Changes for the Better

MITSUBISHI

PROGRAMMABLE CONTROLLERS

MELSEC-F

USER'S MANUAL

FX2N-10PG

FX2N

Foreword

- This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX2N-10PG Pulse Output Block. It should be read and understood before attempting to install or use the unit.

- Further information can be found in the FX2N Series HARDWARE MANUAL, FX2NC Series HARDWARE MANUAL and THE FX SERIES OF PROGRAMMABLE CONTROLLER PROGRAMMING MANUAL II.

- If in doubt at any stage of the installation of FX2N-10PG Pulse Output Block always consult a professional electrical engineer who is qualified and trained to the local and national standards which apply to the installation site.

- If in doubt about the operation or use of FX2N-10PG Pulse Output Block please consult the nearest Mitsubisi Electric distributor.

- This manual is subject to change without notice.

Model FX2N-10PG Pulse Output Block

USER'S MANUAL

Manual number : JY992D93401

Manual revision : B

Date : JULY 2001

FAX BACK

Mitsubishi has a world wide reputation for its efforts in continually developing and pushing back the frontiers of industrial automation. What is sometimes overlooked by the user is the care and attention to detail that is taken with the documentation. However, to continue this process of improvement, the comments of the Mitsubishi users are always welcomed. This page has been designed for you, the reader, to fill in your comments and fax them back to us. We look forward to hearing from you.

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Thank you for taking the time to fill out this questionnaire. We hope you found both the product and this manual easy to use.

Guidelines for the Safety of the User and Protection of the FX2N-10PG Pulse Output Block

This manual provides information for the use of the FX2N-10PG Pulse Output Block. The manual has been written to be used by trained and competent personnel. The definition of such a person or persons is as follows;

a) Any engineer who is responsible for the planning, design and construction of automatic equipment using the product associated with this manual should be of a competent nature, trained and qualified to the local and national standards required to fulfill that role. These engineers should be fully aware of all aspects of safety with regards to automated equipment.

b) Any commissioning or service engineer must be of a competent nature, trained and qualified to the local and national standards required to fulfill that job. These engineers should also be trained in the use and maintenance of the completed product. This includes being completely familiar with all associated documentation for the said product. All maintenance should be carried out in accordance with established safety practices.

c) All operators of the completed equipment should be trained to use that product in a safe and coordinated manner in compliance to established safety practices. The operators should also be familiar with documentation which is connected with the actual operation of the completed equipment.

Note : Note: the term 'completed equipment' refers to a third party constructed device which contains or uses the product associated with this manual.

Notes on the Symbols Used in this Manual

At various times through out this manual certain symbols will be used to highlight points of information which are intended to ensure the users personal safety and protect the integrity of equipment. Whenever any of the following symbols are encountered its associated note must be read and understood. Each of the symbols used will now be listed with a brief description of its meaning.

Hardware Warnings

1) Indicates that the identified danger **WILL** cause physical and property damage.

2) Indicates that the identified danger could **POSSIBLY** cause physical and property damage.

3) Indicates a point of further interest or further explanation.

Software Warnings

4) Indicates special care must be taken when using this element of software.

5) Indicates a special point which the user of the associate software element should be aware of.

6) Indicates a point of interest or further explanation.

- Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment.

- All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples.

- Owing to the very great variety in possible application of this equipment, you must satisfy yourself as to its suitability for your specific application.

Trademark registration

The company names and product names described in this manual are the registered names and trademarks of the relevant companies.

Associated Manuals

This manual describes the handling and operation of MELSEC-FX Series FX2N-10PG Pulse Output Block. For the configuration and commands of the system, also refer to the manuals of the following PLC. Before operation, read this manual and the manuals of the PLC thoroughly and be sure you sufficiently understand their specifications for proper operation.
Also, be sure that the manual is provided to the end user.

Manual name	Manual No.	Description
FX2N-10PG USER'S MANUAL (this manual)	JY992D93401	The manual explains the details of the hardware regarding the specifications, wiring, installation, etc. of the FX2N-10PG Series PLC.
FX2N-10PG Installation Manual (in same package)	JY992D91901	The manual explains the specifications, installation, etc. of the FX2N-10PG Pulse Output Block.
FX2N HARDWARE MANUAL (in same package)	JY992D66301	The manual explains the details of the hardware regarding the specifications, wiring, installation, etc. of the FX2N Series PLC.
FX2NC (D/UL) HARDWARE MANUAL (in same package)	JY992D87201	The manual explains the details of the hardware regarding the specifications, wiring, installation, etc. of the FX2NC (D/UL) Series PLC.
FX2NC (DSS/DS) HARDWARE MANUAL (in same package)	JY992D76401	The manual explains the details of the hardware regarding the specifications, wiring, installation, etc. of the FX2NC (DSS/DS) Series PLC.
THE FX SERIES OF PROGRAMMABLE CONTROLLER PROGRAMMING MANUAL II	JY992D88101	The manual explains the commands of FX2N and FX2NC Series.

Of the manuals listed above, THE FX SERIES OF PROGRAMMABLE CONTROLLER PROGRAMMING MANUAL II are not packed with the product.
If necessary, contact your dealer to request the desired manual.
FX2N-10PG Installation Manual, FX2N Handy Manual and FX2NC Handy Manual are packed with each product.

1.　　Introduction

1.1　　Product outline

FX2N-10PG Pulse Output Block (hereafter abbreviated as FX2N-10PG, Pulse Output Block or PGU) is a special block to output a maximum 1MHz pulse array and drive a single-axis stepping motor or servo motor.

1) FX2N-10PG controls the positioning operation of one single-axis stepping motor or servo motor per unit.

2) FX2N or FX2NC Series PLC is connected to read and write the data with FROM/TO commands.

3) A pulse array of max. 1MHz can be output. (Differential line driver output)

Cautions regarding design

• To make sure the entire system operates safely even when problems such as a faulty external power supply, PLC, or FX2N-10PG Pulse Output Block occurs, provide safety circuits outside the PLC and FX2N-10PG Pulse Output Block.
Otherwise, improper operation or wrong output may cause an accident.

1) The emergency stop circuit, protective circuit, interlock circuit against machine breakage, etc. must be provided as circuits outside the PLC and FX2N-10PG.

2) If the PLC or FX2N-10PG Pulse Output Block detects any problem using the self-diagnosis function for the watchdog timer errors and input value errors, or if any trouble occurs in the input/output control area, etc. which cannot be detected by the PLC CPU, output control may sometimes become impossible.Be sure to design the external circuits and mechanisms to operate the machine safely in such cases.

3) If any relay, transistor, triac, etc. in the output unit of the FX2N-10PG Pulse Output Block or PLC malfunctions, the output may sometimes be kept on or off.
Design the external circuits and mechanisms to operate the machine safely regarding output signals which may lead to a serious accident.

Cautions regarding disposal

• When disposing of the product, handle it as industrial waste.

MEMO

2. Outside dimensions and component names

2.1 Outside dimensions

Unit: mm (inches)
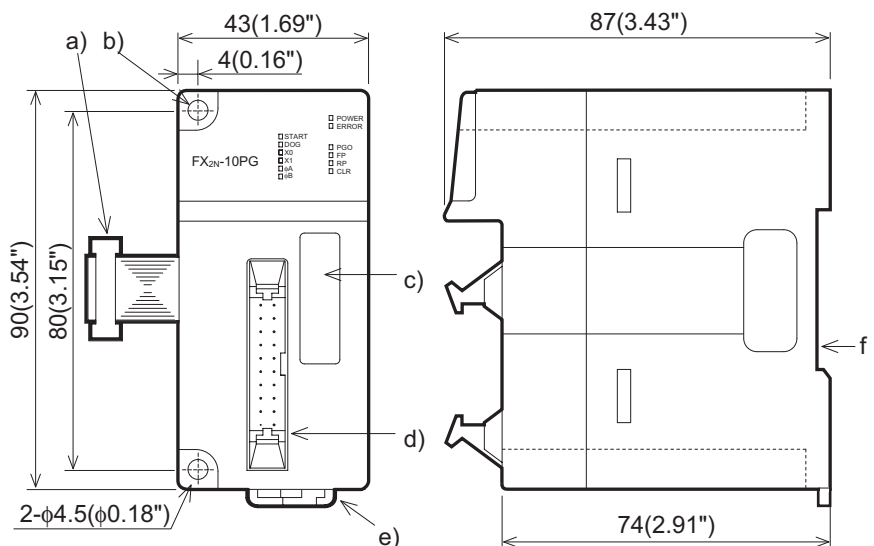
External color : Munsell 0.08GY/7.64/0.81   Mass (Weight): Approx. 0.2kg (0.44lbs)
Accessories   : Special block No. label

a) Extension cable

b) Direct mounting hole (2 - ϕ4.5/0.18")

c) Extension port

d) Input/output port

e) DIN rail mounting hook

f) DIN rail mounting groove (DIN rail: DIN46277 35mm (1.38") wide)

2.2 LED display

LED name	State	Display content
POWER	Unlit	5V DC is not supplied through the extension cable from the PLC.
	Lit	5V DC is supplied through the extension cable from the PLC.
START	Unlit	Start input off
	Lit	Start input on
ERROR	Unlit	Normal operation
	Blinking	Error occurred
	Lit	CPU error occurred
FP	Unlit	Forward pulse or pulse array interrupted.
	Blinking	Forward pulses or pulse array is being output.
RP	Unlit	Reverse pulse or directional output interrupted.
	Blinking	Reverse pulses or directional output is being output.
CLR	Unlit	CLR signal is not output.
	Lit	CLR signal is output (when the origin point return is completed)
DOG	Unlit	DOG input off
	Lit	DOG input on
PG0	Unlit	Zero-point input off
	Lit	Zero-point input on
φA	Unlit	A-phase input of manual pulse generator off
	Lit	A-phase input of manual pulse generator on
φB	Unlit	B-phase input of manual pulse generator off
	Lit	B-phase input of manual pulse generator on
X0,X1	Unlit	Interrupt input off
	Lit	Interrupt input on

2.3   Pin layout and assignment
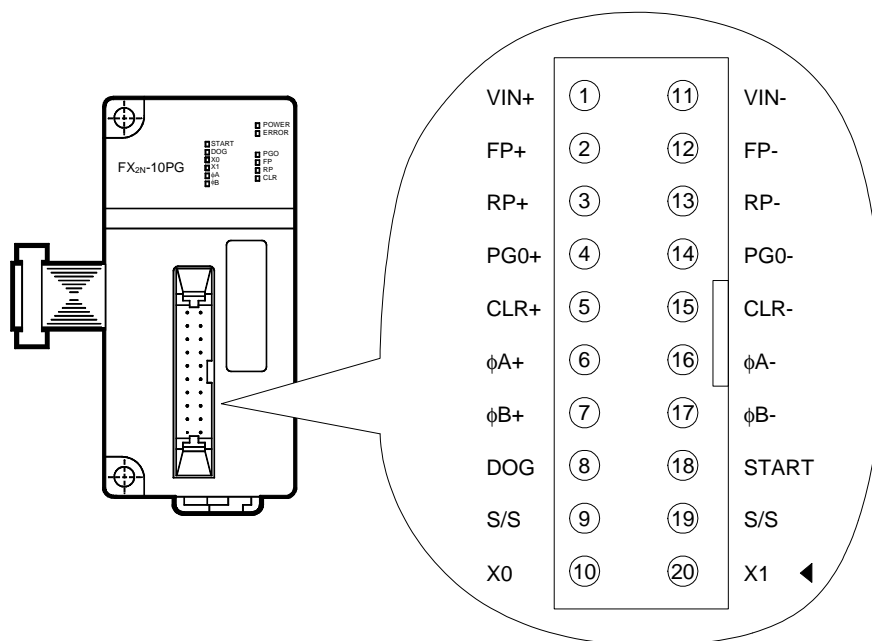
Pin No.	Terminal name	Content
1	VIN+	Power input terminal for pulse output 5V DC to 24V DC
2	FP+	Forward/reverse mode: Forward pulse output terminal Pulse/direction mode: Pulse output terminal
3	RP+	Forward/reverse mode: Reverse pulse output terminal Pulse/direction mode: Direction output terminal
4	PG0+	Zero-point signal input terminal
5	CLR+	Output terminal to clear the deviation counter of servo amplifier
6	ϕA+	A-phase input terminal of 2-phase pulse
7	ϕB+	B-phase input terminal of 2-phase pulse
8	DOG	Near-point DOG input terminal (Input terminal used for origin-point return command)
9,19	S/S	Power input terminal (start, DOG, X0, X1) 24V DC Pins are internally short-circuited.
10	X0	Interrupt input terminal
11	VIN-	Common terminal of VIN+
12	FP-	Common terminal of FP+
13	RP-	Common terminal of RP+
14	PG0-	Common terminal of PG0+
15	CLR-	Common terminal of CLR+
16	ϕA-	Common terminal of A-phase input of 2-phase pulse
17	ϕB-	Common terminal of B-phase input of 2-phase pulse
18	START	Start input terminal
20	X1	Interrupt input terminal

• The above pin layout is seen when looking at the I/O port in the FX2N-10PG from the front face.
  When an I/O cable and connector is prepared by the user, the pin number 20 should be provided where the ▲ mark indicates.
  Be aware of the positions of the ▲ mark and the notch.

2.3.1   Applicable connector and cable size

The connectors for the multi-wire cables are prepared as a set to allow the customer to produce the input/output cables.
The cables and crimp tool should be prepared by the customer.

Model name and configuration of input/output connector	Applicable cable and tool
Model name	**Cable size**
FX2C-I/O-CON-S For multi-wire cable: 5 sets	AWG22(0.3mm^2)
FX2C-I/O-CON-SA For multi-wire cable: 5 sets	AWG20(0.5mm^2)

*1 Since it may be difficult to pass the random cable through the housing depending on the variation of the sheath thickness, UL-1061 cable is recommended.

* Phoenix contact crimp tool.

3.   Installation

Install FX2N-10PG on the right side of the basic unit, extension unit or other extension block of FX2N and FX2NC Series PLC.
For installation, install the block with DIN rail (DIN46277, 35mm (1.38inches) wide) or directly with M4 screws.

3.1   DIN rail installation

Align the upper side of the DIN rail mounting groove with the DIN rail 1), and press the block in 2).
To remove the main body, pull out the DIN rail mounting hook downward 3), and remove the block 4).
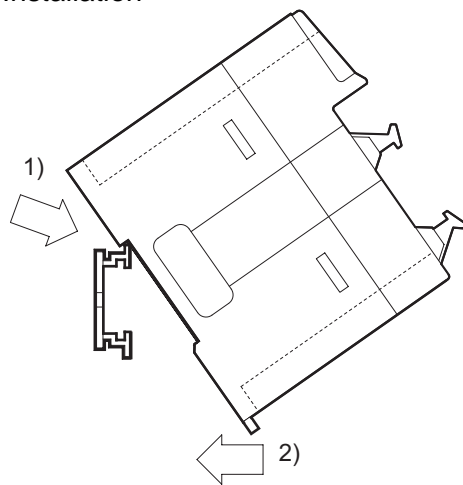
Installation   Removal
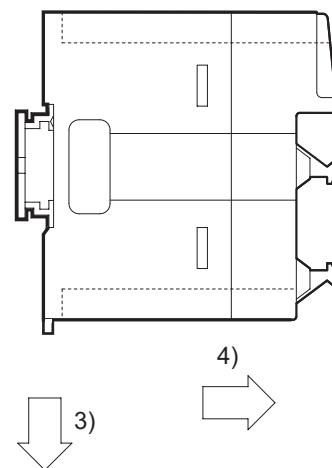
3.2   Direct installation

Pass M4 screws through the two mounting holes provided at the top and bottom on the left side of FX2N-10PG, and install the block on the panel with the screws.
Provide a clearance of 1 to 2mm (0.08inches) between the units during installation.

Cautions regarding installation

1) Use the block under the environmental conditions specified in the manual.
   Do not use the unit in a location surrounded by dust, oil fumes, conductive dust, corrosive gas or combustible gas, exposed to high temperature, condensation, wind or rain, or subject to vibration or impact.
   Use in such a location may cause an electric shock, fire hazard, malfunction, or breakage or degradation of the product.

2) Before installation, wiring or similar work, be sure to switch off the external power supply to isolate the block.
   Otherwise, it may cause an electric shock or damage the product.

3) When turning on the power supply or operating the block after installation, wiring or similar work, be sure to install the top cover.

4) When tapping a hole or routing a wire, prevent chips or wire chips from dropping into the vent windows of FX2N-10PG.
   Such chips may cause a fire hazard or malfunction.

5) Securely fasten the extension cable to a specified connector.
   If it is poorly connected, it will cause a malfunction.

4. System configuration

4.1 Connection with PLC

The PLC is connected to FX2N-10PG with the extension cable.
FX2N-10PG is handled as a special unit of the PLC and is sequentially given the special unit number of 0 to 7 from the unit which is the nearest to PLC. (The unit No. is instructed with FROM/TO commands.)
For details of the input/output assignment of PLC, refer to the manual of FX2N, FX2NC Series PLC.
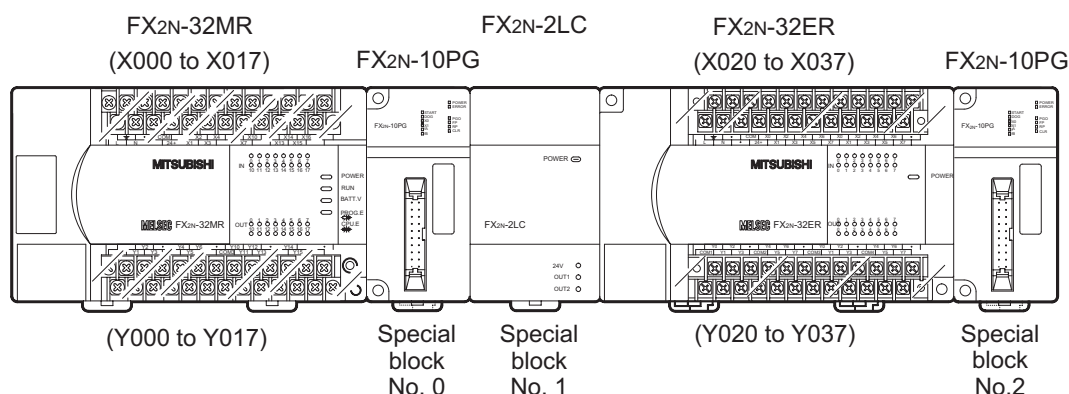
- A maximum of 8 units can be connected to FX2N Series PLC and a maximum of 4 units can be connected to FX2NC Series PLC.

- When connected to FX2NC Series PLC, FX2NC-CNV-IF is required.

- For extension, the separately available FX0N-65EC/FX0N-30EC extension cable and FX2N-CNV-BC are used.
  One extension cable can be used per system.

- The number of occupied I/O points of the FX2N-10PG is 8. The total number of I/O points of the basic unit, extension unit and extension block and the occupied points of the special block must not exceed the max. number of the I/O points of the basic unit (256 points for FX2N and FX2NC).

- The assignment of the I/O number of the PLC is shown in the parentheses. The I/O connectors and occupied points of FX2N-10PG are not included during assignment of I/O numbers of the PLC.

Turn OFF the power at first, then connect/disconnect the cable such as an extension cable.
If you connect/disconnect a cable while the power is supplied, the unit may fail or malfunction.

4.2   Applicable PLC

Series name	Applicable version
FX2N Series	All versions
FX2NC Series	All versions

For connection to FX2NC, FX2NC-CNV-IF is necessary.

5. Specifications

5.1 Environmental specifications

Item	Specifications
Withstand voltage	500V AC One minute (between all external terminals and ground terminal)
Items except above	Same as the environmental specifications of the connected PLC (Refer to the PLC manual.)

5.2 Power supply specifications

Item		Specifications
Drive power supply	Input signal	START, DOG, X0, X1 terminals: 24V DC+/-10% Current consumption 32mA or less PGO terminal: 3 to 5.5V DC Current consumption 20mA or less VIN terminal: 5 to 24V DC Current consumption 100mA or less for 5V, 70mA or less for 24V Each current can be supplied from the external power supply. (START, DOG, X0, X1 terminals can be supplied from the service power supply (24+ terminal) of the PLC.)
	Inner control	5V DC Current consumption 120mA Power is supplied through the extension cable from the PLC.
	Output signal	FP, RP terminals (Power supplied from VIN terminal 5 to 24V DC): Set 25mA or less. CLR: 5 to 24V DC Set 20mA or less. Each is supplied from the servo amplifier or external power supply.

5.3 Performance specifications

Item	Specifications
Number of control axes	• One axis per unit (Max. 8 units and 4 units can be connected to FX2N Series PLC and FX2NC Series PLC respectively.)
Speed command	• The operation speed is set with the buffer memory. • It can be operated at the pulse frequency of 1Hz to 1MHz. • Hz, cm/min, 10 deg/min and inch/min are selectable for the command unit.
Position command	• The travel is set with the buffer memory. • The pulse converted value is in the range of -2,147,483,648 to 2,147,483,647. Pulse, mm, mdeg and 10^{-4}inch are usable for the unit. • The absolute position instruction and relative position instruction are selectable. • The magnification rates of 10^0, 10^1, 10^2 and 10^3 are settable for the position data.
Positioning program	• Positioning is done in the PLC program. (Data read-/writing and operation mode selection are instructed with FROM/TO commands.)
Number of I/O occupied points	• 8 points (Input or output.)
Start time	• 1 to 3ms

5.4   Input specifications

Item	START, DOG, X1	ϕA, ϕB	PG0
Number of input points	Three control input points (START, DOG, PG0), two interrupt input points (X0, X1) 2-phase pulse input point (ϕA, ϕB)		
Input signal voltage	24V DC ± 10%	3.0 to 5.5V DC	3.0 to 5.5V DC
Signal format	Contact or open collector transistor	Differential line driver or open collector transistor	Differential line driver or open collector transistor
Input signal current	6.5 ± 1mA	6 to 20mA	6 to 20mA
Input ON sensitivity	4.5mA or more	6.0mA or more	6.0mA or more
Input OFF sensitivity	1.5mA or less	1mA or less	1mA or less
Input receiving speed	0.1ms or less (1.0ms or less for DOG)	2-phase pulse 30,000Hz or less (Duty 50%)	Pulse width 50ms or more
Circuit insulation	Photocoupler insulation		
Operation indication	LED is lit when input is ON.		

5.5   Output specifications

Item	Pulse output section	Clear signal (CLR)
Number of output points	Three output points (FP, RP, CLR)	
Output system	Forward pulse (FP) / reverse pulse (RP) or pulse (PLS) / direction (DIR) is selectable.	When zero return operation is completed, it is turned on. (Output pulse width: 20ms)
Output type	Differential line driver output	NPN open collector transistor output
Rated load voltage	VIN 5 to 24V DC	VIN 5 to 24V DC
Max. load current	25mA or less	20mA or less
VIN current consumption	24V DC: 70mA 5V DC: 100mA	—
Max. voltage drop during ON	—	1.5V or less
Leak current during ON	—	0.1mA or less
Output frequency	FP+, RP+ Max. 1MHz	20 to 25ms
Operation indication	LED is lit when output is ON.	

6. Wiring

6.1 Input output circuit

| Input terminal | FX2N-10PG | Output terminal | 5 to 24V DC | Servo amplifier drive unit |

7mA/24V DC — 18 START — 3.3kΩ
7mA/24V DC — 8 DOG — 3.3kΩ
7mA/24V DC — 10 X0 — 3.3kΩ
7mA/24V DC — 20 X1 — 3.3kΩ
24V DC — 9 / 19 S/S

5V — VIN+ 1
VIN- 11
FP+ 2
FP- 12
RP+ 3
RP- 13

AM26LS31 or equivalent
Differential line driver
25mA or less

Shielded cable

Manual pulse generator — A phase — 6 φA+ — 120Ω
16 φA- — 120Ω
2-phase pulse
Frequency
30kHz or less — B phase — 7 φB+ — 120Ω
17 φB- — 120Ω

Shielded cable

CLR+ 5
CLR- 15

5 to 24V DC
20mA or less

4 PG0+ — 120Ω
14 PG0- — 120Ω

5V DC
20mA or less

- The pin numbers of the I/O port in the FX2N-10PG are shown above.
  For the pin layout, refer to Section 2.3.

⚠

- Install a safety circuit outside the FX2N-10PG so that the entire system conservatively operates even if an abnormality occurs in the external power supply or a failure occurs in the FX2N-10PG.

1) Make sure to construct an emergency stop circuit, protection circuit, interlock circuit for reverse operations such as normal rotation and reverse rotation and interlock circuit to prevent damages of a machine for upper limit/lower limit, etc. outside the FX2N-10PG.

2) When the CPU in the detects an abnormality such as a watch dog timer error by the self-diagnosis circuit, all outputs turn off. When an abnormality occurs in the I/O control area which cannot be detected by the CPU in the FX2N-10PG, output control may be disabled. Design external circuits and the structure so that the entire system conservatively operates in such cases.

3) Do not lay signal cable near to high voltage power cable or house them in the same trunking duct. Effects of noise or surge induction may occur. Keep signal cables a safe distance of more than 100 mm (4") from these power cables.

4) Where output signal lines are used over an extended distance consideration for voltage drop and noise interference should be made.

5) Fix cables so that any stress is not directly applied on the terminal block or the cable connection area.

6) When a failure occurs in a transistor etc. in the FX2N-10PG, outputs may keep ON or OFF.
For output signals which may lead to severe accidents, design external circuits and the structure so that the entire system conservatively operates.

- Make sure to shut down the power supplies of all phases on the outside before starting installation or wiring.
If the power supplies are not shut down, you may get electrical shock or the unit may be damaged.

- Never touch any terminals while the power is supplied.
If you touch a terminal while the power is supplied, you may get electrical shock or the unit may malfunction.

- Turn off the power at first, then start cleaning or tighten terminals.
If you perform cleaning or tightening while the power is supplied, you may get electrical shock.

- For pairs of inputs such as forward/reverse contacts which would pose a hazard if turned ON simultaneously, provide external interlocks, in addition to interlocks in the program inside the positioning unit, to ensure that they cannot be turned ON simultaneously.
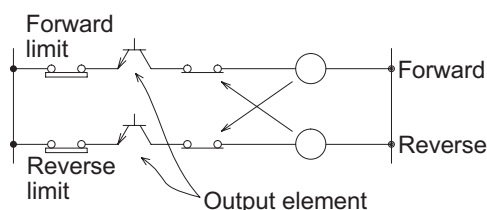
CE MEC Conformity

For compliance to EC EMC regulation it is necessary to add a Ferrite filter on the I/O cable of the FX2N-10PG.

The filter should be attached below with the filter surrounding the I/O cable.

The recommended ferrite filter is the TOKIN ESD-SR-25 or equivalent. The filter should be placesd as near to I/O port the FX2N-10PG as possible.

FX2N-10PG

Ferrite filter
TOKIN ESD-SR-25

TOKIN

I/O cable

150mm (5.9") or less
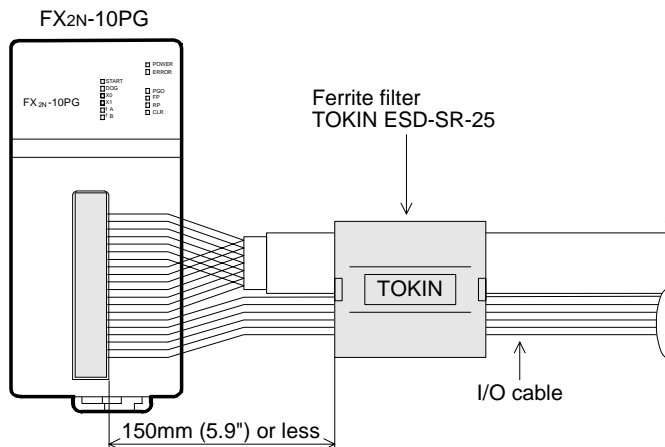
6.2   Input wiring

6.2.1   START, DOG, X0, X1, S/S

External power supply (24V DC) is required for terminals START, DOG, X0, X1 and S/S.
Contact output type and open collector transistor output (NPN, PNP) types of external devices
are applicable.

1) When contacts are used
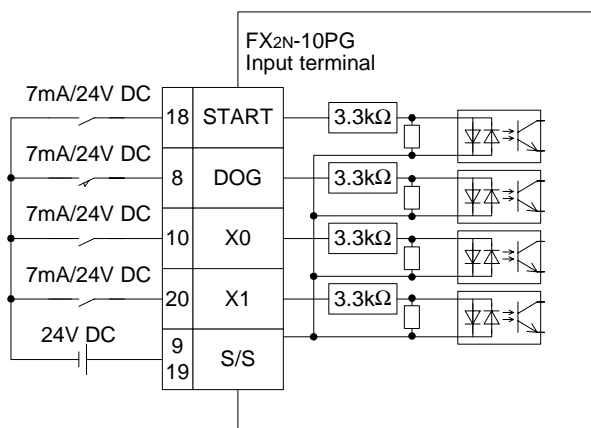
2) When NPN open collector transistors are used
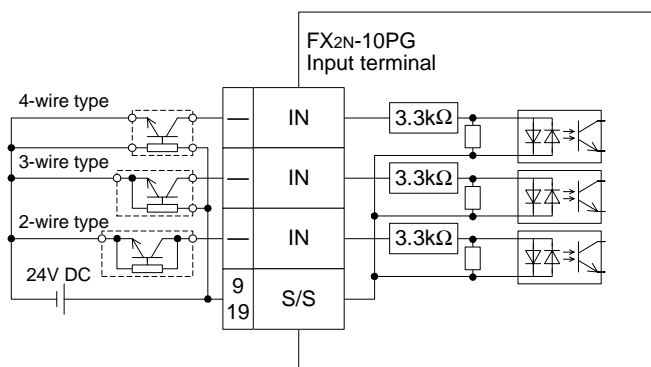
Reread IN terminal as START, DOG, X0 or X1 according to the application.

3) When PNP open collector transistors are used
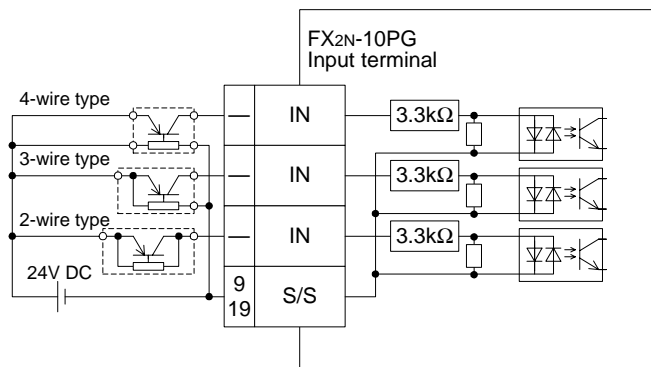
Reread IN terminal as START, DOG, X0 or X1 according to the application.

- The pin numbers of the I/O port in the FX2N-10PG are shown above.
  For the pin layout, refer to Section 2.3.

6.2.2   A-phase +, A-phase -, B-phase +, B-phase -

The differential line driver or the open collector transistor output type manual pulse generator is applicable to the terminals φA+, φA-, φB+ and φB-.
External power supply (5V DC) is required for the open collector transistor output.

1) When a differential line driver is used
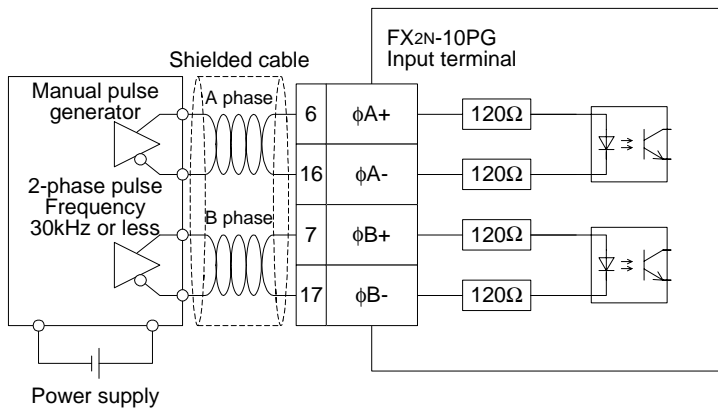
Manual pulse generator
2-phase pulse Frequency 30kHz or less
Shielded cable
A phase
B phase
Power supply

FX2N-10PG Input terminal
6   φA+   120Ω
16 φA-   120Ω
7   φB+   120Ω
17 φB-   120Ω

2) When NPN open collector transistors are used

Manual pulse generator
Shielded cable
A phase
B phase
5V DC

FX2N-10PG Input terminal
6   φA+   120Ω
16 φA-   120Ω
7   φB+   120Ω
17 φB-   120Ω

• The pin numbers of the I/O port in the FX2N-10PG are shown above.
  For the pin layout, refer to Section 2.3.

6.2.3   **PGO+, PGO-**

External power supply (5V DC) is required for the terminals PGO+ and PG0-.
The external device of the differential line driver output type or open collector transistor output (NPN/PNP) type is applicable.

1) When a differential line driver is used
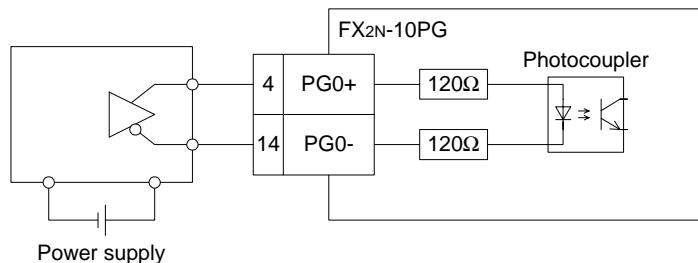
2) When NPN open collector transistor is used
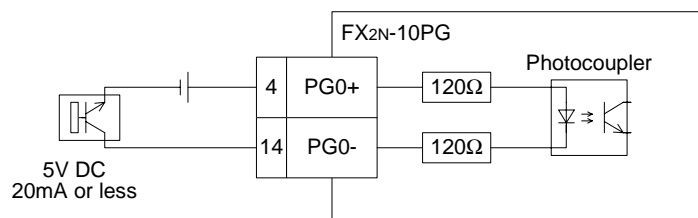
3) When PNP open collector transistor is used
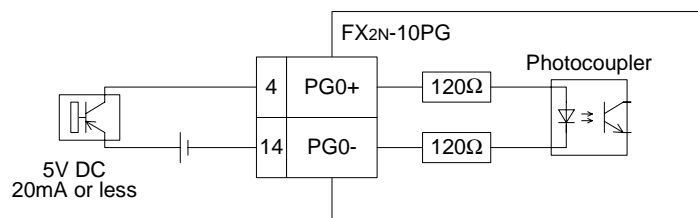
- The pin numbers of the I/O port in the FX2N-10PG are shown above.
  For the pin layout, refer to Section 2.3.

6.3   Output wiring

6.3.1   VIN+, VIN-, FP+, FP-, RP+, RP-

The terminals VIN+, VIN-, FP+, FP-, RP+ and RP- are connected to the servo amplifier and motor driver.
5 to 24V DC is supplied to the terminals VIN+ and VIN- from the external power supply or servo amplifier.
The terminals FP+, FP-, RP+ and RP- are used for the differential line driver output.

1) Connection to differential line receiver
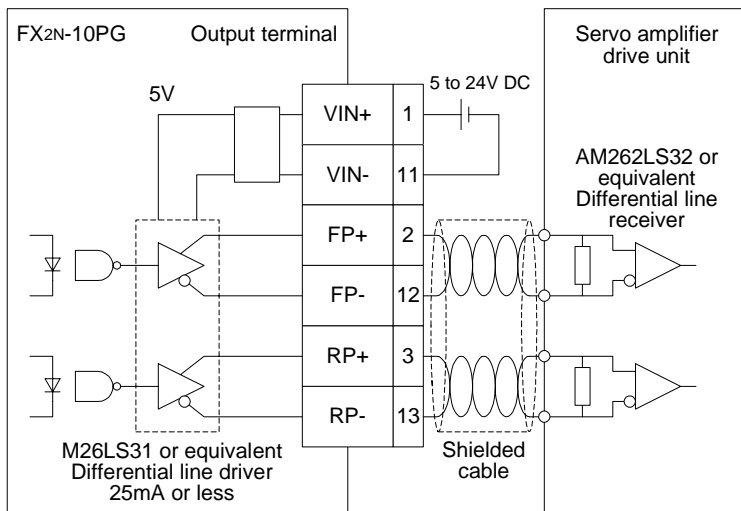
2) Connection to photocoupler
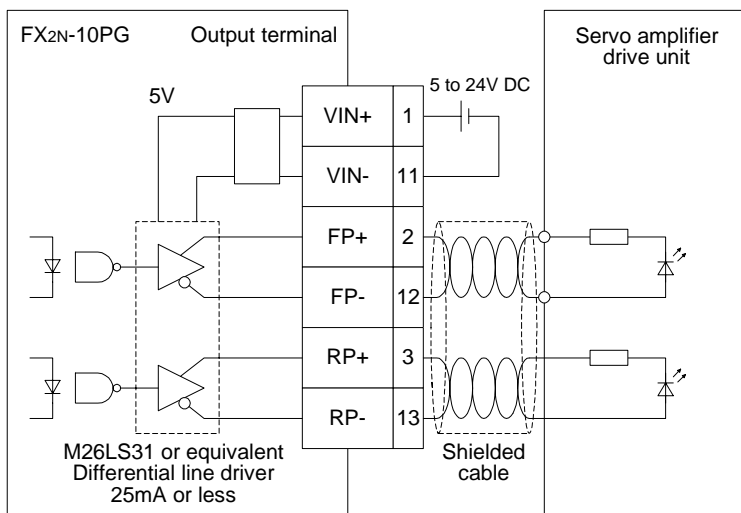
- The pin numbers of the I/O port in the FX2N-10PG are shown above.
  For the pin layout, refer to Section 2.3.

6.3.2   CLR+, CLR-

The terminals CLR+ and CLR- are connected to the servo amplifier.
5 to 24V DC is supplied to the terminals CLR+ and CLR- from the external power supply or servo amplifier.
CLR+ and CLR- are used for the NPN open collector output.
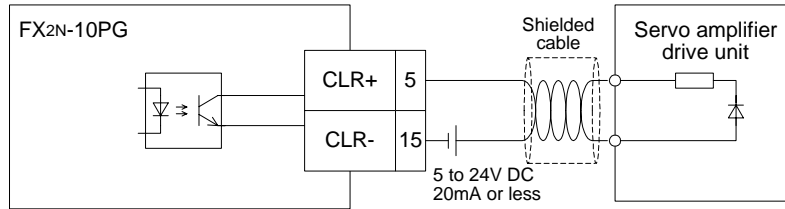
- The pin numbers of the I/O port in the FX2N-10PG are shown above.
    For the pin layout, refer to Section 2.3.

6.4   Connection with stepping motor
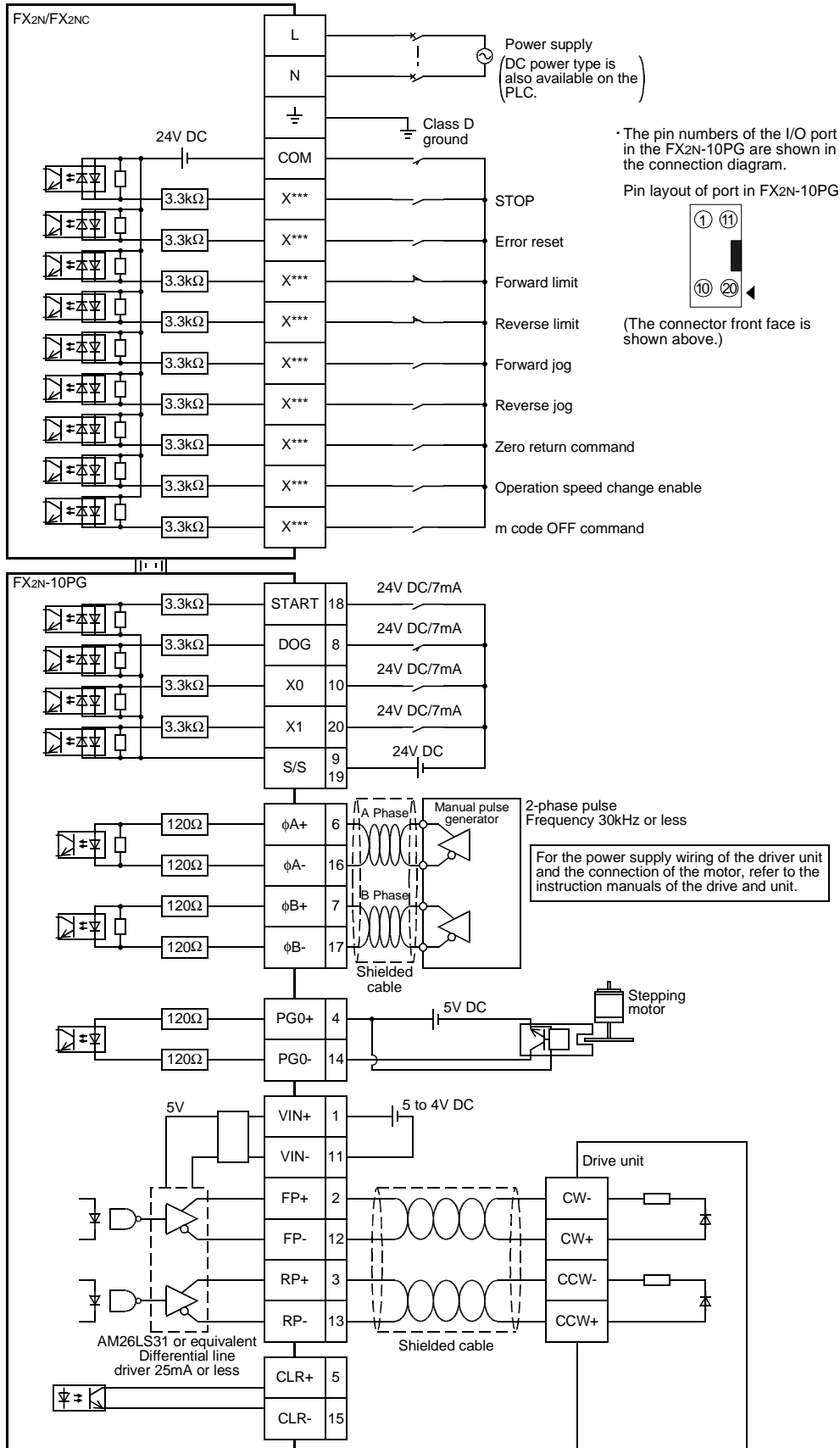
6.5 Connection with Model MR-C Servo Motor

- The pin numbers of the I/O port in the FX2N-10PG are shown in the connection diagram.

Pin layout of port in FX2N-10PG

(The connector front face is shown above.)

- For the pin layout of the servo amplifier, refer to the corresponding manuals.

2-phase pulse
Frequency 30kHz or less

For the power supply wiring of the servo amplifier and the connection of the motor, refer to the instruction manual and technical data of the servo amplifier.

AM26LS31 or equivalent
Differential line
driver 25mA or less

6.6   Connection with Model MR-J Servo Motor

6.7 Connection with Model MR-J2 (-Jr, -Super) Servo Motor

- The pin numbers of the I/O port in the FX2N-10PG are shown in the connection diagram.

Pin layout of port in FX2N-10PG

(The connector front face is shown above.)

- For the pin layout of the servo amplifier, refer to the corresponding manuals.

For the power supply wiring of the servo amplifier and the connection of the motor, refer to the instruction manual and technical data of the servo amplifier.

6.8   Connection with Model MR-H Servo Motor
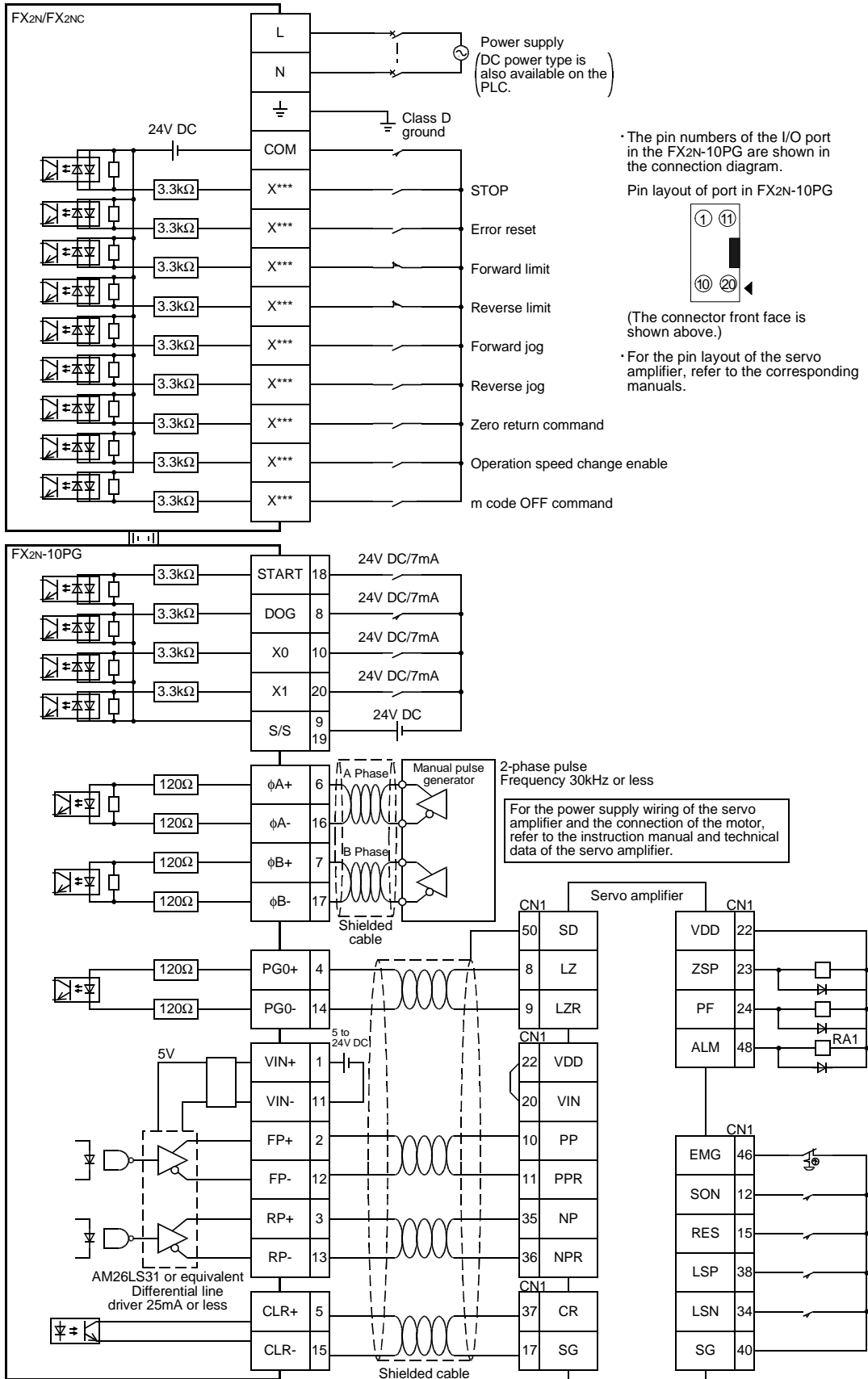
MEMO

7. Buffer memory (BFM)

7.1 BFM list

BFM No.		Name	Content and setting range	Initial value	Unit	Attribute
#1	#0	Max. speed	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	500,000	User unit	R/W
	#2	Bias speed	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 0 to 30,000Hz)	0	User unit	R/W
#4	#3	Jog speed	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	10,000	User unit	R/W
#6	#5	Zero return speed (high speed)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	500,000	User unit	R/W
	#7	Zero return speed (creep)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 0 to 30,000Hz)	1,000	User unit	R/W
	#8	Zero-point signal number (S-shaped control)	0 to 32.767	1	Pulse	R/W
#10	#9	Zero point address	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of -2,147,483,648 to 2,147,483,467)	0	User unit	R/W
	#11	Acceleration time	1 to 5,000ms (trapezoidal control) 64 to 5,000ms (S-shaped control)	100	ms	R/W
	#12	Deceleration time	1 to 5,000ms (trapezoidal control) 64 to 5,000ms (S-shaped control)	100	ms	R/W
#14	#13	Target address I	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of -2,147,483,648 to 2,147,483,467)	0	User unit	R/W
#16	#15	Operation speed I	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	500,000	User unit	R/W
#18	#17	Target address II	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of -2,147,483,648 to 2,147,483,467)	0	User unit	R/W
#20	#19	Operation speed II	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	100,000	User unit	R/W
	#21	Override setting	1 to 30,000	1000	$\times 0.1\%$	R/W
#23	#22	Current value, operation speed	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	0	User unit	R
#25	#24	Current address	-2,147,483,648 to 2,147,483,467	0	User unit	R/W
	#26	Operation command	Refer to the separate sheet.	H000	—	R/W
	#27	Operation pattern	Refer to the separate sheet.	H000	—	R/W

BFM No.		Name	Content and setting range	Initial value	Unit	Attribute
	#28	Status information	Refer to the separate sheet.		—	R
	#29	M code	During M code ON : 0 to 32,767 During M code OFF : -1	-1	—	R
	#30	Machine model code	K5120	5120	—	R
	#31	Not usable.				
#33	#32	Pulse rate	1 to 999,999 PLS/REV	2,000	Pulse	R/W
#35	#34	Feed rate	1 to 999,999 µm/REV	2,000	µm	R/W
	#36	Parameter	Refer to the separate sheet.	H2000	—	R/W
	#37	Error code	Occured error code is stored.	0	—	R
	#38	Terminal information	ON/OFF information of the terminal input is stored.	0	—	R/W
#40	#39	Current address (pulse converted value)	-2,147,483,648 to 2,147,483,467	0	Pulse	R/W
#42	#41	Manual pulse generator input current value	-2,147,483,648 to 2,147,483,467	0	Pulse	R/W
#44	#43	Manual pulse generator input frequency	0 to ±30,000	0	Hz	R
	#45	Electronic gear (numerator) for manual pulse generator input	1 to 32,767	1	—	R/W
	#46	Electronic gear (denominator) for manual pulse generator input	1 to 32,767	1	—	R/W
	#47	Manual pulse generator input response	1, 2, 3, 4, 5 (Low response → High response)	3	—	R/W
#48 to #63		Not usable.				
	#64	Version information			—	R
#65 to #97		Not usable.				
	#98	Table start No.	0 to 199	0	—	R/W
	#99	Executing table No.	-1 to 199	-1	—	R
#101	#100	Position information (Table No. 0)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of -2,147,483,648 to 2,147,483,467)	-1	User unit	R/W
#103	#102	Speed information (Table No. 0)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	-1	User unit	R/W
	#104	m code information (Table No. 0)	-1 to 32,767	-1	—	R/W
	#105	Operation information (Table No. 0)	-1 to 4	-1	—	R/W

BFM No.		Name	Content and setting range	Initial value	Unit	Attribute
#107	#106	Position information (Table No. 1)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of -2,147,483,648 to 2,147,483,467)	-1	User unit	R/W
#109	#108	Speed information (Table No. 1)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	-1	User unit	R/W
	#110	m code information (Table No. 1)	-1 to 32,767	-1	—	R/W
	#111	Operation information (Table No. 1)	-1 to 4	-1	—	R/W
. . .			. . .			
#1295	#1294	Position information (Table No. 199)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of -2,147,483,648 to 2,147,483,647)	-1	User unit	R/W
#1297	#1296	Speed information (Table No. 199)	-2,147,483,648 to 2,147,483,467 (The pulse-converted value of 1 to 1,000,000Hz)	-1	User unit	R/W
	#1298	m code information (Table No. 199)	-1 to 32,767	-1	—	R/W
	#1299	Operation information (Table No. 199)	-1 to 4	-1	—	R/W

• A single buffer memory No. is used for 16-bit data, and that of a serial buffer memory No. is used for 32-bit data.
Use the 16-bit command (FROM/TO) for the buffer memory of 16-bit data.

Use the 32-bit command (**D** FROM/ **D** TO) for the buffer memory of 32-bit data.
Treat the m code information (BFM#104, #110, ... #248) and operation information (BFM#105, #111, ... #1299) as 32-bit data.

```
    ┤ ├────────────────────┤ MOV │ K1 │ D0 │   K1→D0   m code 1

                            ┤ MOV │ K0 │ D1 │   K0→D1   Operation information 0
                                                        (Step-advance operation)

    ┤ ├──┤ D TO │ K0 │ K104 │ D0 │ K1 │        D0→BFM#104
                                               D1→BFM#105
```
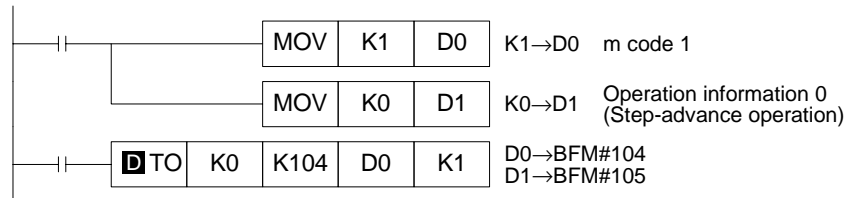
• Attribute : W ... Writing   R ... Reading

• Unit   : User unit ... Varies as the system unit (BFM#36) is set.

7.2 Details of BFM

7.2.1 BFM#1, #0 Maximum speed

The upper limit of the speed in each operation mode.
Set the bias speed (BFM#2), jog speed (BFM#3, #4), zero return speed (high speed) (BFM#5, #6), zero return speed (creep) (BFM#7), operation speed I (BFM#15, #16) and operation speed II (BFM#19, #20) to be less than the maximum speed.
The setting unit varies as "system unit" (BFM#36) is set.
Here, the inclination of ac-/deceration is determined depending on the maximum speed, bias speed (BFM#2), acceleration time (BFM#11) and deceleration time (BFM#12).

7.2.2 BFM#2 Bias speed

The start speed.
If it is used in combination with FX2N-10PG and stepping motor, set the speed, considering the resonant area and self-start frequency.
The inclination of the ac-/deceleration is determined depending on the settings of the maximum speed, bias speed, acceleration time and deceleration time.

7.2.3 BFM#4, #3 Jog speed

The speed during manual forward/reverse (JOG+/JOG-) operation.
Set the jog speed in the range between the bias speed (BFM#2) and maximum speed (BFM#0, #1).
(Maximum speed > Jog speed > Bias speed)
When the jog speed is set at the maximum speed or more, it is operated at the maximum speed, and if the jog speed is at the bias speed or less, it is operated at the bias speed.
When operation speed change (BFM#26 b10) is allowed (OFF), the speed during jog operation can be changed.

7.2.4 BFM#6, #5 Zero return speed (high speed)

The high return speed during machine zero return operation.
Set the zero return speed (high speed) in the range between the bias speed (BFM#2) and maximum speed (BFM#0, #1).
When operation speed change (BFM#26 b10) is allowed (OFF), the speed during zero return operation can be changed.

7.2.5 BFM#7 Zero return speed (creep)

The speed is set for slow-speed operation after input of the near-point signal (DOG) during machine zero return operation.
To improve the precision of the zero position, set to be as slow as possible.
When operation speed change (BFM#26 b10) is allowed (OFF), the speed during zero return operation can be changed.

7.2.6 BFM#8 Zero-point signal number

The number of zero-point signals from dog input ON or OFF (the count timing is set with BFM#36) to the stop is set.
The zero-point signal is counted when the leading edge is detected.
When the setting value is "0", it is immediately stopped if the dog input is turned to ON or OFF.
At this time, it is immediately stopped from the zero return speed (BFM#6, #5).
If a machine may be broken due to immediate stop, the value can be set to stop the machine after the safety speed is gained at the creep speed (BFM#7).

7.2.7   BFM#10, #9   Zero-point address

The address of the current value at the completion time of zero return operation is set.
When the zero return operation is completed, the value is written at the current address (BFM#40, #39).
Here, the user unit (BFM#36) is selected, and the value which also includes the magnification (BFM#36) of the position data is selected.

7.2.8   BFM#11   Acceleration time

The time from the bias speed (BFM#2) to the maximum speed (BFM#1, #0).
The inclination of the acceleration is determined depending on the bias speed (BFM#2), maximum speed (BFM#1, #0) and acceleration time.
The settable range is 1 to 5000ms.
It is operated at 1ms for 0ms or less, and at 5000ms for 5001ms or more.
To use an approx. S-shaped ac-/deceleration control, set 64ms or more.

7.2.9   BFM#12   Deceleration time

The time from the maximum speed (BFM#1, #0) to the bias speed (BFM#2).
The inclination of the deceleration is determined depending on the bias speed (BFM#2), maximum speed (BFM#1, #0) and deceleration time.
The settable range is 1 to 5000ms.
It is operated at 1ms for 0ms or less, and at 5000ms for 5001ms or more.
To use an approx. S-shaped ac-/deceleration control, set 64ms or more.

7.2.10   BFM#14, #13   Target address I

The target position (absolute address) or travel distance (relative address) in each operation mode is set.
When the absolute address is used, the positioning operation is done to the target position specified referring to the current address (BFM#39, #40). At this time, the rotation direction is determined depending on the relationship whether the current address is larger or smaller than the target address.
When the relative address is used, the positioning operation is done only by the travel distance referring to the current work position.
At this time, the rotation direction is determined depending on the symbol of the target address.
Here, the user unit (BFM#36) is selected, and the value which also includes the magnification (BFM#36) of the position data is selected.

7.2.11   BFM#16, #15   Operation speed I

The practical operation speed in each operation mode.
Set the operation speed in the range between the bias speed (BFM#2) and maximum speed (BFM#0, #1).
(Maximum speed > Operation speed I/II > Bias speed)
If the operation speed is set at the maximum speed or more, it will operate at the maximum speed. When the operation speed is set at the bias speed or less, it will operate at the bias speed.
When operation speed change (BFM#26 b10) is allowed (OFF), the speed during positioning operation can be changed.

7.2.12   BFM#18, #17   Target address II

The target position (absolute address) or travel distance (relative address) in the 2nd-speed positioning operation is set.
When the absolute address is used, the positioning operation is done to the target position specified referring to the current address (BFM#39, #40).
When the relative address is used, the positioning operation is done only by the travel distance specified from the 1st speed target address.
Here, the user unit (BFM#36) is selected, and the value which also includes the magnification (BFM#36) of the position data is selected.

7.2.13   BFM#20, #19   Operation speed II

The practical operation speed during 2-speed positioning operation and interrupting 2-speed positioning.
Set the operation speed in the range between the bias speed (BFM#2) and maximum speed (BFM#0, #1).
(Maximum speed > Operation speed I/II > Bias speed)
If the operation speed is set at the maximum speed or more, it will operate at the maximum speed. When the operation speed is set at the bias speed or less, it will operate at the bias speed.
When operation speed change (BFM#26 b10) is allowed (OFF), the speed during positioning operation can be changed.

7.2.14   BFM#21 Override setting

By instructing a ration in the override setting, the practical operation speed can be changed referring to the speed set for the jog speed (BFM#4, #3), operation speed I (BFM#16, #15), operation speed II (BFM#20, #19), zero return speed (BFM#6, #5) or creep speed (BFM#7).
The operation speed can be also changed during positioning.
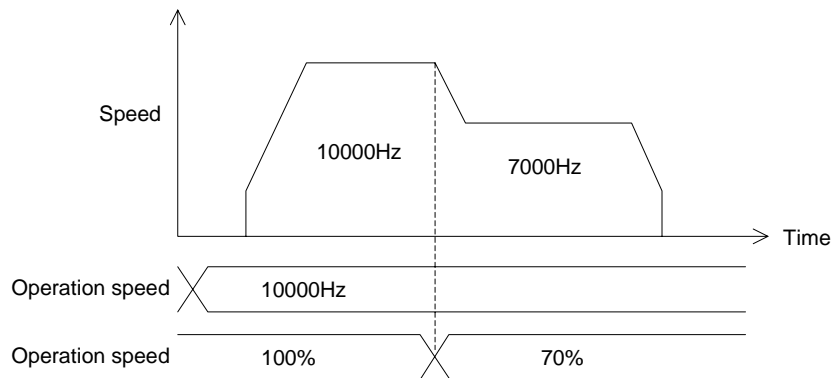
7.2.15   BFM#23, #22 Operation speed current value

When the pulse chain is output, the current value of the operation speed is stored. (When it is stopped or is in the manual pulse generator input operation, it becomes "0".)
Units are as set in user unit (BFM#36).

7.2.16   BFM#25, #24 Current address

The current address data is stored.
The stored address data is always the absolute address.
Here, the user unit (BFM#36) is selected, and the value which also includes the magnification (BFM#36) of the position data is selected.

7.2.17 BFM#26 Operation commands

The items for error reset and pulse chain output start/output stop are assigned to each bit of BFM#26. TO commands from the PLC turn ON and OFF each bit to start the operation.

Bit No.	Operation command	Details	Detection timing
b0	Error reset	If any error occurs, the error will be reset with b0=ON to clear the status information and error code.	Edge detection
b1	STOP	Deceleration is stopped with b1=ON during positioning operation (including the jog operation and zero return).	Level detection
b2	Forward limit	Deceleration is stopped with b2=ON during forward pulse output.	Level detection
b3	Reverse limit	Deceleration is stopped with b3=ON during reverse pulse output.	Level detection
b4	Forward jog	Forward pulses are output while b4 is ON.	Level detection
b5	Reverse jog	Reverse pulses are output while b5 is ON.	Level detection
b6	Zero return command	Machine zero return is started by turning ON b6.	Edge detection
b7	Data set type zero return command	CLR signal is output by turning ON b7, the value of the zero point address (BFM#10, #9) is transferred to the current address (BFM#25, #24 and #40, #39) and the zero return completed flag (BFM#28) is turned on.	Edge detection
b8	Relative/ absolute address	At the time of b8=OFF, operation is done by the absolute address instruction (distance from the address value 0). At the time of b8=ON, operation is done by the relative address instruction (distance from the current address).	Level detection
b9	START	The positioning operation selected in the operation pattern (BFM#27) is started by turning ON b9. Before turning ON b9, select the operation pattern (BFM#27) and produce the PLC program.	Edge detection
b10	Speed change disable during operation	Speed change (operation speed I, operation speed II, zero return speed (high speed) and zero return speed (creep) and jog speed) during operation is disable when b10=ON.	Level detection
b11	m code OFF command	m code is turned OFF by turning ON b11.	Edge detection
b12 to b15	Not defined.	—	—

- Detection timing
  Level detection : Effective while each bit is ON or OFF.
  Edge detection : The change of OFF or ON is detected to start the operation.

- Priority sequence of start flag and stop flag
  In each operation mode, the STOP command during operation is always valid, and is prior to forward jog, reverse jog and start.
  When the STOP command is ON, FX2N-10PG stops deceleration. When the START command is turned ON, the remaining-distance operation or next positioning operation is started. (Selection with BFM36 b15)
  However, If forward jog (BFM#26 b4)/reverse jog (BFM#26 b5) is ON during jog operation, the jog operation will be restarted when the STOP command is turned OFF.

- ON/OFF process of each flag
  If ON or OFF is written into each flag, the state will be held until the power supply of FX2N-10PG is turned off.
  Level detection is executed/stopped by writing ON/OFF.
  Moreover, for edge detection, be sure to produce such a sequence program as each bit is turned OFF after the assigned operation is executed by turning ON each bit.
  (Unless each bit is turned OFF, the operation of 2nd time or following will be impossible.)

- Forward limit (b2) and reverse limit (b3)
  When the forward/reverse limit (BFM#26 b2, b3) is turned ON, deceleration and stop will be applied, and it will not be possible to travel in the direction of the limit switch which is turned ON.
  To drive away from the limit switch, use jog commands or a manual pulse generator in the required direction.
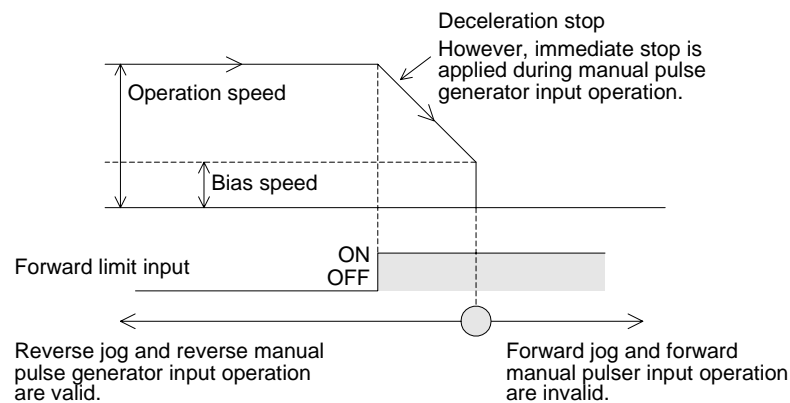
- Transfer method of operation command

Ladder	Coil	Description
X000 —| |—	(M0)	Error reset
X001 —| |—	(M1)	STOP
X002 (N/O contact) —|/|—	(M2)	Forward limit
X003 (N/C contact) —|/|—	(M3)	Reverse limit
X004 —| |—	(M4)	Forward jog
X005 —| |—	(M5)	Reverse jog
X006 —| |—	(M6)	Zero point return command
M8000 —|/|—	(M7)	Data reset type zero return command
M8000 —| |—	(M8)	Relative/absolute address
X007 —| |—	(M9)	START
M8000 —|/|—	(M10)	Speed change disablement during operation
X010 —| |—	(M11)	m code OFF command
M8000 —|/|—	(M12) (M13) (M14) (M15)	Not defined.

M8000 (RUN monitor) —| |—	TO	K0	K26	K4M0	K1

(M15 to M0)→BFM#26(b15 to b0)

- In the above example, consider that the forward limit input switch (X002) and reverse limit input switch (X003) are connected at the N/C contact.

- TO commands are written from the PLC to BFM. The above example shows that FX2N-10PG is a special unit connected as the module nearest to the basic unit.

- If the following program is used, 2nd and following operations are impossible since the OFF state of the start bit in the operation mode can not be produced in FX2N-10PG. Change it as shown in the right.

✕
| X000 —| |— | TO | K0 | K26 | H0200 | K1 |
| X001 —| |— | TO | K0 | K26 | H0200 | K1 |

⇒ ✔
| X000 —| |— | | | | | (M9) |
| X001 —| |— | | | | | |

| M8000 —| |— | TO | K0 | K26 | K4M0 | K1 |
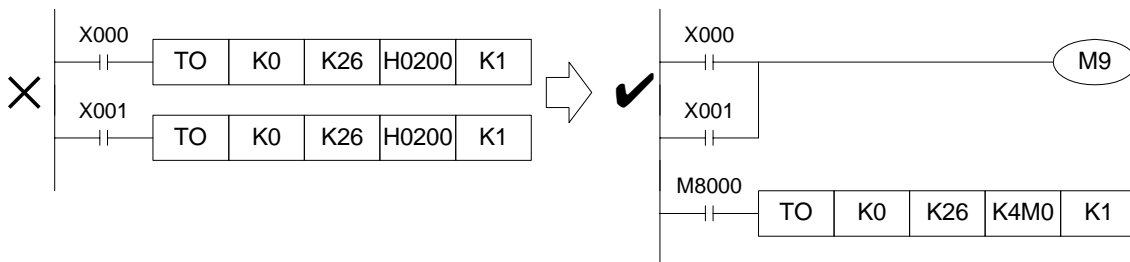
7.2.18　BFM#27　Operation pattern

The operation pattern executed by FX$_{2N}$-10PG is assigned to each bit.
TO commands from the PLC select an operation pattern in which it is operated by turning ON/OFF each bit.

Bit No.	Operation pattern	Remarks
b0	1st-speed positioning operation	When b0 is ON, the 1st-speed positioning operation is selected. Turn ON b0, and write relevant data into the target address I (BFM#14, #13) and operation speed I (BFM#16, #15). Then turn ON START input or START flag (BFM#26 b9), and the positioning operation will begin.
b1	Interrupt 1st-speed positioning operation	When b1 is ON, the interrupt 1st-speed positioning operation is selected. Turn ON b1, and write relevant data into the target address I (BFM#14, #13) and operation speed I (BFM#16, #15). Then turn ON START input or START flag (BFM#26 b9), and the positioning operation will begin. Use X0 for the interrupt input.
b2	2nd-speed positioning operation	When b2 is ON, the 2nd-speed positioning operation is selected. Turn ON b2, and write relevant data into the target address I (BFM#14, #13), target address II (BFM#18, #17), operation speed I (BFM#16, #15) and operation speed II (BFM#20, #19). Then turn ON START input or START flag (BFM#26 b9), and the positioning operation will begin.
b3	Interrupt 2nd-speed positioning operation	When b3 is ON, the interrupt 2nd-speed positioning operation is selected. Turn ON b3, and write relevant data into the target address I (BFM#14, #13), target address II (BFM#18, #17), operation speed I (BFM#16, #15) and operation speed II (BFM#20, #19). Then turn ON START input or START flag (BFM#26 b9), and the positioning operation will begin. Use X0 and X1 for the interrupt input.
b4	Interrupt stop operation	When b4 is ON, the interrupt stop operation is selected. Turn ON b4, and write relevant data into the target address I (BFM#14, #13) and operation speed I (BFM#16, #15). Then turn ON START input or START flag (BFM#26 b9), and the positioning operation will begin. Use X0 for the interrupt input.
b5	Table operation	Positioning operation in the table system is executed. START command (START input or BFM#26 b9) executes the operation form the table No. instructed with BFM#98. (BFM#100 to BFM#1299 are used.)
b6	Variable speed operation	When b6 is ON, the variable speed operation is selected. Turn ON b6 and write the speed data into the operation speed I (BFM#16, #15), and the variable speed operation will start immediately. It is not necessary to turn ON the START input or START flag (BFM#26 b9).
b7	Manual pulse generator input operation	When b7 is ON, the manual pulse generator input operation is selected. Turn ON b6, and apply the manual pulse generator input, and the pulses will be output to the motor. Input from the manual pulse generator is done with φA and φB. It is not necessary to turn ON the START input or START flag (BFM#26 b9).
b8 to b15	Not defined.	—

- Be sure to produce the program of PLC to make the operation pattern selection earlier than START input or START flag (BFM#26 b9) ON.

- When all bits of BFM#27 are OFF or plural bits are ON, the positioning operation will not be started even though START input or START flag (BFM#26 b9) is turned ON. (If any plural bits are turned ON, an error will occur.)

- Valid while each bit is ON. (Level detection)

7.2.19 BFM#28 Status information

The item showing the FX2N-10PG state is assigned to each bit.

FROM command from the PLC read each bit to allow the FX2N-10PG state to be checked.

Bit No.	Status	Details
b0	READY/BUSY	ON: Ready (pulse output stops.) OFF: Busy (Pulses are output.)
b1	Forward pulse outputting	ON when forward pulses are output.
b2	Reverse pulse outputting	ON when reverse pulses are output.
b3	Zero return completion	Set when zero return is normally ended. Reset with power supply OFF, zero return command and data set type zero return command.
b4	Current value overflow	Set when the value of the current address (BFM#25, #24) exceeds the range of 32-bit data (-2,147,483,648 to 2,147,483,467). Reset with power supply OFF, zero return command and data set type zero return command.
b5	Error occurrence	Set if an error occurs, the error code is stored into BFM#7. Can be reset by the operation command (BFM#26).
b6	Positioning end	Set when the positioning operation is normally complete. Cleared with zero return, positioning operation START and operation command (BFM#26) (only when the error occurs).
b7	Remaining distance drive waiting during STOP input	Set with remaining-distance drive waiting during STOP input. Reset by restarting Operation with STOP input is set with the parameter (BFM#36).
b8	m code ON	Set when m code is turned ON. It is reset with m code OFF command (BFM#26).
b9	Manual pulse generator input UP counting	Turned ON when input from manual pulse generator is counted up.
b10	Manual pulse generator input DOWN counting	Turned ON when input from manual pulse generator is counted down.
b11 to b15	Not defined.	—

7.2.20 BFM#29 m code

When m code is ON, the m code No. is stored.
When m code is OFF, -1 is stored.

7.2.21 BFM#30 Machine model code

K5120 (fixed), FX2N-10PG machine model code KS120 (fixed) is stored.

7.2.22 BFM#33, #32 pulse rate

Sets how many pulses per motor revolution are given to the drive unit.
If any electronic gearing is present in the servo motor, it is necessary to consider its magnification.
The relationship between pulse rate and electronic gearing is shown below.

Pulse rate (PARA. 1) = Resolution power of encoder (positioning feedback pulses) / Electronic gearing (CMX/CDV)

The pulse rate is necessary only when the system unit (BFM#36) is set in "mechanical system unit" or "compound system unit", it is ignored when it is set in the "motor system unit".

7.2.23 BFM#35, #34 Feed rate

The machine travel per motor revolution is set.
The feed rate is necessary only when the system unit (BFM#36) is set at "mechanical system unit" or "compound system unit". When "motor system unit is set", it is ignored.

7.2.24 BFM#36 Parameters

Bit No.	Item	Details	
b0	Unit system	(b1, b0)=00: Motor system	(b1, b0)=01: Machine system
b1		(b1, b0)=10: Compound system	(b1, b0)=11: Compound system
b3, b2	Not defined.	—	
b4	Magnification of position data	(b5, b4)=00: 1 times	(b5, b4)=01: 10 times
b5		(b5, b4)=10: 100 times	(b5, b4)=11: 1000 times
b7, b6	Not defined.	—	
b8	Pulse output format	OFF : FP/RP=Forward pulse/reverse pulse ON : FP/RP=Pulse/direction	
b9	Rotation direction	OFF : Current-value increase with forward pulse ON : Current-value decrease with forward pulse	
b10	Zero return direction	OFF : Current-value decrease direction ON : Current-value increase direction	
b11	Ac-/deceleration mode	OFF : Trapezoidal ac-/deceleration control ON : Approx. S-shaped ac-/deceleration control	
b12	Dog input polarity	OFF : N/O contact ON : N/C contact	
b13	Count start timing	OFF : Dog forward end ON : Dog backward end	
b14	Not defined.	—	
b15	STOP mode	OFF : Remaining-distance operation ON : Positioning end	

- b1, b0 system unit

  Units handled for the position and speed are set.

Item	Bit status		Details
	b1	b0	
Motor system unit	0	0	Controls the position based on "PLS" (pules).
Mechanical system unit	0	1	Controls the position based on "μm, mdeg, 10^{-4} inch, etc".
Combined system unit	1	0	The combined system units are used as mechanical system for position command and motor system for speed command.
	1	1	

Setting items for position data and speed data are handled in the units shown in the table below.

Item		Motor system unit	Mechanical system unit	Compound system unit
Pulse rate (BFM#33, #32)		• Invalid	• Pulse	• Pulse
Feed rate (BFM#35, #34)			• μm • deg • m10^{-4}inch	• μm • deg • m10^{-4}inch
Position data	Zero point address (BFM#10, #19) Target address I (BFM#13, #14) Target address II (BFM#18, #17) Current address (BFM#25, #24)	• Pulse	• μm • deg • m10^{-4}inch	• μm • mdeg • m10^{-4}inch
Speed data	Maximum speed (BFM#1, #0) Bias speed (BFM#2) Jog speed (BFM#3, #4) Zero return speed (high speed) (BFM#6, #5) Zero return speed (creep) (BFM#7)	• Hz	• cm/min • 10deg/min • inch/min	• Hz

The values above are necessary only when the unit systems for the pulse rate (BFM#33, #32) and feed rate (BFM#35, #34) are set in "mechanical system unit" and "compound system unit". When the system is set for "motor system unit", they are ignored.

Concept of mechanical system unit

When BFM#36 a(b1, b0) is set at (0,1), (1,0) or (1,1), it is processed in the mechanical system unit of mm, deg or inch. Though there is at this time no buffer memory to select the unit from mm, deg or inch, it is thought that the position data and speed data used in the feed rate (BFM#35, #34) parameter (BFM#36) in the positioning program are all the same unit. Therefore, even though a unit is used for setting, the pulse output of the same amount can be gained if the setting value is the same.

Example

Conditions

Pulse rate	: 4,000 [PLS/REV]
Feed rate	: 100 [mm/REV, mdeg/REV, $\times 10^{-1}$minch/REV]
Minimum command unit	: [3] (The travel is processed in 10^{-3}mm, 10^{-3}deg and 10^{-4}inch.)

Electronic gearing of servo amplifier: 1/1

1) When mm is used for setting

The following pulses are output for the positioning operation of travel 100 [$\times 10^{-3}$mm] and operation speed of 6 [cm/min].

$$\text{Pulses generated} = \text{Travel stroke}^{*1} / \text{Feed rate}^{*1} \times \text{Pulse rate}$$
$$= 100 \, [\times 10^{-3}\text{mm}] / 100 \, [\mu\text{m/REV}] \times 4{,}000 \, [\text{PLS/REV}]$$
$$= 4{,}000 \, [\text{PLS}]$$

$$\text{Pulse frequency} = \text{Operation speed}^{*1} / \text{Feed rate}^{*1} \times \text{Pulse rate}$$
$$= 6 \, [\text{cm/min}] \times 10^4 / 60 / 100 \, [\mu\text{m/REV}] \times 4{,}000 \, [\text{PLS/REV}]$$
$$= 40{,}000 \, [\text{Hz}]$$

*1 The units are matched for each calculation. 1mm = $10^3\mu$m, 1cm = $10^4\mu$m, 1min = 60s

2) When deg is used for setting

The following pulses are output for the positioning operation of travel 100 [$\times 10^{-3}$deg] and operation speed of 6 [deg/min].

$$\text{Pulses generated} = \text{Travel stroke}^{*2} / \text{Feed rate}^{*2} \times \text{Pulse rate}$$
$$= 100 \, [\times 10^{-3}\text{deg}] / 100 \, [\text{mdeg/REV}] \times 4{,}000 \, [\text{PLS/REV}]$$
$$= 4{,}000 \, [\text{PLS}]$$

$$\text{Pulse frequency} = \text{Operation speed}^{*2} / \text{Feed rate}^{*2} \times \text{Pulse rate}$$
$$= 6 \, [\text{deg/min}] \times 10^4 / 60 / 100 \, [\mu\text{deg/REV}] \times 4{,}000 \, [\text{PLS/REV}]$$
$$= 40{,}000 \, [\text{Hz}]$$

*2 Units are matched for each calculation. 1mm = 10^3mdeg, 1cm = 10^4mdeg, 1min = 60s

3) When inch is used for setting

The following pulses are output for the positioning operation of travel 100 [$\times 10^{-4}$inch] and operation speed of 6 [inch/min].

Pulses generated = Travel stroke[*3] / Feed rate[*3] $\times$ Pulse rate
$$= 100 [\times 10^{-4}\text{inch}] / 100 [\times 10^{-1}\text{minch/REV}] \times 4,000 [\text{PLS/REV}]$$
$$= 4,000 [\text{PLS}]$$

Pulse frequency = Operation speed[*3] / Feed rate[*3] $\times$ Pulse rate
$$= 6 [\text{inch/min}] \times 10^{4} / 60 / 100 [\text{minch/REV}] \times 4,000 [\text{PLS/REV}]$$
$$= 40,000 [\text{Hz}]$$

*3 Units are matched for each calculation. 1mm = 10^{3}minch, 1cm = 10^{4}minch, 1min = 60s

- b5, b4 Magnification of position data

The position data which will be written into the zero point address (BFM#10, #9), target address I (BFM#13, #14), target address II (BFM#18, #17) and current address (BFM#25, #24) can be magnified.

Setting of BFM#36 b5, b4	Magnification
b5,b4 = 0, 0	Position data $\times$ 1
b5,b4 = 0, 1	Position data $\times$ 10
b5,b4 = 1, 0	Position data $\times$ 100
b5,b4 = 1, 1	Position data $\times$ 1000

Example

When the content of the target address I (BFM#13, #14) is 123 and BFM#36 b5, b4 is set at 1, 1, the practical address (or travel stroke) becomes as follows.

Motor system unit   : 123 $\times$ 1000 = 123000 (pulses)
Mechanical system unit, compound system unit   : 123 $\times$ 1000 = (mm, mdeg, 10^{4}inch)
                                                                                =123 (mm, deg, 10^{-1}inch)

- b8   Pulse output format

  b8=0: Forward pulses (FP) / reverse pulses (RP)
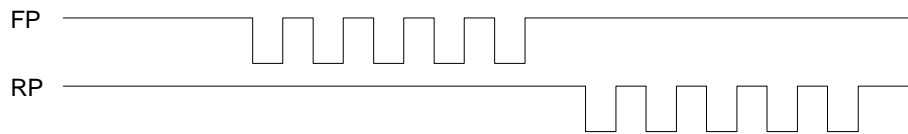
  b8=1: Pulses (FP) / direction DIR (RP)
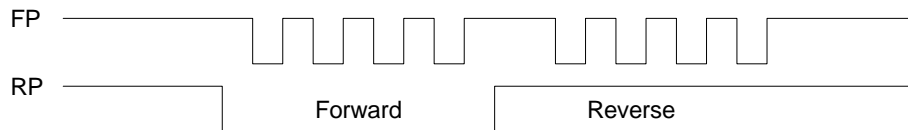
- b9   Rotation direction

  b9=0: The current value is increased by the forward pulses.
  b9=1: The current value is decreased by the forward pulses.

- b10   Zero return direction

  b10=0 : Starts operation in the decreasing direction of the current value when zero
         return is applied.
  b10=0 : Starts operation in the increasing direction of the current value when zero
         return is applied.

- b11   Ac-/deceleration mode

  b11=0: Trapezoid ac-/deceleration control is applied to the operation.
  b11=1: Approximate S-shaped ac-/deceleration control is applied to the operation.

- b12   Polarity of dog input
  b12=0: N/O contact (Activated for input ON.)
  b12=1: N/C contact (Activated for input OFF.)

- b13   Zero point signal count start timing

  b13=0 : When the front end of the near-point dog reaches the DOG switch (OFF to ON).
  b13=1 : When the rear end of the near-point dog reaches the DOG switch (ON to OFF).

- b15   STOP mode

  b15=0 : Operation is interrupted by the stop command, the remaining-distance is started
          with the restart command.
  b15=1 : Operation remaining-distance is not completed, positioning is executed to the next
          position.

7.2.25 BFM#37 Error code

If an error occurs, the error code will be stored in BFM#37.

Error code	Details
K0	No error
K1	Not defined.
K○○○○2	The value setting range is faulty. A value outside the range is set at each BFM. Example: The pulse rate is outside 1 to 999,999.
K○○○○3	The setting value overflows. When the pulses are converted into the travel or operation speed, a value which exceeds 32-bit data is set.
K4	Forward or reverse limit reached. When the work is moved from the limit switch by jog or manual pulse generator, the error is cancelled.
K5	Not defined.
K6	At BFM#26, the zero return command (b6), data set type zero return command (b7) and start (b9) are ON at the same time. (When the forward jog (b4) and reverse jog (b5) are ON at the same time, there is not an error.)
K7	At BFM#27, plural operation patterns are selected.

- ○○○○ relates to BFM 0 ~ 1299.

7.2.26 BFM#38 Terminal information

Items below show the state of each input terminal.

Bit No.	Terminal information	Details
b0	START input	When START terminal input is on, b0 is ON.
b1	DOG input	When DOG terminal input is on, b1 is ON.
b2	PG0 input	When PG0 terminal input is on, b2 is ON.
b3	X0 input	When X0 terminal input is on, b3 is ON.
b4	X1 input	When X1 terminal input is on, b4 is ON.
b5	ϕA input	When A terminal input is on, b5 is ON.
b6	ϕB input	When B terminal input is on, b6 is ON.
b7	CLR signal	When CLR signal is on, b7 is ON.
b8 to b15	Not usable.	—

- As b7 is turned ON/OFF, CLR output terminal can be forced ON/OFF.

7.2.27 BFM#40, #39 Current address

The current address data is stored as a pulse converted value.

7.2.28 BFM#42, #41 Manual pulse generator input current value

Pulses input from the manual pulse generator are stored.
Forward increases and reverse decreases the stored value.
Here, the stored data does not includes the magnification of the manual pulse generator input electronic gearing (BFM#45, #46).

7.2.29   BFM#44, #43   Manual pulse generator input frequency

The current frequency of pulses input from the manual pulse generator is stored.
Here, the stored data does not includes the magnification of the manual pulse generator input electronic gearing (BFM#45, #46).

7.2.30   BFM#45   Manual pulse generator input electronic gearing (numerator)

The magnification applied to the pulse chain input from the manual pulse generator is written.

7.2.31   BFM#46   Manual pulse generator input electronic gearing (denominator)

The dirsion applied to the pulse chain input from the manual pulse generator is written.

The manual pulse generator input electronic gearing (numerator) and manual pulse generator input electronic gearing (denominator) is applied to the pulse chain input from the manual pulse generator as follows.

Input from manual pulse generator $\times$ numerator of manual pulse generator input electronic gear (BFM#45) / denominator of manual pulse generator input electronic gearing (BFM#46) = Number of output pulses

7.2.32   BFM#47   Input response of manual pulse generator

The follow-up ability of the pulse chain input from the manual pulse generator and the pulse chain output is set in five steps of 1 through 5.
If the value is small, the response becomes low and acceleration/deceleration is smooth.
If the value is large, the response becomes high and a pulse chain which is almost identical to the input pulse chain is output.

7.2.33   BFM#64   Version information

The FX2N-10PG version information is stored.
Example: Version 1.00 $\rightarrow$ 100 is stored.

7.2.34   BFM#98   Table start No.

When positioning operation is executed with the program of the table system, the start table No. is written.

7.2.35   BFM#99   Executing table No.

The table No. which is currently being executed is stored.

7.2.36   BFM#100 and later   BFM for program with table system

The table No. and BFM number are assigned as follows.

Table No.	Position information	Speed information	m code information	Operation information
0	BFM#101, #100	BFM#103, #102	BFM#104	BFM#105
1	BFM#107, #106	BFM#109, #108	BFM#110	BFM#111
2	BFM#113, #112	BFM#115, #114	BFM#116	BFM#117
3	BFM#119, #118	BFM#121, #120	BFM#122	BFM#123
⋮	⋮	⋮	⋮	⋮
199	BFM#1295, #1294	BFM#1297, #1296	BFM#1298	BFM#1299

8. Operation pattern

8.1 General items for positioning operation

8.1.1 Outline of positioning operation
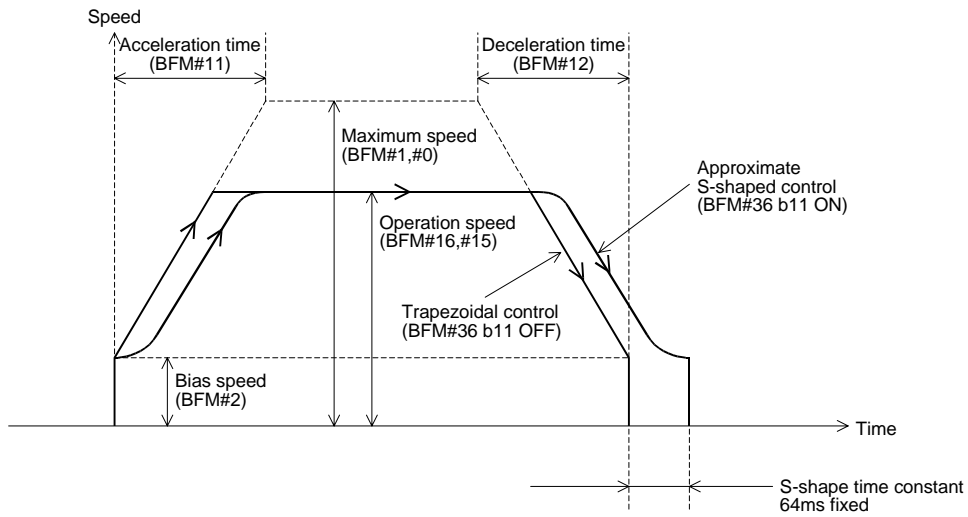
Item		BFM No.	Details
Maximum speed		BFM#1,#0	Upper limit of speed in each operation mode
Bias speed		BFM#2	The start speed.
Operation speed	Operation speed I	BFM#16,#15	Actual operation speed in each operation mode
	Operation speed II	BFM#20,#19	Actual operation speed during 2nd-speed positioning operation and interrupt 2nd-speed positioning
	Jog speed	BFM#4,#3	Speed during manual forward/reverse (jog+/jog-) operation
Acceleration time		BFM#11	Time from bias speed to maximum speed
Deceleration time		BFM#12	Time from maximum speed to bias speed
Travel	Target address I	BFM#14,#13	Target position (absolute address) or travel distance (relative address) in each operation mode
	Target address II	BFM#18,#17	Target position (absolute address) or travel distance (relative address) during 2nd-speed positioning operation

- The gradient of ac-/deceleration is determined by the maximum speed, bias speed, acceleration time and deceleration time.

- Trapezoidal control or approximate S-shaped control (approximate S-shaped ac-/deceleration control) is selected with the parameter (BFM#36 b11).

- A difference of 64ms is generated on the positioning operation completion time between trapezoidal control and approximate S-shaped control. The travel is the same.

- For approximate S-shaped control, set the acceleration time (BFM#11) and deceleration time (BFM#12) at 64ms or more (64 to 5000).

- Jog speed, operation speed I, operation speed II, zero return speed (high speed) and zero return speed (creep), are operated at the bias speed when 0Hz is set for the applied speed data.
  The minimum value for the bias speed is 1Hz.

8.1.2   STOP command process

In each operation mode, STOP command during operation is valid at all times.
The STOP switch is wired to the input terminal of the PLC, ON/OFF is written into b1 of BFM#26 with the program (TO command) of the PLC.
When STOP command (BFM#26 b1) is turned ON, FX2N-10PG will decelerate and stop.
When it is restarted, the operation remaining distance (it travels the remaining distance of the positioning operation to which STOP is input) or the positioning end (the positioning operation to which STOP is input is ended, and the next positioning operation is newly started) is selected according to the setting of parameter (BFM#36, b15).
However, when the command of forward jog (BFM#26 b4)/reverse jog (BFM#26 b5) is ON during jog operation, the jog operation starts again when the STOP command is turned OFF.

8.1.3   Overlapped command of operation modes

Positioning operations are not started even if START is input or START command (BFM#26 b9) is turned ON when plural operation patterns are selected with BFM#27, or the manual pulse generator input operation is selected (plural bits are on). (The error code K6 or K7 is written in BFM#37.)

The positioning operation is not completed when the forward jog (BFM#26 b4), reverse jog (BFM#26 b5) or other plural positioning operation commands are ON at the same time.

8.1.4   Small travel

1st-speed positioning operation

Travel time < Acceleration time + Deceleration time
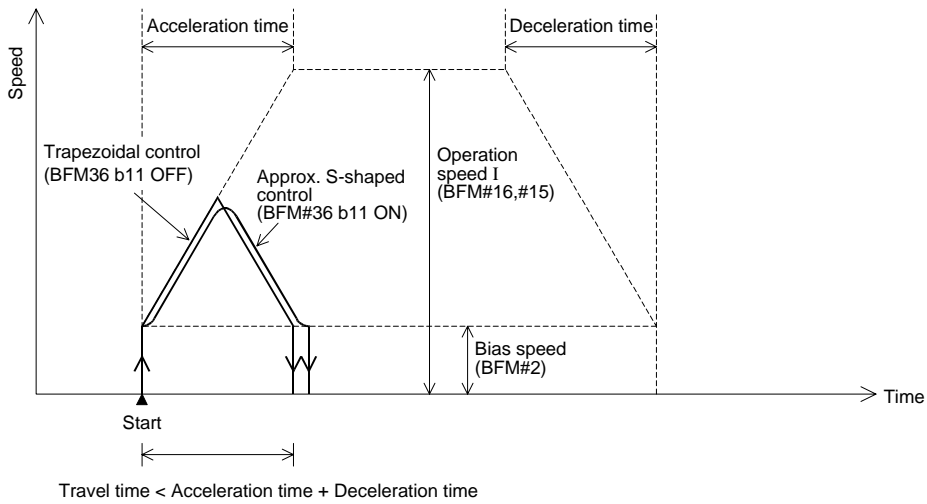
- If the time required for the travel (BFM#14, #13, #18, #17) is shorter than the acceleration/ deceleration time, the practical operation does not reach the set operation speed.

Interrupt 1st-speed positioning

Travel time < Deceleration time
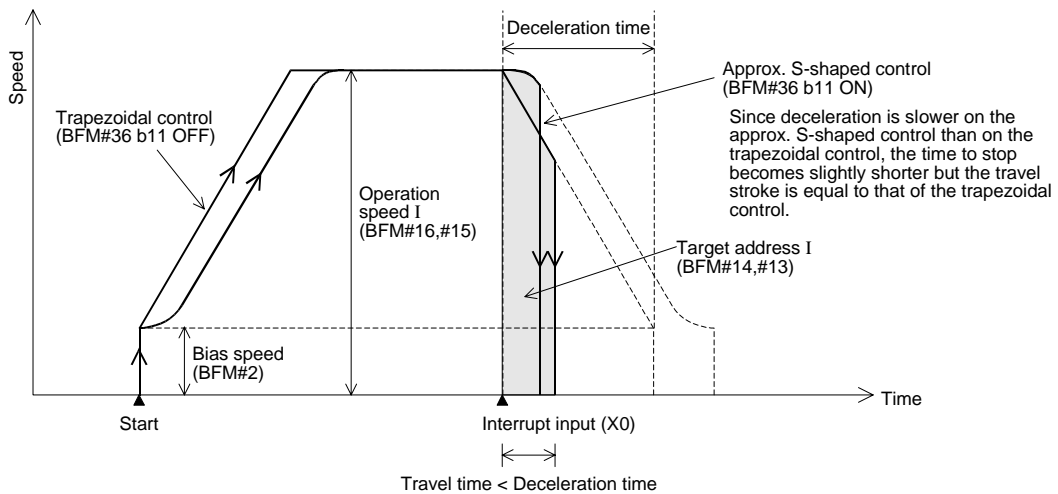
- If the time required for the travel (BFM#14, #13) is shorter than the deceleration time, the pulse output will be stopped when it reaches the target address I (BFM#14, #13) during deceleration.

- If the travel is 0, it will immediately stop when the interrupt input X0 is turned on.

2nd-speed positioning operation

1) When 1st-speed travel is small

Travel time < Deceleration time
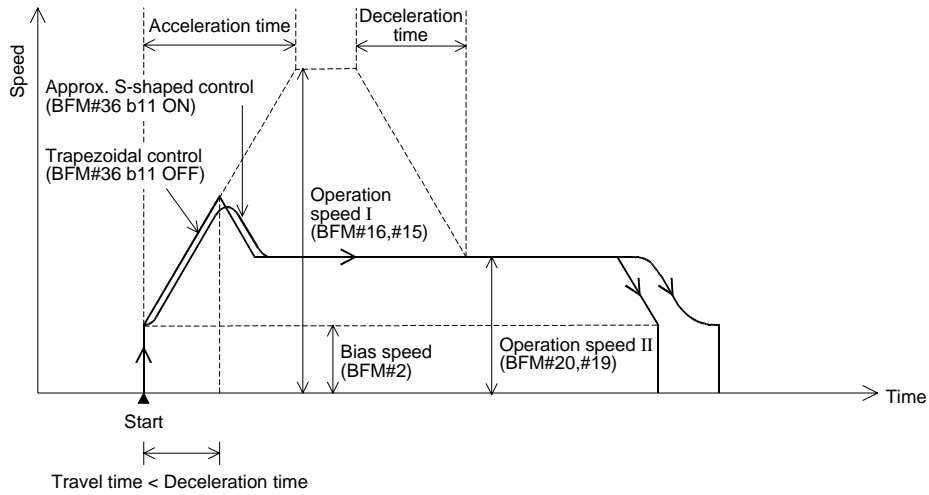
- If the travel time of 1st speed is shorter than the time required for deceleration to operation speed II (BFM#20, #19), the operation speed of 1st speed does not reach operation speed I (BFM#16, #15).

- If the travel of the 1st speed is 0, it will operate at the operation speed and travel of 2nd speed. (There is no error.)

2) When 2nd-speed travel is small

Travel time < Deceleration time
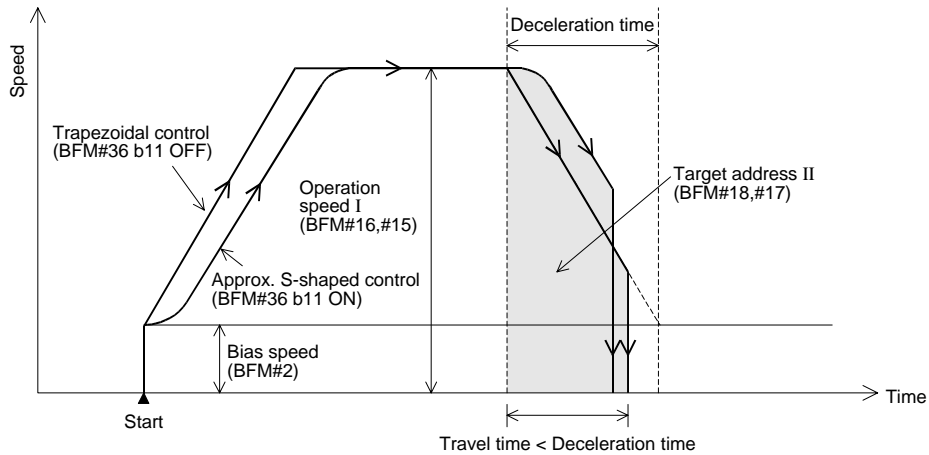
- If the travel time of 2nd speed is shorter than the time required for deceleration from operation speed II (BFM#20, #19), it will immediately stop when the travel reaches target address II (BFM#18, #17).

- If the travel of the 2nd speed is 0, the work will be decelerated and stopped to make the travel distance equal to target address I (BFM#14, #13) as for a 1st-speed positioning operation. (There is no error.)

8.1.5 Forward/reverse limits

FX2N-10PG does not name inputs for the forward/reverse limit switches. The switches should be connected to the PLC, the bits b2 (forward limit) and b3 (reverse limit) of BFM#26 are turned ON or OFF with these inputs. For safety, the limit switches should be wired to both the PLC and the servo amplifier.
In the example below the limit switches to the PLC are made to activate slightly earlier than those to the servo amplifier.
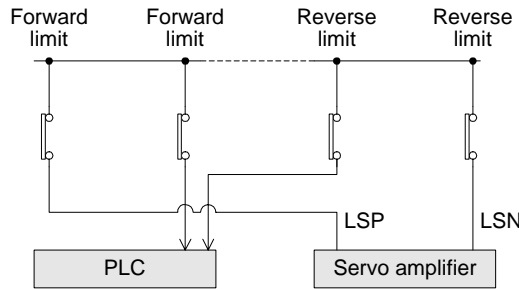
- Since such terminals are not provided on the drive amplifier for the stepping motor, be sure to provide the terminals in the PLC.

When the forward/reverse limit (BFM#26 b2, b3) is turned ON, deceleration and stop will be applied, and it will not be possible to travel in the direction of the limit switch which is turned ON.
To drive away from the limit switch, use jog commands or a manual pulse generator in the required direction.
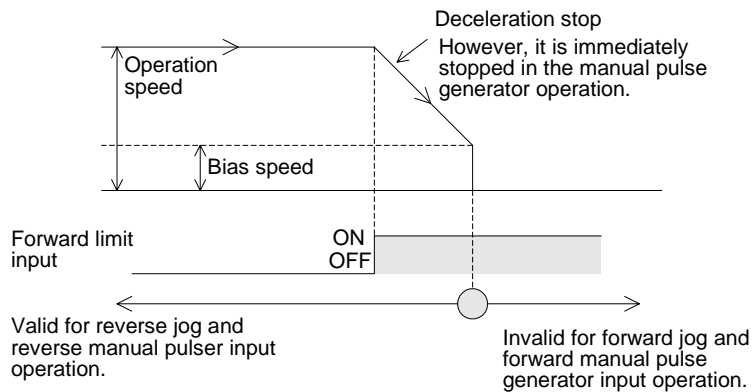
8.1.6   Cautions for use of mechanical system/compound system units

- Error of output pulse amount
  When the pulse rate (BFM#33, #32), feed rate (BFM#35, #34) and relative travel distance are designated A, B and C respectively, C $\times$ (A/B) expresses the pulse amount which is output from FX2N-10PG.
  If C $\times$ (A/B) is an integer even though (A/B) is not an integer, a command error will not occur. However, if C $\times$ (A/B) is not an integer, an integrated error will occur in the current address when the relative travel is repeated for operation. Moreover, though an error of less than one pulse occurs during the absolute address operation because of the rounding process of a fractional number, an integrated error will not occur.
  However, such an integrated error does not occur when the motor system unit is used.

- Limitation of output pulse frequency
  The following relationship is present between the motor system unit and mechanical system unit, and is automatically converted.

$$\boxed{\begin{array}{l}\text{Speed command}\\ \text{cm/min, 10deg/min, inch/min}\end{array}} \times \frac{\text{Pulse rate (BFM\#33, \#32)} \times 10^4}{\text{Feed rate (BFM\#35, \#34)}} = \text{Speed command (Hz)} \times 60$$

When setting the speed data in the mechanical system unit, set a pulse-converted value in the range of 1 to 1,000,000Hz.

8.2   Jog operation

8.2.1   Outline of jog operation
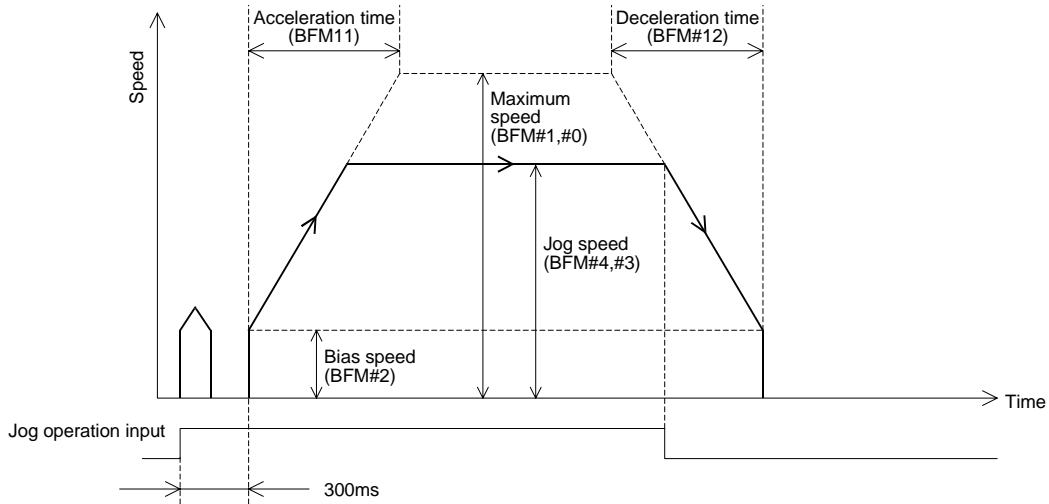
- Forward pulses are output for forward jog.

- Reverse pulses are output for reverse jog.

- When ON time of the forward/reverse jog (BFM#26 b4, b5) is less than 300ms, a pulse chain which is equivalent to +/- (user unit) at the current address is output.

- When ON time of the forward/reverse jog (BFM#26 b4, b5) is 300ms or more, a pulse chain is continuously output.
  Deceleration stop is applied by turning OFF the forward/reverse jog (BFM#26 b4,b5).

- Deceleration stop is applied when jog operation is executed in the opposite direction during forward or reverse jog operation.

- Deceleration stop is applied when the forward/reverse limit (BFM#26 b2, b3) is turned ON. When the forward/reverse limit has been reached, the work can be driven away using the forward/reverse jog, whichever is applicable.
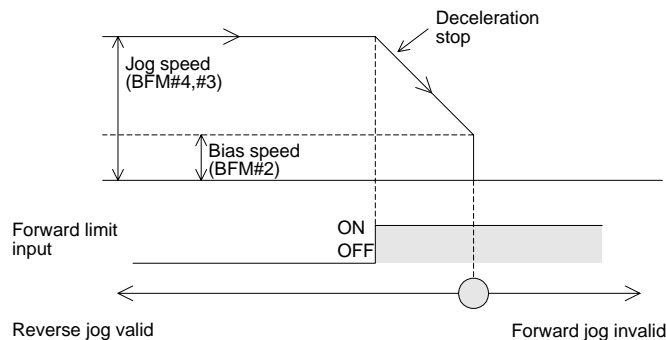
8.2.2   Speed change during jog operation

Change with Jog speed setting
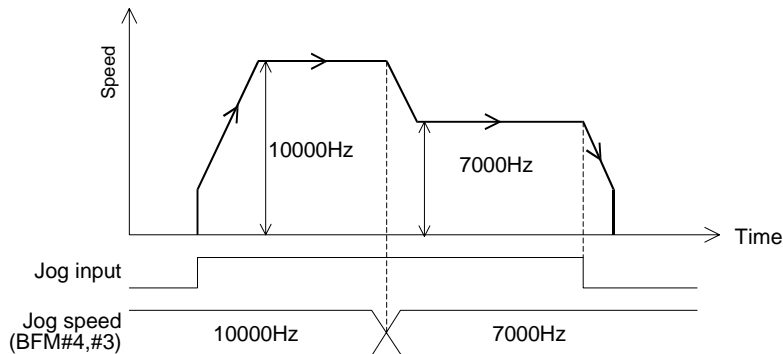
- When speed change disable (BFM#26 b10) during operation is ON, the change of jog speed (BFM#4, #3) is not permitted.

Change with override setting
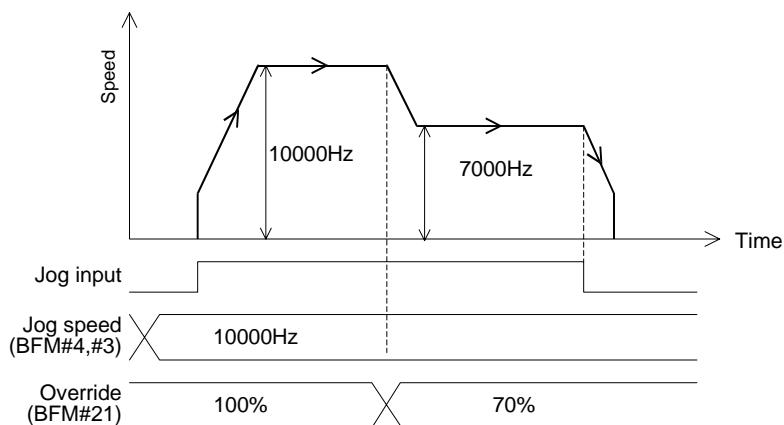
- According to the override setting (BFM#21), the actual operation speed is instructed or changed with the ratio in reference to the jog speed (BFM#4, #3).

8.3   Machine zero return

8.3.1   Outline of zero return
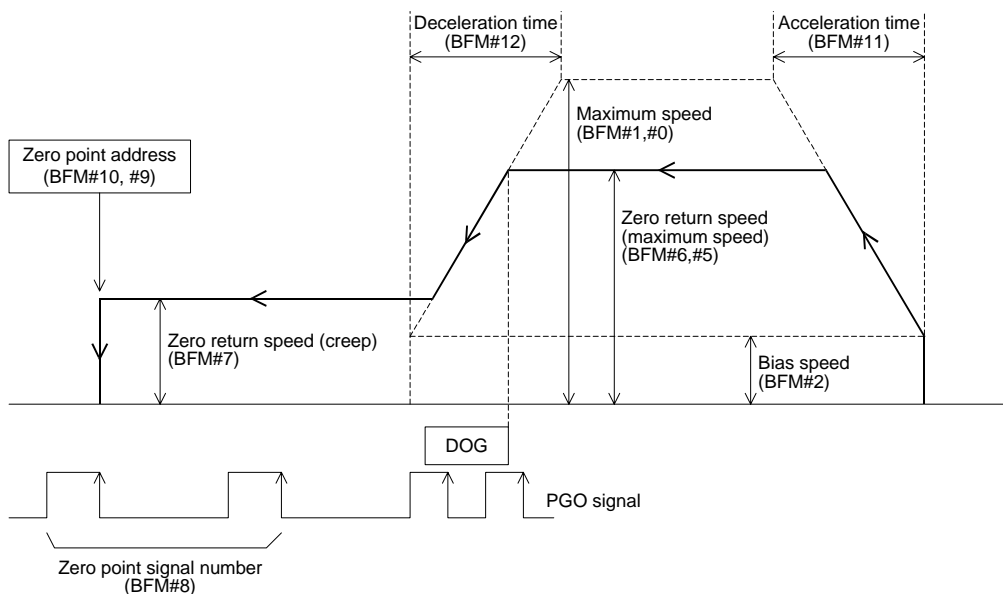
- Zero return operation
  Zero return operation is started with the leading edge (change of OFF → ON) of the zero return command (BFM#26 b6).
  After moving in the zero return direction (BFM#36 b10) at the zero return speed (high speed) (BFM#6, #5), speed decelerated to the zero return speed (creep)(BFM#7) with the dog input, and the work is stopped after a number (BFM#8) instructed by the zero point signal is counted.

8.3.2   Zero return direction

BFM#36 b10=0, decreases current position value.
BFM#36 b10=1, increases current position value.

8.3.3   Polarity of dog input

BFM#36 b12=0, N/O contact.
BFM#36 b12=1, N/C contact.

8.3.4   Count start timing

BFM#36 b13=0, zero signal counting is started at the front edge (OFF → ON) of the near-point dog.
BFM#36 b13=1, zero signal counting is started at the rear edge (ON → OFF) of the near-point dog.

8.3.5   Zero return speed

- Zero return speed (high speed)
  Set Bias speed (BFM#2) $\leq$ Zero return speed (high speed) (BFM#6, #5) $\leq$ Maximum (BFM#1, #0).
  If Bias speed > Zero return speed (high speed), operation is executed at the bias speed.

- Zero return speed (creep)
  Set Bias speed $\leq$ Zero return speed (creep) (BFM#7) $\leq$ Maximum speed (BFM#1, #0).
  If Bias speed > Zero return speed (creep), operation is executed at the bias speed.

8.3.6   Zero return completed flag

When a series of operations are completed, CLR signal (20 to 30ms) is output. The value of the zero point address is written into the current address, and the zero return completion (BFM#28 b3) is turned ON.
The zero return completed flag is reset with the zero return command, data set type zero return command or power shutdown.

8.3.7   Change of zero return speed

The zero return speed (high speed) and zero return speed (creep) can be changed at any time.
However, a change can not be received when the speed change disable (BFM#26 b10) during operation is ON.

8.3.8   Data set type zero return

In the data set type zero return mode, the work does not move, and the zero return process is applied on the spot.
On equipment that does not use a dog switch, or a transfer line without a mechanical zero point, the zero return process is done on the spot by turning ON the data set type zero return command (BFM#26 b7) after moving the work to a desired position in the jog mode.
CLR signal (20 to 30ms) is output at the leading edge of the data set type zero return command (BFM#26 b7), the value of the zero point address is written into the current address, and the zero return completion (BFM#28 b3) is turned ON.
The zero return completed flag is reset with the zero return command, data set type zero return command or the power shutdown.

8.3.9 Dog search function

When the forward/reverse limits (BFM#26 b2, b3) are provided, zero return which uses the dog search function can be executed.
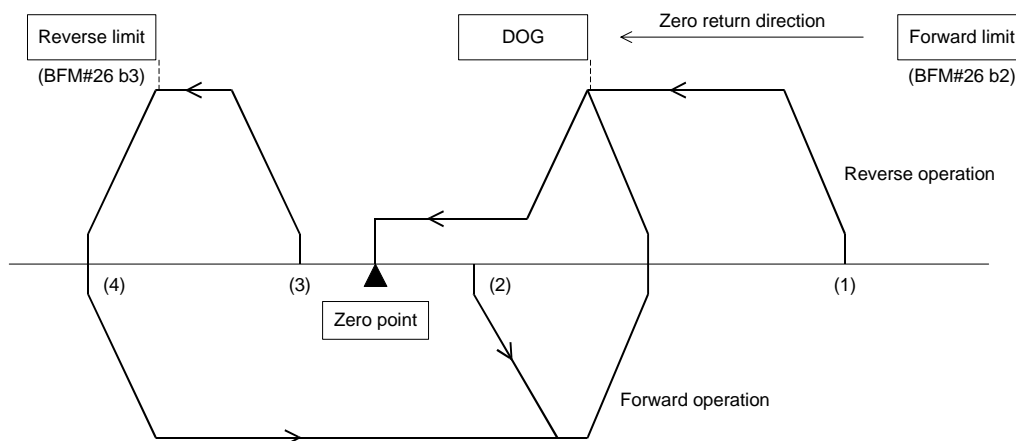
1) Start position, near-point signal OFF (before passing the dog)
   Operation is at the zero return speed (high speed) in the zero return direction. After the dog is detected, speed decelerates to creep, and the PGO signal is counted for stopping.

2) Start position, near-point signal ON
   Operation is at the zero return speed in the direction opposite to the zero return direction once, until it moves outside of the dog signal.
   Hereafter, operation is at the zero return speed in the zero return direction. After the dog is detected, speed decelerates to creep, and the PGO signal is counted for stopping.

3) Start position, near-point signal OFF (after passing at the dog)
   Operation is at the zero return speed in the zero return direction, and is decelerated and stopped at the forward/reverse limit.
   Hereafter, operation is at the zero return speed in the direction opposite to the zero return direction. After the dog is detected, speed is decelerated and stopped.
   Operation is at the zero return speed in the zero return direction again. After the dog is detected, speed decelerates to creep, and the PGO signal is counted for stopping.

4) When the extreme limit switch (forward limit or reverse limit) in the zero return direction is on, it is operated at the zero return speed in the direction opposite to the zero return direction. After the dog is detected (escaping), it is decelerated and stopped.
   It is operated at the zero return speed in the zero return direction. After the dog is detected, speed decelerates to creep, and the PGO signal is counted for stopping.

8.3.10 Forced ON/OFF of CLR signal

The status of CLR signal is assigned to b7 of BFM#38.
If ON/OFF is written to the bit, the CLR signal can be forced ON/OFF.

8.4   1st-speed positioning operation

8.4.1   Outline of 1st-speed positioning operation
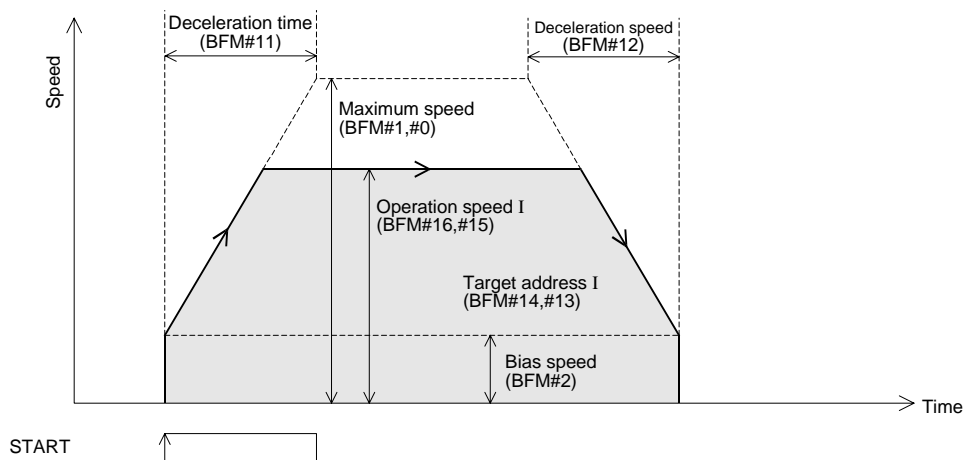
- Positioning operation
  If START is input or START (BFM#26 b9) is turned ON when the 1st-positioning operation (BFM#27 b0) operation pattern is selected, the positioning operation is started to target address I (BFM#14, #13) at operation speed I (BFM#16, #15).

8.4.2   Operation speed

The actual operation speed is expressed as [Actual operation speed = Operation speed I (BFM#16, #15) × Override (BFM#21)].
Operation speed I can be changed at all times.
However, the operation speed can not be changed when the speed change disable (BFM#26 b10) during operation is ON.

8.4.3   Address instruction

Absolute address and relative address can be used with BFM#26 b8.
b8=OFF : Absolute address instruction (Travel is set by the distance from the address value 0.)
b8=ON : Relative address instruction (Travel is set by the distance from the current address.)

8.4.4   Rotation direction

Absolute address mode : The rotation direction is determined depending on the large/small relationship between the current address (BFM#25, #24) and target address I (BFM#14, #13).
Relative address mode : The rotation direction is determined depending on the symbol (positive/negative) of target address I (BFM#14, #13).

8.4.5   Positioning complete flag

The positioning complete flag (BFM#28 b6) is reset with START input, START command (BFM#26 b9), forward jog (BFM#26 b4), reverse jog (BFM#26 b5), zero return (BFM#26 b6), data set type zero return (BFM#26 b7), variable-speed operation, manual pulse generator input operation or power shutdown, and is turned ON when the target address is reached. However, it is not reset with START input or START command when the travel is 0.
(If it is OFF before start of positioning, it is turned ON.)

- When positioning operation is stopped with STOP command, the positioning complete flag (BFM#28 b6) is not turned ON.
  If the STOP command is received in the deceleration process to the target address, it is stopped when it arrives at the target address, as the gradient of deceleration will be the same.
  At this time, the positioning complete flag (BFM#28 b6) is not turned ON.

8.4.6   STOP command

When STOP command (BFM#26 b1) is turned ON, the work is decelerated and stopped.
When it is restarted, the operation is different depending on the setting of the parameter (BFM#36 b15).

     BFM#36 b15=0 : The remaining-distance operation is executed with restart.
     BFM#36 b15=1 : The 1st-speed positioning operation is ended, and the next new
                                positioning operation is started.

8.5 Interrupt 1st-speed positioning operation

8.5.1 Outline of interrupt 1st-speed positioning operation
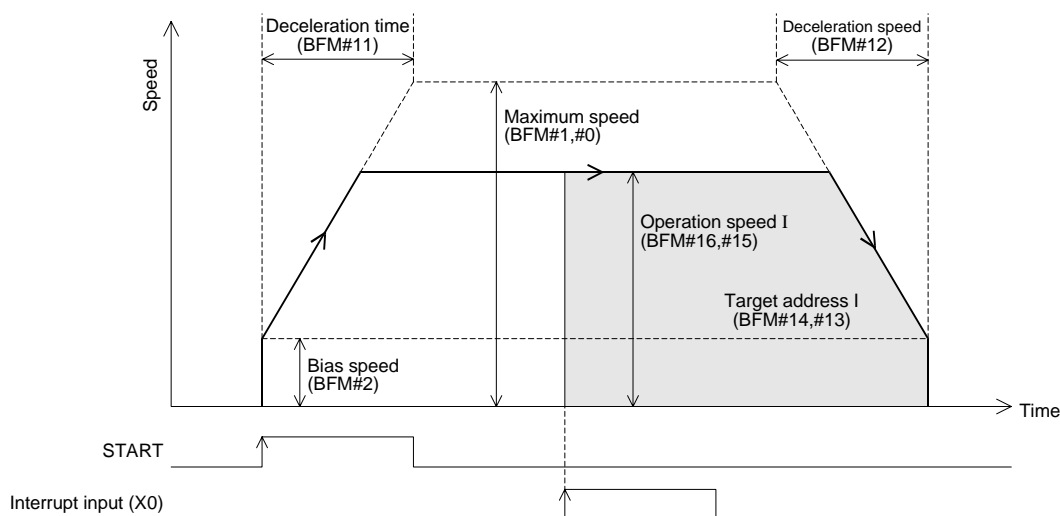
- Positioning operation
  If START is input or START (BFM#26 b9) is turned ON when the interrupt 1st-speed positioning operation (BFM#27 b1) operation pattern is selected, the positioning operation is started at operation speed I (BFM#16, #15). After interrupt input (interrupt input X0 is the edge detection) is operated, the work moves by the target address I (BFM#14, #13) and is stopped.

8.5.2 Operation speed

The actual operation speed is expressed as [Actual operation speed = Operation speed I (BFM#16, #15) $\times$ Override (BFM#21)].
Operation speed I can be changed at all times.
However, the operation speed can not be changed when the speed change disablement (BFM#26 b10) during operation is ON.

8.5.3 Address instruction

The travel (BFM#14, #13) is handled as the relative address (distance from the current address) regardless of the setting of the relative/absolute address instruction (BFM#26 b8).

8.5.4 Rotation direction

The rotation direction is determined depending on the positive/negative symbol the target address I (BFM#14, #13).

   Symbol of target address is positive : Forward pulse output
   Symbol of target address is negative : Reverse pulse output

8.5.5   Positioning complete flag

The positioning complete flag (BFM#28 b6) is reset with START input, START command (BFM#26 b9), forward jog (BFM#26 b4), reverse jog (BFM#26 b5), zero return (BFM#26 b6), data set type zero return (BFM#26 b7), variable-speed operation, manual pulse generator input operation or power shutdown, and is turned ON when the target address is reached. However, it is not reset with START input or START command when the travel is 0.
(If it is OFF before start of positioning, it is turned ON.)

- When positioning operation is stopped with STOP command, the positioning complete flag (BFM#28 b6) is not turned ON.
  If the STOP command is received in the deceleration process to the target address, it is stopped when it arrives at the target address as the gradient of deceleration will be the same.
  At this time, the positioning complete flag (BFM#28 b6) is not turned ON.

8.5.6   STOP command

When STOP command (BFM#26 b1) is turned ON, the work is decelerated and stopped.
When it is restarted, the operation is different depending on the setting of the parameter (BFM#36 b15).

BFM#36 b15=0 : The remaining-distance operation is executed with restart.
BFM#36 b15=1 : The interrupt 1st-speed positioning operation is ended, and the next new
positioning operation is started.

8.6 2nd-speed positioning operation

8.6.1 Outline of 2nd-speed positioning operation
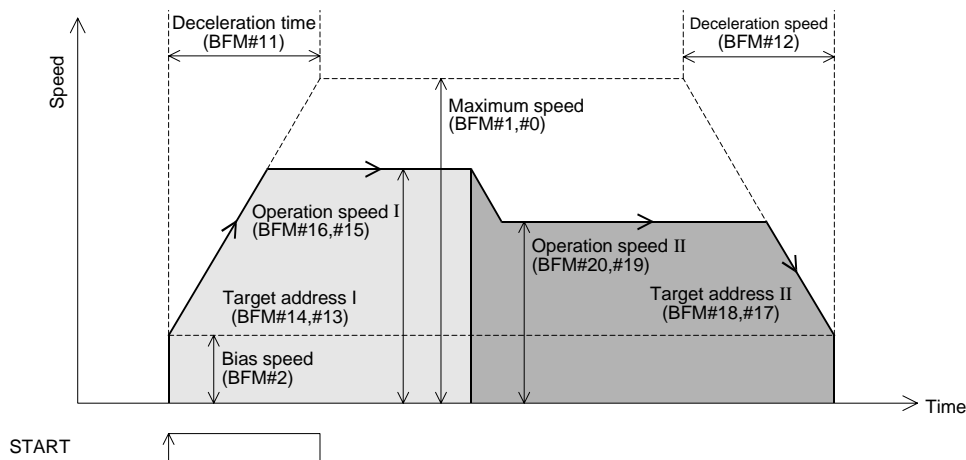
- Positioning operation

  If START is input or START (BFM#26 b9) is turned ON when the interrupt 1st-speed positioning operation (BFM#27 b1) operation pattern is selected, the work moves to target address I (BFM#14, #13) at operation speed I (BFM#16, #15). Then, it moves to target address II (BFM#18, #17) at operation speed II (BFM#20, #19), and is decelerated and stopped.

8.6.2 Operation speed

The actual operation speed becomes as follows:

Operation speed I (BFM#16, #15) $\times$ Override (BFM#21)
Operation speed II (BFM#20, #19) $\times$ Override (BFM#21)

Operation speeds I and II can be changed at all times.
However, the operation speed can not be changed when the speed change disable (BFM#26 b10) during operation is ON.

8.6.3 Address instruction

The absolute address and relative address can be set in BFM#26 b8.

b8=OFF : Absolute address instruction (The travel is set as the distance from the address value 0.)
b8=ON : Relative address instruction (The travel is set as the distance from the current address.)

8.6.4   Rotation direction

Absolute address mode : The rotation direction is determined depending on the large/small relationship between the current address (BFM#25, #24) and target address I (BFM#14, #13).

Relative address mode : The rotation direction is determined depending on the symbol (positive/negative) of target address I

When absolute address is used, the reverse rotation sometimes occurs depending on the small/large relationship of the current address, target address I (BFM#14, #13) of 1st speed, and target address II (BFM#18, #17) of 2nd speed.
Moreover, when the relative address is instructed, the reverse rotation occurs if the symbols (positive/negative) of target address I and target address II are different.

Caution

The rapid change of rotation direction may break the machine.
Also, it will cause an error to occur if the motor is overloaded.
If any stop time is required when the rotation direction is changed during operation, the operation is applied according to the 1st-speed positioning operation.

8.6.5   Positioning complete flag (BFM#28 b6)

The positioning complete flag (BFM#28 b6) is reset with START input, START command (BFM#26 b9), forward jog (BFM#26 b4), reverse jog (BFM#26 b5), zero return (BFM#26 b6), data set type zero return (BFM#26 b7), variable-speed operation, manual pulse generator input operation or power shutdown, and is turned ON when the target address is reached.
However, it is not reset with START input or START command when the travel is 0.
(When OFF before start of positioning, the flag is turned ON.)

- When positioning operation is stopped with STOP command, the positioning completed flag (BFM#28 b6) is not turned ON.
  If the STOP command is received in the deceleration process to the target address, the work is stopped when it arrives at the target address as the gradient of the deceleration is the same.
 At this time, the positioning complete flag (BFM#28 b6) is not turned ON.

8.6.6   STOP command

When STOP command (BFM#26 b1) is turned ON, the work is decelerated and stopped.
When restarted, the operation is different depending on the setting of parameter (BFM#36 b15).

BFM#36 b15=0 : The remaining-distance operation is executed with restart.
BFM#36 b15=1 : The 2nd-speed positioning operation is ended, and the next new
                        positioning operation is started.

8.7 Interrupt 2nd-speed positioning operation

8.7.1 Outline of interrupt 2nd-speed positioning operation
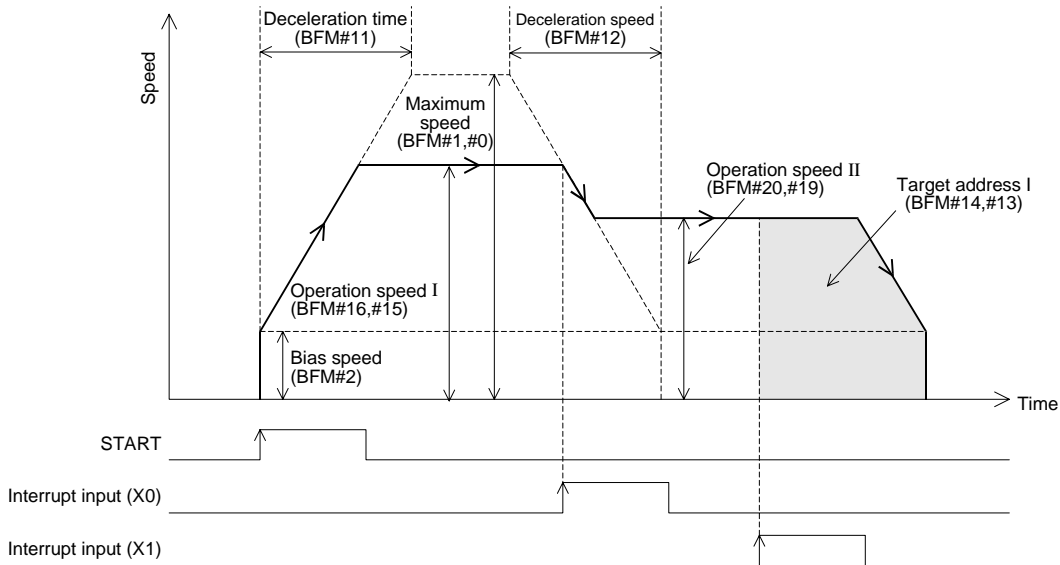
- Positioning operation

  If START is input or START (BFM#26 b9) is turned ON when the interrupt 2nd-speed positioning operation (BFM#27 b3) operation pattern is selected, it moves at operation speed I (BFM#16, #15).

  When interrupt input X0 (interrupt input is the edge detection) is turned ON, the speed is changed to operation speed II (BFM#20, #19). When the interrupt input X1 (interrupt input is the edge detection) is turned ON, the work moves by the target address I (BFM#14, #13 travel is set with the relative address.) and is decelerated and stopped.

8.7.2 Operation speed

The actual operation speed is expressed as follows:

Operation speed I (BFM#16, #15) $\times$ Override (BFM#21)
Operation speed II (BFM#20, #19) $\times$ Override (BFM#21)

Operation speeds I and II can be changed at all times.
However, the operation speed can not be changed when the speed change disablement (BFM#26 b10) during operation is ON.

8.7.3 Address instruction

Absolute address and relative address can be set with BFM#26 b8.

b8=OFF : Absolute address instruction
         (The travel is set as with the distance from the address value 0.)
b8=ON : Relative address instruction
         (The travel is set as the distance from the current address.)

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8.7.4 **Rotation direction**

Absolute address mode : The rotation direction is determined depending on the large/small relationship between the current address (BFM#25, #24) and target address I (BFM#14, #13).

Relative address mode : The rotation direction is determined depending on the symbol (positive/negative) of target address I.

8.7.5 **Positioning complete flag (BFM#28 b6)**

The positioning complete flag (BFM#28 b6) is reset with START input, START command (BFM#26 b9), forward jog (BFM#26 b4), reverse jog (BFM#26 b5), zero return (BFM#26 b6), data set type zero return (BFM#26 b7), variable-speed operation, manual pluse generator input operation or power shutdown, and is turned ON when the target address is reached.
However, it is not reset with START input or START command when the travel is 0.
(When it is OFF before start of positioning, the flag is turned ON.)

- When positioning operation is stopped with STOP command, the positioning complete flag (BFM#28 b6) is not turned ON.)
  If the STOP command is received in the deceleration process to the target address, it is stopped when it arrives at the target address as the gradient of the deceleration is the same.
 At this time, the positioning complete flag (BFM#28 b6) is not turned ON.

8.7.6 **STOP command**

When STOP command (BFM#26 b1) is turned ON, the work is decelerated and stopped.
When restarted, the operation is different depending on the setting of the parameter (BFM#36 b15).

  BFM#36 b15=0 : The remaining-distance operation is executed with restart.
  BFM#36 b15=1 : The interrupt 2nd-speed positioning operation is ended, and the next new positioning operation is started.

8.8 Interrupt stop operation

8.8.1 Outline of interrupt stop operation
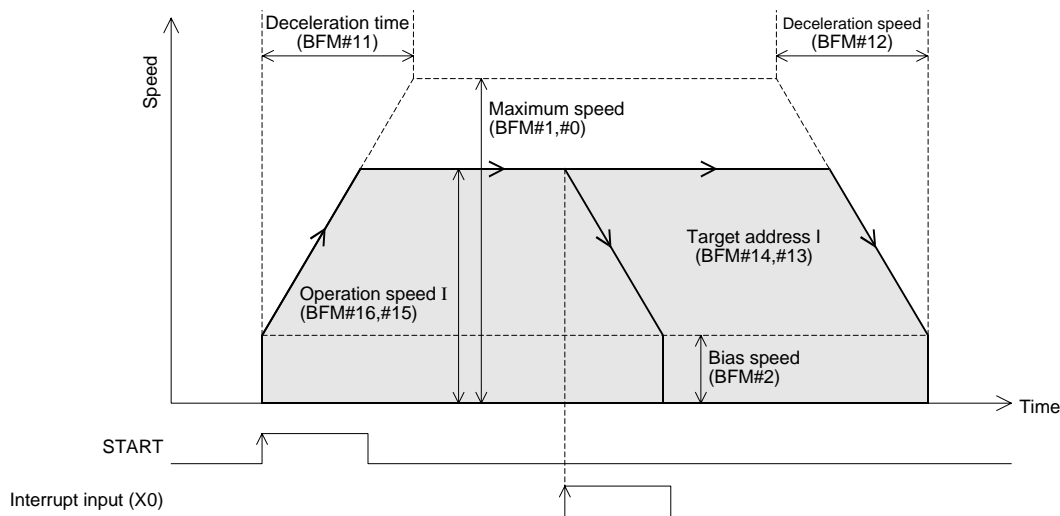
- Positioning operation
  If START is input or START (BFM#26 b9) is turned ON when the interrupt stop operation (BFM#27 b4) operation pattern is selected, the positioning operation is started at the operation speed I (BFM#16, #15).
  When the work arrives at target address I (BFM#14, #13) (deceleration stop) or the interrupt is input (interrupt input X0 is the edge detection), it is decelerated and stopped with the positioning ended.

8.8.2 Operation speed

The actual operation speed is expressed as [Actual operation speed = Operation speed I (BFM#16, #15) × Override (BFM#21)].
Operation speed I can be changed at all times.
However, the operation speed can not be changed when the speed change disablement (BFM#26 b10) during operation is ON.

8.8.3 Address instruction

Absolute address and relative address can be instructed with BFM#26 b8.

b8=OFF : Absolute address instruction (The travel is set as the distance from the address value 0.)
b8=ON   : Relative address instruction (The travel is set as the distance from the current address.)

8.8.4 Rotation direction

Absolute address mode : The rotation direction is determined depending on the large/small relationship between the current address (BFM#25, #24) and target address I (BFM#14, #13).

Relative address mode : The rotation direction is determined depending on the symbol (positive/negative) of target address I.

8.8.5   Positioning complete flag

The positioning complete flag (BFM#28 b6) is reset with START input, START command (BFM#26 b9), forward jog (BFM#26 b4), reverse jog (BFM#26 b5), zero return (BFM#26 b6), data set type zero return (BFM#26 b7), variable-speed operation, manual pulse generator input operation or power shutdown, and is turned ON when the target address is reached. However, it is not reset with START input or START command when the travel is 0.
(When it is off before start of positioning, the flag is turned ON.)

- When positioning operation is stopped with STOP command, the positioning complete flag (BFM#28 b6) is not turned ON.)

- If the STOP command is received in the deceleration process to the target address, it is stopped when it arrives at the target address as the gradient of the deceleration is the same.
  At this time, the positioning completed flag (BFM#28 b6) is not turned ON.

8.8.6   STOP command

When STOP command (BFM#26 b1) is turned ON, the work is decelerated and stopped. When restarted, the operation is different depending on the setting of the parameter (BFM#36 b15).

BFM#36 b15=0 : The remaining-distance operation is executed with restart.
BFM#36 b15=1 : The interrupt stop operation ended, and the next new positioning
                  operation is started.

8.9   Table operation

8.9.1   Outline of table operation

In FX2N-10PG, the program of positioning control can be produced with a table.
When the table operation is used, continuous operation (multi-speed operation) and position-to-speed operation (the work is de-/accelerated to stop at a desired position) become possible.
One positioning operation per table can be registered. (The number of tables are 200 points from No. 0 to 199.)
One table is given four attributes of position information (target address), speed information (operation speed), m code information and operation information.
The buffer memory of FX2N-10PG is used as the storage destination of the information.
The assignment of the buffer memory and positioning table number is fixed, BFM#100 through BFM#1299 are assigned to the table numbers of No. 0 through 199. When the positioning data and operation pattern table operation (BFM#27 b5) are selected to the assigned buffer memory with TO commands from the PLC, positioning operation is started according to the written information from the table set with the table start number (BFM#98) if START (BFM#26 b9) is turned ON.

- Position information
    The target address is set.
    Absolute address and relative address can be set.

- Speed information
    The operation speed is set.
    During operation, the speed information can be changed and the speed can be changed with an override.

- m code information
    No m code : 1
    m code, AFTER mode (ON when positioning complete) : 0 through 999
    m code, WITH mode (ON during positioning)   : 1000 through 32,767

    m code during continuous operation
    If m code of with mode is instructed to the position-to-speed and continuous operation, a series of continuous operation is done and m code output is sequentially switched even though the m code OFF command is input.
    (m codes which are previously turned on are automatically turned off.)

- Operation information
    Refer to the following table.

Setting value	Name	Details
0	Step-advance operation	When START signal is turned ON, positioning is executed table by table. The speed information can be changed during operation.
1	Continuous operation	The next table is continuously and sequentially executed. (Multi-speed operation) The speed information can be changed during operation.
2	Position-to-speed operation	At the address which is written in the position information, the work is ac-/decelerated to reach the set speed information. (Position-to-speed operation) The next table is continuously and sequentially executed. The speed information can be changed during operation.
3	END (end)	The table operation is ended.
4	JMP	Positioning operation jumps to the table No. which is set in the position information.

- If any m code is used in the after mode during continuous operation, the continuous operation will be interrupted at the time.

- When a series of continuous operations with m codes are ended and are shifted to the positioning operation which is registered in the step-advance operation, m code OFF command must be consistent with START command (START input or BFM#26 b9).

- START signal is necessary to end the step-advance operation and shift to the positioning operation in which the continuous operation and position-to-speed operation are registered. (When m code is used, m code OFF command is also necessary.)

- When positioning is shifted from continuous operation to position-to-speed operation or is on the contrary shifted from position-to-speed operation to continuous operation, it will be automatically shifted after deceleration and stopping. (When any m code of the after code is not used and when a m code of the after mode is used, it will wait for m code OFF command.)

8.9.2   Assignment of tables and BFM Nos.

Table No.	Position information	Speed information	m code information	Operation information
0	BFM#101, #100	BFM#103, #102	BFM#104	BFM#105
1	BFM#107, #106	BFM#109, #108	BFM#110	BFM#111
2	BFM#113, #112	BFM#115, #114	BFM#115	BFM#116
3	BFM#118, #117	BFM#120, #119	BFM#121	BFM#122
⋮	⋮	⋮	⋮	⋮
199	BFM#1295, #1294	BFM#1297, #1296	BFM#1298	BFM#1299

- Each data is stored even at power failure.
  Be sure to produce the sequence program to write each data every time when PLC is in RUN.

- The initial value of the table is "-1".

- The table No. under execution is stored in the BFM#99.

8.9.3   Operation example 1 (continuous operation)

When the absolute address assignment and table start No. are 0, the current address at the time of START is 0.
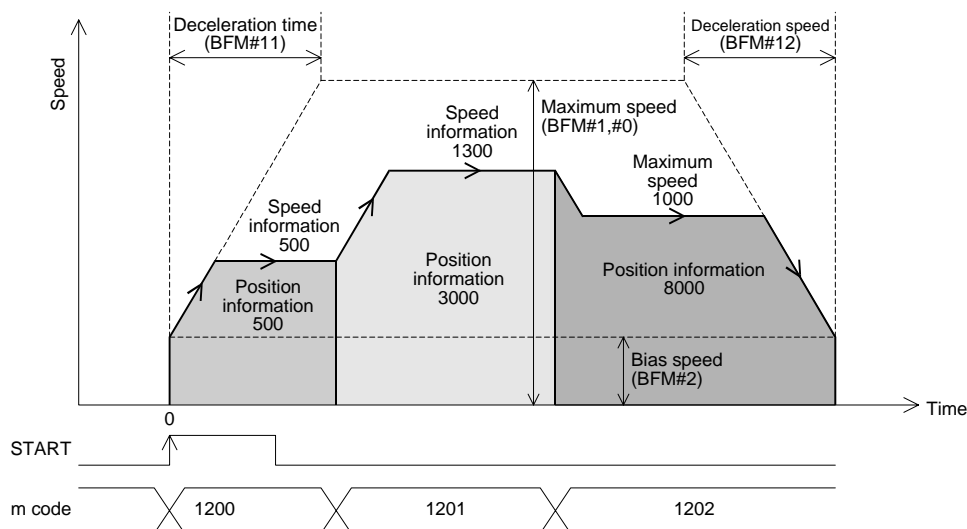
Table No.	Position information	Speed information	m code information	Operation information
0	500	500	1200	1
1	3500	1300	1201	1
2	11500	1000	1202	1
3	-1	-1	-1	3

8.9.4   Operation example 2 (position-to-speed operation)

When the absolute address assignment and table start No. are 0, the current address at the time of START is 0.
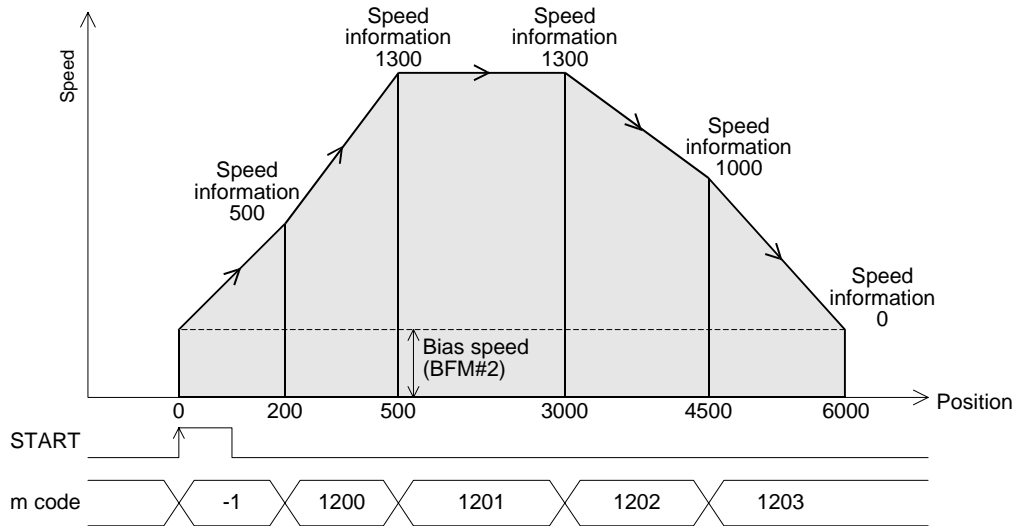
Table No.	Position information	Speed information	m code information	Operation information
0	200	500	-1	2
1	500	1300	1200	2
2	3000	1300	1201	2
3	4500	1000	1202	2
4	6000	0	1203	2
5	-1	-1	-1	3

8.9.5   Operation example 3 (step-advance operation)

When the absolute address assignment and table start No. are 0, the current address at the time of START is 0.
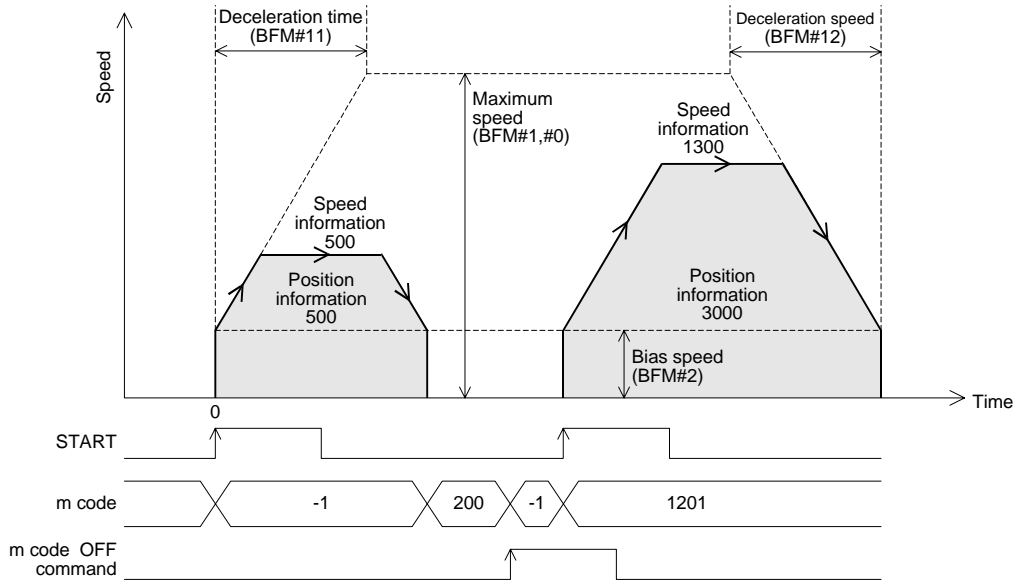
Table No.	Position information	Speed information	m code information	Operation information
0	500	500	200	0
1	3000	1300	1201	0
2	-1	-1	-1	3

8.10 Variable-speed operation

8.10.1 Outline of variable-speed operation
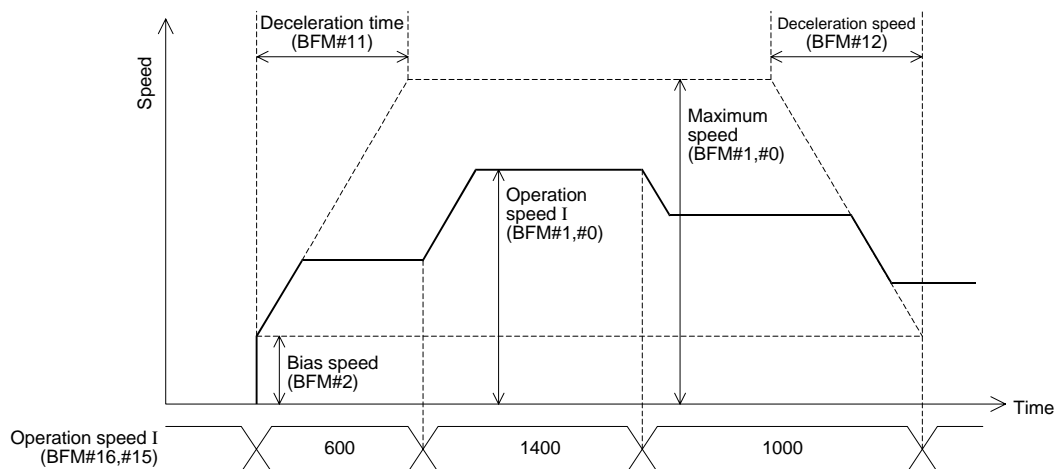
- Positioning operation
  When the variable-speed operation (BFM#27 b6) operation pattern is selected, the work is accelerated to operation speed I (BFM#16, #15), and the operation is started.
  It is not necessary to turn ON target address I (BFM#14, #13) and START (BFM#26 b9).
  When operation speed I is changed, the acceleration/deceleration is applied according to the acceleration time (BFM#11) or deceleration time (BFM#12) in order to change to the speed of operation speed I.
  (The operation speed can not be changed when the speed change disable (BFM#26 b10) during operation is ON.)
  When operation speed I is 0, the work is decelerated and stopped.
  The positioning complete flag (BFM#28 b6) is not turned ON.

8.10.2 Operation speed

The actual operation speed is expressed as [Actual operation speed = Operation speed I (BFM#16, #15) $\times$ Override (BFM#21)].
When operation speed I is 0, the work is decelerated and stopped.
Operation speed I can be changed at all times.
However, the operation speed can not be changed when the speed change disable (BFM#26 b10) during operation is ON.

8.10.3   Rotation direction

The rotation direction is determined depending on whether the operation speed I (BFM#16, #15) is positive or negative.

When operation speed I is positive, the current value is increased.
When operation speed I is negative, the current value is decreeased.

Caution:

If the rotation direction is rapidly changed, the machine may be broken.
Also, it is estimated that it will cause an error resulting from the overload of the motor. Therefore, to change the rotation direction, be sure to set operation speed I at "0", provide time for the motor to sufficiently stop after deceleration and stopping, and change the rotation direction.
If the value of operation speed I is changed from positive to negative (Example: 100 $\rightarrow$ -100) on FX2N-10PG, reverse rotation is immediately applied after deceleration and stop.

8.10.4   STOP command

When STOP command (BFM#26 b1) is turned ON, the work is decelerated and stopped.
When STOP command (BFM#26 b1) is turned OFF, the work is accelerated to operation speed I (BFM#16, #15) again and the operation is started or resumed.

8.11 Manual pulse generator input operation

8.11.1 Outline of manual pulse generator input operation

- When the manual pulse generator input operation (BFM#27 b7) operation pattern is ON, operation with the manual pulse generator input is possible.

- 2-phase pulse (A phase/B phase) can be input from the manual pulse generator.

- The positioning complete flag is not turned ON.

- When the work arrives at the forward/reverse limit during forward/reverse, it is immediately stopped, being regarded as the forward/reverse limit error.
  When the forward limit is ON, reverse is applied, when reverse limit is ON, forward is applied. Thus, it is possible to drive from the ON state of the limit switch.
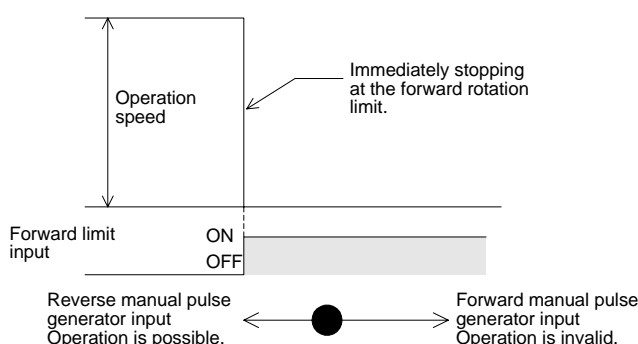
- The operation speed is proportional to the frequency of pulse chain input from the manual pulse generator with the electronic gearing (BFM#45, #46) for manual pulse generator input.
  Moreover, the value of the override setting (BFM#21) is invalid.
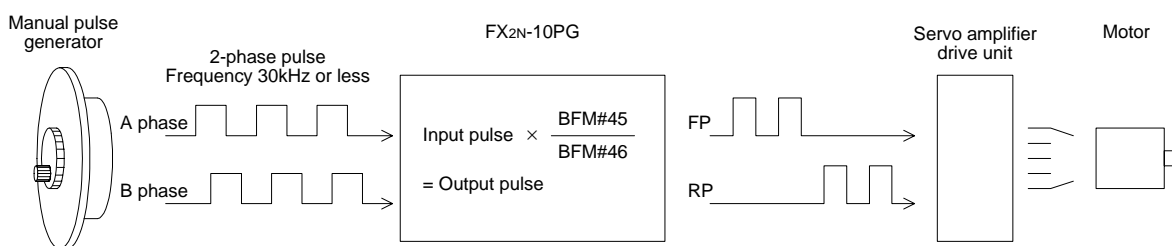
The output pulse (frequency and pulse amount) of FX2N-10PG is gained as follows:

Input pulse (frequency and pulse amount) from the manual pulse generator × manual pulse generator input electronic gearing (BFM#45 / BFM#46)

If the value of the manual pulse generator input electronic gearing is less than 1/1, one pulse is output for plural input pulses.
Accordingly, the frequency of output pulse is low, and the pulse amount is small.
If the value of the manual pulse generator input electronic gearing is more than 1/1, one input pulse is output for plural input pulses.
Accordingly, the frequency of output pulse is high, and the pulse amount is large.
Moreover, if the value of the manual pulse generator input electronic gearing is larger than 1/1, the revolution amount of the motor becomes larger for one input pulse. Therefore, the positioning precision becomes less accurate.

8.11.2   Pulse output valid range

The pulse output range can be provided with target address I (BFM#14, #13) and target address II (BFM#18, #17).

In case of Target address I > Target address II, pulse output in the range becomes valid.
In case of Target address I < Target address II, pulse output becomes valid in the whole range (between the forward limit and reverse limit).
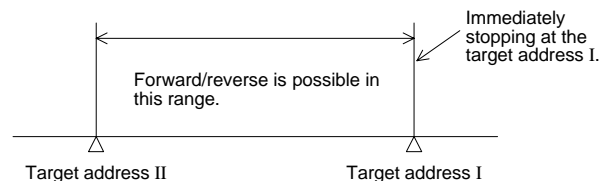
8.11.3   Manual pulse generator input current value

The current value of the total input pulses to the manual pulse generator input is stored in BFM#42 and #41.

8.11.4   Manual pulse generator input frequency

The frequency of the manual pulse generator input is stored in BFM#44 and #43.
The + symbol is applied to UP count, and the - symbol is applied to DOWN count.

8.11.5   Manual pulse generator   Electronic gearing (numerator)

The multiplier to the input pulse can be set in BFM#45.
The set range is 1 to 32,767.

8.11.6   Manual pulse generator   Electronic gearing (denominator)

The division to the input pulse can be set in BFM#46.
The set range is 1 to 32,767.

8.11.7   Manual pulse generator response

The pulse chain input from the manual pulse generator in BFM#47 and the following ability of the output pulse chain can be set in five steps of 1 through 5.
If the value is small, the response is lower to smooth the acceleration and deceleration.
On the contrary, if the value is large, the response ability is higher to output the pulse chain which is near the pulse chain input.

9.   Program example

9.1   Outline of FROM/TO commands

FX2N-10PG reads and writes the travel, operation speed and operation pattern with FROM/TO commands of PLC.
FROM/TO commands are outlined as follows.

					m1	m2	$(D\cdot)$	n	

```
 ┌──────────┐
 │   FNC78  │          X010                  m1     m2   (D•)    n
 │ D FROM P │           ┤├──── FROM │ K2 │ K26 │ D120 │ K2 │    BFM#26 to #27 of special unit No. 2
 └──────────┘          Read                                     → D120 through D121
   BFM reading         command
```
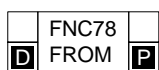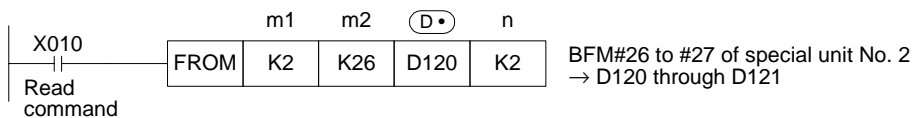
m1 : Special unit or block No. (K0 to K7 numbered from the unit nearest to the basic unit)

m2 : Head instructed number (m2=K0 to K31) of buffer memory

$(D\cdot)$: It is the head element No. of the transfer destination, and can be designated T, C, D, KnM, KnY, Kns, V and Z. It can be provided with the modifier of the element No..

n   : Number of transfer points (n=K1 to K32, but n=K1 to K16 for 32-bit command)

```
 ┌──────────┐
 │   FNC79  │          X011                  m1     m2   (S•)    n
 │ D  TO  P │           ┤├──── TO P │ K2 │ K0 │ D0 │ K16 │     D0 through D15 → BFM#0 to #15
 └──────────┘          Write                                    of Special unit No.2
   BFM writing         command
```
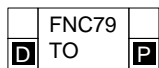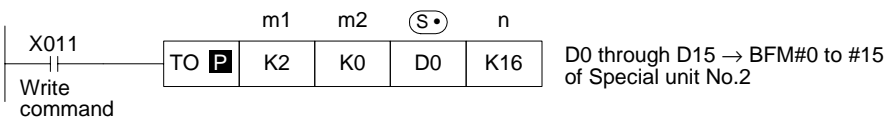
m1,m2,n : Same as above

$(S\cdot)$: It is the head element No. of the transfer destination, and can be designated T, C, D, KnX, KnM, KnY, Kns, V, Z, K and H. It can be provided with the modifier of the element No. by the index.

• When X010 and X011 are OFF, the transfer is not executed and the data of the transfer destination does not vary. For details, refer to the FX Series programming manual II.

9.2   Length feed operation (1st-speed positioning)

The program example of the length feed operation (1st-speed positioning) is described.
Moreover, also in this example, the forward/reverse operation and zero return operation are
possible in the jog operation mode.

9.2.1   Operation explanation

• Zero return operation

1) When X006 in the PLC is turned ON, the zero return operation is started in the decreasing direction of the current value.

2) When the dog input is turned ON, the work is decelerated to the creep speed.

3) When the zero point signal is input by one count after the dog input is turned off again, the work is stopped, the zero point address is written as the current value, and the clear signal is output.

4) The dog search function can be used from the start position of the zero return operation. (X002 and X003 are provided for the forward limit and reverse limit respectively.)

- Maximum speed   : 500,000Hz
- Acceleration time   : 100ms
- Deceleration time   : 100ms
- Pulse output format   : Forward pulse (FP) / reverse pulse (RP)
- Rotation direction   : The current value is increased with forward pulse.
- Zero return direction   : Decreasing direction of current value
- Dog input logic   : N/O contact
- Zero point signal count start timing : DOG back end
- Zero return speed   : 100,000Hz
- Creep speed   : 1,000Hz
- Zero point address   : 0
- Number of zero point signals : 1
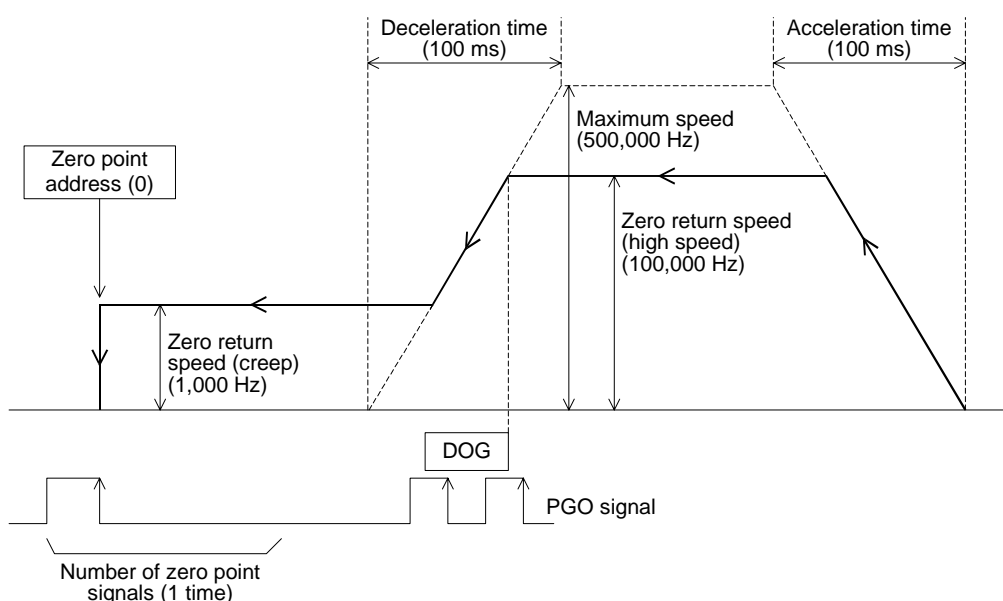
- Jog operation

1) When X004 in the PLC is turned ON, jog operation is executed in the forward direction. When X005 is turned ON, jog operation is executed in the reverse direction.

   - Maximum speed   : 500,000Hz

   - Acceleration time   : 100ms

   - Deceleration time   : 100ms

   - Pulse output format : Forward pulse (FP) / reverse pulse (RP)

   - Rotation direction   : The current value is increased with forward pulses.

   - Jog speed   : 10,000Hz
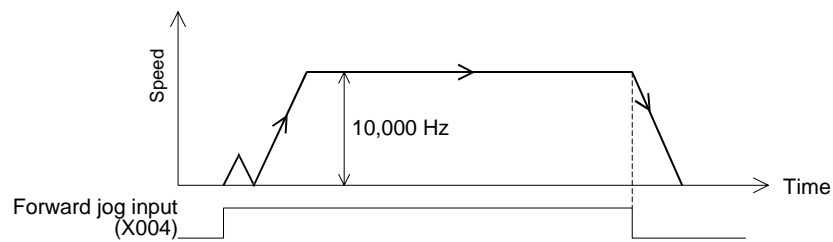
When the reverse operation jog input (X005) is turned ON, the work starts moving in the reverse direction at the same speed as above.

- Length feed (1st-speed positioning)

1) When X007 in the PLC is turned ON, the work moves a specified distance in the forward direction, and is decelerated and stopped.
   If X007 is turned ON again, the work will move the same distance. (Relative position positioning)

2) When X001 (STOP) is turned ON during positioning operation, the work is decelerated and stopped. When X007 is turned ON again, the work will be decelerated and stopped after it moves the remaining distance.

   - Maximum speed   : 500,000Hz
   - Acceleration time   : 100ms
   - Deceleration time   : 100ms
   - Pulse output format : Forward pulse (FP) / reverse pulse (RP)
   - Rotation direction   : The current value is increased with forward pulses.
   - Target address I   : 100,000 pulses
   - Operation speed I   : 30,000 Hz
   - Stop mode   : Remaining-distance movement

9.2.2 **Device assignment (PLC)**

Element	Element No.	Assignment	
Input	X000	Error reset	
	X001	Stop	
	X002	Forward limit (The external wiring is the N/C contact.)	
	X003	Reverse limit (The external wiring is the N/C contact.)	
	X004	Forward jog	
	X005	Reverse jog	
	X006	Zero return operation start	
	X007	1st-speed positioning operation start	
Auxiliary relay	M0	Operation pattern	1st-speed positioning operation (Normal ON)
	M1		Interrupt 1st-speed positioning operation (Normal OFF)
	M2		2nd-speed positioning operation (Normal OFF)
	M3		Interrupt 2nd-speed positioning operation (Normal OFF)
	M4		Interrupt stop operation (Normal OFF)
	M5		Table operation (Normal OFF)
	M6		Variable-speed operation (Normal OFF)
	M7		Manual pulse generator input operation (Normal OFF)
	M8 to M15		Not used. (Normal OFF)
	M20	Operation command	Error reset
	M21		Stop
	M22		Forward limit
	M23		Reverse limit
	M24		Forward jog
	M25		Reverse jog
	M26		Zero return command
	M27		Data set type zero return command
	M28		Relative address/absolute address
	M29		Start
	M30		Speed change disablement during operation (Normal enable)
	M31		m code OFF command
	M32 to M35		Not used. (Normal OFF)
Data register	D14,D13	Target address I (Moving distance during 1st-speed positioning operation: 100,000 pulses)	
	D16,D15	Operation speed I (Operation speed during 1st-speed positioning operation: 30,000Hz)	
	D23,D22	Output frequency	
	D25,D24	Current address (user unit)	
	D28	Status	
	D37	Error code	
	D38	Terminal information	
	D40,D39	Current address (Pulse-converted value)	

9.2.3   **Sequence program**

M8002 (Initial pulse)

DTO	K0	K0	K500000	K1	Maximum speed (500,000Hz)
TO	K0	K2	K0	K1	Bias speed (0Hz)
DTO	K0	K3	K10000	K1	Jog speed (10,000Hz)
DTO	K0	K5	K100000	K1	Zero return speed (high speed) (100,000Hz)
TO	K0	K7	K1000	K1	Creep speed (1,000Hz)
TO	K0	K8	K1	K1	Zero point signal number (1st time)
DTO	K0	K9	K0	K1	Zero point address (0)
TO	K0	K11	K100	K1	Acceleration time (100ms)
TO	K0	K12	K100	K1	Deceleration time (100ms)
TO	K0	K36	H2000	K1	Parameter

M8000 (RUN monitor)

(M0)   1st-speed positioning operation

M8000 (RUN monitor)

(M1)   Interrupt 1st-speed positioning operation

(M2)   2nd-speed positioning operation

(M3)   Interrupt 2nd-speed positioning operation

(M4)   Interrupt stop operation

(M5)   Table operation

(M6)   Variable-speed operation

(M7)   Manual pulse generator input operation

(M8)

(M9)

(M10)

(M11)

(M12)   Not defined.

(M13)

(M14)

(M15)

M8000 (RUN monitor)

TO	K0	K27	K4M0	K1	Operation pattern

|				
M8002 (Initial pulse)	DMOV	K100000	D13		Target address setting (100,000 pulses)
	DMOV	K30000	D15		Operation speed setting (30,000Hz)
M8000 (RUN monitor)	DTO	K0	K13	D13	K1	Target address I
	DTO	K0	K15	D15	K1	Operation speed I
X000 (Error reset input)				(M20)	Error reset
X001 (STOP input)				(M21)	STOP
X002 (Forward limit input)				(M22)	Forward limit
X003 (Reverse limit input)				(M23)	Reverse limit
X004 (Forward jog input) M25 (Reverse jog)				(M24)	Forward jog
X005 (Reverse jog input) M24 (Forward jog)				(M25)	Reverse jog
X006 (Zero return command input)				(M26)	Zero return command
M8000 (RUN monitor)				(M27)	Data set type zero return command
M8000 (RUN monitor)				(M28)	Relative (ON)/absolute (OFF) address
X007 (START input)				(M29)	START
M8000 (RUN monitor)				(M30)	Speed change disablement during operation
				(M31)	m code OFF command
				(M32)	
				(M33)	
				(M34)	Not defined.
				(M35)	
M8000 (RUN monitor)	TO	K0	K26	K4M20	K1	Operation command
M8000 (RUN monitor)	DFROM	K0	K22	D22	K1	Output frequency current value (Hz)
	DFROM	K0	K24	D24	K1	Current address (user unit)
	FROM	K0	K28	D28	K1	Status information
	FROM	K0	K37	D37	K1	Error code
	FROM	K0	K38	D38	K1	Terminal information
	DFROM	K0	K39	D39	K1	Current address (pulse-converted value)
				END	

9.3   Multi-speed operation (table operation)

A program example for multi-speed operation (table operation) is described.
Moreover, also in this example, the forward/reverse operation and zero return operation are possible in the jog operation mode.

9.3.1   Operation explanation

- Zero return operation

1) When X006 in the PLC is turned ON, the zero return operation is stared in the decreasing direction of the current value.
(Only when m code is OFF, the zero return operation can be started.)

2) When the jog input is turned ON, the work is decelerated to the creep speed.

3) Positioning is stopped when the zero point signal is input for one count after the dog input is turned OFF again. The zero point address is written into the current value and the clear signal is output.

4) The dog search function can be used depending on the start position of the zero return operation.
(Set X002 and X003 at the forward and reverse limits respectively.)

- Maximum speed   : 500,000Hz

- Acceleration time   : 100ms

- Deceleration time   : 100ms

- Pulse output format : Forward pulse (FP) / reverse pulse (RP)

- Rotation direction   : The current value increases with forward pulse.

- Zero return direction: Decreasing direction of current value

- Dog input logic   : N/O contact

- Zero point signal count start timing : DOG backward end

- Zero return speed   : 100,000Hz

- Creep speed   : 1,000Hz

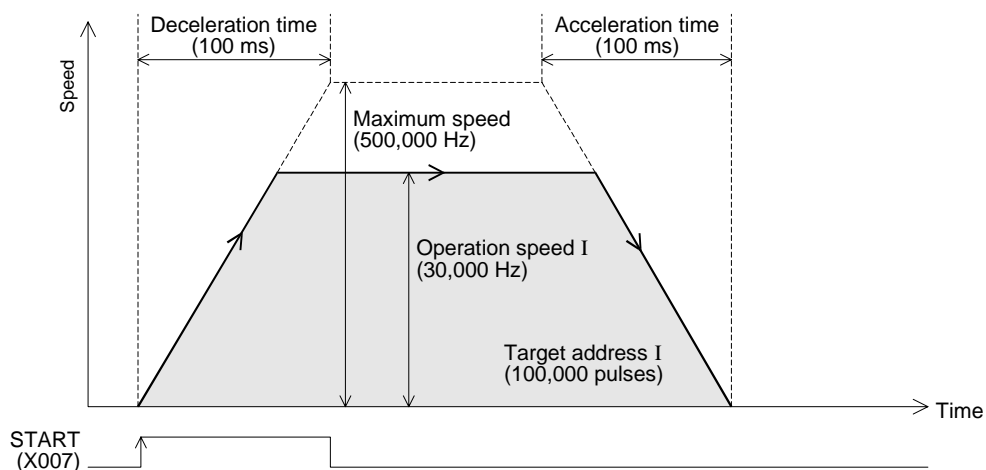- Zero point address   : 0

- Number of zero point signals : 1
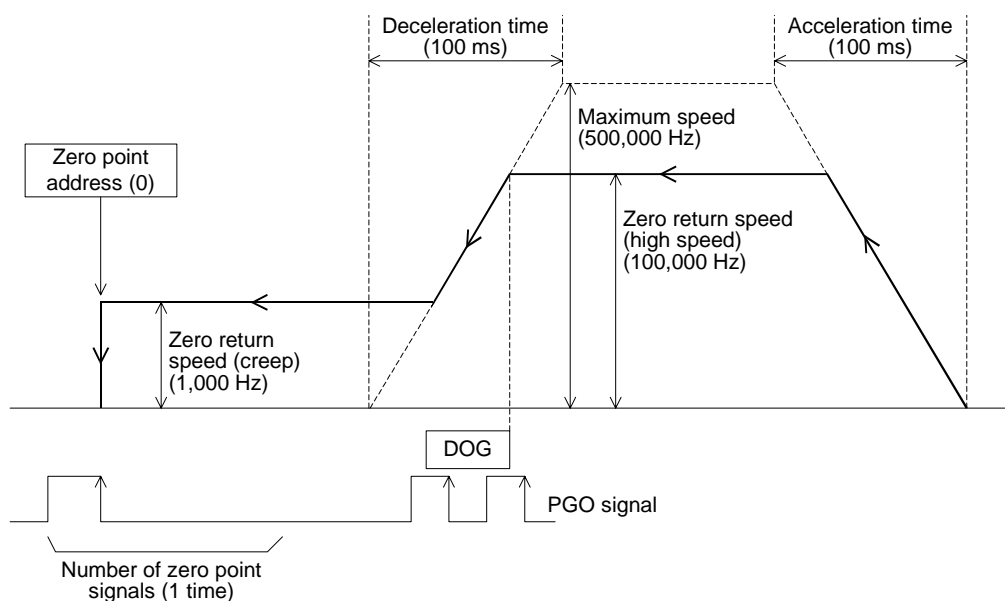
- Jog operation

1) When X004 in the PLC is turned ON, jog operation is executed in the forward direction. When X005 is turned ON, jog operation is executed in the reverse direction.
(Only when m code is OFF, jog operation can be started.)

  - Maximum speed   : 1,000,000Hz
  - Acceleration time   : 100ms
  - Deceleration time   : 100ms
  - Pulse output format : Forward pulse (FP) / reverse pulse (RP)
  - Rotation direction   : The current value increases with forward pulse.
  - Jog speed   : 10,000Hz
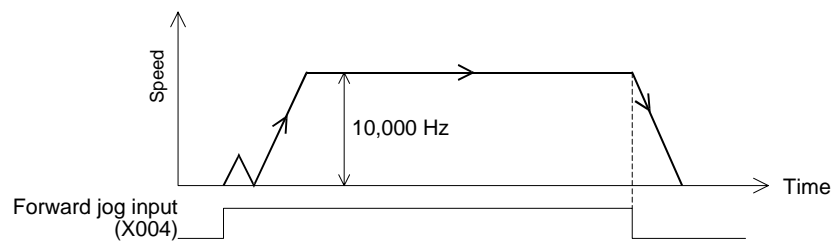
When the reverse operation jog input (X005) is turned ON, the work starts moving in the reverse direction at the same speed as above.

• Multi-speed operation (table operation)

1) When X007 in the PLC is turned ON, the multi-speed operation is started in the forward direction.

2) The operation speed has three steps, and an m code is turned ON according to each step. When the multi-speed operation ends, the final m code is turned ON. Until it is turned OFF, any other operation (jog operation and zero return operation) or 2nd multi-speed operation is not received.
   When X007 is turned ON again after m code OFF command (X010) is turned ON, it will move the same again. (Relative position positioning)

3) When X001 (STOP) is turned ON during positioning operation, the work is decelerated and stopped. When X007 is turned ON again, the work is decelerated and stopped after it moves the remaining distance.

   - Maximum speed   : 1,000,000Hz

   - Acceleration time   : 100ms

   - Deceleration time   : 100ms

   - Pulse output format : Forward pulse (FP) / reverse pulse (RP)

   - Rotation direction   : The current value increases with forward pulse.

   - Stop mode   : Movement of remaining distance

   - Travel stroke   : 1st speed ....500 pulses
                           2nd speed........3,000 pulses
                           3rd speed.........8,000 pulses

   - Operation speed   : 1st speed 500Hz
                           2nd speed........1,300Hz
                           3rd speed.........1,000Hz

Table No.	Position information	Speed information	m code information	Operation information
0	500	500	1200	1
1	3500	1300	1201	1
2	11500	1000	1202	1
3	-1	-1	-1	3

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9.3.2   Device assignment (PLC)

Element	Element No.	Assignment	
Input	X000	Error reset	
	X001	STOP	
	X002	Forward limit (External wiring is the N/C contact.)	
	X003	Reverse limit (External wiring is the N/C contact.)	
	X004	Forward jog	
	X005	Reverse jog	
	X006	Zero return operation start	
	X007	Multi-speed operation start	
	X010	m code OFF command	
Output	Y000	ON when m code is 1200.	
	Y001	ON when m code is 1201.	
	Y002	ON when m code is 1202.	
Auxiliary relay	M0	Operation pattern	1st-speed positioning operation (Normal OFF)
	M1		Interrupt 1st-speed positioning operation (Normal OFF)
	M2		2nd-speed positioning operation (Normal OFF)
	M3		Interrupt 2nd-speed positioning operation (Normal OFF)
	M4		Interrupt stop operation (Normal OFF)
	M5		Table operation (Normal ON)
	M6		Variable-speed operation (Normal OFF)
	M7		Manual pulse generator input operation (Normal OFF)
	M8 to M15		Not used (Normal OFF)
	M20	Operation command	Error reset
	M21		STOP
	M22		Forward limit
	M23		Reverse limit
	M24		Forward jog
	M25		Reverse jog
	M26		Zero return command
	M27		Data set type zero return command
	M28		Relative address/absolute address
	M29		START
	M30		Speed change disablement during operation (Normally enable)
	M31		m code OFF command
	M32 to M35		Not used. (Normal OFF)

Element	Element No.	Assignment
Data register	D23,D22	Output frequency
	D25,D24	Current address (user unit)
	D28	Status
	D37	Error code
	D38	Terminal information
	D40,D39	Current address (Pulse-converted value)
	D101,D100	Position information of table No. 0
	D103,D102	Speed information of table No. 0
	D104	m code information of table No. 0
	D105	Operation information of table No. 0
	D107,D106	Position information of table No. 1
	D109,D108	Speed information of table No. 1
	D110	m code information of table No. 1
	D111	Operation information of table No. 1
	D113,D112	Position information of table No. 2
	D115,D114	Speed information of table No. 2
	D116	m code information of table No. 2
	D117	Operation information of table No. 2
	D119,D118	Position information of table No. 3
	D121,D120	Speed information of table No. 3
	D122	m code information of table No. 3
	D123	Operation information of table No. 3

9.3.3 Sequence program

M8002 (Initial pulse)

DTO	K0	K0	K500000	K1	Maximum speed (500,000Hz)
TO	K0	K2	K0	K1	Bias speed (0Hz)
DTO	K0	K3	K10000	K1	Jog speed (10,000Hz)
DTO	K0	K5	K1000000	K1	Zero return speed (high speed) (100,000Hz)
TO	K0	K7	K1000	K1	Creep speed (1,000Hz)
TO	K0	K8	K1	K1	Zero point signal number (1 time)
DTO	K0	K9	K0	K1	Zero point address (0)
TO	K0	K11	K100	K1	Acceleration time (100ms)
TO	K0	K12	K100	K1	Deceleration time (100ms)
TO	K0	K36	H2000	K1	Parameter

M8000 (RUN monitor)

- (M0) 1st-speed positioning operation
- (M1) Interrupt 1st-speed positioning operation
- (M2) 2nd-speed positioning operation
- (M3) Interrupt 2nd-speed positioning operation
- (M4) Interrupt stop operation

M8000 (RUN monitor)

- (M5) Table operation

M8000 (RUN monitor)

- (M6) Variable-speed operation
- (M7) Manual pulse generator input operation
- (M8)
- (M9)
- (M10)
- (M11)
- (M12) Not defined.
- (M13)
- (M14)
- (M15)

M8000 (RUN monitor)

TO	K0	K27	K4M0	K1	Operation pattern

M8002 (Initial pulse)		DMOV	K500	D100		Position information of table No. 0 (500 pulses)
		DMOV	K500	D102		Speed information of table No. 0 (500Hz)
		MOV	K1200	D104		m code information of table No. 0 (m1200)
		MOV	K1	D105		Operation information of table No. 0 (Continuous operation)
		DMOV	K3000	D106		Position information of table No. 1 (300 pulses)
		DMOV	K1300	D108		Speed information of table No. 1 (1,300Hz)
		MOV	K1201	D110		m code information of table No. 1 (m1201)
		MOV	K1	D111		Operation information of table No. 1 (continuous operation)
		DMOV	K8000	D112		Position information of table No. 2 (8,000 pulses)
		DMOV	K1000	D114		Speed information of table No. 2 (1,000Hz)
		MOV	K1202	D116		m code information of table No. 2 (m1200)
		MOV	K1	D117		Operation information of table No. 2 (continuous operation)
		DMOV	K-1	D118		Position information of table No. 3 (without travel)
		DMOV	K-1	D120		Speed information of table No. 3 (without speed command)
		MOV	K-1	D122		m code information of table No. 3 (without m code)
		MOV	K3	D123		Operation information of table No. 3 (END)
M8002 (Initial pulse)	TO	K0	K98	K0	K1	Table start No. (Start from 0)
M8000 (RUN monitor)	DTO	K0	K100	D100	K12	Table data writing
					WDT	*1 Watch dog timer refresh

*1 If any FROM/TO commands are used for many buffer memories at the same time, an watch dog timer error will occur.
If many tables are used, divide FROM/TO commands into plural parts and refresh the watch dog timers.

X000 (Error reset input)			(M20)	Error reset
X001 (STOP input)			(M21)	STOP
X002 (Forward rotation limit input)			(M22)	Forward limit
X003 (Reverse rotation limit input)			(M23)	Reverse limit
X004 (Forward jog input)	M25 (Reverse jog)		(M24)	Forward jog
X005 (Reverse jog input)	M24 (Forward jog)		(M25)	Reverse jog
X006 (Zero return command input)			(M26)	Zero return command
M8000 (RUN monitor)			(M27)	Data set type zero return command
M8000 (RUN monitor)			(M28)	Relative (ON)/absolute (OFF) address
X007 (START input)			(M29)	START
8000 (RUN monitor)			(M30)	Speed change disablement during operation
X010 (m code OFF command input)			(M31)	m code OFF command

	ZRST	Y000	Y002	General reset of output (Y000 to Y002)

8000 (RUN monitor)			
	(M32)		
	(M33)		Not defined.
	(M34)		
	(M35)		

M8000 (RUN monitor)					
	TO	K0	K26	K4M20	K1	Operation command

M8000 (RUN monitor)					
	DFROM	K0	K22	D22	K1	Output frequency current value (Hz)
	DFROM	K0	K24	D24	K1	Current address (user unit)
	FROM	K0	K28	D28	K1	Status information
	FROM	K0	K29	D29	K1	m code
	CMP	K1201	D29	Y000		m code → output
	FROM	K0	K37	D37	K1	Error code
	FROM	K0	K38	D38	K1	Terminal information
	DFROM	K0	K39	D39	K1	Current address (Pulse-converted value)

END	

MEMO

10.   Diagnostics

If any trouble occurs, first check for loose terminal screws on the power supply unit, PLC and I/O devices, and for poor contacts on FX2N-10PG, and the connectors of the motor drivers and servo amplifier.

10.1   Diagnostics LED

LED name	Status	Display details	Countermeasure
POWER	Unlit.	5V DC is not supplied via the extension cable from PLC.	Unless LED is lit even though power is supplied to PLC, check the following items. • Properly connect the extension cable between PLC and FX2N-10PG. • Properly supply the power of PLC. • The service power of PLC may exceed the supply power capacity. Disconnect the wiring of the service power supply terminal, and turn on the power supply.
START	Unlit.	START input OFF	• If LED is not lit even though START input of FX2N-10PG is turned ON, check the input wiring. External power supply (24V DC) is necessary for START, DOG, X0 and X1 of FX2N-10PG.
ERROR	Blinking	Error occurrence	• An error occurs in FX2N-10PG. After checking the content of the buffer memory (BFM#37), take a countermeasure according to the content. For details of BFM#37, refer to the separate USER'S MANUAL.
	Lit.	CPU error	• If does not return even though the power is supplied again, contact your nearest system service company of Mitsubishi Electric.
FP	Unlit.	Forward pulse or pulse chain stops.	If LED does not blink even though each operation is executed, check the following item. • Using the program of PLC, check whether each operation mode selection and the start command are properly applied or not. • When STOP command or forward/reverse limit command is applied, the pulse output is not output.
RP	Unlit.	Reverse pulse or direction output stops.	
CLR	Unlit.	CLR signal is not output.	• When LED is not lit during zero return end or CLR signal forced output, check whether zero return operation and data set type zero return with program of PLC, and forced output of CLR signal are executed or not.
	Lit.	CLR signal is output.	• If the deviation counter is not cleared in the servo amplifier even though CLR signal is output (LED is lit), check the output wiring. The external power supply (5 to 24V DC) is necessary for CLR output of FX2N-10PG.

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LED name	Status	Display details	Countermeasure
DOG	Unlit.	Dog input OFF	• If LED is not lit when dog input is turned on, check the input wiring. The external power supply (24V DC) is necessary for START, DOG, X0 and X1 input of FX2N-10PG.
PG0	Unlit.	Zero point signal input OFF	• If LED is not lit even though zero-point signal is input, check the input wiring. The external power supply (5V DC) is necessary when the open collector transistor is used for PGO input of FX2N-10PG.
φA	Unlit.	A-phase input OFF of manual pulse generator	• If LED is not lit even though pulse is input from the manual pulse generator, check the input wiring. The external power supply (5V DC) is necessary when the manual pulse generator of open collector output type is used.
φB	Unlit.	B-phase input OFF of manual pulse generator	
X0,X1	Unlit.	Interrupt input OFF	• If LED is not lit even though interrupt input is turned on, check the input wiring. The external power supply (24V DC) is necessary for START, DOG, X0 and X1 input of FX2N-10PG.

10.2   Diagnostics (BFM#37)

If an error occurs, the error code will be stored into BFM#37.

Error code	Details	Countermeasure
K0	No error	—
K1	Not defined.	—
K○○○○2	Value setting range defect A value outside the settable value range is set in the buffer memory.	Change the setting value of the relevant buffer memory to within the setting range.
K○○○○3	Overflow of setting value The pulse-converted value of the travel, operation speed and so exceeds 32 bits.	Change the setting value of the relevant buffer memory to make the pulse-converted value smaller than 32-bit data.
K4	The work is stopped at the forward/reverse limit.	In the jog operation mode or manual pulse generator input operation mode, drive the work from the forward/reverse limit.
K5	Not defined.	—
K6	In BFM#26, the zero return command (b6) and data set type zero return command (b7), START (b9) are ON at the same time. (It is not an error if the forward jog b4 and jog b5 are ON at the same time.)	Change the program of PLC to prevent the start command of the positioning operation from overlapping.
K7	In BFM#27, the plural operation patterns are selected.	Change the program of PLC to make select operation pattern.

• OOOO represents BFM No. 0 to 1299.

10.3   Diagnostics PLC

If any trouble occurs in the PLC connected to FX2N-10PG, FX2N-10PG will not properly operate since FROM/TO commands may not the provided.

Some errors which can be checked with PLC are partially described as follows:
For details of the wiring, special auxiliary relay and special data registers, refer to the PLC instruction manual.

LED display of PLC

LED name	Status	Display details	Countermeasure
POWER	Unlit.	• Power is not supplied to PLC. • The service power supply of PLC may exceed the supply capacity.	• Properly supply the power of PLC. • Disconnect the wiring of the service power terminal of PLC, and resupply the power.
ERROR	Blinking	Error occurs.	• An error occurs in PLC. After checking the content of the special auxiliary relay (M8060 to M8060, M8109) and special data register (D8060 to D8069, M8109), take countermeasures according to the content.
	Lit.	CPU error	• Stop PLC. If LED is unlit when power is resupplied, a watch dog timer error may occur. (The calculation time of the PLC becomes long.) • Check whether the program is in such a state as the END command is not executed owing to CJ command or FOR/NEXT command or not. • In case of CPU error, repair is necessary. Consult a system service company of Mitsubishi Electric.

• If any calculation error occurs in the PLC, the ERROR LED will continue unlit.
(Any command in which an calculation error occurs can not be executed.)
Using the programming device, check whether M8067 (calculation error flag) is ON.

USER'S MANUAL

FX2N-10PG

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Specification are subject
to change without notice.