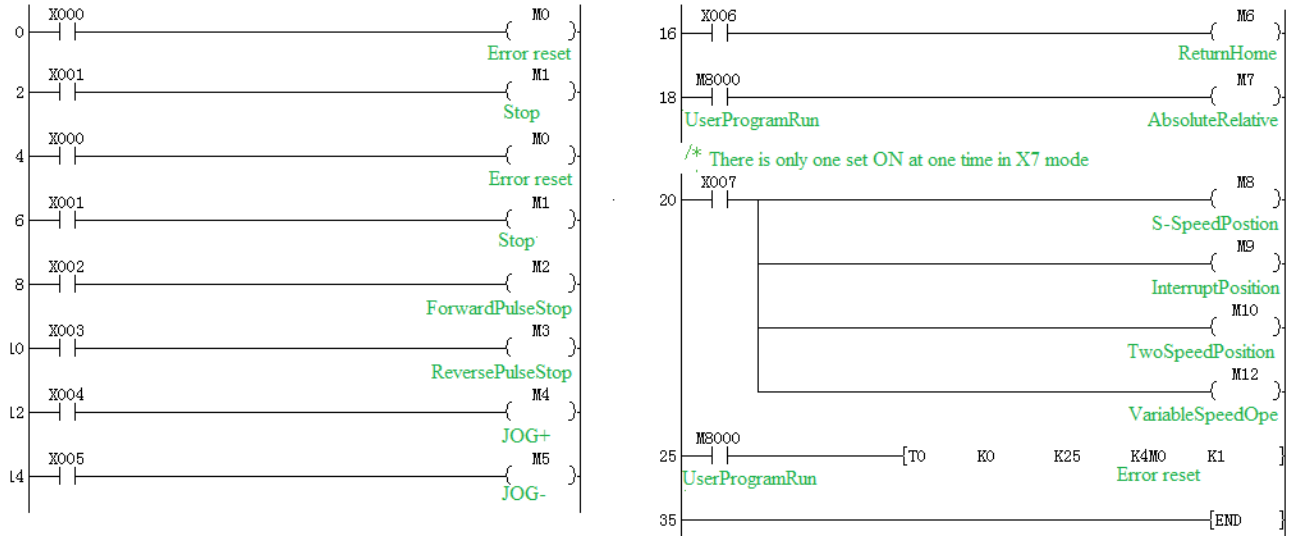
[b10] When b10 = 0→1: Two-speed positioning operation is performed.

[b11] Reserved

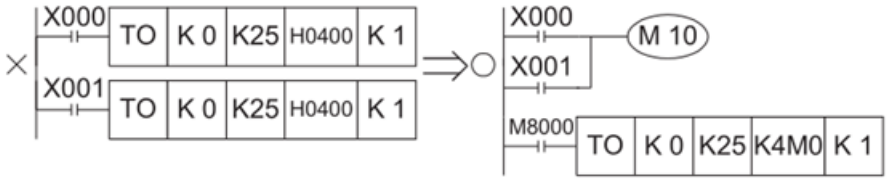
[b12] When b12 = 1: Variable speed operation is performed.

Operation command data transfer method

- Error can be reset by forcedly turning on/off the peripheral unit. The input X000 does not have to be used. When the data on absence/presence of error and the error code should be saved even after power interrupt, use power down save register.
- In operation which does not require returning to the home position such as inching operation with a constant feed rate, the input X006 is not required.



- In the program below, the start bit for the operation mode cannot be set to OFF inside the PGU, so operation from the second time and later cannot be performed. Correct it as shown in the right.



4.2.5 Status and Error Codes

1) [BFM #28] Status information (b0 to b10)

The status information to notify the PC of the PGU status is automatically saved in the BFM #28. Read it into the PC using the FROM instruction.

[b0] When b0 = 0: BUSY. When b0 = 1: READY. This bit is set to BUSY while the PGU is generating pulses.

[b1] When b1 = 0: Reverse rotation. When b1 = 1: Forward rotation. This bit is set to 1 when operation is started with forward pulse.

[b2] When b2 = 0: Home position return unexecuted. When b2 = 1: Home position return completed. When returning to the home position is completed, b2 is set to 1, and continues to be 1 until the power is turned off. To reset b2, use the program.

[b3] When b3 = 0: STOP input OFF. When b3 = 1: STOP input ON.

[b4] When b4 = 0: DOG input OFF. When b4 = 1: DOG input ON.

[b5] Reserved

[b6] When b6 = 1: Current position value overflow. The 32-bit data saved in the BFMs (#27 and#26) has overflown. This bit is reset when returning to the home position is completed or the power is turned off.

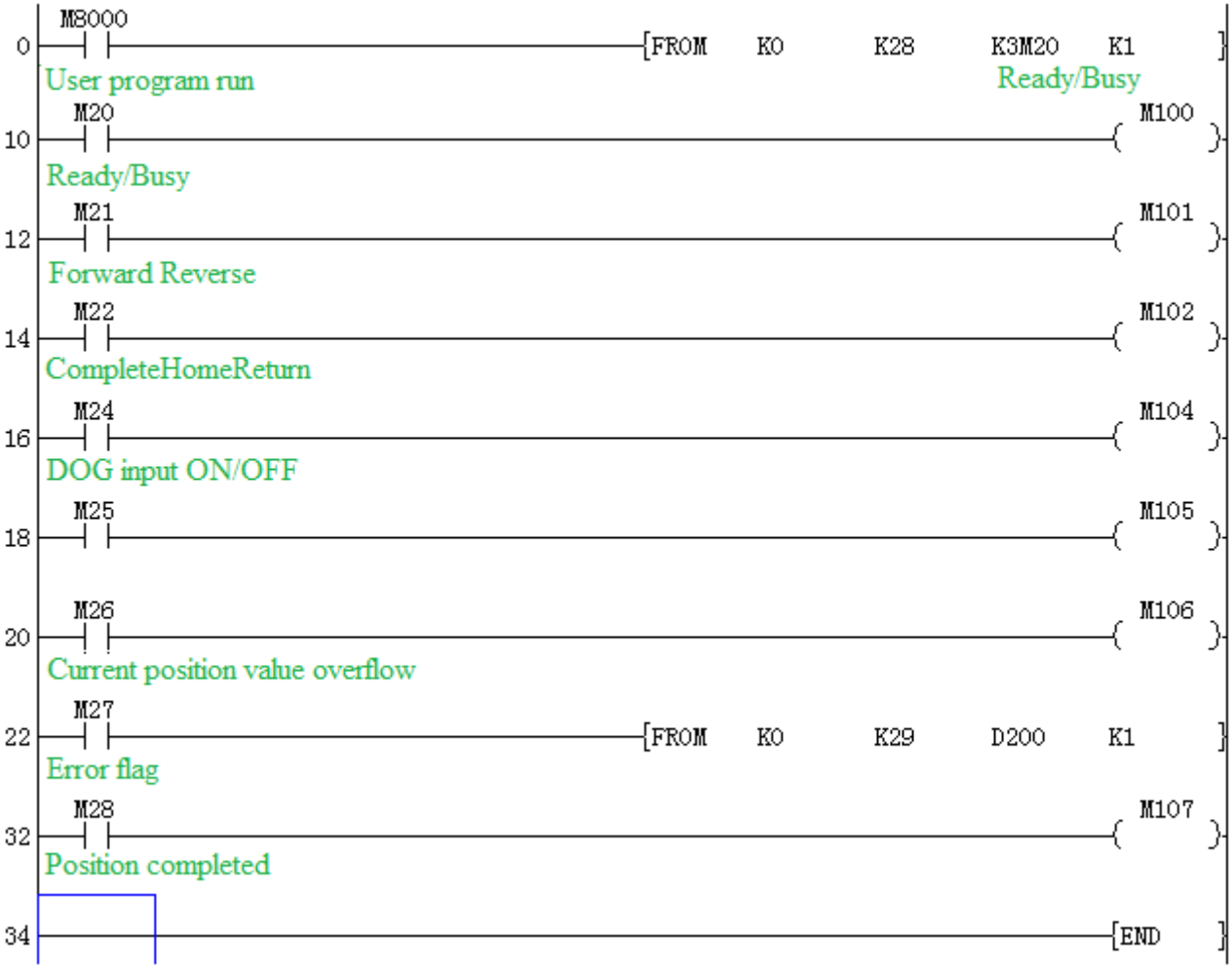
[b7] When b7 = 1: Error flag, b7 becomes 1 when an error has occurred in the PGU, and the contents of the error are saved in the BFM #29. This error flag is reset when the BFM #25 b0 becomes 1 or the power is turned off.

[b8] When b8 = 0: Positioning started. When b8 = 1: Positioning completed b8 is cleared when positioning is started home position return start, or error reset, and set when positioning is completed. b8 is also set when returning to the home position is completed.

[b9] CLR signal, when returning to the home position is completed, CLR signal is output, the duration is XXX ms.

[b10] When b10=0: interrupt input OFF. When b10 = 1: interrupt input ON.

- Various start commands are accepted exclusively while the BFM #28 b0 is set to 1 (READY).
- Various data is also accepted exclusively while the BFM #28 b0 is set to 1 (READY). However, the BFM #25 b1 (stop command), the BFM #25 b2 (forward pulse stop) and the BFM #25 b3 (reverse pulse stop) are accepted even while the BFM #28 b0 is set to 0 (BUSY)



2) [BFM #29] Error code number

The following error codes Nos. are saved in the BFM#29. Read and check it when the BFM #28 b7 is set to 1 (Error present).

001: Large/small relationship is incorrect. (V max <Vbia or V RT < V CR);
002: Setting is not performed yet. (V (I), P (I), V (II) or P (II));
003: Setting range is incorrect;

00 indicates the corresponding BFM No. For example, “172" indicates that the BFMs #18 and #17 are set to 0. “043" indicates that the BFMs #5 and #4 are set to a value outside the range.

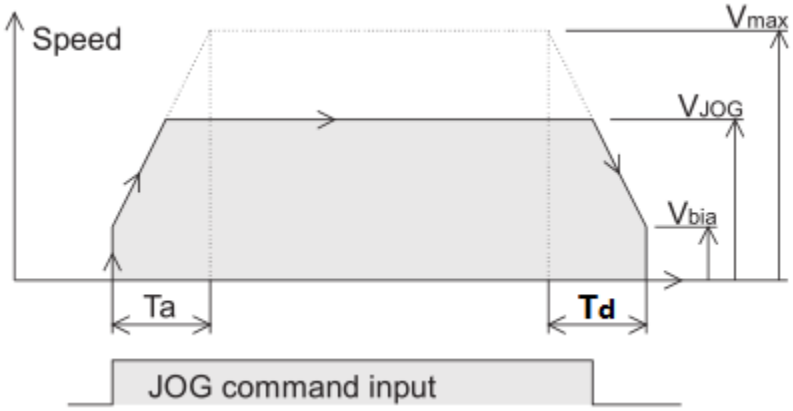
When a speed command specifies a value equivalent to or more than V max or a value equivalent to or less than Vbia, error does not occur. V max or Vbia is used for operation. Though the ready status can be specified even while an error is present, the start command is not accepted.

4.3Function description

Seven operation modes are available in the PG in accordance with the start command type. The data on speed and position should be transferred preliminarily from the PC to the buffer memories (BFMs) of the PG.

4.3.1 JOG operation

While the forward or reverse button is pressed and held, the motor is driven forward or in reverse.

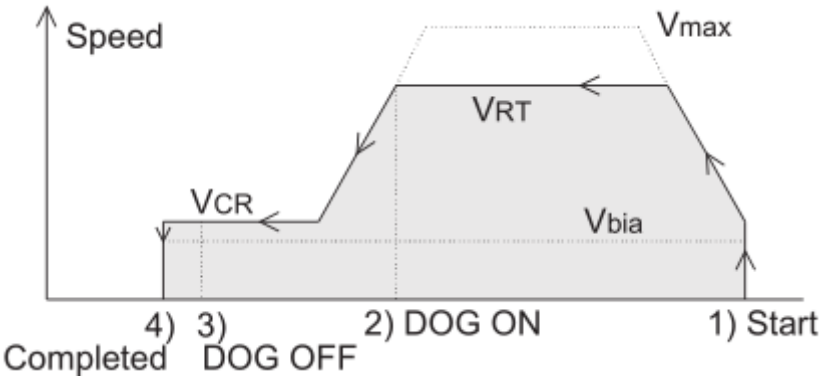


Any value between the bias speed V_{bia} (BFM #6) and the maximum speed V_{max} (BFMs #5 and #4) is valid as the command speed V_{JOG} (BFMs #8 and #7). When JOG signal continues to be 1 for less than

300ms, one reverse pulse is generated. When JOG signal continues to be 1 for 300 ms or more, continuous reverse pulses are generated.

4.3.2 Machine home position return operation

When the home position start command is received, the motor makes the machine return to the home position. When returning to the home position is completed, the home position HP (BFMs #14 and #13) value is written to the current position CP (BFMs #27 and #26).

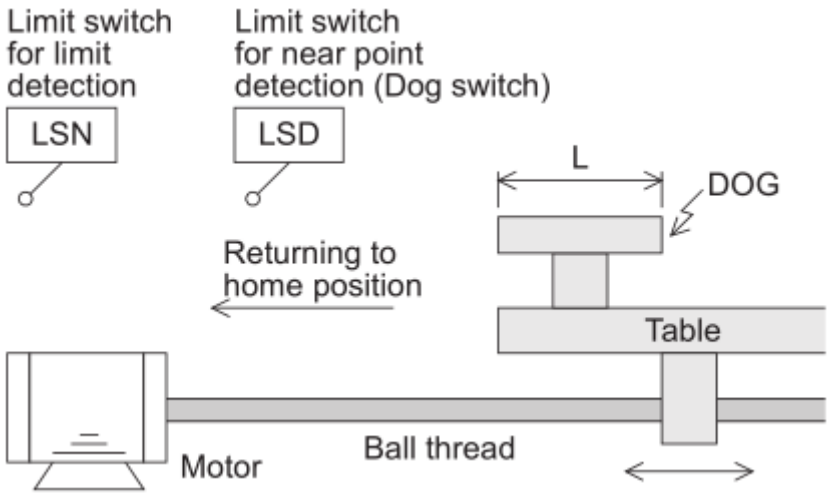


- When the home position return start command is changed from OFF to ON, the home position return operation is started at the speed V RT (BFMs #10 and #9).
- When the near point signal DOG input is turned on, the motor decelerates to the creep speed V CR (BFM #11).
- When the near point signal DOG input is changed from ON to OFF, the motor is immediately stopped in the position 4).

For the details, refer to “DOG Switch” and “Home Position Return Operation”

1) DOG Switch

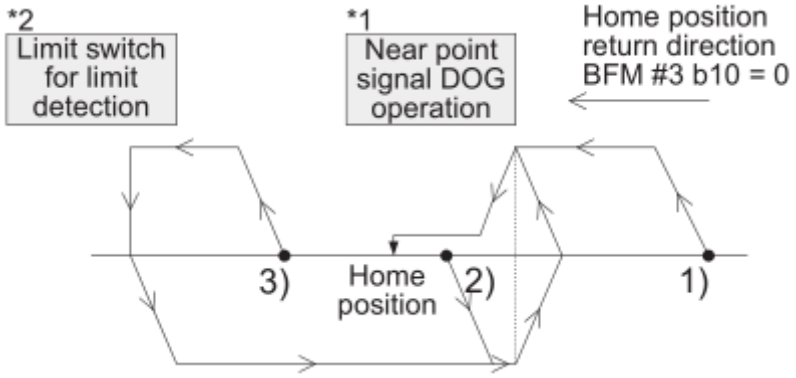
DOG switch for returning to home position



- A dog whose length is L is fixed to a table driven in the left and right direction by a servo motor via a ball thread.
- When the table moves in the home position return direction, the dog is in contact with the limit switch (LSD) for near point detection, and the LSD is actuated.
- The LSD is turned ON from OFF when the BFM #3 b12 is set to 0, and turned OFF from ON when the BFM #3 b12 is set to 1.
- The home position return direction is determined by the BFM #3 b9 (rotation direction) and b10 (home position return direction).
- The limit switch LSD is often referred to as dog switch. The actuation point of the dog switch is rather dispersed.

2) Home Position Return Operation

The home position return operation varies depending on the start position.



1) The near point signal is turned off (before the DOG passes).
2) The near point signal is turned on.
3) The near point signal is turned off (after the DOG has passed).

For this operation, the limit switches for detecting the forward limit and the reverse limit should be provided on the PC.

When the limit switch for limit detection is actuated, the home position return operation is not performed even if the home position return operation is started. Move the dog by performing the JOG operation so that the limit switch for limit detection is not actuated, then start the home position returns operation.

*1 The example above shows the case where the BFM #3 b12 is set to 0 (DOG input polarity OFF→ON).

*2 When the limit switch for limit detection is turned on, the pulse output is immediately stopped (BFM #25 b3: ON). At this time, the clear signal is also output.

When the stepper motor is used

When the stepper motor is used, rigid attention should be paid to the following items.

a) If the motor capacity is not sufficient compared with the load torque, the motor may stall. In such a case, even if the specified quantity of pulses are supplied the motor, the expected drive quantity may not be obtained.

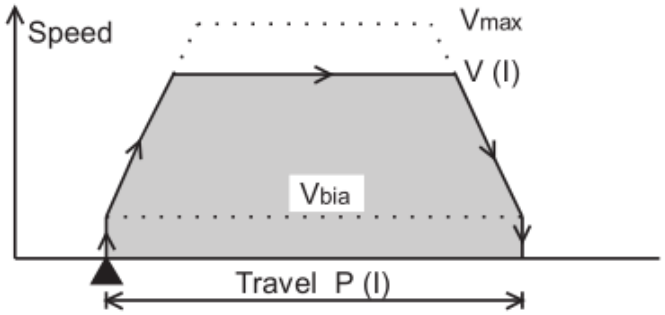
b) Start and stop the motor slowly enough (by setting a long acceleration/deceleration time to the BFM #15) so that the acceleration/ deceleration torque does not become excessive.

c) A resonance point is present in low speed operation. It is recommended to avoid this point. Set the bias speed (BFM #6), and do not perform operation at a speed slower than that.

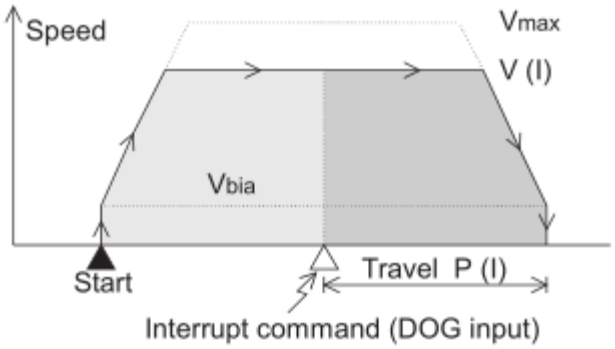
d) An external power supply may be required for signal communication with the drive amplifier.

4.3.3 Single-Speed Positioning Operation

When the start command is given, the motor accelerates up to the operating speed V (I) (BFMs #20 and #19), then decelerates and stops in the set position P(I) (BFMs #18 and #17).



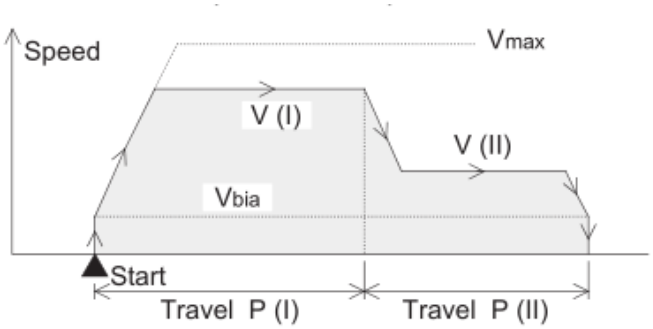
4.3.4 Interrupt Single-Speed Positioning Operation



When the start command is received, the motor starts operation. When the INTERRUPT input is received, the motor moves by the specified distance, then stops (The relative travel exclusively can be specified.) The current value is cleared by the start command. The current value starts to change

by the INTERRUPT input, and becomes equivalent to the set position when the operation is completed.

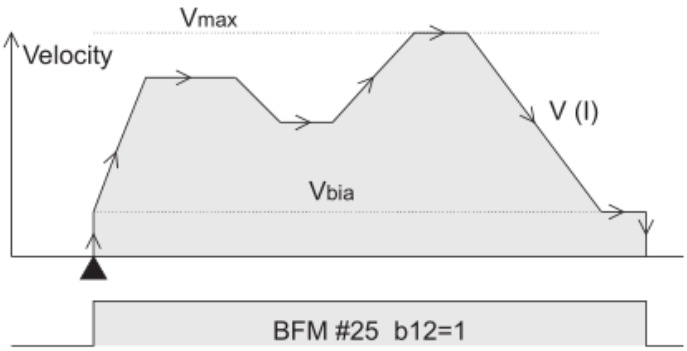
4.3.5 Two-Speed Positioning Operation



The motor performs the following operation by the two-speed positioning operation command. Approach at high speed as well as processing and moving forward at low speed can be performed. When the start command is received, the motor performs positioning at the operating speed V(I) (BFMs #20 and #19) until the set position P(I) (BFMs #18 and #17), then at the operating speed V(II) (BFMs #24 and #23) until the set position P(II) (BFMs #22 and #21) (two-step speed).

4.3.6 Variable Speed Operation

- When the operation command BFM #25 b12 is set to 1, the speed pulses specified in the BFMs (#20 and #19) are generated.
- This operating speed can be freely changed even while pulses are generated. However, acceleration and deceleration must be controlled by the PC.
- Only b0 (error reset) and b12 (variable speed operation) of the operation command BFM #29 are valid in this mode.
  When b12 is set to 1, variable speed operation is performed.
  When b12 is set to 0, pulse output is stopped.



- The pulse output does not stop even if “0” is written in BFM #21, #20

- As for the parameter BFM #3, only b1 and b0 (system of units) and b8 (pulse output format) are valid.
- The rotation direction (forward or reverse) can be specified by the sign (positive or negative) of the speed command (BFMs #20 and #19)

The procedure of changing the direction of the rotation

1) Turn OFF b12 of BFM #25.
2) Change the value at drive speed (BFM #20, BFM #19).
3) Again, turn ON b12 of BFM #25.

4.4 Common Matter for Operation Modes

4.4.1 Handling the stop command

In all operation modes, the stop command is valid at any time during operation. However, if a stop command is received during a positioning operation, the motor decelerates and stops. And after restarting, the motor doesn't travel by the remaining distance, but the next positioning operation.

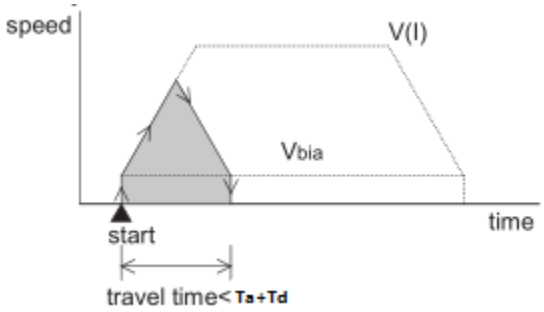
4.4.2 About multiple commands

When the bits which determine operation modes such as b4, b5 and b8, b10 are turned on simultaneously in the operation command BFM #25, any operation is not executed. If other mode input is turned on while operation is being performed in any mode, such an input is neglected.

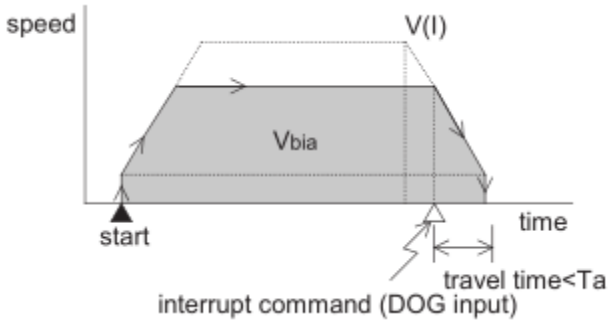
4.4.3 When travel time is small

When the travel time is small compared to the acceleration/deceleration time (Ta), the motor cannot realize specified speed.

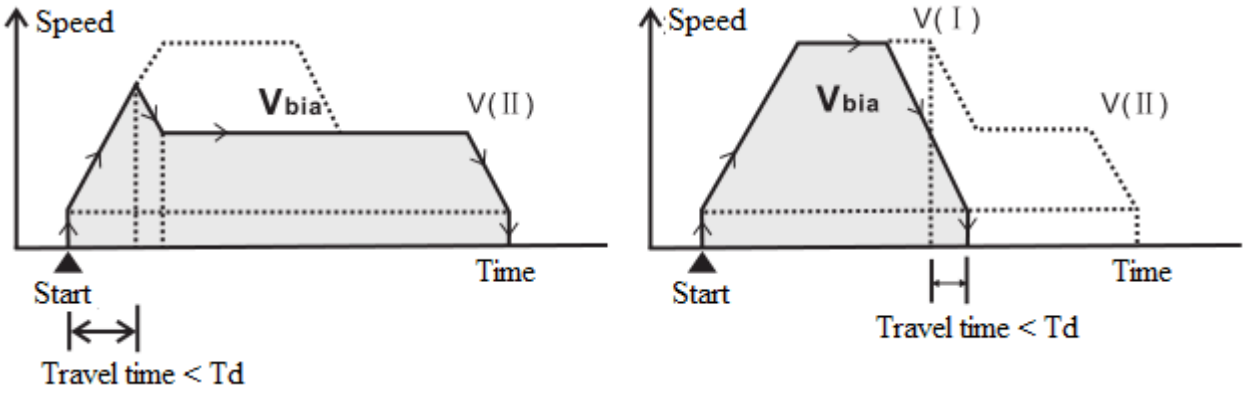
- Single-speed positioning operation



- Interrupt single operation



- Two-speed positioning operation



4.4.4 Connection of DOG and X Inputs and Handling of Limit Switches for Limit Detection

Various limit switch inputs are connected to the DOG input and the X input in accordance with the operation mode.

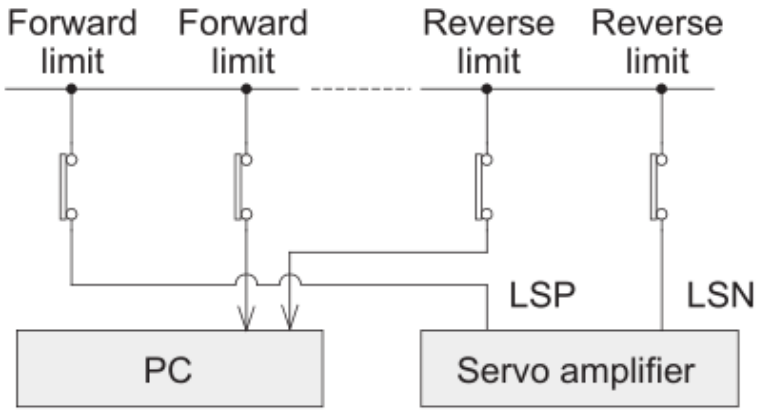
The polarity of these limit switch inputs is inverted by the state of the BFM #3 b12 and b6.

To assure safety, provide limit switches for detecting the forward and reverse limits on the servo amplifier also.

Make sure so that the limit switches on the PLC are actuated simultaneously with or a little earlier than the limit switches on the servo amplifier.

Because a drive amplifier for a stepper motor does not have these terminals, make sure to provide limit switches on the PLC.

Evade from the state of the pulse output stop by Jog in the opposite direction when forward pulse stop or reverse pulse stop is turned on.



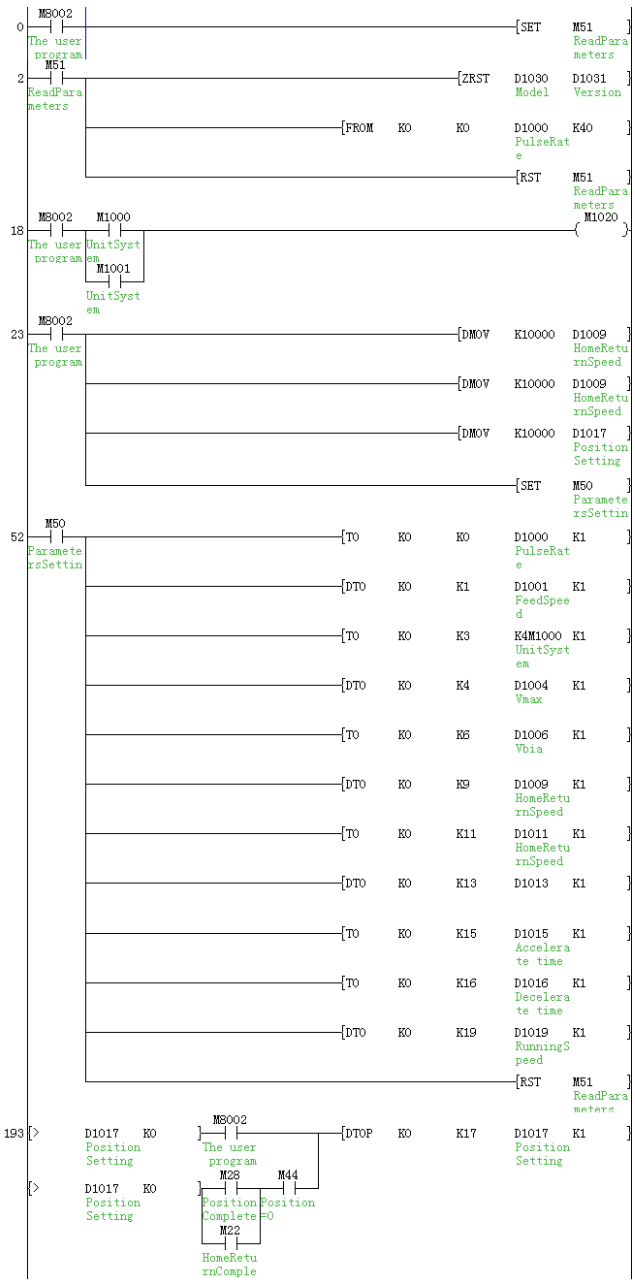
5. Example

The reciprocation by single-speed positioning

Do not put the load on the motor for safety when you confirm the operation according to this program example.

1) The position of the motor moves to the machine home position according to the home position return start instruction now. (Machine home position return operation) At this time, the machine home position address is assumed to be “0”.
2) While the forward or reverse button is pressed and held, the motor is driven forward or in reverse. (Jog operation)
3) The value of the motor advances 10000 mm according to the automatic drive start instruction.
4) After wards, Y000 is turned on for two seconds as a stand by display stopping and at this time. Finally, the value of the motor retreats by 10000 mm. (Single-speed positioning operation)

<table>
<tr><th colspan="2">Input</th><th>Output</th><td>4PG terminals</td></tr>
<tr><td>X000: error reset</td><td>X005:JOG- operation</td><td rowspan="6">Y000: display</td><td>DOG: input return signal</td></tr>
<tr><td>X001: stop command</td><td>X006: start home return</td><td>FP: Pulse output to servo amplifier PP</td></tr>
<tr><td>X002: stop forward pulse</td><td rowspan="3">X007: Single-speed positioning operation</td><td rowspan="2">RP: pulse output direction</td></tr>
<tr><td>X003: stop reverse pulse</td><td rowspan="2"></td></tr>
<tr><td>X004: JOG+ operation</td></tr>
</table>



6. Diagnostic

Preliminary Checks and Error Indication

To ensure correct operation

1) Make sure that the PG I/O wiring and the extension cable connections are correct.
   Indicate clearly the special block No. on the panel face by adhering the labels offered as accessories.

2) In any positioning operation, the specified data should be written preliminarily to the BFMs #0 to #24, and then the BFM #25 should give an appropriate command. Otherwise, the PG does not function.

Error indication

1) LED indication

   The PG panel has the following LEDs:

   Power indication: The POWER LED is lighted when 5 V power is supplied from the PLC.

   Input indication: When DOG or X is received by the PG, the corresponding LED is lighted respectively.

   Output indication: When FP or RP is output by the PG, the corresponding LED is lighted respectively.

   Error indication: When an error occurs, the ERR LED flashes.

2) Error check

   Errors are indicated by BFM#28 bit 7. Various errors can be checked by reading the contents of the BFM #29 to the PC.

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