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PROGRAMMABLE CONTROLLERS
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Changes for the Better

HARDWARE / PROGRAMMING MANUAL

FX2N-10GM, FX2N-20GM



FX_{2N}

Foreword

- This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the communication facilities of FX_{2N}-10GM, FX_{2N}-20GM unit.
For programming instructions please refer to the E-20TP-E OPERATION MANUAL, FX-PCS-VPS/WIN-E SOFTWARE MANUAL and FX-PCS-KIT-GM-EE SOFTWARE MANUAL.
- Before attempting to install or use the communication facilities of FX_{2N}-10GM, FX_{2N}-20GM unit this manual should be read and understood.
- If in doubt at any stage of the installation of the communication facilities of FX_{2N}-10GM, FX_{2N}-20GM units 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 the communication facilities of FX_{2N}-10GM, FX_{2N}-20GM units please consult the nearest Mitsubishi Electric distributor.
- This manual is subject to change without notice.

FX₂N-10GM, FX₂N-20GM

Hardware / Programming Manual

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Guidelines for the Safety of the User and Protection of the FX_{2N}-10GM, FX_{2N}-20GM unit

This manual provides information for the use of the FX_{2N}-10GM, FX_{2N}-20GM Units. 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 (see Note) should be trained to use this product in a safe manner in compliance to established safety practices. The operators should also be familiar with documentation which is associated with the 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 throughout 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 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.
- Please contact a Mitsubishi Electric distributor for more information concerning applications in life critical situations or high reliability.

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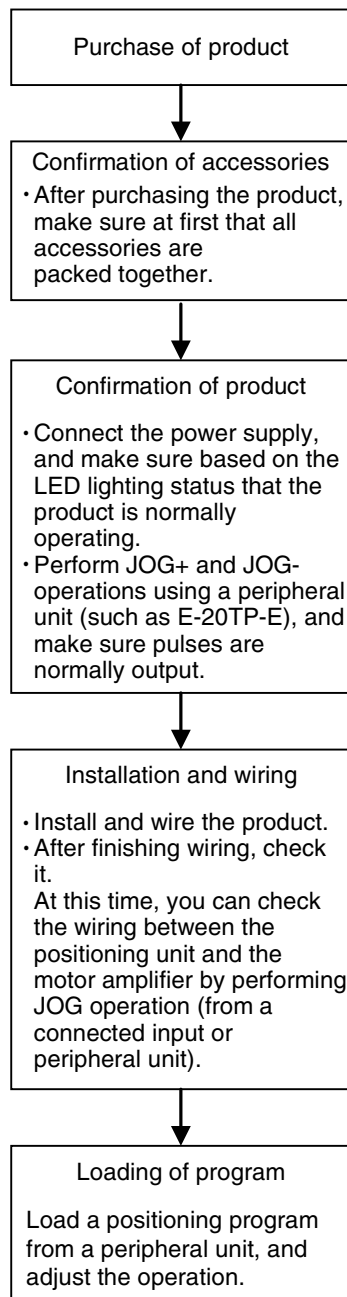
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1. Introduction

1.1 Introduction Procedure and Reference Manuals

Introduction procedure



The FX2N-10GM/20GM is packed together with the following accessories.

- Power cable
FX2NC-100MPCB 1 cable
FX2NC-100BPCB (only in FX2N-20GM)
- PC connection cable
FX2N-GM-5EC 1 cable

LED lighting status

POWER LED: Lit
READY-x LED: Lit
READY-y LED: Lit
Other LEDs: Extinguished

During JOG+ ON

The READY (READY-x or READY-y) LED for the specified axis is extinguished, and the FP LED is flashing at a high speed (so looks like being lit).

During JOG-ON

The READY (READY-x or READY-y) LED for the specified axis is extinguished, and the RP LED is flashing at a high speed (so looks like being lit).

For operating procedures of peripheral units, refer to corresponding operation manuals.

Correctly perform wiring in accordance with "3. Wiring" in this manual.

For an operation which may cause danger, perform wiring so that the unit conservatively operates when the power is shut down.

Set interlock to positions which should not be driven at the same time.

- For creation of programs and description on instructions, refer to "5. Expression in Program" in this manual.
- For operating procedures of peripheral units, refer to corresponding operation manuals.
- If an error occurs, refer to "10. Troubleshooting" in this manual.

Reference manuals**1) E-20TP-E Operation Manual**

This manual describes inputs, monitoring and tests of programs using the E-20TP-E.

2) FX-PCS-KIT-GM-EE Operation Manual

This manual describes inputs, monitoring and tests of programs using a personal computer and the FX-PCS-KIT-GM-EE.

3) FX-PCS-VPS/WIN-E SOFTWARE MANUAL

This manual describes inputs, monitoring and tests of programs using a personal computer and the FX-PCS-VPS/WIN-E.

Each of the above manuals is packed together with the corresponding unit.

Or you can acquire only manuals by asking a dealer from which you have purchased the FX_{2N}-10GM/20GM.

1.2 Outline of Product

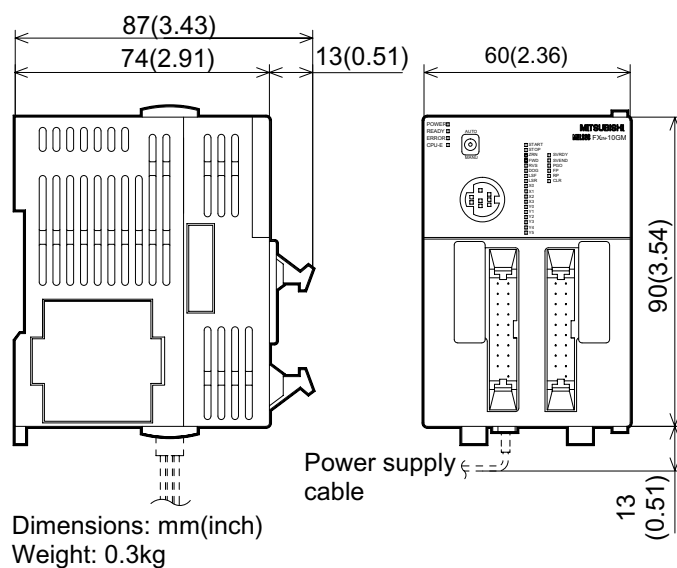
The positioning unit FX_{2N}-10GM and the positioning unit FX_{2N}-20GM (hereafter referred to as "FX_{2N}-10GM", "FX_{2N}-20GM" or "positioning unit" when indicating the both models) are special units to output pulse trains.

The positioning unit allows you to control positioning using a stepping motor or servo motor via a drive unit.

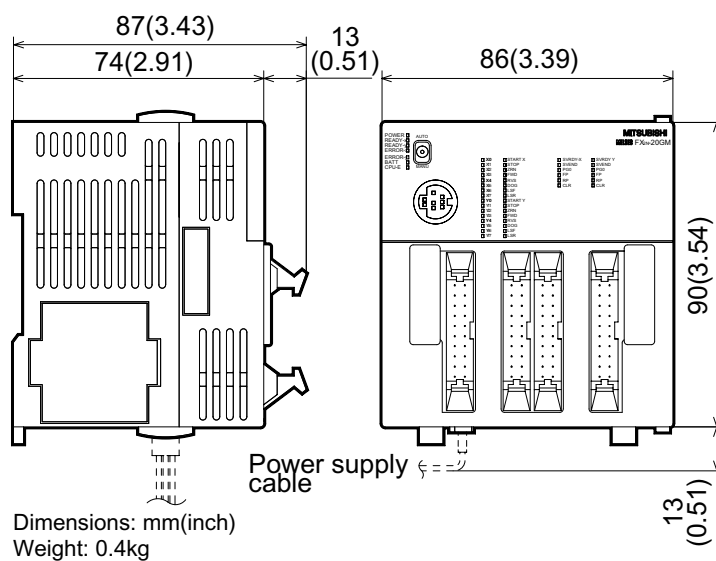
- 1) Number of control axes (The number of axes indicates the number of controlled motors.)
One FX_{2N}-10GM can control one axis. One FX_{2N}-20GM can control two axes.
(The FX_{2N}-20GM is equipped with linear/circular interpolation functions.)
- 2) Positioning language
The positioning unit is equipped with a dedicated positioning language (cod instructions) and sequence language (basic instructions and application instructions).
The FX_{2N}-10GM can perform position control using programs saved in the PLC main unit without using the dedicated positioning language. (This is called the table method.)
- 3) Manual pulse generator
Manual feed is enabled when a general-purpose manual pulse generator (open collector type) is connected.
- 4) Absolute position (ABS) detection
Returning to the zero point at every startup can be saved when a servo amplifier equipped with absolute position (ABS) detection function is connected.
- 5) Connected PLC
Positioning data can be read/written when an FX_{2N}, FX_{3U}, FX_{2NC}, FX_{3UC} Series PLC is connected.
When connecting to an FX_{2NC} PLC, the FX_{2NC}-CNV-IF must be used.
When connecting to an FX_{3UC} PLC, the FX_{2NC}-CNV-IF or FX_{3UC}-1PS-5V must be used.
The positioning unit can also operate independently without a PLC.

1.3 Outline dimensions

FX₂N-10GM



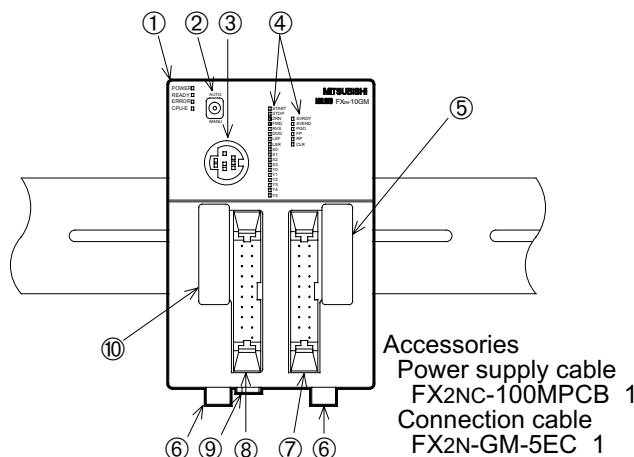
FX₂N-20GM



1.4 Product composition

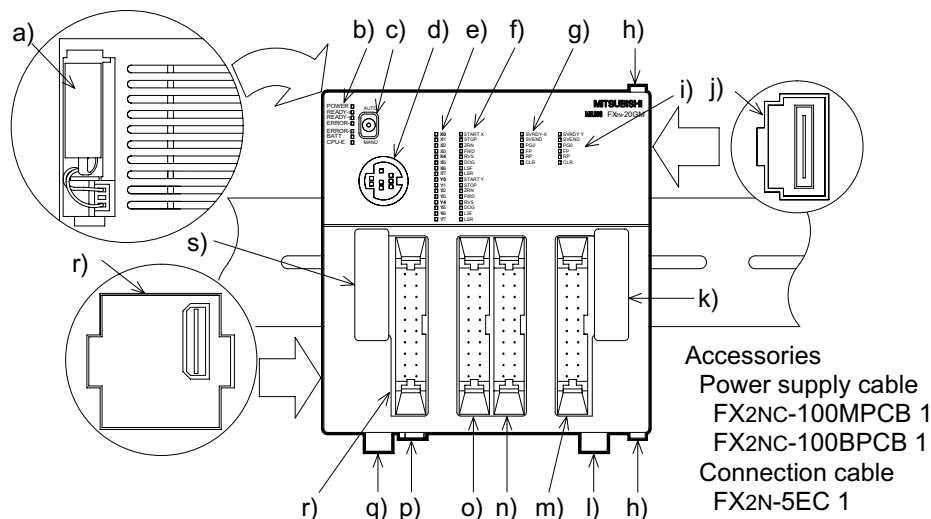
1.4.1 Part names

The name and description of each part of the FX₂N-10GM are explained below.



- | | |
|-------------------------------------|---------------------------------------|
| ① Operation indicator LED | ⑥ Hook for DIN rail installation |
| ② MANU/AUTO switch | ⑦ Connector for motor amplifier: CON2 |
| ③ Connector for programming tool | ⑧ Connector for I/O: CON1 |
| ④ I/O display | ⑨ Connector for power supply |
| ⑤ Connector for PLC extension block | ⑩ Connector for PLC |

The name and description of each part of the FX₂N-20GM are explained below.



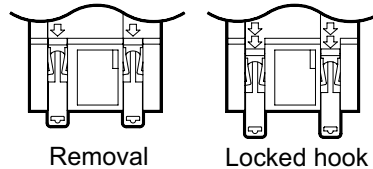
- | | |
|--|---|
| a) Battery (Refer to Section 11.) | k) Connector for PLC extension block |
| b) Operation indicator LED | l) Hook for DIN rail installation |
| c) MANU/AUTO switch | m) Connector for y axis motor amplifier: CON4 |
| d) Connector for programming tool | n) Connector for x axis motor amplifier: CON3 |
| e) General-purpose I/O display | o) Connector for input equipment: CON2 |
| f) Display for equipment inputs | p) Connector for power supply |
| g) x axis status display | q) Connector for general-purpose I/O: CON1 |
| h) Lock to fix extension block of FX ₂ N-20GM | r) Connector for memory board |
| i) y axis status display | s) Connector for PLC |
| j) Connector for FX ₂ N-20GM extension block | |

1.4.2 Installation method

The positioning unit can be directly attached to a DIN rail DIN46277 (width: 35 mm).

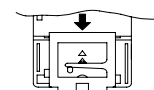
When removing the positioning unit, slightly pull out the DIN rail hook.

When the DIN rail hook is pulled out by one more step, it can be locked in the open status.

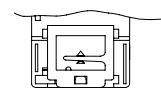


When using an extension block for the FX₂NC Series together with the FX₂N-20GM, push out the mounting hook in the arrow direction shown in the figure on the right, when attaching it to the DIN rail.
(An extension block cannot be connected to the FX₂N-10GM.)

Extension
block



When attached
to DIN rail



When directly attached
(at shipment)



- 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.

Caution

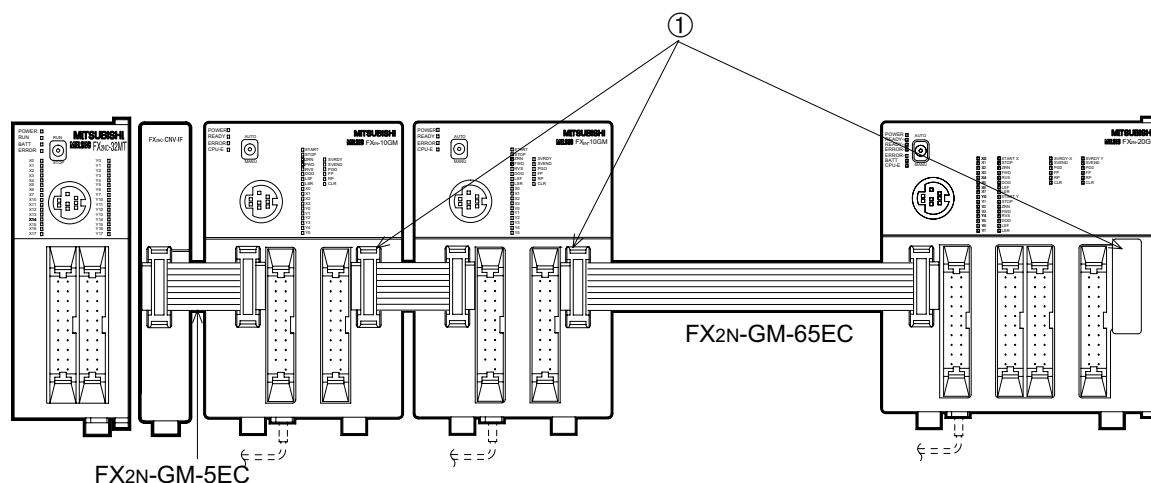
- Units should not be installed in areas subject to the following conditions: excessive or conductive dust, corrosive gas (Salt air, Cl₂, H₂S, SO₂, NO₂, etc.) or flammable gas, moisture or rain, excessive heat, regular impact shocks or excessive vibration.
- Take special care not to allow debris to fall inside the unit during installation e.g. cut wires, shavings etc. Once installation is complete remove the protective paper band: to prevent overheating.

General notes

- Always ensure that mounted units and blocks are kept as far as possible from high-voltage cables, high-voltage equipment and power equipment.
- Wiring cautions
- Do not run input signals in the same multicore cable as output signals or allow them to share the same wire.
- Do not lay I/O signal cables next to power cables or allow them to share the same trunking duct. Low voltage cables should be reliably separated or insulated with regard to high voltage cabling.
- Where I/O signals lines are used over an extended distance consideration for voltage drop and noise interference should be made.

1.4.3 Connecting the PLC main unit

Connect the PLC main unit and the positioning unit with a PLC connection cable FX2N-GM-5EC (which is offered as an accessory) or FX2N-GM-65EC (which is separately sold).



- Up to eight positioning units can be connected to the FX2N, FX3U, FX3UC^{*1} Series PLC. Up to four positioning units can be connected to the FX2NC Series PLC.

^{*1} Up to seven positioning units can be connected to the FX3UC-32MT-LT PLC.

- When connecting to an FX2NC PLC, the FX2NC-CNV-IF must be used.
When connecting to an FX3UC PLC, the FX2NC-CNV-IF or FX3UC-1PS-5V must be used.
(When connecting the positioning unit to the FX2N, FX3U Series PLC, the FX2NC-CNV-IF is not required.)
- Only one extension cable FX2N-GM-65EC (650 mm) can be used in one system.
- An extension block, extension unit, special block or special unit connected to the connector ① shown in the figure above is treated as an extension unit of the PLC main unit.
When extending I/O points to the FX2N-20GM, connect them to an extension connector provided on the right side of the FX2N-20GM.
(I/O points cannot be extended to the FX2N-10GM.)



- Securely connect cables such as extension cables and memory cassettes to specified connectors.
Imperfect contact may cause malfunction.
- 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.

1.4.4 System configuration and I/O assignment

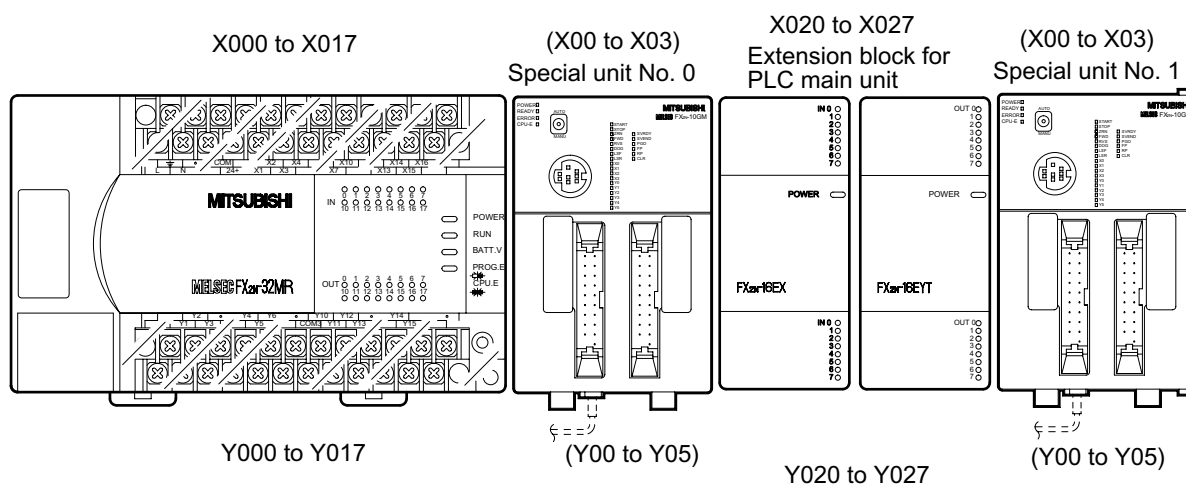
FX2N-10GM

The FX2N-10GM is equipped with a power supply, a CPU, operation system inputs, mechanical system inputs and an I/O drive unit. It can also operate independently.

The FX2N-10GM is equipped with four input points (X0 to X3) and six output points (Y0 to Y5) for general purpose, and can be connected to external I/O equipment. If I/O points are not sufficient, use the FX2N-10GM together with an FX2N, FX3U, FX2NC, FX3UC Series PLC.

At this time, the FX2N-10GM is treated as a special function unit of the PLC. Up to eight special function units (including FX2N-10GM, analog I/O and high-speed counter) can be connected to an FX2N, FX3U, FX3UC^{*1} Series PLC. Up to four special units (including FX2N-10GM, analog I/O and high-speed counter) can be connected to an FX2NC Series PLC.

^{*1} Up to seven special function units can be connected to the FX3UC-32MT-LT PLC.



I/O assignment shown inside () indicates I/O points in the FX2N-10GM.

I/O assignment

The FX2N-10GM units are treated as special units of the PLC. From the one nearest to the PLC, the special unit Nos. 0 to 7 are automatically assigned to the connected special units. (This special unit No. is used by FROM/TO instructions.)

Separate from I/O points in the PLC, and general-purpose I/O points in the FX2N-10GM are controlled as I/O points in the FX2N-10GM. (One PLC occupies eight I/O points.)

For the details of assignment of I/O points in the PLC, refer to the manuals of the FX2N, FX3U, FX2NC or FX3UC.

FX2N-20GM

The FX2N-20GM is equipped with a power supply, CPU, operation system inputs, mechanical system inputs and an I/O drive unit. It can also operate independently.

The FX2N-20GM is equipped with eight input points (X00 to X07) and eight output points (Y00 to Y07) for general purpose, and can be connected to external I/O equipment. If I/O points are not sufficient, the following extension blocks can be connected as an extension of the FX2N-20GM.

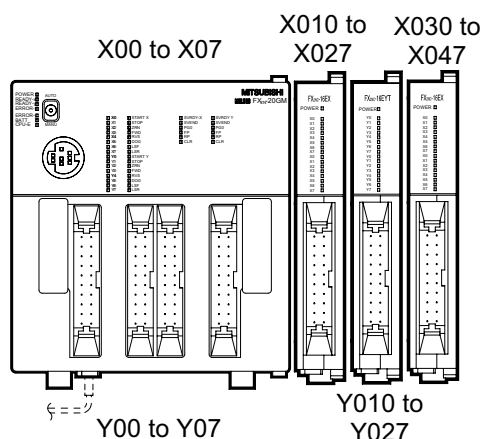
- FX2NC series extension block
(FX2NC-16EX-DS, FX2NC-16EYT-DSS, FX2NC-32EX-DS, FX2NC-32EYT-DSS, FX2NC-16EX-T-DS, FX2NC-16EX-D/UL, FX2NC-16EYT-D/UL, FX2NC-32EX-D/UL, FX2NC-32EYT-D/UL)
- FX2N series extension block (FX2NC-CNV-IF needs to be used)
(FX2N-16EX-ES/UL, FX2N-16EYT-ESS/UL)

The FX2N-20GM can be used together with an FX2N, FX3U, FX2NC, FX3UC Series PLC. At this time, the FX2N-20GM is treated as a special function unit of the FX2N/2NC PLC. Up to eight special units (including FX2N-20GM, analog I/O and high-speed counter) can be connected to the FX2N, FX3U, FX3UC^{*1} Series PLC. Up to four special function units (including FX2N-20GM, analog I/O and high-speed counter) can be connected to the FX2NC Series PLC.

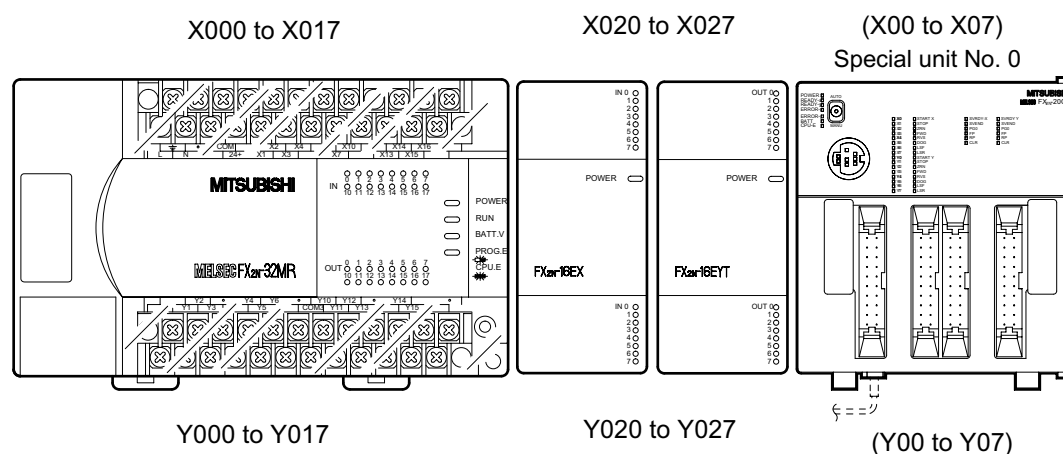
Either when independently using the FX2N-20GM or connecting it to the PLC main unit, make sure that the simultaneous ON ratio is 50% or less in the I/O extension area of the FX2N-20GM.

^{*1} Up to seven special function units can be connected to the FX3UC-32MT-LT PLC.

When independently using the FX2N-20GM



When connecting the FX2N-20GM to the PLC main unit



I/O assignment shown inside () indicates I/O points in the FX2N-10GM.

I/O assignment

When independently using the FX_{2N}-20GM:

In addition to 16 I/O points (8 input points and 8 output points) built in to the FX_{2N}-20GM, up to 48 I/O points can be added. (Accordingly, up to 64 points in total are available.) Extended inputs and extended outputs are separately assigned from the one nearest to the FX_{2N}-20GM unit.

When connecting the FX_{2N}-20GM to the PLC main unit:

FX_{2N}-20GM units are treated as special units of the PLC. From the one nearest to the PLC, the special unit Nos. 0 to 7 are automatically assigned to the connected special units. (This special unit No. is used by FROM/TO instructions.)

Separate from I/O points in the PLC, general-purpose I/O points in the FX_{2N}-20GM are controlled as I/O points in the FX_{2N}-20GM. (One PLC occupies eight I/O points.)

For details on I/O point assignment in the PLC, refer to the manuals of the FX_{2N}, FX_{3U} FX_{2NC} and FX_{3UC} main units.

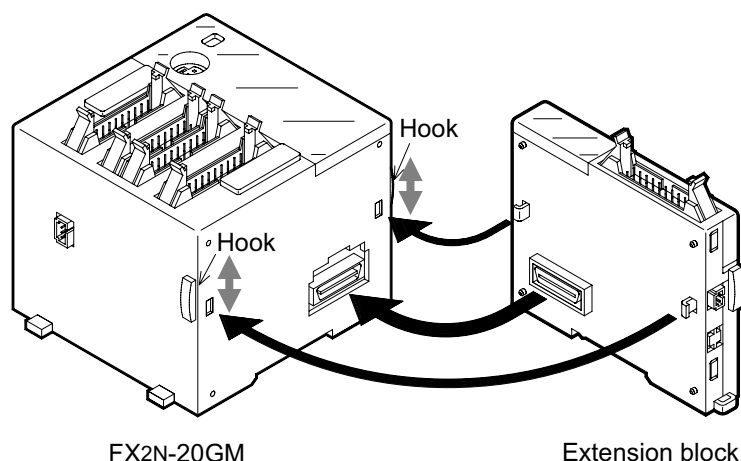
I/O extension connector:

The FX_{2N}-20GM can connect the following extension block.

- FX_{2NC} series extension block
(FX_{2NC}-16EX-DS, FX_{2NC}-16EYT-DSS, FX_{2NC}-32EX-DS, FX_{2NC}-32EYT-DSS, FX_{2NC}-16EX-T-DS, FX_{2NC}-16EX-D/UL, FX_{2NC}-16EYT-D/UL, FX_{2NC}-32EX-D/UL, FX_{2NC}-32EYT-D/UL)
- FX_{2N} series extension block (FX_{2NC}-CNV-IF needs to be used)
(FX_{2N}-16EX-ES/UL, FX_{2N}-16EYT-ESS/UL)

The number of extension points should be up to 48. The simultaneous ON ratio should be 50% or less.

Remove the extension connector cover from the right side of the FX_{2N}-20GM. Pull up hooks, and fit claws on an extension block into mounting hole in the FX_{2N}-20GM for connection. Then, pull down the hooks to fix the extension block. Connect an extension block to another extension block in the same way.



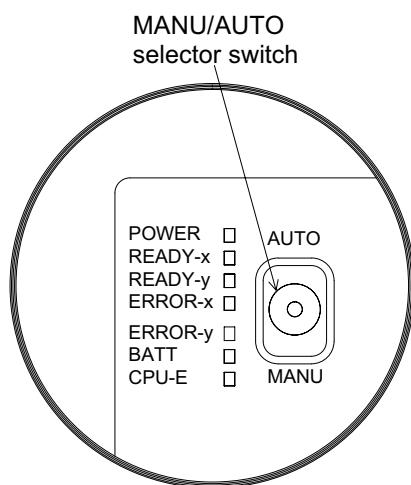
1.4.5 Status indication

LEDs provided on the positioning unit indicate the status of the unit.

Table 1.1: Status indication

LED	FX2N-10GM	FX2N-20GM
POWER	Lit while power is normally supplied.If this LED is not lit even while power is supplied, supply voltage may be abnormal or power circuit may be abnormal caused by invasion of conductive foreign objects, etc.	
READY	Lit while FX2N-10GM is ready for receiving diversified operation commands. Extinguished while positioning is being performed (that is, while pulses are being output) or an error is present.	—
READY-X	—	Lit while X axis of FX2N-20GM is ready for receiving diversified operation commands. Extinguished while positioning is performed by X axis (that is, while pulses are being output) or an error is present.
READY-Y	—	Lit while Y axis of FX2N-20GM is ready for receiving diversified operation commands. Extinguished while positioning is performed by Y axis (that is, while pulses are being output) or an error is present.
ERROR	Lit or flashing when an error has occurred during positioning operation. You can read error code on a peripheral unit to check contents of error.	—
ERROR- X	—	Lit or flashing when an error has occurred during positioning operation by X axis. You can read error code on a peripheral unit to check contents of error.
ERROR-Y	—	Lit or flashing when an error has occurred during positioning operation by Y axis. You can read error code on a peripheral unit to check contents of error.
BATT	—	Lit while power is turned on if battery voltage is low.
CPU-E	Lit when a watch dog timer error has occurred. [Estimated causes are invasion of conductive foreign objects, abnormal noise or low battery voltage (only in FX2N-20GM).]	

1.4.6 MANU/AUTO selector switch



Set this switch to "MANU" for manual operation, or to "AUTO" for automatic operation.

Select the MANU mode when writing programs or setting parameters.

In the MANU mode, positioning programs and subtask programs stop.

When this switch is changed over from "AUTO" to "MANU" during automatic operation, the positioning unit performs the current positioning operation, then waits for the END instruction.

The undermentioned product can switch MANU/AUTO by General-purpose input of the positioning unit or TO instruction of the PLC main unit.

Table 1.2: Correspondence version

Model name	Correspondence version
FX2N-10GM	V2.10 or more
FX2N-20GM	V3.40 or more

There is the following allocations in the special assistance Relay to switch MANU/AUTO by the TO instruction on an input of the general purpose of the positioning unit and the PLC main unit.

M9167 : The switch of MANU/AUTO by a general-purpose input of the positioning unit becomes effective. (ON: effective, OFF: invalidity)

FX2N-10GM occupies X3 FX2N-20GM occupies X7

When it turns on of each general-purpose input, it is MANU mode

M9168 : MANU mode instruction by PLC main unit. (ON: MANU mode, OFF: Invalidity)

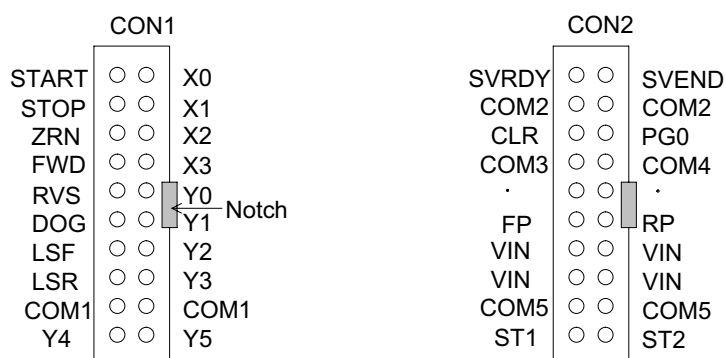
Table 1.3: Operation and priority level

Switch of positioning unit	M9167	M9168	Operation
MANU	ON/OFF	ON/OFF	It becomes MANU mode without any relation to the state of M9167, M9168, and a general-purpose input (FX2N-10GM is X3, FX2N-20GM is X7).
AUTO	OFF	OFF	It becomes AUTO mode.
	ON	OFF	It becomes MANU mode when it turns ON X3 (FX2N-10GM) or X7 (FX2N-20GM), and it becomes AUTO mode when turning it OFF.
	OFF	ON	It becomes MANU mode.
	ON	ON	It becomes MANU mode without any relation to the state of a general-purpose input (FX2N-10GM is X3, FX2N-20GM is X7).

The MANU mode of the main unit switch is prioritized, and it is given priority next in order of MANU mode instruction (M9168) and general-purpose input (M9167).

1.4.7 I/O connector

FX₂N-10GM (Pin array on positioning unit I/O connector engagement side.)

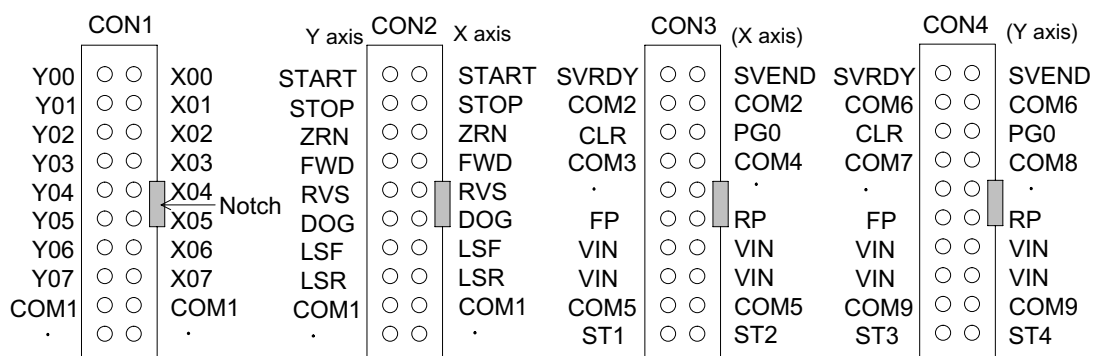


All terminals with identical names are shorted internally. (Ex. COM1-COM1, VIN-VIN, etc.)

Do not wire " · " terminals.

Refer to the FX₂N-10GM, FX₂N-20GM HARDWARE PROGRAMMING MANUAL for wiring information.

FX₂N-20GM (Pin array on positioning unit I/O connector engagement side.)



All terminals with identical names are shorted internally. (Ex. COM1-COM1, VIN-VIN, etc.)

Do not wire " · " terminals.

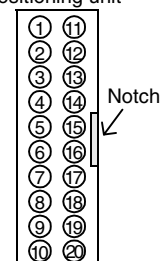
About the pin array of the positioning unit

When wiring the I/O cable, the pin number of I/O connector of the positioning unit and Cable side connector may not correspond.

- When the pin numbers are written on the cable connector, the pin number of the positioning unit connector and pin number of the cable connector may not correspond.
- When "▲" is printed on the cable connector, the position of pin ① of the positioning unit connector and the "▲" mark of the cable connector may not correspond.

Align the notch position, and wire correctly referring to the pin array of the above-mentioned equipment.

I/O connector pin array of positioning unit



- Perform grounding resistance of 100Ω or less with an electric wire of 2 mm² or more to the ground terminal in the positioning unit. However, never perform common grounding with a strong power system.

Signals in connectors

Table 1.4: Signals in connectors

Abbreviation	Function/application
START	Automatic operation start input While the AUTO mode is in ready status and the start command is set ON, pulses will be output from the controller. This signal is reset by the stop command, m00 or m02.
STOP	Stop input When STOP signal transitions from OFF to ON, stop command is set and operation stops. Priority is given to STOP signal over START, FWD and RVS signals. Stop operation varies depending on setting (0 to 7) of PARA. 23.
ZRN	Mechanical zero point return start input (manual) When ZRN signal transitions from OFF to ON, zero point return command is set and machine starts to return to zero point. ZRN signal is reset when return to zero point is finished or stop command is given.
FWD	Normal rotation input (manual) When FWD signal turns ON, positioning unit generates a forward pulse of minimum command unit. When FWD signal remains ON for 0.1 sec or more, positioning unit generates continuous forward pulses.
RVS	Reverse rotation input (manual) When RVS signal turns ON, positioning unit generates a backward pulse of minimum command unit. When RVS signal remains ON for 0.1 sec or more, positioning unit generates continuous backward pulses.
DOG	Dog (near point signal) input
LSF	Normal rotation stroke end
LSR	Reverse rotation stroke end
COM1	Common
X0 to X7	General-purpose inputs Parameters, these pins can be assigned to inputs of digital switch type, m code OFF command, manual pulse generator, absolute position (ABS) detection data, step mode, etc. When STEP input set by a parameter turns on, step mode is selected, and program execution proceeds to next line in accordance with the "OFF → ON" transition of start command. Step operation is disabled until command in current line is completed.
Y1 to Y8	General-purpose outputs Parameters, these pins can be assigned to outputs of digit changeover of digital switch type, ready signal, m code, absolute position (ABS) detection control signal, etc.
SVRDY	Receives READY signal (which indicates that preparation for operation is completed) from servo amplifier.
COM2	Common of SVRDY and SVEND signals (X axis)
CLR	Outputs deviation counter clear signal.
COM3	Common of CLR signal (X axis)
FP	Normal rotation pulse output
VIN	Input (5 V, 24 V) for power for FP and RP
COM5	Common of FP and RP signals (X axis)
ST1	Short-circuit ST1 and ST2 when connecting PG0 to 5 V power supply.
SVEND	Receives INP (positioning completion) signal from servo amplifier.
PG0	Receives zero point signal.
COM4	Common of PG0 (X axis)
RP	Reverse rotation pulse output
ST2	Short-circuit ST1 and ST2 when connecting PG0 to 5 V power supply.

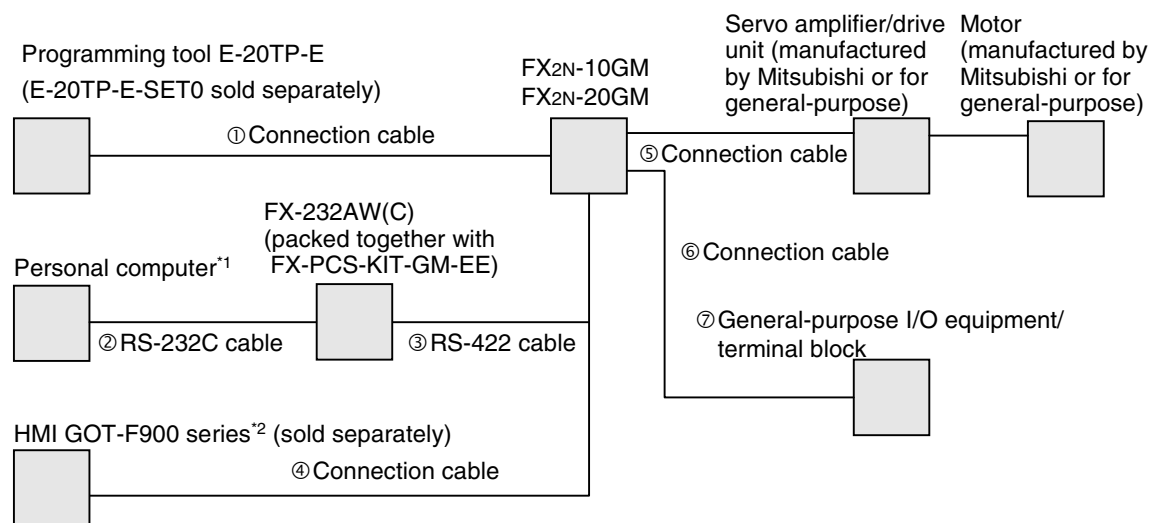
Table 1.4: Signals in connectors

Abbreviation	Function/application
COM6	Common of SVRDY and SVEND signals (Y axis)
COM7	Common of CLR signal (Y axis)
COM9	Common of FP and RP signals (Y axis)
ST3	Short-circuit ST3 and ST4 when connecting PG0 to 5 V power supply.
COM8	Common of PG0 signal (Y axis)
ST4	Short-circuit ST3 and ST4 when connecting PG0 to 5 V power supply.

- While the FX_{2N}-20GM is performing simultaneous 2-axis operation, step mode command, start command, stop command and m code OFF command are effective to the both axes even if such a command is given to only either the X or Y axis.

1.5 System Configuration

The figure below shows the system configuration to use the positioning unit.



*1: Software for personal computer

FX-PCS-KIT-GM-EE : Applicable personal computer PC-AT compatible machine.
Applicable OS MS-DOS.

FX-PCS-VPS/WIN-E : Applicable OS Windows®95, Windows®98, Windows NT®4.0,
Windows®ME, Windows®2000, Windows®XP.

*2: Some models in the GOT-F900 Series cannot be connected to the positioning units (FX_{2N}-10GM and FX_{2N}-20GM).

For details, refer to the catalogue or **HARDWARE MANUAL (CONNECTION)** for the GOT-F900 SERIES.

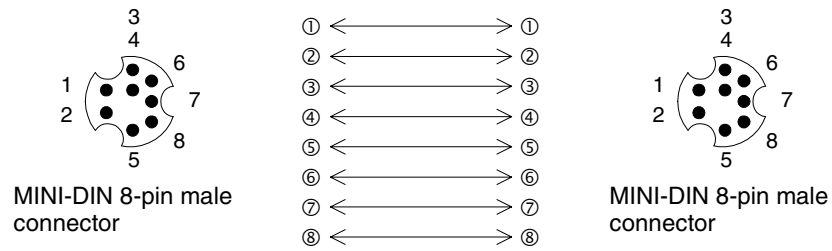
Connection cables and terminal blocks

- ① Cable to connect E-20TP-E
E-20TP-CAB0 (3 m, packed together with E-20TP-E-SET0)
FX-20P-CAB0 (1.5 m, sold separately)
- ② RS-232C cable to connect personal computer
F2-232CAB (25 pins ↔ 25 pins) (packed together with FX-PCS-KIT-GM-EE)
F2-232CAB-2 (half-pitch 14 pins ↔ 25 pins) (sold separately)
F2-232CAB-1 (9 pins ↔ 25 pins) (sold separately)
- ③ RS-422 cable to connect personal computer (packed together with FX-PCS-KIT-GM-EE)
FX-422CAB0
- ④ GOT-F900 series connection cable
Refer to "GOT-F900 series Hardware Manual (connection diagram)"
- ⑤ Cable to connect servo amplifier/drive unit (sold separately)
Cable to connect MR-C E-GMC-200CAB (2 m)
Cable to connect MR-J E-GMJ-200CAB (2 m)
Cable to connect MR-J2(S) E-GMJ2-200CAB1A (2 m)
Cable to connect MR-H E-GMH-200CAB (2 m)
Cable to connect general-purpose drive unit E-GM-200CAB (2 m)
(relayed by terminal block FX-16E-TB)

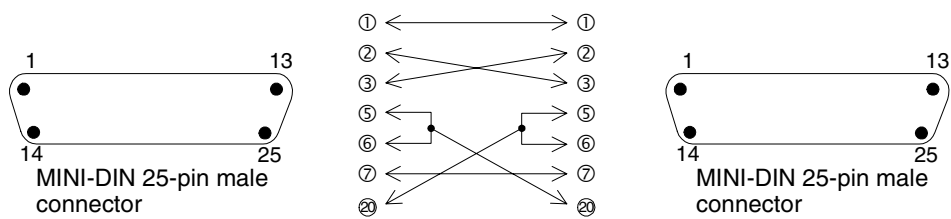
- ⑥ Connection cable to connect general-purpose I/O equipment/terminal block (sold separately)
 - FX-16E-150CAB: Flat cable with connector on each end (1.5 m)
 - FX-16E-300CAB: Flat cable with connector on each end (3.0 m)
 - FX-16E-500CAB: Flat cable with connector on each end (5.0 m)
 - FX-16E-150CAB-R: Round multi-core cable with connector on each end (1.5 m)
 - FX-16E-300CAB-R: Round multi-core cable with connector on each end (3.0 m)
 - FX-16E-500CAB-R: Round multi-core cable with connector on each end (5.0 m)
 - FX-16E-500CAB-S: Cable with connector on only one end (5.0 m)
- ⑦ Terminal block (sold separately)
 - For positioning unit/extension block:
 - FX-16E-TB, FX-32E-TB
 - For extension block (cannot be connected to positioning unit):
 - FX-16EY□-TB (□ = R, S or T), FX-16EYT-H-TB

1.6 Pin Assignment and Connection Diagram of Each Cable

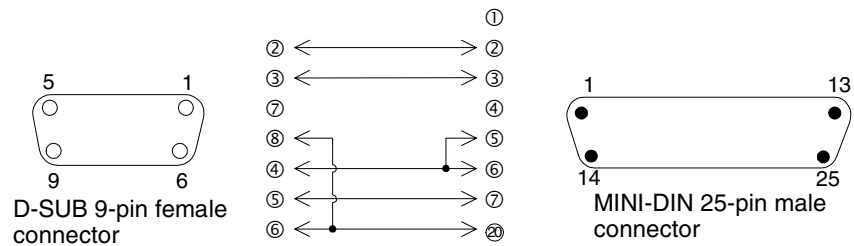
Connection cable E-20TP-CAB0 / FX-20P-CAB0



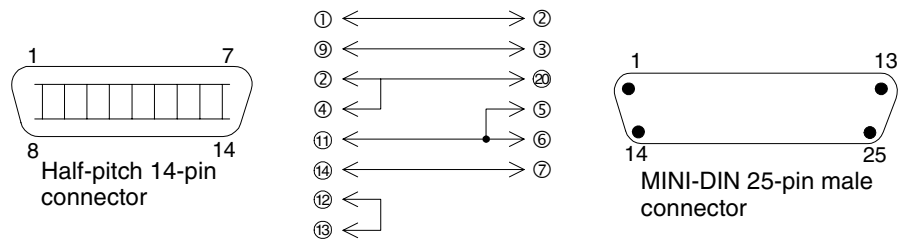
RS-232C connection cable F2-232CAB



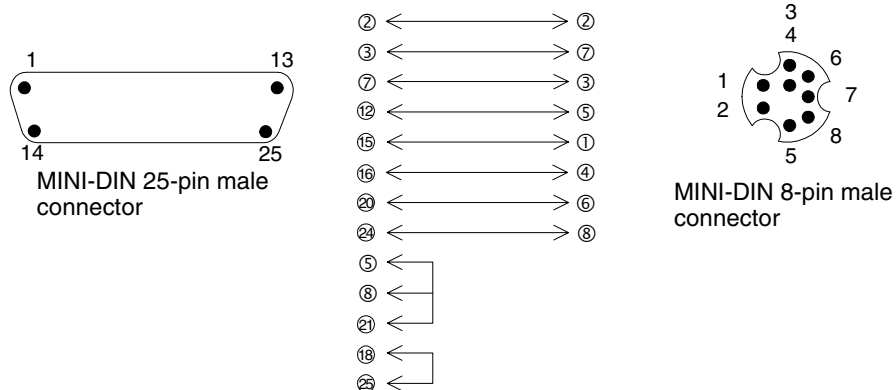
RS-232C connection cable F2-232CAB-1



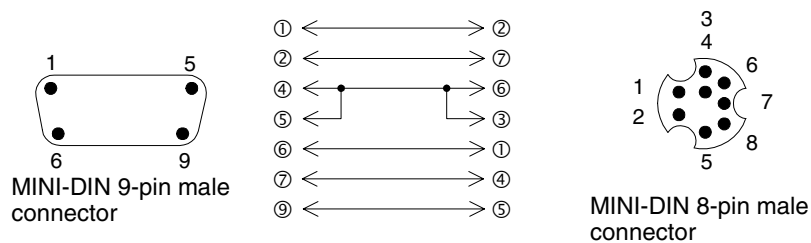
RS-232C connection cable F2-232CAB-2



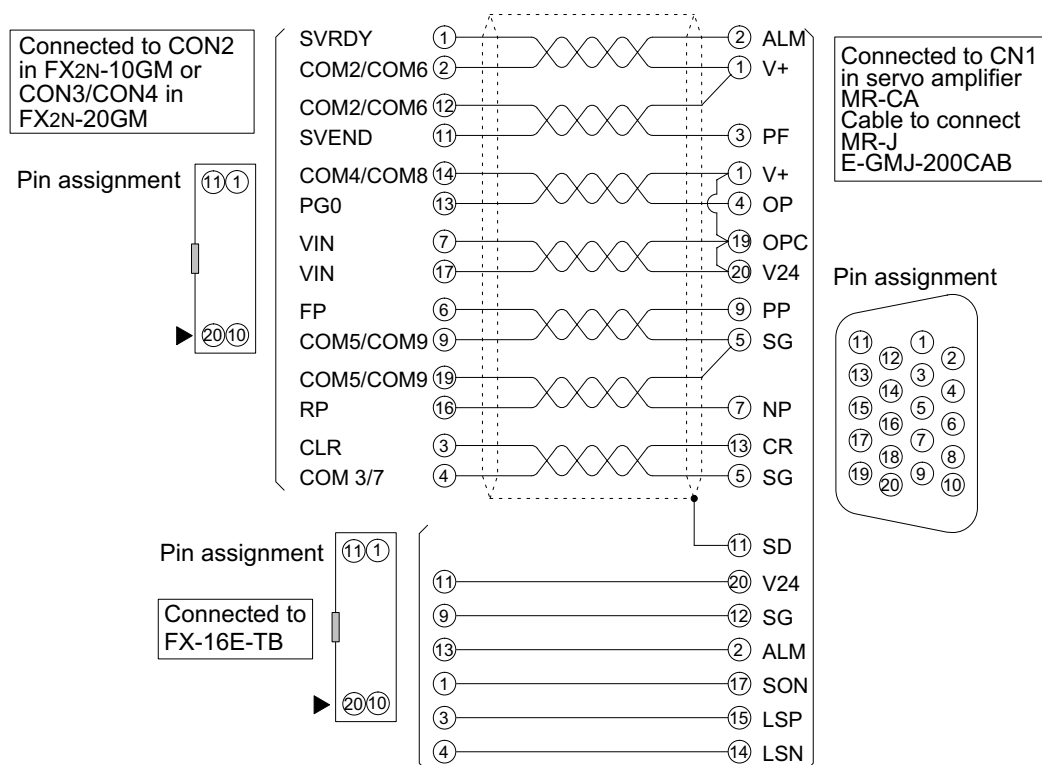
RS-422 connection cable FX-422CAB0



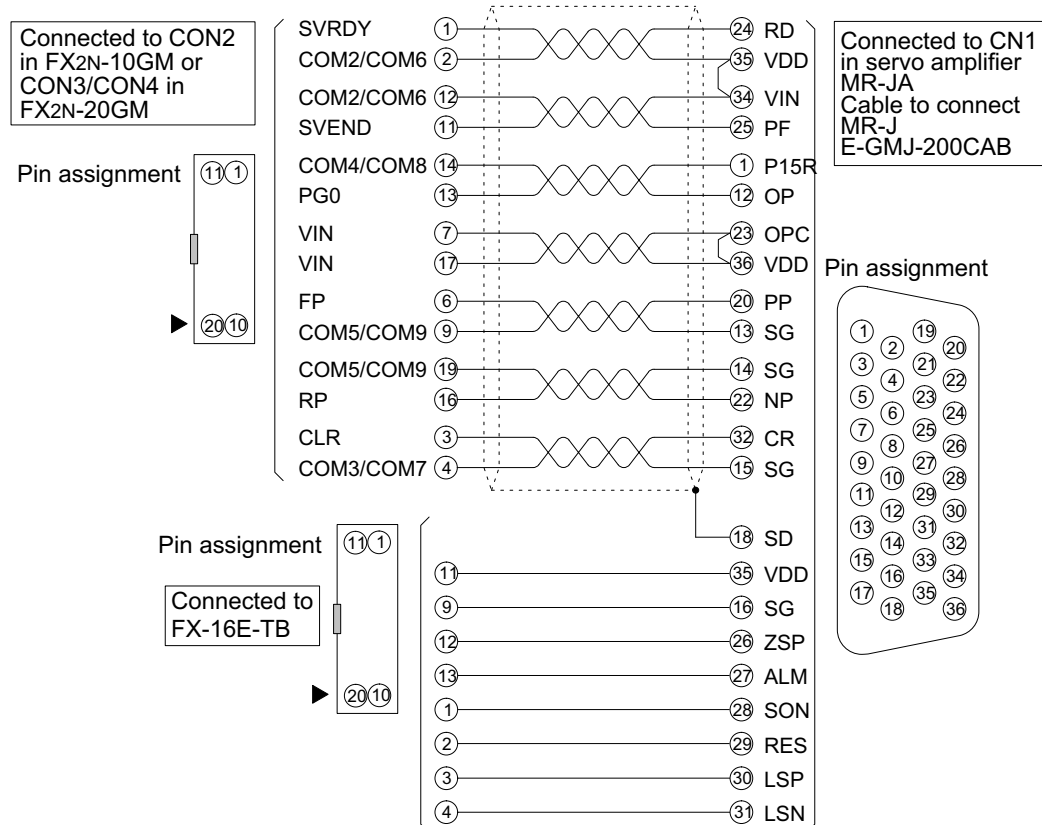
Connection cable FX-50DU-CAB0, FX-50DU-CAB0-1M, FX-50DU-CAB0-10M, FX-50DU-CAB0-20M, FX-50DU-CAB0-30M and FX-50DU-CAB0L



Cable to connect MR-C E-GMC-200CAB

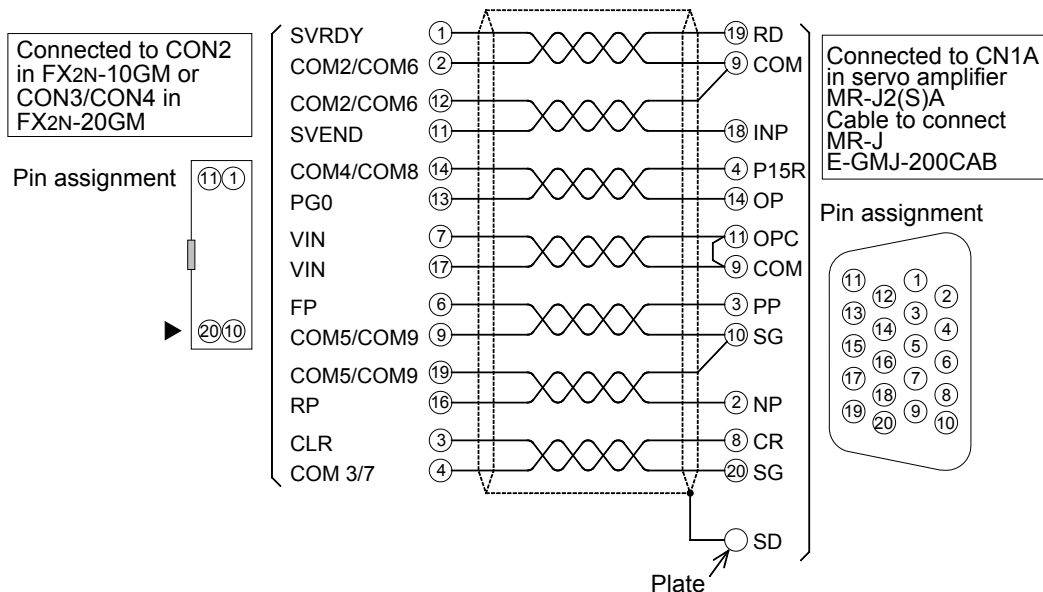


Cable to connect MR-J E-GMJ-200CAB

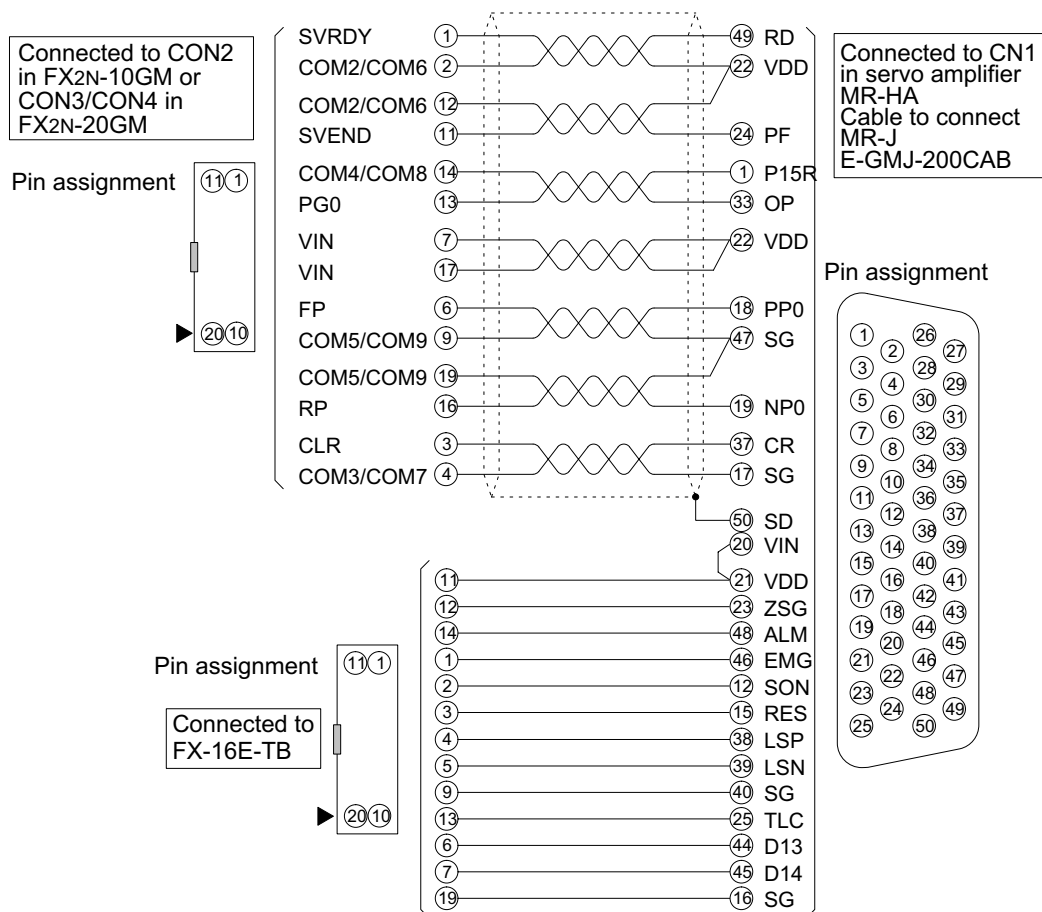


- The figures above indicate the pin assignment when the connector is seen from the side on which the positioning unit/extension block/terminal block is connected (engaged).

Cable to connect MR-J2(S) E-GMJ2-200CAB1A

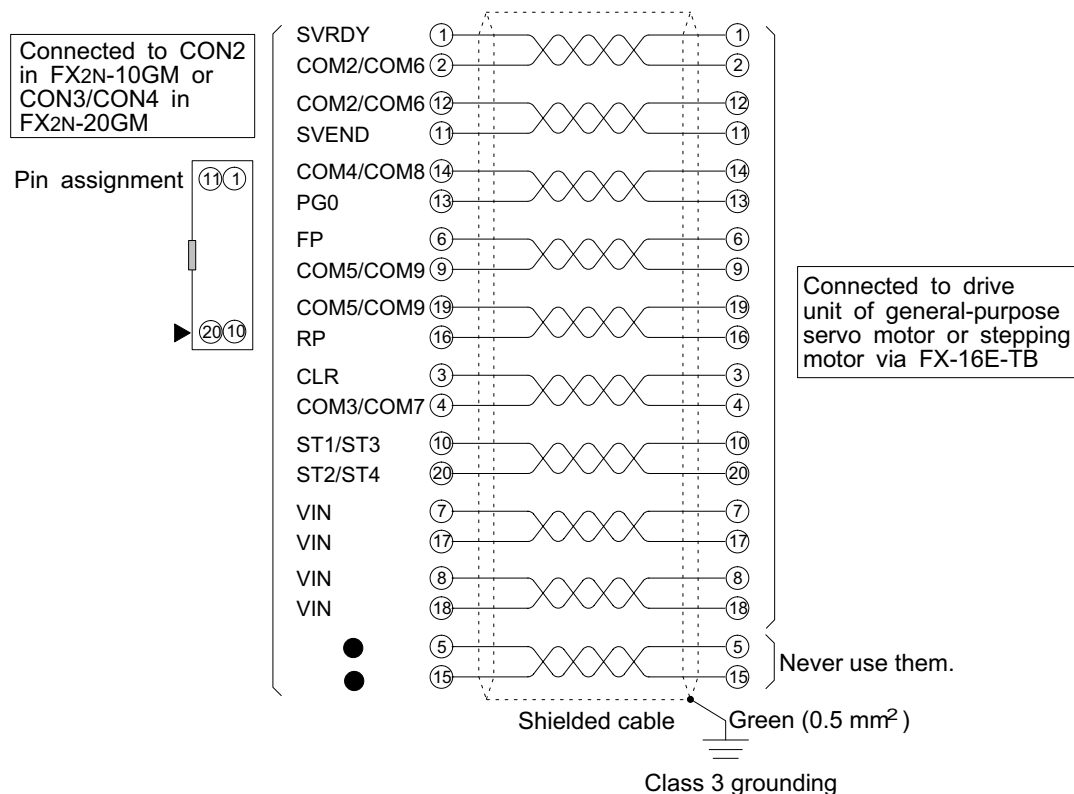


Cable to connect MR-H E-GMH-200CAB

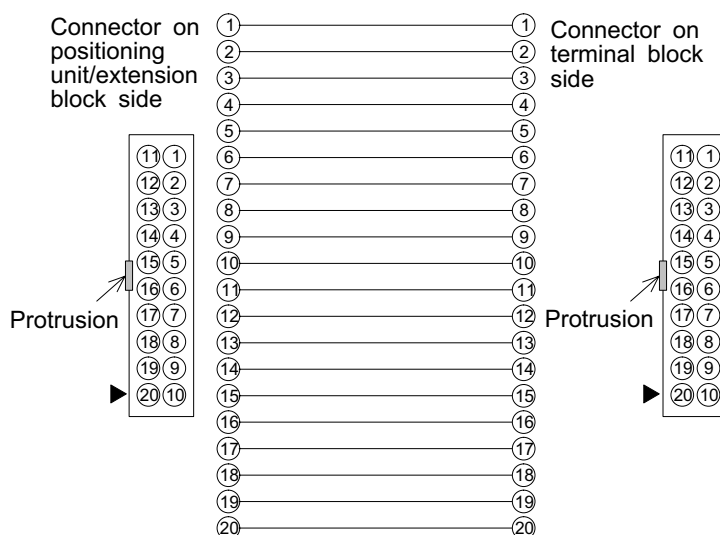


- The figures above indicate the pin assignment when the connector is seen from the side on which the positioning unit/extension block/terminal block is connected (engaged).

Cable to connect general-purpose drive unit E-GM-200CAB

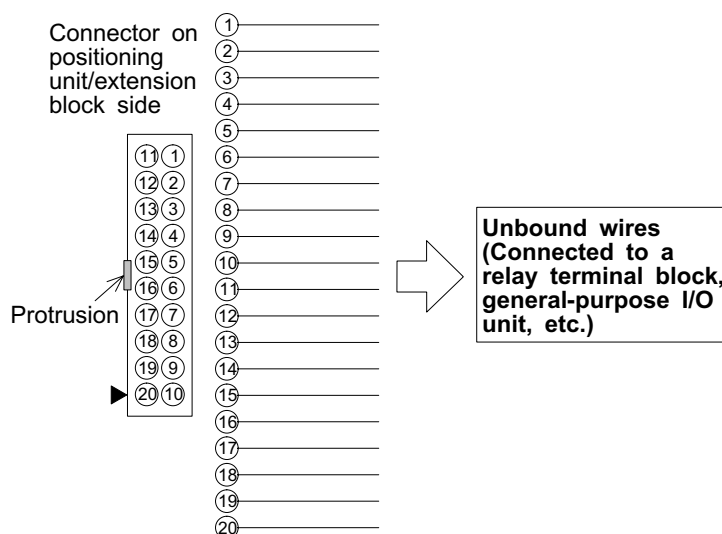


I/O cables FX-16E-150CAB, FX-16E-300CAB, FX-16E-500CAB, FX-16E-150CAB-R, FX-16E-300CAB-R, FX-16E-500CAB-R



- The figures above indicate the pin assignment when the connector is seen from the side on which the positioning unit/extension block/terminal block is connected (engaged).

I/O cable FX-16E-500CAB-S



- The figure above indicates the pin assignment when the connector is seen from the side on which the positioning unit/extension block is connected (engaged).

Creation of I/O cable

We offer set parts of connectors for flat cables and unbound wires so that you can create I/O cables by yourself.

Electric wires and crimp tools are to be prepared by you.

Table 1.5: Creation of I/O cable

Model name and configuration of I/O connector		Applicable electric wire and tool ^{*1}	
Model name in Mitsubishi	Included parts (manufactured by Daiichi Denshi)	Electric wire size	Crimp tool (manufactured by Daiichi Denshi)
FX2C-I/O-CON for flat cable (10 connectors)	Crimp connector FRC2-A020-30S	AWG28 (0.1 mm ²), 1.27 pitch, 20-core	Main body 357J-4674D Attachment 357J-4664N
FX2C-I/O-CON-S for unbound wire (5 sets)	Housing HU-200S2-001 Crimp contact HU-411S	AWG22 (0.3 mm ²)	357J-5538
FX2C-I/O-CON-SA for unbound wire (5 sets)	Housing HU-200S2-001 Crimp contact HU-411SA	AWG20 (0.5 mm ²)	357J-13963

^{*1} When using unbound wires, you may not be able to smoothly insert them into a housing due to dispersion in the sheath thickness. We recommend wires UL-1061.

The Pin numbers or the "▲" mark printed on these products do not correspond to the pin array of the connector on the FX2N-10GM, FX2N-20GM.

1.7 Terminal Block

A terminal block converts the I/O area of a positioning unit or a connector type extension block from a connector into a terminal block.

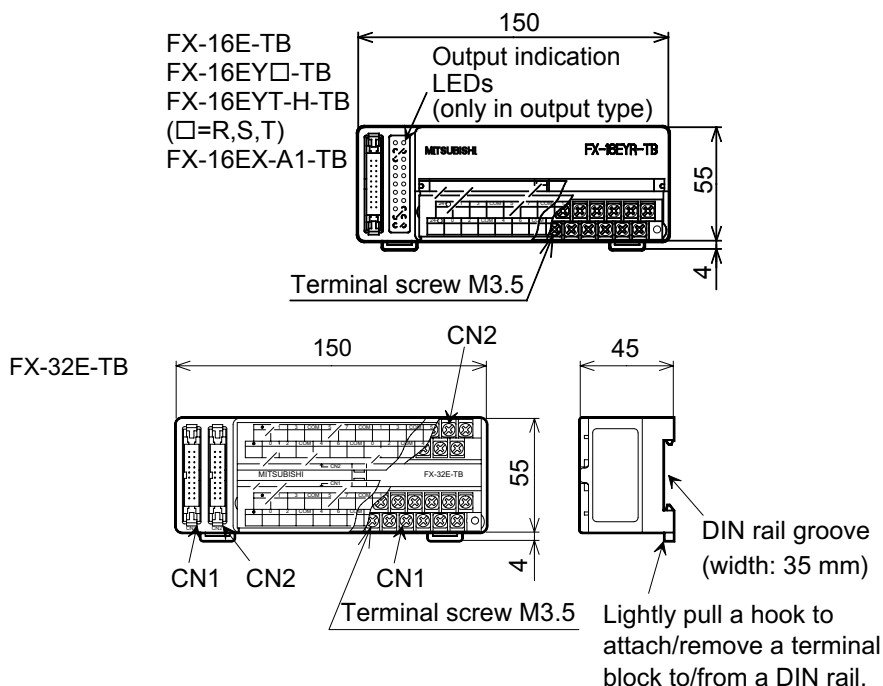
The following terminal blocks are available.

- FX-16E-TB : For both input and output, 16 points, can be connected to positioning unit and extension block
- FX-32E-TB : For both input and output, 32 points, can be connected to positioning unit and extension block
- FX-16EX-A1-TB : For only AC input, 16 points, can be connected to extension block (cannot be connected to positioning unit)
- FX-16EY□-TB (□ = R, S or T) : For only output, 16 points, can be connected to extension block (cannot be connected to positioning unit)
- FX-16EYT-H-TB : For only output, 16 points, can be connected to extension block (cannot be connected to positioning unit)

You can use a terminal block for only AC input or for only output to convert a connector type extension block connected to the FX_{2N}-20GM into a terminal block. Have in mind that you cannot connect such a terminal block to the I/O area of the positioning unit.

For the details of terminal blocks, refer to an instruction manual offered together with each terminal block.

1.7.1 Outside dimensions



1.7.2 I/O specifications of terminal block (AC input type)

Table 1.6: I/O specifications of terminal block (AC input type)

Model	FX-16EX-A1-TB (AC input type)
Input signal voltage	100 to 120V AC+10%-15%, 50/60 Hz
Input signal current	6.2 mA / 110V AC, 60 Hz or 4.7 mA / 100V AC, 50 Hz
Input ON current	3.8 mA / 80V AC
Input OFF current	1.7 mA / 30V AC
Response time	25 to 30 ms (Intake at high speed is not possible.)
Input signal type	Contact with voltage
Circuit insulation	Photocoupler insulation
Input operation indication	No input LED (Only 24 V power LED is provided.)
Input impedance	Approx. 21 K Ω / 50 Hz or 18 K Ω / 60 Hz
Current consumption	3 mA / 24V DC at each point

1.7.3 Output specifications of terminal block

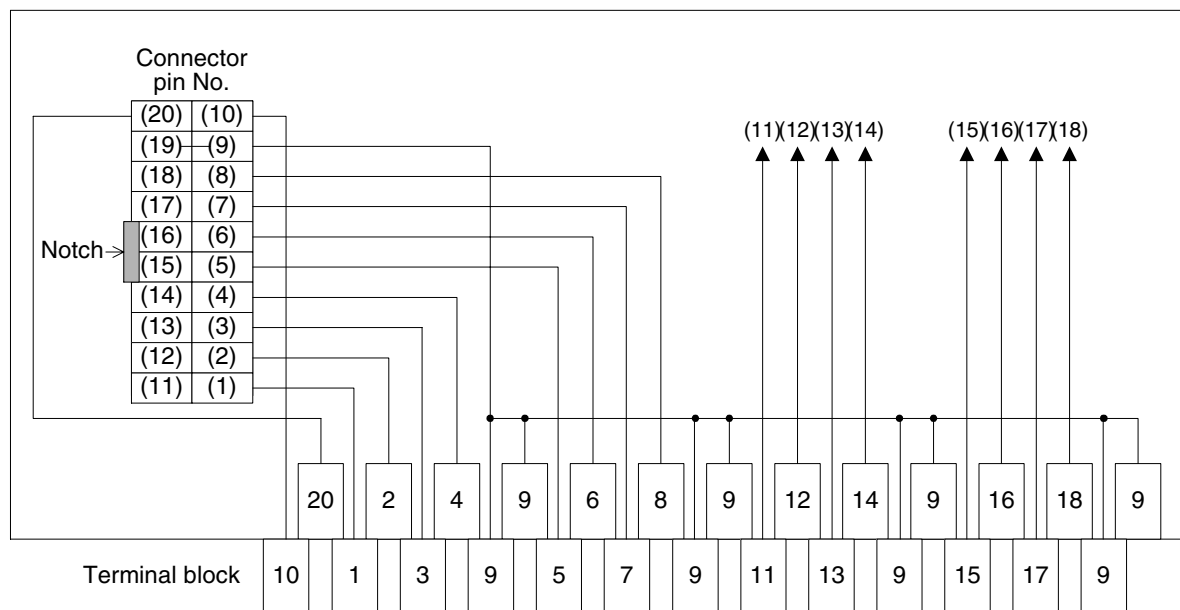
Table 1.7: Output specifications of terminal block

Model		FX-16EYR-TB (relay output)	FX-16EYS-TB (TRIAC output)	FX-16EYT-TB (transistor output)	FX-16EYT-H-TB (transistor output)
Load voltage		250V AC / 30V DC or less	85V AC to 242V AC	5V DC to 30V DC	5V DC to 30V DC
Circuit insulation		Mechanical insulation	Photothyristor insulation	Photocoupler insulation	Photocoupler insulation
Operation indication		While power is supplied to relay coil, LED is lit.	While power is supplied to photothyristor, LED is lit.	While power is supplied to photocoupler, LED is lit.	While power is supplied to photocoupler, LED is lit.
Maximum load	Resistance load	2 A / point 8 A / 4 points	0.3 A / point 0.8 A / 4 points	0.5 A / point 0.8 A / 4 points	1 A / point 3 A / 4 points
	Inductive load	80 VA	15VA / 100V AC 30VA / 200V AC	12W / 24V DC	24W / 24V DC
	Ramp load	100W	30W	1.5W / 24V DC	3W / 24V DC
Closed circuit leak current		—	1mA / 100V AC 2mA / 200V AC	0.1mA / 30V DC	0.1mA / 30V DC
Minimum load		5 VDC, 2 mA (reference values)	0.4VA / 100V AC 1.6VA / 200V AC	—	—
Response time	OFF→ON	Approx. 10 ms	2 ms or less	0.2 ms or less	0.3 ms or less
	ON→OFF	Approx. 10 ms	12 ms or less	1.5 ms or less	4 ms or less
Input signal current		5mA / 24V DC at each point (current consumption)	7mA / 24V DC at each point (current consumption)	7mA / 24V DC at each point (current consumption)	7mA / 24V DC at each point (current consumption)

Other general specifications are equivalent to those of the positioning unit.

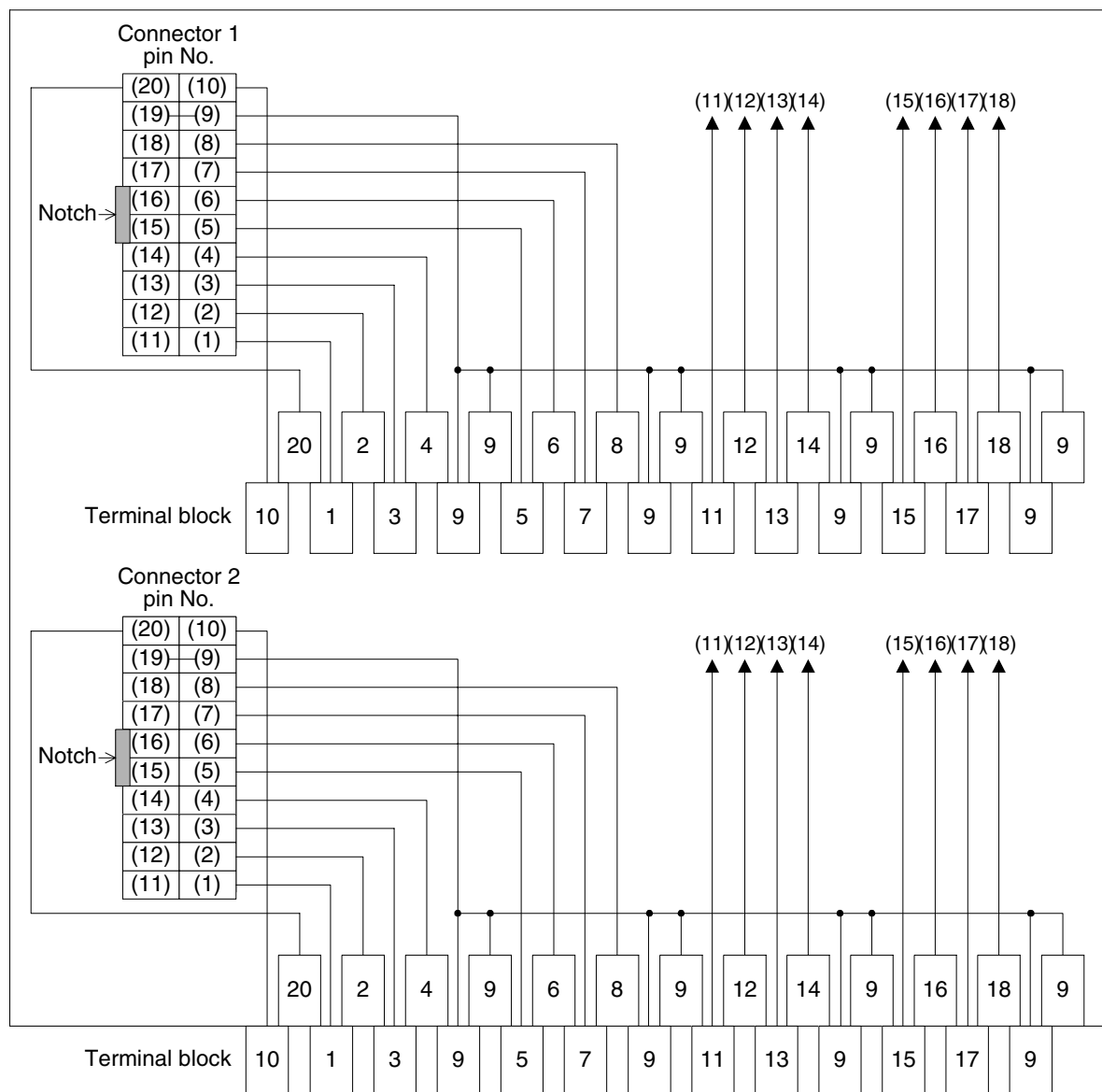
1.7.4 Internal connection diagram of terminal block

FX-16E-TB



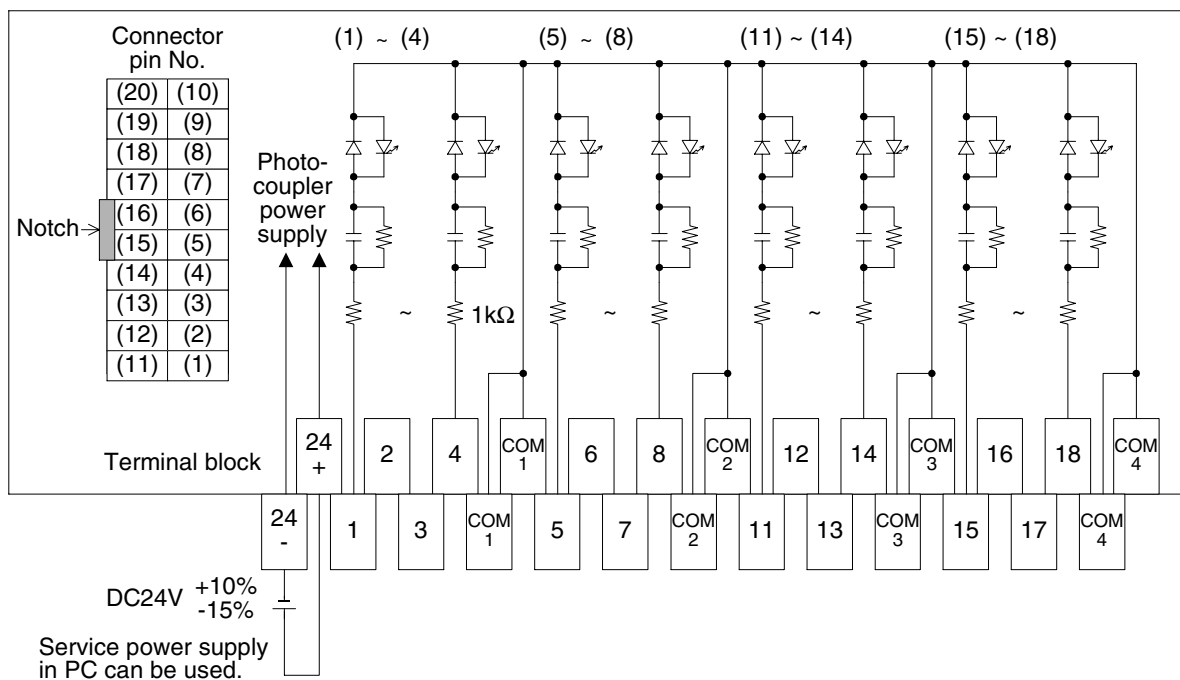
- (9) and (19) of the connector are short-circuited internally.

FX-32E-TB

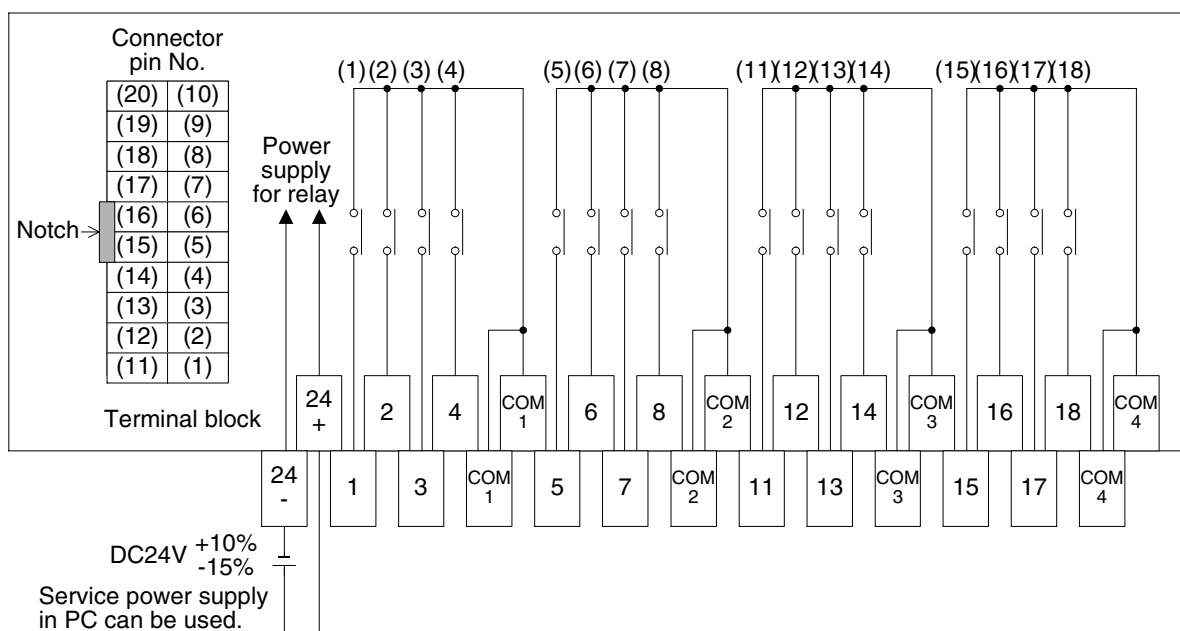


- (9) and (19) of both connectors 1 and 2 are short-circuited internally.

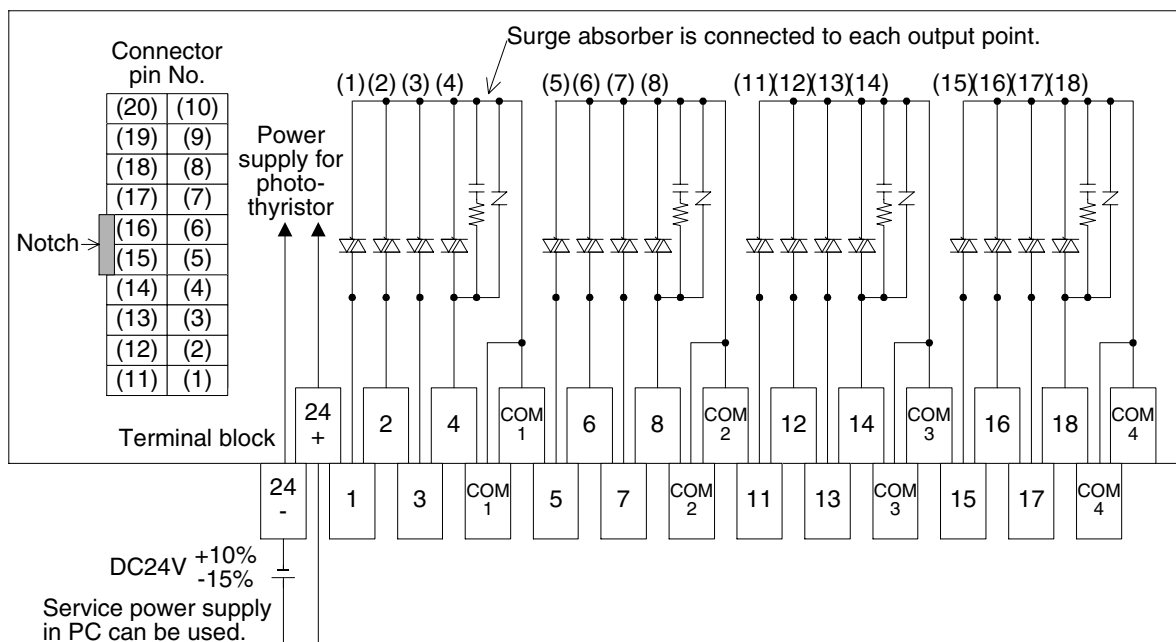
FX-16EX-A1-TB



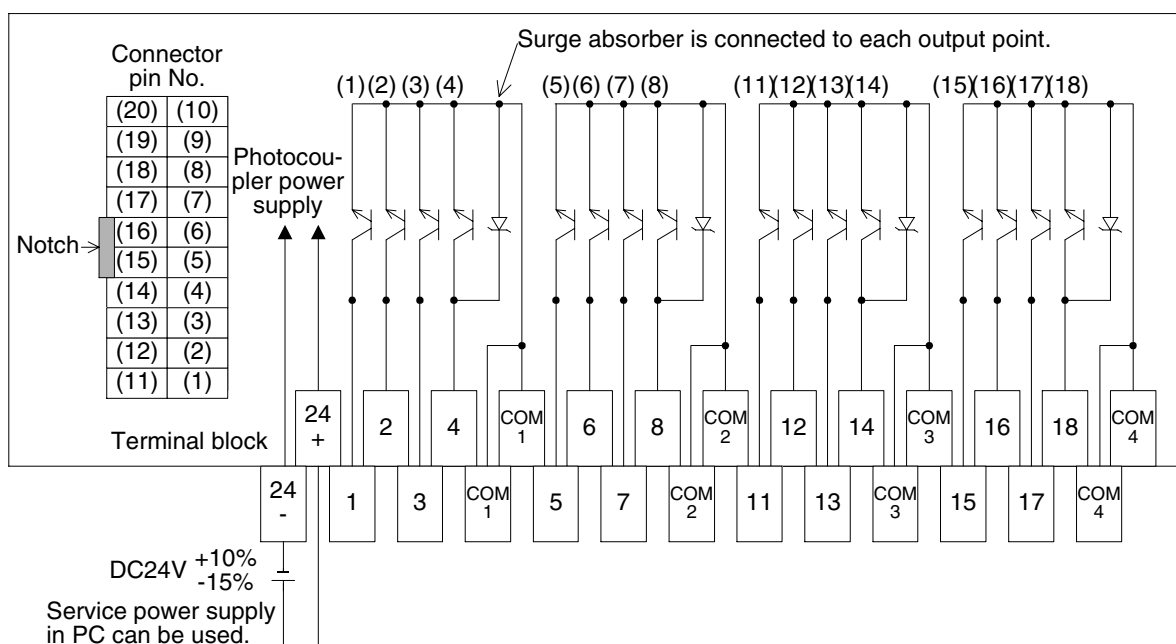
FX-16EYR-TB



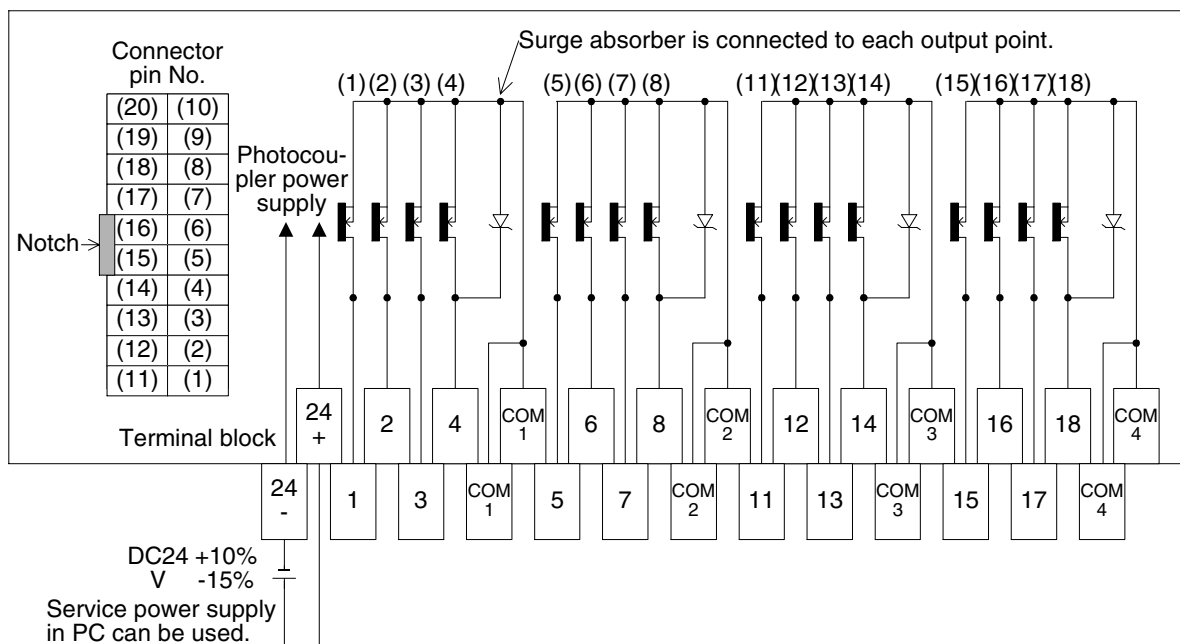
FX-16EYS-TB



FX-16EYT-TB



FX-16EYT-H-TB

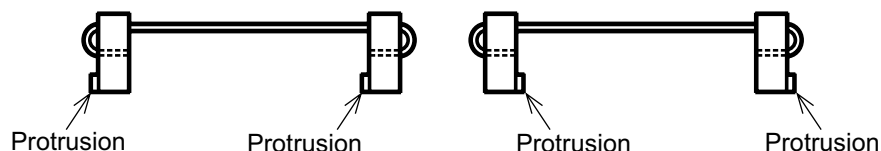


For the details of wiring, refer to an instruction manual offered together with each terminal block, the FX_{2N} Handy Manual and the FX_{2NC} Handy Manual.

1.7.5 Terminal block layout

The terminal layout in the terminal block varies depending on the connector of the connected positioning unit or extension block. Major terminal layout combinations are shown below. In any cases not shown below, assign the terminal layout while referring to "1.7.4 Internal connection diagram of terminal block".

When connecting a flat cable, make sure to align the direction of a protrusion on each connector as shown below.



CON1 in FX₂N-10GM → FX-16E-TB (connected with FX-16E-○○○CAB)

	Y05	STOP	FWD	COM1	DOG	LSR	COM1	X01	X03	COM1	Y01	Y03	COM1
Y04	START	ZRN	COM1	RVS	LSF	COM1	X00	X02	COM1	Y00	Y02	COM1	

CON1 in FX₂N-20GM → FX-16E-TB (connected with FX-16E-○○○CAB)

●	Y01	Y03	COM1	Y05	Y07	COM1	X01	X03	COM1	X05	X07	COM1
●	Y00	Y02	COM1	Y04	Y06	COM1	X00	X02	COM1	X04	X06	COM1

CON2 in FX₂N-20GM → FX-16E-TB (connected with FX-16E-○○○CAB)

●	STOP	FWD	COM1	DOG	LSR	COM1	STOP	FWD	COM1	DOG	LSR	COM1
●	START	ZRN	COM1	RVS	LSF	COM1	START	ZRN	COM1	RVS	LSF	COM1

CON2 in FX₂N-10GM or CON3 in FX₂N-20GM → FX-16E-TB (connected with E-GM-200CAB)

x	x	x	x	x	x	x	x	x	x	x	x	x
ST2	COM2	COM3	COM5	FP	VIN	COM5	COM2	COM4	COM5	RP	VIN	COM5
x	x	x	x	x	x	x	x	x	x	x	x	x
ST1	SVRDY	CLR	COM5	●	VIN	COM5	SVEND	PG0	COM5	●	VIN	COM5

CON4 in FX₂N-20GM → FX-16E-TB (connected with E-GM-200CAB)

y	y	y	y	y	y	y	y	y	y	y	y	y
ST4	COM6	COM7	COM9	FP	VIN	COM9	COM6	COM8	COM9	RP	VIN	COM9
y	y	y	y	y	y	y	y	y	y	y	y	y
ST3	SVRDY	CLR	COM9	●	VIN	COM9	SVEND	PG0	COM9	●	VIN	COM9

FX₂NC-16EX(The first) → FX-16E-TB (connected with FX-16E-○○○CAB)

	⊙	X11	X13	COM	X15	X17	COM	X21	X23	COM	X25	X27	COM
	⊙	X10	X12	COM	X14	X16	COM	X20	X22	COM	X24	X26	COM

FX₂NC-16EX(The second) → FX-16E-TB (connected with FX-16E-○○○CAB)

	●	X31	X33	COM	X35	X37	COM	X41	X43	COM	X45	X47	COM
	●	X30	X32	COM	X34	X36	COM	X40	X42	COM	X44	X46	COM

FX₂NC-16EX(The third) → FX-16E-TB (connected with FX-16E-○○○CAB)

	●	X51	X53	COM	X55	X57	COM	X61	X63	COM	X65	X67	COM
	●	X50	X52	COM	X54	X56	COM	X60	X62	COM	X64	X66	COM

FX₂NC-16EYT(The first) → FX-16E-TB (connected with FX-16E-○○○CAB)

	●	Y11	Y13	COM	Y15	Y17	COM	Y21	Y23	COM	Y25	Y27	COM
	●	Y10	Y12	COM	Y14	Y16	COM	Y20	Y22	COM	Y24	Y26	COM

FX₂NC-16EYT(The second) → FX-16E-TB (connected with FX-16E-○○○CAB)

	●	Y31	Y33	COM	Y35	Y37	COM	Y41	Y43	COM	Y45	Y47	COM
	●	Y30	Y32	COM	Y34	Y36	COM	Y40	Y42	COM	Y44	Y46	COM

FX₂NC-16EYT(The third) → FX-16E-TB (connected with FX-16E-○○○CAB)

	●	Y51	Y53	COM	Y55	Y57	COM	Y61	Y63	COM	Y65	Y67	COM
	●	Y50	Y52	COM	Y54	Y56	COM	Y60	Y62	COM	Y64	Y66	COM

CN1 of the MR-CA servo amplifier → FX-16E-TB (connected with E-GMC-200CAB)

	●	●	LSN	SG	●	●	SG	●	●	●	●	●	●
	●	SON	LSP	SG	●	●	SG	V24	ALM	●	●	●	●

CN1 of the MR-JA servo amplifier → FX-16E-TB (connected with E-GMH-200CAB)

	●	RES	LSN	SG	●	●	SG	ZSP	●	SG	●	●	SG
●	SON	LSP	SG	●	●	SG	VDD	ALM	SG	●	●	SG	

CN1 of the MR-HA servo amplifier → FX-16E-TB (connected with E-GMH-200CAB)

	●	SON	LSP	SG	DI3	●	SG	ZSP	ALM	SG	●	●	SG
●	EMG	RES	SG	LSN	DI4	SG	VDD	TLC	SG	●	●	SG	

2. Specifications

2.1 Power Supply Specifications

Table 2.1: Power Supply Specifications

Item	FX2N-10GM	FX2N-20GM
Power supply	24V DC +10%, -15%	
Allowance power failure time	The operation is continued if the momentary power failure is 5ms or less.	
Power consumption	5W	10W
Fuse	125V 1A	

2.2 General Specifications

Table 2.2: General Specifications

Item	Contents
Ambient temperature	0 to 55 °C (operation). -20 to 70 °C (storage).
Surrounding humidity	35 to 85% (No condensation) operation
Vibration resistance	Frequency 10 to 57Hz : Half 0.035mm amplitude, Frequency 57 to 150Hz: 4.9 m/s ² Acceleration Sweep count for X,Y,Z: 10 times (80 min in each direction).
Shock resistance	147m/s ² acceleration, Action time: 11ms. 3 times in each direction X, Y, Z.
Noise immunity	1,000Vp-p, 1μs. 30 to 100Hz, tested by noise simulator.
Dielectric withstand voltage	500V AC > 1 min, tested between all points, terminal and ground.
Insulation resistance	5MΩ > 500V DC, tested between all points, terminal and ground
Ground	Grounding resistance 100Ω or less
Use atmosphere	Ambient conditions to be free of corrosive gases. Dust should be minimal.
Working altitude	<2000m*1

*1 Do not use the PLC under pressure higher than the atmospheric pressure. Doing so may damage the PLC.

2.3 Performance Specifications

Table 2.3: Performance Specifications

Item	FX2N-10GM	FX2N-20GM
Number of control axes	One axes	Two axes (two axes or two independent axes simultaneously)
Application PLC	Bus connection with FX2N, FX3U, FX2NC and the FX3UC series PLC. The number of I/O points occupied is 8 points. When connecting to an FX2NC PLC, the FX2NC-CNV-IF must be used. When connecting to an FX3UC PLC, the FX2NC-CNV-IF or FX3UC-1PS-5V must be used.	
Program memory	Built-in EEPROM (3.8 k steps). Allocated rewrite able frequency: 10000 times (The memory of the option cannot be used.)	Built in RAM (7.8 k steps). Optional memory board: FX2NC-EEPROM-16 (7.8 k steps). The memory board with the clock function cannot be used.

Table 2.3: Performance Specifications

Item		FX2N-10GM	FX2N-20GM
Battery		Nobattery included.	With built-in FX2NC-32BL type lithium battery. Longevity and about three years.
Positioning unit		Command units: mm, deg, inch, pls, (relativity/absolutely) Max command value $\pm 999,999$ (32 bits when indirectly specifying)	
Accumulation address		-2,147,483,648 to 2,147,483,647 pulses	
Speed instruction		200kHz max., 153,000cm/min (200kHz or less). Automatic trapezoidal pattern acceleration/deceleration (The interpolation drive is 100kHz or less).	
Zero return		Manual operation or automatic operation. The DOG type machine zero return (The DOG search function is provided). An automatic electric zero return is possible by the electric starting point setting.	
Absolute position detection		The absolute position detection is possible with MR-J2, MR-J2S, MR-J3 and the MR-H type servo motor with the ABS detection function.	
Control inputs		Operation system: FWD (manual forwarding), RVS (manual reversal) ZRN (machine zero return), START (automatic start), STOP, Manual pulse generator (2kHz max), Single-step operation input (Depends upon the parameter setting). Mechanical system: DOG (near-point signal), LSF (forward rotation limit), LSR (reverse rotation limit), Interrupt: 4 points Servo system: SVRDY (servo ready), SVEND (servo end), PG0 (zero-point signal)	
		General purpose: The main body has X0 to X3.	General purpose: The main body has X0 to X7. X10 to X67 can be input by using the extension block. (max I/O point: 48 points)
Control outputs		Servo system: FP (forward rotation pulse). RP (reverse rotation pulse), CLR (counter clear).	
		General purpose: The main body has Y0 to Y5.	General purpose: The main body has Y0 to Y7. Y10 to Y67 can be output by using the extension block. (max I/O point: 48 points)
Control method		Program method: The program is written in the FX2N-10GM by a special programming tool, and the positioning control is done. Table method : When the PLC is used together, the positioning control is done by the FROM/TO instruction.	Program method: The program is written in the FX2N-20GM by a special programming tool, and the positioning control is done.
Program No.		Ox00 to Ox99 (Positioning program), O100 (sub-task program)	O00 to O99 (two axes simultaneously), Ox00 to Ox99 and Oy00 to Oy99 (two independent axes), O100 (sub-task program)
Instruc- tion	Positioning	Cod No. system (used with instruction cods). 13 kinds.	Cod No. system (used with instruction cods)-19 types.
	Sequence	LD, LDI, AND, ANI, OR, ORI, ANB, ORB, SET, RST and NOP.	
	Application	FNC number system-29 types.	FNC number system-30 types.

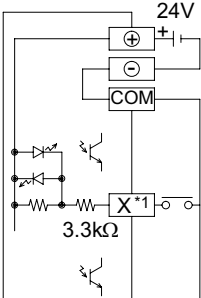
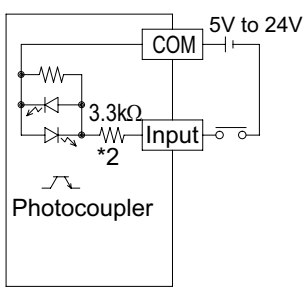
Table 2.3: Performance Specifications

Item	FX2N-10GM	FX2N-20GM
Parameter	System setting-9 types. Positioning-27 types. I/O Control-18 types.	System setting-12 types. Positioning-27 types. I/O Control-19 types.
	Settings in the program can be changed by using a special data register (The system settings are excluded)	
m cods	m00: Program stop (WAIT), m02: (End of positioning program), m01 and m03 to m99 can be arbitrarily used. (AFTER mode and WITH mode) m100 (WAIT) and m102 (END) are used by a sub-task.	
Device	Inputs: X0 to X3, X375 to X377 Outputs: Y0 to Y5, Supplementary relay: M0 to M511 (general purpose), M9000 to M9175 (special) Pointer: P0 to P127 Data register: D0 to D1999 (general purpose) (16 bits) D4000 to D6999 (file register and latched relays)* D9000 to D9599 (special) Index: V0 to V7 (16 bits), Z0 to Z7 (32 bits)	Inputs: X0 to X67, X372 to X377 Outputs: Y0 to Y67, Supplementary relay: M0 to M99 (general purpose), M100 to M511 (general purpose and battery backup area)*, M9000 to M9175 (special)*, Pointer: P0 to P255, Data register: D0 to D99 (general purpose), D100 to D3999 (general purpose and battery backup area)* (16 bits), D4000 to D6999 (file register and battery backup area)* D9000 to D9599 (special) Index: V0 to V7 (16 bits), Z0 to Z7 (32 bits)
Self-diagnosis	"Parameter error", "Program error", and "External error" can be diagnosed by the display and the error code.	

* Battery backup area (In FX2N-10GM, data is held by EEPROM against power interruption.)
The number of used file registers should be set in PARA. 101.

2.4 Input Specification

Table 2.4: Input Specification

Item		Input from general-purpose equipment	Input from drive unit
Input signal name	Group 1	START, STOP, ZRN, FWD, RVS, LSF, LSR	SVRDY, SVEND
	Group 2	DOG	PG0 ^{*1}
	Group 3	General-purpose input: X00 to X03 (FX2N-10GM) X00 to X07 (FX2N-20GM) Interruption input: X00 to X03 (FX2N-10GM)	—
	Group 4	Manual pulse generator: (FX2N-10GM, FX2N-20GM) Interruption input: X00 to X07 (FX2N-20GM)	—
Output circuit configuration			
Circuit insulation		By photocoupler	By photocoupler
Operation indication		LED is lit while input is ON	LED is lit while input is ON
Signal voltage		24V DC \pm 10% (internal power supply)	5 to 24V DC \pm 10%
Input current		7mA/24V DC	7mA/24V DC (PG0 11.5mA/24V DC)
Input ON current		4.5mA or more	0.7mA or more (PG0 1.5mA or more)
Input OFF current		1.5mA or less	0.3mA or less (PG0 0.5mA or less)
Signal format		Contact input or NPN open collector transistor input.	
Response time	Group 1	Approx. 3msec	Approx. 3msec
	Group 2	Approx. 0.5msec	Approx. 50 μ s
	Group 3	Approx. 3msec ^{*2}	—
	Group 4	Approx. 0.1msec ^{*2}	—
Turning ON rate of I/O simultaneously		50% or less (FX2N-20GM)	

^{*1} In the case of a stepping motor, short-circuit the terminals ST1 and ST2 to change the resistance from 3.3 k Ω to 1 k Ω .

^{*2} The positioning unit automatically judges the target (general-purpose input, manual pulse generator input or interrupt input) based on parameters and programs, and automatically changes the filter constant. (Interrupt inputs are available only in the FX2N-20GM.)
The maximum response frequency of the manual pulse generator is 2 kHz.

Each signal fetch timing

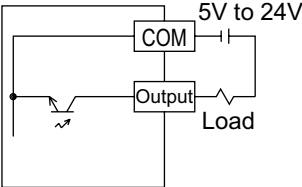
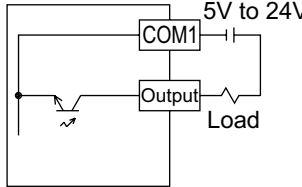
Table 2.5: Each signal fetch timing

Input signals	MANU mode		AUTO mode	
	Motor stopped	Motor running	Motor stopped	Motor running
SVRDY	Before drive.	Continuously monitored	Before drive.	Continuously monitored
SVEND	After drive.	—	After drive.	—
PGO	—	After near-point DOG actuation.	—	After near-point DOG actuation.
DOG	Before zero return drive.	During zero return operation	Before zero return drive.	During zero return operation
START	—	—	During READY status	—
STOP	Continuously monitored			
ZRN	Continuously monitored	—	During standby after END step.	—
FWD, RVS (JOG+, JOG-)	Continuously monitored		During standby after END step.	
LSF, LSR	Before drive.	Continuously monitored	Before drive.	Continuously monitored
X00 to X07	When the manual pulse generator is operating		When the manual pulse generator is operating, During standby after END step.	During execution of INT, SINT, DINT instructions.
General purpose inputs	—		When the corresponding instruction is executed.	
Inputs specified by parameters.	—		Continuously monitored.	

The special auxiliary relays for command inputs are also continuously monitored in the AUTO mode.

2.5 Output Specification

Table 2.6: Output Specification

Item	General-purpose output	Output to drive unit
Signal name	Y00 to Y05 (FX ₂ N-10GM) Y00 to Y07 (FX ₂ N-20GM)	FP, RP, CLR
Output circuit configuration		
Circuit isolation	By photocoupler	
Operation indication	LED is lit while output is ON	
External power supply	5 to 24V DC \pm 10%	
Load current	50mA or less	20mA or less
Open circuit leak current	0.1mA/24V DC or less	
Output ON voltage	0.5V max (CLR is 1.5V max.)	
Response time	0.2ms max. for both OFF \rightarrow ON and ON \rightarrow OFF.	Pulse output FP RP is 200kHz max. Pulse output width of the CLR signal: Approx. 20msec.
Turning ON rate of I/O simultaneously	50% or less (FX ₂ N-20GM)	

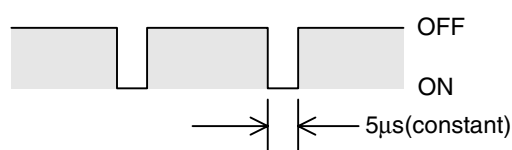
Pulse output waveforms

The following types of pulse waveforms are output to a drive unit.

You do not have to set the pulse output waveform using parameters. The pulse output waveform automatically changes in accordance with the practical frequency.

1) In the case of interpolation drive instructions (FX₂N-20GM)

When a simultaneous 2-axis drive instruction (cod 01/02/03/31) is given, the following waveform is acquired at the operation frequency of 1 to 100 kHz.



2) In the case of other drive instructions

- When the maximum speed (pulse conversion value of PARA. 4) in the FX₂N-20GM is 1 to 100 kHz, the ON/OFF ratio is 50%/50%.
- When the maximum speed (pulse conversion value of PARA. 4) in the FX₂N-20GM is 100,001 to 200 kHz, the ON period is fixed to 2.5 μ s. Accordingly, the ON period becomes equivalent to the OFF period at 200 kHz.
Blinking output LED(FP,RP) might not be able to check because the turning on time is short.
- When the operation frequency in the FX₂N-10GM is 1 to 200 kHz, the ON/OFF ratio is 50%/50%.

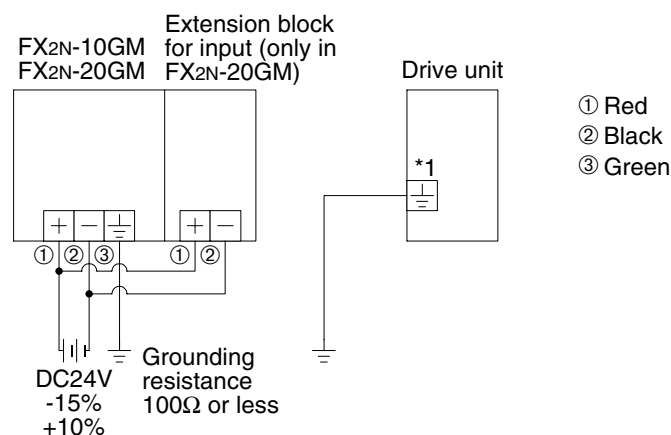
3. Wiring

This section describes the wiring related to the positioning unit.

After finishing wiring, it is recommended to check the wiring by JOG operation before writing a program. (At this time, set the positioning unit to the MANU mode. The JOG speed is determined by the setting of PARA. 5.) (Refer to Paragraph 4.3.1.)

3.1 Wiring of Power Supply


When independently using the positioning unit



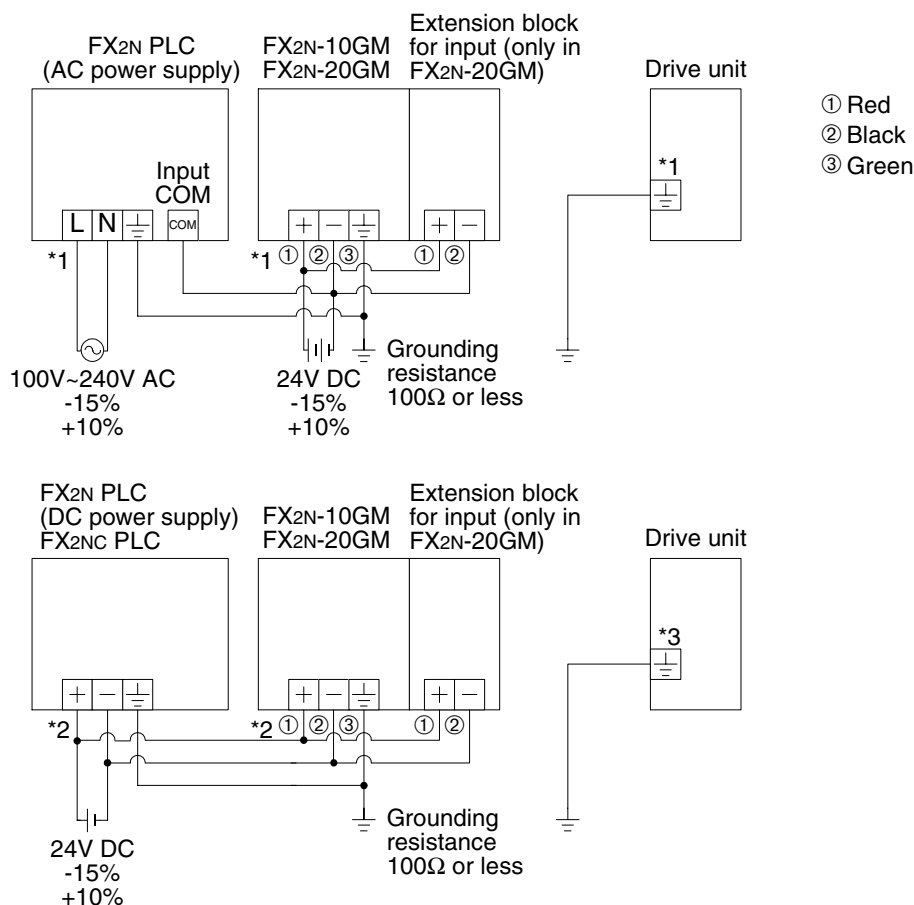
*1 The name is different such as \square , \square FG and \square PE in each drive unit.

- Use the FX₂NC-100MPCB attachment for power supply wiring of the FX₂N-10GM and FX₂N-20GM units.
- Use the FX₂NC-100BPCB (attached to FX₂N-20GM) for the first input extension block (nearest FX₂N-20GM) when connecting the input extension block for the FX₂NC series PLC with the FX₂N-20GM unit.
- Connect between each input extension blocks by the cross wiring the FX₂NC-10BPCB1 (attached to the input extension block) when connecting two input extension blocks or more.
- Perform common grounding to \square in the positioning unit and \square in the drive unit.



- 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.
- Connect the power cable of the FX_{2N}-10GM/20GM to a dedicated connector as described in this manual.
If the AC power supply is connected to a DC I/O terminal or DC power terminal, the PLC may be burnt.
- Never connect a cable of an external unit to a spare terminal  in the FX_{2N}-10GM/20GM.
Such wiring may damage the unit.
- Perform grounding resistance of 100Ω or less with an electric wire of 2 mm² or more to the ground terminal in the positioning unit. However, never perform common grounding with a strong power system.
- 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.
- Correctly connect a battery for memory backup in the FX_{2N}-20GM. Never charge, disassemble, heat, throw into flame or short-circuit the battery. Such an action may cause bursting or fire.

When connecting the positioning unit to the PLC



*1 Supply power to the positioning unit (FX2N-10GM, FX2N-20GM) and extension block before or at the same time the PLC is powered.
The power supplies may be cut at the same time after ensuring system safety.

*2 It is recommended to use the same power source to power the PLC, positioning unit (FX2N-10GM, FX2N-20GM) and extension block.
If two sources are required follow the guidelines in *1.

*3 The name is different such as $\frac{+}{-}$, $\frac{FG}{PE}$ and $\frac{PE}{PE}$ in each drive unit.

- Use the FX2NC-100MPCB attachment for power supply wiring of the FX2N-10GM and FX2N-20GM units.
- Use the FX2NC-100BPCB (attached to FX2N-20GM) for the first input extension block (nearest FX2N-20GM) when connecting the input extension block for the FX2NC series PLC with the FX2N-20GM unit.
- Connect between each input extension blocks by the cross wiring the FX2NC-10BPCB1 (attached to the input extension block) when connecting two input extension blocks or more.
- Perform common grounding to $\frac{+}{-}$ in the positioning unit and $\frac{FG}{PE}$ in the drive unit.
- When power is separately supplied from another power supply to each of the PLC, perform common grounding to $\frac{+}{-}$ in the PLC and $\frac{FG}{PE}$ in the positioning unit, and connect "24-" in each power supply.
At this time, connect an input common terminal in the AC type PLC, or connect "24-" in the DC type PLC.

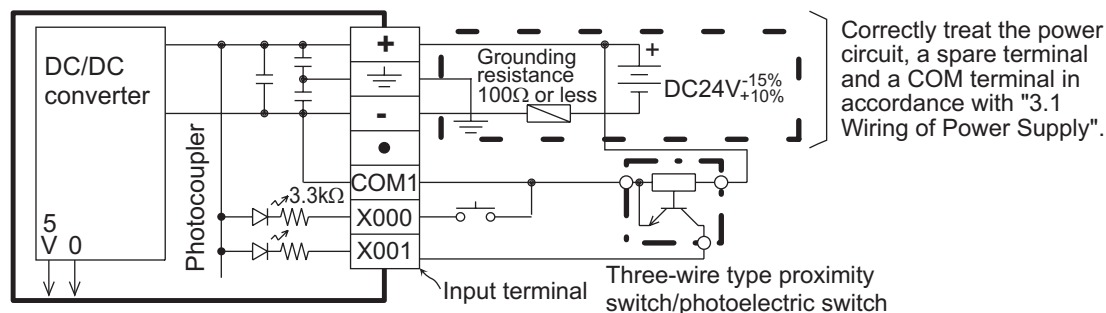


- Make sure to shut down the power supplies of all phases on the outside before starting installation or wiring.
If the power supplies are not shut down, you may get electrical shock or the unit may be damaged.
- When the programmable controller is used, refer to the hardware manual of the programmable controller and perform correct wiring.
- When the 24V DC of the FX_{2N}-10GM is not supplied from the programmable controller, refer to "When the FX_{2N}-10GM operates independently" on the previous page.
- For the number of extension blocks connected after the FX-10GM, refer to Section 1.4.5.
- 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.

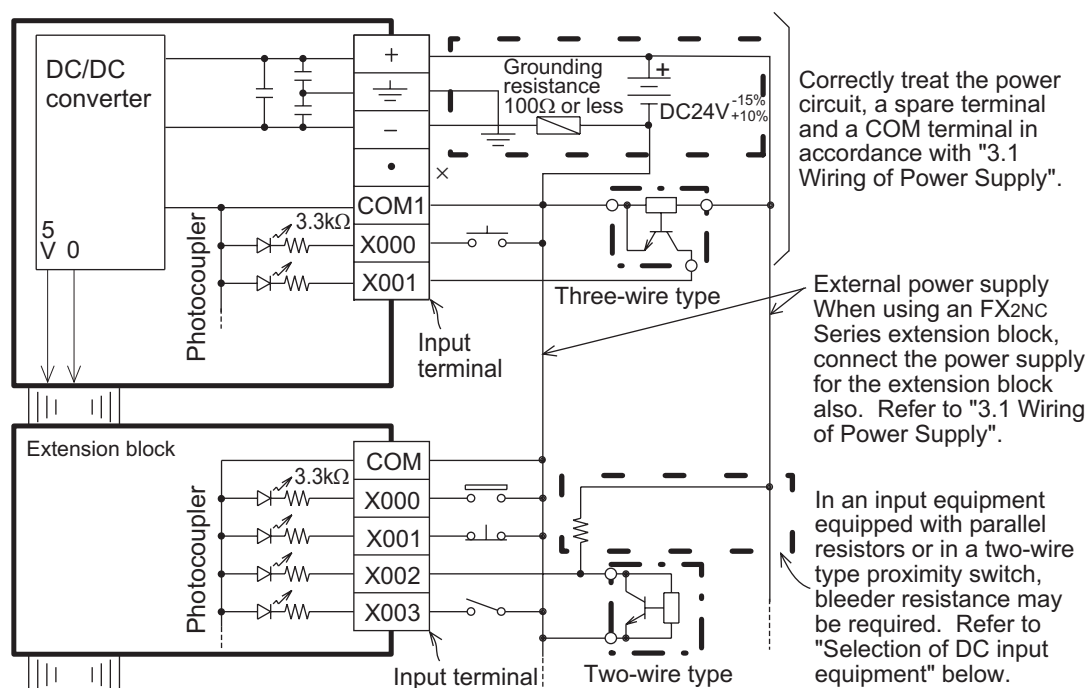
3.2 Wiring of I/O

3.2.1 Example of wiring of input

FX2N-10GM



FX2N-20GM



- **Input circuit**
When an input terminal and a COM terminal are connected with no-voltage contact or NPN open collector transistor, the input turns on. Two or more input COM terminals are connected inside the PLC.
- **Operation indication**
While input is turned on, the input indicator LED is lit.
- **Circuit insulation**
The primary circuit and the secondary circuit of input are insulated by photocouplers, and a C-R filter is provided in the secondary circuit to prevent malfunction caused by chattering in input contacts or invasion of noise from input lines.

- **Input sensitivity**
The input current of the positioning unit is 24V DC, 7 mA. However, in order to securely turn on the positioning unit, the input current should be 4.5 mA or more. In order to securely turn off the positioning unit, the input current should be 1.5 mA or less. Accordingly, if series diodes or resistors are present in input contacts (which hinder complete ON) or if parallel resistors or leak current is present in input contacts (which hinder complete OFF), you should select input equipment with rigid care.
- **Selection of DC input equipment**
The input current of the positioning unit is 24V DC, 7 mA. Select small input equipment suitable to such weak current.



- Install a safety circuit outside the PLC so that the entire system conservatively operates even if an abnormality occurs in the external power supply or a failure occurs in the PLC. If the safety circuit is installed inside the PLC, malfunction and erroneous output may cause accidents.
 - 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 PLC.
 - 2) When the CPU in the positioning unit 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 PLC, output control may be disabled.
Design external circuits and the structure so that the entire system conservatively operates in such cases.
 - 3) When a failure occurs in a relay, transistor, TRIAC, etc. in the output unit, 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.
- All general purpose input of the GM unit are configured as SINK inputs.
- 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.

Selecting DC input device

Example: Following products manufactured by OMRON

Micro switch: Z, V, D2RV

Proximity switch: TL, E2M

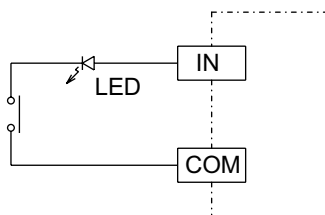
Operation switch: A3P

Photoelectric switch: E3S, E3N

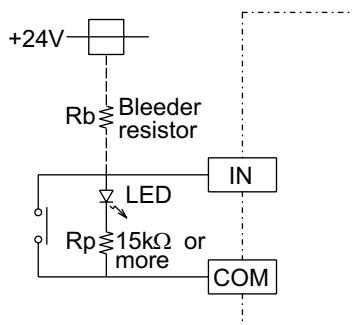
Imperfect contact may occur when a switch for large current is used.

Input device with diodes connected in series

Make sure that the voltage drop of the diodes connected in series is approximately 4 V or less. Accordingly, in the case of a lead switch with LEDs connected in series, two or less LEDs can be connected in series.



Input device with resistors connected in parallel or two-wired proximity switches.



Make sure that the parallel resistance R_p is 15 k Ω or more.

When R_p is less than 15 k Ω , connect a bleeder resistor R_b satisfying the following formula between the [24+] and [IN] terminals.

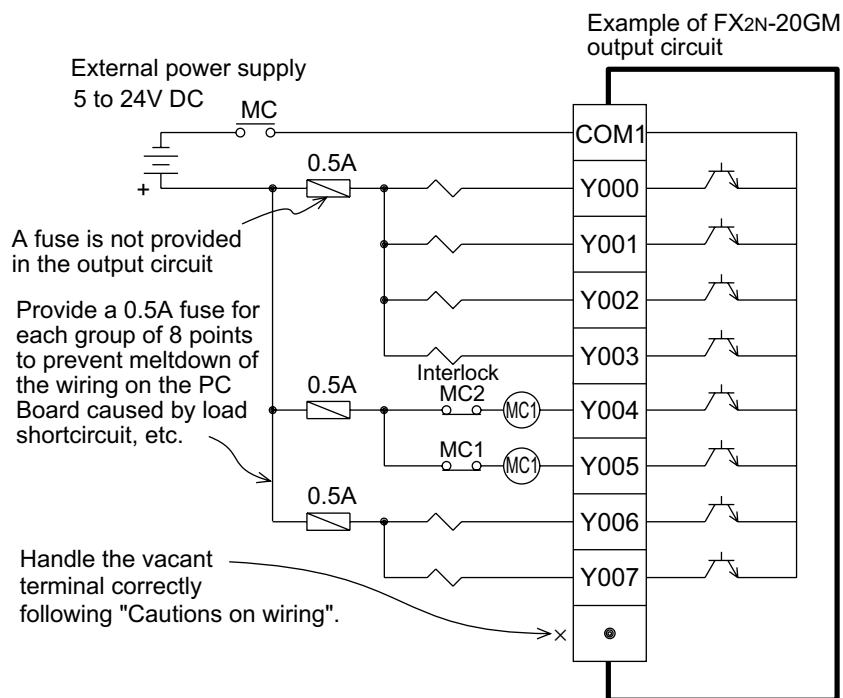
$$R_b \leq \frac{4R_p}{15-R_p} \text{ (k}\Omega\text{)}$$

Make sure that the leak current I_l is 1.5 mA or less when the two-wired proximity switch is turned OFF.

When I exceeds 1.5 mA, connect a bleeder resistor R_b satisfying the following formula in the same way.

$$R_b \leq \frac{6}{I_l - 1.5} \text{ (k}\Omega\text{)}$$

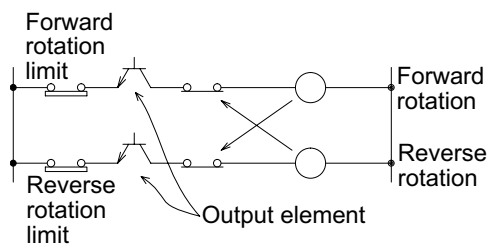
3.2.2 Output connection example



- In the positioning unit, use COM1 for both input and output (common I/O).

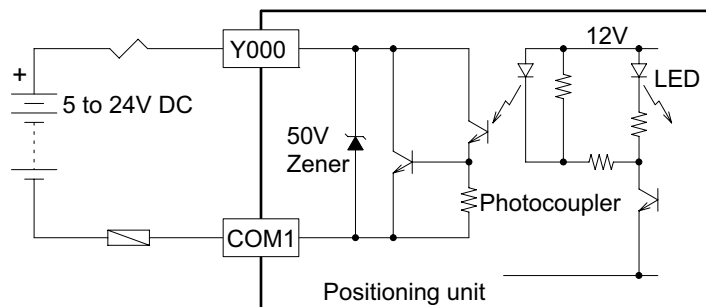


- For pairs of inputs such as forward/reverse rotation contacts which would pose a hazard if turned ON simultaneously, provide external interlocks, in addition to interlocks in the program inside the positioning unit, to ensure that they cannot be turned ON simultaneously.



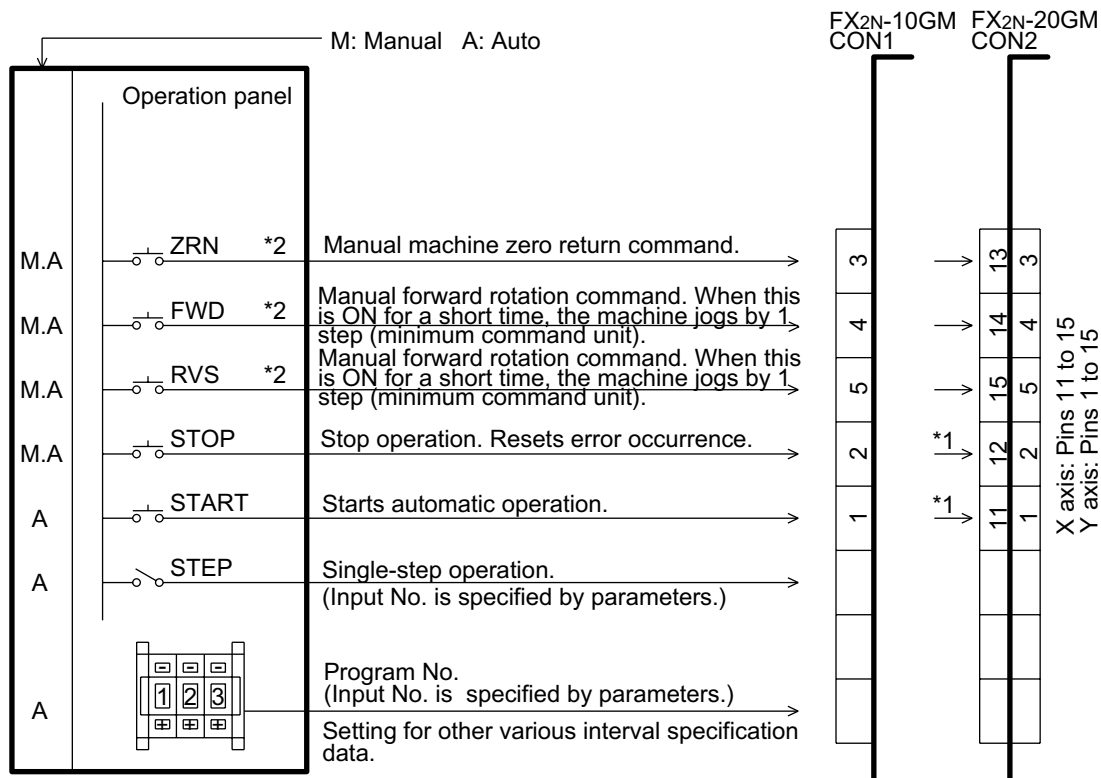
- Make sure to shut down the power supplies of all phases on the outside before starting installation or wiring.
If the power supplies are not shut down, you may get electrical shock or the unit may be damaged.
- Never touch any terminals while the power is supplied.
If you touch a terminal while the 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.

- **Output terminals:**
The output terminals of the positioning unit are located in a 16-point connector in which both inputs and outputs are located.
The power supply for driving the loads must be 5 to 30V DC smoothed power supply.



- **Circuit isolation:**
The internal circuits of the positioning unit are isolated optically from the output transistors by a photocoupler. In addition, each common block is isolated from the others.
- **Operation indication:**
When a photocoupler is driven, the LED is lit and the output transistor is turned ON.
- **Output current:**
Refer to Section 2.5.
The ON voltage of an output transistor is approximately 1.5 V.
When driving semiconductors, etc., make sure that the input voltage of the device does not exceed this value.
- **Response time:**
For the response time between activation or deactivation of a photocoupler and turning ON or OFF of an output transistor, refer to Section 2.5.
- **Leak current in open circuit:**
The leak current is 0.1 mA or less.

3.2.3 Operation input wiring



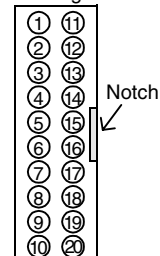
*1: In simultaneous 2-axis operation, connect either of the X and Y axes.

*2: In AUTO mode (while the MANU input is OFF), the input terminals [ZRN], [FWD] and [RVS] can be used as general purpose inputs.

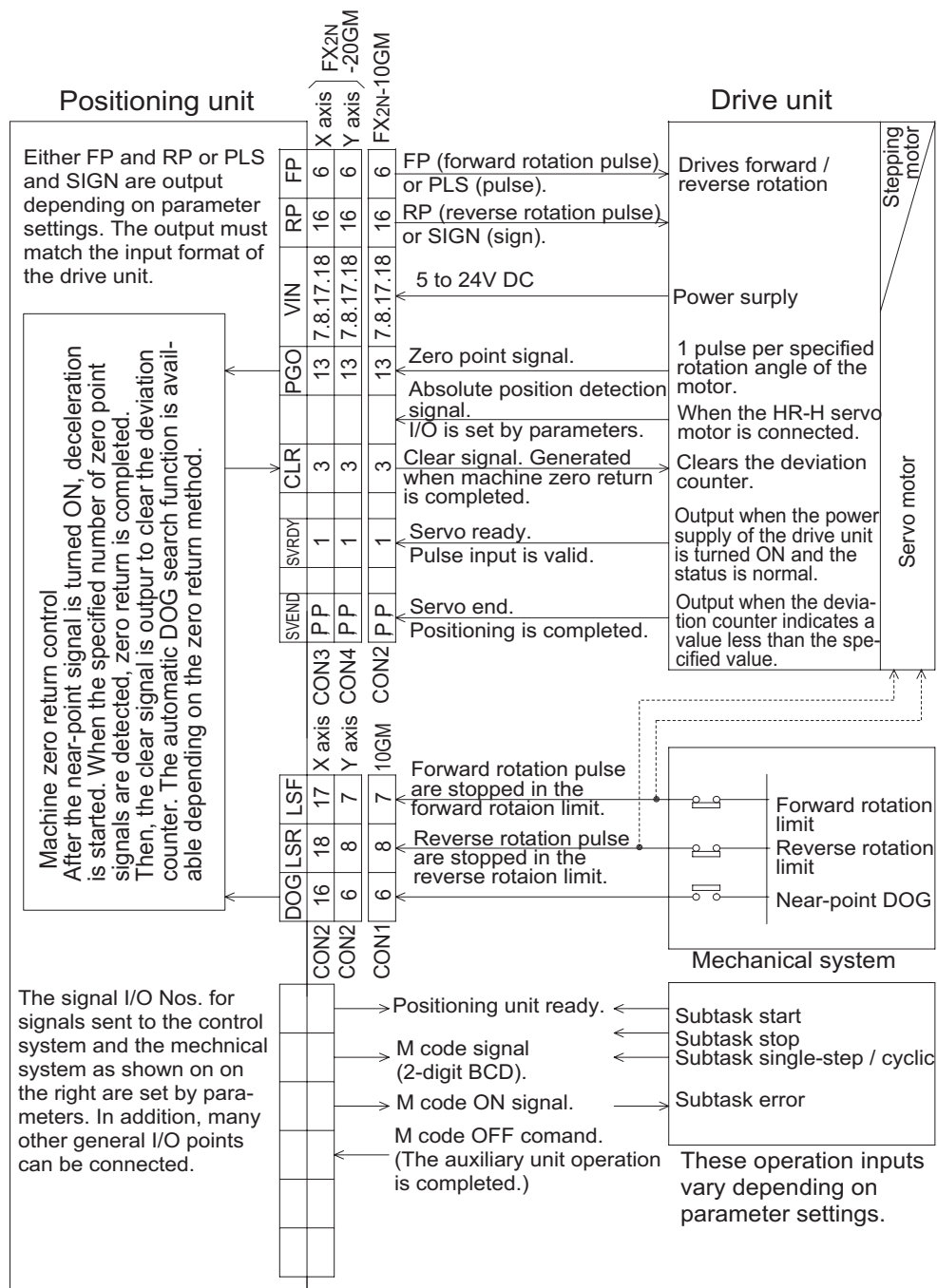
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side). The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.

I/O connector pin array of positioning unit



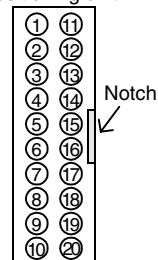
3.2.4 Drive system/mechanical system I/O wiring



About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.

I/O connector pin array of positioning unit

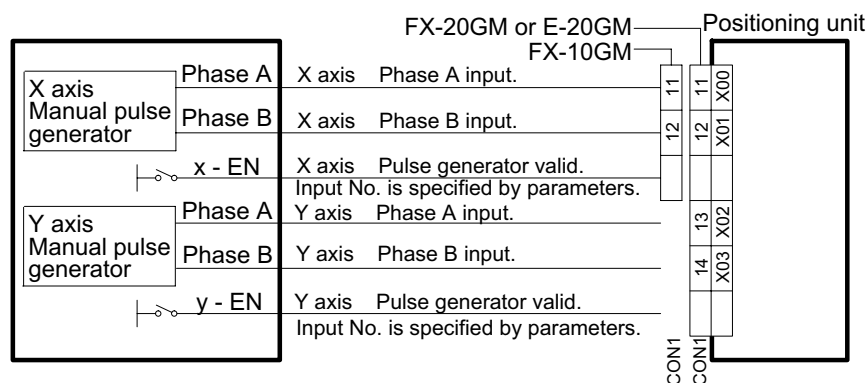


3.2.5 Manual pulse generator wiring

This section explains the wiring when a manual pulse generator is used. When a manual pulse generator is used, parameter settings are required. In the wiring shown below, the parameters are set as follows.

PARA 39	: Manual pulse generator	Set to "1" : One pulse generator. Set to "2" : Two pulse generators.
PARA 40	: Magnification ratio	Set according to necessity. (1 to 255)
PARA 41	: Division	Set according to necessity. (0 to 7: FX _{2N} -20GM)
PARA 42	: Enable input	One manual pulse generator can be changed over for the

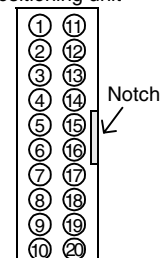
X axis or the Y axis in the FX_{2N}-20GM.
(X02 to X03: FX_{2N}-10GM, X02 to X67: FX_{2N}-20GM)



About the pin array

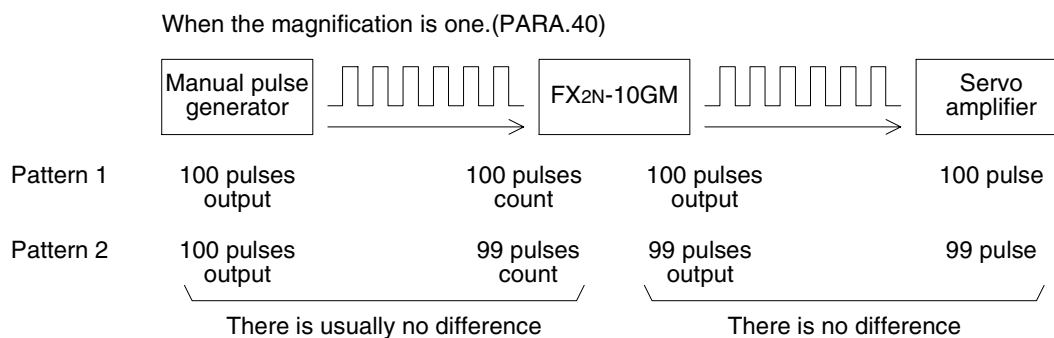
- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector.
Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side).
The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used.
Match the position of notch, and wire correctly.

I/O connector pin array
of positioning unit





- When the manual pulse generator is used with FX_{2N}-10GM, the operation becomes as follows.



In FX_{2N}-10GM, the difference is uncommonly generated in the number of pulses output from the manual pulse generator and the numbers of pulses which FX_{2N}-10GM counted.(pattern 2)

However, the difference is not generated in the current value of the servo amplifier and FX_{2N}-10GM.

- Use the manual pulse generator of the NPN open collector type.

3.2.6 Absolute position (ABS) detection wiring

This section explains the wiring needed when a Mitsubishi MR-H/MR-J2/MR-J2-Super/MR-J3 servo motor is connected and the absolute position detection function (ABS) is used. To detect the absolute position, the parameter Nos. 50, 51 and 52 must be set.

When general purpose I/O are used (FX2N-10GM, FX2N-20GM)

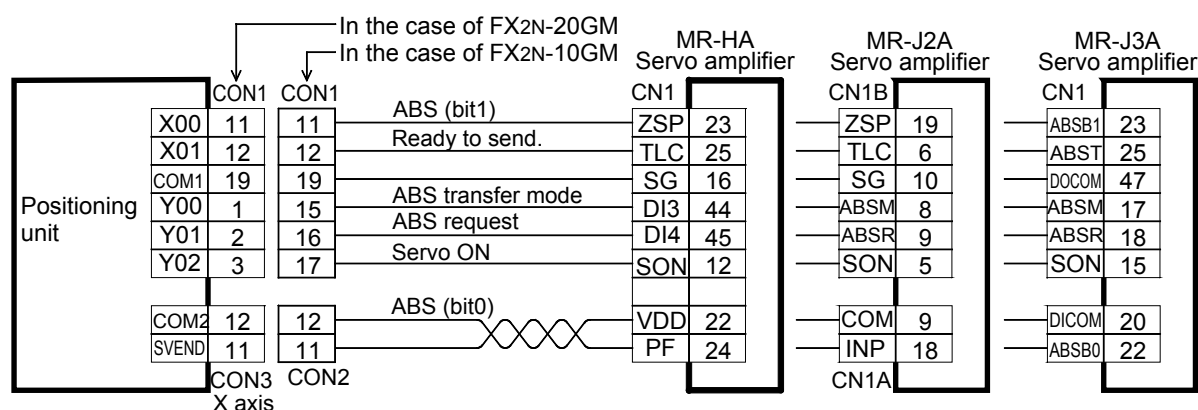
The figure below shows an example of wiring when the general purpose I/O points built in the positioning unit are used.

In the example below, the parameters are set as follows.

PARA 50: ABS interface. Set to "1": Valid

PARA 51: ABS input head No. Set to "0": X00

PARA 52: ABS control output head No. Set to "0": Y00



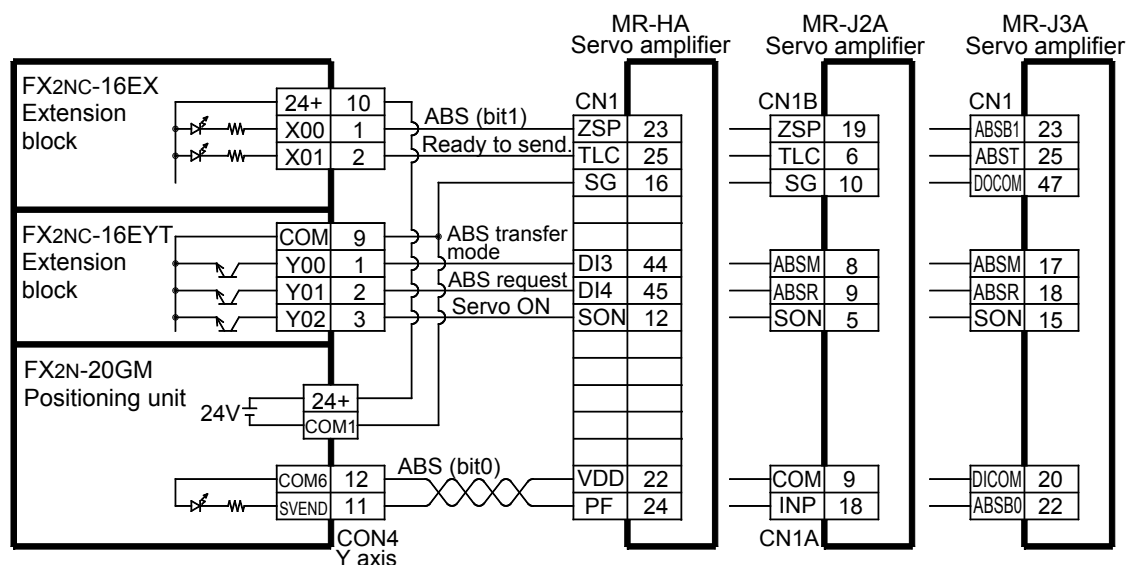
When extension blocks are connected (FX2N-20GM)

The example below shows the wiring performed when the absolute position is detected using extension blocks connected to CON5 of the FX2N-20GM.

PARA 50: Set to "1"

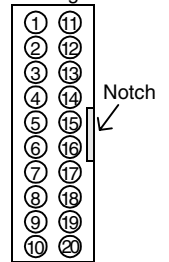
PARA 51: Set to "10": X10

PARA 52: Set to "10": Y10



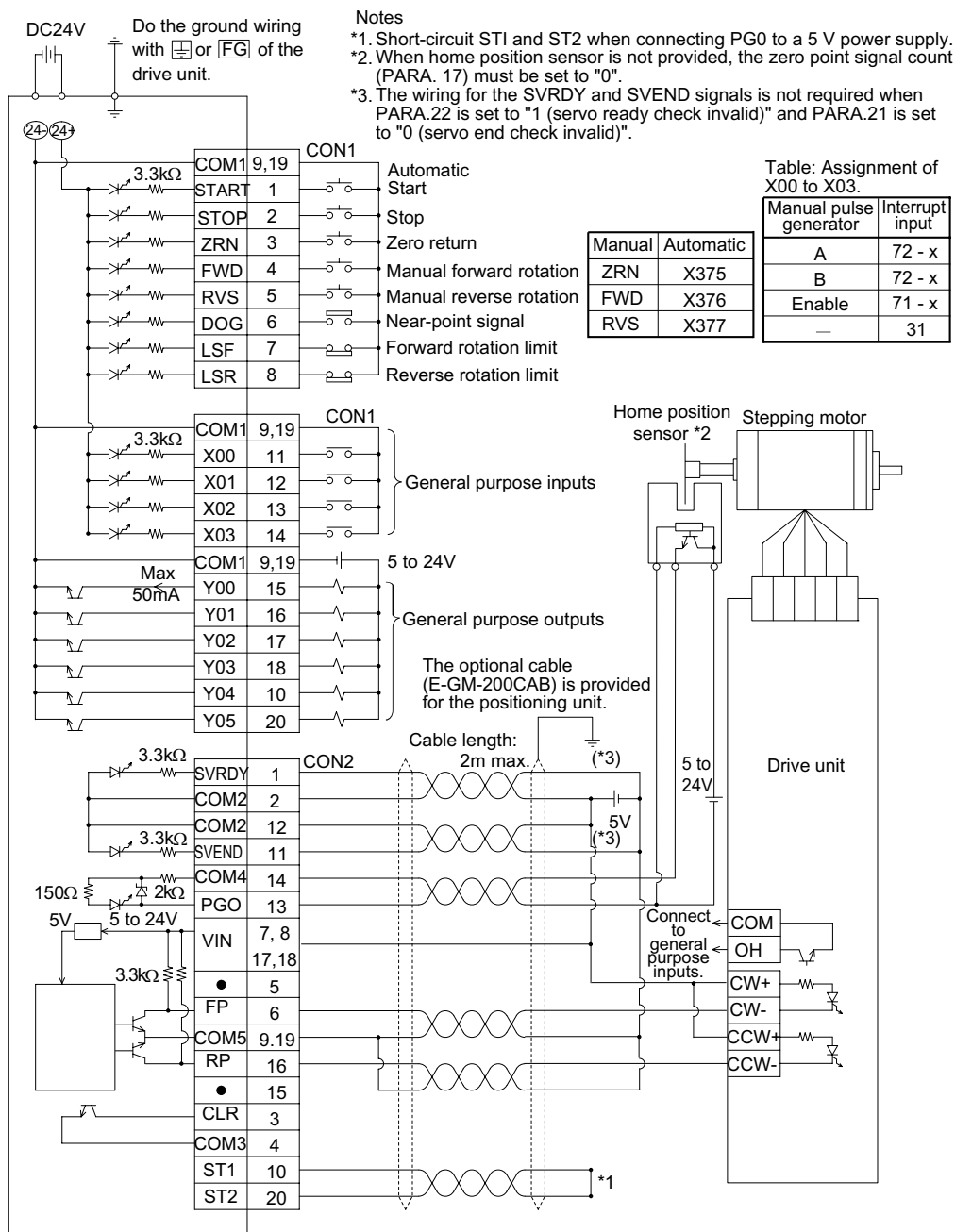
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector.
Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side).
The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used.
Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

I/O connector pin array
of positioning unit

3.2.7 I/O connection example

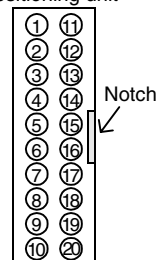
When the FX₂N-10GM is connected to a stepping motor.



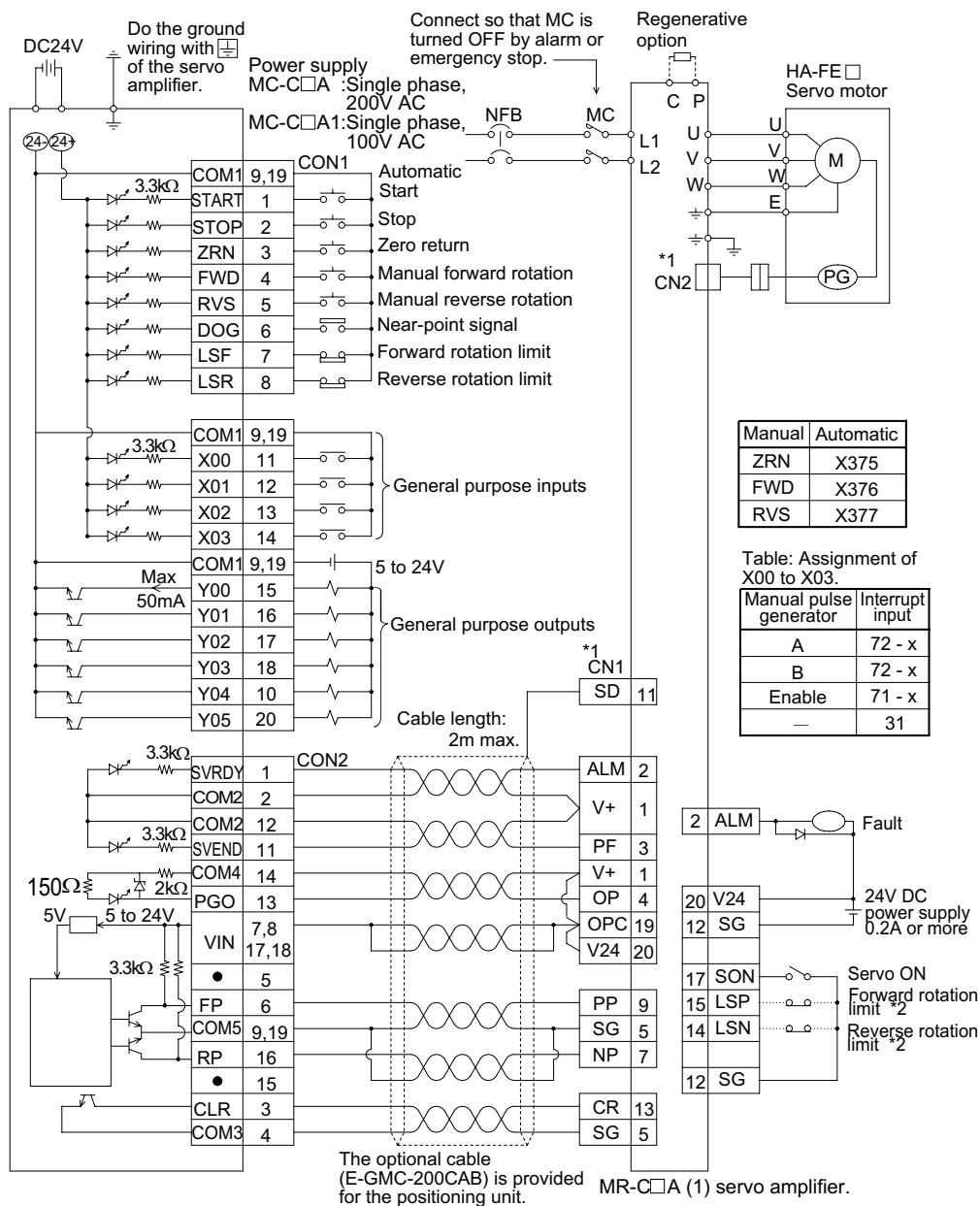
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector.
Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side).
The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used.
Match the position of notch, and wire correctly.
- For the pin layout of the drive unit, refer to the corresponding manuals.

I/O connector pin array
of positioning unit



When the FX_{2N}-10GM is connected to a MR-C servo motor.



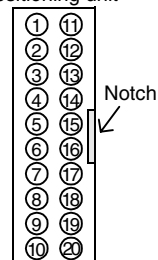
*1: CN1 and CN2 have the same shape. If they are confused in connection, fault may occur.

*2: When the factory is shipped, LSP and LSN are setting of normally open. Wiring can be omitted.

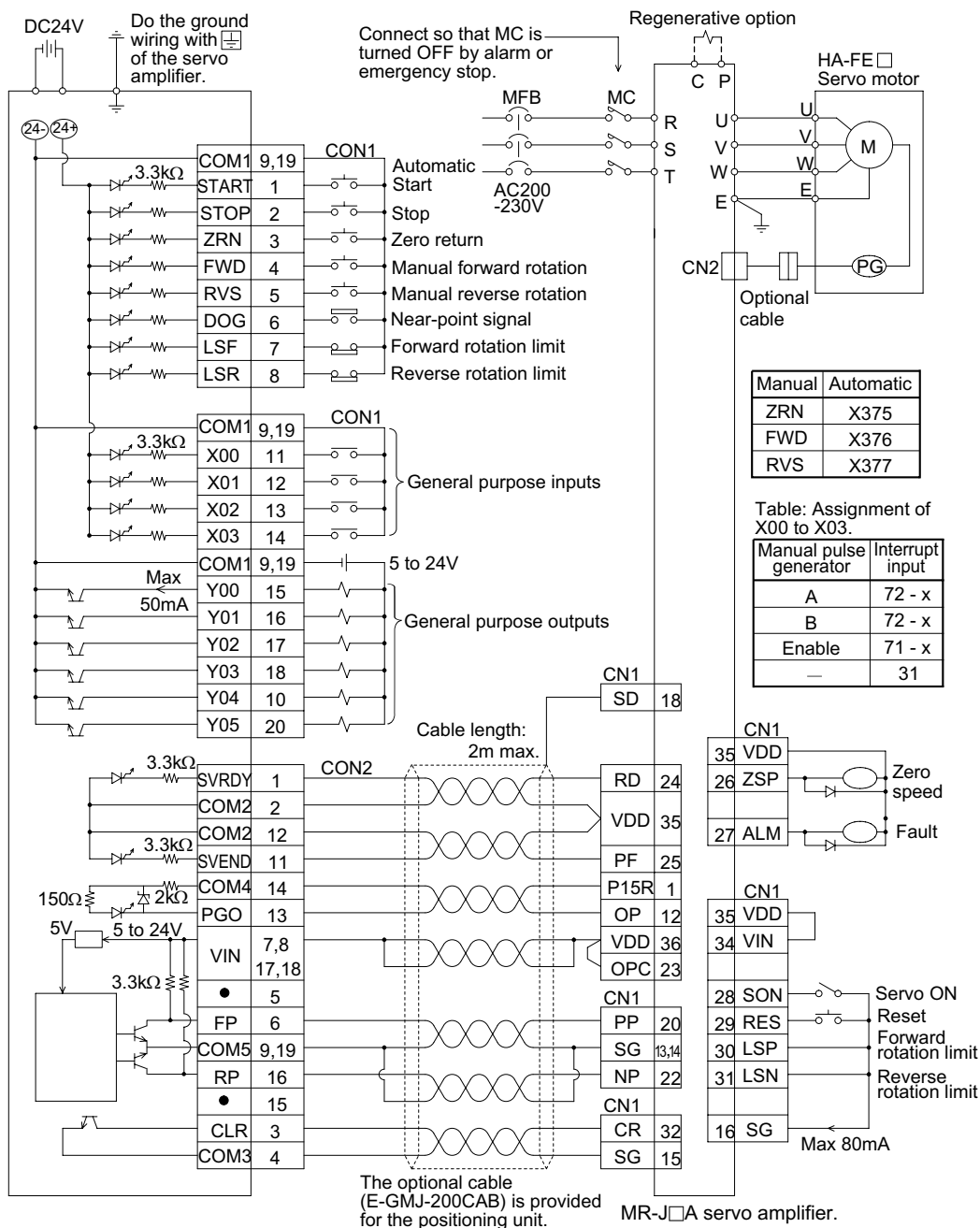
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side). The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

I/O connector pin array of positioning unit



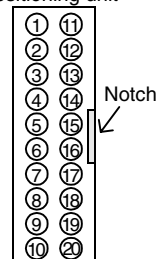
When the FX_{2N}-10GM is connected to a MR-J servo motor.



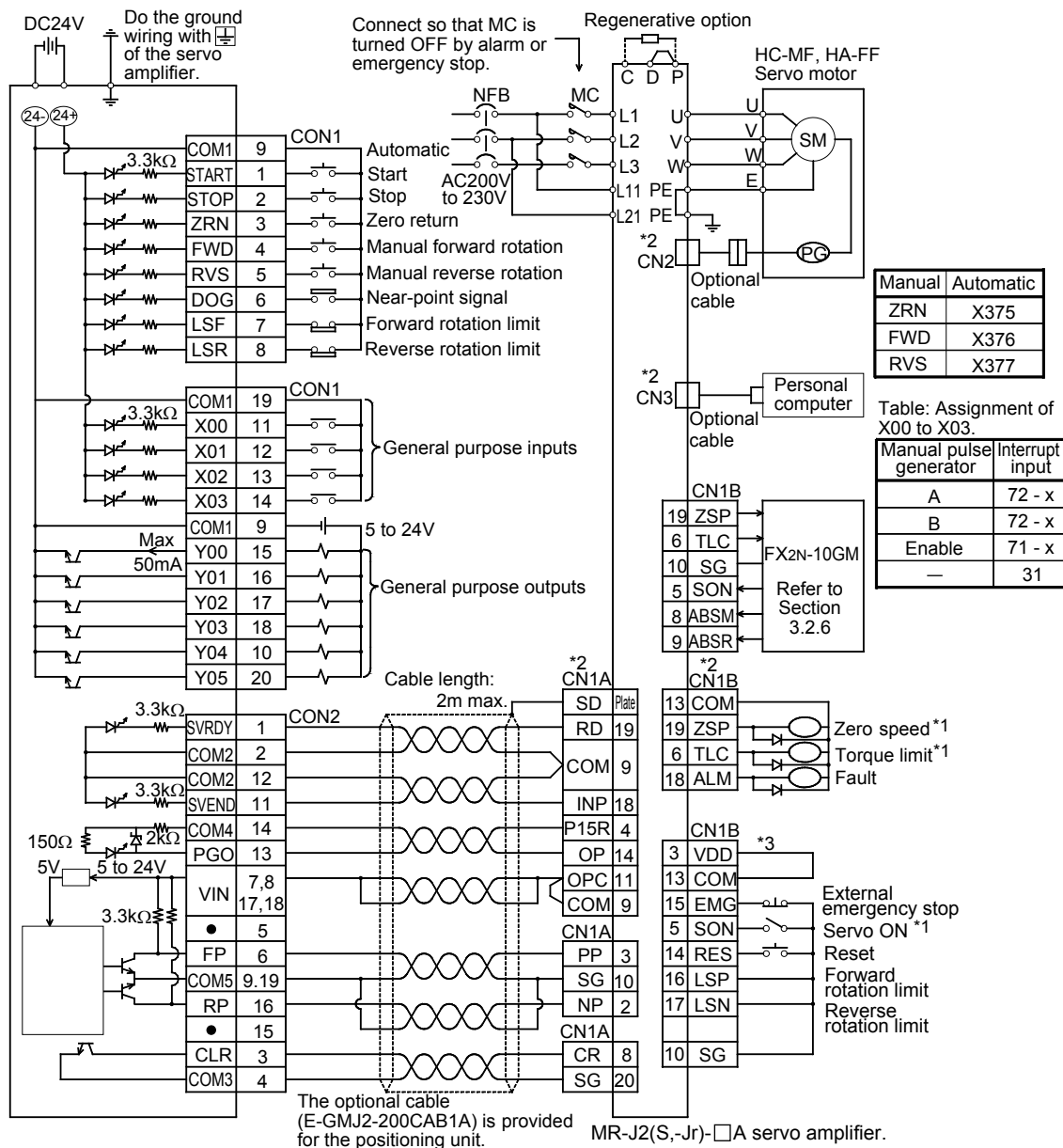
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

I/O connector pin array of positioning unit



When the FX₂N-10GM is connected to a MR-J2(S, -Jr) servo motor.



*1. Connect to the positioning unit when detecting absolute position.

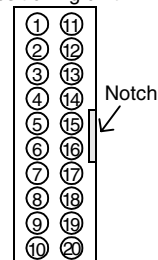
*2. CN1A, CN1B, CN2 and CN3 have the same shape. If they are confused in connection, fault may occur.

*3. Connect when using the internal power supply.

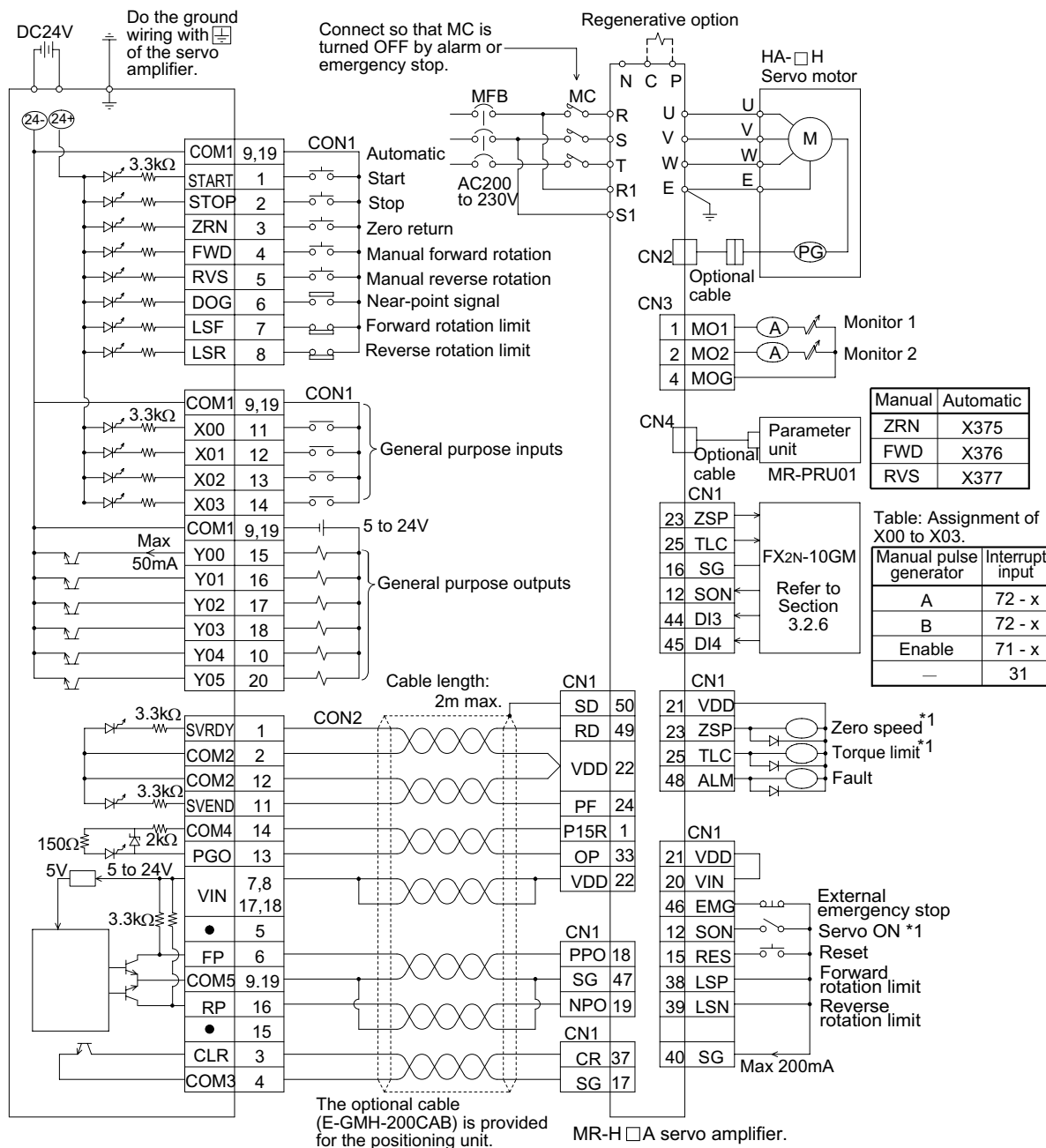
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

I/O connector pin array of positioning unit



When the FX₂N-10GM is connected to a MR-H servo motor.

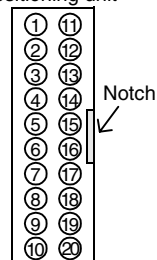


*1. Connect to the positioning unit when detecting absolute position.

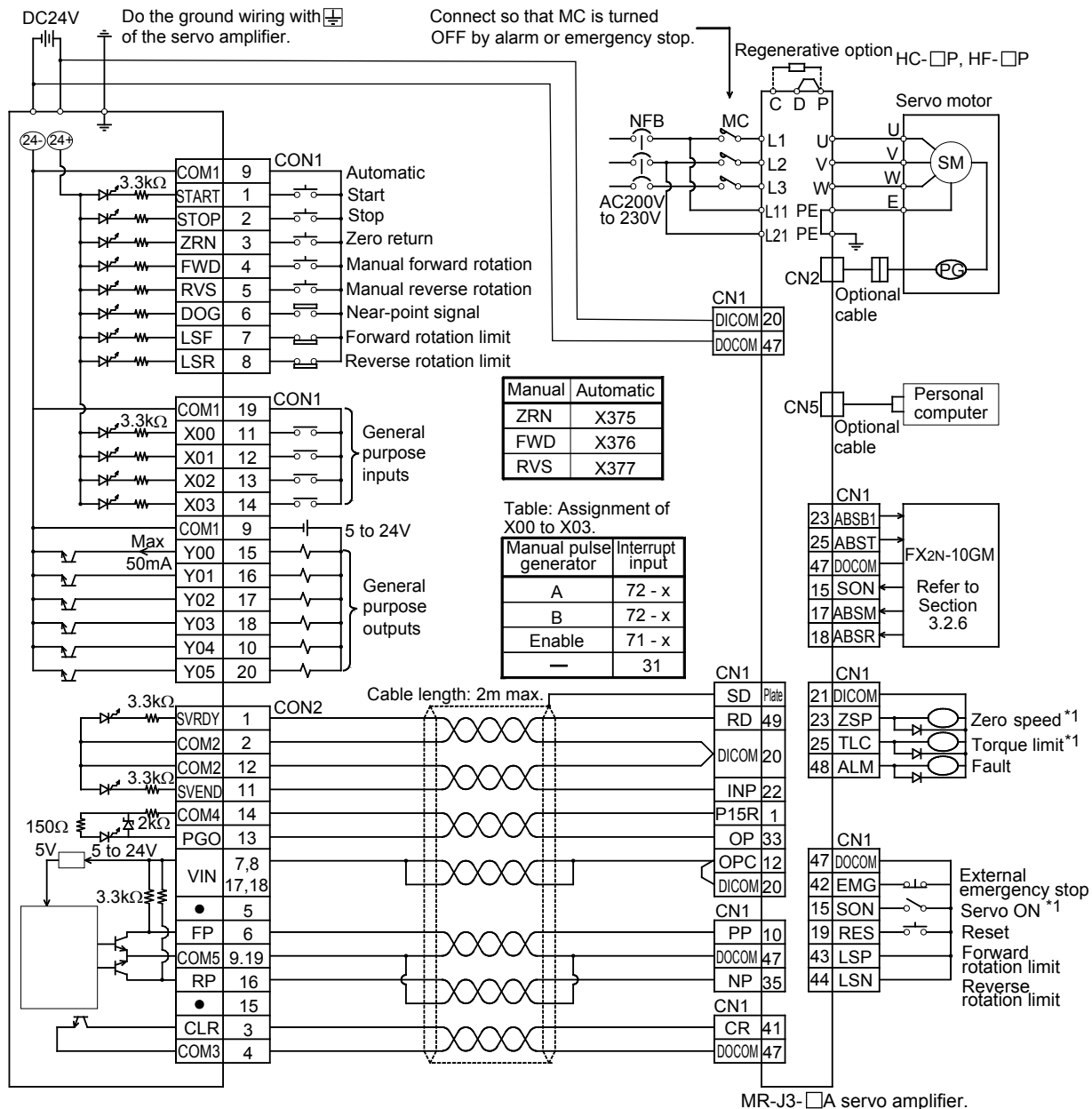
About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

I/O connector pin array of positioning unit



When the FX₂N-10GM is connected to a MR-J3 servo motor.

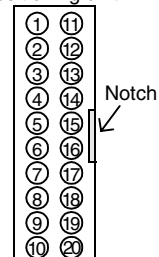


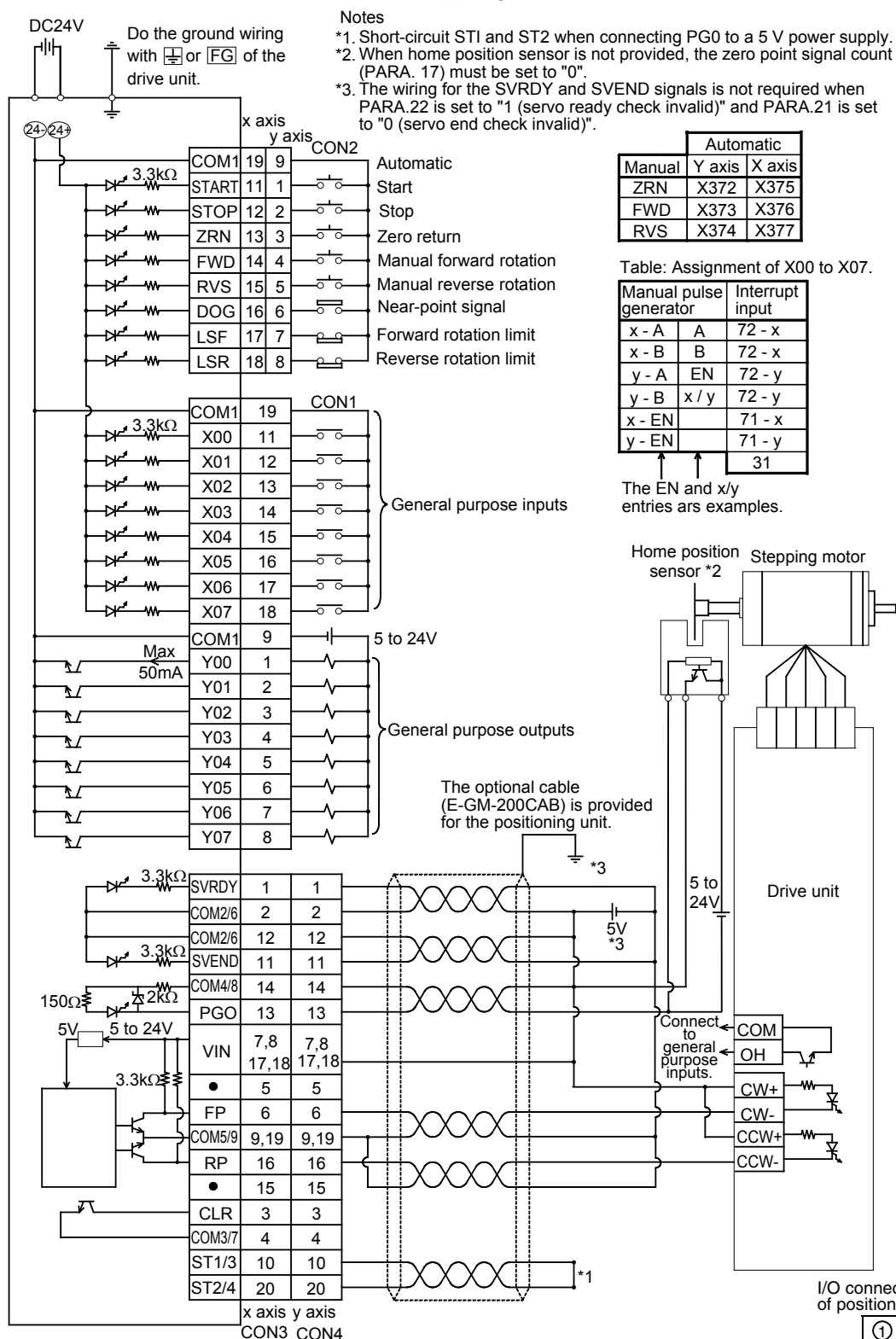
*1.Connect to the positioning unit when detecting absolute position.

About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector.
Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side).
The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used.
- Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

I/O connector pin array
of positioning unit

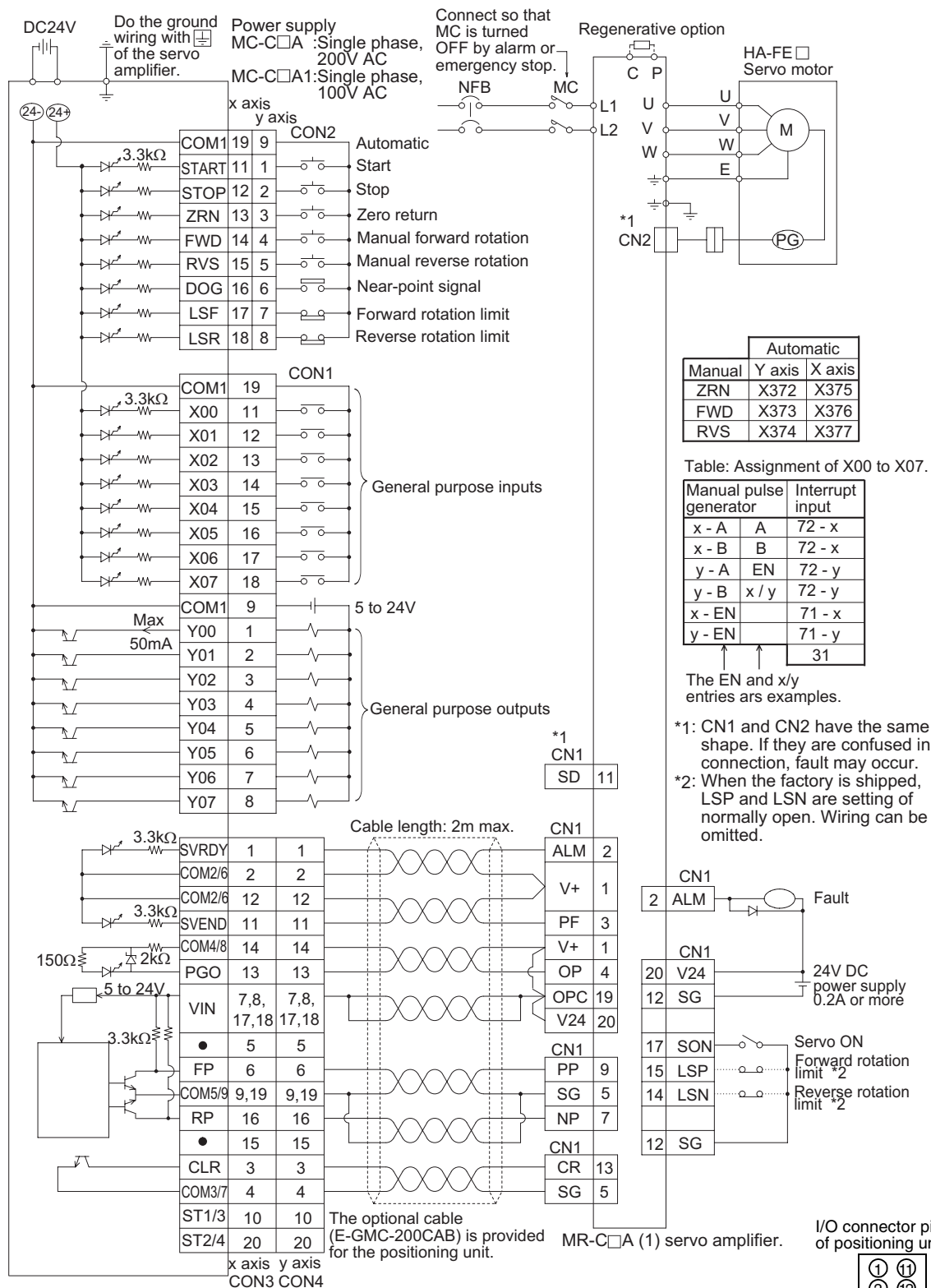


When the FX_{2N}-20GM is connected to a stepping motor.

About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the drive unit, refer to the corresponding manuals.

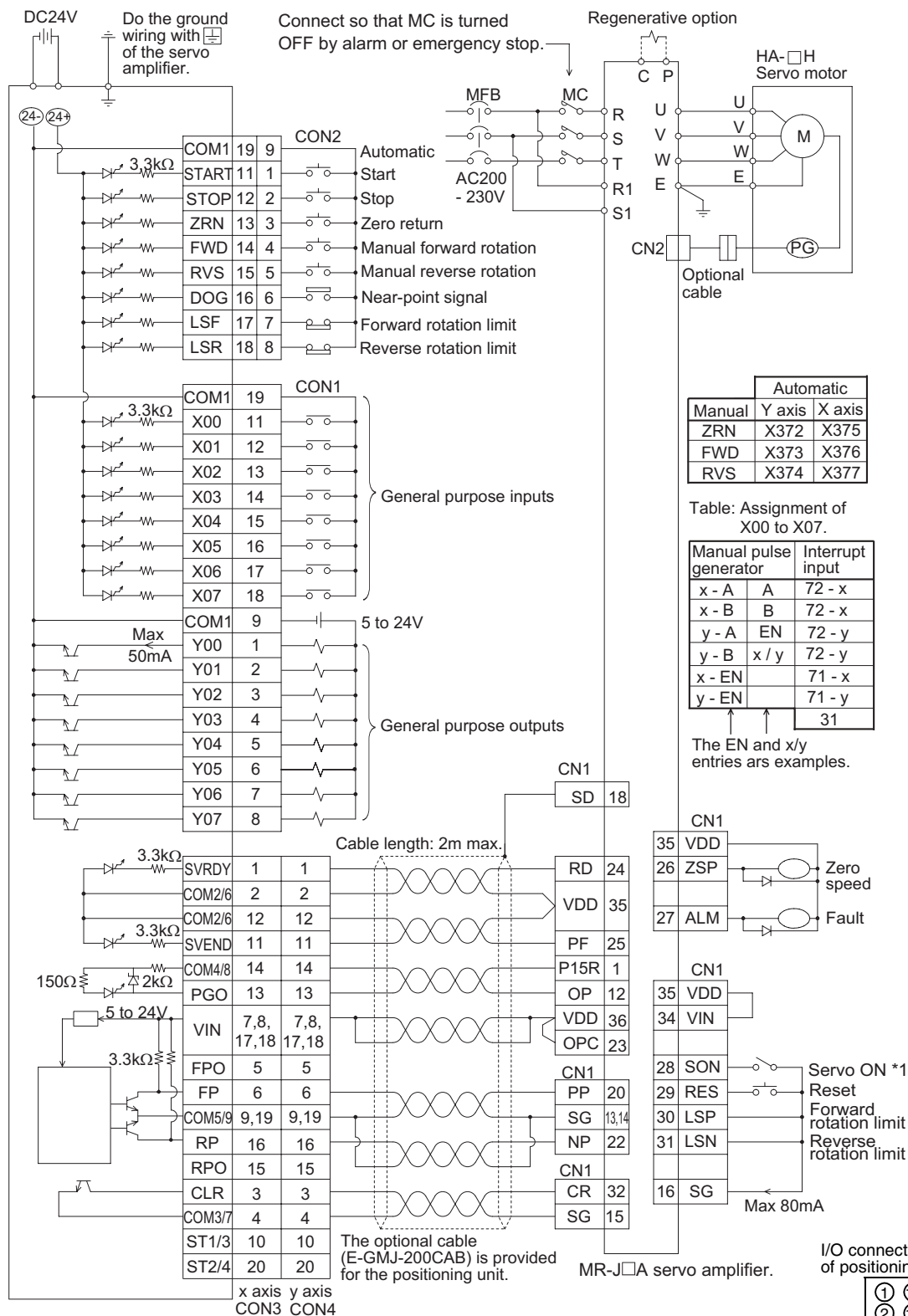
When the FX₂N-20GM is connected to a MR-C servo motor.



About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

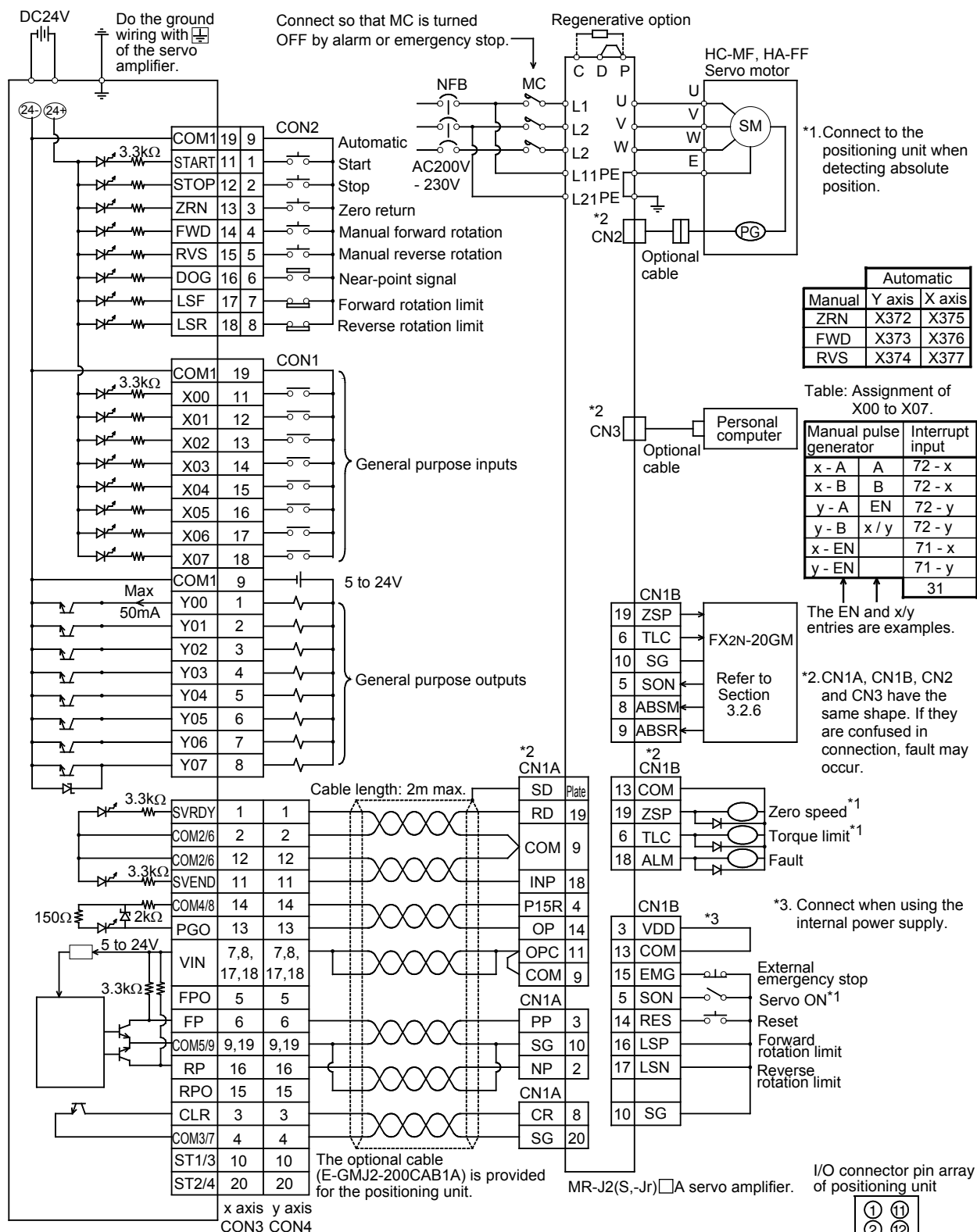
When the FX₂N-20GM is connected to a MR-J servo motor.



About the pin array

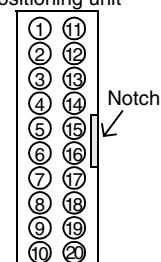
- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning unit's connector from the connected equipment side (engagement side). The pin number of the positioning unit and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

When the FX_{2N}-20GM is connected to the MR-J2(S, -Jr) servo motor.

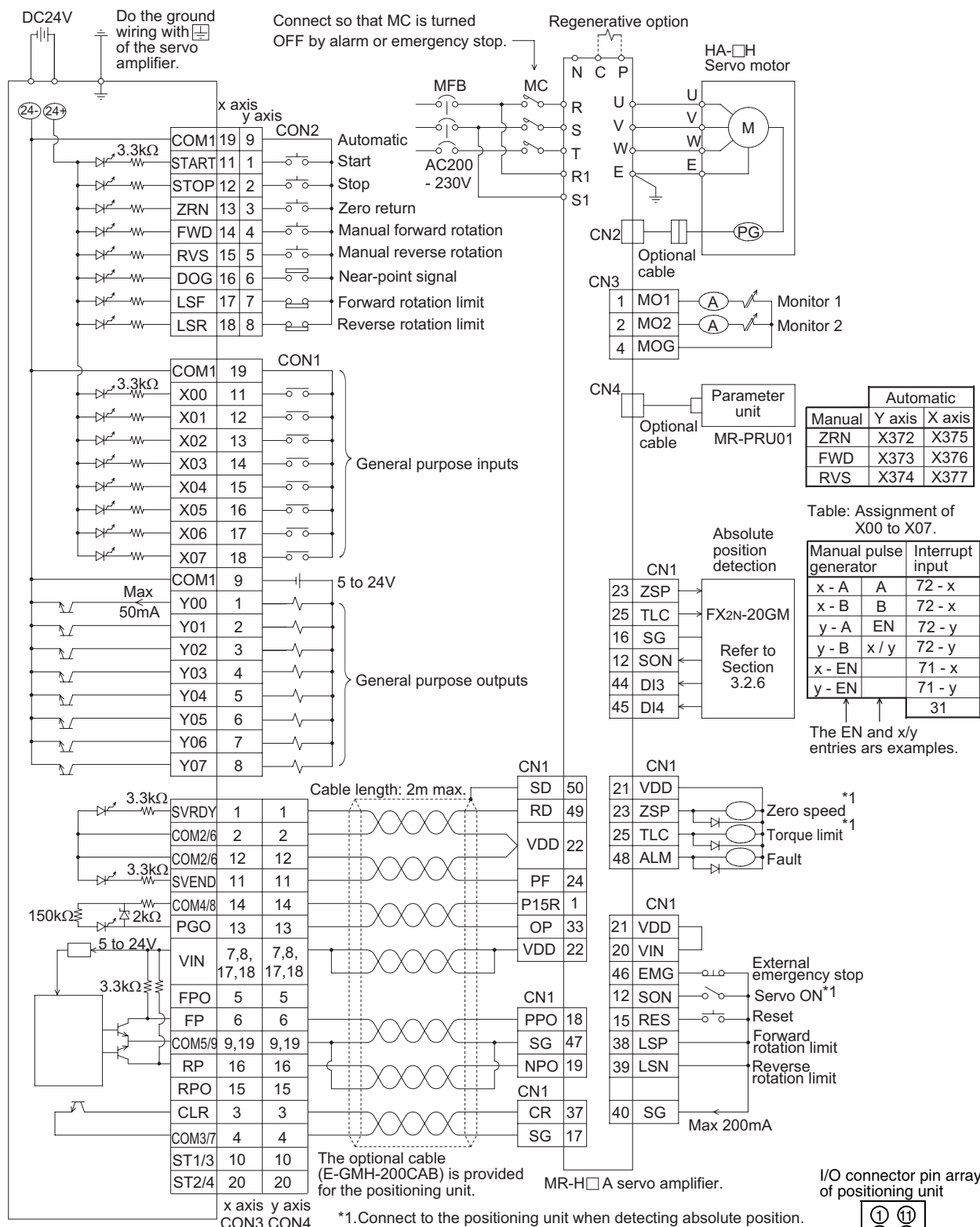


About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector.
Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side).
The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used.
Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

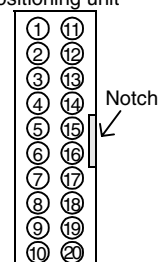


When the FX_{2N}-20GM is connected to the MR-H servo motor.

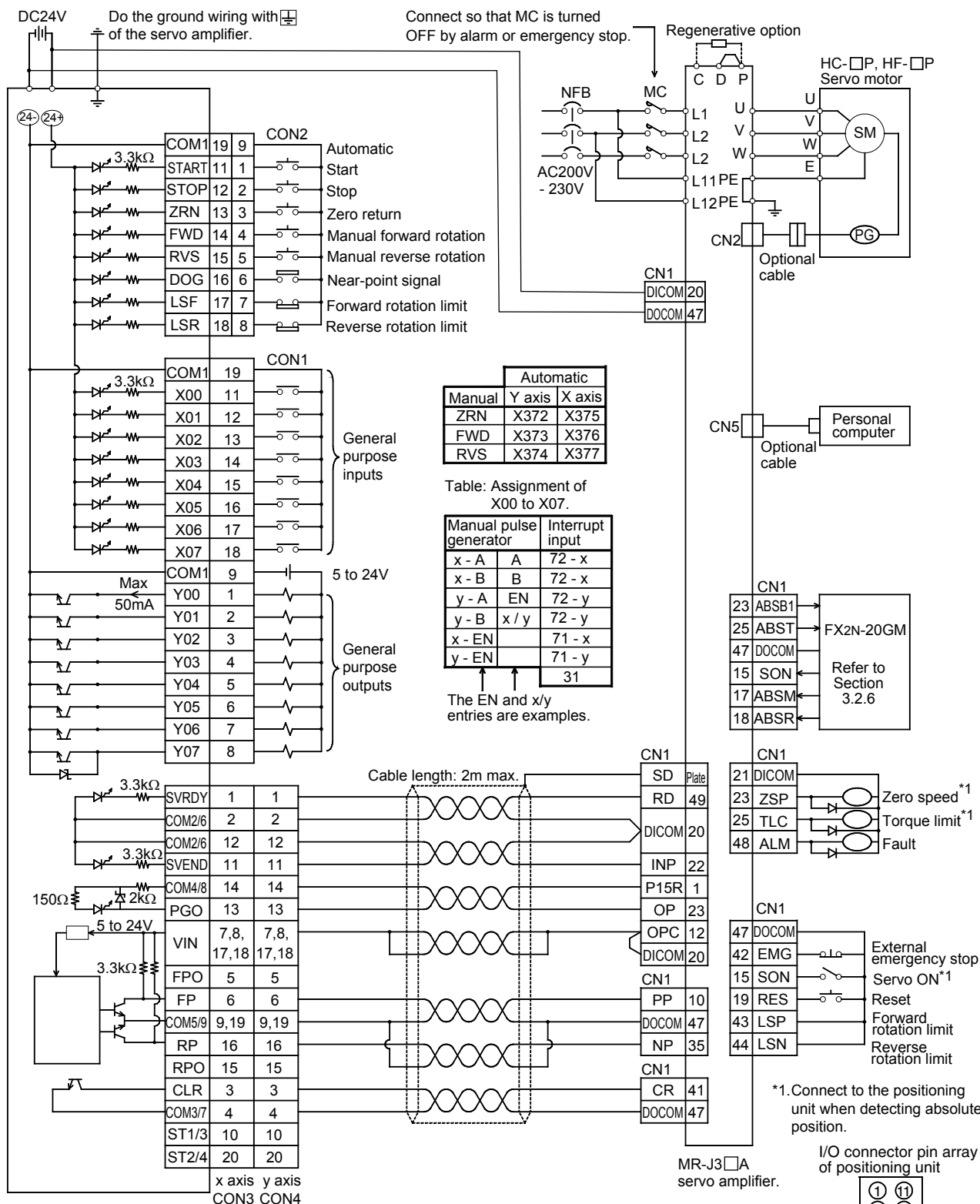


About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector. Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side). The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used. Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.

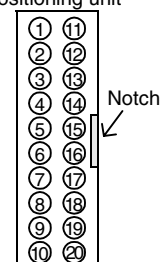


When the FX_{2N}-20GM is connected to the MR-J3 servo motor.



About the pin array

- The pin numbers of the positioning unit above describe the pin numbers of the positioning unit's I/O connector.
Wiring should be done by looking at the positioning units connector from the connected equipment side (engagement side).
The pin number of the positioning units and the pin number at the "▲" may vary according to the connector being used.
Match the position of notch, and wire correctly.
- For the pin layout of the servo amplifier, refer to the corresponding manuals.



MEMO

4. Parameters

4.1 Notes on Parameters in General

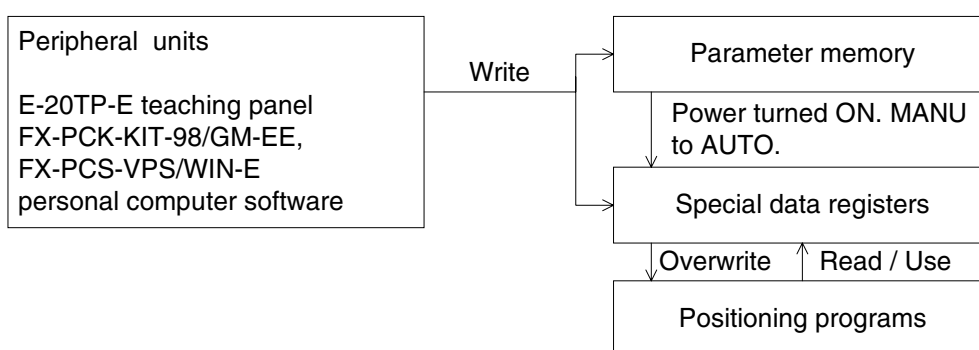
Set parameters to determine the operating condition of the positioning unit.

The positioning unit can satisfy diversified needs through parameter setting in accordance with the operation specifications and the control specifications.

Parameters are mainly classified into the following three types.

- Positioning parameters (PARA. 0 ~)
Determine the units, the speed, etc. for positioning control.
- I/O control parameters (PARA. 30 ~)
Determine the contents related to the I/Os of the positioning unit such as the method of specifying the program No., the destination of the m code, etc.
- System parameters (PARA. 100 ~)
Determine the memory size of the program, the number of file registers, etc.

In the FX₂N-20GM, the positioning parameters and the I/O control parameters for independent 2-axis operation must be set for each of the X and Y axes. In simultaneous 2-axis mode, some parameters operate according to the settings for the X axis. (For parameter assignment, refer to Section 4.2.) In the FX₂N-10GM, the parameters must be set for one axis (the X axis) exclusively.



With some exceptions, each parameter is assigned a special data register (special D). When parameters are set from the panel of a peripheral unit, the same data is simultaneously set in the special Ds.

The data in the special Ds can be changed using the positioning program during operation. Operation is then performed in accordance with the changed data.

However, when power is turned ON, the special Ds are initialized with the held data in the parameter memories.

This also happens when the mode is changed over from MANU to AUTO.

→ Continued on the next page. When a value beyond the allowed range of a parameter is entered, the positioning unit performs the following operation.

- Parameter written using a peripheral unit
A parameter set error (Error code: 2000 to 2056) occurs, and the positioning unit stops.
When this error occurs, the ERROR-x and/or ERROR-y LEDs provided on the panel of the positioning unit are lit.
A correct value must be written to the parameter to reset the error status.
- Parameter written using a positioning program
Though the positioning unit does not stop, the parameter is set to the following value.
When the entered value is larger than the effective range:
A parameter related to time or speed is set to the maximum value.
When the entered value is smaller than the effective range:
A parameter related to time or speed is set to the minimum value.

4.2 Parameter List

Table 4.1: Parameter List

	PARA. No.	Item	Description ([]: unit)	Initial value
Positioning parameters	0	System of unit	0: Mechanical system of units 1: Motor system of units 2: Composite system of units	1
	1	Pulse rate *1,*3	1 to 65,535 [PLS/REV]	2,000
	2	Feed rate *2,*3	1 to 999,999 [μm/REV, mdeg/REV, 10 ⁻¹ minch/REV]	2,000
	3	Minimum command units	0: 10 ⁰ [mm], 10 ⁰ [deg], 10 ⁻¹ [inch], 10 ³ [PLS]	2
			1: 10 ⁻¹ [mm], 10 ⁻¹ [deg], 10 ⁻² [inch], 10 ² [PLS]	
			2: 10 ⁻² [mm], 10 ⁻² [deg], 10 ⁻³ [inch], 10 ¹ [PLS]	
			3: 10 ⁻³ [mm], 10 ⁻³ [deg], 10 ⁻⁴ [inch], 10 ⁰ [PLS]	
	4	Maximum speed	1 to 153,000 [cm/min, 10deg/min, inch/min], 1 to 200,000 [Hz] (Approx. 5,000 Hz is recommended for stepping motor.)	200,000
	5	JOG speed	1 to 153,000 [cm/min, 10deg/min, inch/min], 1 to 200,000 [Hz] (Approx. 1,000 Hz is recommended for stepping motor.)	20,000
	6	Bias speed	1 to 15,300 [cm/min, 10deg/min, inch/min], 1 to 20,000 [Hz]	0
	7	Backlash correction	0 to 65,535 [PLS]	0
	8	Acceleration time	1 to 5,000 [ms]	200
	9	Deceleration time	1 to 5,000 [ms]	200
	10	Interpolation time constant *5	0 to 5,000 [ms]	100
	11	Pulse output type	0: FP = normal rotation pulse, RP = reverse rotation pulse	0
			1: FP = rotation pulse, RP = direction specification	
	12	Rotation direction	0: Increases current value by normal rotation pulse (FP).	0
			1: Decreases current value by normal rotation pulse (FP).	
	13	Zero position return speed	1 to 153,000 [cm/min, 10deg/min, inch/min], 10 to 200,000 [Hz]	100,000
	14	Creep speed	1 to 15,300 [cm/min, 10deg/min, inch/min], 10 to 20,000 [Hz]	1,000
	15	Zero position return direction	0: Direction in which current value increases	1
			1: Direction in which current value decreases	
	16	Mechanical zero point address	-999,999 to +999,999 [PLS]	0
	17	Zero point signal counting times	0 to 65,535 [times]	1
	18	Zero point signal count start point	0: Starts counting at forward end of near point DOG (OFF→ ON).	1
			1: Starts counting at backward end of near point DOG (ON → OFF).	
			2: No near point DOG	

Table 4.1: Parameter List

	PARA. No.	Item	Description ([]: unit)	Initial value
Positioning parameters	19	DOG input logic	0: Normally open contact (A - contact)	0
			1: Normally closed contact (B - contact)	
	20	LS logic * ⁶	0: Normally open contact (A - contact)	0
			1: Normally closed contact (B - contact)	
	21	Error judgement time	0 to 5,000 ms (When "0" is set, servo end check is invalid.)	0
	22	Servo ready check	0: Valid, 1: Invalid	1
	23	Stop mode * ⁷	0, 4: Disables stop command.	1
			1: Enables remaining distance drive. (Jumps to END instruction during interpolation operation.)	
			2: Ignores remaining distance. (Jumps to END instruction during interpolation operation.)	
			3, 7: Ignores remaining distance, and jumps to END instruction.	
			5: Performs remaining distance drive (including interpolation operation).	
			6: Ignores remaining distance. (Jumps to NEXT instruction during interpolation operation.)	
	24	Electrical zero point address	-999,999 to + 999,999 [PLS]	0
	25	Software limit (large) * ⁸	-2,147,483,648 to +2,147,483,647 Software limit is invalid in case of "PARA. 25 ≤ PARA. 26".	0
	26	Software limit (small) * ⁸	-2,147,483,648 to +2,147,483,647 Software limit is invalid in case of "PARA. 25 ≤ PARA. 26".	0

Table 4.1: Parameter List

	PARA. No.	Item	Description ([]: unit)	Initial value
I/O control parameters	30	Program No. specification method ^{*4}	0: Program No. 0 (fixed)	0
			1: 1 digit of digital switch (0 to 9)	
			2: 2 digits of digital switch (00 to 99)	
			3: Specified by special data registers (D9000, D9010)	
	31	Head No. for digital switch time division read input ^{*4}	FX2N-20GM: X0 to X67, X372 to X374	0
			FX2N-10GM: X0 to X3	
	32	Head No. for digital switch time division read output ^{*4}	FX2N-20GM: Y0 to Y67	0
			FX2N-10GM: Y0 to Y5	
	33	Digital switch read interval ^{*4}	7 to 100 [ms] (increment: 1 ms)	20
	34	RDY output validness ^{*4}	0: Invalid, 1: Valid	0
	35	RDY output No. ^{*4}	FX2N-20GM: Y0 to Y67	0
			FX2N-10GM: Y0 to Y5	
	36	m code external output validness ^{*4}	0: Invalid, 1: Valid	0
	37	m code external output No. ^{*4}	FX2N-20GM: Y0 to Y57 (Nine points are occupied.)	0
			FX2N-10GM: Y0 (Six points are occupied.)	
	38	m code OFF command input No. ^{*4}	FX2N-20GM: X0 to X67, X372 to X377	0
			FX2N-10GM: X0 to X3, X375 to X377	
	39	Manual pulse generator validness	0: Invalid, 1: Valid (1 pulse generator), 2: Valid (2 pulse generators) (In FX2N-10GM, only "0" or "1" is available.)	0
	40	Magnification per pulse of manual pulse generator	×1 to ×255	1
	41	Dividing ratio of magnification result	FX2N-20GM: 2 ⁿ , n = 0 to 7	0
			FX2N-10GM: Not available	—
	42	Head No. for input of manual pulse generator enable signal	FX2N-20GM: X2 to X67 (One point is occupied by one manual pulse generator.)	2
			FX2N-10GM: X2 to X3 (Nine points are occupied.)	—
	43 to 49	—	—	—
	50	ABS interface	0: Invalid, 1: Valid	0
	51	ABS input head No.	FX2N-20GM: X0 to X66 (Two points are occupied.)	0
			FX2N-10GM: X0 to X2, X375 to X376 (Two points are occupied.)	
	52	ABS control output head No.	FX2N-20GM: Y0 to X65 (Three points are occupied.)	0
			FX2N-10GM: Y0 to Y3 (Three points are occupied.)	
	53	Step operation	0: Invalid, 1: Valid	0

Table 4.1: Parameter List

	PARA. No.	Item	Description ([]: unit)	Initial value
I/O control parameters	54	Step mode input No.	FX2N-20GM: X0 to X67, X372 to X377 (One points are occupied.)	0
			FX2N-10GM: X0 to X3, X375 to X377 (One points are occupied.)	
	55	—	—	—
	56	FWD/RVS/ZRN general-purpose input	0: Disables general-purpose inputs.	0
			1: Enables general-purpose inputs in AUTO mode. (Commands by special M are invalid.)	
			2: Always enables general-purpose inputs. (Commands by special M are invalid.)	
			3: Enables general-purpose inputs in AUTO mode. (Commands by special M are valid.)	
			4: Always enables general-purpose inputs. (Commands by special M are valid.)	
System parameters	100	Memory size	0: 8K step, 1: 4K step In FX2N-10GM, only "1 (4K step)" is available.	20GM: 0
				10GM: 1
	101	File register	0 to 3,000 [points] (assigned by D4,000 to D6,999)	0
	102	Battery status	0: Lights LED, and does not make GM give output (M9127 : OFF).	20GM: 0
			1: Does not light LED, and does not make GM give output (M9127 : ON).	
			2: Does not light LED, and makes GM give output (M9127 : OFF).	
			Not available in FX2N-10GM.	10GM: —
	103	Battery status output No.	FX2N-20GM: Y0 to Y67	0
			Not available in FX2N-10GM.	—
	104	Subtask start	0: When mode is changed over from MANU to AUTO	0
			1: When input specified by PARA. 105 turns on (in AUTO mode)	
			2: When mode is changed over from MANU to AUTO or when input specified by PARA. 105 turns on (in AUTO mode)	
	105	Subtask start input	FX2N-20GM: X0 to X67, X372 to X377	0
			FX2N-10GM: X0 to X3, X375 to X377	0
	106	Subtask stop	0: When mode is changed over from MANU to AUTO	0
			1: When input specified by PARA. 107 turns on or When mode is changed over from MANU to AUTO	
	107	Subtask stop input	FX2N-20GM: X0 to X67, X372 to X377	0
			FX2N-10GM: X0 to X3, X375 to X377	0
	108	Subtask error	0: Does not make positioning unit give output when an error occurs.	0
			1: Makes positioning unit give output when an error occurs.	

Table 4.1: Parameter List

	PARA. No.	Item	Description ([]: unit)	Initial value
System parameters	109	Subtask error output	FX2N-20GM: Y0 to Y67	0
			FX2N-10GM: Y0 to Y5	0
	110	Subtask operation mode changeover	0: Disables general-purpose inputs. When M9112 is set by program, machine performs step operation. When M9112 is reset by program, machine performs cycle operation.	0
			1: Enables general-purpose inputs. Step operation and cycle operation are changed over by input specified by PARA. 111 or M9112.	
	111	Subtask operation mode changeover input	FX2N-20GM: X0 to X67, X372 to X377	0
			FX2N-10GM: X0 to X3, X375 to X377	0

- *1 Indicates the number of command pulses (PLS/REV) given by one rotation of the motor. This parameter is invalid when PARA. 0 is set to "1 (motor system of units)".
- *2 Indicates the movement quantity ($\mu\text{m}/\text{REV}$, mdeg/REV , $10^{-1} \text{ minch}/\text{REV}$) given by one rotation of the motor. This parameter is invalid when PARA. 0 is set to "1 (motor system of units)".
- *3 The operation speed and radius position during interpolation operation is calculated according to PARA. 1 and PARA. 2 set for the X axis.
- *4 In simultaneous 2-axis mode, the value set for the X axis is valid and the value set for the Y axis is ignored.
- *5 In interpolation operation, the value set for the X axis is valid, and the value set for the Y axis is ignored.
- *6 In interpolation operation, set a same value to both the X axis and the Y axis.
- *7 In simultaneous 2-axis mode, set a same value to both the X axis and the Y axis.
- *8 Set both PARA. 25 and PARA. 26. When either side is unnecessary, set the maximum value to the unnecessary side.

4.3 Positioning Parameters

4.3.1 Positioning Parameters

Setting the units used

PARA. 0: System of units

Set the units used for the position and the speed.

Table 4.2: System of units

FX2N-10GM	FX2N-20GM
Setting = "0" :Controls the position based on "mm, deg, 1/10 inch, etc.", which is called the mechanical system of units.	
Setting = "1" :Controls the position based on "PLS" (pulses), which is called the motor system of units (initial value).	
Setting = "2" :Controls the position using the mechanical system of units and the speed using the motor system of units, which is called the combined system of units.	

In accordance with the setting of PARA. 0, the parameters are expressed in the units shown in the table below.

Table 4.3: Unit of parameter

PARA No.	"0": Mechanical	"1": Motor	"2": Combined
No.1, No.2	Setting required	Ignored	Setting required
No.3	mm, deg, 10 ⁻¹ inch	PLS	mm, deg, 10 ⁻¹ inch
No.4, No.5, No.6 No.13, No.14	cm/min, ×10deg/min, inch/min	Hz	Hz

PARA. 1 and PARA. 2 are valid only when PARA. 0 is set to "0 (mechanical system of units)" or "2 (combined system of units)".

They are ignored when PARA. 0 is set to "1 (motor system of units)".

The relationship between the motor system of units and the combination system of units is expressed in the following formula.

$$\text{Motor system of units (PLS)} = \frac{\text{PARA.1 (A)} \times \text{Travel (mm, deg, inch)} \times 10^{-1}}{\text{PARA.2} \times 10^{-3}}$$

PARA. 1: Pulse rate (The pulse rate is expressed as "A".)

Set the number of pulses per rotation of the motor to be given to the drive unit.

Table 4.4: Pulse rate

FX2N-10GM	FX2N-20GM
1 to 65,535 PLS/REV	

- When the servo motor is equipped with an electronic gear, its magnification should be taken into account. The relationship between the pulse rate and the electronic gear is as follows.

$$\text{Pulse rate (PARA.1)} = \frac{\text{Resolution of encoder (positioning feedback pulse)}}{\text{Electronic gear (CMX/CDV)}}$$

PARA. 2: Feed rate (The feed rate is expressed as "B".)

Set the travel of the machine per rotation of the motor.

Table 4.5: Feed rate

FX2N-10GM	FX2N-20GM
1 to 999,999 $\mu\text{m}/\text{REV}$	
1 to 999,999 mdeg/REV	
1 to 999,999 $\times 10^{-1} \text{minch}/\text{REV}$	

PARA. 3: Minimum command unit

Set the unit of travel specified by the positioning program.

Table 4.6: Minimum command unit

Setting in FX2N-20GM and FX2N-10GM	PARA No.0			
	Set value "0" : Mechanical system of units. Set value "2" : Combined system of units.			Set value "1" Motor system of units.
	mm	deg	inch *1	PLS
Set value: "0"	10^0	10^0	10^{-1}	10^3
Set value: "1"	10^{-1}	10^{-1}	10^{-2}	10^2
Set value: "2"	10^{-2}	10^{-2}	10^{-3}	10^1
Set value: "3"	10^{-3}	10^{-3}	10^{-4}	10^0

*1: 10^{-1} inch = 2.54 mm

Example:

When PARA. 0 is set to "0", PARA. 3 is set to "2", and " $\times 10^{-2}$ mm" is selected:
In the case of "cod 00 (DRV) x1000 y2000", x is set to "10 mm" and y is set to "20 mm".

When PARA. 0 is set to "1", PARA. 3 is set to "2", and " $\times 10^1$ PLS" is selected:
In the case of "cod 00 (DRV) x1000 y2000", x is set to "10,000 PLS" and y is set to "20,000 PLS".

Concept of mechanical system of units

When PARA. 0 (system of units) is set to "0" or "2", the mechanical system of units ("mm", "deg", "inch", etc.) is selected. At this time, there is no parameter to select either one among "mm", "deg", "inch", etc. However, because all of the positioning parameters as well as the positioning data and the speed data used in the positioning program adopt one same unit, the same pulse output is acquired without regard to the unit as far as the set value is equivalent.

Example:

Condition

Pulse rate	:4,000 [PLS/REV]
Feed rate	:100 [$\mu\text{m}/\text{REV}$, mdeg/REV, $\times 10^{-1}$ minch/REV]
Minimum command unit	:3 (The movement quantity is regarded as " 10^{-3} mm", " 10^{-3} deg" or " 10^{-4} inch".)
Electronic gear in servo amplifier	:1/1

When you set values in "mm"

In a positioning operation with the movement quantity of 100 [$\times 10^{-3}$ mm] and the operation speed of 6 [cm/min], the following pulse output is given.

$$\begin{aligned}\text{Generated pulse quantity} &= \text{Movement quantity}^{*1} / \text{Feed rate}^{*1} \times \text{Pulse rate} \\ &= 100 [\times 10^{-3} \text{ mm}] / 100 [\mu\text{m}/\text{REV}] \times 4,000 [\text{PLS}/\text{REV}] \\ &= 4,000 [\text{PLS}]\end{aligned}$$

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

*1 The unit is aligned during calculation. 1 mm = $10^3 \mu\text{m}$, 1 cm = $10^4 \mu\text{m}$, 1 min = 60 s

When you set values in "deg"

In a positioning operation with the movement quantity of 100 [$\times 10^{-3}$ deg] and the operation speed of 6 [deg/min], the following pulse output is given.

$$\begin{aligned}\text{Generated pulse quantity} &= \text{Movement quantity}^{*2} / \text{Feed rate}^{*2} \times \text{Pulse rate} \\ &= 100 [\times 10^{-3} \text{ deg}] / 100 [\text{mdeg}/\text{REV}] \times 4,000 [\text{PLS}/\text{REV}] \\ &= 4,000 [\text{PLS}]\end{aligned}$$

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

*2 The unit is aligned during calculation. 1 deg = 10^3 mdeg, 1 min = 60 s

When you set values in "inch"

In a positioning operation with the movement quantity of 100 [$\times 10^{-4}$ inch] and the operation speed of 6 [inch/min], the following pulse output is given.

$$\begin{aligned}\text{Generated pulse quantity} &= \text{Movement quantity}^{*3} / \text{Feed rate}^{*3} \times \text{Pulse rate} \\ &= 100 [\times 10^{-4} \text{ inch}] / 100 [\times 10^{-1} \text{ minch}/\text{REV}] \times 4,000 [\text{PLS}/\text{REV}] \\ &= 4,000 [\text{PLS}]\end{aligned}$$

$$\begin{aligned}\text{Pulse frequency} &= \text{Operation speed}^{*3} / \text{Feed rate}^{*3} \times \text{Pulse rate} \\ &= 6 [\text{inch}/\text{min}] \times 10^4 / 60 / 100 [\times 10^{-1} \text{ minch}/\text{REV}] \times 4,000 [\text{PLS}/\text{REV}] \\ &= 40,000 [\text{Hz}]\end{aligned}$$

*3 The unit is aligned during calculation. 1 inch = 10^3 minch, 1 min = 60 s

How to use an electronic gear

Some servo motors require pulse trains at 200 kHz or more (in calculation) in order to satisfy the rated rotation speed. For example, the command pulse frequency required to operate the HC-MF Series servo motor manufactured by Mitsubishi at the rated rotation speed of 3,000 rev/min can be obtained as follows. (Suppose that the electronic gear ratio is the initial value "1/1".)

$$f_0 = P_t \times \frac{N_0}{60} \times \frac{CDV}{CMX}$$

$$f_0 = 8,192 \times \frac{3,000}{60} \times 1$$

$$f_0 = 409,600 \text{ [Hz]}$$

f_0 : Command pulse frequency [Hz] (open collector type)

CMX: Electronic gear (numerator of command pulse magnification)

CDV: Electronic gear (denominator of command pulse magnification)

N_0 : Rotation speed of servo motor [rev/min]

P_t : Resolution of encoder (positioning feedback pulse) [PLS/REV]
(P_t is "8,192" in the HC-MF Series.)

However, because the input command pulse in the open collector type servo amplifier and the pulse output from the positioning unit is 200 kHz (100 kHz during interpolation operation) maximum, operation at 409,600 Hz is impossible.

In such a case, you should change the electronic gear in the servo amplifier.

The electronic gear can be obtained as follows.

$$\frac{CMX}{CDV} = P_t \times \frac{N_0}{60} \times \frac{1}{f_0}$$

$$\frac{CMX}{CDV} = 8,192 \times \frac{3,000}{60} \times \frac{1}{200,000}$$

$$\frac{CMX}{CDV} = \frac{256}{125}$$

f_0 : Command pulse frequency [Hz]
(open collector type)

CMX: Electronic gear (numerator of command pulse magnification)

CDV: Electronic gear (denominator of command pulse magnification)

N_0 : Rotation speed of servo motor [rev/min]

P_t : Resolution of encoder
(positioning feedback pulse) [PLS/REV]
(P_t is "8,192 PLS/REV" in the HC-MF Series.)

The table below shows the setting of major electronic gears and pulse rates obtained by the above calculation.

Table 4.7: Setting of major electronic gears and pulse rates

Rated rotation speed of servo motor	Servo amplifier		Command pulse frequency (200 kHz)		Command pulse frequency (100 kHz) (during interpolation operation)	
	Maximum input pulse frequency	Encoder resolution (feedback pulse)	Electronic gear	Pulse rate (PARA.1)	Electronic gear	Pulse rate (PARA.1)
3,000 r/min	200 kHz (open collector)	4,000 PLS/REV	1/1	4,000 PLS/REV	2/1	2,000 PLS/REV
		8,192 PLS/REV	256/125		512/125	
		16,384 PLS/REV	512/125		1024/125	
2,000 r/min	200 kHz (open collector)	4,000 PLS/REV	2/3 *1	6,000 PLS/REV	4/3	3,000 PLS/REV
		16,384 PLS/REV	1024/375	6,000 PLS/REV	2048/375	1,500 PLS/REV
1,000 r/min	200 kHz (open collector)	4,000 PLS/REV	1/3 *1	12,000 PLS/REV	2/3 *1	6,000 PLS/REV
		16,384 PLS/REV	512/375	12,000 PLS/REV	1024/375	3,000 PLS/REV

*1 If the electronic gear is less than "1/1", you can set it to "1/1" and limit the command pulse frequency given by the positioning unit. In such a case, make sure that the rotation speed of the servo motor does not exceed the maximum rotation speed. (You can set the maximum speed by PARA. 4 in the positioning unit.)

The actual values may be different depending on the specifications of the used servo motor/ servo amplifier and the required operation speed. Thoroughly read the instruction manuals of the servo motor and the servo amplifier, then set proper values in accordance with the required application.

PARA. 4: Maximum speed

Set the maximum speed in this parameter. When the speed is not specified in a positioning program, the machine operates at the speed set here. Other speeds must be set to a value equivalent to or less than this maximum value.

Table 4.8: Maximum speed

FX2N-10GM	FX2N-20GM
Mechanical system :0 to 153,000 (cm,/min, 10deg-min, inch/min) *1	
Motor system :0 to 200,000 Hz	

*1: 200 kHz or less when converted into pulses.

PARA. 5: Jog speed

Set the speed for manual operation (by FWD/RVS input ON or JOG+/- operation from a peripheral unit).

Set a value equivalent to or less than the value set to PARA. 4 above.

Table 4.9: Jog speed

FX2N-10GM	FX2N-20GM
Mechanical system :0 to 15,300 (cm,/min, 10deg-min, inch/min) *1	
Motor system :0 to 200,000 Hz	

*1: 200 kHz or less when converted into pulses.

PARA. 6: Bias speed (Invalid during interpolation)

Set the speed adopted when the system is started.

Table 4.10: Bias speed

FX2N-10GM	FX2N-20GM
Mechanical system :0 to 15,300 (cm,/min, 10deg-min, inch/min) *1	
Motor system :0 to 200,000 Hz	

*1: 20 kHz or less when converted into pulses.

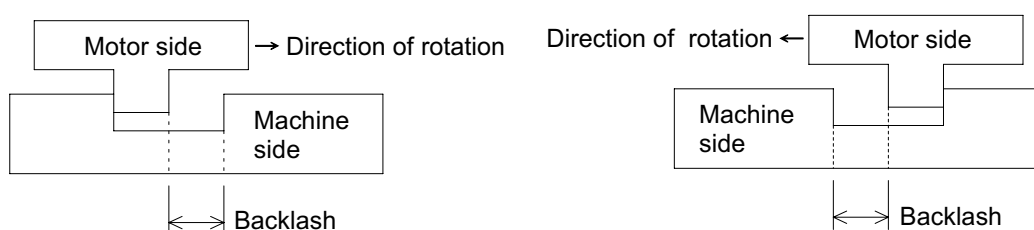
PARA. 7: Backlash compensation (Valid exclusively for the cod 00 instruction.)

When the rotation direction is reversed by the cod 00 (DRV) instruction, the compensation quantity set to this parameter is automatically added to the travel quantity, then positioning is performed. However, the compensation quantity is not added to the present value register.

When you operate the machine by the cod00 (DRV) instruction immediately after turning on the power, the machine corrects the backlash while regarding the case as the situation after operation in the direction in which the current value increases.

- The machine does not perform interpolation while the cod00 instruction sets an operation in the direction in which the current value increases.
- The machine performs interpolation while the cod00 instruction sets an operation in the direction in which the current value decreases.

When you operate the machine by any instructions other than an instruction for JOG operation, instruction for returning to the zero point or the cod00 instruction immediately after turning on the power, the machine corrects the backlash for an operation just before the cod00 (DRV) instruction when reversing the rotation direction.



Other compensations as follows can be performed in the positioning program.

Cod73 (MOVC):Travel compensation, cod74 (CNTC):Center point compensation, cod75 (RADC):Radius compensation, cod76 (CANC):Cancel of compensation (except the backlash).

Table 4.11: Backlash compensation

FX2N-10GM	FX2N-20GM
Mechanical system of units:0 to 65,535 *1	
Motor system of units :0 to 65,535 PLS	

*1: The unit is decided by PARA.3. The pulse conversion value must become 65,535 PLS or less.

PARA. 8: Acceleration time

Set the time required to achieve the maximum speed.

Table 4.12: Acceleration time

FX2N-10GM	FX2N-20GM
0 to 5,000ms	

When PARA. 8 is set to "0", the machine actually accelerates in 1 ms.

PARA. 9: Deceleration time

Set the time required to stop the machine.

Table 4.13: Deceleration time

FX2N-10GM	FX2N-20GM
0 to 5,000 ms	

When PARA. 9 is set to "0", the machine actually decelerates in 1 ms.

PARA. 10: Interpolation time constant

Set the time required to achieve the speed specified by the program. (The bias speed is always regarded as "0".) This parameter is valid while interpolation control is performed in the FX2N-20GM.

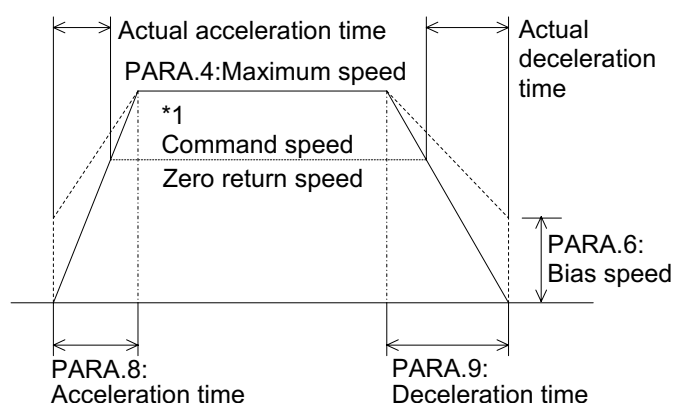
Table 4.14: Interpolation time constant

FX2N-10GM	FX2N-20GM
0 to 5,000 ms *1	0 to 5,000 ms

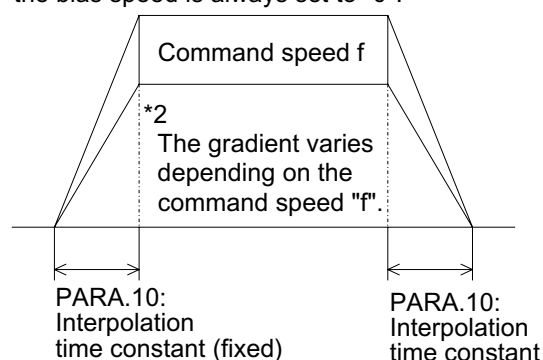
*1 In the FX2N-10GM, acceleration/deceleration time is set to the value set in this parameter when the cod 01/ cod 31 command is used.

The parameters explained on the previous page have the relationship shown in the figure below.

Cod 00/28/30/71/72: Manual operation.



When the cod 01/02/03/31 instruction is used, the bias speed is always set to "0".



*1 The acceleration time indicates the time required to achieve the maximum speed. Accordingly, when all of the command speed, the zero return speed and the jog speed are equivalent to or less than the maximum speed, the actual acceleration time becomes shorter.

*2 The interpolation time constant is always fixed while interpolation control is performed. Accordingly, the gradient of acceleration/deceleration varies depending on change in the command speed. If the speed is not specified, "100 kHz" is automatically set to the FX2N-20GM and "200 kHz" to the FX2N-10GM. In the FX2N-10GM, multistep speed operation is performed.

The parameters explained on the previous page have the relationship shown in the figure below.

$$\text{Speed command value} \times \frac{\text{PARA. 1 (PLS / REV)}}{\text{PARA. 2 (\mu m/REV, mdeg/REV, } 10^{-1} \text{ minch/REV)}} \times \frac{10^4}{60}$$

Unit matching

$\frac{10^4}{60}$

$\left(\begin{array}{l} \text{cm/min} \\ 10\text{deg/min} \\ \text{inch/min} \end{array} \right)$

Make sure that the values obtained by the above equation are within the following ranges.

Value of PARA. 4 / PARA. 5 \leq 200,000 Hz

Value of PARA. 6 \leq 20,000 Hz

PARA. 11: Pulse output format

Set the pulse output format for the drive unit.

Table 4.15: Pulse output format

FX2N-10GM	FX2N-20GM
Setting = "0": Forward rotation pulses and reverse rotation pulses.	
Setting = "1": Rotation pulses and direction specification (Interpolation operations are not possible). Refer to figures below for the pulse format. *1	

The LED on the positioning unit is lit when the pulse waveform is at the L level (when the transistor is ON).

Table 4.16: Pulse output chart

Setting = "0" FP = forward rotation pulses. RP = reverse rotation pulses.	Setting = "1" FP = rotation pulses. RP = direction specification.

*1: During interpolation operation (cod1, cod2, cod3) or when a manual pulse generator is used, the pulse output format is 'forward rotation pulses and reverse rotation pulses.' (It is irrelevant to the setting of PARA. 11.)

PARA. 12: Rotation direction

Set the rotation direction of the motor.

Table 4.17: Rotation direction

FX2N-10GM	FX2N-20GM
Setting = "0" : The present value increases when forward rotation pulses (FP) are output.	
Setting = "1" : The present value decreases when forward rotation pulses (FP) are output.	

PARA. 13: Zero return speed

Set the speed adopted when the machine is returning to the zero point. The set value must be equivalent to or less than the maximum speed set to PARA. 4.

Table 4.18: Zero return speed

FX2N-10GM	FX2N-20GM
Mechanical system : 1 to 153,000 (cm/min, x10deg/min, inch/min) *1	
Motor system : 10 to 200,000 Hz	

*1: 200 kHz or less when converted into pulses.

PARA. 14: Creep speed

Set the low speed adopted after the near-point DOG signal is turned ON.

Table 4.19: Creep speed

FX2N-10GM	FX2N-20GM
Mechanical system : 1 to 15,300 (cm/min, x10deg/min, inch/min) *1	
Motor system : 10 to 200,000 Hz	

*1: 200 kHz or less when converted into pulses.

PARA. 15: Zero return direction

Set the direction in which the machine travels when the zero return instruction is given.

Table 4.20: Zero return direction

FX2N-10GM	FX2N-20GM
Setting = "0" : Direction in which the present value increases.	
Setting = "1" : Direction in which the present value decreases.	

PARA. 16: Machine zero point address

Set the present address at which the machine is placed when the zero return operation is completed.

Table 4.21: Machine zero point address

FX2N-10GM	FX2N-20GM
-999,999 to +999,999	

The units of the set value are determined by PARA. 0 and PARA. 3. The value set here is treated as an absolute address. Set this parameter to "0" when absolute position detection (ABS) is performed.

PARA. 17: Zero point signal count

Set the number of zero point signals to be counted after the DOG switch input is turned ON or OFF (The count timing is set by PARA. 18.) until the machine is stopped. One zero point signal pulse is output per rotation of the motor (in the case of a servo motor) in general.

Table 4.22: Zero point signal count

FX2N-10GM	FX2N-20GM
0 to 65,535	



When PARA. 17 is set to "0", the machine immediately stops when the DOG input turns on or off. (You can set the counting timing by PARA. 18.) At this time, the machine drastically stops from the zero point return speed (PARA. 13).

If the machine may be damaged by drastic stop, set parameters so that the machine safely decelerates to the creep speed (PARA. 14), then stops.

PARA. 18: Zero signal count start timing

Set the point at which the zero signal count is started.

Table 4.23: Zero signal count start timing

FX2N-10GM	FX2N-20GM
Setting = "0": When the front end of the near-point dog reaches the DOG switch (OFF to ON).	
Setting = "1": When the rear end of the near-point dog reaches the DOG switch (ON to OFF).	
Setting = "2": When the near-point dog is not used.	

PARA. 19: DOG switch input logic

Set the DOG switch input logic.

Table 4.24: DOG switch input logic

FX2N-10GM	FX2N-20GM
Setting = "0" : Normally open. (The DOG switch is closed at the near-point.)	
Setting = "1" : Normally closed. (The DOG switch is opened at the near-point.)	

PARA. 20: Limit switch logic

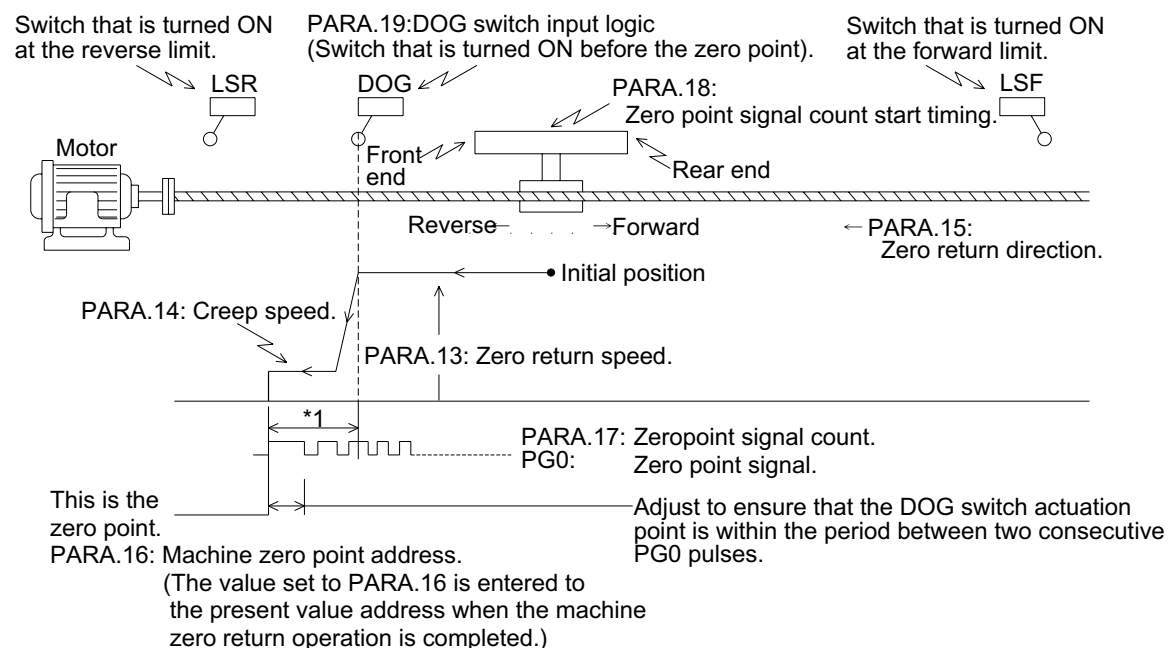
Set the logic of the limit switch (LS) used to confirm the machine operation limit. Apart from the limit switches, software limits (set by PARA. 25 and PARA. 26) are also available.

Table 4.25: Limit switch logic

FX2N-10GM	FX2N-20GM
Setting = "0" : Normally open. (The limit switch is closed at the limit.)	
Setting = "1" : Normally closed. (The limit switch is opened at the limit.)	

PARA. 13 to PARA. 20 control the portion shown in the figure below.

For the details of return to the zero point, refer to "8.2.1 Zero point return control instruction".



*1 The number of zero point signal pulses (PG0) sent from the drive unit to the positioning unit is counted, and operation is stopped when this number reaches the specified value. Usually, one zero point pulse is generated per rotation of the motor.

The machine zero return command can be given by either of the following four methods.

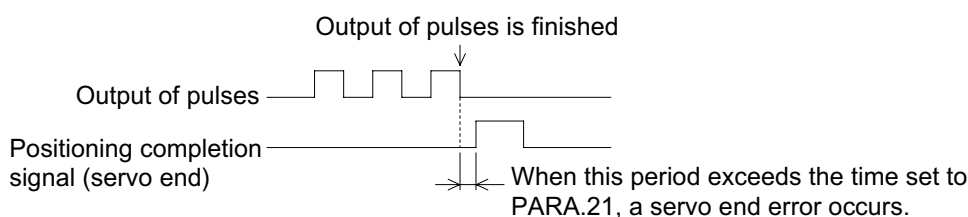
- 1) Turning ON an external input (from the [ZRN] terminal).
- 2) Executing the cod 28 (DRVZ, machine zero return) command.
- 3) Sending the machine zero return command from a peripheral unit.
- 4) Turning ON the special auxiliary relay (M9008 for the X axis and M9024 for the Y axis).

PARA. 21: Positioning completion error evaluation time

If the positioning completion signal is not entered within the time set to this parameter when output of pulses is finished, a servo end error occurs. When the servo end check instruction (cod 09 (CHK)) or an instruction (cod 00 (DRV), cod 28 (DRVZ), etc. For details, refer to Section 5.) which automatically performs the servo end check is executed, evaluation is performed within the set time. When "0" is set to this parameter, the servo end check is not performed.

Table 4.26: Positioning completion error evaluation time

FX2N-10GM	FX2N-20GM
0 to 5000 msec (When set to "0", the servo end check is not performed).	



If the used motor is not equipped with the positioning completion signal, set the wiring so that it always gives the servo end signal (by always turning on the SVEND signal) or set PARA. 21 to "0". For the wiring, refer to Paragraph 3.2.7.

PARA. 22: Servo ready check

Set whether or not to confirm the ready signal (to notify preparation completion) of the servo motor.

Table 4.27: Servo ready check

FX2N-10GM	FX2N-20GM
Setting = "0" : Valid. Pulses are output exclusively when the servo motor is in the ready status.	
Setting = "1" : Invalid. Pulses are output even when the servo motor is not in the ready status.	

If the used motor is not equipped with the servo ready signal, set the wiring so that it always gives the servo ready signal (by always turning on the SVRDY signal) or set PARA. 22 to "1". For the wiring, refer to Paragraph 3.2.7.

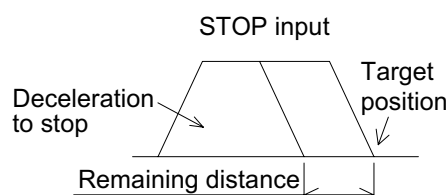
PARA. 23: Stop mode

Set the operation mode of the positioning program when the stop instruction is entered (that is, when the external input terminal [STOP] or the special auxiliary relays M9002 for the X axis and M9018 for the Y axis is turned ON).

Table 4.28: Stop mode

	FX2N-10GM	FX2N-20GM
Setting = "0" or "4"	: The STOP command is invalid (in the AUTO mode). However, error reset is valid in the MANU mode.	
Setting = "1"	: The machine decelerates to stop when the STOP command is given, and restarts its operation from the remaining distance when the START command is given (The remaining distance is valid). (Program execution jumps to END while interpolation or interrupt positioning is performed.)	
Setting = "2"	: The machine decelerates to stop when the STOP command is given, and restarts its operation from the next step when the START command is given (The remaining distance is ignored, and program execution jumps to "NEXT".) (Program execution jumps to END while interpolation or interrupt positioning is performed.) When the STOP command is given while the cod 04 (TIM) instruction is executed, program execution immediately proceeds to the next step while ignoring the remaining time.	
Setting = "3" or "7"	: The machine decelerates to stop when the STOP command is given, and program execution jumps to END while ignoring the remaining distance. When the STOP command is given while the cod 04 (TIM) instruction is executed, program execution immediately proceeds to the next step while ignoring the remaining time. When the STOP command is given during the m code standby, the m code No. is changed into "m02 (END)" but the m code ON signal remains ON.	
Setting = "5"	While the cod 31 instruction is executed in the FX2N-10GM, the remaining distance drive is performed in the setting "1" or "5", and the NEXT jump is executed in the setting "2" or "6". (Program execution jumps to END while interrupt positioning is performed.)	: The remaining distance drive is performed in the same way as "1" even while interpolation is performed (when the M9015 (continuous path mode) is OFF). (Program execution jumps to END while interrupt positioning is performed.)
Setting = "6"		: The NEXT jump is executed in the same way as "2" even while interpolation is performed (when the M9015 (continuous path mode) is OFF). (Program execution jumps to END while interrupt positioning is performed.)

- "While interpolation is performed" indicates that the cod 01/02/03/31 instruction is executed.
- "While interrupt is performed" indicates that the cod 71/72 instruction is executed.
- The "remaining distance drive" indicates to drive the distance between the position in which the machine was stopped by the STOP command and the target position. The "NEXT" jump does not drive this distance but performs the operation from the next step of the program.



Operation caused by STOP command**Table 4.29: Operation caused by STOP command**

Setting	FX2N-10GM	FX2N-20GM	Operation caused by STOP command		
			Remaining distance	Timer	m code
0, 4	✓	✓	The machine does not stop	The machine does not stop	Not changed
1	✓	✓	Valid	*1	Not changed *3
2	✓	✓	Ignored	*2	Not changed *3
3, 7	✓	✓	Ignored	*2	*4
5	—	✓	Valid	*1	Not changed *3
6	—	✓	Ignored	*2	Not changed *3

*1 The timer stops. The machine is driven for the remaining time.

*2 The timer stops. The machine is not driven for the remaining time.

*3 The m code ON signal does not change by the stop command while the machine is waiting for the m code.

Accordingly, when performing positioning after jump by the NEXT instruction, the m code OFF command is required before the positioning start command.

*4 The m code No. changes into m02 (END). However, the m code ON signal does not change.

PARAM. 24: Electrical zero point address

Set the absolute address for electrical zero return executed by the cod 30 (DRVR) instruction.

Table 4.30: Electrical zero point address

FX2N-10GM	FX2N-20GM
-999,999 to +999,999	

The unit is determined by PARAM. 0 and PARAM. 3. The address set by PARAM. 24 represents an absolute value.

PARAM. 25: Software limit (upper)

When the present value becomes equal to or more than the set value, a limit error occurs.

Table 4.31: Software limit (upper)

FX2N-10GM	FX2N-20GM
Set a 32-bit value within the following range. -2,147,483,648 to +2,147,483,647	

PARA. 26: Software limit (lower)

When the present value becomes equal to or less than the set value, a limit error occurs.

Table 4.32: Software limit (lower)

FX2N-10GM	FX2N-20GM
Set a 32-bit value within the following range. -2,147,483,648 to +2,147,483,647	

- When the software limit is reached, the machine is immediately stopped in the same way as a stop caused by the limit switches (limit error).
- The software limit becomes valid after a zero return operation or an absolute position detection is performed. After either operation is performed, the present value establish flags M9144 (for the X axis) and M9145 (for the Y axis) are turned ON (The M9144 only is turned ON in the FX2N-10GM.).
- When the value set to PARA. 25 is equal to or less than the value set to PARA. 26, the software limit function is invalid.
- When a limit error occurs, the error code 4004 is actuated. Jog operation in the opposing direction is possible even in the error status. When the machine is returned from an area beyond the limit position, the error is reset.

4.3.2 I/O Control Parameters

This section explains the settings of the parameters to read the program No., output the m code and detect the absolute position by utilizing the general purpose I/Os of the positioning unit.

PARA. 30: Program No. specification method

Set the program No. specification source. The program No. can be specified from the positioning unit or the programmable controller.

Table 4.33: Program No. specification method

FX2N-10GM	FX2N-20GM
Setting = "0": The program No. is fixed to "0".	
Setting = "1": The program No. consisting of one digit is specified in a range "00" to "09" by an external digital switch.	
Setting = "2": The program No. consisting of two digits is specified in a range "00" to "99" by an external digital switch.	
Setting = "3": The program No. is specified by the special data registers (D). (To specify the program No. from the programmable controller use this setting.) *The program No. is set by D9000 (for simultaneous 2-axis or the X axis (including the FX2N-10GM)) and D9010 (for the Y axis).	

[Specification by the digital switch (DSW)]

When PARA. 30 is set to "1" or "2", the following parameters must be set. (These parameters are invalid when PARA. 30 is set to "0" or "3".)

PARA. 31: Head input No. for DSW time-sharing reading

Specify the head input No. of the four input points (1, 2, 4 and 8) for the DSW data.

Table 4.34: Head input No. for DSW time-sharing reading

FX2N-10GM	FX2N-20GM
X0	X0 to X64 X372 to X374

PARA. 32: Head output No. for DSW time-sharing reading

Specify the output destination for the DSW data.

Table 4.35: Head output No. for DSW time-sharing reading

FX2N-10GM	FX2N-20GM
Y0 to Y5	Y0 to Y67

When PARA.30 is set to "1", one output point is occupied.

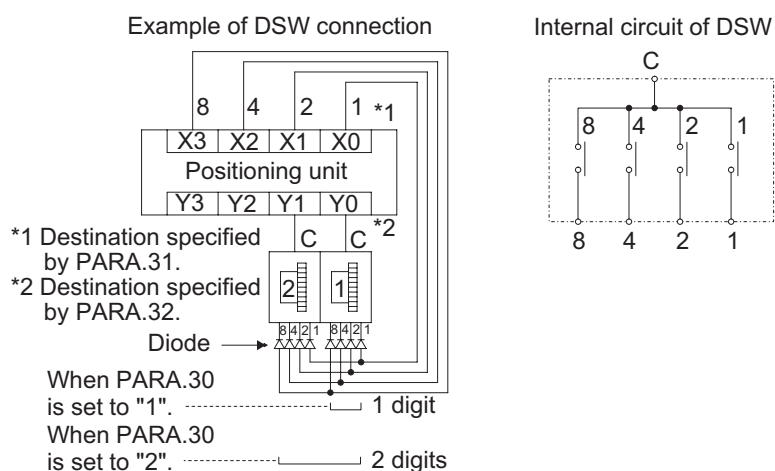
When PARA.30 is set to "2", two output points are occupied.

PARA. 33: DSW reading interval

Set the interval during which the DSW data is read (ON time of the output set by PARA. 32).

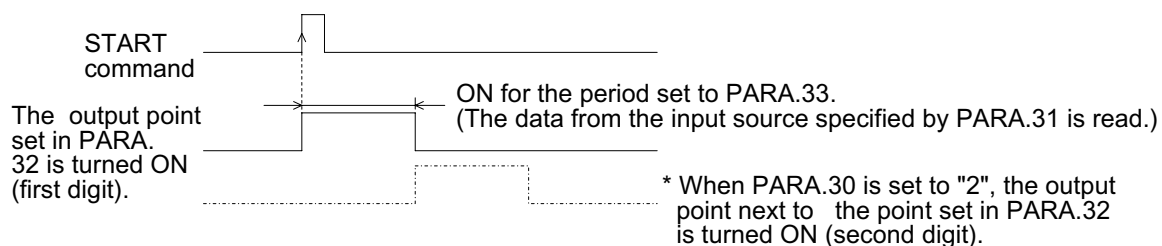
Table 4.36: DSW reading interval

FX2N-10GM	FX2N-20GM
7 to 100 msec (increment:1 msec)	



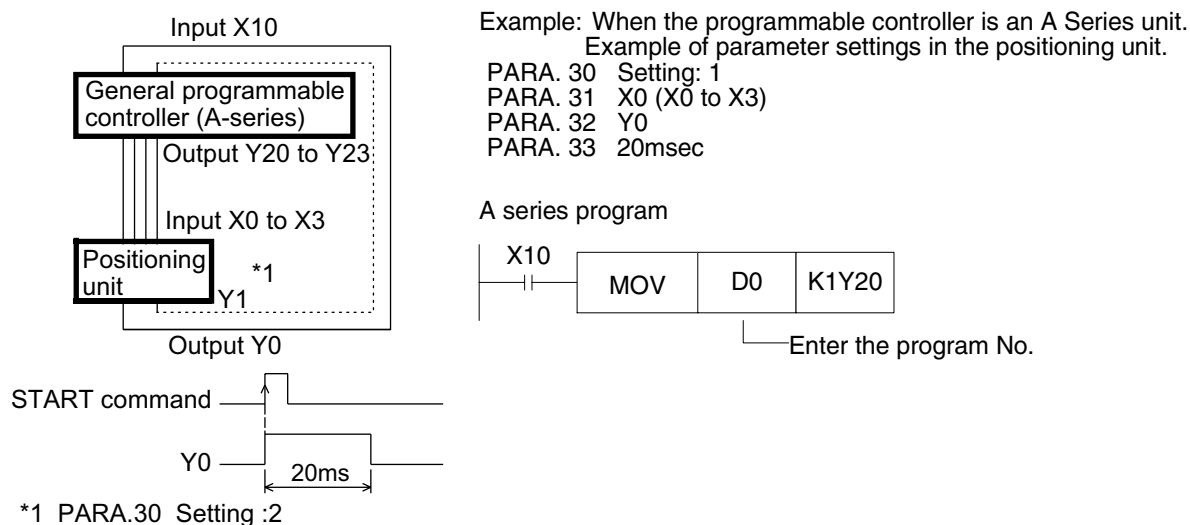
When PARA. 30 is set to "2", attach 50 V, 0.1 A diodes to the digital switch to prevent revolving paths.

The DSW data to specify the program No. to be executed is automatically read immediately after the START command is given even if the EXT instruction is not given.



Specifying the program No. from a general programmable controller

When specifying the program No. from any programmable controller other than an FX2N/FX3U/FX2NC/FX3UC Series unit, perform the following procedure. (When an FX2N/FX3U/FX2NC/FX3UC Series unit is connected, the program No. can be specified via communication with the buffer memory.)



PARA. 34: Ready (RDY) output valid

Set whether or not to output the ready (preparation completion) signal of the positioning unit.

Table 4.37: Ready (RDY) output valid

FX2N-10GM	FX2N-20GM
Setting = "0" : Invalid	
Setting = "1" : Valid (PARA.35 must be set.)	

PARA. 35: RDY output No.

Set the output point No. from which the RDY signal is output when PARA. 34 is set to "1". (One point is occupied.)

Table 4.38: RDY output No.

FX2N-10GM	FX2N-20GM
Y0 to Y5	Y0 to Y67

PARA. 36: m code external output valid

Set whether or not the m code is output to the outside using general-purpose output of the positioning unit.

(When the positioning unit is connected to the FX2N/FX3U/FX2NC/FX3UC Series PLC, the m code can be sent through communication with the buffer memory.)

Table 4.39: m code external output valid

FX2N-10GM	FX2N-20GM
Setting = "0" : Invalid	
Setting = "1" : Valid (PARA.37 and PARA.38 must be set.)	

Even when PARA. 36 is set to "0 (invalid)", the special relays and the special data registers (such as the m code, the m code ON signal, the m code OFF signal, etc.) related to the m code are still valid. When PARA. 36 is set to "1", PARA. 37 and PARA. 38 must be set.

PARA.37: m code external output No.

Specify the head No. of the output destination of the m code from the positioning unit.

This parameter occupies 6 points in the FX2N-10GM, and 9 points in the FX2N-20GM.

Table 4.40: m code external output No.

FX2N-10GM	FX2N-20GM
Y0 m code ON output: Y0 (1 point) m code output (1-digit BCD): Y1 to Y5*1 (5 points) Occupies 6 points in total.	Y0 to Y57 m code ON output: Specified head No. (1 point) m code output (2-digit BCD): Consecutive 8 points Occupies 9 points in total.

*1 Y1 to Y4 output one digit. Y5 turns on when the second digit is "1", "3", "5", "7" or "9".

(In the FX2N-10GM, the number of output points is fixed to "6". Accordingly, it outputs only one bit of the second digit.)

PARA. 38: m code OFF command input No.

Specify the input No. of the positioning unit to which the m code OFF command is entered.

Table 4.41: m code OFF command input No.

FX2N-10GM	FX2N-20GM
X0 to X3, X375 to X377	X0 to X67, X372 to X377

Example of a program in which output of m code to the outside is used

The program below shows an example of control in which auxiliary unit control commands are transferred to the PLC by I/O signals while using the FX_{2N}-20GM and a general PLC. In this program, the FX_{0N}-60MR is used as the general PLC.

(While the positioning unit is connected to the FX_{2N}/FX_{3U}/FX_{2NC}/FX_{3UC} Series PLC, m codes can be transferred via communication with the buffer memory.)

Description of operations

- 1) When a program including the m code is executed in the FX_{2N}-20GM, the m code output (Y10 to Y17) as 2-digit BCD and the m code ON signal (Y07) are turned ON.
- 2) The programmable controller converts them into binary and decodes them, then drives the specified auxiliary equipment control output in accordance with the decoded output.
- 3) In this example, when the m code "m** (** = 00 to 99)" is executed in the FX_{2N}-20GM, the auxiliary relay M** (** = 00 to 99 equivalent to the m code) in the programmable controller is turned ON.
- 4) The programmable controller confirms the operation of the auxiliary equipment, then drives the m code OFF command output (Y00).
- 5) When receiving the m code OFF command input (X07), the FX_{2N}-20GM turns OFF the m code ON signal (Y07) and processes the next instruction.

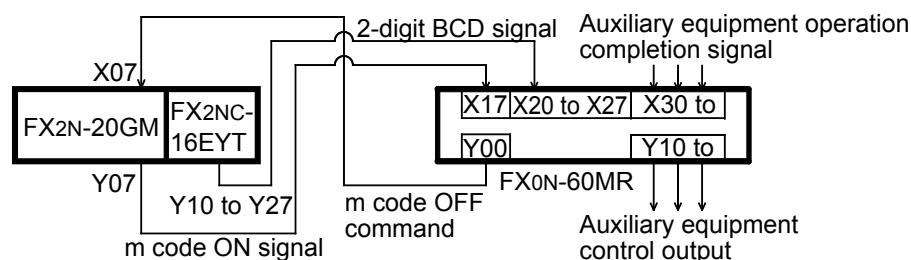
Set the parameters as follows.

PARA. 36: "1" External output of the m code is valid.

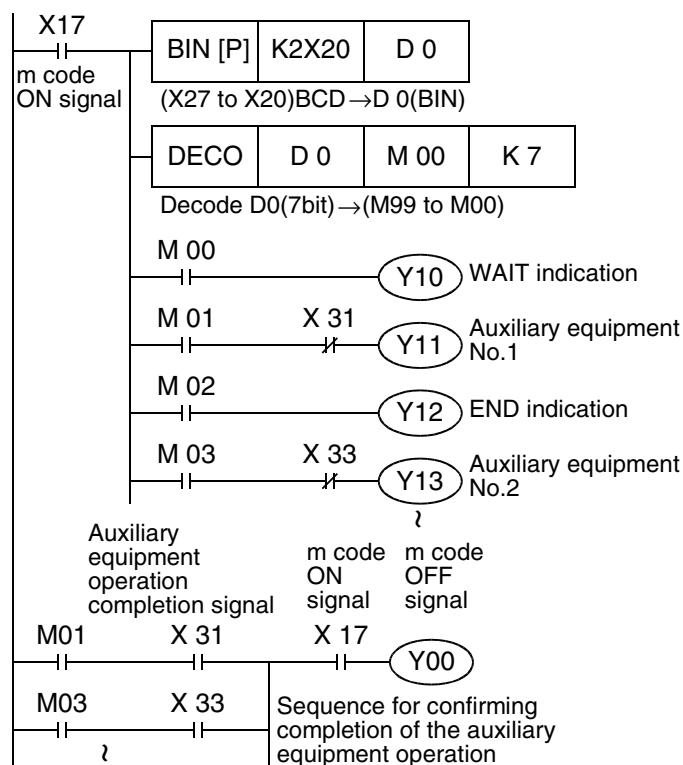
PARA. 37: "7" The head No. of the destination for m code output is set to "Y07".

PARA. 38: "7" The m code OFF command input No. is set to "X07".

I/O connection



Program in the programmable controller



PARA. 39: Manual pulse generator

Set whether or not to use manual pulse generators.

Table 4.42: Manual pulse generator

FX2N-10GM	FX2N-20GM
Setting = "0" : Invalid	Setting = "0" : Invalid
Setting = "1" : Valid (one pulse generator).	Setting = "1" : Valid (one pulse generator).
—	Setting = "2" : Valid (two pulse generators).

Set the manual pulse generator using parameters on the X axis side. (The setting on the Y axis side is ignored.) Refer to Table 4.46.

When you enable manual pulse generators by setting PARA. 39 to "1" or "2", you should set PARA. 40 to PARA. 42 also.

(In PARA. 40 to PARA. 42, set each of the X and Y axes respectively.)

PARA. 40: Multiplying factor per pulse generated by manual pulse generator

The input pulses are multiplied by a value set here, then output.

Table 4.43: Multiplying factor per pulse generated by manual pulse generator

FX2N-10GM	FX2N-20GM
1 to 255	

PARA. 41: Division rate for multiplied result

The input pulses multiplied by the value set to PARA. 40 are divided by the value set here.

Table 4.44: Division rate for multiplied result

FX2N-10GM	FX2N-20GM
—	2^n $n = 0 \text{ to } 7$

Multiplying factor and division rate

The number of input pulses is multiplied by the multiplying factor and divided by the division rate as follows.

$$\text{Number of input pulses entered from manual pulse generator} \times \frac{\text{PARA. 40 (multiplying factor: 1 to 255)}}{\text{PARA. 41 (division rate: } 2^n \text{) }^{*1}} = \text{Number of output pulses.}$$

*1 The dividing ratio is not available in the FX2N-10GM.

$$\text{Number of pulses input from manual pulse generator} \times \text{Magnification} = \text{Number of output pulses}$$

PARA.42: Head input No. for manual pulse generator enable (pulse input permission)

When the input No. set here is ON, the positioning unit receives the input from the manual pulse generator.

Table 4.45: Head input No. for manual pulse generator enable

Setting for the FX2N-10GM	Setting for the FX2N-20GM
X2 to X3 (One point is occupied.)	X2 to X67 (Two points are occupied.) When setting PARA.39 is "2", the range becomes X4 to X67.

The input No. of the manual pulse generator is fixed. However, the number of occupied points varies depending on the setting of PARA. 39.

Table 4.46: The input No. of the manual pulse generator is fixed

Input		FX2N-10GM	FX2N-20GM	
		PARA.39 "1"	PARA.39 "1"	PARA.39 "2"
These input Nos. are fixed.	X00	Phase A	Phase A	X axis, Phase A
	X01	Phase B	Phase B	X axis, Phase B
	X02	—	—	Y axis, Phase A
	X03	—	—	Y axis, Phase B
Set to PARA.42		Enable (ON)	Enable (ON)	X axis enable (ON)
Input number following setting PARA.42.		—	Switching between the X and Y axis. *1	Y axis enable (ON)

*1 When only one manual pulse generator is connected, it can be used for the X axis while the specified input is OFF or for the Y axis and while the specified input is ON.

- Operation by manual pulse generators is available in the MANU mode or while the positioning unit is waiting for END (m02) in the AUTO mode.
While the enable signal is ON in the status in which manual pulse generators are available, any other inputs is ignored except the MANU/AUTO changeover input.

- While manual pulse generators are used, the interrupt input No. from cod31 or cod72 instruction is not available because the input No. from the manual pulse generators overlaps the interrupt input No. from cod31 or cod72 instruction.
The interrupt input No. from cod71 instruction is fixed to X02 (when the FX_{2N}-10GM is used) or X04 and X05 (when the FX_{2N}-20GM is used). Make sure that X02 (or X04 and X05) does not overlap the setting of PARA. 42. (Refer to Paragraph 5.6.11.)

Example:

When PARA. 42 is 5 (X05):

X05 is turned ON : The input from the manual pulse generator is accepted. (Enable)

X06 is turned OFF: Manual pulse generator for X axis.

X06 is turned ON : Manual pulse generator for Y axis.

PARA. 50: ABS interface

Set whether or not the absolute position is detected.

When the absolute position is detected, the current value is automatically read from a servo motor equipped with the absolute position detection function. As a result, return to the zero point can be saved when the power is turned on again.

(Only when the system starts up for the first time, the machine should return to the zero point.)

Table 4.47: ABS interface

FX _{2N} -10GM	FX _{2N} -20GM
Setting = "0" : Invalid	
Setting = "1" : Valid	

When setting is "1", it is necessary to set PARA.51 and PARA.52.

PARA. 51: Head input No. for ABS

Set the head input No. of the input destination for the absolute position data.

Table 4.48: Head input No. for ABS

FX _{2N} -10GM	FX _{2N} -20GM
X0 to X2, X375 to X376(Two points are occupied.) Specified No. (head): ABS data bit 1. (Next No.): Send data ready.	X0 to X66(Two points are occupied.) Specified No. (head): ABS data bit 1. (Next No.): Send data ready.

PARA. 52: Head output No. for ABS control

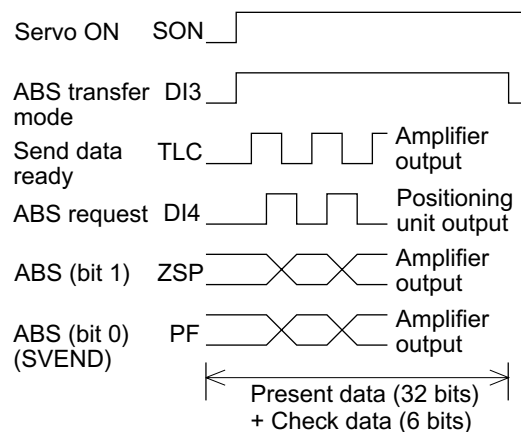
Set the head output No. of the destination for the absolute position data control.

Table 4.49: Head output No. for ABS control

FX2N-10GM	FX2N-20GM
Y0 to Y3 (Three points are occupied.) Specified device No. (head): ABS transfer mode. (Next No.): ABS request and servo ON.	Y0 to Y3 (Three points are occupied.) Specified device No. (head): ABS transfer mode. (Next No.): ABS request and servo ON.

Absolute position detection operation

- 1) When the power of the positioning unit is turned ON, it drives the servo ON output and the ABS transfer mode output.
- 2) In response to these outputs, 38(32+6)-bit data is communicated while receiving and sending are confirmed using the send data ready signal and the ABS request signal.
- 3) The data is transmitted via the 2-bit line (ABS bit 0 and ABS bit 1).
- 4) When detecting the absolute position, set PARA. 16 (machine zero point address) to "0".

**Storage destination for absolute position detection (FX2N-10GM V2.20 or later)**

V2.20 or later of the FX2N-10GM, when M9171 is turned ON (rising edge detection), the following actions are completed (MANU mode, ready):

- The value of D9301 and D9300 is written in program memory (EEPROM) as PARA50.
- The value of D9303 and D9302 is written in program memory (EEPROM) as PARA51.
- The value of D9305 and D9304 is written in program memory (EEPROM) as PARA52.

When the power supply of FX2N-10GM is turned ON again, each value in the storage destinations of the program memory becomes effective.

- If this function is used in conjunction with the table method, the absolute position detection function becomes possible due to the program in the PLC.
- Using a FX2N-10GM programming tool to set the parameter implies writing each parameter directly to the program memory is not needed.

PARAM. 53: Single-step operation

Set whether or not to perform the single-step operation.

Table 4.50: Single-step operation

FX2N-10GM	FX2N-20GM
Setting = "0" : Invalid	
Setting = "1" : Valid	

PARAM. 54 must be set when PARAM. 53 is set to "1 (valid)".

PARAM. 54: Single-step mode input No.

The single-step mode is valid while the input set here is ON.

Table 4.51: Single-step mode input No.

FX2N-10GM	FX2N-20GM
X0 to X3, X375 to X377 (One point is occupied.)	X0 to X67, X372 to X377 (One point is occupied.)

Single-step operation

The single-step mode is valid while PARAM. 53 is set to "1" and the input No. set to PARAM. 54 is ON. When the START signal is turned ON in the single-step mode, the specified program is executed one line at a time.

The single-step mode can be made available by turning ON the M9000 (for the X axis), M9001 (for the Y axis) or M9002 (for subtask) instead of using PARAM. 53 and PARAM. 54. If special auxiliary relays are used the setting of PARAM. 53 and PARAM. 54 is not necessary.

PARA. 56: General purpose input declaration for FWD/RVS/ZRN

The dedicated inputs FWD (forward rotation JOG), RVS (reverse rotation JOG) or ZRN (zero return) can be used as general purpose inputs.

When X372 to X377 (X375 to X377 in the FX_{2N}-10GM) are used for general purpose inputs in the parameters or the programs, this parameter must be set properly.

Table 4.52: General purpose input declaration for FWD/RVS/ZRN

Setting	FX _{2N} -10GM		FX _{2N} -20GM	
	Use X372 to X377 as general purpose input	FWD/RVS/ZRN signal valid	Special M signal valid	
0	Never	Always	Always	
1	In Auto mode	Manu mode only (not Auto mode).	Manu mode only (not Auto mode).	
2	Always	Never	Never	
3	In Auto mode	Manu mode only (not Auto mode).	Always	
4	Always	Never	Always	

The table below shows the details of the special auxiliary relays.
(Those for the X axis only are available in the FX_{2N}-10GM.)

Table 4.53: Special auxiliary relays

Details of command	X axis	Y axis
Machine zero return command	M9004	M9020
FWD JOG command	M9005	M9021
RVS JOG command	M9006	M9022

The table below shows the input No. when the dedicated inputs are used as general purpose inputs. (Those for the X axis only are available in the FX_{2N}-10GM.)

Table 4.54: General purpose inputs

Details of command	X axis	Y axis
ZRN	X375	X372
FWD	X376	X373
RVS	X377	X374

4.3.3 System Parameters

The system parameters set the positioning program memory size, the number of file registers, the battery status and items related to subtasks.

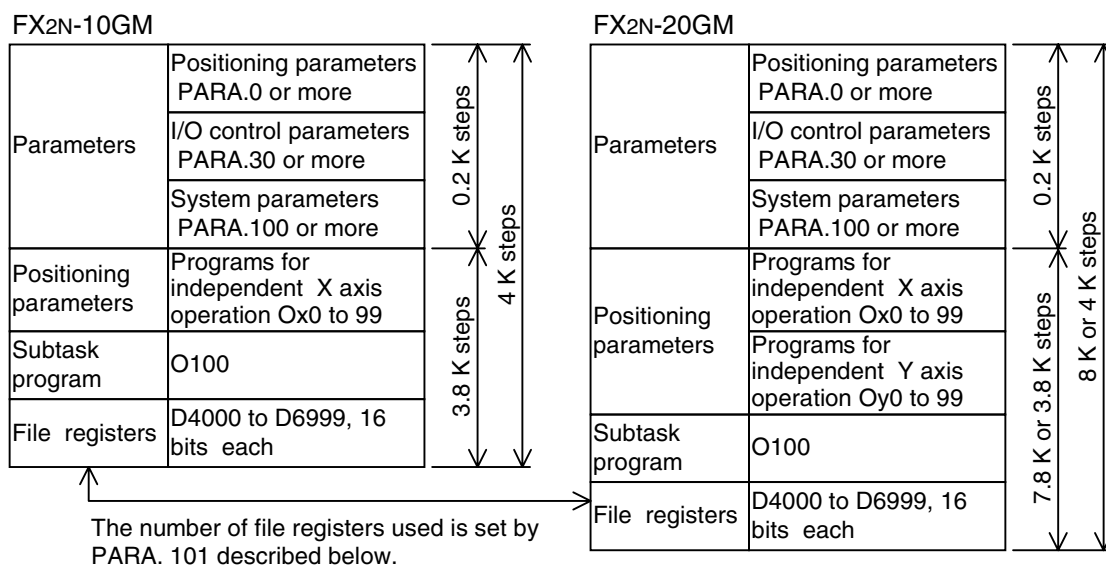
PARAM. 100: Memory size

Set the program memory size.

Table 4.55: Memory size

FX2N-10GM	FX2N-20GM
Setting = "1": 3.8K steps	Setting = "0": 7.8K steps
	Setting = "1": 3.8K steps

The program memory consists as follows.



PARAM. 101: File registers

Set the number of points used for file registers. One point requires one step of program memory. Serial numbers beginning with D4000 are valid as the file register Nos.

Table 4.56: File registers

FX2N-10GM	FX2N-20GM
Setting : 0 to 3000 Initial value:0	
	D4000 to D6999

PARAM. 102: Battery status

Set whether or not the LED on the front panel is lit and a warning signal is issued when the voltage of the FX2NC-32BL battery inside the FX2N-20GM becomes low.

(Batteries are not built in the FX2N-10GM.)

Table 4.57: Battery status

FX2N-10GM	FX2N-20GM			
	Setting	LED	GM output	M9127
—	0	ON	No output	OFF
	1	OFF	No output	ON
	2	ON	Output set in PARA.103 set ON	OFF

PARA. 103: Battery status output No.

Set the output No. in the FX_{2N}-20GM when PARA. 102 is set to "2".

Table 4.58: Battery status output No.

FX _{2N} -10GM	FX _{2N} -20GM
—	Setting = Output relay (Y) No. in a range of 0 to 67. Initial value=0

PARA. 104: Subtask start

Set the subtask start command timing.

Table 4.59: Subtask start

FX _{2N} -10GM	FX _{2N} -20GM
Setting = "0" : Starts a subtask when the mode is changed from MANU to AUTO (initial value)	
Setting = "1" : Starts a subtask when the input specified by PARA.105 is turned ON.	
Setting = "2" : Starts a subtask when the mode is changed from MANU to AUTO or when the input specified by PARA.105 is turned ON.	

PARA. 105: Subtask start input No.

Set the subtask start input No. when PARA. 104 is set to "1" or "2".

Table 4.60: Subtask start input No.

FX _{2N} -10GM	FX _{2N} -20GM
X0 to X3, X375 to X377	X0 to X67, X372 to X377

PARA. 106: Subtask stop

Set the subtask stop command timing.

Table 4.61: Subtask stop

FX _{2N} -10GM	FX _{2N} -20GM
Setting = "0" : Stops a subtask when the mode is changed from AUTO to MANU (initial value).	
Setting = "1" : Stops a subtask when the input specified by PARA.107 is turned ON or when the mode is changed from AUTO to MANU.	

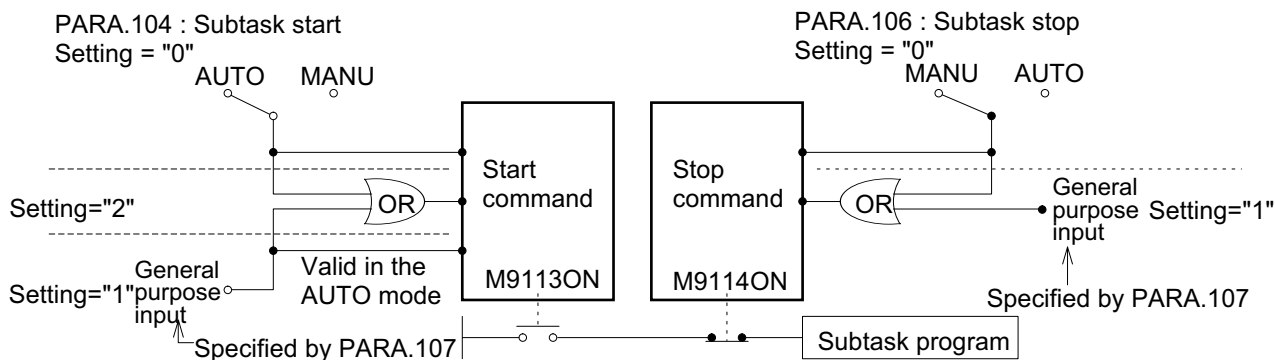
PARA. 107: Subtask stop input No.

Set the subtask stop input No. when PARA. 106 is set to "1".

Table 4.62: Subtask stop input No.

FX _{2N} -10GM	FX _{2N} -20GM
X0 to X3, X375 to X377	X0 to X67, X372 to X377

Subtask start/stop configuration diagram



PARA. 108: Subtask error

Set whether or not the positioning unit outputs an error when the error occurs in the subtask.

Table 4.63: Subtask error

FX2N-10GM	FX2N-20GM
Setting = "0" :Does not output from the positioning unit when an error occurs (initial value).	
Setting = "1" :Outputs from the positioning unit when an error occurs.	

PARA. 109: Subtask error output

Set the output device No. when PARA. 108 is set to "1".

Table 4.64: Subtask error output

FX2N-10GM	FX2N-20GM
Y0 to Y5	Y0 to Y67

When an error occurs in the subtask, M9129 is turned ON. The error can be reset by turning ON M9115.

PARA. 110: Subtask single-step/cyclic operation

Set the operation mode (single-step or cyclic) of the subtask.

Single-step :Executes one program line every time the start input is turned ON.

(When the mode is changed over from "MANU" to "AUTO", the positioning unit waits for m 102 (END). By the first start input, the machine reads the program No. By the second start input, the machine executes the first command.)

Cyclic :Executes the program to the end (marked by "m102") when the start input is turned ON, then automatically stops execution.

Continuous cyclic operation can be executed by jumping to the head of the subtask program using the unconditional jump instruction.

Table 4.65: Subtask single-step/cyclic operation

FX2N-10GM	FX2N-20GM
Setting = "0" :Does not use the general purpose input (initial setting). Performs single-step operation when M9112 is set in the program, and performs cyclic operation when M9112 is reset in the program.	
Setting = "1" :Uses the general purpose input. Changes over between single-step operation and cyclic operation by the specified input or M9112.	

PARA. 111: Subtask single-step/cyclic operation input

Enter the input device No. when PARA. 110 is set to "1".

Single-step operation is performed when the input device specified by this parameter is turned ON.

Table 4.66: Subtask single-step/cyclic operation input

FX2N-10GM	FX2N-20GM
X0 to X3, X375 to X377	X0 to X67, X372 to X377

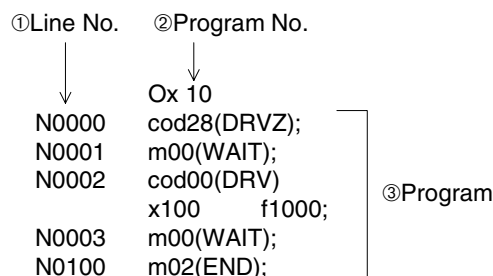
The positioning controllers can be stopped during the Automatic Operation by the stop input (PARA.107), the special auxiliary relay stop command (M9114) or by switching the mode from AUTO to MANU. In every case the program jumps to the END instruction.

MEMO

5. Program format

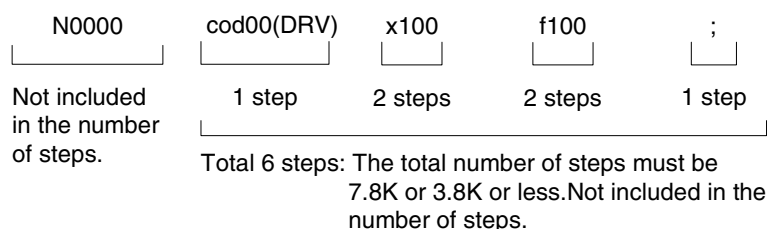
5.1 Positioning program

The positioning program is expressed as follows.



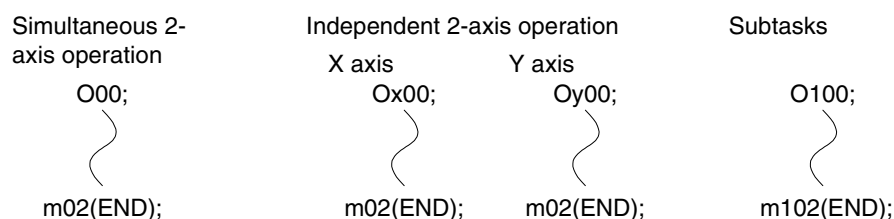
① Line No.

- The line No. (N0 to N9999) is assigned to each instruction so that separation of instruction words can be easily distinguished. The head line No. is entered from a peripheral unit. After that, the next No. is automatically assigned to the next instruction every time the delimiter (;) is entered. Instruction words can be read using the line No.
- Any numeric of 4 digits or less can be selected as the head line No. The same No. can be assigned to different programs which have a different program No. (refer to the next page.). The head line No. does not have to be "N0000".
- The capacity of the program is controlled by the number of steps. The number of steps used in one line varies depending on the instruction word. The line No. is not included in the number of steps.



② Program No.

- The program No. is assigned to each positioning program. A different No. is assigned to a program for different operation.
- "O" is attached to the program No. The program No. format is classified into that for simultaneous 2-axis operation (in the FX_{2N}-20GM), that for independent 2-axis operation (1-axis operation in the FX_{2N}-10GM) and that for subtasks.



Only program No. for the X axis and subtasks are available in the FX_{2N}-10GM.

- The END instruction ("m02" for simultaneous 2-axis operation, X axis operation or Y axis operation and "m102" for subtasks) must be provided at the end of each program.
- Program No.00 to 99 (100 in total) are available as follows. ("O100" only is available for subtasks.)
O00 to O99 Ox00 to Ox99 Oy00 to Oy99 O100
- In the FX2N-20GM, programs for simultaneous 2-axis operation and programs for independent 2-axis operation cannot be mixed together. Only one type or the other is allowed.
If both types of program are present, a program error (error code: 3010) occurs.
- The program No. to be executed can be specified from a digital switch or programmable controller depending on the setting of PARA. 30 (program No. specification method).

③ Program

- When the START input is entered, the positioning program whose program No. is specified is executed step by step from the top.

Specified program No.

```
Ox20, N0;
N0000   cod28  (DRVZ);
N0001   cod00  (DRV)
        x1000  f2000;
        .
        .
        .
N0002   cod04  (TIM)
        K100;
        m02    (END);
N0003
```

Execution in the order programmed.

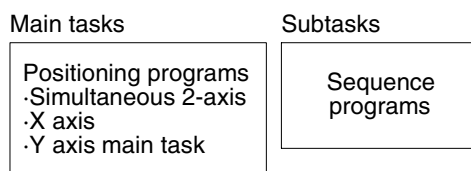
When execution of one instruction is finished, the instruction in the next line is executed. For example, in the case of "N0001" shown on the left, when the X axis travel reaches "1000", execution proceeds to the next line. In the line N0002, when the timer reaches timeout, execution proceeds to the next line.

5.2 Subtask program

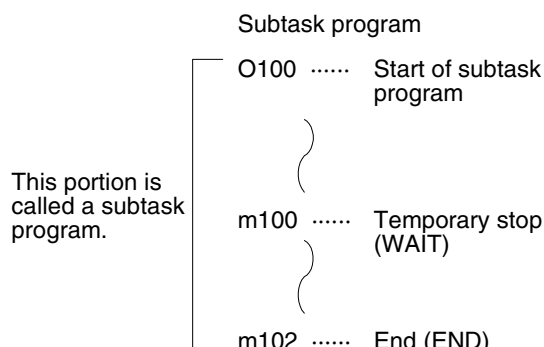
This section explains the subtask which mainly processes programmable controller programs.

Main task and subtask

- A main task is a positioning program expressed as O, Ox and Oy which performs positioning in the simultaneous 2-axis mode or independent 2-axis mode (Ox exclusively is available in the FX_{2N}-10GM.).
A subtask is a program which mainly consists of sequence instructions and does not perform positioning control.
- There are two or more main programs, and the program to be executed can be selected using PARA. 30 (program No. specification).
Only one subtask can be created. The selected main tasks and the subtask are executed simultaneously.



Rules for subtasks



Specifying the subtask

The program No. of any subtask is O100 which must be included in the first line.

Add "m102 (END)" at the end of a program. Use "m100 (WAIT)" for a temporary stop. "m102" and "m100" are fixed.

Subtask program position

A subtask can be created in any position in the program area (Steps 0 to 3799 or 0 to 7799) of the positioning unit. It is recommended for easy recognition to create it after the positioning program.

Subtask start/stop

Start, stop, single-step operation, etc. of a subtask are set by parameters (Refer to Section 4.3.3.). For special auxiliary relays and special data registers for subtasks, refer to Section 6.2.

Processing of subtasks

Unconditional
jump

```

O100
P0;
LD X00;
AND X01;
SET Y0;
FNC 04 (JMP)
P0;
m102;

```

The subtask is processed one line at a time in the same way as a positioning program. When the START signal is entered, the subtask is processed from the first line, and finishes at "m102 (END)" then waits for the next START signal.

For cyclic operation, use a jump instruction such as FNC04 (JMP) as shown in the example on the left. However, jumping from the subtask to a positioning program (main program) is impossible.

Inside a subtask, all the sequence and application instructions (described in Section 5) and the following code instructions are valid.

cod 04 (TIM)	Dwell
cod 73 (MOVC)	Travel compensation
cod 74 (CNTC)	Center point compensation
cod 75 (RADC)	Radius compensation
cod 76 (CANC)	Compensation cancel
cod 92 (SET)	Present position change

m code outputs are not available. The m100 (WAIT) and the m102 (END) only are valid instructions.

The subtask processing speed is approximately 1 to 3 msec per line. It is recommended to restrict the number of lines to approximately 100 when the subtask is processed repeatedly so that the operation time does not become too long.

Program examples

Two examples of subtask programs are shown below. Note that processes which would take a long time if performed in a positioning program and controls other than positioning control are best handled by the subtask.

Fetching the digital switch data

```

O100, N0;
N00 P255;
N01 FNC 74 ([D]SEGL)
    D9004 Y00 K4 K0
N02 FNC 04 (JMP) P255;
N03 m102 (END);

```

The example on the left displays the lower 4 digits of the X-axis current position.

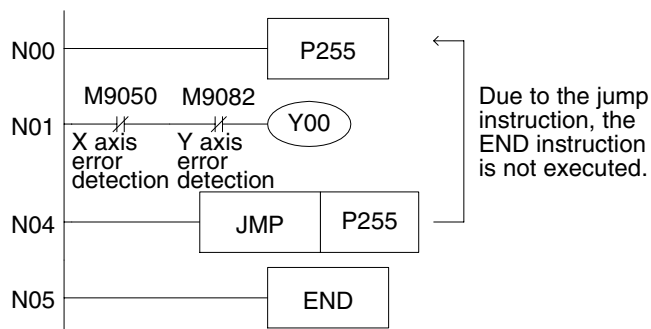
In a similar manner anything not directly connected to positioning operations can be programmed in the subtask program.

Error detection output

```

O100, N0;
N00 P255;
N01 LDI M9050;
N02 ANI M9082;
N03 FNC 90 (OUT) Y00;
N04 FNC 04 (JMP) P255;
N05 m102 (END);

```



The program above turns OFF the normal output Y00 when detecting an error in either the X or Y axes.

5.3 Instruction List and Execution Time

5.3.1 Instruction list

Table 5.1: Instruction list

Instruction	Description	FX2N-10GM	FX2N-20GM
Positioning instructions			
cod00 DRV	Positioning at high speed	✓	✓
cod01 LIN	Linear interpolation positioning	✓	✓
cod02 CW	Circular interpolation positioning (clockwise)	×	✓
cod03 CCW	Circular interpolation positioning (counterclockwise)	×	✓
cod04 TIM	Settling time (dwell time)	✓	✓
cod09 CHK	Servo end check	✓	✓
cod28 DRVZ	Return to mechanical zero point	✓	✓
cod29 SETR	Electrical zero point setting	✓	✓
cod30 DRVR	Return to electrical zero point	✓	✓
cod31 INT	Interrupt stop (Remaining distance is ignored.)	✓	✓
cod71 SINT	Interrupt stop at 1-step speed	✓	✓
cod72 DINT	Interrupt stop at 2-step speed	✓	✓
cod73 MOVC	Movement quantity correction	✓	✓
cod74 CNTC	Center position correction	×	✓
cod75 RADC	Radius correction	×	✓
cod76 CANC	Correction cancel	✓	✓
cod90 ABS	Absolute address specification	✓	✓
cod91 INC	Incremental address specification	✓	✓
cod92 SET	Current value setting	✓	✓
Sequence basic instructions			
LD	Arithmetic operation start (a-contact)	✓	✓
LDI	Arithmetic operation start (b-contact)	✓	✓
AND	Series connection (a-contact)	✓	✓
ANI	Series connection (b-contact)	✓	✓
OR	Parallel connection (a-contact)	✓	✓
ORI	Parallel connection (b-contact)	✓	✓
ANB	Series connection between circuit blocks	✓	✓
ORB	Parallel connection between circuit blocks	✓	✓
SET	Drive of operation holding type coil	✓	✓
RST	Reset of driven operation holding type coil	✓	✓
NOP	No processing	✓	✓

Table 5.1: Instruction list

Instruction	Description	FX2N-10GM	FX2N-20GM
Sequence control instructions			
FNC00 CJ	Conditional jump	✓	✓
FNC01 CJN	Negated conditional jump	✓	✓
FNC02 CALL	Subroutine call	✓	✓
FNC03 RET	Subroutine return	✓	✓
FNC04 JMP	Unconditional jump	✓	✓
FNC05 BRET	Return to bus line	✓	✓
FNC08 RPT	Repetition start	✓	✓
FNC09 RPE	Repetition end	✓	✓
FNC10 CMP	Comparison	✓	✓
FNC11 ZCP	Zone comparison	✓	✓
FNC12 MOV	Transfer	✓	✓
FNC13 MMOV	Magnifying transfer with sign extension	✓	✓
FNC14 RMOV	Reducing transfer with sign holding	✓	✓
FNC18 BCD	Conversion from binary into binary-coded decimal	✓	✓
FNC19 BIN	Conversion from binary-coded decimal into binary	✓	✓
FNC20 ADD	Binary addition	✓	✓
FNC21 SUB	Binary subtraction	✓	✓
FNC22 MUL	Binary multiplication	✓	✓
FNC23 DIV	Binary division	✓	✓
FNC24 INC	Binary increment	✓	✓
FNC25 DEC	Binary decrement	✓	✓
FNC26 WAND	Logical product (AND)	✓	✓
FNC27 WOR	Logical sum (OR)	✓	✓
FNC28 WXOR	Exclusive logical sum (XOR)	✓	✓
FNC29 NEG	Complement	✓	✓
FNC72 EXT	Time division read of digital switch	✓	✓
FNC74 SEGL	Seven-segment display with latch	✓	✓
FNC90 OUT	Output	✓	✓
FNC92 XAB	X axis absolute position detection	✓	✓
FNC93 YAB	Y axis absolute position detection	✓	✓

5.3.2 Instruction execution time and startup time

Instruction execution time

Basic instructions

Table 5.2: Basic instructions

[Unit: ms]

	10GM	20GM
LD	0.4	1.0
LDI	0.4	1.0
AND	0.4	1.0
ANI	0.4	1.0
ANB	0.4	1.0

	10GM	20GM
OR	0.4	1.0
ORI	0.4	1.0
ORB	0.4	1.0
SET	0.4	1.0
RST	0.4	1.0
NOP	0.3	0.8

Sequence instructions

Table 5.3: Sequence instructions

[Unit: ms]

	10GM	20GM
FNC00(CJ)	0.7	2.0
FNC01(CJN)	0.4	1.0
FNC02(CALL)	0.7	2.0
FNC03(RET)	0.4	1.0
FNC04(JMP)	0.7	2.0
FNC05(BRET)	0.4	1.0
FNC08(RPT)	0.5	1.3
FNC09(RPE)	0.6	1.7
FNC10(CMP)	0.8	1.7
DFNC10	0.8	1.7
FNC11(ZCP)	0.9	1.9
DFNC11	0.9	1.9
FNC12(MOV)	0.7	1.8
DFNC12	0.7	1.8
FNC13(MMOV)	0.7	1.6
FNC14(RMOV)	0.7	1.6
FNC18(BCD)	0.7	1.6
DFNC18	0.8	1.7
FNC19(BIN)	0.8	1.7
DFNC19	0.9	1.9

	10GM	20GM
FNC20(ADD)	0.6	1.6
DFNC20	0.6	1.6
FNC21(SUB)	0.6	1.6
DFNC21	0.6	1.6
FNC22(MUL)	0.6	1.6
DFNC22	0.7	1.9
FNC23(DIV)	0.7	1.7
DFNC23	1.6	3.7
FNC24(INC)	0.5	1.5
DFNC24	0.5	1.5
FNC25(DEC)	0.5	1.5
DFNC25	0.5	1.5
FNC26(WAND)	0.8	2.3
DFNC26	0.8	2.3
FNC27(WOR)	0.8	2.3
DFNC27	0.8	2.3
FNC28(WXOR)	0.8	2.3
DFNC28	0.8	2.3
FNC29(NEG)	0.4	1.5
DFNC29	0.4	1.5
FNC72(EXT)	82.5	84.6
FNC74(SEGL)	2.5	2.7
FNC90(OUT)	0.4	1.1

Positioning instructions (Instructions generating pulses are described in "Startup time" below.)

Table 5.4: Positioning instructions

[Unit: ms]

	FX2N-10GM		FX2N-20GM	
	Motor system	Mechanical system	Motor system	Mechanical system
cod29(SETR)	1.0	1.9	1.8	1.8
cod73(MOVC)	0.5	0.5	1.8	1.8
cod74(CNTC)	—	—	1.8	1.8
cod75(RADC)	—	—	1.8	1.8
cod76(CANC)	0.5	0.5	1.8	1.8
cod90(ABS)	0.5	0.5	1.8	1.8
cod91(INC)	0.5	0.5	1.8	1.8
cod92(SET)	0.6	2.3	2.4	9.0

Startup time

Period of time after a start signal is input until a pulse is output (including input filter time of 3 ms)

Table 5.5: Startup time

[Unit: ms]

	FX2N-10GM				FX2N-20GM			
	Motor system	Mechanical system	First time		Motor system	Mechanical system	First time	
cod00(x)	13.0	17.0	+3.0	*1	20.0	30.0	+10.0	
cod00(x, y)					30.0	50.0	+20.0	
cod01	13.0	17.0	+3.0		140.0	150.0	+10.0	*2
cod02/cod03	—	—			155.0	165.0	+10.0	*3
cod28	12.0	18.0	+4.0		30.0	40.0	+0	
cod30	12.0	16.0	+4.0		25.0	38.0	+20.0	
cod31	13.0	18.0	+3.0		140.0	150.0	+10.0	*4
cod71	12.0	15.0	+5.0		20.0	30.0	+10.0	
cod72	22.0	27.0	+4.0		25.0	35.0	+15.0	
cod04(TIM)	0.5	0.5			1.8	1.8		
after m	3.5	3.5		*5	1.5	1.5		*5
Current value update	0.6	1.4			1.2	2.8		

*1 When repeated: 5.0/8.0

When only address is changed (without changing speed): 8.0/11.0

During operation at multi-step speed: 24.0/28.0

*2 When M9015 is ON: 120 + 30N (N = Number of times of continuous passes)

*3 When M9015 is ON: 120 + 50N (N = Number of times of continuous passes)

*4 When M9015 is ON: 120 + 30N (N = Number of times of continuous passes)

*5 When the m code is output to the outside (including the transistor output response time of 0.2 ms)

- The startup time shown above indicates the period of time when operation is actuated by start input.

When operation is actuated by the TO instruction from the PLC or a subtask, the input filter time (3 ms) should be subtracted from and the execution time of a started instruction (TO instruction: $94.1 + 556.7n \mu\text{s}$, [D]TO instruction: $96.3 + 1098.6n \mu\text{s}$, "n" = number of transfer points) should be added to the value shown above.

5.4 General Rules for Positioning Control Instructions

A command matter of the cod instruction and m code are explained.

5.4.1 m code instruction format

m code instructions are used to drive various auxiliary equipment (such as chucks, drills, etc.) in association with positioning operations.

m code: m00 to m99 (100 points) (Each of the X and Y axes has 100 m code instructions.)

m01, m03 to M100, m102 (100 points) (subtask program has 100 m code instructions.)

m00 (WAIT) : Uses by the positioning program. It becomes a start instruction waiting.

m02 (END) : It becomes END instruction because of the positioning program.

m100 (WAIT) : Uses by the subtask program. It becomes a start instruction waiting.

m102 (END) : It becomes END instruction because of the subtask program.

m01, m03 to m99 : For general. It becomes m code OFF instruction waiting.

m code instructions are expressed as "m" to be distinguished from "M" which stands for an auxiliary relay.

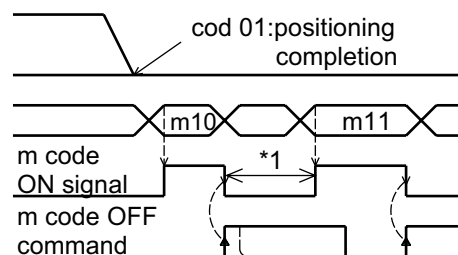
m code driving methods

In the AFTER mode, only m code instructions are executed. In the WITH mode, m code instructions and other instructions are simultaneously executed.

AFTER mode

```

N0 cod01 (LIN) X400 Y300 f200;
N1 m10; The m code is programmed on a
   separate line.
N2 cod04 (TIM) k5; 50ms
N3 m11; Other auxiliary equipment is driven
   immediately afterwards.
  
```

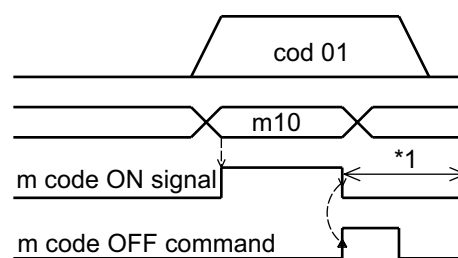


WITH mode

```

cod0 1(LIN) X400 Y300 f200 m10;
  
```

When an m code is added as the final operand in any type of positioning control instruction, the WITH mode is established as shown below. The program execution proceeds to the next line after execution of the instruction is completed and the m code OFF signal is turned ON.



*1: Lengthen the turning OFF time more than the scan time of the programmable controller.

- In either case above, when an m code is driven, the m code ON signal is turned ON and the mcode No. is saved in special Ds. The m code ON signal remains ON until the m code OFF signal is turned ON.

Table 5.6: Allocation of m code

	X axis		Y axis	
	Special M/D	Buffer memory	Special M/D	Buffer memory
m code ON signal	M9051	#23 (b3)	M9083	#25 (b3)
m code OFF command	M9003	#20 (b3)	M9019	#21 (b3)
m code No.	D9003	#9003	D9013	#9013

- Only the X axis is available in the FX_{2N}-10GM.
- In the FX_{2N}-20GM or the FX_{2N}-10GM, m codes can be transmitted with the FX_{2N}/FX_{3U}/FX_{2NC}/FX_{3UC} Series programmable controller using buffer memories.
- The signals related to m codes can be output to an external unit using PARAs 36 to 38. (For details, refer to Section 4.3.1.)
- Lengthen the turning OFF time of m code ON signal more than the scan time of the programmable controller when you continuously use m codes.

5.4.2 Continuous paths (FX_{2N}-20GM)

Continuous paths indicate to consecutively execute the interpolation control instructions such as cod 01, cod 02 and cod 03.

Example of continuous paths

cod 01	Linear interpolation	(LIN)
cod 02	Circular interpolation	(CW)
cod 01	Linear interpolation	(LIN)
cod 03	Linear interpolation	(CCW)

When any instruction other than applicable instructions (the cod 01, the cod 02 and the cod 03) is executed, continuous path operation is not performed. The machine is temporarily stopped, then proceeds to the next operation.

The machine is stopped in the following cases.

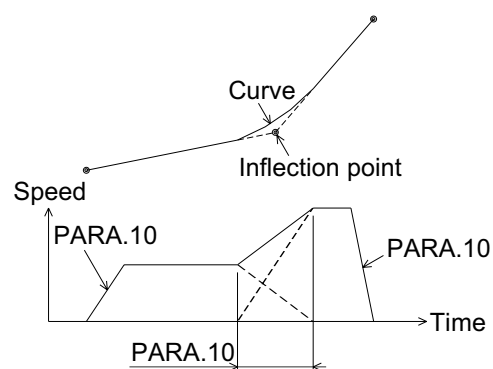
- When another cod instruction is executed.
- When a sequence instruction is executed.
- When an m code of the AFTER mode is executed.
- When the cod 09 (CHK) servo end check instruction is executed (that is, when PARA. 21 is between 1 to 5000).

Continuous path operation

- Consecutive interpolation instructions are operated without stopping, and inflection points become smooth curves.

The radius of curvature varies depending on the interpolation time constant (set to PARA. 10). A larger time constant makes a larger radius of curvature.

- In order to draw a precise locus, create a program using circular interpolation instructions.
- When the speed between each interpolation instruction is different, the composite speed of the current deceleration and the next acceleration is used.



When this period becomes larger, the radius of curvature becomes larger.

Number of continuous paths

The number of continuous paths varies depending on the operation of the special auxiliary relay M9015.

When the M9015 is OFF

While an interpolation operation is performed, preparation for interpolation control for the next process is performed. Accordingly, there is no restriction in the number of continuous paths. However, if there is a short-time path as follows, the next process cannot be read in advance and the machine may temporarily stop its operation at this short-time path.

- Path whose travel time is 50 ms or less.
- Path whose travel time is the interpolation time constant or less.

When the M9015 is ON

For up to 30 continuous paths^{*1}, preparation for interpolation control is preliminarily performed before the continuous paths are started. Accordingly, the machine never stops its operation if any short-time path is present. However, the machine stops temporarily just before executing the 31st continuous path.

When the number of continuous paths between the RPT and the RPE is 30 or less, repetitious operations are also continuously performed. For most operations, setting M9015 OFF is usual.

^{*1} The FX_{2N}-20GM normally counts a single continuous path per cod instruction, however, when the travel time from start to stop for a circular interpolation path (CW, CCW) is less than the Interpolation time constant (PARA.10), the FX_{2N}-20GM counts two continuous paths for that instruction.

The flag M9015 is not defined in FX_{2N}-10GM. In this case, the actual operation is performed as if M9015 is turned OFF.

Operations of m codes during continuous paths

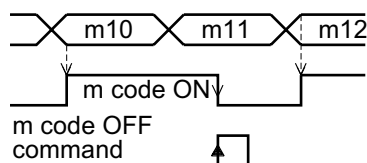
When m codes of the WITH mode are specified in continuous path interpolation instructions, a series of continuous operations are performed even if the m code OFF command is not entered. When a series of operations are completed and the m code OFF command is entered, the machine proceeds to the next operation.

When different m codes are specified in each interpolation drive instruction as in the program shown below, the m code outputs are switched one by one. Note that a new m code cannot be read if the m code OFF command is not given before the switching point.

Program example

```
cod 01    (operand) m10;
cod 01    (operand) m11;
cod 01    (operand) m12;
```

(operand): Set the operands x, y, f, etc.



In the example above, a strobe to read m11 is not obtained.

Other cautions and remarks

Incremental travel of interpolation control.

- The incremental travel caused by one interpolation control instruction is restricted to 28 bits when converted into pulses.
- For example, when a travel of 1 μm per pulse is supposed, it corresponds to the incremental travel of 268 m.

Stepping motor and continuous paths.

- When a stepping motor is used to perform continuous path control, the motor may be out of order depending on the motor characteristics.

Interpolation control and pulse output format.

- In interpolation control, PARA. 11 (pulse output format) must be set to "0".

Remarks on circular interpolation.

- During circular interpolation, the radius is constant and the pulses are distributed to the X and Y axes.

Accordingly, if the ratio of the pulse rate and the feed rate (set to PARAs 1 and 2) is not equivalent in the X and Y axes, a deformed arc will be obtained. In this case, adjust the electronic gear of the servo amplifier to make the ratio equivalent in both the X and Y axes.

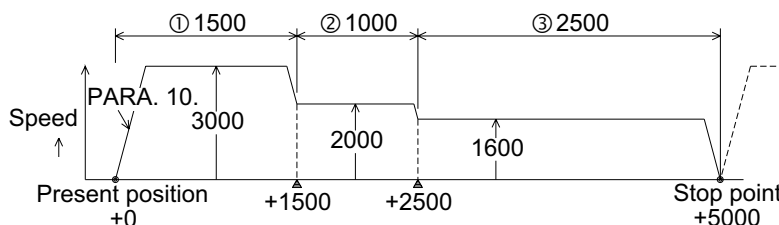
- When an arc is small and the travel time from the start point to the end point is shorter than the Interpolation time constant (set to PARA. 10), interpolation is impossible. In this case, the locus of the travel from the start point to the end point becomes linear instead of circular.

5.4.3 Multistep operation using continuous paths (FX₂N-10GM).

Though the cod 01 (LIN) is a linear interpolation instruction, it can be used for multistep operation by specifying continuous paths in the FX₂N-10GM.

- Create a program according to the operation example shown below.

- The travel can be specified by either the absolute drive method (ABS) or the incremental drive method (INC). However, when the drive method is changed during continuous paths, the machine stops temporarily.



Example of incremental drive

Ox 00,N0	Program No.0
N0 cod91(INC);	Incremental drive method
N1 cod01(LIN)	
x1500	
f3000;	
N2 cod01(LIN)	
x1000	
f2000;	
N3 cod01(LIN)	
x2500	
f1600;	
N4 m02(END);	END command

Continuous path section

Example of absolute drive

Ox 00,N0	Program No.0
N0 cod90(ABS);	absolute drive method
N1 cod01(LIN)	
x1500	
f3000;	
N2 cod01(LIN)	
x2500	
f2000;	
N3 cod01(LIN)	
x5000	
f1600;	
N4 m02(END);	END command

Continuous path section

- The operation is not consecutive and it stops temporarily at the following.
 - When the amount of the movement which changes from the speed into the next steps speed now is less than the amount of the pulse which requires it to accelerate/to decelerate
 - When the movement time is 50 ms or less
- The number of multi-steps (number of continuous paths) is not restricted at all. The operations using m codes are performed in the same way as described for continuous paths on the previous page.
- In the FX₂N-20GM also, multistep operation is possible by specifying only one axis (X axis or Y axis) for operation. (In this case, however, only programs for simultaneous 2-axis operation are possible because interpolation control is required. The unspecified axis does not move.)

m code control during operation at multi-step speed by M9160 (FX₂N-10GM)

Operation while an m code is used is equivalent to operation by continuous passes described in the previous page.

However, operation is different if the special auxiliary relay M9160 is driven.

Outline:

When operation at multi-step speed is performed while the special auxiliary relay M9160 in the FX₂N-10GM is ON, an m code (WITH mode) realizes the following operation.

- When the m code OFF command is not given, the machine does not continue operation at multi-step speed, but waits for the m code OFF command.
- When the m code OFF command is given, the machine continues operation at multi-step speed.

However, when the current operation is located in the deceleration range, the machine positions the target address of the current instruction, then moves to the next instruction.

Use example 1 (M9160 is ON.)

Operation by a program example is described below.

```

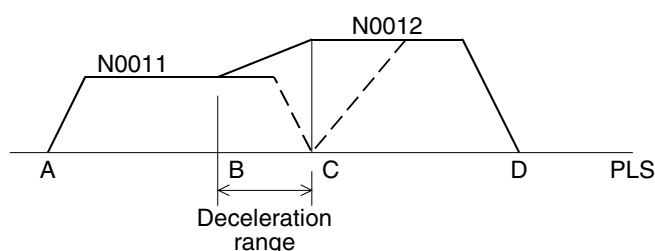
N0000    Ox0,N0;
        .
        .
        .

N0010    SET M9160;
N0011    cod01 xC f100,000 m10;
N0012    cod01 xD f200,000;
N0013    RST M9160;
        .
        .
        .

N0020    m02(END)

```

By the program above, the machine operates as follows.



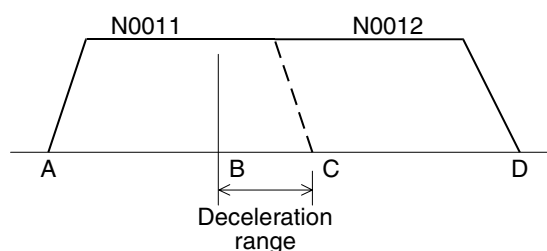
- 1) When the m code OFF command is given in the range between the points A and B, the speed changes to the next step.
- 2) When the m code OFF command is not given in the range between the points A and C, the machine stops at the point C and waits for the m code OFF command. When the m code OFF command is given, the machine moves to the point D.
- 3) When the m code OFF command is given in the range between the points B and C, the machine stops at the point C, then immediately moves to the point D.

Use example 2 (M9160 is ON.)

```

N0000    Ox0,N0;
        .
        .
        .
N0010    SET M9160;
N0011    cod01 xC f100,000 m10;
N0012    cod01 xD f200,000;
N0013    RST M9160;
        .
        .
        .
N0020    m02(END)

```



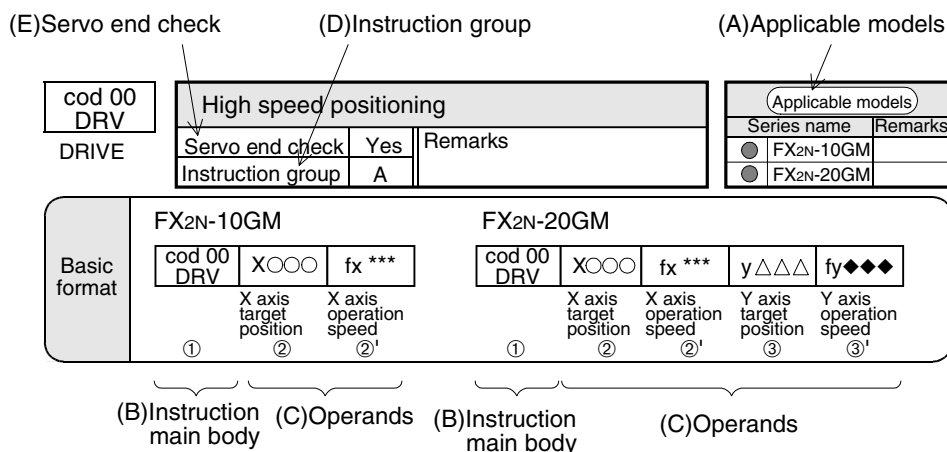
Operation in the use example 2 is equivalent to that in the use example 1.

- 1) When the m code OFF command is given in the range between the points A and B, the speed changes to the next step.
- 2) When the m code OFF command is not given in the range between the points A and C, the machine stops at the point C and waits for the m code OFF command.
When the m code OFF command is given, the machine moves to the point D.
- 3) When the m code OFF command is given in the range between the points B and C, the machine stops at the point C, then immediately moves to the point D.

*Note: Have in mind that, in operation at multi-step speed (cod01), the machine may not operate continuously depending on the combination of the movement quantity and the Interpolation time constant (PARA. 10).

If the number of movement pulses required to change from the current operation speed to the next step speed cannot be assured or if the movement time is short, the machine cannot operate continuously.

5.5 Instruction format



(A) Applicable models

The models in which the instruction described can be used are indicated.

The models are classified into "FX_{2N}-10GM" and "FX_{2N}-20GM". The applicable group is marked with "●".

(B) Instruction main body

The positioning control instruction consists of the instruction main body and the operands (shown in the table below). (Some instructions do not include any operand.)

The instruction main body consists of the instruction word (such as DRV, LIN, CW, etc.) and the code No. (cod No.).

An instruction can be written to or read from a peripheral unit by specifying either the word or the code No.

(C) Operands

Various types of operands such as the travel, the speed, etc. are available for various types of instruction. Select the required operands in the specified sequence. The table below shows the available operands.

Table 5.7: Type of operands

Type of operands	FX _{2N} -10GM	FX _{2N} -20GM	Units	Indirect specification	Omission of operand
x :X axis coordinates (travel), incremental/absolute.	✓	✓	Set by parameter	Possible using data register (D)	The axis whose operand is omitted maintains its present status and does not move.
y :Y axis coordinates (travel), incremental/absolute.	—	✓			
i :X axis coordinates (arc center), incremental.	—	✓			If omitted, the incremental travel is regarded as "0".
i :Y axis coordinates (arc center), incremental.	—	✓			This operand cannot be omitted.
r :Arc radius.	—	✓			The "f" value of the previous usage becomes valid.
f :Vector speed or peripheral speed.	✓	✓	10ms	Unable	This operand cannot be omitted.
k :Timer constant.	✓	✓			
m:m code in WITH mode.	✓	✓	—	Unable	This operand can be omitted (No m code is output.)

Units of operands

The units of the value specified by the operands are determined by the parameters.

- Travel (x, y, i, j, r)
The motor system (PLS) or the mechanical system (mm, inch, deg) is valid in accordance with the setting of PARA. 0 (system of units).
The scaling of the set value is performed in accordance with the setting of PARA. 3 (minimum command unit).
- Speed (f)
The set value must be equal to or less than the setting of PARA. 4 (maximum speed).
FX_{2N}-20GM :200 kHz or less. (100 kHz or less for linear/circular interpolation.)
FX_{2N}-10GM :200 kHz or less.

Indirect specification

Indirect specification indicates the method to write indirectly the set values by specifying data registers (including file registers and index registers) instead of writing directly the set values to the operands.

Direct specification

cod00	x1000	f2000;	
	↑	↑	
	Travel = 1000	Speed = 2000	The set values are directly written.

Indirect specification

cod00	xD10	fD20;	
	↑	↑	
	Travel = D10	Speed = D20	The set values are determined in accordance with the contents of the data registers.

When the set value exceeds 16 bits, specify "xDD10" for example. By this specification, 32-bit data (D11, D10) can be handled.

The data register No. used for indirect specification can be modified with index registers V and Z. The data can be selected by modification.

Example : When (V2) = 10, "D20V2" indicates "D30". When the contents of D30 is "500", "xD20V2" becomes equivalent to "xD30" (that is, "x500").

Sixteen index registers in all, V0 to V7 and Z0 to Z7, are available.

V0 to V7 :16-bit registers

Z0 to Z7 :32-bit registers

When the set value is 16 bits or less or when a sequence instruction is 16 bits, use V0 to V7.

When the set value exceeds 16 bits or when a sequence instruction is 32 bits, use Z0 to Z7.

Omission of operands

In the instructions (CW, CCW and TIM) in which r (arc radius) or K (timer constant) must be specified, the operands cannot be omitted.

When fx (X axis operation speed) or fy (Y axis operation speed) are omitted in the cod 00 (DRV) instruction, the corresponding axis will operate at the maximum speed specified by PARA. 4 (maximum speed).

(D) Instruction groups

In this manual, instructions are classified into four groups (A to D).

Group A

When the same instruction (same code No.) is used consecutively the code No. can be omitted and only the necessary operands are required.

Instruction names : cod00(DRV), cod01(LIN), cod02(CW), cod03(CCW), cod31(INT)

Example : N100 cod00(DRV) x100;
N101 x200; Executed by the cod 00 instruction.

Group B

The code No. cannot be omitted. An instruction in this group is valid only in the line No. in which the instruction is specified.

Instruction names :cod04(TIM), cod09(CHK), cod28(DRVZ), cod29(SETR),
cod30(DRBR), cod71(SINT), cod72(DINT), cod92(SET)

Group C

An instruction in this group remains valid once executed until the contents are changed by the same instruction.

Instruction names :cod73(MOVC), cod74(CNTC), cod75(RADC), cod76(CANC)

Example : N200 cod73(MOVC) X10; The X axis travel is compensated by "+10".
The travel is compensated by "+10" in this area.
N300 cod73(MOVC) X20; The X axis travel is compensated by "+20".

Group D

An instruction in this group remains valid once executed until another instruction in this group is executed.

Instruction names : cod90(ABS), cod91(INC)

Example : N300 cod91(INC); The travel is indicated by the incremental drive method.
Incremental addresses are indicated in this area.
N400 cod90(ABS); The travel is indicated by the absolute drive method.

(E) Servo end check

When an instruction for which the servo end check is executed, the servo end check is automatically performed after driving is completed. The system makes sure that the deviation pulses inside the servo amplifier are less than the quantity specified (set by servo amplifier parameters), then proceeds to the next operation.

If the servo end signal is not transmitted from the servo amplifier to the positioning unit within the time set to PARA. 21 (positioning completion signal error evaluation time), an external error (Error code: 4002 = servo end error) occurs and the machine stops operation. When PARA. 21 is set to "0", the servo end check is not performed even if the servo end check is "Yes" for the instruction executed.

The cod 09 (CHK) instruction described later can be used to perform the servo end check.

5.6 Drive Control Instructions

This section explains the drive control instructions which function as the basis of positioning control.

5.6.1 cod 00 (DRV): High speed positioning

cod 00 DRV DRIVE	High speed positioning			Applicable models	
	Servo end check	Yes	Remarks	Series name	Remarks
	Instruction group	A		● FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-10GM			FX2N-20GM				
	cod 00 DRV	x○○○	f***	cod 00 DRV	x○○○	f***	y△△△	f◆◆◆
		X axis target position	X axis operation speed		X axis target position	X axis operation speed	Y axis target position	Y axis operation speed
	①	②	②'	①	②	②'	③	③'

① DRIVE

This instruction specifies the travel to the target coordinates with independent settings for the X and Y axes (only one axis in the FX2N-10GM). The maximum speed and the acceleration/deceleration speed of each axis are set by parameters.

When single axis drive is used in the FX2N-20GM, specify only the X or Y axis target position.

② X axis target position

The target position is specified in units defined by PARA. 3 (minimum command unit).

Whether the position is incremental (distance from the present position) or absolute (distance from the zero point) is specified by the cod 91 (INC) or cod 90 (ABS) instruction.

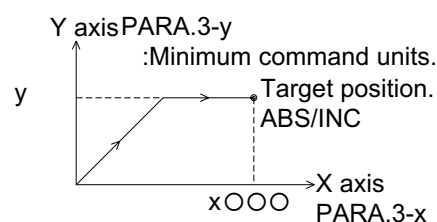


Table 5.8: Specification method

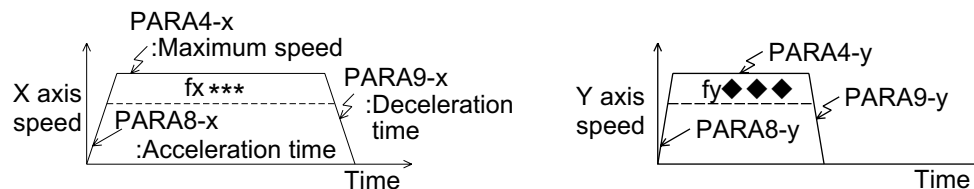
Specification method	Set range
Direct specification	x0 to x ± 999,999
Indirect specification (16-bit)	xD0 to xD6999 *1
Indirect specification (32-bit)	xDD0 to xDD6998 *1

*1: D2000 to D3999 are not available in the FX2N-10GM.

③ Y axis target position : Same as for the X axis.

②' ③' Operation speed

Set these operands to operate the machine at a speed less than the maximum speed (set to PARA. 4). If these operands are not set, the machine operates at the maximum speed. When programming, use "f" only for both fx and fy.

**Table 5.9: Specification method**

Specification method	Set range
Direct specification	f0 to f200,000
Indirect specification (16-bit)	fD0 to fD6999 *2
Indirect specification (32-bit)	fDD0 to fDD6998 *2

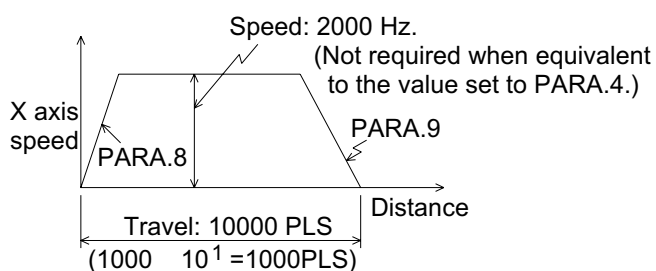
*2: D2000 to D3999 are not available in the FX_{2N}-10GM.

Program example

PARA.0 :System of units. Setting = "1"
(motor system of units)

PARA.3 :Minimum command unit.
Setting = "2" (10^1)

```
cod91 (INC); Incremental drive method
cod00 (DRV)
x1000
f2000;
```



5.6.2 cod 01 (LIN): Linear interpolation positioning

cod 01 LIN	Linear interpolation positioning, Multi-step operation (10GM)			Applicable models	
	Servo end check	Yes	Remarks	Series name	Remarks
	Instruction group	A		● FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-20GM				<ul style="list-style-type: none"> This instruction is not available in the programs (Ox, Oy and O100) for independent 2-axis operation and subtasks. If this instruction is used in one of these programs, it is ignored. In the FX2N-10GM (Ox), this instruction is used for multi-step operation.
	cod 01 LIN	x ○○○	y △△△	f □□□	
		X axis target position	X axis operation speed	Vector speed	
	①	②	③	④	

① LINEAR

This instruction moves the machine to the target coordinates (X, Y) in a linear route by using the both axes at the same time.

It outputs without any relation to setting of PARA.11 in the form of "Forward pulse + reverse pulse".

It cannot use the interpolation instruction by the output form of pulse row + direction.

(It outputs without any relation to setting of PARA.11 in the form of "Forward pulse + reverse pulse".)

When using this instruction, pay rigid attention to PARA. 23 (stop mode). (Refer to Paragraph 4.3.1.)

②③ X axis/Y axis target position

The unit of the target position is set by PARA. 3.

Whether the target position is incremental (indicating the distance from the current position) or absolute (indicating the distance from the coordinate zero point) is set by cod91 (INC) or cod90 (ABS).

The table below shows the set range for the X axis. The set range for the Y axis is equivalent.

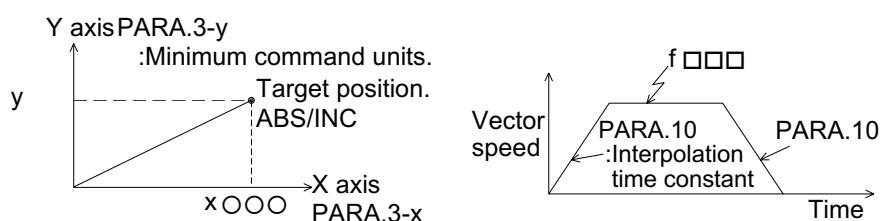


Table 5.10: Specification method

Specification method	Set range
Direct specification	x0 to x±999,999
Indirect specification (16-bit)	xD0 to xD6999 *1
Indirect specification (32-bit)	xDD0 to xDD6998 *1

*1: D2000 to D3999 are not available in the FX2N-10GM.

④ Vector speed

Set the vector speed within the range shown in the table below. (The set value must not exceed the value set to PARA. 4.)

Table 5.11: Specification method

Specification method	Set range
Direct specification	f0 to f100,000 *2
Indirect specification (16-bit)	fD0 to fD6999 *3
Indirect specification (32-bit)	fDD0 to fDD6998 *3

*2: FX_{2N}-10GM: f0 to f200,000

*3: D2000 to D3999 are not available in the FX_{2N}-10GM.

When the vector speed (f) is omitted, the machine operates at the following speed.
(The value is not same PARA.4 (maximum speed))

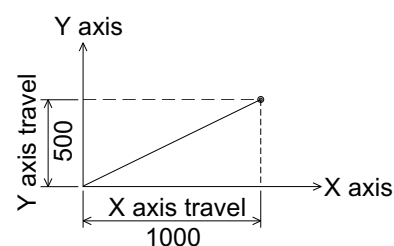
Table 5.12: Vector speed (f)

	10GM	20GM
1st time	200kHz	100kHz
2nd time or Later	Previous f value	

- When interpolation instructions are consecutively executed, path operation is performed. In the FX_{2N}-10GM, multistep operation is performed (Refer to Section 5.4.3).
- It decides the amount of the movement of the interpolation drive by Pulse rate (PARA.1) and sending rate (PARA.2) of each axis.
It decides the drive speed by Pulse rate (PARA.1) and sending rate (PARA.2) of X axis.

Program example

```
cod91 (INC) ; Incremental drive
cod91 (LIN)
x1000
y500
f2,000;
```



5.6.3 cod 02 (CW), cod 03 (CCW): Circular interpolation with center point specification

cod 02 CW		Circular interpolation with center point specification			Applicable models	
cod 03 CCW		Servo end check	No	Remarks	Series name	Remarks
		Instruction group	A		<div><div></div></div> FX2N-10GM	
					<div><div></div></div> FX2N-20GM	

Basic format

FX2N-20GM

cod 02 CW	x○○○	y△△△	i ***	j ◆◆◆	f □□□
	X axis target position	Y axis target position	X axis center coordinate	Y axis center coordinate	Peripheral speed

cod 03 CCW	x○○○	y△△△	i ***	j ◆◆◆	f □□□
	X axis target position	Y axis target position	X axis center coordinate	Y axis center coordinate	Peripheral speed

①

②

③

④

⑤

⑥

This instruction is not available in the programs (Ox, Oy and O100) for independent 2-axis operation and subtasks.

If this instruction is used in one of these programs, it is ignored.

This instruction is not available in the programs (Ox, Oy and O100) for independent 2-axis operation and subtasks. If this instruction is used in one of these programs, it is ignored.

① CW/CCW

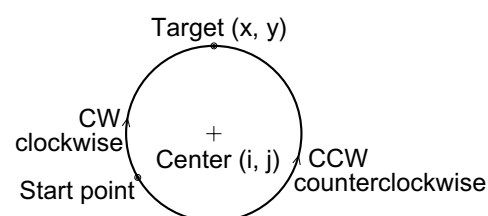
This instruction specifies the travel to the target position around the center coordinates at the peripheral speed "f".

When the start point is equivalent to the end point or when the endpoint coordinates (target coordinates) are not specified, the travel locus makes a complete circle.

It cannot use the interpolation instruction by the output form of pulse row + direction.

(It outputs without any relation to setting of PARA.11 in the form of "Forward pulse + reverse pulse".)

When using this instruction, pay rigid attention to PARA. 23 (stop mode). (Refer to Paragraph 4.3.1.)



②③ X/Y axis target position (x, y)

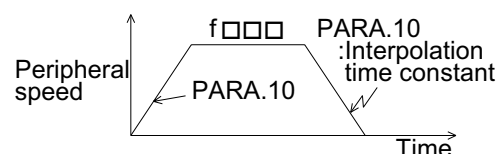
The target position can be specified by an incremental or absolute address. The units and the set range are equivalent to those for cod 00 and cod 01.

④⑤ X/Y axis center coordinates (i, j)

The center coordinate always treated as an incremental address from the start point. The units and the set range are equivalent to those for cod 00 and cod 01.

⑥ Peripheral speed "f"

Set the circular operation speed. The Interpolation time constant (PARA. 10) and the units of peripheral speed are equivalent to those for cod 01.

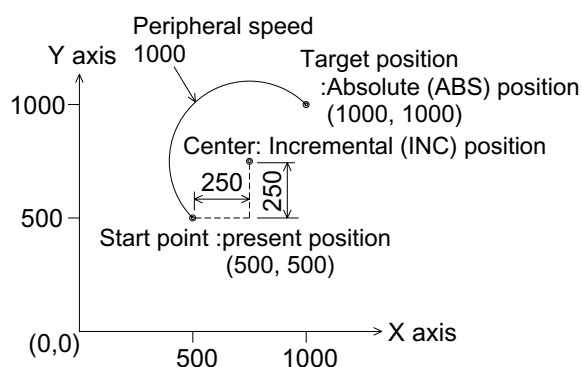


Program example

```

cod90 (ABS); Absolute drive method.
cod02 (CW)
    x1000
    y1000
    i250
    j250
    f1000;

```



- When interpolation instructions are executed consecutively, path operation is performed (Refer to Section 5.4.2).
- When an arc is small and the travel time from the start point to the end point is shorter than the Interpolation time constant (set to PARA. 10), interpolation is impossible. In this case, the locus of the travel from the start point to the end point becomes linear instead of circular.
- It decides the amount of the movement of the interpolation drive by Pulse rate (PARA. 1) and sending rate (PARA. 2) of each axis.
It decides the drive speed by Pulse rate (PARA. 1) and sending rate (PARA. 2) of X axis.
- During circular interpolation, the radius is constant and the pulses are distributed to the X and Y axes.
Accordingly, if the ratio of the pulse rate and the feed rate (set to PARA. 1 and 2) is not equivalent in the X and Y axes, a deformed arc will be obtained. In this case, adjust the electronic gear of the servo amplifier to make the ratio equivalent in both the X and Y axes.

cod 02 CW	Circular interpolation with radius specification			Applicable models	
cod 03 CCW	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	A		FX2N-10GM	
				FX2N-20GM	

Basic format	FX2N-20GM				
	cod 02 CW	x○○○	y△△△	r ***	f □□□
		X axis target position	Y axis target position	Radius	Peripheral speed
	①	②	③	④	⑤
	cod 03 CCW	x○○○	y△△△	r ***	f □□□
		X axis target position	Y axis target position	Radius	Peripheral speed
		②	③	④	⑤

This instruction is not available in the programs (Ox, Oy and O100) for independent 2-axis operation and subtasks. If this instruction is used in one of these programs, it is ignored.

① CW/CCW (clockwise/counterclockwise)

This instruction moves the machine to the target position (X,Y) at the peripheral speed "f".

The radius of the arc is determined by "r". When "r" is positive, the movement route is a small circle A shown on the right. When "r" is negative, the movement route is a large circle B. (The radius may be positive or negative.)

This instruction cannot make a route of true circle.

The error (Error code 3004) occurs when the target position has the same current value as the position.

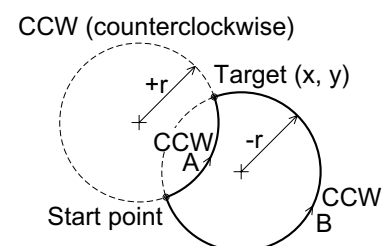
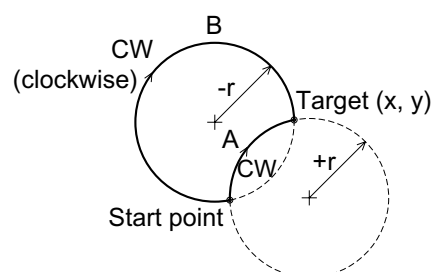
When a route of true circle is required, specify the circle center coordinates as described in the previous page.

It cannot use the interpolation instruction by the output form of pulse row + direction.

(It outputs without any relation to setting of PARA.11 in the form of "Forward pulse + reverse pulse".)

After using this instruction, pay rigid attention to PARA. 23 (stop mode).

(Refer to Paragraph 4.3.1.)



②③ X/Y axis target position (x, y)

The target position can be specified by an incremental or absolute address. The unit and the set range are equivalent to those for cod 00 and cod 01.

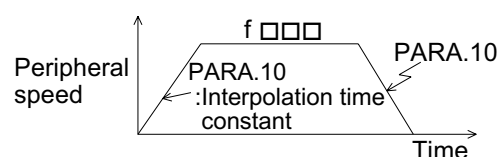
The error (Error code 3004) occurs when the target position has the same current value as the position.

④ Radius "r"

The radius is always treated as an incremental address from the center point (which does not have to be set). The unit and the set range are equivalent to those for cod 00 and cod 01. Programs for true circles cannot be created using this instruction.

⑤ Peripheral speed "f"

Set the circular operation speed. The Interpolation time constant (set to PARA. 10) and the unit of peripheral speed are equivalent to those for cod 01.

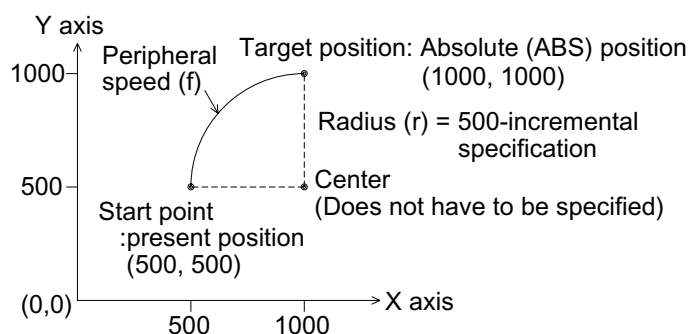


Program example

```

cod90 (ABS); Absolute drive method.
cod02 (CW)
  x1000
  y1000
  i250
  j250
  f1000;

```



- When interpolation instructions are executed consecutively, path operation is performed (Refer to Section 5.4.2.).
- When an arc is small and the travel time from the start point to the end point is shorter than the Interpolation time constant (set to PARA. 10), interpolation is impossible. In this case, the locus of the travel from the start point to the end point becomes linear instead of circular.
- The movement quantity during interpolation operation is determined by the pulse rate and feed rate (PARA. 1 and PARA. 2) in each axis, and the operation speed and radius position is determined by the pulse rate and feed rate in the X axis.
- If the ratio of the pulse rate and the feed rate is not equivalent in the X and Y axes, a deformed arc will be obtained. Moreover, if the movement quantity per pulse for the Y axis is smaller than that for the X axis and the value for radius is small, a program error occurs because the Y axis cannot reach the target position. In this case, adjust the electronic gear of the servo amplifier to make the ratio of the pulse rate and feed rate equivalent in both the X and Y axes.

5.6.4 cod 04 (TIM): Stabilization time

cod 04 T I M TIMER	Stabilization time (Dwell)			Applicable models	
	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	B		<input type="radio"/> FX2N-10GM	
				<input type="radio"/> FX2N-20GM	

Basic format	FX2N-10GM		FX2N-20GM	
	cod 04 T I M	K ***	cod 04 T I M	K ***
	Stabilization time		Stabilization time	
	①	②	①	②

① TIMER

Use this instruction to set the waiting time between completion of one instruction and execution of another.

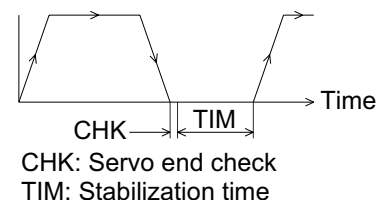
② Stabilization time (Dwell)

The increment is 10 msec. "k100" indicates a delay of 1 second.

Table 5.13: Specification method

Specification method	Set range
Direct specification	k0 to k65,535
Indirect specification (16-bit)	D0 to D6999 *1
Indirect specification (32-bit)	DD0 to DD6998 *1

*1: D2000 to D3999 are not available in the FX2N-10GM.



5.6.5 cod 09 (CHK): Servo end check

cod 09 CHK SERVO END CHECK	Servo end check		
	Servo end check	No	Remarks
	Instruction group	B	

Applicable models		
Series name		Remarks
<input checked="" type="radio"/>	FX2N-10GM	
<input checked="" type="radio"/>	FX2N-20GM	

Basic format	FX2N-10GM	FX2N-20GM
	<div><div>cod 09 CHK</div><div>①</div></div>	<div><div>cod 09 CHK</div><div>①</div></div>

① CHECK

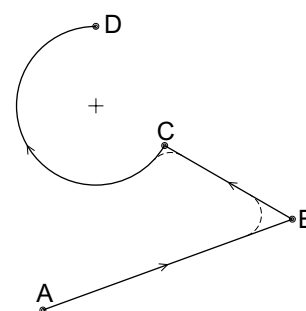
By this instruction, the machine performs the servo end check at the end point of interpolation operation, then moves to the next operation.

When pulses accumulated in the servo amplifier become the specified quantity or less, the machine performs the servo end check in accordance with the positioning completion signal (SV END) sent from the servo amplifier to the positioning unit.

When the period of time from end of pulse output to input of the positioning completion signal exceeds the period of time set in PARA. 21, the positioning unit regards it as a positioning error.

While interpolation operation continues, the machine performs non-stop operation and inflection points make a smooth curve.

When you would like to move the machine to the target position B or C shown in the figure on the right, use the cod09 instruction after the cod01 to cod03 instructions in the program. At the time of shipment, PARA. 21 is set to "0" to disable the servo end check. When you use the cod09 (CHK) instruction, properly set PARA. 21.



5.6.6 cod 28 (DRVZ): Machine zero return

cod 28 DRVZ DRIVE TO ZERO	Machine zero return			Applicable models	
	Servo end check	Yes	Remarks	Series name	Remarks
	Instruction group	B		● FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-10GM	FX2N-20GM
	<div>cod 28 DRVZ</div> <div>①</div>	<div>cod 28 DRVZ</div> <div>①</div>

① DRVZ

When this instruction is executed, a machine zero return operation is performed. (For details of the machine zero return operation, refer to Section 8.2.1.)

When a machine zero return operation is completed, the special auxiliary relays M9057 (X axis) and M9089 (Y axis) are turned ON (Only M9057 is available in the FX_{2N}-10GM.).

When a machine zero return operation is performed once in the MANU or AUTO mode, these special auxiliary relays remain turned ON (They are turned OFF when the power is turned OFF.).

Program example

The following program uses the special Ms, described on the left, and a jump command to skip the zero return operation when the machine is restarted.

```
Ox00
LD M9057;
FNC 00 (CJ) P0;
cod 28 (DRVZ);
P0; ←
```

Once a zero return operation has been completed, program execution jumps.

In simultaneous 2-axis operation in the FX_{2N}-20GM, this instruction returns both the X and Y axes to the zero point simultaneously. To return only one axis to the zero point, refer to the following program example.

M9008: Prohibits the machine zero return operation of the X axis.

(These settings are valid in the FX_{2N}-20GM Ver. 3 or later manufactured in May, 1995 or later.)

M9024: Prohibits the machine zero return operation of the Y axis.

Program example

(Only X axis is returned to the zero point first, then the Y axis is returned to the zero point.)

O0, N0 (simultaneous 2-axis program)

SET M9024 ; Prohibits zero return operation of Y axis.

cod 28 (DRVZ) ; Returns X axis only to zero point. (M9008 = OFF, M9024 = ON)

RST M9024 ; Allows zero return operation of Y axis.

SET M9008 ; Prohibits zero return operation of X axis.

cod 28 (DRVZ) ; Returns Y axis only to zero point. (M9008 = ON, M9024 = OFF)

RST M9008 ; Allows zero return operation of X axis.

When both M9008 and M9024 are turned ON, no operation is performed even if cod 28 is executed. The zero return completion flags (M9057, M9089) are not turned ON when zero return is prohibited for the corresponding axis.

5.6.7 cod 29 (SETR): Electrical zero point setting

cod 29 SETR SET RETURN ADDRESS	Electrical zero point setting			Applicable models	
	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	B		<input type="radio"/> FX2N-10GM	
				<input type="radio"/> FX2N-20GM	

Basic format	FX2N-10GM	FX2N-20GM
	<div>cod 29 SETR</div> <div>①</div>	<div>cod 29 SETR</div> <div>①</div>

① SETR

When this instruction is executed, the present position (set to the present value register) is written to the electrical zero point register.

5.6.8 cod 30 (DRVr): Electrical zero return

cod 30 DRVr DRIVE TO RETURN ADDRESS	Electrical zero return			Applicable models	
	Servo end check	Yes	Remarks	Series name	Remarks
	Instruction group	B		<input type="radio"/> FX2N-10GM	
				<input type="radio"/> FX2N-20GM	

Basic format	FX2N-10GM	FX2N-20GM
	<div>cod 30 DRVr</div> <div>①</div>	<div>cod 30 DRVr</div> <div>①</div>

① DRVr

When this instruction is executed, the machine returns to the electrical zero point (set to the electrical zero point register) at a high speed, and the servo end check is performed. The acceleration/deceleration time is determined by PARA. 8 and PARA. 9, and the operation speed is determined by PARA. 4 (maximum speed).

5.6.9 cod 31 (INT): Interrupt stop (ignoring the remaining distance)

cod 31 INT INTERRUPT STOP	Interrupt stop (ignoring the remaining distance)			Applicable models	
	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	A		● FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-10GM			FX2N-20GM			
	cod 31 INT	X○○○	f □□□	cod 31 INT	X○○○	y△△△	f □□□
		X axis target position	speed		X axis target position	Y axis target position	Vector speed
	①	②	④	①	②	③	④

① INT

By this instruction, the machine decelerates and stops by an interrupt input during positioning at 1-step speed (FX2N-10GM) or linear interpolation (FX2N-20GM). When using this instruction, pay rigid attention to PARA. 23 (stop mode). (Refer to Subsection 4.3.1.)

In the FX2N-10GM

Positioning is performed to the target position (x○○○) at the speed (f). When the interrupt input X02 or X03 (selected by M9170) is turned ON, positioning is aborted, the machine is decelerated and stopped, sub sequentially the next instruction is executed.

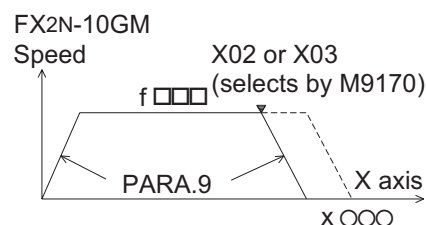
Program ON/OFF of M9170 before instruction (cod31) of INT. (The INT instruction action inside cannot change the interrupting input number.)

Selection of interrupting input number

M9170 OFF : X03 (Level detection)

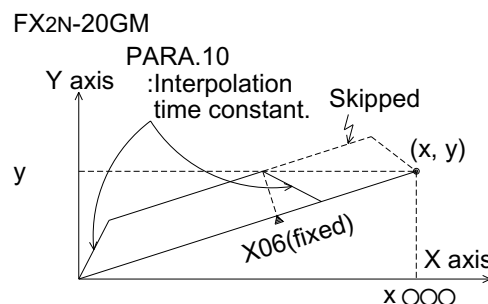
M9170 ON: X02 (Level detection)

- In FX2N-10GM before V2.20, the interrupting input number is X3 fixation.
 - Select X02 when MANU/AUTO is switched by general purpose input.
- (Refer to Subsection to 1.4.6)



In the FX2N-20GM

Linear interpolation operation is performed to the target coordinates (x, y) at the vector speed (f). When the interrupt input X06 (fixed) is turned ON, positioning is aborted, the machine is decelerated and stopped, then the next instruction is executed. This instruction is available only in the simultaneous 2-axis mode (O00 to O99).



②③X/Y axis target position

The position can be specified by either the incremental address or the absolute address. The unit and the set range are equivalent to those for the cod 01.

④ Speed

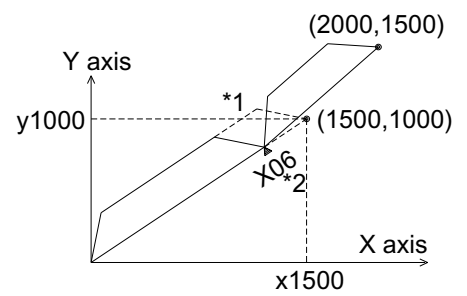
The unit and the set range are equivalent to those for the cod 01.

Program example (in the FX₂N-20GM)

```

cod 31 (INT)
  x1500
  y1000
  f2000;
cod 01 (LIN) *2
  x2000
  y1500
  f2000;

```



*1: When the interrupt input X06 is turned ON, the machine is decelerated and stopped. Then, the machine proceeds to the next positioning while ignoring the remaining distance indicated in dotted line.

*2: The machine moves to the target position if input X06 is not turned ON.

5.6.10 cod 71 (SINT): Interrupt jog feed (one-step speed)

cod 71 SINT INTERRUPT STOP	Interrupt jog feed (one-step speed)			Applicable models	
	Servo end check	Yes	Remarks	Series name	Remarks
	Instruction group	B		● FX2N-10GM ● FX2N-20GM	

Basic format	FX2N-10GM			FX2N-20GM		
	cod 71 SINT	X○○○	fx ***	cod 71 SINT	X○○○	fx ***
		X axis incremental distance	Speed		X axis incremental distance	Speed
	①	②	②'	①	②	②'

Basic format	FX2N-20GM			FX2N-20GM		
	cod 71 SINT	y△△△	fy ◆◆◆	cod 71 SINT	y△△△	fy ◆◆◆
		Y axis incremental distance	Speed		Y axis incremental distance	Speed
	①	③	③'	①	③	③'

① SINT

The machine operates at the speeds fx and fy until the interrupt inputs are turned ON. When the interrupt input are turned ON, the machine travels the specified distance without changing speed and then stops.

Interrupt inputs

X02 (X axis): FX2N-10GM

X04 (X axis), X05 (Y axis): FX2N-20GM

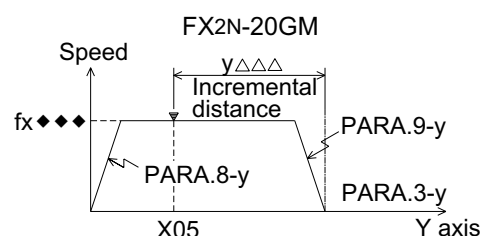
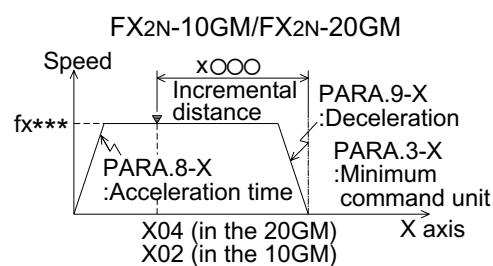
The machine continues to travel without restriction until the interrupt inputs are turned ON.

②③ X/Y axis incremental travel

Though the units and the set range are equivalent to those for the cod 00 (DRV), the specified numeric is always treated as an incremental address.

②'③' X/Y axis speed

The units and the set range are equivalent to those for the cod 00 (DRV). However, the settings cannot be omitted.



Program example

cod90 (ABS);Incremental address.

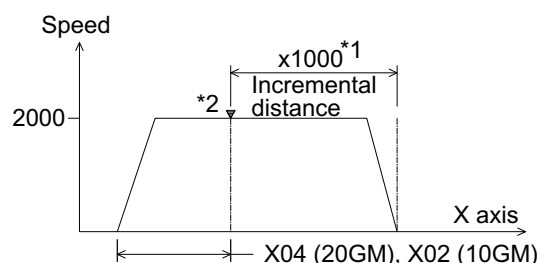
cod71 (SINT)

x1000 *1

f2000;

*1: Even if the absolute drive method is used in the program, the travel is treated as incremental address after the cod 71 is executed.

*2: When the incremental travel is small and the specified speed is high, the servo motor drastically decelerates and the machine is stopped at the specified position (If the machine has gone too far, the travel direction is reversed.). Be careful if using a stepping motor as it may become out of order.



5.6.11 cod 72 (DINT): Interrupt jog feed (two-step speed)

cod 72 DINT	Interrupt jog feed (two-step speed)			Applicable models	
	Servo end check	Yes	Remarks	Series name	Remarks
	Instruction group	B		● FX2N-10GM ● FX2N-20GM	

Basic format	FX2N-10GM				FX2N-20GM			
	cod 72 DINT	X○○○	fx ***	fx ◆◆◆	cod 72 DINT	X○○○	fx ***	fx ◆◆◆
		X axis incremental distance	First-step speed	Second-step speed		X axis incremental distance	First-step speed	Second-step speed
	①	②	②'	②''	①	②	②'	②''

Basic format	FX2N-20GM				Y axis one-step speed			
	cod 72 DINT	y△△△	fy ***	fy ◆◆◆	cod 72 DINT	y△△△	fy ***	fy ◆◆◆
		X axis incremental distance	First-step speed	Second-step speed		X axis incremental distance	First-step speed	Second-step speed
	①	③	③'	③''	①	③	③'	③''

① DINT

The machine operates at the first-step speed fx^{***} or $fy◆◆◆$ until the interrupt input is turned ON.

When the speed-change input (X00) is turned ON, the operation speed is changed into the second-step speed fx^{***} or $fy◆◆◆$.

And when the stop input (X01) is turned ON, the machine performs incremental travel of the specified distance, then stops.

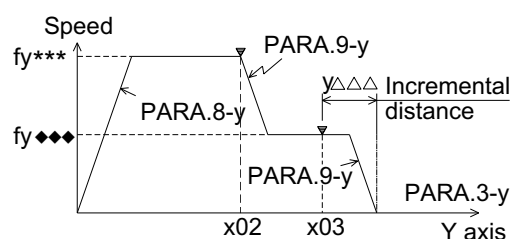
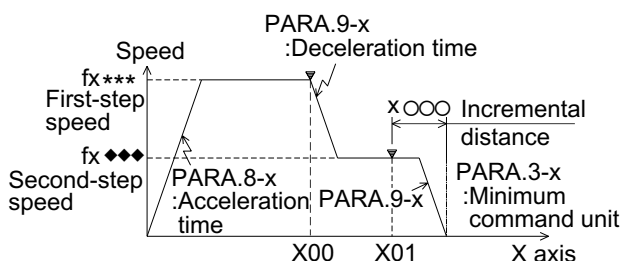


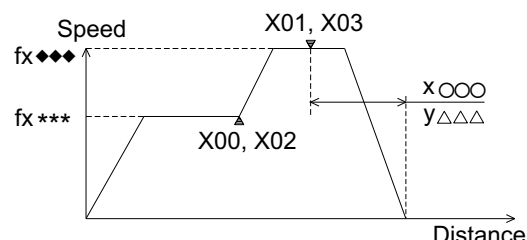
Table 5.14:

	Speed-change inputs	Stop inputs
X axis (FX2N-10GM FX2N-20GM)	X00	X01
Y axis (FX2N-20GM)	X02	X03

The machine continues operation without restriction until both the speed-change input and the stop input are turned ON.

②③X/Y axis incremental travel

The units and the set range are equivalent to those for cod 00 (DRV). However, the settings are always treated as incremental values and cannot be omitted.



②'②''③'③''X/Y axis speed

The units and the set range are equivalent to those for cod 00 (DRV) (However, the settings of the travel and the speed cannot be omitted.).

The second-step speed can be set higher (faster) than the first-step speed.

However, when the travel distance is short and the travel is finished within the deceleration time set to PARA. 9, the machine stops immediately. In this case, a stepping motor (if used) may become out of order.

Interrupt Drive Instructions

The inputs shown in the table below are assigned as the stop commands and deceleration commands for interrupt drive control.

Table 5.15: Interrupt Drive Instructions

Input	FX2N-10GM	FX2N-20GM
X00	cod 72 : x axis speed-change input	cod 72 : x axis speed-change input
X01	cod 72 : x axis stop input	cod 72 : x axis stop input
X02	cod 71 : x axis	cod 72 : y axis speed-change input
X03	cod 31	cod 72 : y axis stop input
X04		cod 71 : x axis
X05		cod 71 : y axis
X06		cod 31 : Simultaneous 2-axis

Because these inputs are treated as general-purpose inputs and can also be used with a manual pulse generator they may not be available. (Refer to PARA. 39 (manual pulse generator) described in Section 4.4.3.)

5.6.12 cod 73 (MOVC): Travel compensation

cod 73 MOVC	Travel compensation/Center point compensation/ Radius compensation/Compensation cancel			Applicable models	
	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	C		● FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-10GM			FX2N-20GM		
	cod 73 MOVC	x○○○	Travel CORRECTION	cod 73 MOVC	x○○○ y△△△	
	①	② X axis target position		①	② X axis target position	③ Y axis target position

① MOVC

Compensation is performed to the travel (target distance) performed after this instruction.

②③ Correction value

The correction can be set within the range from 0 to $\pm 999,999$. The current value address contains the correction value.

When the following special auxiliary relays turn on, the machine operates while ignoring the correction values set in cod73, cod74 and cod75 during incremental drive (performed when cod91 is executed). (Because the correction value is added to both normal rotation and reverse rotation, displacement occurs if correction is performed to a reciprocating motion in incremental drive.)

M9163: For the X axis

M9164: For the Y axis

5.6.13 cod 74 (CNTC): Center point compensation, cod 75 (RADC): Radius compensation

cod 74 CNTC	Travel compensation/Center point compensation/ Radius compensation/Compensation cancel			Applicable models	
cod 75 RADC	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	C		FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-20GM				
	CENTER CORRECTION		cod 74 CNTC	i ***	j ◆◆◆
				X axis center position	Y axis center position
				③	④
	RADIUS CORRECTION		cod 75 RADC	r □□□	
				X axis center position	
				②	⑤

① CNTC

Compensation is performed to the center point specified by the cod 02 and cod 03 instructions executed after this instruction.

② RADC

Compensation is performed to the radius specified by the cod 02 and cod 03 instructions executed after this instruction.

③④⑤ Correction value

The correction can be set within the range from 0 to $\pm 999,999$. The current value address contains the correction value.

When the following special auxiliary relays turn on, the machine operates while ignoring the correction values set in cod73, cod74 and cod75 during incremental drive (performed when cod91 is executed). (Because the correction value is added to both normal rotation and reverse rotation, displacement occurs if correction is performed to a reciprocating motion in incremental drive.)

M9163: For the X axis

M9164: For the Y axis

5.6.14 cod 76 (CANC): Compensation cancel

cod 76 CANC	Travel compensation/Center point compensation/ Radius compensation/Compensation cancel			Applicable models	
	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	C		<input checked="" type="radio"/> FX2N-10GM	
				<input checked="" type="radio"/> FX2N-20GM	

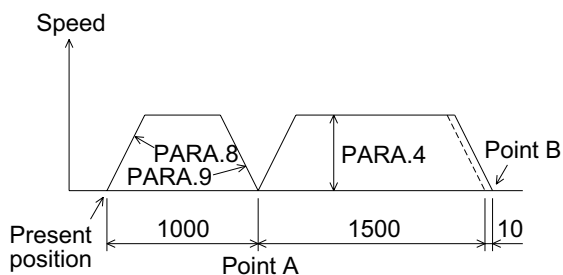
Basic format	FX2N-10GM		FX2N-20GM	
	cod 76 CANC	Compensation cancel	cod 76 CANC	
	①		①	

① CANC

The compensations cod73 to cod75 above are canceled.

Program example

cod91 (INC); Specifies the incremental travel method.
 cod00 (DRV) Moves the machine to Point A.
 x1000;
 cod73 (MOVC) Compensates the travel.
 x10; Sets the X axis compensation value to "10".
 cod00 (DRV) Moves the machine to Point B.
 x1500;
 cod76 (CANC) Cancels compensation.



Acceleration is determined by PARA. 8 and PARA. 9.
 The operation speed is determined by PARA. 4 (maximum speed).

5.6.15 cod 90 (ABS): Absolute address, cod 91 (INC): Incremental address

cod 90 ABS	Absolute/Incremental address			Applicable models	
cod 91 INC	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	D		● FX2N-10GM	
				● FX2N-20GM	

Basic format	FX2N-10GM		FX2N-20GM
	cod 90 ABS	Absolute address	cod 90 ABS
	①		①
	cod 91 INC	Incremental address	cod 91 INC
	②		②

① ABS

The address coordinates (x, y) used after the cod 90 instruction are regarded as absolute values from the zero point (0, 0).

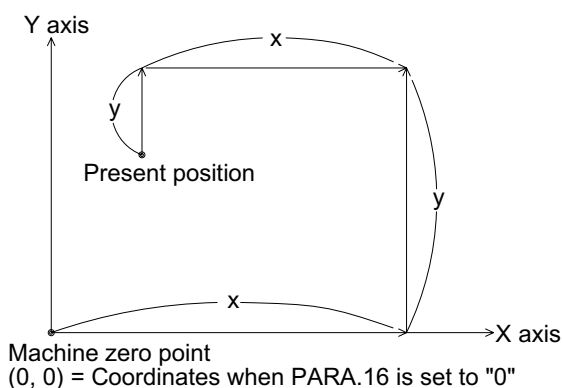
However, the coordinates of the arc center point (i, j), the radius (r), the travel by cod 71 (SINT) and cod 72 (DINT) are always regarded as incremental values. An address is regarded as an absolute value when specification is omitted.

② INC

The address coordinates (x, y) used after the cod 91 instruction are regarded as incremental values from the present position.

Correction disabling function during incremental drive

While special auxiliary relays M9163 (for the X axis) and M9164 (for the Y axis) are ON, the correction data set in cod73, cod74 and cod75 are ignored during incremental drive (performed when cod91 is executed), and the machine operates without correction.



5.6.16 cod 92 (SET): Present value change

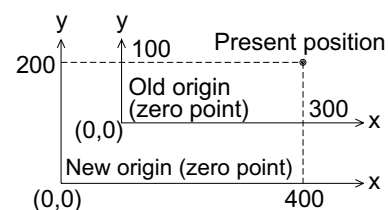
cod 92 SET	Present value change			Applicable models	
	Servo end check	No	Remarks	Series name	Remarks
	Instruction group	B		<input type="radio"/> FX2N-10GM	
SET				<input type="radio"/> FX2N-20GM	

Basic format	FX2N-10GM		FX2N-20GM	
	cod 92 SET	X○○○ X axis present value	cod 92 SET	X○○○ y△△△ X axis present value Y axis present value

When this instruction is executed, the value in the present value register changes to the value specified by this instruction. Accordingly, both the machine zero point and the electrical zero point are also shifted.

Example

The figure on the right indicates the new and old origin before and after "cod 92 (SET) x400, y200" is executed in the present position (300, 100) (absolute coordinates).



5.7 Common Items in Sequence Control Instructions

This paragraph describes basic instructions (such as LD and AND) and application instructions in sequence control.

These instructions are used together with positioning control instructions, and control auxiliary units accompanied by positioning.

5.7.1 Difference in operation by PLC

The difference from arithmetic operation in the PLC is that sequence control instructions are step type, so do not perform cyclic arithmetic operation.

For example, in the program shown on the right, if X00 is OFF when the line N100 is executed, Y00 is not output.

When cyclic arithmetic operation is required, use jump instructions described later. (Refer to Paragraph 5.10.)

Contact instructions have nothing to do with positioning control instructions (cod instructions). In the program shown on the right, cod00 in the line N201 is executed without regard to the ON/OFF status of X00 in the line N200.

```

      )
N100 LD X00
N101 SET Y00
      )
N200 LD X00
N201 cod00(DRV)
      )
      x1000;
```

5.7.2 Applicable devices

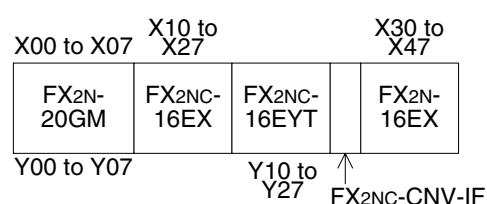
Table 5.16: Applicable devices

	FX2N-10GM	FX2N-20GM	
	Main unit	Main unit	Extension
Input relays (X) *5	X00 to X03 4 points X375 to X377 3 points *1	X00 to X07 8 points X372 to X377 6 points *1	X10 to X67 48 points *2
Output relays (Y)	Y00 to Y05 6 points	Y00 to Y07 8 points	Y10 to Y67 48 points*2
Auxiliary relays (M)	M0 to M511 512 points (general purpose) M9000 to M9175 (special)	M0 to M99 (general purpose) 100 points M100 to M511 (general purpose) 412 points *3 M9000 to M9175 (special)	—
Data registers (D)	D0 to D1999 2000 points (general purpose) D4000 to D6999 (files) 3000 points*3 D9000 to D9313 (special)	D0 to D99 (general purpose) 100 points D100 to D3999 (general purpose) 3900 points*3 D4000 to D6999 (files) 3000 points *3 D9000 to D9599 (special)	—
Index registers	V0 to V7 (16-bit)8 points Z0 to Z7 (32-bit)8 points	V0 to V7 (16-bit) 8 points Z0 to Z7 (32-bit) 8 points	—
Pointers	P0 to P127 128 points	P0 to P255 256 points	—

*1 When PARA. 56 (general purpose declaration) is set to "1" to "4", the [ZRN], [FWD] and [RVS] terminals can be used for general purpose inputs (Refer to Section 4.4.5).

*2 Lower numbers are assigned to extension blocks from the one closest to the FX2N-20GM main unit. The total number of extension I/Os must be 48 or less (Refer to Section 1.4.5.).

Example of I/O assignment



*3 Battery backup area

When the power is turned off, the FX2N-20GM stores the status just before the power is turned off with the lithium battery FX2NC-32BL. The FX2N-10GM stores the status with an EEPROM. The number of used file registers should be set in PARA. 101.

*4 The use of extension blocks is not possible with the FX2N-10GM. When more I/Os are required, use a programmable controller.

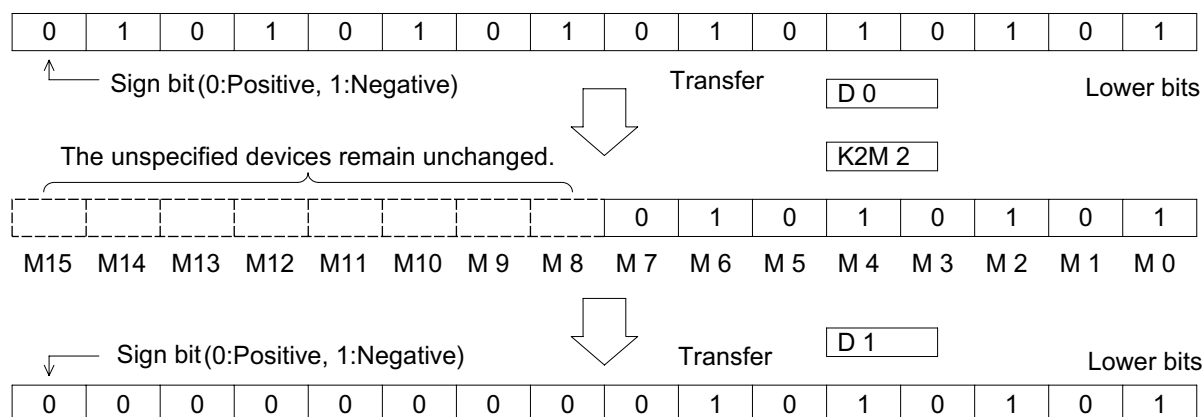
*5 When manual pulse generators or interrupt positioning instructions (cod 31, cod 71 and cod 72) are used, a part or the whole of these cannot be used for general purpose inputs (Refer to Section 5.6.11).

5.7.3 Bit devices

The devices such as X, Y and M which handle ON/OFF information are called bit devices. Other devices such as D, V and Z which handle numeric data are called word devices. Bit devices, however, can be grouped to handle numeric data. The combination of bit devices is expressed by a digit "n" following "K" (Kn) and the head device No.

The bit devices can be grouped in unit of 4 bits. The "n" in KnM0 defines the number of groups of 4 bits to be combined for data operation.

K1 to K4 are allowed for 16-bit data operation, and K1 to K8 are allowed for 32-bit data operation. For example, K2M0 indicates 2 groups of 4 bits using the bit devices M0 to M7.



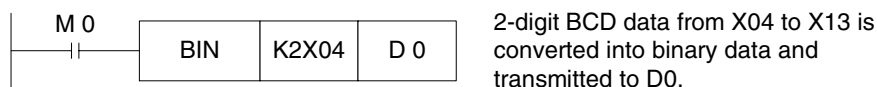
When 16-bit data is transmitted to K1M0 to K3M0, the overflowing bit data is not transmitted. This is also true for 32-bit data.

When a 16-bit (32-bit) data operation is executed and the digit specification for a bit device is K1 to K3 (K1 to K7), "0" is placed in the higher digit bit positions.

For example, if K4Y00 is used for a 32 bit data operation, the upper 16 bits are regarded as "0". If 32-bit data with the sign is required, K8Y00 must be specified.

Any bit device No. can be used. However, it is recommended to use "0" in the lowest digit place of the X and Y No. (X00, X10, X20 . . . , Y00, Y10, Y20, etc.).

For M, it is ideal to use multiples of 8. However, because the use of such No. may lead to confusion in assigning device No., it is recommended to use multiples of 10 such as M0, M10, M20, etc. in the same way as X and Y.



Specification of series of words

A series of data registers beginning with D1 means D1, D2, D3, D4, ...

When grouped bit devices are used for a series of words, they will be specified in the following way.

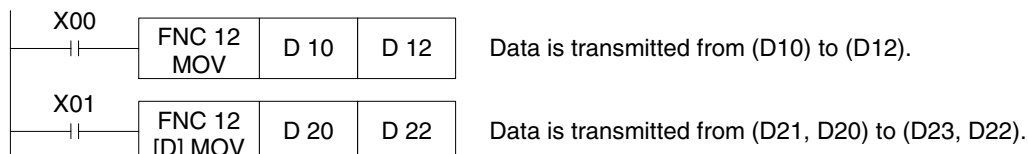
K1X00, K1X04, K1X14, ...; K2Y10, K2Y20, K2Y30, ...;

K3M0, K3M12, K3M24, K3M36, ...

That is, all bit devices will be used so that no device is skipped.

5.7.4 Data length and instruction execution format

Application instructions which handle numerics are either 16-bit or 32-bit depending on the bit length of the numeric data.



32-bit instructions are indicated by prefixing the symbol D as D MOV, FNC D 12, FNC12 D, etc. In this case, numeric data is handled as follows.

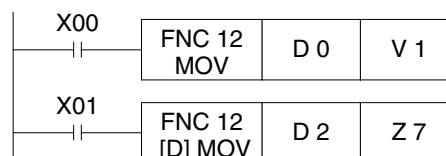
- 1) Kn of grouped bit devices such as KnX, KnY and KnM can be assigned values from K1 (4 bits) to K8 (32 bits).
- 2) Using an even No. data register for the lower 16 bits, the succeeding data register is used for the upper 16 bits. Specify the lower device for operands.
- 3) Z index registers should be used when specified as the operand with 32-bit instructions.

In the same way as general data registers, the file registers can be used in various instructions.

5.7.5 Indexing of devices

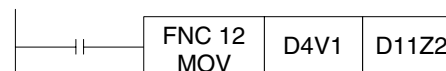
The index data registers V and Z are 16-bit or 32-bit data registers which allow writing and reading of numeric data in the same way as general registers.

The registers V are used as 16-bit operand, and the registers Z are used as 32-bit operands.



Changing of a device No. in accordance with the contents of V or Z, as shown in the figure on the left, is called "indexing" of the device No.

The registers V and Z, when indexing devices, can be used together without any distinction between 16-bit and 32-bit instructions.



Assuming (V1) = 8, (Z2) = 10:
 $4 + 8 = 12$, $11 + 10 = 21$
 D12 moved to D21

Modifiable devices:

X, Y, M, P (pointer), KnX, KnY, KnM, D

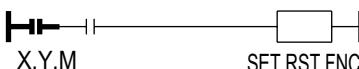
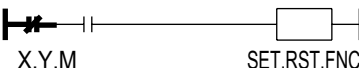
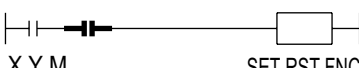
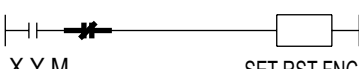
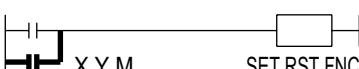
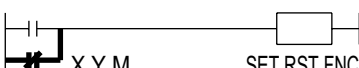
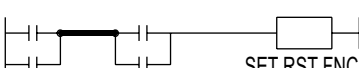
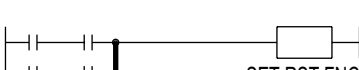
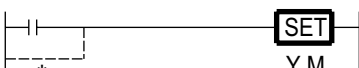
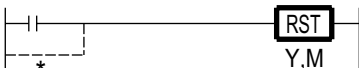
The devices that can be modified by the index registers are those used in application instructions as shown on the left.

However, "Kn" of group bit devices and the jump destination label No. "P" cannot be modified.

5.8 Basic sequence instructions

The sequence instructions are classified into the basic type and the application type. The format of both types is equivalent to that for the FX Series programmable controller. These sequence instructions are used in positioning programs (including subtasks).

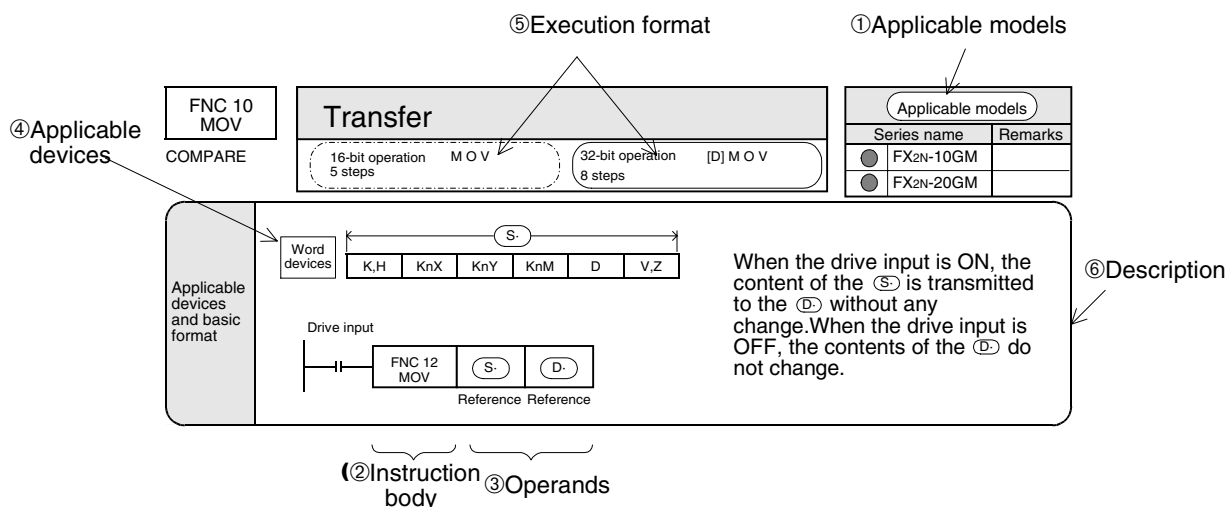
Table 5.17: Basic sequence instructions

Symbol and name	Function	Circuit indication and applicable devices	Description
LD Load	Operation start Normally open contact	 X,Y,M SET,RST,FNC	The contact instructions shown on the left are used to drive coil instructions such as SET, RST and the application instructions described later. The applicable devices are contacts of X (input relay), Y (output relay) and M (auxiliary relay). For example, when "LD X00" is encountered, program execution is not held until the X00 is turned ON; the ON or OFF status of the X00 is detected and the next step is immediately executed. (This is true for all contact instructions.)
LDI Load inverse	Operation start Normally close contact	 X,Y,M SET,RST,FNC	
AND And	Series connection Normally open contact	 X,Y,M SET,RST,FNC	
ANI And inverse	Series connection Normally close contact	 X,Y,M SET,RST,FNC	
OR Or inverse	Parallel connection Normally open contact	 X,Y,M SET,RST,FNC	
ORI Or inverse	Operation start Normally close contact	 X,Y,M SET,RST,FNC	There are no applicable devices for the ANB (Series connection between parallel circuit blocks) and ORB (parallel connection between series circuit blocks) instructions.
ANB And block	Series connection between blocks	 SET,RST,FNC	
ORB Or block	Parallel connection between blocks	 SET,RST,FNC	Once the SET instruction is driven by turning its contact ON, it remains operational until the RST instruction is driven by turning its contact ON. The applicable devices are coils of Y and M.
SET Set	Operation-maintaining coil instruction	 * Y,M	
RST Reset	Operation-canceling coil instruction	 * Y,M	
NOP No operation	No operation	Used to erase a program or enter spaces.	

* Can be driven even without a contact instruction.

5.9 Application instruction format

In this manual, each application instruction is expressed as follows.



① Applicable models

The models in which the described instruction is available are indicated.

The models are classified into the FX2N-10GM and the FX2N-20GM. "●" is added to the applicable series.

Remarks; ✓: Can be used

×: Not use

② Instruction body

An application instruction is specified by the function No. FNC 00 to the FNC 93. To each instruction, a symbol (mnemonic or instruction symbol) which represents the contents is assigned. For example, "MOV" is assigned to the FNC 12.

Some application instructions only require the instruction body. In most cases, however, the instruction body is combined with one or more operands which follow it.

③ Operands

The operands specify the condition and the contents required to execute the instruction. Specify the operands in the order stated.

S: Source

The operands whose contents are not changed by execution of the instruction are called sources and are identified by the symbol (S). If a source operand can be indexed (as described later), it is followed by "." and indicated as (S ·). When there are two or more sources, they are indicated as (S1 ·), (S2 ·), etc.

D: Destination

The operands whose contents are changed by execution of the instruction are called destinations and are identified by the symbol (D). If a destination operand can be indexed (as described later), it is followed by "." and indicated as (D ·). When there are two or more destinations, they are indicated as (D1 ·), (D2 ·), etc.

n: Constant

The operands for which only constant K or H can be specified are indicated as "n". When there are two or more constants, they are indicated as n1, n2, etc.

④ Applicable devices

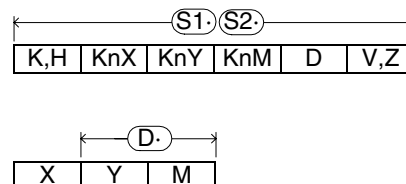
Devices such as X, Y, M and D can be used as operands.

X, Y and M can be used as bit devices or word devices (Refer to "5.6.3 Bit devices").

The data registers D (16-bit) and the index registers V (16-bit) and Z (32-bit) are handled as data.

The expression shown on the left indicates that constants K and H, group bit devices KnX, KnY and KnM, data registers D and index registers V and Z are applicable as operands (S1 ·) and (S2 ·).

And this expression also indicates that bit devices Y and M can be specified as (D ·).



- The indexes V0 to V7 and Z0 to Z7 cannot be further indexed. (For example, V0Z is invalid.)

⑤ Execution format

The instructions handling 16-bit numbers as well as 32-bit numbers are indicated by prefixing the symbol [D] (Refer to "5.6.4 Data length and instruction execution format").

⑥ Description

The basic contents such as what the instruction can do, how the operands must be set, etc. are described here.

Application instruction drive input

An application instruction can either be driven via some contact or directly driven without regard to any contact.

The instructions FNC 03 to FNC 09 are exceptions, and are always driven directly without regard to any contact.

In the case of an application instruction which is driven via some contact, it is not executed when the drive input is OFF (as if the instruction is skipped by the jump function.)

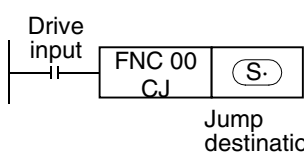
The contact circuits are automatically reset when a positioning control instructions, m code instructions, FNC 03 to FNC 05, FNC 08 and FNC 09, etc. are specified in the program. After that, program execution returns to the bus line.

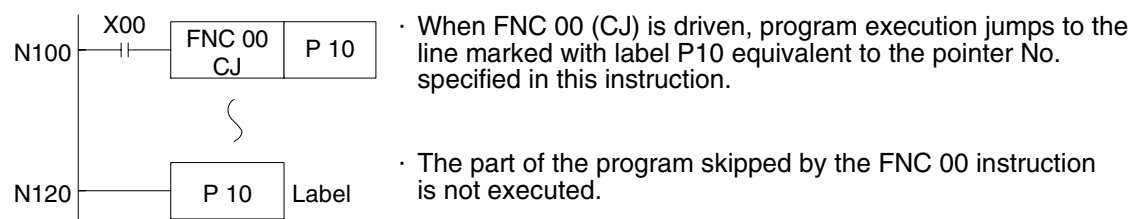
5.10 Description on Sequence Application Instructions

This paragraph describes the details of sequence application instructions.

5.10.1 FNC00 (CJ): Conditional jump

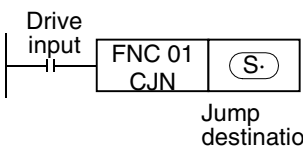
FNC 00 CJ CONDITIONAL JUMP	Conditional jump	Applicable models	
	16-bit operation CJ 3 steps	Series name	Remarks
		● FX2N-10GM	
		● FX2N-20GM	

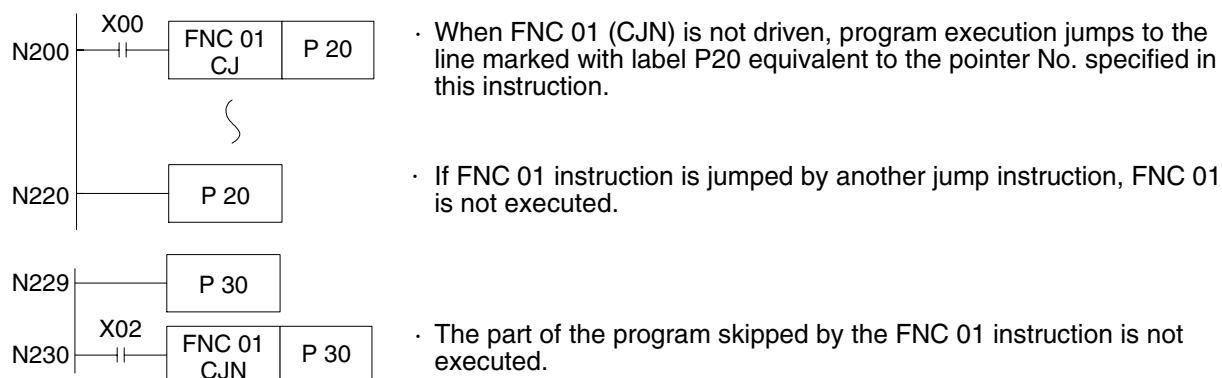
Applicable devices and basic format	(S) : Pointers P0 to P127 (in the 10GM) P0 to P255 (in the 20GM)		(Pointers used for CALL instructions should not be used for JUMP instructions.)
		• When the drive input condition is satisfied, program execution jumps to the specified label.	



5.10.2 FNC00 (CJN): Conditional jump not

FNC 01 CJN CONDITIONAL NOT JUMP	Conditional jump not	Applicable models	
	16-bit operation CJN 3 steps	Series name	Remarks
		● FX2N-10GM	
		● FX2N-20GM	

Applicable devices and basic format	(S) : Pointers P0 to P127 (in the 10GM) P0 to P255 (in the 20GM)		(Pointers used for CALL instructions should not be used for JUMP instructions.)
		• When the drive input condition is not satisfied, program execution jumps to the specified label.	



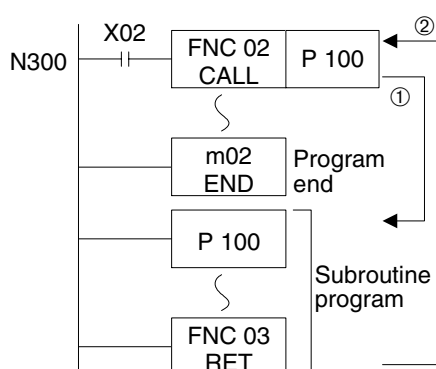
5.10.3 FNC02 (CALL): Subroutine call, FNC03 (RET): Subroutine return

FNC 02 CALL	Subroutine call/Subroutine return	Applicable models	
FNC 03 RET	16-bit operation 3 steps : CALL 1 steps : RET	Series name	Remarks
		● FX2N-10GM	
		● FX2N-20GM	

Applicable devices and basic format	(S) : Pointers P0 to P127 (in the 10GM) P0 to P255 (in the 20GM)	No applicable devices	
	(Pointers used for CALL instructions should not be used for JUMP instructions.)	(Do not nest more than 15 levels of CALL instructions from subroutines called by a CALL instruction.)	

Drive input	FNC 02 CALL	(S)	The subroutine program whose No. is equivalent to (S) is executed.
			Call destination

FNC 03 RET	The program from the label to the RET instruction is regarded as a subroutine program.
------------	--



- When FNC 02 (CALL) instruction is driven, program execution jumps to the line marked with label P100 (Operation ②).
- The subroutine program that starts at P100 is executed, then program execution returns to the former line No. N300 by FNC 03 (RET) instruction (Operation ①).
- The program from label (P) after m02 (m102 for a subtask) to FNC 03 instruction is regarded as a subroutine program.

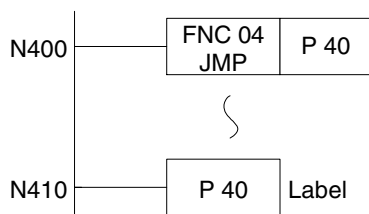
5.10.4 FNC04 (JMP): Unconditional jump

FNC 04 JMP	Unconditional jump	Applicable models	
JUMP	16-bit operation JMP 1 steps	Series name	Remarks
		● FX2N-10GM	
		● FX2N-20GM	

Applicable devices and basic format	(S) : Pointers P0 to P127 (in the 10GM) P0 to P255 (in the 20GM)	(Pointers used for CALL instructions should not be used for JUMP instructions.)	

Drive input	FNC 04 JMP	(S)	Program execution jumps to the label specified by (S) without regard to condition.

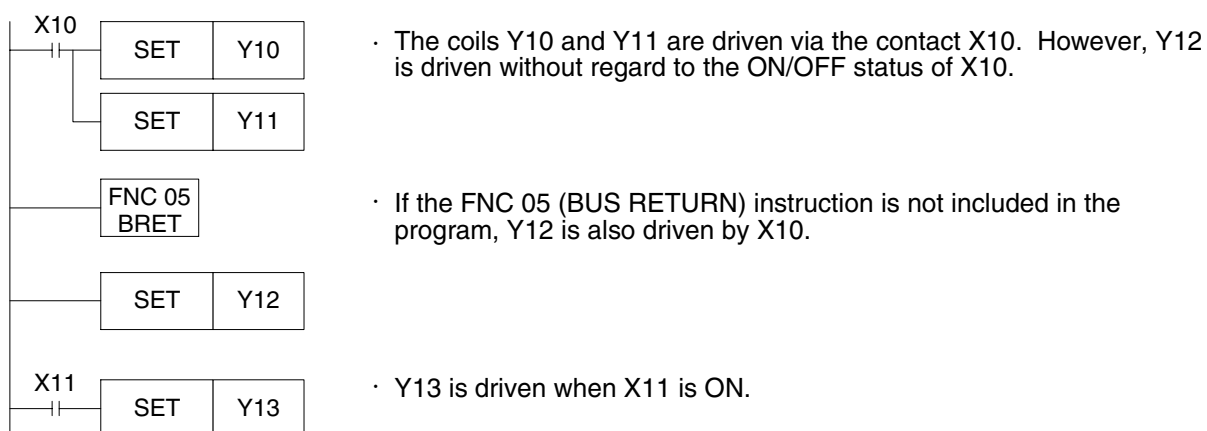
			Jump destination
--	--	--	------------------



- When FNC 04 (JMP) instruction is driven, program execution jumps unconditionally to the line marked with label P40.
- If this instruction is skipped by another JUMP instruction, this instruction is not executed.

5.10.5 FNC05 (BRET): Bus return

FNC 05 BRET	Bus return	Applicable models	
BUS RETURN	16-bit operation BRET 1 steps	Series name	Remarks
		● FX2N-10GM	
		● FX2N-20GM	
Applicable devices and basic format		No applicable devices	
		FNC 05 BRET	<ul style="list-style-type: none"> When FNC 05 (BUS RETURN) instruction is executed, the instructions after that are treated as those connected to the bus.



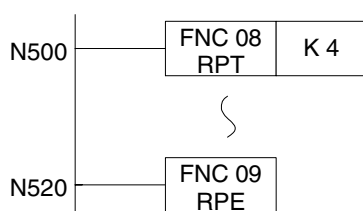
Other instructions that cause a return to the bus

When either of the following instructions is used in the program, bus line return is automatically performed even if the BRET instruction is not included in the program.

- 1) Positioning control instructions (cod instructions).
- 2) m code instructions in AFTER mode.
- 3) Application instructions such as FNC 03 (RET), FNC 04 (JMP), FNC 08 (RPT), FNC 09 (RPE), etc. that are not used with drive contacts.
- 4) When FNC 00 (CJ) or FNC 01 (CJN) instruction is executed.

5.10.6 FNC08 (RPT): Start of repeat, FNC09 (RPE): End of repeat

FNC 08 R P T	Start/End of repeat		Applicable models	
REPEAT	16-bit operation 3 steps : RPT1 steps : RPE		Series name	Remarks
FNC 09 R P E			● FX2N-10GM	
REPEAT END			● FX2N-20GM	
Applicable devices and basic format	Word devices			
	S Z is excluded. K,H KnX KnY KnM D V,Z			
	FNC 08 RPT	• Program execution is repeated by the number specified in S .		FNC 09 RPE
Number of repetitions				
• The program from FNC 08 to FNC 09 is repeatedly executed.				
• End of repetition				



- The part of the program from FNC 08 to FNC 09 is repeatedly executed.
- The number of repetitions is specified by (S ·) in FNC 08.
- Do not nest more than 15 levels of RPT instructions in a program that starts with an RPT instruction.
- A value from 1 to 32,767 can be assigned to (S ·). When "0" is set, the program is executed only once. When a negative value is set, the program is executed continuously and does not stop.

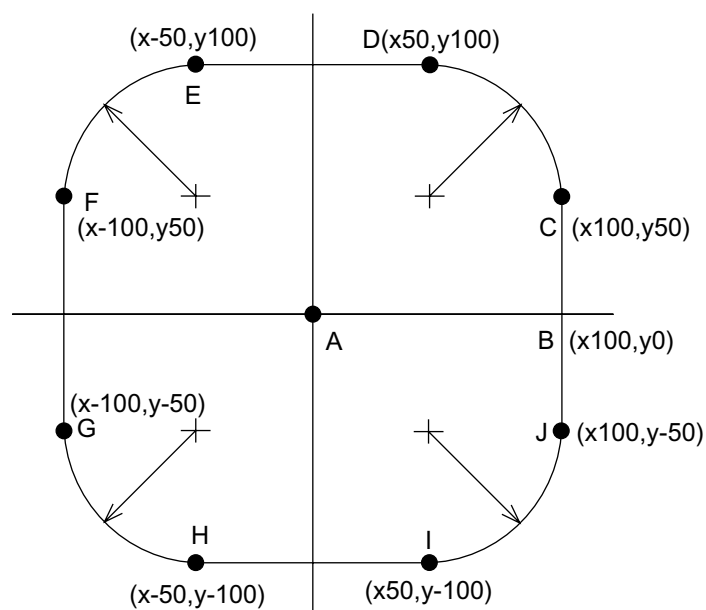
Continuous paths and repeat instructions (in the FX_{2N}-20GM only)

If a cod 01, cod 02 or cod 03 instruction is used at the beginning and end of a program delimited by RPT and RPE instructions, these cod instructions are processed as if they are continuing. Using this function, a locus can be traced repeatedly. When tracing a locus repeatedly, set M9015 (continuous path mode) to OFF.

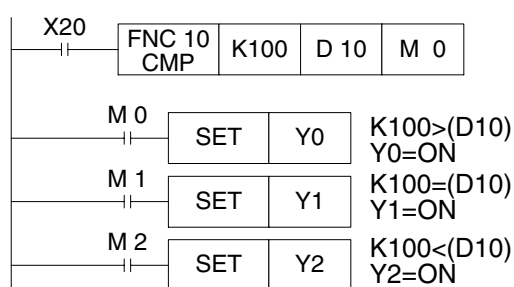
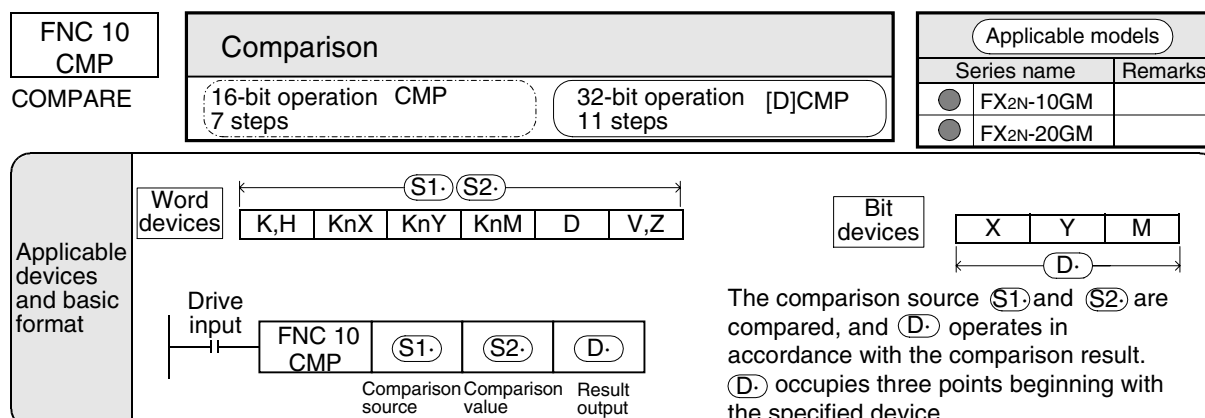
Program example

Program					Operation
O15	Program No.				
N100	cod28	(DRVZ)	To point A		
N101	cod90	(ABS)			
N102	cod00	(DRV)	x 100		A → B
N103	FNC08	(RPT)	K 100		
N104	cod01	(LIN)	(x 100) y 50 f 500		B → C
N105	cod03	(CCW)	x 50 y 100 i -50		C → D
N106	cod01	(LIN)	x -50 (y100)		D → E
N107	cod03	(CCW)	x -100 y 50 j -50		E → F
N108	cod01	(LIN)	(x -100) y -50		F → G
N109	cod03	(CCW)	x -50 y -100 i 50		G → H
N110	cod01	(LIN)	x 50 (y -100)		H → I
N111	cod03	(CCW)	x 100 y -50 j 50		I → J
N112	cod01	(LIN)	(x100) y 0		J → B
N113	FNC09	(RPE)			
N114	m02	(END)			

(): The x and y specifications in parentheses can be omitted.

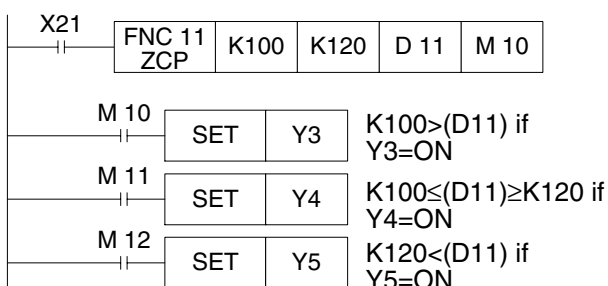
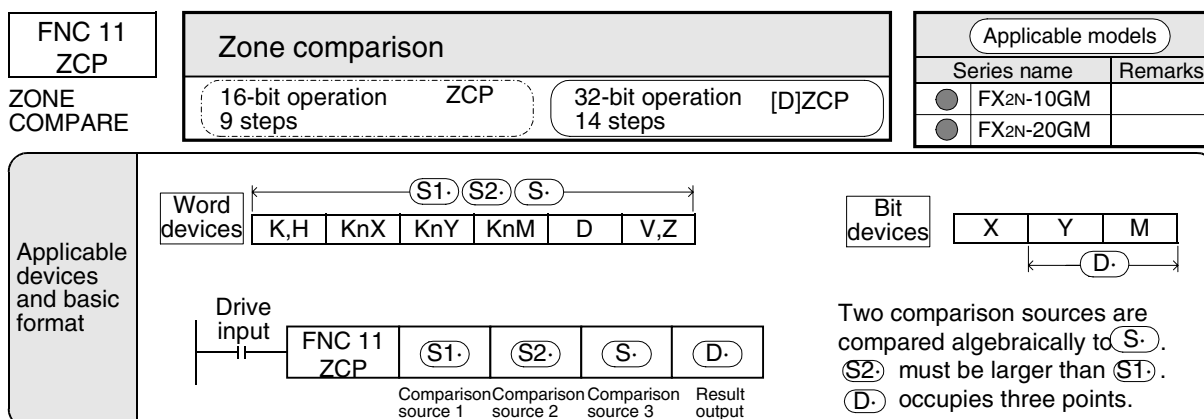


5.10.7 FNC10 (CMP): Comparison

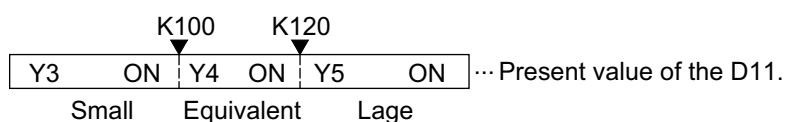


- The present value of K100 and D10 are compared algebraically. (For example, $-10 < 2$)
- Three points are assigned for the result output. This result output remains in the previous status even when the drive contact (X20) is turned OFF and the comparison instruction is not executed.

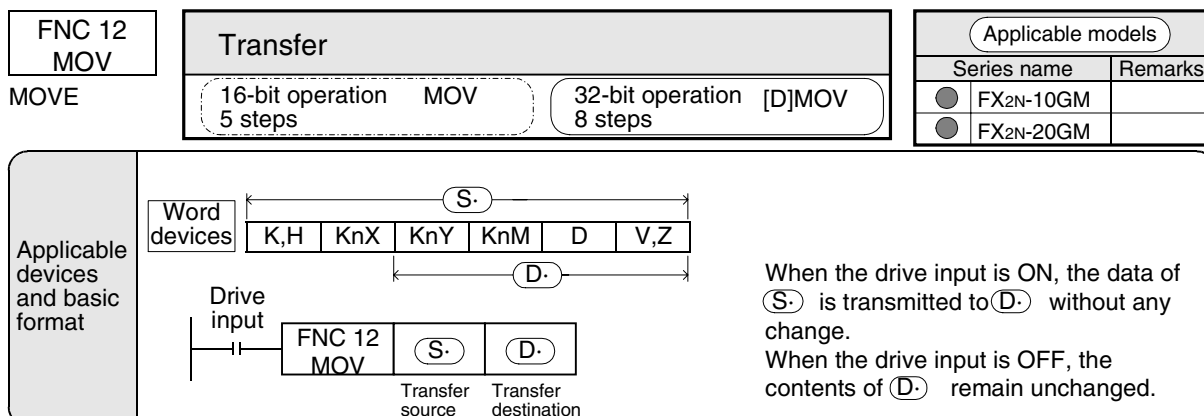
5.10.8 FNC11 (ZCP): Zone comparison



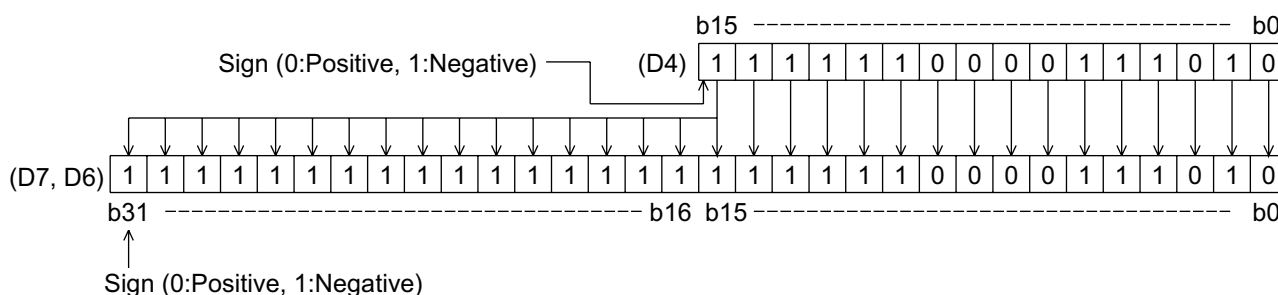
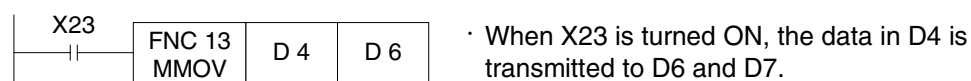
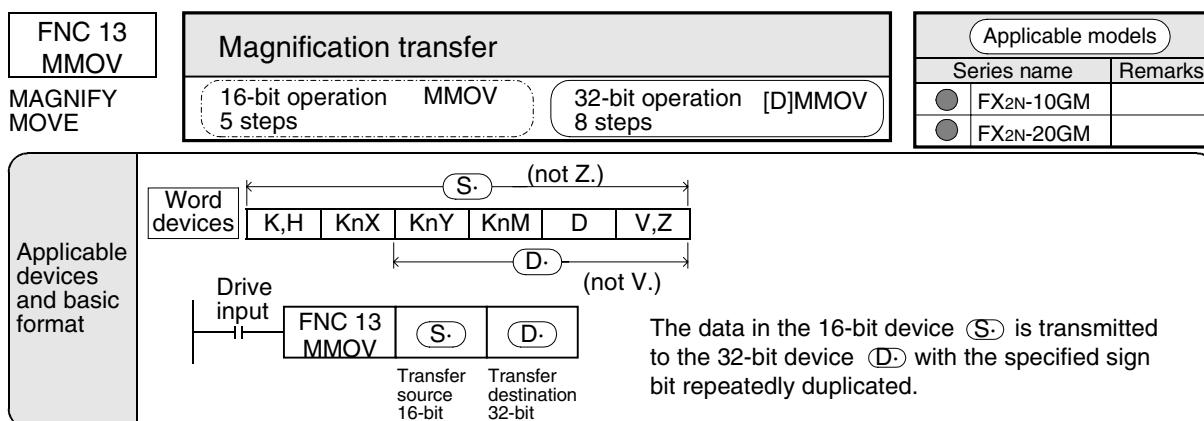
- The K100 is compared with the D11. The K120 is also compared with the D11.
- Three points are assigned for the result output. This result output remains in the previous status even when the drive contact (X21) is turned OFF and the comparison instruction is not executed.



5.10.9 FNC12 (MOV): Transfer

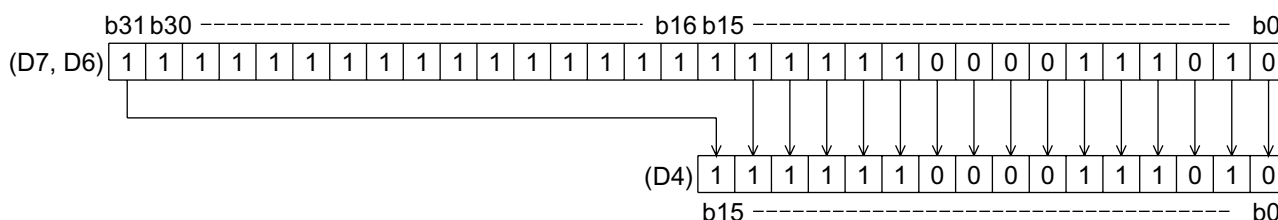
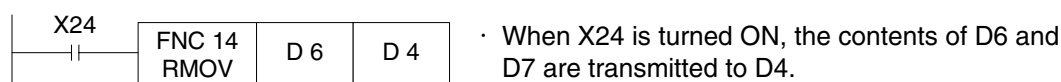
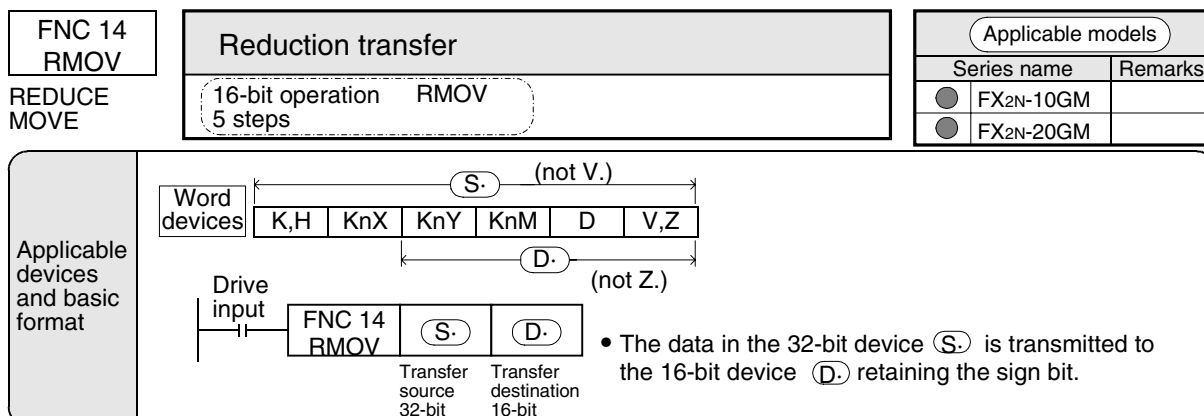


5.10.10 FNC13 (MMOV): Magnification transfer



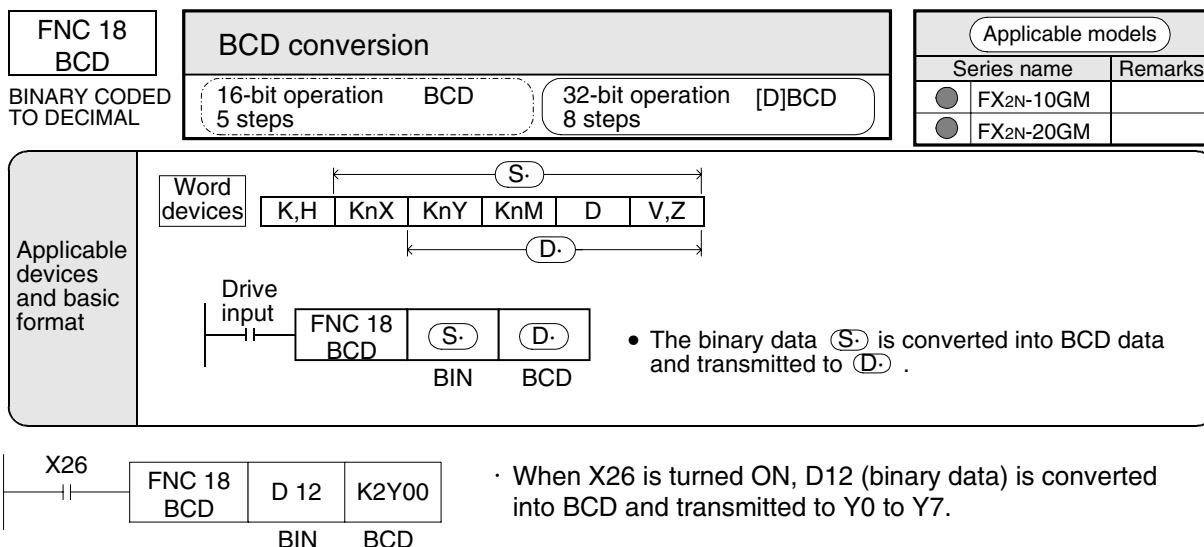
- In the example above, b15 of D4 is transmitted to b15 to b31 of (D7/D6), and the data of (D7/D6) becomes a negative value (the same as D4).

5.10.11 FNC14 (RMOV): Reduction transfer



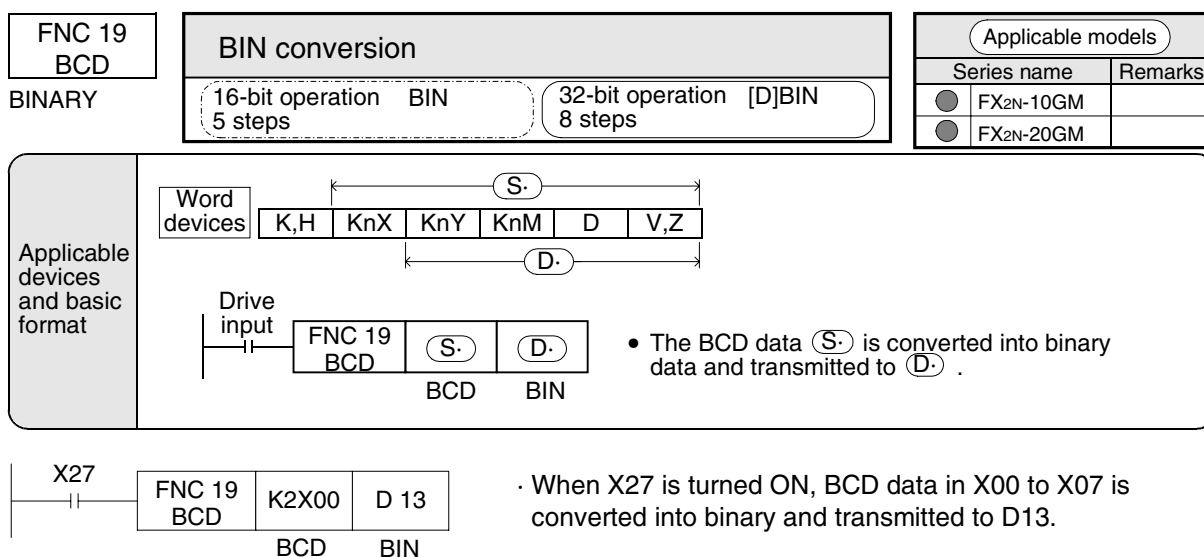
When X24 is turned ON, the most significant bit in (S ·) is transmitted to most significant bit in (D ·). Other bits are transmitted in turn from the least significant bit. b15 to b30 are ignored and not transmitted.

5.10.12 FNC18 (BCD): BCD conversion



- The BCD instruction is not executed if the BCD conversion result is outside 0 to 9,999. The [D] BCD instruction is not executed if the BCD conversion result is outside 0 to 99,999,999.
- The BCD instruction is used to convert binary data in the positioning unit into BCD data (for 7-segment display, etc.) to be output to external equipment.

5.10.13 FNC19 (BIN): BIN conversion



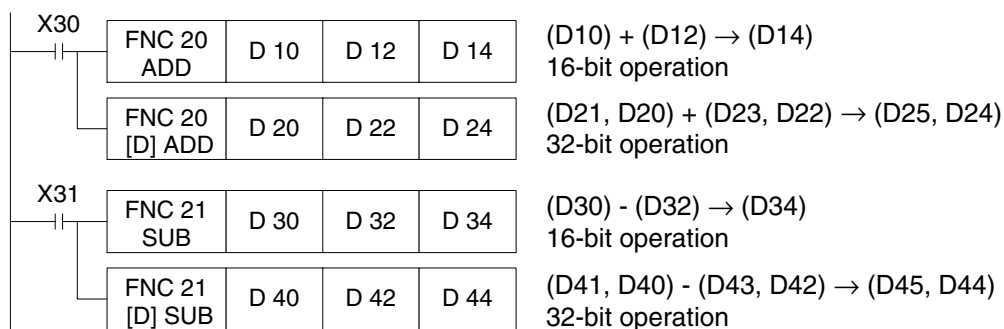
- The BIN instruction is used to fetch digital switch set value (BCD data) to the positioning unit. When the source data is not BCD, this instruction is not executed.
- Constant K is automatically converted into the BIN code and treated. There is no necessity for using this instruction.

5.10.14 FNC20 (ADD): Addition, FNC21 (SUB): Subtraction

FNC 20 ADD	Addition/Subtraction		Applicable models	
FNC 21 SUB	16-bit operation 7 steps	32-bit operation 11 steps	Series name	Remarks
	ADD SUB	[D]ADD [D]SUB	FX2N-10GM	
			FX2N-20GM	

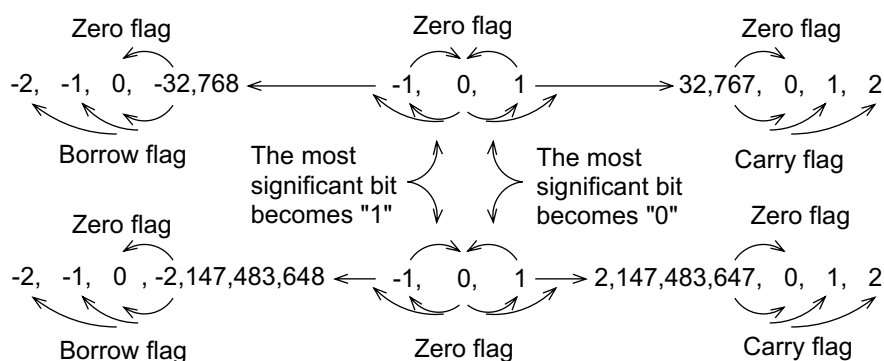
Applicable devices and basic format	Word devices		Flags: Described below.	
	(S1) (S2)	(S1) (S2)	X axis, simultaneous 2-axis	Y axis (Not 10GM)
	K,H KnX KnY KnM D V,Z	D	Zero	M9061
		D	Borrow	M9062
	Drive input	FNC 20 ADD (S1) (S2) (D)	Carry	M9063
		Augend Addend Result		
	Drive input	FNC 21 SUB (S1) (S2) (D)		
		Minuend Subtrahend Result		

- $(S1) + (S2) = (D)$
A negative value is treated as two's complement.
- $(S1) - (S2) = (D)$
A negative value is treated as two's complement.



Flag operations

As shown in the table above, selection of the special auxiliary relays used as flags varies depending on program type (for the X axis, for simultaneous 2-axis, for the Y axis and for subtasks).



5.10.15 FNC22 (MUL): Multiplication

FNC 22 MUL MULTIPLICATION	Multiplication		Applicable models	
	16-bit operation MUL 7 steps	32-bit operation [D]MUL 11 steps	Series name	Remarks
Applicable devices and basic format			● FX2N-10GM	
			● FX2N-20GM	

X32	FNC 22 MUL	D 0	D 2	D 4	(D0) × (D2) → (D5, D4) 16 bits × 16 bits → 32 bits
	FNC 22 [D]MUL	D 10	D 12	D 14	(D11, D10) × (D13, D12) → (D17, D16, D15, D14) 32 bits × 32 bits → 64 bits

- When the data of either source is a negative value, the product is also a negative value. In a 32-bit operation, the product is 64 bits. Because 64-bit data cannot be monitored, numerics handled in multiplication must be such that the multiplication product is 32 bits or less.

5.10.16 FNC23 (DIV): Division

FNC 23 DIV DIVISION	Division		Applicable models	
	16-bit operation DIV 7 steps	32-bit operation [D] DIV 11 steps	Series name	Remarks
Applicable devices and basic format			● FX2N-10GM	
			● FX2N-20GM	

X33	FNC 23 DIV	D 0	D 2	D 4	Dividend ÷ Divisor → Quotient ... Remainder (D0) (D2) (D4) (D5) 16-bit 16-bit 16-bit 16-bit
	FNC 22 [D]DIV	D 10	D 12	D 14	(D11, D10) ÷ (D13, D12) → (D15, D14) ... (D17, D16) 32-bit 32-bit 32-bit 32-bit

- This instruction is not executed when the divisor is "0".
- The quotient becomes a negative value when either the dividend or the divisor is a negative value. The remainder becomes a negative value when the dividend is a negative value.

5.10.17 FNC24 (INC): Increment, FNC25 (DEC): Decrement

FNC 24 INC	Increment/Decrement		Applicable models
INCREMENT			Series name Remarks
FNC 25 DEC	16-bit operation 3 steps INC DEC	32-bit operation [D]INC [D]DEC 5 steps	● FX2N-10GM ● FX2N-20GM
DECREMENT			

Applicable devices and basic format

Word devices

K,H

KnX

KnY

KnM

D

V,Z

$\xrightarrow{\quad D \quad}$

Drive input

FNC 24
INC

D

+1

Drive input

FNC 25
DEC

D

-1

- Every time the instruction is executed, "1" is added to the value of (D).
- Every time the instruction is executed, "1" is subtracted from the value of (D).

Change to (D) in a 16-bit operation

+1 (INC)

-32,768 0 +32,767

-1 (DEC)

Change to (D) in a 32-bit operation

+1 (INC)

-2,147,483,648 0 +2,147,483,647

-1 (DEC)

* The ring operations shown above are performed, but the flags do not operate.

5.10.18 FNC26 (WAND): Logical product, FNC27 (WOR): Logical sum, FNC28 (WXOR): Logical equivalence

FNC 26 WAND	Logical product (AND)/Logical sum (OR)/Logical equivalence (XOR)		Applicable models
FNC 27 WOR			Series name Remarks
FNC 28 WXOR	16-bit operation 7 steps WAND WOR WXOR	32-bit operation [D]AND [D]OR [D]XOR 11 steps	● FX2N-10GM ● FX2N-20GM

Applicable devices and basic format

Word devices

K,H

KnX

KnY

KnM

D

V,Z

$\xrightarrow{\quad S1 \cdot S2 \quad}$

Drive input

FNC 26
WAND

S1

S2

D

S1 S2 D

Drive input

FNC 27
WOR

S1

S2

D

S1 S2 D

Drive input

FNC 28
WXOR


S1

S2

D

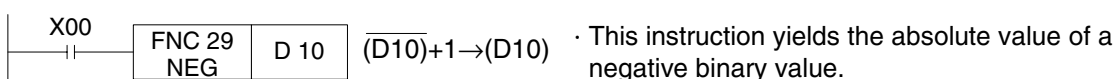
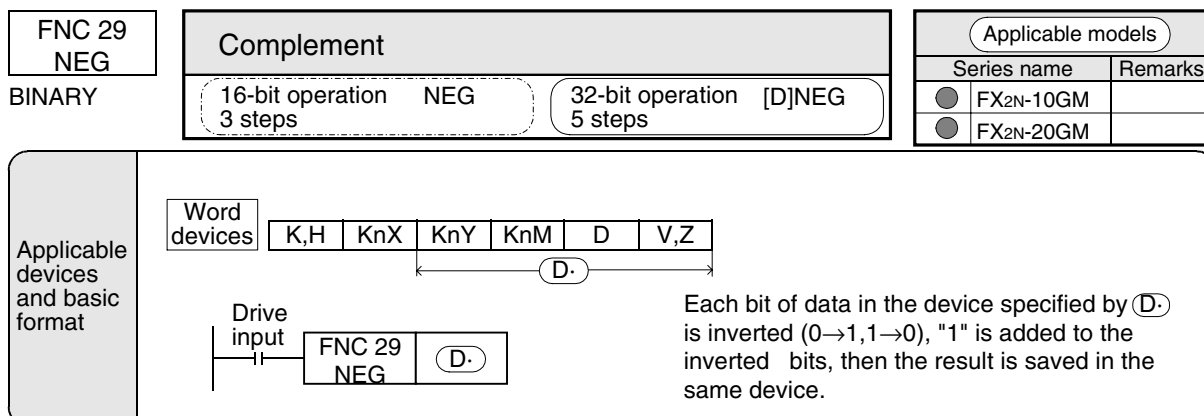
S1 S2 D

- Logical multiplication operation is executed between each pair of bits.
 $1 \wedge 1=1, 1 \wedge 0=0, 0 \wedge 1=0, 0 \wedge 0=0$
Convenient to set a certain bit to "0".
- Logical addition operation is executed between each pair of bits.
 $1 \vee 1=1, 1 \vee 0=1, 0 \vee 1=1, 0 \vee 0=0$
Convenient to set a certain bit to "1".
- Logical equivalence operation is executed between each pair of bits.
 $1 \nabla 1=0, 1 \nabla 0=1, 0 \nabla 1=1, 0 \nabla 0=0$
Convenient to compare between certain bits to evaluate
Convenient to compare between certain bits to evaluate

 MITSUBISHI

5-60

5.10.19 FNC29 (NEG): Complement

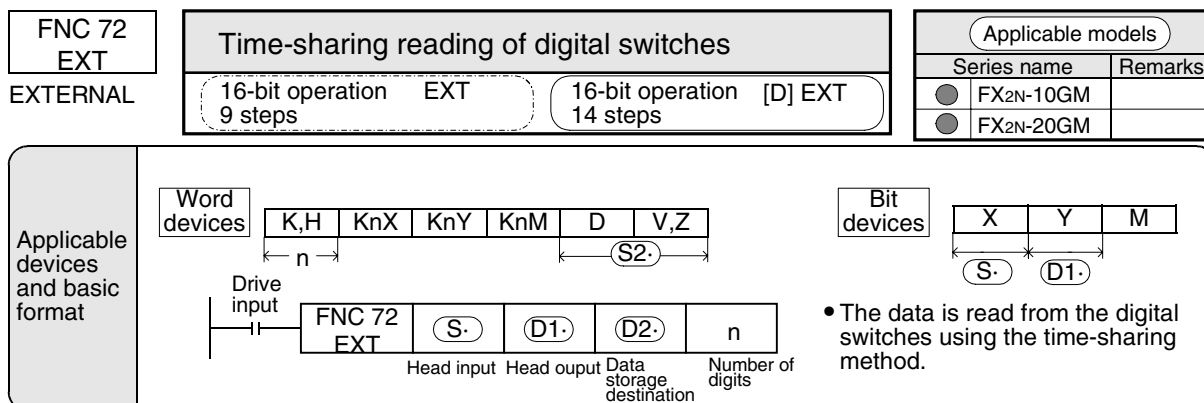


Obtaining the absolute value of a negative value

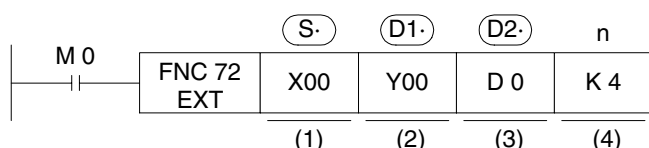
$(D 10) = 2$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 000000000000000010 </div>	
$(D 10) = 1$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 000000000000000001 </div>	
$(D 10) = 0$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 000000000000000000 </div>	
$(D 10) = -1$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 111111111111111111 </div>	$\rightarrow \overline{(D 10)} + 1 = 1$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 000000000000000001 </div>
$(D 10) = -2$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 111111111111111100 </div>	$\rightarrow \overline{(D 10)} + 1 = 2$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 0000000000000000010 </div>
$(D 10) = -3$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 111111111111111000 </div>	$\rightarrow \overline{(D 10)} + 1 = 3$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 00000000000000000011 </div>
}	
$(D 10) = -32,766$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 1000000000000000100 </div>	$\rightarrow \overline{(D 10)} + 1 = 32,766$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 0111111111111111110 </div>
$(D 10) = -32,767$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 1000000000000000011 </div>	$\rightarrow \overline{(D 10)} + 1 = 32,767$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 0111111111111111111 </div>
$(D 10) = -32,768$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 1000000000000000000 </div>	$\rightarrow \overline{(D 10)} + 1 = -32,768$ <div style="border: 1px solid black; padding: 2px; display: flex; justify-content: space-between;"> 1000000000000000000 </div>

The maximum absolute value is 32,767 for 16-bit operation.

5.10.20 FNC72 (EXT): Time-sharing reading of digital switches



Reading of a positive value



This instruction performs time-sharing reading of the data from the digital switches.

1) Head input No. (Occupies 4 input points.)

The connections in this example are as follows.

X00: Terminal 1 of DSW

X01: Terminal 2 of DSW

X02: Terminal 4 of DSW

X03: Terminal 8 of DSW

2) Head output No. for time-sharing operation (Occupies 1 to 8 output points.)

The connections in this example are as follows.

Y00: Terminal C of DSW (10^0 digit)

Y01: Terminal C of DSW (10^1 digit)

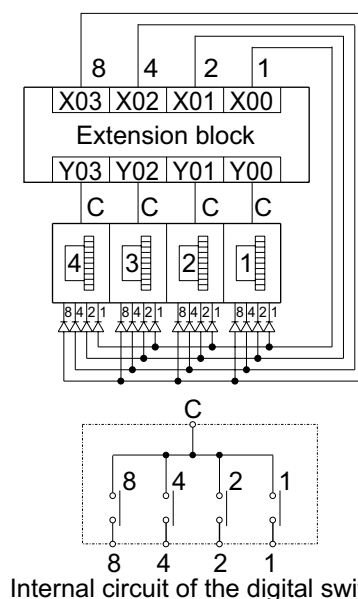
Y02: Terminal C of DSW (10^2 digit)

Y03: Terminal C of DSW (10^3 digit)

3) Data storage destination

When a 16-bit instruction is executed, a digital switch BCD value of up to 4 digits is converted into binary data and saved in D0.

When a 32-bit instruction is executed, a digital switch BCD value of up to 8 digits (FX2N-10GM is 6 digits or less) is converted into binary data and saved in (D1, D0).



Internal circuit of the digital switch.

↑ ↑
 Upper 4 digits Lower 4 digits

4) Number of digits

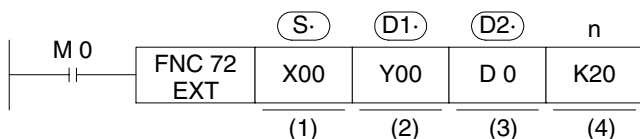
K1 to K4 are used with 16-bit instructions, and K5 to K8 are used with 32-bit instructions. (Refer to the next page.)

The same number of digit-switching output points as the specified number of digits is required.

In the FX2N-10GM, K1 to K6 (6 digits) are available.

Reading a positive/negative numeric (Not available in the FX_{2N}-10GM.)

When K17 to K24 are used to specify the number of digits, negative numeric values can also be read.



This instruction performs time-sharing reading of the data from the digital switches.

1) Head input No. (Occupies 5 input points.)

The connections in this example are as follows.

X00: Positive/negative specification input.

When the X00 is ON:Negative value.

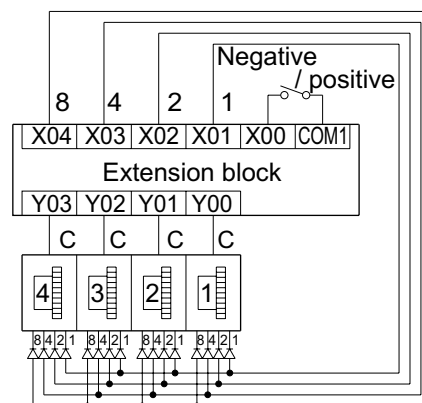
When the X00 is OFF:Positive value

X01: Terminal 1 of DSW

X02: Terminal 2 of DSW

X03: Terminal 4 of DSW

X04: Terminal 8 of DSW



2) Head output No. for time-sharing operation (Occupies 4 output points.)

Same as the description on the previous page.

3) Data storage destination

Same as the description on the previous page.

4) Number of digits

K17 (H11) to K24 (H18) are used in accordance with the number of digits from 1 to 8 (16 is added to the number of digits to determine the "K" value.).

A 32-bit instruction must be used when the number of digits is 5 to 8.

List of specification of number of digits

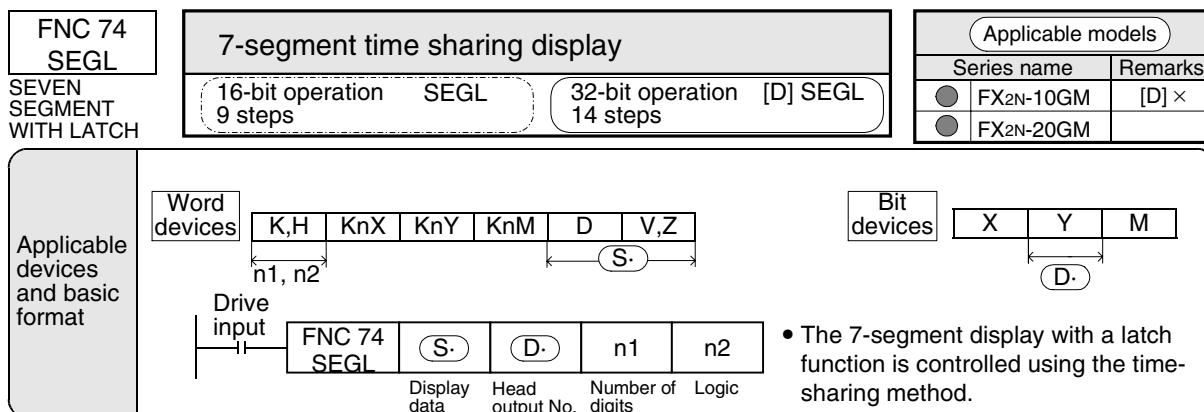
The I/Os shown in the table below are required for the EXT instruction in accordance with the number of digits to be read.

Table 5.18: List of specification of number of digits

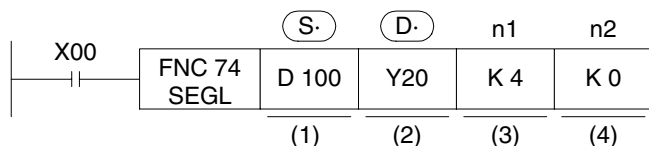
Number of digits to be read	Reading a positive value.			Reading a negative value.			Number of data registers occupied
	Number of inputs	Number of outputs	"n" set value	Number of inputs	Number of outputs	"n" set value	
1	4	1	K1	5	1	K17	1
2		2	K2		2	K18	
3		3	K3		3	K19	
4		4	K4		4	K20	
5		5	K5		5	K21	2
6		6	K6		6	K22	
7		7	K7		7	K23	
8		8	K8		8	K24	

To read DSW settings, the digit-switching time (Initial value: 20 msec) set to PARA. 33 is required. When a DSW is connected to the positioning unit, PARA. 33 can be set to approximately 7 msec. If programmable controller outputs are used instead of a DSW take the digit-switching time of the programmable controller into consideration and set a sufficient length of time.

5.10.21 FNC74 (SEGL): 7-segment time sharing display

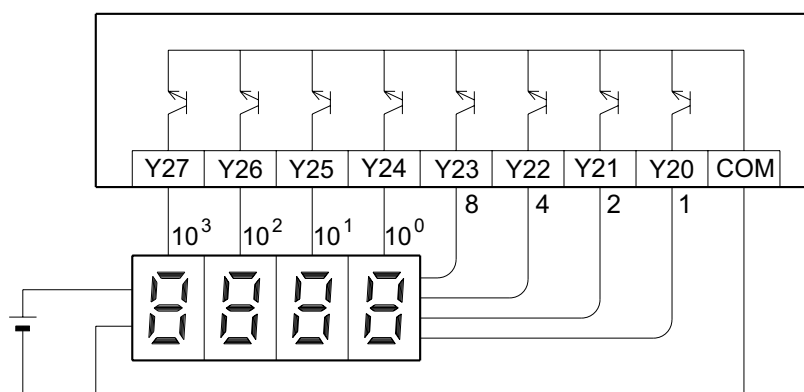


Displaying a positive numeric



Time-sharing outputs are used for the 7-segment display with the latch function.

- 1) Device No. in which the data to be displayed is saved.
In this example, it is the data register D100. In the case of a 32-bit instruction, it would be D101 and D100.
- 2) Head No. for data output.
In this example, the output No. are as follows.
 - Y20: To the terminal for BCD input 1
 - Y21: To the terminal for BCD input 2
 - Y22: To the terminal for BCD input 4
 - Y23: To the terminal for BCD input 8
 - Y24: To 10⁰ digits strobe input
 - Y25: To 10¹ digits strobe input
 - Y26: To 10² digits strobe input
 - Y27: To 10³ digits strobe input

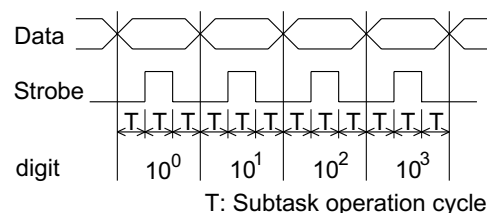


- 3) Number of digits
K1 to K4 are used with 16-bit instructions, and K5 to K8 are used with 32-bit instructions. The same number of strobe signal outputs as the specified number of digits is required. Because in the FX2N-10GM, there are only up to 2 digits (K2) available for display use this instruction to display the program No. being executed, etc.

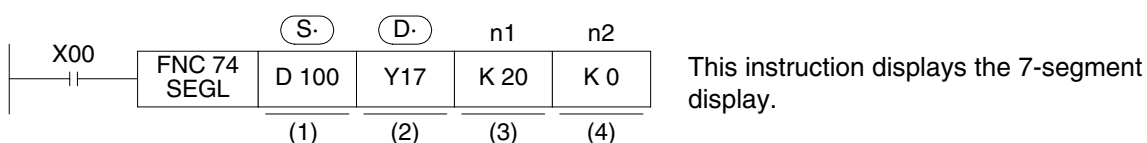
4) Logic parameter

Refer to "7-segment display logic" on the next page.

- The internal binary data is converted into BCD data, then output using the time-sharing method.
- This instruction is processed in accordance with an operation cycle. It takes 12 operation cycles to display 4 digits. This instruction can be used only twice. (This instruction can be used only subtask program.)

**Reading a positive/negative numeric (Not available in the FX_{2N}-10GM.)**

When K17 to K24 are used to specify the number of digits, negative numeric values can also be read.



1) Display data device No.

Same as on the previous page.

2) Head No. for data output

Y17 : For identifying positive/negative.

When the Y17 is ON: Negative value.

When the Y17 is OFF: Positive value.

Y20 to Y27 : Same with the previous page. (I/Os are octal, so Y18 and Y19 are not available.)

3) Number of digits

K17 (H11) to K24 (H18) are used in accordance with the number of digits from 1 to 8 (16 is added to the number of digits to determine the "K" value.).

4) Logic parameters

Refer to the table below.

7-segment display logic

Data input: "Positive logic" indicates that the input data is expressed as BCD at the high level.

"Negative logic" indicates that the input data is expressed as BCD at the low level.

Strobe signal: "Positive logic" indicates that data is latched and held when the signal level is high. "Negative logic" indicates that data is latched and held when the signal level is low.

Table 5.19: 7-segment display logic

Data input	Strobe signal	n2
Positive	Positive	K0
	Negative	K1
Negative	Positive	K2
	Negative	K3

List of specification of number of digits

The I/Os shown in the table below are required for the SEGL instruction in accordance with the number of digits to be displayed.

Table 5.20: List of specification of number of digits

Number of digits to be read	Reading a positive value		Reading a negative value		Number of data registers occupied
	Number of outputs	"n1" set value	Number of outputs	"n1" set value	
1	5	K1	6	K17	1
2	6	K2	7	K18	
3	7	K3	8	K19	
4	8	K4	9	K20	
5	9	K5	10	K21	2
6	10	K6	11	K22	
7	11	K7	12	K23	
8	12	K8	13	K24	

In the FX_{2N}-10GM, only K1 or K2 can be set when a positive value is output, and only K17 can be set when a negative and positive values are output.

5.10.22 FNC90 (OUT): Output

<div>FNC 90 OUT</div>	<div>Output</div>	<div>Applicable models</div>	
OUT	<div>16-bit operation OUT 3 steps</div>	<div>Series name</div>	<div>Remarks</div>
		<div>● FX2N-10GM</div>	
		<div>● FX2N-20GM</div>	

Applicable devices and basic format	<div>Bit devices</div>	<div>X Y M</div> <div>← D. →</div>
	<div>Drive input</div> <div><div><div><div></div></div><div>FNC 90 OUT</div><div>D.</div></div></div>	<div>• This is an ordinary coil instruction. When this instruction is driven with the contact turned ON, the output is turned ON. When this instruction is driven with the contact turned OFF, the output is turned OFF.</div>

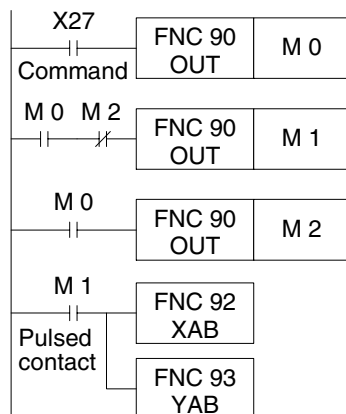


- Y00 is output if X00 is ON when the program shown on the left is executed. Y00 is turned OFF when X00 is OFF.
- If there is no contact instruction for drive input before the FNC 90 (OUT) instruction (that is, when FNC 90 instruction is directly given from the bus), Y00 continues to be ON.

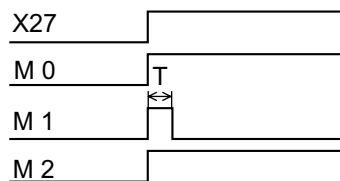
5.10.23 FNC92 (XAB), FNC93 (YAB): Absolute position detection

FNC 92 XAB X ABSOLUTE FNC 93 YAB Y ABSOLUTE	Absolute position detection		Applicable models	
	16-bit operation 1 steps	XAB YAB	Series name	Remarks
			● FX2N-10GM	XAB
			● FX2N-20GM	

Applicable devices and basic format	Applicable devices: Y, M (specified by PARA.50 and PARA.51)		
	<div> Drive input </div> <div> Drive input </div>	<ul style="list-style-type: none"> • X axis absolute position detection. • Y axis absolute position detection. (Not available in the FX2N-10GM.) 	<ul style="list-style-type: none"> • ABS sensing is automatically performed when the power is turned ON. However, this instruction allows it to be performed at any other time. Each time this instruction is executed, the present value is read from the servo amplifier and saved in the present value register. This instruction is only available when ABS sensing is enabled by PARAs 50 to 52.



- To allow repeated execution and yet execute this instruction only once, a pulsed signal is required. An example of a pulsed signal is shown below. When the command input is X, replace it with an M. (This establishes a direct method for controlling the input and output when the instruction is executed.)
- This instruction is usually used in the subtask program O100.



T: Subtask operation cycle

- If emergency stop input of only the servo amplifier turned on or the power of the servo amplifier turned off while the positioning unit was operating, the servo ON input cannot enter the positioning unit and the servo amplifier is disabled even after the servo amplifier is recovered. In such a case, when the above instructions are executed, the servo amplifier is enabled again.

6. Special auxiliary relays and Special data registers

This section explain the special auxiliary relays and the special data registers of the positioning unit.

6.1 General description

The auxiliary relays from M9000 and the data registers from D9000 onwards are assigned as special devices. Various command inputs, status information and parameter set values can be read and written in accordance with control.

Special auxiliary relays (M9000 or more)

The special auxiliary relays (special Ms) are mainly used for command inputs by writing and as status information by reading.

- Command inputs (writing (reading))
Operation commands can be given by turning ON the special Ms such as start/stop and FWD/RVS/ZRN, and can be controlled by programs without using external input terminals. Some special Ms are turned ON when a command is entered from an external input terminal, so can also be used for reading.
- Status information (reading)
These special Ms are read and used to indicate the status of the positioning unit.

Special data registers (D9000 or more)

The information of the present position and the program No./step No. being executed and various parameter settings are saved in special data registers, and can be read and written by programs.

- The special Ms and the special Ds are also assigned to the buffer memories (BFM), and those in the FX_{2N}-10GM or the FX_{2N}-20GM can be read and written from a programmable controller using the programmable controller program (FROM/TO instruction). (Refer to Section 7.)

How to use the special Ms/Ds

The special Ms and the special Ds are used (in the positioning program) as follows.

How to use the special auxiliary relays for reading

```

O100, N0;                Subtask program
N00 P100
N01 LD M9050;            X axis error detection
N02 OUT Y0;              Y0 output
    }
N10 FNC04 (JMP)
    P100;
    m102;                END
  
```

- Special Ms are treated as contacts when reading. In the example shown on the left, a general purpose output Y0 is used to give an output to the outside when an error occurs in the X axis. (For subtasks, refer to Section 5.2.)

How to use the special data registers for reading

```

O100, N0;                Subtask program
    }
N40 FNC74 (SEGL)          7-segment time-sharing display
    D9004 .....          X axis present position
    Y0
    K3
    K0
    }
    m102;                END
  
```

- The present value (3 digits) of the X axis is displayed on the outside using the FNC 74 (SEGL) instruction. (For the FNC 74, refer to Section 5.10.21.)

How to use the special auxiliary relays for writing

```

O100, N0;                Subtask program
N0 LD X0;                General purpose input X0
N1 OUT M9007;            X axis error reset
    }
    m102;                END
  
```

- Special Ms are treated as coils when writing. In the example shown on the left, the X axis error is reset (M9007) using the general purpose input X0.

How to use the special data registers for writing

```

O100, N0;                Subtask program
    }
N40 FNC12 ( [D] MOV )     Transfer instruction (32 bits)
    K20,000
    D9208; .....        PARA.4: Maximum speed
    }
    m102;                END
  
```

- Change the setting of PARA. 4 (maximum speed for the X axis) to "20,000". In this case the special D needs to be a double word, also a 32-bit instruction must be used. Using an even No. data register for the lower 16 bits, the succeeding data register is used for the upper 16 bits. Specify the lower device for operands.

6.2 Special auxiliary relays list

Special auxiliary relays (specification inputs) for writing. (Y axis not available in FX_{2N}-10GM.)

Table 6.1: Special auxiliary relays list

X axis	Y axis	Subtask	Attribute	Description	
M9000	M9016	M9112	R/W	Single-step mode command.	When these special Ms are driven by a main task program (simultaneous 2-axis program or X/Y axis program) or subtask program, they function as substitute commands for input terminal commands of the positioning unit.
M9001	M9017	M9113		Start command.	
M9002	M9018	M9114		Stop command.	
M9003	M9019	—		m code OFF command.	
M9004	M9020	—		Machine zero return command.	
M9005	M9021	—		FWD JOG command.	
M9006	M9022	—		RVS JOG command.	
M9007	M9023	M9115		Error reset.	
M9008	M9024	—		Zero return axis control. (Refer to Subsection 5.6.6.)	
M9009	M9025	—		Unusable ^{*5}	
M9010	M9026	—		Unusable ^{*5}	
M9011	M9027 to M9030	M9116 to M9125	—	Unusable ^{*5}	—
M9012				However, M9118 functions as shown on the next page.	
M9013					
M9014			W	16-bit FROM/TO mode (general purpose/file register).	—
M9015		—		Continuous path mode.	FX2N-10GM is unusable. ^{*5}
—	M9031	M9126		Unusable ^{*5}	—
—	—	M9127	R/W	Battery LED. Lighting control.	FX2N-10GM is unusable. ^{*5}
M9036 to M9047			—	Unusable ^{*5}	—
M9160 ^{*1}	—	—	W	m code control during operation at multi-step speed.	FX2N-20GM is unusable. ^{*5}
M9161		—	R/W	Teaching mode effective.	—
M9162			—	Unusable ^{*5}	—
M9163	M9164	—	R/W	When it executes INC instruction disregard of correction data of cod73to75 instruction.	—
M9165	—	—	R/W	Table method effective.	FX2N-20GM is unusable. ^{*5}
M9166			—	Unusable ^{*5}	—
M9167			R/W	MANU/AUTO switch by general-purpose input.	FX2N-10GM occupies x3 and FX2N-20GM occupies x7.
M9168			R/W	MANU mode instruction from main unit. (Refer to Subsection 1.4.6.)	—
M9169			—	Unusable ^{*5}	—
M9170			R/W	Interrupting input number selection when interrupt stop (cod31) is used (FX2N-10GM V2.20 or later)	FX2N-20GM is unusable. ^{*5}

Table 6.1: Special auxiliary relays list

X axis	Y axis	Subtask	Attribute	Description	
			R/W	Storage instruction of parameters for absolute position detection (FX2N-10GM V2.20 or later)	FX2N-20GM is unusable. *5
			—	Unusable *5	—

See next page for the special auxiliary relays for reading.

The attribute and notes are found below the list of special auxiliary relays for reading.

Special auxiliary relays (status information) for reading. (Y axis not available in FX_{2N}-10GM.)

Table 6.2: Special auxiliary relays list

X axis	Y axis	Subtask	Attribute	Description	
M9048	M9080	M9128	R	READY(ON)/BUSY(OFF)	These special Ms are turned ON/OFF in accordance with the status of the positioning unit.
M9049	M9081	—		Positioning completed.	
M9050	M9082	M9129		Error detection.	
M9051	M9083	—		m code ON signal. *2	
M9052	M9084	—		m code standby status. *2	
M9053	M9085	M9130		m00 (m100) standby status.	
M9054	M9086	M9131		m02 (m102) standby status.	
M9055	M9087	—		Stop remaining drive standby status.	
M9056	M9088	M9132		Automatic operation in progress *2 (subtask operation in progress). START→ON END→OFF	
M9057	M9089	—		Zero return completed. *3 It is clear in interception of the power supply or machine zero return command.	
M9058	M9090	—		Unusable	These special Ms are turned ON/OFF in accordance with the ON/OFF status of the positioning unit.
M9059	M9091	—		Unusable	
M9060	M9092	M9118		Operation error. *2	
M9061	M9093	M9133		Zero flag. *2	
M9062	M9094	M9134		Borrow flag. *2	
M9063	M9095	M9135		Carry flag. *2	
M9064	M9096	—		DOG input.	
M9065	M9097	—		START input.	
M9066	M9098	—		STOP input.	
M9067	M9099	—		ZRN input.	
M9068	M9100	—	—	FWD input.	These special Ms are turned ON/OFF in accordance with the ON/OFF status of the positioning unit.
M9069	M9101	—		RVS input.	
M9070	M9102	—		Unusable	
M9071	M9103	—		Unusable	
M9072	M9104	—		SVRDY input.	
M9073	M9105	—		SVEND input.	
M9074 to M9079	M9106 to M9111	M9136 to M9138		Unusable	
—	—	M9139	R	Independent 2-axis/ simultaneous 2-axis. *4	These special Ms are turned ON/OFF in accordance with the program being executed, the terminal input status, etc. in the positioning unit.
—	—	M9140		Terminal input : MANU	
—	—	—		Unusable	
—	—	M9142		Unusable	
—	—	M9143		Low battery voltage. *4	

Table 6.2: Special auxiliary relays list

X axis	Y axis	Subtask	Attribute	Description
M9144	M9145	—	R/W	Present value establish flag *3 (This is set when zero return or absolute position detection is performed once and reset when the power is turned OFF).
M9172 to M9175			—	Unusable

Attribute

R : This special auxiliary relay can be used only for read. You should not write it.

W : This special auxiliary relay can be used only for write.

R/W : This special auxiliary relay can be used both for write and read. It turns on when a command input is given from an external input terminal.

You can turn off M9144 and M9145 by the RST instruction.

*1 Unusable in the FX_{2N}-20GM. (Refer to Section 5.4.3)

- In the simultaneous 2-axis mode (available only in the FX_{2N}-20GM), even if the single-step mode command, the start command, the stop command or the m code OFF command is given only to the X or Y axis, it is valid for the both axes.
- The ON/OFF status of the special auxiliary relays for command inputs are continuously monitored by the CPU inside the positioning unit.
- When the power is turned ON, each special auxiliary relay is initialized to OFF.

*2 Both the X and Y axes operate simultaneously in simultaneous 2-axis operation.

*3 The zero point return completion flags (M9057 and M9089) do not turn on even if absolute position detection is finished.

When you would like to use a flag to indicate that absolute position detection is finished, use the current value establishment flags (M9144 and M9145). (The current value establishment flags are not reset by return to the zero point.)

*4 Not defined in the FX_{2N}-10GM.

*5 Make sure to set those special auxiliary relays for writing to OFF if "Unusable" is indicated in the list.

6.3 Special data registers list

Special data registers (Y axis not available in FX_{2N}-10GM.)

Table 6.3: Special data registers list

X axis		Y axis		Subtask		Attribute		Description
Upper	Lower	Upper	Lower	Upper	Lower	Direction of forwarding	Instruction form	
—	D9000	—	D9010	—	—	R/W	[S]	Program No. specification (PARA.30:"3"). *1
—	D9001	—	D9011	—	—	R		Program No. being executed. *2
—	D9002	—	D9012	—	D9100			Line No. being executed. *2
—	D9003	—	D9013	—	—			m code (binary). *2
D9005	D9004	D9015	D9014	—	—	R/W	[D]	Present position (Refer to the bottom on the next page).
D9007	D9006	D9017	D9016	—	—	—	—	Unusable
D9009	D9008	D9019	D9018	—	—	—	—	Unusable
—	—	—	—	—	D9020	R	[S]	Memory capacity.
—	—	—	—	—	D9021			Memory type.
—	—	—	—	—	D9022			Battery voltage. *3
—	—	—	—	—	D9023			Low battery voltage detection level (Initial value:3.0V). *3
—	—	—	—	—	D9024			Number of momentary power interruptions detected. *3
—	—	—	—	—	D9025			Momentary power interruption detection time. (Initial value:10 msec) *3
—	—	—	—	—	D9026			Model No.: 5210 (FX2N-20GM) or 5310 (FX2N-10GM)
—	—	—	—	—	D9027			Version
—	—	—	—	—	D9028	—	—	Unusable
—	—	—	—	—	D9029	—	—	Unusable
D9030 to D9039		D9040 to D9049		D9050 to D9059		—	—	Unusable

Table 6.3: Special data registers list

X axis		Y axis		Subtask		Attribute		Description
Upper	Lower	Upper	Lower	Upper	Lower	Direction of forwarding	Instruction form	
—	D9060	—	D9080	—	D9101	R	[S]	Step No. being executed. *2
—	D9061	—	D9081	(D9103)	D9102			Error code. *2
—	D9062	—	D9082	—	—			Instruction group A: cod present status. *2
—	D9063	—	D9083	—	—			Instruction group D: cod present status. *2
D9065	D9064	D9085	D9084	D9105	D9104		[D]	Dwell time set value. *2
D9067	D9066	D9087	D9086	D9107	D9106		[D]	Dwell time present value. *2
(D9069)	D9068	(D9089)	D9088	(D9109)	D9108		[S]	Number of repeats set value. *2
(D9071)	D9090	(D9091)	D9090	(D9111)	D9110			Number of repeats present value. *2
D9073	D9072	D9093	D9092			—	—	Unusable
D9075	D9074	D9095	D9094			R	[D]	Present position (converted into pulses).
(D9077)	D9076	(D9097)	D9096	(D9113)	D9112	R	[S]	Step No. in which operation error has occurred. *2
D9079	D9078	D9099	D9098	D9114 to D9119		—	—	Unusable
D9121	D9120	D9123	D9122	—	—	R/W	[D]	X/Y axis compensation data.
D9125	D9124	—	—	—	—			Arc center point (i) compensation data. *3
—	—	D9127	D9126	—	—			Arc center point (j) compensation data. *3
Upper bits D9129 to Lower bits D9128				—	—			Arc radius (r) compensation data. *3
—	—	—	—	D9130 to D9139		—	—	Unusable

Table 6.3: Special data registers list

X axis		Y axis		Subtask		Attribute		Description
Upper	Lower	Upper	Lower	Upper	Lower	Direction of forwarding	Instruction form	
—	—	—	—	—	D9140	R/W	[S]	Index register. V0
—	—	—	—	—	D9141			Index register. V1
—	—	—	—	—	D9142			Index register. V2
—	—	—	—	—	D9143			Index register. V3
—	—	—	—	—	D9144			Index register. V4
—	—	—	—	—	D9145			Index register. V5
—	—	—	—	—	D9146			Index register. V6
—	—	—	—	—	D9147			Index register. V7
—	—	—	—	D9149	D9148		[D]	Index register. Z0
—	—	—	—	D9151	D9150			Index register. Z1
—	—	—	—	D9153	D9152			Index register. Z2
—	—	—	—	D9155	D9154			Index register. Z3
—	—	—	—	D9157	D9156			Index register. Z4
—	—	—	—	D9159	D9158			Index register. Z5
—	—	—	—	D9161	D9160			Index register. Z6
—	—	—	—	D9163	D9162			Index register. Z7
D9164 to D9199						—	—	Unusable

Attribute

R: This data register can be used only for read. You should not write it.

R/W: This data register can be used both for write and read. When reading or writing data, use a 16-bit instruction for a data register classified as "S", or a 32-bit instruction for a data register classified as "D".

*1 In simultaneous 2-axis mode (available only in the FX_{2N}-20GM), the special D for the X axis is valid and the special D for the Y axis is ignored.

*2 In simultaneous 2-axis mode (available only in the FX_{2N}-20GM), the same data is saved in the special D for the X axis and the special D for the Y axis.

*3 Unusable in the FX_{2N}-10GM.

Special data registers for current position data

Special data registers "D9005 and D9004" and "D9015 and D9014" shown in the previous page store the current position data based on the practical unit set in PARA. 3.

You can write numeric data to these data registers while the positioning unit is ready (in the AUTO or MANU mode) and is not waiting for remaining distance drive. When writing data, use 32-bit instructions.

On the other hand, special data registers "D9075 and D9074" and "D9095 and D9094" indicating the current position converted into pulses can be used only for read, and their data automatically changes in accordance with changes in the data stored in data registers "D9005 and D9004" and "D9015 and D9014".

Special data registers for parameters. (Positioning parameters)
(Y axis not available in FX_{2N}-10GM)

Table 6.4: Special data registers list

X axis		Y axis		Attribute		Description
Upper	Lower	Upper	Lower	Direction of forwarding	Instruction form	
D9201	D9200	D9401	D9400	R/W	[D]	PARA.0: System of units.
D9203	D9202	D9403	D9402			PARA.1: Number of command pulses per rotation of motor. *1
D9205	D9204	D9405	D9404			PARA.2: Travel per rotation of motor. *1
D9207	D9206	D9407	D9406			PARA.3: Minimum command unit.
D9209	D9208	D9409	D9408			PARA.4: Maximum speed.
D9211	D9210	D9411	D9410			PARA.5: JOG speed.
D9213	D9212	D9413	D9412			PARA.6: Bias speed.
D9215	D9214	D9415	D9414			PARA.7: Backlash compensation.
D9217	D9216	D9417	D9416			PARA.8: Acceleration time.
D9219	D9218	D9419	D9418			PARA.9: Deceleration time.
D9221	D9220	D9421	D9420			PARA.10: Interpolation time constant. *2
D9223	D9222	D9423	D9422			PARA.11: Pulse output format.
D9225	D9224	D9425	D9424			PARA.12: Rotation direction. *3
D9227	D9226	D9427	D9426			PARA.13: Zero return speed.
D9229	D9228	D9429	D9428			PARA.14: Creep speed.
D9231	D9230	D9431	D9430			PARA.15: Zero return direction.
D9233	D9232	D9433	D9432			PARA.16: Machine zero point address.
D9235	D9234	D9435	D9434			PARA.17: Zero point signal count.
D9237	D9236	D9437	D9436			PARA.18: Zero point signal count start timing.
D9239	D9238	D9439	D9438			PARA.19: DOG switch input logic.
D9241	D9240	D9441	D9440			PARA.20: Limit switch logic.
D9243	D9242	D9443	D9442			PARA.21: Positioning completion error evaluation time.
D9245	D9244	D9445	D9444			PARA.22: Servo ready check.
D9247	D9246	D9447	D9446			PARA.23: Stop mode.
D9249	D9248	D9449	D9448			PARA.24: Electrical zero point address.
D9251	D9250	D9451	D9450			PARA.25: Software limit (upper).
D9253	D9252	D9453	D9452			PARA.26: Software limit (lower).

Attribute

R/W: This data register can be used both for write and read. When reading or writing data, use a 32-bit instruction "D"

*1 The operation speed and radius position during interpolation operation is calculated according to PARA. 1 and PARA. 2 set for the X axis.

*2 Although the special Ds for the Y axis (D9421, D9420) are assigned, only the special Ds for the X axis (D9221, D9220) are valid. Those for the Y axis are ignored.

*3 When using the absolute position detection function, set the rotation direction using a peripheral unit dedicated to the positioning unit. (When the absolute position is detected, the setting of PARA. 12 is reflected on the sign of the current address.)

Special data register for parameters. (I/O control parameters) (Y axis not available in FX2N-10GM)

Table 6.5: Special data registers list

X axis		Y axis		Attribute		Description
Upper	Lower	Upper	Lower	Direction of forwarding	Instruction form	
D9261	D9260	D9461	D9460	R/W	[D]	PARA.30:Program No. specification method. *1
D9263	D9262	D9463	D9462			PARA.31:Head input No. for DSW time-sharing reading. *1
D9265	D9264	D9465	D9464			PARA.32:Head output No. for DSW time-sharing reading. *1
D9267	D9266	D9467	D9466			PARA.33:DSW reading interval. *1
D9269	D9268	D9469	D9468			PARA.34:RDY output valid. *1
D9271	D9270	D9471	D9470			PARA.35:RDY output No. *1
D9273	D9272	D9473	D9472			PARA.36:m code external output valid. *1
D9275	D9274	D9475	D9474			PARA.37:m code external output No. *1
D9277	D9276	D9477	D9476			PARA.38: m code OFF command input No.*1
D9279	D9278	D9479	D9478			PARA.39:Manual pulse generator.
D9281	D9280	D9481	D9480			PARA.40: Multiplying factor per pulse generated by manual pulse generator.
D9283	D9282	D9483	D9482			PARA.41:Division rate for multiplied result.
D9285	D9284	D9485	D9484			PARA.42:Head input No. for manual pulse generator enable.
D9287	D9286	D9487	D9486			Vacant.
D9289	D9288	D9489	D9488			
D9291	D9290	D9491	D9490			
D9293	D9292	D9493	D9492			
D9295	D9294	D9495	D9494			
D9297	D9296	D9497	D9496			
D9299	D9298	D9499	D9498			
D9301	D9300	D9501	D9500	R *2	PARA.50:ABS interface.	
D9303	D9302	D9503	D9502		PARA.51:Head input No. for ABS.	
D9305	D9304	D9505	D9504		PARA.52:Head output No. for ABS control.	
D9307	D9306	D9507	D9506	R/W	PARA.53:Single-step operation.	
D9309	D9308	D9509	D9508		PARA.54:Single-step mode input No.	
D9311	D9310	D9511	D9510		PARA.55:Vacant.	
D9313	D9312	D9513	D9512		PARA.56:General-purpose input declaration for FWD/RVS/ZRN.	

Attribute

R/W: This data register can be used both for write and read. When reading or writing data, use a 32-bit instruction "D"

*1 In simultaneous 2-axis mode, the value set for the X axis is valid and the value set for the Y axis is ignored.

*2 D9300 to D9305 and D9500 to D9505 are assigned as parameters to detect the absolute position. Because absolute position detection is executed when the power of the positioning unit turns on, it cannot be actuated by special auxiliary relays. To execute absolute position detection, directly set parameters using a peripheral unit dedicated to positioning.

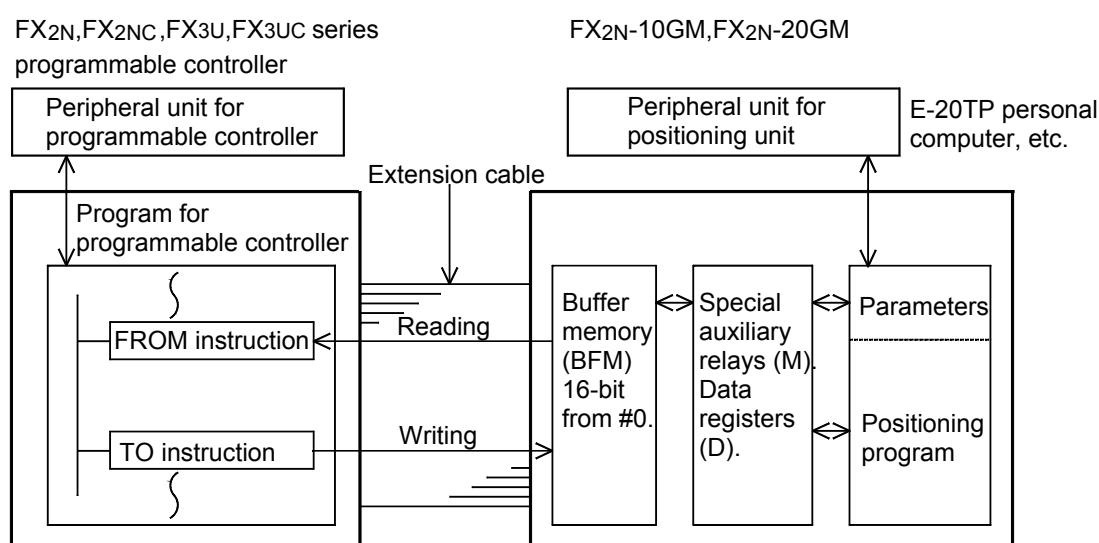
MEMO

7. Communication with Programmable Controller

When the FX2N-10GM/FX2N-20GM positioning unit is connected to the FX2N/FX2NC/FX3U/FX3UC Series programmable controller, positioning data such as the travel, the operation speed, etc., can be set and the present position can be monitored. This section explains the communication with the programmable controller to perform these operations.

7.1 Outline

Communication with the programmable controller is performed using the FROM/TO instruction of the programmable controller via buffer memories (BFM) inside the positioning unit. The schematic diagram below shows the communication between the programmable controller and the positioning unit. (For system configuration, refer to Section 1.)



FROM instruction: Reads the contents of the BFM to the programmable controller.

TO instruction: Writes the contents of the programmable controller to the BFM.

- Between the programmable controller and the buffer memories in the positioning unit, communication is performed when the FROM or TO instruction in the sequence program is executed. At this time, the positioning unit may be in the MANU or AUTO mode.
- The buffer memories interlock with the special M's and the special D's in the positioning unit. When the contents of the buffer memories change, the contents of the special Ms and the special D's also change. The positioning unit automatically performs communication between them.

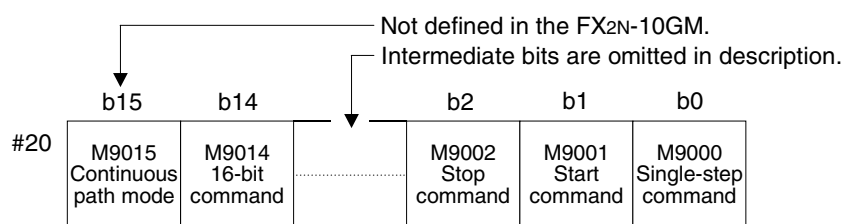
7.2 Buffer Memories

7.2.1 Configuration of the buffer memories

The buffer memories correspond to the device memories such as parameters, various special Ms and various special Ds as shown in the configuration diagram on the previous page. (For details, refer to Section 6.)

- The buffer memory No. is indicated as "#". One point consists of 16-bit data.
- Bit devices such as auxiliary relays, I/O relays, etc. in the positioning unit and word devices such as data registers, parameters, etc. are assigned to 16-bit data in the buffer memories.
- Each bit of the buffer memories to which bit devices are assigned operates differently.

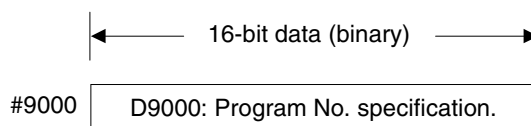
Example: BFM#20



The figure above shows the buffer memory #20. The special auxiliary relays M9000 to M9015 are assigned to #20. For example, M9001 (X axis start command) is assigned to Bit 1 of #20. When a sequence program is created so that this bit is turned ON by the TO instruction (writing to the buffer memories), the start command is given.

- The buffer memory to which a word device is assigned expresses a single value in 16 bits or 32 bits.

Example: BFM#9000



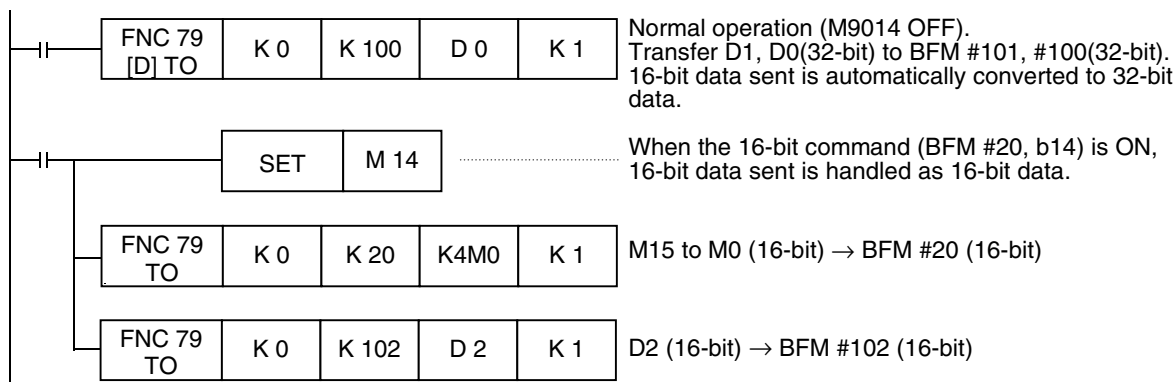
D9000 is assigned to the buffer memory #9000.

By wiring data to #9000 using the TO instruction, you can specify the program No.

As to word devices, the buffer memory No. is equivalent to the special data register No.

- Buffer memories are classified into the independent use type (16-bit [S]) and the consecutive use type (32-bit [D]). For 32-bit data such as the current position, add "[D]" to the FROM/TO instruction.

When you would like to treat a buffer memory of the consecutive use type as the 16-bit type, turn on the special auxiliary relay M9014 (BFM #20 b14). Then, you can use it as 16 bits in the FROM/TO instruction (without "[D]") in a program. However, you cannot treat special data registers (D9000 and later) as the 16-bit type.



7.2.2 Assignment of buffer memories

Buffer memories, diversified devices and parameters in the positioning unit are assigned as shown in the table below, and same data is stored in each pair of buffer memory and devices/parameters.

For the details of special auxiliary relays, special data registers and parameters, refer to Section 6.

In the FX_{2N}-10GM, buffer memories corresponding to unsupported devices such as special auxiliary relays, special data registers and parameters for the Y axis are not used.

Table 7.1: BFM list

BFM No.	Assigned devices	Attribute		Remarks
#0 to #19	D9000 to D9019	Varies depending on attribute of special data registers. (Refer to Section 6.)		Special data registers are assigned. These buffer memories overlap BFM #9000 to #9019.
#20	M9015 to M9000	R/W	[S]	Special auxiliary relays are assigned.
#21	M9031 to M9016			
#22	M9047 to M9032			
#23	M9063 to M9048	R		
#24	M9079 to M9064			
#25	M9095 to M9080			
#26	M9111 to M9096			
#27	M9127 to M9112			
#28	M9143 to M9128			
#29	M9159 to M9144	R/W		
#30	M9175 to M9160			
#31	Unusable	—	—	—
#32	X07 to X00	R	[S]	Input relays are assigned. However, X10 to X357 are not assigned. In FX2N-10GM, X0 to X3 and X375 to X377 are assigned.
#33 to #46	Unusable	—	—	
#47	X377 to X360	R	[S]	
#48	Y07 to Y00	R/W	[S]	Output relays are assigned. However, Y10 to Y67 are not assigned. In FX2N-10GM, Y0 to Y5 are assigned.
#49 to #63	Unusable	—	—	
#64 to #95	M15 to M0 to M511 to M496	R/W	[S]	General-purpose auxiliary relays are assigned.
#96 to #99	Unusable	—	—	—
#101, #100 to #3999, #3998	D101, D100 to D3999, D3998	R/W	[D]	General-purpose data registers are assigned. However, D0 to D99 are not assigned.
#4001, #4000 to #6999, #6998	D4001, D4000 to D6999, D6998	R	[D]	File registers are assigned.

Table 7.1: BFM list

BFM No.	Assigned devices	Attribute		Remarks
#7000 to #8999	Not defined	—	—	—
#9000 to #9019	D9000 to D9019	Varies depending on attribute of special data registers. (Refer to Section 6.)		Special data registers are assigned. These buffer memories overlap BFM #0 to #19.
#9020 to #99119	D9020 to D9199	Varies depending on attribute of special data registers. (Refer to Section 6.)		Special data registers are assigned.
#9200 to #9339	D9200 to D9339	R/W	[D]	X axis parameters are assigned. *1
#9400 to #9599	D9400 to D9599	R/W	[D]	Y axis parameters are assigned. *1 (FX2N-10GM: Unusable)

Attribute

R: This buffer memory can be used only for read. You should not write it.

R/W: This buffer memory can be used both for write and read. When reading or writing data, use a 16-bit instruction for a buffer memory classified as "S", or a 32-bit instruction for a buffer memory classified as "D".

- As to word devices, the buffer memory No. is equivalent to the special data register No.
- The execution time of a transfer instruction (FROM/TO) to the buffer memory #32 or later is approximately twice the regular execution time.
- File registers (#4000 to #6999) are valid only for [D] FROM instructions. [D] TO instructions are not executed.

*1: When using the absolute position detection function, set the following parameters using a peripheral unit dedicated to the positioning unit. Because the absolute position is detected when the power of the positioning unit is turned ON, buffer memories cannot be used for absolute position detection. (However, buffer memories can be read.)

Note that a peripheral unit dedicated to the positioning unit is also required when the table method described later is used (in the FX2N-10GM).

PARA. No.	Item	BFM No.		Special data register	
		X axis	Y axis	X axis	Y axis
12	Rotation direction	#9225, #9224	#9425, #9424	D9225, D9224	D9425, D9524
50	ABS interface	#9301, #9300	#9501, #9500	D9301, D9300	D9501, D9500
51	ABS input head No.	#9303, #9302	#9503, #9502	D9303, D9302	D9503, D9502
52	ABS control output head No.	#9305, #9304	#9505, #9504	D9305, D9304	D9505, D9504

7.3 Program example

This section explains examples of the basic functions available in the programmable controller such as specification of the program No., operation commands, reading of the present value, etc.

Specifying the program No.Section 7.3.1

Operation commands (start/stop)Section 7.3.2

Reading the present valueSection 7.3.3

Setting the travel and speedSection 7.3.4

Reading m codesSection 7.3.5

Reading/Changing the parameters...Section 7.3.6

7.3.1 Specifying the program No.

Buffer memory No.

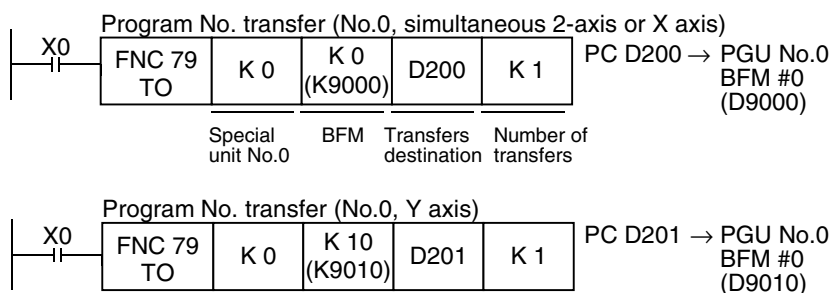
#0 or #9000: Simultaneous 2-axis, X-axis (FX_{2N}-10GM).

#10 or #9010: Y-axis

Either can be set. (FX_{2N}-10GM: #0 or #9000)

When specifying a program from a programmable controller, set PARA. 30 (program No. specification method) to "3".

Program example



Write the program No. to be executed to D200 and D201.

The program No. can be directly specified using data registers other than D200 and D201 or using K (constant).

Data change timing

The positioning unit tries to read the program No. to be executed when the start command is given.

Accordingly, the values set before the start command is given are valid regardless of the mode (MENU or AUTO).

The BFM can be changed even after the start command is given. However, the new program No. set can not be executed until after the positioning program is finished at "END" and the start command is given again.

7.3.2 Operation commands (start/stop)

Give various operation commands from the programmable controller.

Buffer memory No.

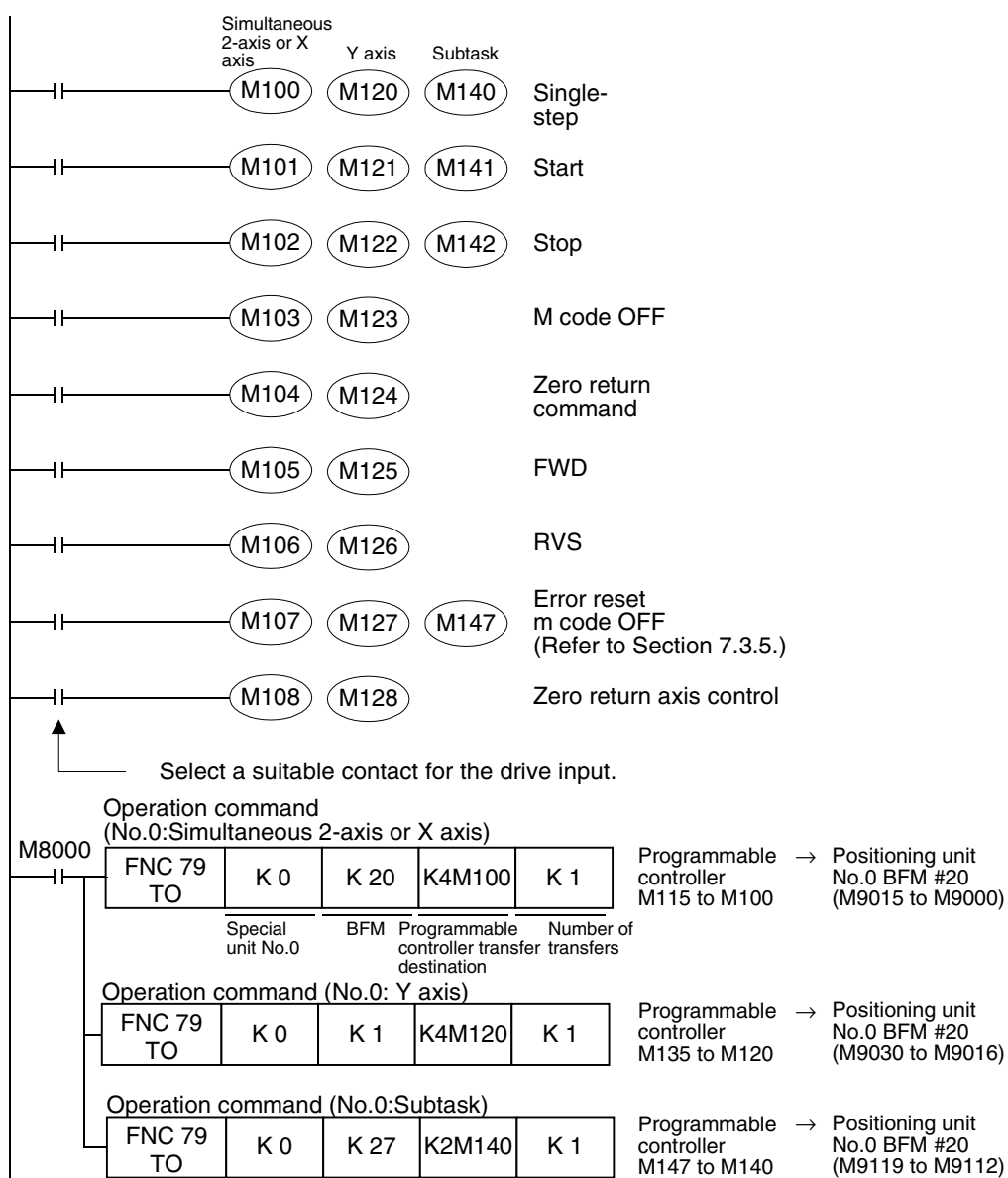
BFM #20 (simultaneous 2-axis, X axis), #21 (Y axis) and #27 (subtask)

Assignment of each bit is shown below.

b15	b14	b8	b7	b6	b5	b4	b3	b2	b1	b0
Continuous paths	16-bit command	Zero return	Error reset	RVS	FWD	Zero return command	M code OFF	Stop	Start	Single-step

b13 to b9 of #20 and #21 are not defined. Only b0, b1, b2 and b7 of #27 (subtask) are defined. The figure above indicates the bit assignment in #20 (simultaneous 2-axis, X axis), #21 (Y axis) and #27 (subtask).

Program example



Input timing

The single-step, start, stop, zero return, FWD and RVS commands are processed in parallel with the external terminals of the positioning unit. Select a suitable contact for the drive input.

7.3.3 Reading the present value

Read the present value to the programmable controller.

Buffer memory No.

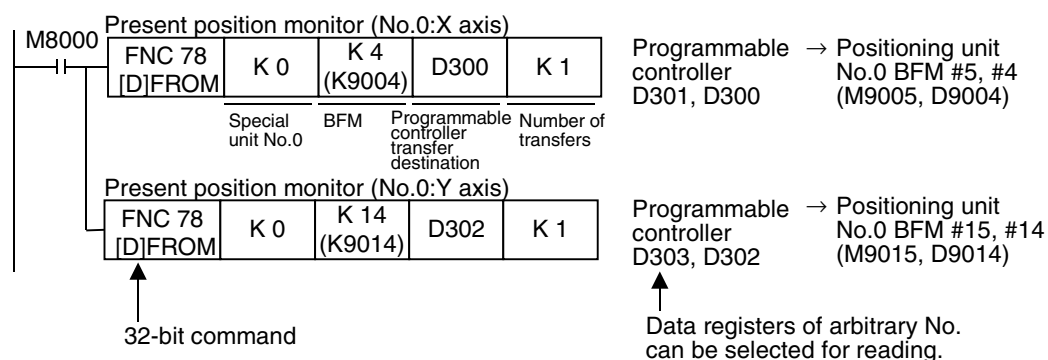
#5, #4 or #9005, #9004: X axis (FX_{2N}-10GM)

#15, #14 or #9015, #9014:Y axis

The same present position is saved.

The present position is saved as 32-bit data.

Program example



Data reading timing

The present position can be read without regard to the mode (AUTO or MANU) or the status (BUSY or READY) of the positioning unit.

7.3.4 Setting the travel and the operation speed

Set the positioning data such as the travel and operation speed from the programmable controller.

Buffer memory No.

#100 to #1999:FX_{2N}-10GM

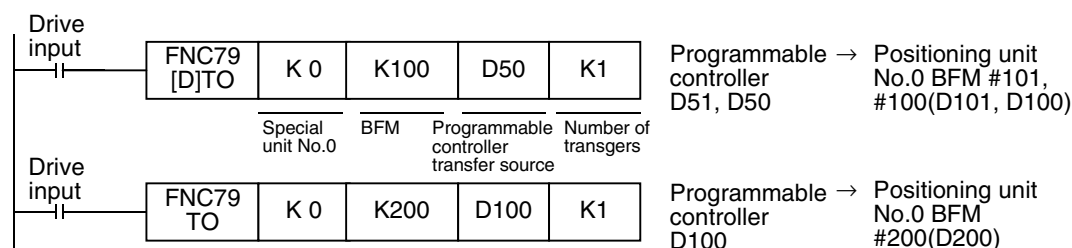
#100 to #6999:FX_{2N}-20GM

These buffer memories are always handled as 32-bit data.

Refer to the positioning program example shown below.

Program example

Write the set values in the D51, the D50 and the D100 to the BFM.



By turning ON special auxiliary relay M9014 (BFM #20, b14), 32-bit buffer memories are treated as separate 16-bit types. This allows the TO instruction (without D) to send 16-bit data to each BFM separately. (Refer to Section 7.2.1.)

Positioning program example

In the positioning program, the travel, the operation speed, etc. are specified indirectly (Refer to Section 5.5.).

Only travel and speed are shown in this example. In addition, all the devices such as the radius, the center point, etc. that can be specified indirectly can be set from the programmable controller.

```

    )
cod00(DRV)
x DD100; ← The travel is specified by D101 and D100 (32-bit data). ("DD"
            specifies 32 bits.) The speed is specified as "fDDQQQ".
            Data register No.                                Data register No.
    )

cod00(DRV)    The travel is specified by D0 (16-bit data). The speed is
x D0; ←       specified as fDQQQ.
            Data register No.
    )
  
```

Data change timing

The data can be written to the buffer memories without regard to the mode (AUTO or MANU) or the status (BUSY or READY) of the positioning unit. However, because the positioning unit reads the travel and the speed set when the program is executed (when the cod instruction is executed in the example above), the set data must be written to the buffer memories before the instruction is executed. The data written while or after the instruction is executed becomes valid when the instruction is executed next time.

7.3.5 Reading m codes

Read out m codes to the programmable controller to drive auxiliary equipment.

Buffer memory No.

The table below shows the buffer memories related to the m codes.

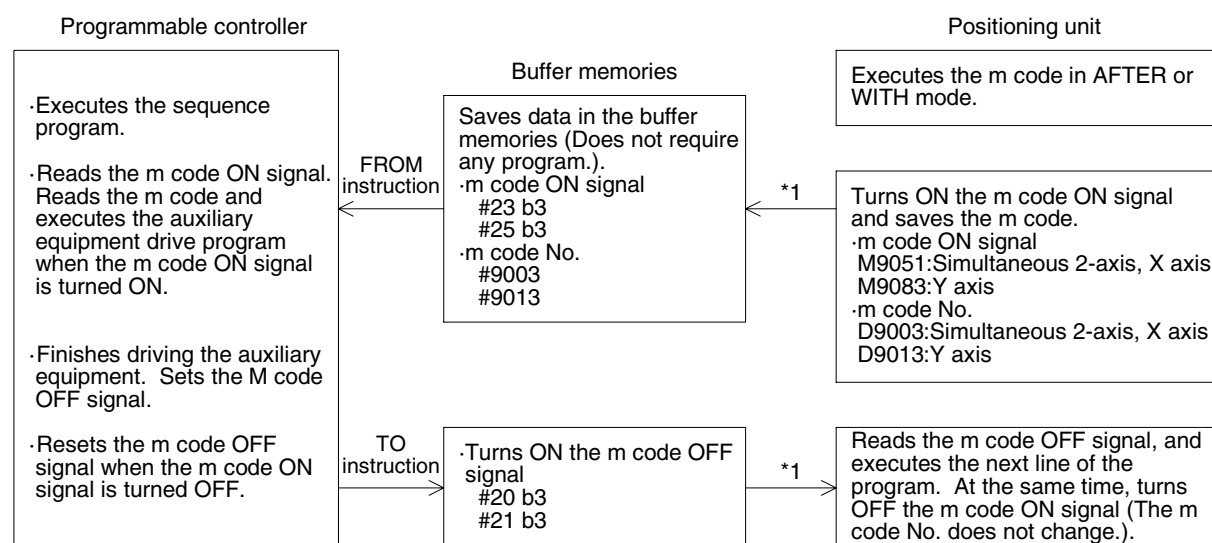
Table 7.2: Buffer memory No.

	Simultaneous 2-axis, X axis *1		Y axis	
	Buffer memory	Special M/D	Buffer memory	Special M/D
m code ON signal	#23 b3	M9051	#25 b3	M9083
m code OFF command	#20 b3	M9003	#21 b3	M9019
m code No.	#9003	D9003	#9013	D9013

*1: The X axis only is available in the FX2N-10GM.

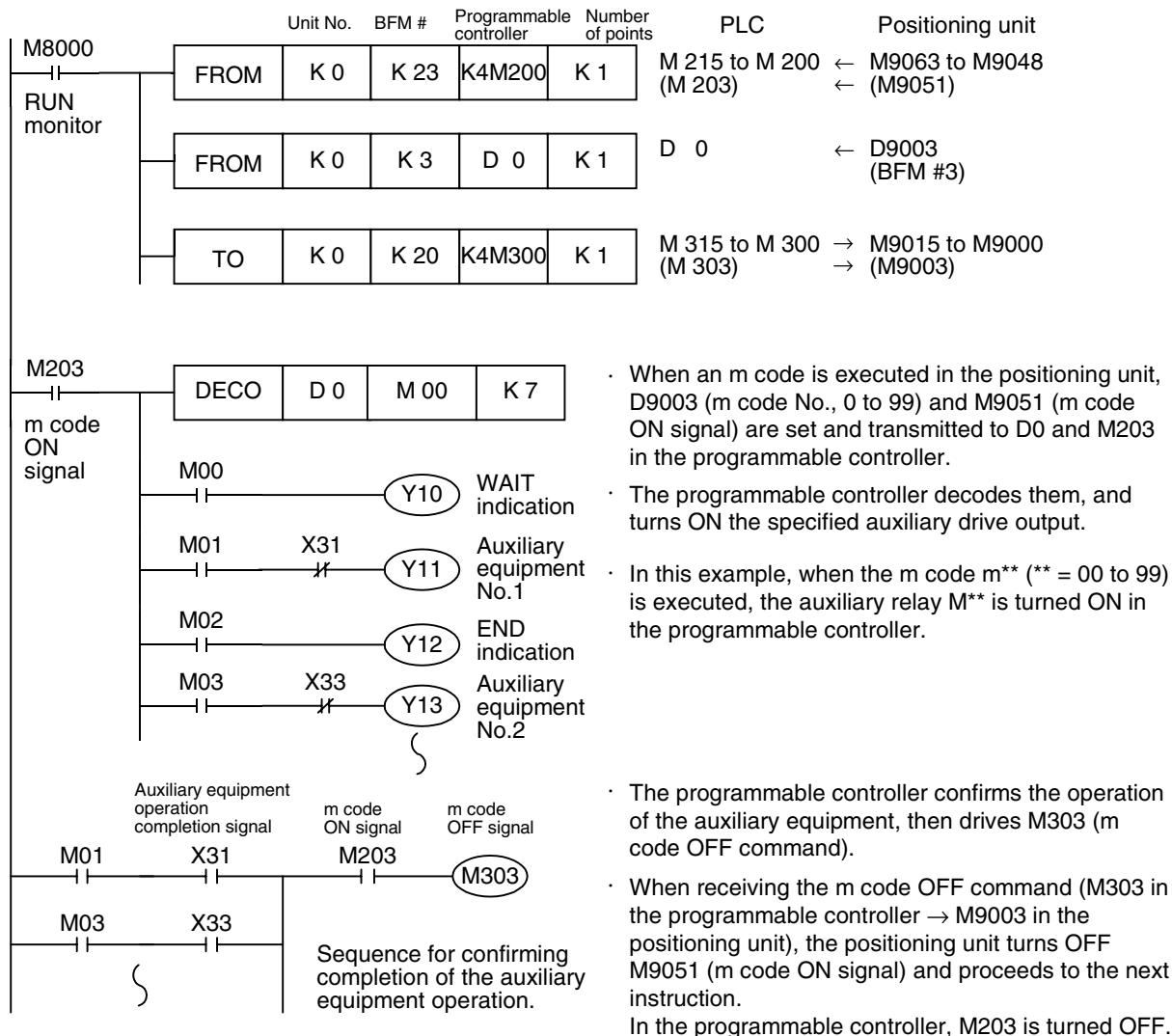
Operations of the m codes

- Each m code is driven in AFTER mode or WITH mode (Refer to Section 5.1.3.). In either mode, when the m code is driven, the m code ON signal is turned ON and the m code No. is saved in the appropriate special data register (interlocking with the buffer memory). The m code ON signal remains ON until the m code OFF signal is turned ON.
- The diagram below shows the communication between the programmable controller and the m codes.



*1 The positioning unit automatically reads from or writes to the buffer memories, the special auxiliary relays and the special data registers.

Sequence program example (Example for the X axis)



Positioning program example

- | | |
|---|---|
| <pre> } cod 00 (DRV) x1000 m01 } m03; } m00; (WAIT) </pre> | <ul style="list-style-type: none"> This is an m code drive command in WITH mode. The m code 01 is saved in BFM. In the example above, Y11 is driven. This is an m code drive command in AFTER mode. The m code 03 is saved in BFM. In the example above, Y13 is driven. When the WAIT instruction is executed, m code 00 is saved in BFM. In the example above, Y10 is driven. |
|---|---|

Data reading timing

The data can be read without regard to the mode (AUTO or MANU) or the status (BUSY or READY) of the positioning unit.

However, it is recommended to drive the auxiliary equipment when the m code ON signal is turned ON as shown in the sequence program example above because the m code No. is only read when an m code drive instruction is executed in the positioning program.

7.3.6 Reading / Changing the parameters

Read or change the contents of the parameters in the positioning unit. The system parameters cannot be changed.

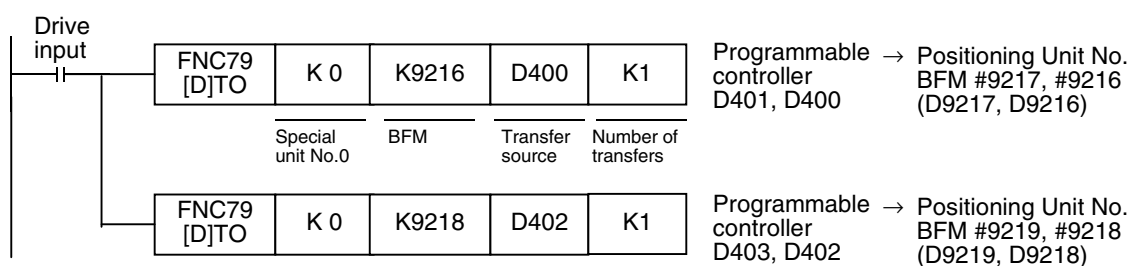
Buffer memory No.

#9200 to #9513

(X axis only in the FX₂N-10GM. Also, some parameters are not available. For details, refer to Section 4.)

Sequence program example

Change the acceleration/deceleration time of the X axis.



Data change timing

The data can be written to the buffer memories without regard to the mode (AUTO or MANU) of the positioning unit. However, if some parameters are changed during operation, correct positioning may not be realized.

Make sure to change the parameters before starting operation (that is, before entering the start input). The contents of the parameters are reset to those set by a peripheral unit when the power of the positioning unit is turned OFF.

7.4 Positioning using the table method (FX_{2N}-10GM)

In FX_{2N}-10GM, the program only for positioning is unused, and the positioning control can be achieved by programming the PLC (FROM/TO instruction). This function allows positioning control operations using peripheral equipment for the PLC even when peripheral equipment dedicated to the positioning unit is not available.

(FX_{2N}-10GM V2.20 or later can set the absolute position detection parameter by programming the PLC.

FX_{2N}-10GM V2.20 or earlier cannot set the absolute position detection parameter by programming the PLC. Peripherals only for the positioning unit are necessary to set the position detection parameter.)

7.4.1 Outline of the table function

When the special auxiliary relay M9165 of the FX_{2N}-10GM is turned ON, positioning control using the table method becomes valid.

A maximum of 100 table entries are provided. Each entry holds four types of information: command code (corresponding to the instruction), position data (address), speed data and m code value. The information is saved in the general-purpose registers of the positioning unit. Two data registers (32 bits) are used to save one piece of information.

The data register No. and the table entry No. (described later) are fixed. D1000 is assigned to entry No. 0. (One hundred entries No. 0 to 99 are available.)

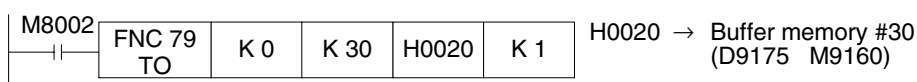
When the positioning data is written to the assigned data registers using the TO instruction and operation is started, positioning is performed based on the written information. (AUTO mode)

7.4.2 Declaration of table method

To use the table method, the special auxiliary relay M9165 of the FX_{2N}-10GM must be turned ON.

M9165: Table method function valid (Buffer memory #30 b5)

Sequence program example (switches M9165 ON):



The table method continues to operate independent of the status of the M9165, however, when the power supply is turned OFF the table method resets to 0.

7.4.3 Assignment of table data

- When the table method becomes valid, the data registers D1000 to D1999 of the FX_{2N}-10GM are assigned as the positioning data storage registers. (The data is not backed up by the battery.)
- One hundred entries No. 0 to 99 are provided. Four types of information, command code, position data, speed data and m code, are assigned to each entry.
- Two data registers (32 bits) are allocated for each piece of information. Accordingly, each entry occupies eight data registers.

Table 7.3: Assignment of table data

Entry No.	Command code	Position data	Speed data	m code
No.0	D1000, D1001	D1002, D1003	D1004, D1005	D1006, D1007
No.1	D1010, D1011	D1012, D1013	D1014, D1015	D1016, D1017
No.2	D1020, D1021	D1022, D1023	D1024, D1025	D1026, D1027
⋮				
No.98	D1980, D1981	D1982, D1983	D1984, D1985	D1986, D1987
No.99	D1990, D1991	D1992, D1993	D1994, D1995	D1996, D1997

100 entries (No. 0 to 99) are available. (For a full table list, refer to 12.4.)

The data register is changed as follows by the action of M9165 after the table method is declared once.

Table 7.4: Operation of M9165

M9165 state	Parameter buffer (D9200 or more)	Data registers (D0 to D1997)
ON	Not changed by changeover between MANU and AUTO.	Not changed by changeover between MANU and AUTO.
OFF	Initialized when MANU is changed to AUTO	Cleared to 0 when AUTO is changed to MANU

7.4.4 Setting of table data

It is necessary to set four data (Command cod, position data, speed data m code).

Command code


Specify the operation such as high-speed positioning (DRV), returning to the mechanical zero point (DRVZ), etc. which corresponds to a positioning instruction as the command code.

Table 7.5: Setting of positioning data

Command code	Description	Command code	Description
0	High-speed positioning. (DRV)	71	Interrupt jog feed at one-step speed. (One entries are used.) (SINT)
1	Multi speed operation. (LIN)	72	Interrupt jog feed at two-step speed. (Two entries are used.) (DINT)
4	Timer. (TIM)		
9	Servo end check. (CHK)	73	Travel compensation. (MOVC)
28	Returning to mechanical zero point. (DRVZ)	76	Cancel of compensation. (CANC)
29	Setting of electrical zero point. (SETR)	90	Specification of absolute address. (ABS)
30	Returning to electrical zero point. (DRVZ)	91	Specification of incremental address. (INC)
31	Interrupt stop (Remaining distance is ignored). (INT)	92	Change of present value. (SET)

- WAIT instruction (m00)

When “1” is added at the head of the two-digit command code, the WAIT instruction (m00) is included in the operation.



 WAIT instruction
 Command code (00 to 92)

Example

k171: When the command code is set to “171”, interrupt jog feed is performed, then the unit enters the WAIT (m 00) state and waits for start.

- END instruction (m 02)

When i2î is added at the head of the two-digit command code, the END instruction (m 02) is included in the operation.


 END instruction
 Command code (00 to 92)

Example

k231: When the command code is set to “231”, interrupt stop is performed, then the unit performs the END (m 02) command.

Position data

Set the travel distance or address as the position data.

Some instructions do not require position data to be set. Refer to the list below.

The setting range is equivalent to that for the cod instructions. Refer to Section 5.

Speed data

Set the operation speed for positioning as the speed data.

The setting range is equivalent to that for the cod instructions. Refer to Section 5.

m code information

When a positioning instruction is driven, an m code is output.

At this time, the m code ON signal, the m code No. and the m code wait signal are written to special auxiliary relays and special data registers (assigned to the X axis).

The m code OFF command is also given through a special auxiliary relay.

m code ON signal: M9051

m code No. (binary): D9003

m code wait signal: M9052

m code OFF command: M9003

In the m code information, the AFTER mode (in which an m code is output after positioning is completed) or the WITH mode (in which an m code is output while positioning is performed) can be set for m code output.

Set value "0": No m code

Set value "1", "3" to "99": m code output in the AFTER mode

Set value "100" to "199": m code output in the WITH mode



- When "2" is set, the actual operation does not correspond to the END instruction. (In the monitor display by a peripheral unit, however, "END" is displayed.)
When using the END instruction, add "2" at the top of the positioning information as described above.

Positioning data list

The table below shows the list of information set for each command code. The items marked with "✓" are required to be set. When a value is entered for an item indicated as "Undefined", it is ignored.

The command code "72" indicates interrupt jog feed at two-step speed, and uses two entries because two speeds are required to be set (Refer to the next page.).

Table 7.6: Positioning data list

Command code	Position data	Speed data	m code	Remarks
0	✓	✓ *1	✓	High-speed positioning. (DRV)
1	✓	✓	✓	Multi speed operation. (LIN)
4	✓	Undefined	✓	Timer. (TIM)
9	Undefined	Undefined	✓	Servo end check. (CHK)
28	Undefined	Undefined	✓	Return to mechanical zero point. (DRVZ)
29	Undefined	Undefined	✓	Setting of electrical zero point. (SETR)
30	Undefined	Undefined	✓	Return to electrical zero point. (DRVR)
31	✓	✓	✓	Interrupt stop (Remaining distance is neglected). (INT)
71	✓	✓	✓	Interrupt jog feed at one-step speed. (One entries are used.) (SINT)
72	✓	✓	Undefined	Interrupt jog feed at two-step speed. (Two entries are used.) (DINT)
	Undefined	✓	✓	
73	✓	Undefined	✓	Travel compensation. (MOVC)
76	Undefined	Undefined	✓	Cancel of compensation. (CANC)
90	Undefined	Undefined	✓	Specification of absolute address. (ABS)
91	Undefined	Undefined	✓	Specification of incremental address. (INC)
92	✓	Undefined	✓	Change of present value. (SET)

*1: When the speed data is set to "0", the command code (0) is ignored and the next entry is executed.

Cautions on command codes

1) Handling of command code 0 (high-speed positioning)

When the speed is set to "0" no processing is performed and the entry is skipped.

Though the speed can be omitted in the cod 00 instruction, it cannot be omitted in the table method.

2) Handling of command code 72 (interrupt jog feed at two-step speed)

When 72 (interrupt jog feed at two-step speed) is set, two speed commands are required. Make sure to use two entries.

Table No.0	72]	Two entries make one positioning operation.
Table No.1	72		

⋮

Table No.10	72]	Even if only one entry is set for "72" the next entry (No. 11) is regarded as the second-step speed of "72".
Table No.11	01		

3) Error information

Appropriate error codes are generated in the same way as positioning using instructions.

For the meaning of errors and the troubleshooting procedures, refer to Section 10.

7.4.5 Handling of parameters

The positioning parameters and the I/O control parameters can be written from the PLC.
(The system parameters cannot be changed.)

- When the power is turned ON, the initial values (default values) are set to the parameters. When the parameter data is changed from the PLC, the corresponding parameters are changed. When the power is turned OFF, the parameters are returned to the initial values. Make sure to set the parameters as necessary after the power is turned ON.
- Use peripherals only for the positioning unit when changing (PARA.50 to PARA.52) the absolute position detection function parameter.
("When the power supply for the positioning unit is turned ON, the absolute position detection" is executed. The absolute position detection does not operate normally even if the set value is written from the Programmable controller in the TO instruction.)
- For the parameter change procedures, refer to section 7.3.6.

7.4.6 Handling of absolute position detection function

When the power supply for the positioning unit is turned ON, the absolute position detection is executed. Even if the content (PARA.50 to PARA.52) of the absolute position detection function parameter is written from the PLC in the **D** TO instruction, no action occurs.

The following parameter operations are necessary.

V2.20 or earlier

Set (PARA.50 to PARA.52) the absolute position detection function parameter with peripherals for the positioning unit.

V2.20 or later

Turn ON b11(M9171) of # 30 after writing set data in BFM #9300 to #9305(D9300 to D9305). FX2N-10GM does the following actions by turning ON M9171 (rising edge).

- The value of D9301 and D9300 is written in program memory (EEPROM) as PARA50.
- The value of D9303 and D9302 is written in program memory (EEPROM) as PARA51.
- The value of D9305 and D9304 is written in program memory (EEPROM) as PARA52.

(EEPROM can be rewritten up to 10,000 times. The rewriting processing is not executed when the value of D9300 to D9305 is the same as the value of each parameter.)

Turn ON M9171 at READY (M9048 is turned ON) in the MANU mode (M9140 is turned ON). When the power supply of FX2N-10GM is turned on again, each value of the storage in the program memory becomes effective.

If this function is used when the table method is used, the use of the absolute position detection function becomes possible due to the program of the PLC.

When the parameter is set with a special programming tool of FX2N-10GM, the above mentioned function need not be used to write each parameter directly in the program memory.

The following FX2N-10GM conditions occurs when storage processing to the EEPROM fails.

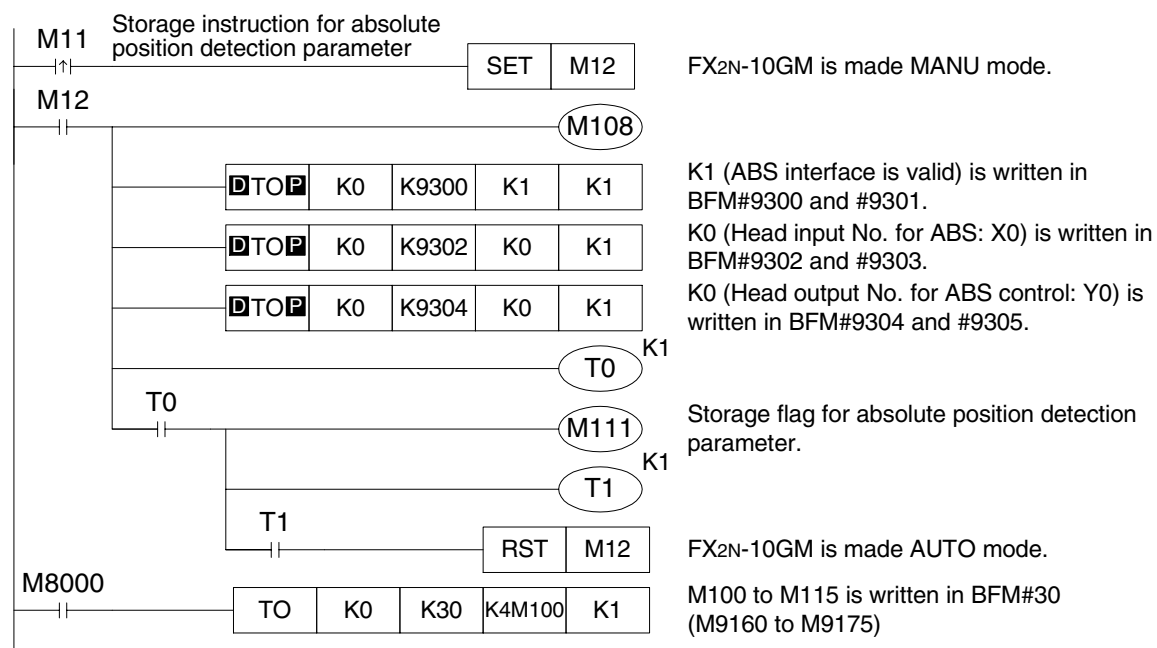
ERROR_LED : Lighting

READY_LED : Turning OFF

Error code : 9000(memory error) is written in D9061.

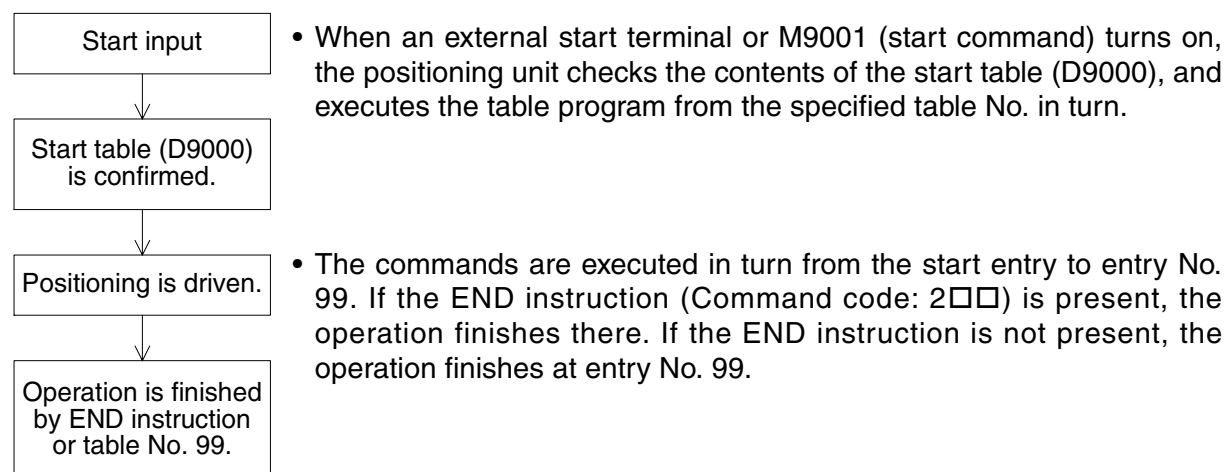
Program example of PLC (FX₂N-10GM V2.20 or later)

Do the storage of the value of BFM#9300 to #9305 as parameter 50/51/52 of FX₂N-10GM by turning ON M11 in the following programs.



7.4.7 Table method operation

In the table method operation, the special data register D9000 specifies the start (first) table entry No. When the start input is given, the commands are executed in turn starting with the table entry No. saved in D9000.



The following special auxiliary relays and data registers are related to start and stop of the table method operation.

Table 7.7: Special auxiliary relays and data registers related to start and stop

	Special M/D	Buffer memory (BFM)
Start	M9001	#20 b1 or external start input
Stop	M9002	#20 b2 or external stop input
Start entry No.	D9000	#0 or #9000
Activated start entry No.	D9001	#1 or #9001
Entry No. being executed.	D9002	#2 or #9002

8. Operation, Maintenance and Inspection

8.1 Before Starting Operation

Check the following items before starting operation.

8.1.1 System design

Check the machine with regard to the following items to ensure that a suitable motor is selected.

Load torque, Load inertia, Acceleration/deceleration time, Operation speed, Stopping accuracy, Operation frequency, etc.

8.1.2 Preliminary inspection (Turn OFF the power.)

Incorrect connection of the power supply terminal, contact between a DC input line and a power line, a short-circuit in the output wiring, etc. can cause serious damage.

Before turning ON the power, make sure that the power supply and the ground are correctly connected and the I/O lines are correctly wired.

Measure the withstand voltage and the insulation resistance of the positioning unit using the following procedure.

- 1) Disconnect all the I/O wiring and the power line of the positioning unit.
- 2) Connect all the terminals except the ground terminal of the positioning unit with a jumper wire while the positioning unit is not connected to any other unit.
- 3) Measure the voltage and the resistance between the jumper wire and the ground terminal.

Withstand voltage : 500V AC, 1 minute (FX_{2N}-10GM, FX_{2N}-20GM)

Insulation resistance : 5 MΩ or more by 500V DC Program check.

8.1.3 Program check (Turn ON the power, and set the positioning unit to the MANU mode.)

Write a program using a peripheral unit (Release the write-protect switch of the EEPROM in the FX_{2N}-20GM.)

After that, read the program and check whether it is correctly written, and check the program and the parameters using the program check function of the peripheral unit.



- Thoroughly read the manual, sufficiently confirming safety, then perform returning to the zero point in the MANU/AUTO mode, jog operation, step operation or automatic operation. Erroneous operation may damage the unit or cause accidents.

8.1.4 Incremental/absolute drive method

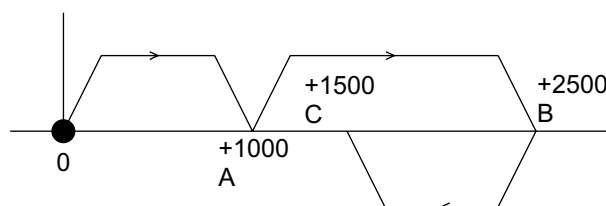
To specify the travel (or rotation angle) of the machine, absolute drive and incremental drive methods can be selected. Absolute drive method indicates the position from a reference point and incremental drive method indicates the position by travel distance from the present position.

Absolute drive method

The distance from the reference point (zero point) is specified.

Program example

```
Ox00
cod00(DRV)
x1000;
cod00(DRV)
x2500;
cod00(DRV)
x1500;
m02(END)
```



In the example above, Point A is placed at "+1000" from the zero point.

Point B is placed at "+2500" from the zero point. When the machine returns from Point B to Point C, it moves in the minus direction but the travel is indicated as "+1500".

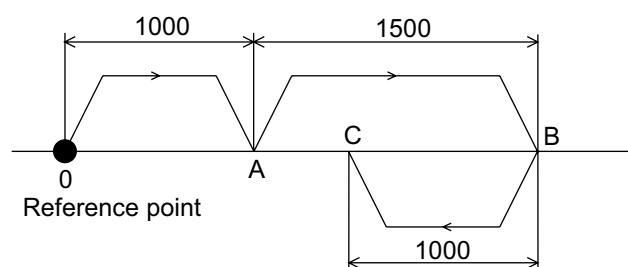
A program example is given.

Incremental drive method

The distance of travel from the present position is specified.

Program example

```
Ox00
cod91(INC);
cod00(DRV)
x1000;
cod00(DRV)
x1500;
cod00(DRV)
x-1000;
m02(END)
```



In the example above, the operation equivalent to that explained in the absolute drive method is indicated. Here, Point A is placed at "+1000" from the initial position.

Point B is placed at "+1500" (incremental travel) from Point A (reference point).

In the same way, Point C is placed at "-1000" from Point B (reference point).

Drive method specification

The absolute drive method can be selected by entering "cod90 (ABS)" in the positioning program, and the incremental drive method can be selected by entering "cod91 (INC)". The absolute drive method is automatically selected when nothing is specified (Refer to Section 5.6.15.).

8.1.5 Direction of motor rotation

This section explains the setting to drive the motor correctly.

Direction of motor rotation

The direction of motor rotation is determined by the settings of PARA 12 and PARA 15 and by the method used to connect the positioning unit and the drive unit.

Table 8.1: Direction of motor rotation

PARAMETER	Direction of rotation setting "0"	Direction of rotation setting "1"
Present value	Increased by forward rotation pulses (FP) Decreased by reverse rotation pulses (RP)	Decreased by forward rotation pulses (FP) Increased by reverse rotation pulses (RP)
Instruction operations	+x and +y instructions generate forward rotation pulses (FP) -x and -y instructions generate reverse rotation pulses (RP)	+x and +y instructions generate reverse rotation pulses (RP) -x and -y instructions generate forward rotation pulses (FP)
FWD input JOG+input	Generate forward rotation pulses (FP)	Generate reverse rotation pulses (RP)
RVS input JOG-input	Generate reverse rotation pulses (RP)	Generate forward rotation pulses (FP)
Zero return direction	When PARA 15 is set to "0", forward rotation pulses (FP) are generated. When PARA 15 is set to "1", reverse rotation pulses (RP) are generated.	When PARA 15 is set to "0", reverse rotation pulses (RP) are generated. When PARA 15 is set to "1", forward rotation pulses (FP) are generated.

The direction of motor rotation and the direction of machine travel in response to forward rotation pulses depend on the method used to connect the drive unit and the machine specifications.

8.1.6 Connection of limit switches

Incorrect connection of the limit switches may operate the motor incorrectly.
The limit switch used must be matched to setting PARA.20.

When PARA 20 is set to "0", input of pulses is stopped when the LS is turned ON.

When PARA 20 is set to "1", input of pulses is stopped when the LS is turned OFF.

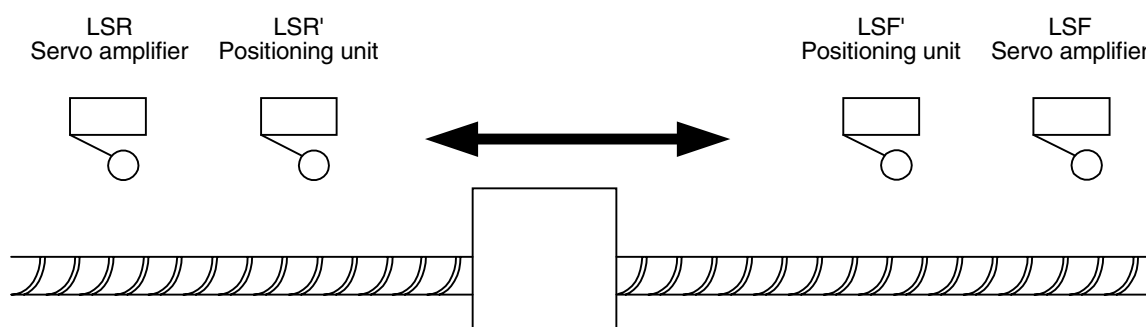
When it uses the servo motor, it can install limit LS in the servo amplifier.

Install preliminary limit switch LSF 'LSR' which operates before LSF and LSR of the servo amplifier operate, and connect this to the positioning unit.

It can use the DOG search function for the Home position return to operate.

When LSF' or LSR' operates, it is possible to move it by the JOG operation in the opposite direction.

(It is not possible to move it with the manual pulse generator)



If driving a servo motor, operation will not be possible unless LSF and LSR are connected to the drive unit and the positioning unit is set to always ON (PARA 20: 1) or always OFF (PARA 20: 0).

However, in this connection status, even if LSF or LSR is actuated and the drive unit stops automatically, the positioning unit will not detect that the drive unit has stopped.

Therefore, it is best to install preliminary limit switches LSF' and LSR' that are actuated before LSF and LSR, and connect these to the positioning unit.

To avoid this double use, connect LSF and LSR to the positioning unit and set the drive unit always to ON, in the same way as the stepping motor connection.

8.1.7 Each signal fetch timing

In order to write programs correctly, the writer must be aware of the timing in which the positioning unit detects and executes operations in response to the various inputs.

Table 8.2: Each signal fetch timing

Input signals	MANU mode		AUTO mode	
	Motor stopped	Motor running	Motor stopped	Motor running
SVRDY	Before drive.	Continuously monitored	Before drive.	Continuously monitored
SVEND	After drive	—	After drive	—
PGO	—	After near-point DOG actuation.	—	After near-point DOG actuation.
DOG	Before zero return drive.	During zero return operation.	Before zero return drive.	During zero return operation.
START	—	—	During READY status.	—
STOP	Continuously monitored.			
MANU	Continuously monitored.			
ZRN	Continuously monitored	—	During standby after END step.	—
FWD, RVS (JOG+, JOG-)	Continuously monitored		During standby after END step.	
LSF, LSR	Before drive.	Continuously monitored	Before drive.	Continuously monitored
X00 to X07	When the manual pulse generator is operating.		When the manual pulse generator is operating, During standby after END step.	During execution of INT, SINT, DINT instructions.
General purpose inputs X00 or more	—		When the corresponding instruction is executed.	
Inputs specified by parameters.	—		Continuously monitored.	

Special auxiliary relays for the instruction input is always observed in the AUTO mode.
(Refer to Section 6.2)

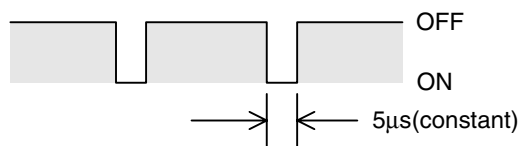
8.1.8 Pulse output waveform

The following types of pulse waveforms are output to a drive unit.

You do not have to set the pulse output waveform using parameters. The pulse output waveform automatically changes in accordance with the practical frequency.

1) In the case of interpolation drive instructions (FX_{2N}-20GM)

When a simultaneous 2-axis drive instruction (cod01/02/03/31) is given, the following waveform is acquired at the operation frequency of 1 Hz to 100 kHz.



2) In the case of other drive instructions

- When the operation frequency in the FX_{2N}-10GM is 200 kHz to 1 Hz, the ON/OFF ratio is 50%/50%.
- When the operation frequency in the FX_{2N}-20GM is 200 kHz to 101 kHz, the ON period is fixed to 2.5 μs. Accordingly, the ON period becomes equivalent to the OFF period at 200 kHz.
- When the operation frequency in the FX_{2N}-20GM is 100 kHz to 1 Hz, the ON/OFF ratio is 50%/50%.

8.2 Diversified Operations

In order to safely use the positioning unit, you should know available control.
This paragraph describes operations realized by the positioning unit.

8.2.1 Zero return

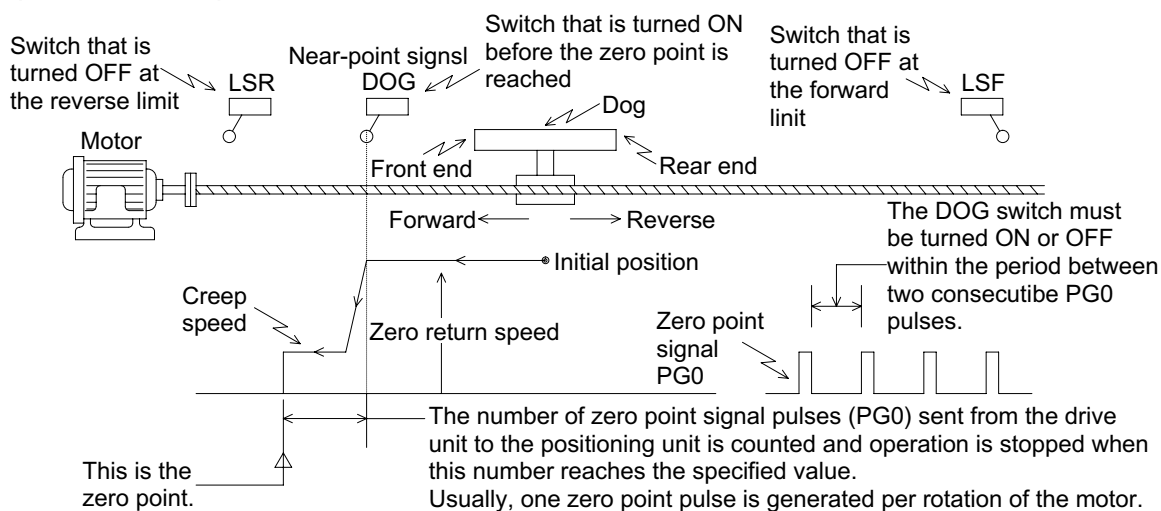
The positioning unit incorporates a present value register in order to record the absolute position. This is incremented and decremented in accordance with the forward rotation and reverse rotation pulses that it itself generates. This means that the machine position is always known. The present position of the machine must be taught by writing it to this register when operation is started for the first time.

Because the present value register is cleared when the power is turned OFF, the machine zero return operation must always be executed after turning the power ON.

* Note that this does not apply if an MR-H, MR-J2, MR-J2-Super or MR-J3 servo motor is used because such a motor has a function for counting pulses after the power is turned OFF and a function for retaining the present value, which means that the zero return operation need only be performed once. (Refer to Section 4.3.2.)

The machine zero return operation is performed as follows.

- 1) The machine zero return command is given.
- 2) The machine travels toward the machine zero return direction specified by PARA 15 at the zero return speed specified by PARA 13.
- 3) When the near-point signal (DOG) is turned ON, the machine decelerates to the creep speed specified by PARA 14.
- 4) When the zero point signals are counted to the number specified by PARA 17 (after the near-point signal is turned ON), the machine is stopped and the machine zero return operation is completed.

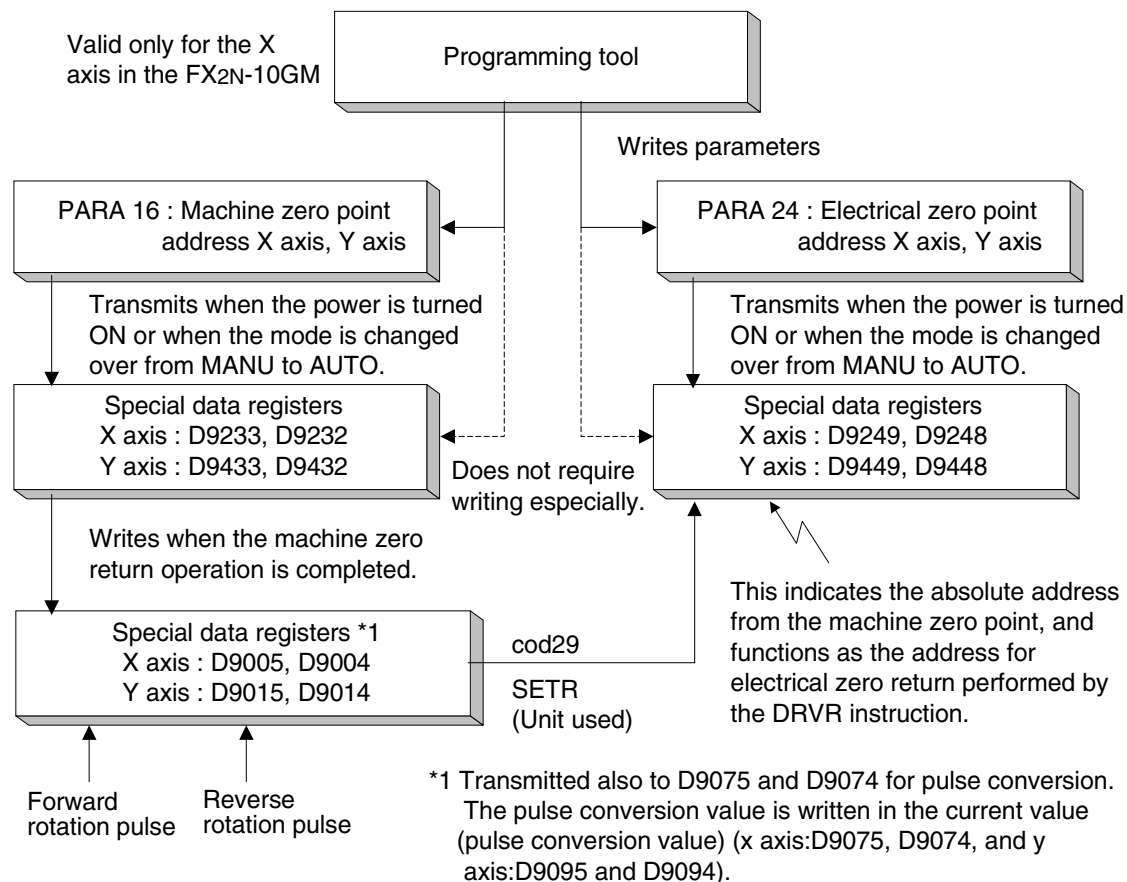


Operation command methods

The following methods are available to perform machine zero return.

- ZRN signal entered from an external unit
(The ZRN signal is entered to each of the X and Y axes in the FX_{2N}-20GM.)
MANU mode :Always valid
AUTO mode :Valid during m02 (END) standby
- During execution of cod28 (DRVZ) (Refer to Section 5.4 for the FX_{2N}-20GM.)
MANU mode: Invalid
AUTO mode: During execution of instruction
- Commands sent from a subtask
Turn ON M9004 (X axis) and M9020 (Y axis) while the subtask is in the AUTO mode.
MANU mode: Invalid
- Commands sent from the programmable controller
Turn ON the buffer memories #20 b4 (X axis) and #21 b4 (Y axis).
MANU mode: Always valid.
AUTO mode: Valid during m02 (END) standby

The figure below shows the relationship between the parameters and the special data registers while the machine zero return operation is performed.



Special auxiliary relay M9057 (x axis) and M9089 (y axis) operate completing the machine zero return.

Again, if the machine zero return command is done, each special auxiliary relay becomes turning off, and becomes on again because of the zero return completion.

The relays M9057 and M9089 remain actuated when the mode is changed over from MANU to AUTO after the machine zero return operation is performed in the MANU mode.

Handling of DOG switch

The following four methods are available for the machine zero return operation depending on the design of the DOG (width from the front end to the rear end) and the DOG switch.

1) Method used to avoid installation of a DOG switch (Operation example 1).

Forward and reverse travel can be executed in manual operation. When the system is stopped, the present position can be set as the machine zero position by using push-button commands.

2) Method used when the DOG width must be as small as possible (Operation example 2).

In order to make it easier to adjust the point at which the DOG switch operates, the zero return speed must be set as slow as possible.

If the zero return command is given at a position after the DOG has passed the DOG switch, the machine first travels until the reverse limit switch is actuated, then travels forward until the machine has passed the DOG switch, then travels in the reverse direction again to return to the zero point.

This is called the DOG search function.

3) Method used when it is possible to set the DOG width greater than the motor deceleration to creep distance (Operation example 3).

Deceleration is started when the front end of the DOG reaches the DOG switch, and the zero point signal count is started when the rear end of the DOG reaches the DOG switch.

Since the zero point signal count starts after the creep speed has been attained, this method makes adjustment of the DOG switch actuation point easier. The DOG search function is executed in the same way as described in 2).

4) Method used when the DOG switch is a long way from the reverse limit switch and the DOG search operation would take too long (Operation example 4).

If the DOG width is increased so that the DOG switch remains ON after completion of the zero return operation, another zero return operation can be performed using this as a basis.

Operation example 1

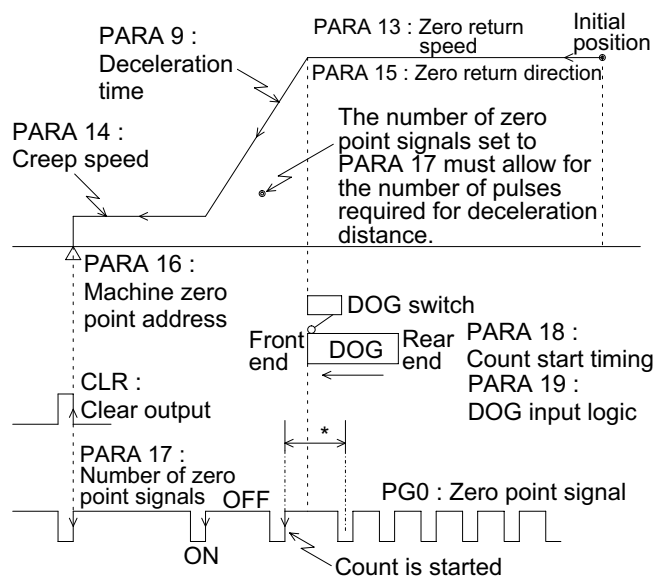
When installation of a DOG switch must be avoided.

- Set PARA 18 to "2 (mode without DOG)", and return the machine to the zero point manually.
- Move the machine to the specified position using the FWD and RVS buttons. When the machine is stopped, press the ZRN button.
- Then, the CRL signal is issued and the deviation counter of the servo amplifier is cleared.
- The zero point address set to PARA 16 is written in the present value register.
- This operation need only be performed once when the absolute drive method is selected using the MR-H/MR-J2/MR-J2-Super/MR-J3 servo motor.

Operation example 2

When the DOG width must be as small as possible.

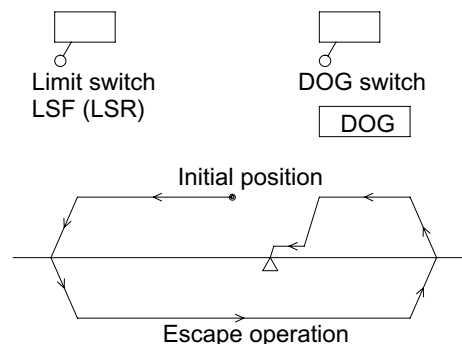
- If the ZRN input is turned ON in the MANU mode or the DRVZ instruction is executed in the AUTO mode, a machine zero return operation will be executed.
- The zero return speed, the zero return direction, the deceleration time, the creep speed, etc. are set by parameters.
- Deceleration is started when the front end of the DOG reaches the DOG switch, and the zero signal count is started when either the front end or the rear end of the DOG reaches the DOG switch. (The setting of PARA 18 determines the start timing.)
- When the PG0 count value reaches the specified value (set to PARA 17), travel is stopped, the clear signal (CLR) is issued, and the zero point address (set to PARA 16) is written to the present value register.



- * Adjust to ensure that the DOG switch actuation point is within the period between two consecutive PG0 pulses. In order to make adjustment easier, the zero return speed must be made as low as possible.

Dog search function

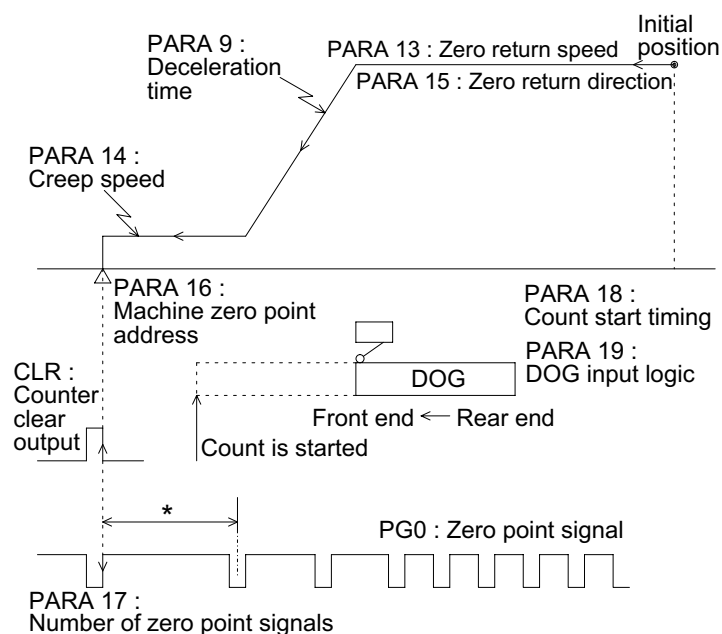
- If a zero return operation is executed when the DOG has already passed the DOG switch and is stopped, the machine first travels until the limit switch is actuated and then reverses the direction and executes the zero return operation again.
- The limit switches and the DOG switch used can be either the normally open type or the normally closed type (The type can be set by parameters.).
- If the limit switches LSR and LSF are not connected to the positioning unit, the escape operation must be performed manually.



Operation example 3

When it is possible to set the DOG width greater than the motor deceleration to creep distance

- If the ZRN input is turned ON in the MANU mode or when the DRVZ instruction is executed in the AUTO mode, a machine zero return operation will be executed.
- The zero return speed, the zero return direction, the deceleration time, the creep speed, etc. are set by parameters.
- Set the parameters so that deceleration starts when the front end of the DOG reaches the DOG switch and the zero signal count is started when the rear end of the DOG reaches the DOG switch.
- When the PG0 count value reaches the specified value (set to PARA 17), travel is stopped, the clear output (CLR) is issued, and the zero point address (set to PARA 16) is written to the present value register.



- * Adjust to ensure that the DOG switch actuation point is within the period between two consecutive PG0 pulses. The DOG width must be wider than the machine deceleration distance.

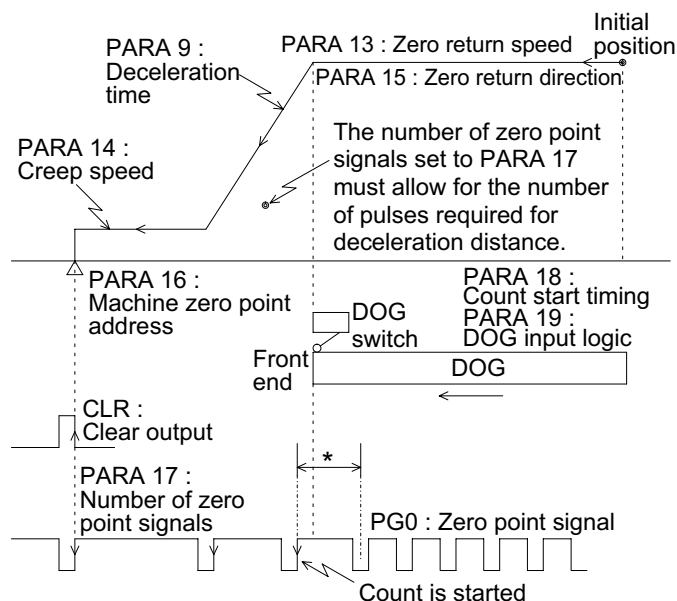
Dog search function

The DOG search is performed in the same way as described on the previous page, using a limit switch.

Operation example 4

When the DOG switch is a long way from the reverse limit switch and the DOG search operation would take too long

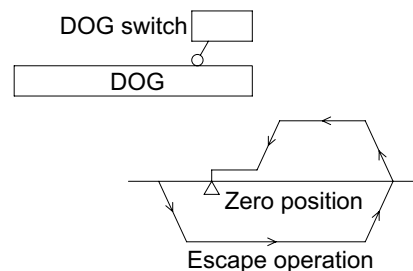
- If the ZRN input is turned ON in the MANU mode or the DRVZ instruction is executed in the AUTO mode, a machine zero return operation will be executed.
- The zero return speed, the zero return direction, the deceleration time, the creep speed, etc. are set by parameters.
- Set the parameters so that deceleration and the zero signal count are started when the front end of the DOG reaches the DOG switch.
- When the PG0 count value reaches the specified value, travel is stopped, the clear output (CLR) is issued, and the zero point address (set to PARA 16) is written to the present value register.



* Adjust to ensure that the DOG switch actuation point is within the period between two consecutive PG0 pulses. In order to make adjustment easier, the zero return speed must be made as low as possible.

DOG search function

- If the DOG is in contact with the DOG switch even after completion of a zero return operation, the system will automatically escape from this situation before performing the zero return operation.
- Automatic escape is also possible when the limit switches are connected to the servo amplifier and not to the positioning unit.



8.2.2 JOG operation

This paragraph describes manual forward/backward operation.

JOG operation is available as soon as the wiring is finished. It is recommended to perform JOG operation at first in the MANU mode to check the wiring.

Outline of operation

One forward or reverse pulse corresponding to the smallest command unit is generated when the FWD (manual forward) or RVS (manual reverse) input signal is turned ON. If the key is held down for longer than 0.1 s, pulses are generated continuously.

Direction of rotation FWD (manual forward) : Direction increases with current value

 RVS (manual reverse) : Direction decreases with current value

The direction of the rotation is decided by setting PARA12.

Operation methods

The following methods are available to perform manual forward/reverse operation.

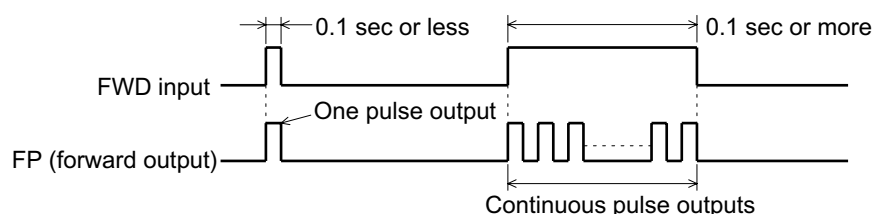
- FWD/RVS signal entered from an external unit.
(The FWD/RVS input signal is entered to each of the X and Y axes in the FX_{2N}-20GM.)
MANU mode: Always valid
AUTO mode: Valid during m02 (END) standby
- Commands sent from a subtask (while the subtask is in the AUTO mode). (*Valid only for the X axis in the FX_{2N}-10GM.)
Turn ON M9005 (X axis, FWD) and M9021 (Y axis, FWD) or M9006 (X axis, RVS) and M9022 (Y axis, RVS).
MANU mode: Always valid
AUTO mode: Valid during m02 (END) standby.
- Commands sent from the programmable controller. (*Valid only for the X axis in the FX_{2N}-10GM.)
Turn ON #20 b5 (X axis, FWD) and #21 b5 (Y axis FWD) or #20 b6 (X axis, FWD) and #21 b6 (Y axis, FWD).
MANU mode : Always valid
AUTO mode : Valid during m02 (END) standby

Operation example

Both the external inputs and the commands sent from the programming tool become valid by OR processing in the positioning unit.

- The positioning unit performs the following operations in response to the command inputs.
The RVS input also generates the RP (reverse input).

PARA. 11: 0 , PARA. 12: 0



- The pulse output speed can be set by PARA 5 (jog speed).
- The generated pulses are added to or subtracted from the present value register, and saved in D9005 and D9004 for the X axis and D9015 and D9014 for the Y axis.
- In the jog operation, the positioning completion signals (M9049: X axis, M9081: Y axis) are not turned ON after the pulse outputs are finished. Check the READY/BUSY signal (M9048: X axis, M9080: Y axis) to confirm completion of the operation. (When the unit is in the ready status, M9048 and M9080 are ON.)

8.2.3 Teaching

What is the teaching function

By using this function, you can set the current value of the point changed by manual operation (JOG+ and JOG-) from the teaching panel E-20TP-E as the target value (address value) in the program.

The teaching function is valid while the positioning unit is in the MANU mode or while the special auxiliary relay M9161 is ON in the AUTO mode.

(For the teaching operation, refer to p.5-14 in the E-20TP-E Operation Manual.)

- Special auxiliary relay M9161
In order to perform teaching in the AUTO mode, the special auxiliary relay M9161 should be ON.
While M9161 is ON, you can perform teaching from the E-20TP-E while the positioning unit is in the AUTO mode.
You can turn on M9161 using the forced ON/OFF function of the teaching panel or using a program as shown below.

Program example

Ox 10, N0 : Specifies the X axis, the Y axis (O, Ox, Oy) or subtask program (O100).

SET M9161;: Enables teaching in the AUTO mode.

Once M9161 turns on by the SET instruction, teaching is enabled in the AUTO mode until the power is turned off

Object instruction and object element of teaching

✓:Object instruction

×: Off the subject instruction

Object instruction		object element	FX2N-10GM	FX2N-20GM
cod00	Positioning at high speed	X axis,Y axis	✓	✓
cod01	Linear interpolation positioning	X axis,Y axis	✓	✓
cod02	Circular interpolation positioning (clockwise)	X axis,Y axis	×	✓
cod03	Circular interpolation positioning (counterclockwise)	X axis,Y axis	×	✓
cod31	Interrupt stop (Remaining distance is ignored.)	X axis,Y axis	✓	✓
cod71	Interrupt stop at 1-step speed	X axis,Y axis	✓	✓
cod72	Interrupt stop at 2-step speed	X axis,Y axis	✓	✓
cod73	Movement quantity correction	X axis,Y axis	✓	✓
cod92	Current value setting	X axis,Y axis	✓	✓

- E-20TP-E does not accept the teaching operation to the instruction and the element of off the subject.
- Teaching can be operated only at time when the address is -999999 to +999999 of the object elements when current.
- E-20TP-E does not accept a set operation, except when the address is current -999999 to +999999.

8.2.4 Single step operation

This section explains single-step operation.

Outline of operation

Every time the start input is entered while the single-step command is turned ON, the positioning program is executed by one line.

Operation methods

PARAMETER 53 must be set to "1 (single-step operation valid)" to perform the single-step operation. The following methods are available to perform the single-step operation.

- Turn ON the input set by PARAMETER 54 (single-step mode input No.).
MANU mode :Invalid AUTO mode:Always valid
- Commands sent from a subtask (while the subtask is in the AUTO mode). (Valid only for the X axis in the FX_{2N}-10GM.)
Turn ON M9000 (X axis) and M9016 (Y axis).
- Commands sent from the programmable controller
Turn ON #20 b0 (X axis), #21 b0 (Y axis) and #27 b0 (subtask).
MANU mode :Invalid AUTO mode:Always valid

Operation example

The following operations are performed in response to the commands entered.

Program example

```
Ox00
N0000 cod28 (DRVZ);
      }
N0100 cod01 (DRV) x1000 m10;
      }
N0200 m02 (END);
```

- While the single-step command input is ON, the program is executed one line every time the start command is turned ON. The next start command input is not accepted until positioning is completed.
- In the line N0000, the next command input is not accepted until machine zero return is completed.
- The program including m codes does not accept the next command input until positioning is completed and the m code OFF signal sent from the programmable controller is turned ON.

8.2.5 Automatic operation

This section explains the automatic operation.

Outline of operation

The positioning programs (and subtask program) are executed in automatic mode.

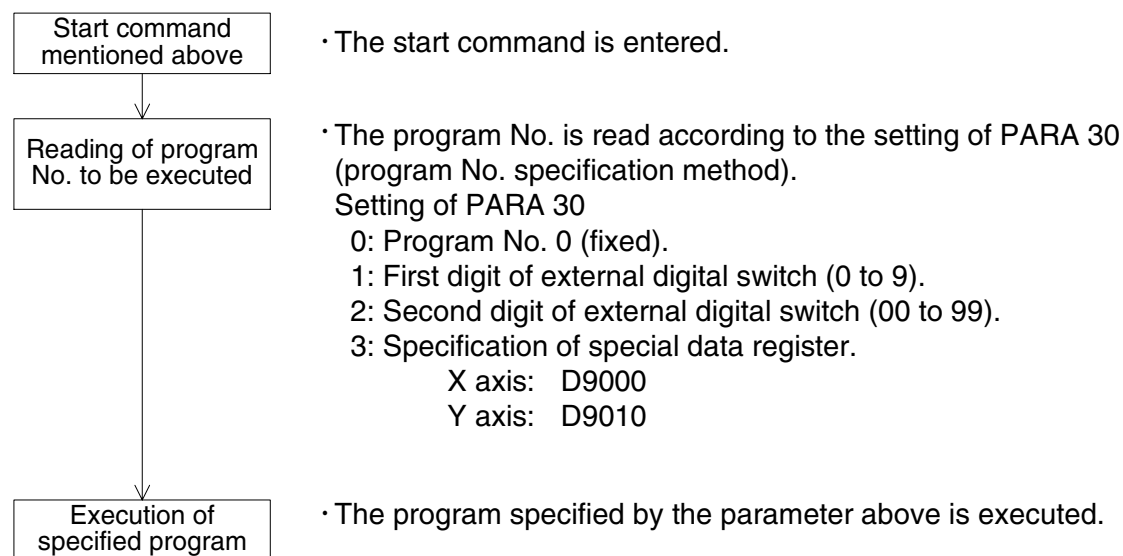
Operation instruction input

The following operation commands are offered to execute the positioning programs. (Each of these commands can be accepted in the AUTO mode.)

- START ON command entered from an external unit.
 - Commands sent from a subtask (while the subtask is in the AUTO mode).
Turn ON M9001 (X axis) and M9017 (Y axis).
 - Commands sent from the programmable controller.
Turn ON #20 b1 (X axis) and #21 b1 (Y axis).
- * The subtask start timing is determined by the setting of PARA 104 (subtask start).

Operation example

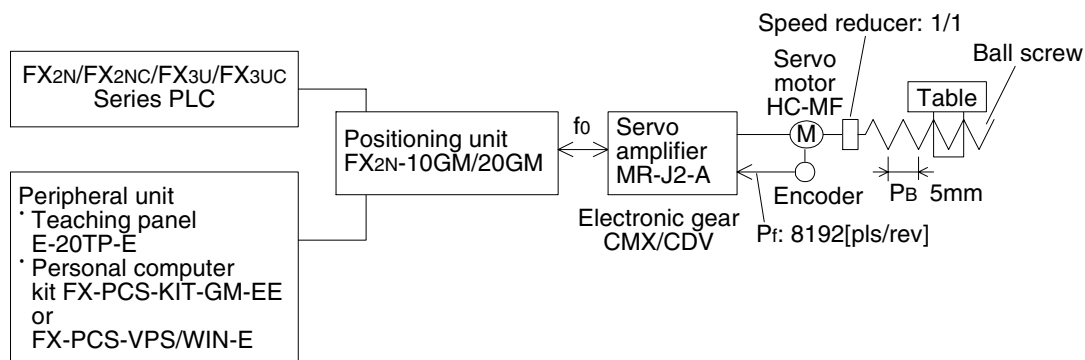
The following operations are performed in response to the command inputs.



9. Program Examples

This section introduces setting of parameters and program examples using a model system.

9.1 Configuration of Model System



- f_o : Command pulse frequency [Hz]
- CMX: Electronic gear (numerator of command pulse magnification)
Servo amplifier parameter No. 3
- CDV: Electronic gear (denominator of command pulse magnification)
Servo amplifier parameter No. 4
- P_r : Number of feedback pulses (positioning feedback pulse) [pls/rev]
- P_B : Ball screw pitch

9.2 Setting of Parameters

Set parameters in the following order.

- 1) Obtain the command pulse frequency from the maximum operation speed, and change the electronic gear on the servo amplifier if required.
- 2) Determine the system of units (PARA. 0).
- 3) Determine the pulse rate (PARA. 1) and the feed rate (PARA. 2).
However, when you select the motor system of units in PARA. 0, you do not have to set the pulse rate and the feed rate.
- 4) Determine other parameters.

9.2.1 Command pulse frequency and maximum operation speed

Obtain the command pulse frequency required to rotate the servo motor HC-MF at the rated rotation speed (3,000 r/min).

Because the command pulse frequency (f_0) becomes equivalent to the feedback pulse frequency at a certain rotation speed due to the characteristics of the servo motor, the following equation is obtained.

$$f_0 \times \frac{CMX}{CDV} = P_f \times \frac{N_0}{60} \dots\dots\dots ①$$

N_0 : Rotation speed of servo motor [r/min]

When supposing that the electronic gear ratio is "1:1" (which is the initial value of a parameter in the servo amplifier) and obtaining " f_0 " from the equation ①

$$\begin{aligned} f_0 &= P_f \times \frac{N_0}{60} = 8,192 \text{ [pls/rev]} \times \frac{3000 \text{ [r/min]}}{60} \\ &= 409,600 \text{ [Hz]} \end{aligned}$$

However, because the maximum frequency of the positioning unit is 200 kHz*, you should change the electronic gear.

When obtaining $\frac{CMX}{CDV}$ (electronic gear) from the equation ①

$$\begin{aligned} \frac{CMX}{CDV} &= P_f \times \frac{N_0}{60} \times \frac{1}{f_0} = 8,192 \text{ [pls/rev]} \times \frac{3000 \text{ [r/min]}}{60} \times \frac{1}{200 \times 10^3 \text{ [Hz]}} \\ &= \frac{256}{125} \end{aligned}$$

Accordingly, set the parameters Nos. 3 (CMX) and 4 (CDV) in the servo amplifier to "CMX = 256, CDV = 125".

* In the FX2N-20GM, the maximum frequency is 100 kHz during interpolation operation.

9.2.2 System of units

There are three types of systems of units, the mechanical system, the motor system and the composite system, which offer the following characteristics.

Mechanical system [0]:

When you select this system, you have to set the unit of parameters related to the movement quantity and the speed as well as the unit of the movement quantity and the operation speed in the mechanical quantity (mm/min, cm/min). In addition, you have to set the pulse rate and the feed rate.

Motor system[1]:

When you select this system, you have to set the unit of parameters related to the movement quantity and the speed as well as the unit of the movement quantity and the operation speed in the pulse quantity (pls, Hz). You do not have to set the pulse rate and the feed rate.

Composite system [2]:

When you select this system, you have to set the unit of parameters related to the movement quantity and the unit of the movement quantity in the mechanical quantity (mm), and the unit of parameters related to the speed and the unit of the operation speed in the pulse quantity (Hz). In addition, you have to set the pulse rate and the feed rate.

In program examples shown in this section, the composite system of units [2] is adopted. When using the composite or mechanical system of units, set the pulse rate and the feed rate as described below.

9.2.3 Pulse rate and feed rate

Obtain the pulse rate and the feed rate as follows.

- 1) The pulse rate indicates the pulse quantity required for one rotation of the servo motor, and can be obtained using the equation ②

$$\text{Pulse rate (parameter No. 1) } A = P_f \times \frac{1}{\frac{\text{CMX}}{\text{CDV}}} \dots\dots\dots ②$$

When the values (CMX = 256, CDV = 125) obtained in Paragraph 9.2.1 are substituted in the equation ② and the pulse rate is obtained,

$$\begin{aligned} \text{Pulse rate (parameter No. 1) } A &= 8192 \text{ [pls/rev]} \times \frac{1}{\frac{256}{125}} \\ &= 4000 \text{ [pls/rev]} \end{aligned}$$

- 2) The feed rate indicates the workpiece movement quantity by one rotation of the servo motor shaft. In the system shown in Paragraph 9.1, the feed rate can be obtained using the following equation.

Feed rate (parameter No. 2) B

$$= [\text{Speed reducer ratio}] \times P_B [\text{Ball screw pitch}] \times \frac{1}{\text{Number of rotations}} \dots\dots\dots ③$$

Actually, it can be obtained as follows.

$$\begin{aligned} \text{Feed rate (parameter No. 2) } B &= \frac{1}{1} \times 5 \text{ [mm]} \times \frac{1}{1[\text{rev}]} \\ &= 5 \text{ [mm/rev]} \\ &= 5000 \text{ [}\mu\text{m/rev]} \end{aligned}$$

Conversion from the movement quantity into the pulse quantity

1) Movement quantity

Pulse quantity

$$= \frac{\text{Mechanical quantity}}{\text{Movement quantity per rotation of motor (feed rate)}} \times \frac{\text{Pulse quantity required for one rotation of motor (pulse rate)}}{1}$$

In the system configuration shown in Paragraph 9.1, the mechanical quantity "200 mm" can be converted into the pulse quantity as follows.

$$\begin{aligned} \text{Pulse quantity [pls]} &= \frac{200[\text{mm}]}{5000[\mu\text{m/rev}]} \times 4000 [\text{pls/rev}] \\ &= 160000 [\text{pls}] \end{aligned}$$

2) Speed

$$\text{Pulse quantity} = \frac{\text{Mechanical quantity} \times 10^4 \times 1/60}{\text{Movement quantity per rotation of motor (feed rate)}} \times \frac{\text{Pulse quantity required for one rotation of motor (pulse rate)}}{1}$$

In the system configuration shown in Paragraph 9.1, the mechanical quantity "30 cm/min" can be converted into the pulse quantity as follows.

$$\begin{aligned} \text{Pulse quantity [Hz]} &= \frac{30[\text{cm/min}] \times 10^4 \times 1/60}{5000[\mu\text{m/rev}]} \times 4000 [\text{pls/rev}] \\ &= \frac{300 \times 1/60}{5} \times 4000 \\ &= 4000 [\text{Hz}] \end{aligned}$$

Caution

- When adopting the mechanical system of units, make sure that the set value of the parameter No. 4 (maximum speed converted into pulse quantity) does not exceed "200 kHz". If it exceeds "200 kHz", the operation speed corresponding to "200 kHz" is automatically set.
- If the operation speed is set to "100 kHz" or more in the FX_{2N}-20GM, the operation speed during interpolation operation is automatically set to the value corresponding to 100 kHz.

9.2.4 Setting of parameters

Table 9.1: Positioning parameters

PARA. No.	Description	Set value	Remarks
No.0	System of units	2	Refer to Paragraph 4.3.1. [Composite system of units]
No.1	Pulse rate	4,000	Refer to Paragraph 4.3.1 ①. [pls/rev]
No.2	Feed rate	5,000	Refer to Paragraph 4.3.1 ②. [pls/rev]
No.3	Minimum command unit	1	The movement quantity and the mechanical zero point address are specified in the unit of "1/10 mm".
No.4	Maximum speed	200,000	Initial value [Hz]
No.5	JOG speed	20,000	Initial value [Hz]
No.6	Bias speed	0	Initial value [Hz]
No.7	Backlash correction	0	Initial value [μ m]
No.8	Acceleration time	200	Initial value [ms]
No.9	Deceleration time	200	Initial value [ms]
No.10	Interpolation time constant	100	Initial value [ms]
No.11	Pulse output type	0	Initial value <Normal rotation pulse + Reverse rotation pulse>
No.12	Rotation direction	0	Initial value <The current value increases by normal rotation pulse.>
No.13	Zero position return speed	100,000	Initial value [Hz]
No.14	Creep speed	1,000	Initial value [Hz]
No.15	Zero position return direction	1	Initial value <Direction in which the current value decreases>
No.16	Mechanical zero point address	*	Set the mechanical zero point address [1/10 mm].
No.17	Zero point signal counting times	1	Initial value [times]
No.18	Zero point signal count start point	1	Initial value <Backward end of near point DOG>
No.19	DOG input logic	0	Initial value <Normally open contact>
No.20	LS logic	0	Initial value <Normally open contact>
No.21	Error judgement time	5,000	After pulse output, the servo end check is performed. If the SVEND (servo end) signal does not turn ON within 5,000 ms, it is regarded as an error. When the SVEND signal turns ON, an instruction in the next step is executed.
No.22	Servo ready check	0	Whether or not the servo is ready is checked.
No.23	Stop mode	1	Initial value <Remaining distance drive is valid.>
No.24	Electrical zero point address	0	Initial value < \times 1/10mm>
No.25	Software limit (large)	0	The software limit is invalid.
No.26	Software limit (small)	0	

* Though the initial value is "0", set this parameter in accordance with each program.
 Set the I/O control parameters and the system parameters to the initial values respectively.
 However, in the FX2N-10GM, set the system parameter No. 100 (memory size) to "1 (4K step)".

9.3 Independent 2-Axis Position Control Operation (Independent Operation)

9.3.1 Constant-quantity feed (FX_{2N}-10GM, FX_{2N}-20GM)

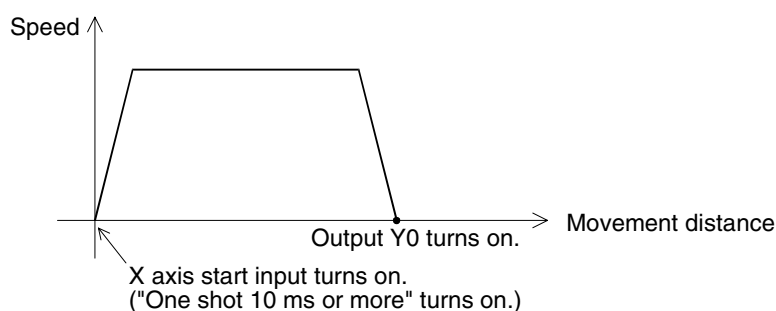
1) Outline of positioning

The machine moves only by the preset movement quantity.

2) Operating procedure

- ①The machine moves by the preset quantity when receiving the start command from the outside.
- ②When movement is completed, the output Y0 turns on.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	RST Y0;	Turns off the output Y0.
N1	cod91(INC);	Specifies the incremental address.
N2	cod92(SET) x0;	Sets the current value to "0".
N3	cod00(DRV) x900;	Moves the machine to the target address "x900".
N4	SET Y0;	Turns on the output Y0.

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

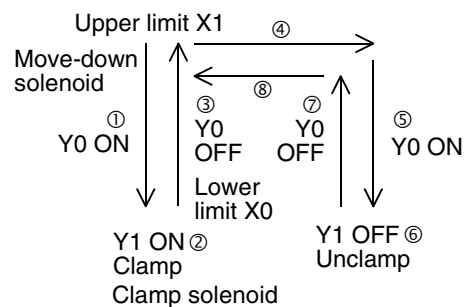
9.3.2 Positioning by constant quantity of reciprocating motion (FX₂N-10GM, FX₂N-20GM)

1) Outline of positioning

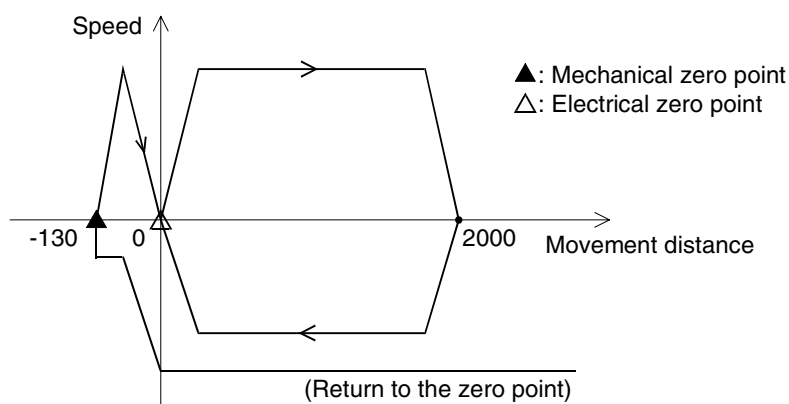
The machine moves a workpiece from the left table to the right table.
A single solenoid is used to move up and down the workpiece.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The move-down solenoid Y0 turns on. When the lower limit X0 turns on, the clamp solenoid Y1 turns on and the machine clamps a workpiece.
- ③ After the clamp wait period of time (1.5 seconds), the move-down solenoid Y0 turns off and the machine moves up.
- ④ When the upper limit X1 turns on, the machine moves to the right table.
- ⑤ When the machine reaches the right table, the move-down solenoid Y0 turns on. When the lower limit X0 turns on, the clamp solenoid Y1 turns off and the machine unclamps (= releases) the workpiece.
- ⑥ After the unclamp wait period of time (1.5 seconds), the move-down solenoid Y0 turns off and the machine moves up.
- ⑦ When the upper limit X1 turns on, the machine returns to the left table.



3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	LD M9057;	
N1	FNC00(CJ) P0;	Jumps to P0 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = -130).
N3	cod00(DRV) x0;	Moves the machine to the address "0".
N4	cod29(SETR);	Sets the electrical zero point.
N5	→ P0;	
N6	SET Y0;	Turns on the move-down solenoid.
N7	→ P1;	Confirms that the machine has moved down. (Repeated until X0 turns on.)
N8	LD X0;	
N9	FNC01(CJN) P1;	
N10	SET Y1;	Makes the machine clamp a workpiece.
N11	cod04(TIM) K150;	Sets the clamp wait time to "1.5 sec".
N12	RST Y0;	Turns off the move-down solenoid, and moves up the machine.
N13	→ P2;	Confirms that the machine has moved up. (Repeated until X1 turns on.)
N14	LD X1;	
N15	FNC01(CJN) P2;	
N16	cod00(DRV) x2000;	Moves the machine to the address "2000".
N17	SET Y0;	Turns on the move-down solenoid.
N18	→ P3;	Confirms that the machine has moved down. (May be made into a subroutine because these lines are equivalent to the lines N7 to N9 above.)
N19	LD X0;	
N20	FNC01(CJN) P3;	
N21	RST Y1;	Makes the machine unclamp the workpiece.
N22	cod04(TIM) K150;	Sets the unclamp wait time to "1.5 sec".
N23	RST Y0;	Turns off the move-down solenoid, and moves up the machine.
N24	→ P4;	Confirms that the machine has moved up. (May be made into a subroutine because these lines are equivalent to the lines N13 to N15 above.)
N25	LD X1;	
N26	FNC01(CJN) P4;	
N27	cod30(DRVR);	Returns the machine to the electrical zero point.
N28	m02 (END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "-130". For other parameters, refer to Paragraph 9.2.4.

9.3.3 Repetitious operation (FX2N-10GM, FX2N-20GM)

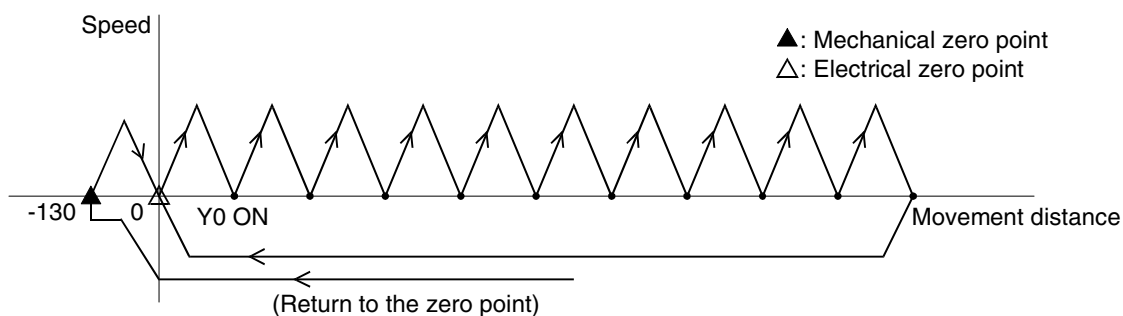
1) Outline of positioning

The machine performs positioning operation by repeating constant-quantity positioning several times.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The machine repeats constant-quantity feed 10 times, then returns to the electrical zero point.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	FNC02(CALL) P127;	Calls a subroutine for return to the zero point.
N1	cod91(INC);	Specifies the incremental address.
N2	FNC08(RPT) K10;	Sets the number of times of repetition to "10".
N3	cod00(DRV) x100;	Moves the machine to the target position "100".
N4	SET Y0;	Turns on Y0.
N5	cod04(TIM) K150;	Sets the wait time to "1.5 sec".
N6	RST Y0;	Turns off Y0.
N7	cod04(TIM) K150;	Sets the OFF wait time to "1.5 sec".
N8	FNC09(RPE);	Finishes repetitious motion.
N9	cod30(DRV) R;	Returns the machine to the electrical zero point.
N10	m02(END);	
N11	P127;	Subroutine for return to the zero point.
N12	LD M9057;	
N13	FNC 00(CJ) P126;	Jumps to P126 if the zero point return completion flag M9057 is ON.
N14	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = -130).
N15	cod00(DRV) x0;	Moves the machine to the address "0". (Adopts the absolute drive methods because the drive method is not specified.)
N16	cod29(SETR);	Sets the electrical zero point.
N17	P126;	
N18	FNC03(RET);	Subroutine return (Specifies the end of the subroutine.)

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "-130". For other parameters, refer to Paragraph 9.2.4.

9.3.4 Positioning operation in which movement quantity is variable (FX_{2N}-10GM, FX_{2N}-20GM)

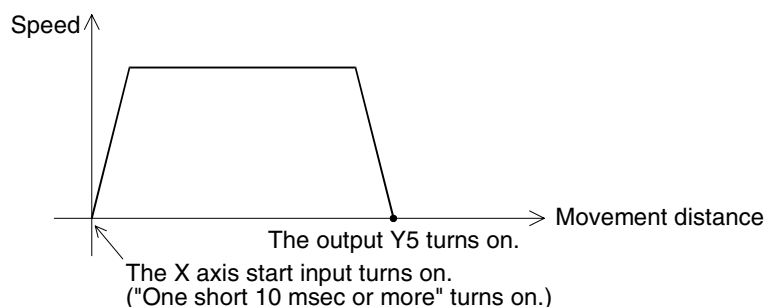
1) Outline of positioning

A digital switch is connected to the positioning unit, and the machine moves by the movement quantity set by the digital switch.

2) Operating procedure

- ① The feed quantity (incremental value) is set from the digital switch. (For a connection example, refer to the attached connection diagram.)
- ② By the start command from the outside, the machine moves by the quantity set in ①.
- ③ When movement is completed, the output Y5 turns on.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	RST Y5;	Turns off the output Y5.
N1	cod91(INC);	Specifies the incremental address.
N2	cod92(SET) x0 ;	Sets the current value to "0".
N3	cod00(DRV) XD0;	Moves the machine by the quantity set to D0.
N4	SET Y5;	Turns on the output Y5.
N5	m02(END);	
O100,N0	P0;	
N1	FNC72(EXT) X0 Y0 D0 K5; (Head No. for digital switch connection input: X0 (X0 to X3 will be used.)) (Head No. for digital switch connection output: Y0) (Data storage destination: D0) (Number of digits: 5 (Y0 to Y4 will be used.))	
N2	FNC04(JMP) P0;	
N3	m102(END);	

In order to read the digital switch, the digit changeover time (initial value = 20 msec) should be set by PARA. 33.

When a digital switch is connected to the FX_{2N}-10GM / 20GM main body, this changeover time is fixed to "7 ms". As a result, the operation time is reduced.

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

9.3.5 Interrupt stop (FX₂N-10GM, FX₂N-20GM)

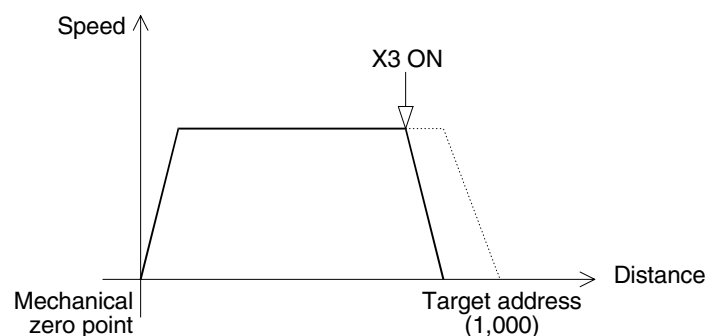
1) Outline of positioning

When the interrupt input X3 (X6 in the FX₂N-20GM) turns on, the machine decelerates and stops, then proceeds to the next step while ignoring the remaining distance.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time. After that, the machine moves to the target position.
- ② When the interrupt input X3 turns on during operation, the machine decelerates and stops, then proceeds to the next step while ignoring the remaining distance.
- ③ After the output Y0 turns on and off, the machine returns to the address "0".

3) Operation chart



4) Program (FX₂N-10GM)

Line No.	Instruction	Description
Ox0, N0 *	LD M9057;	
N1	FNC00(CJ) P126;	Jumps to P126 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = 0).
N3	→ P126;	
N4	cod31(INT) x1000 f1200;	Sets the target address to "1000".
N5	SET Y0;	Turns on Y0.
N6	cod04(TIM) K150;	Sets the operation wait time to "1.5 sec".
N7	RST Y0;	Turns off Y0.
N8	cod04(TIM) K150;	Sets the OFF wait time to "1.5 sec".
N9	cod00(DRV) x0 f1200;	Returns the machine to the zero point.
N10	m02(END);	

* In the FX₂N-20GM, change this portion to "O0, N0".

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

Caution

If this program is executed in the FX₂N-20GM, the Y axis (which is not controlled in this program) cannot be controlled because instructions for simultaneous 2-axis operation are actually used.

9.3.6 Interrupt stop at 1-step speed (FX_{2N}-10GM, FX_{2N}-20GM)

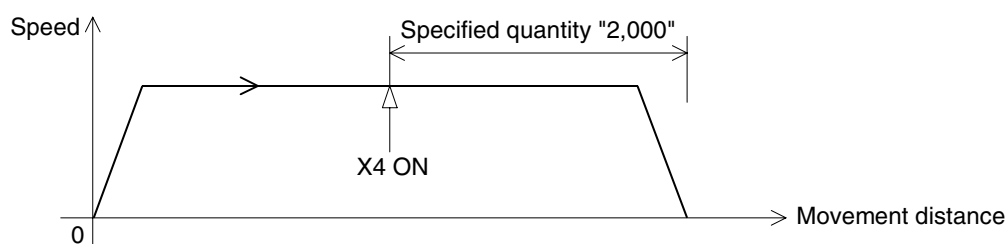
1) Outline of positioning

When an interrupt signal is input from the outside while the machine is operating in the speed mode, the positioning mode is selected, and the machine stops after moving for the specified distance.

2) Operating procedure

① The machine starts to move by the start command. When the interrupt signal X4 (X2 in the FX_{2N}-10GM) <for the X axis> is turned on from the outside, the machine moves by the specified incremental quantity from that point, then stops.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	cod92(SET) x0;	Sets the current value to "0".
N1	cod71(SINT) x2000 f1200;	Moves the machine at the speed "1,200" until X4 turns on. When X4 turns on, the machine moves by the incremental quantity "2,000" at the same speed, then stops.
N2	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

9.3.7 Interrupt stop at 2-step speed (FX_{2N}-10GM, FX_{2N}-20GM)

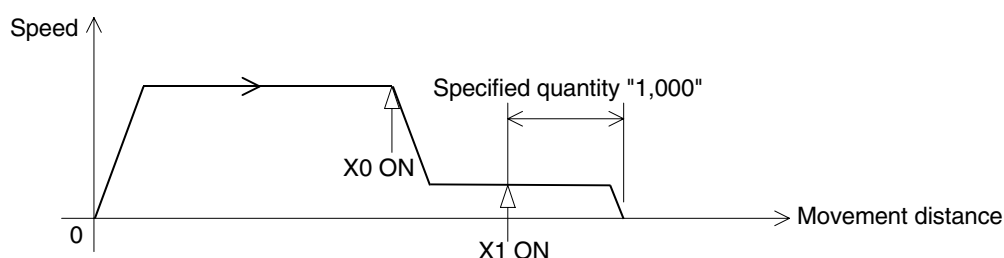
1) Outline of positioning

When an interrupt signal for the first step is input from the outside while the machine is operating in the speed mode, the operation speed decreases. When an interrupt signal for the second step is input, the positioning mode is selected, and the machine stops after moving for the specified distance.

2) Operating procedure

- ① The machine starts to move by the start command. When the interrupt signal X0 (for the X axis) for the first step is turned ON from the outside, the operation speed decreases. When the interrupt signal X1 (for the X axis) for the second step is turned ON, the machine moves by the specified incremental quantity from that point, then stops.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	cod92(SET) x0;	Sets the current value to "0".
N1	cod72(DINT) x1000 f1200 f200;	Moves the machine at the speed "1200" until X0 turns on. When X0 turns on, the machine reduces the speed from "1,200" to "200", moves by the incremental quantity "1,000" at the speed "200", then stops.
N2	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

9.3.8 Operation at multi-step speed (independent operation)

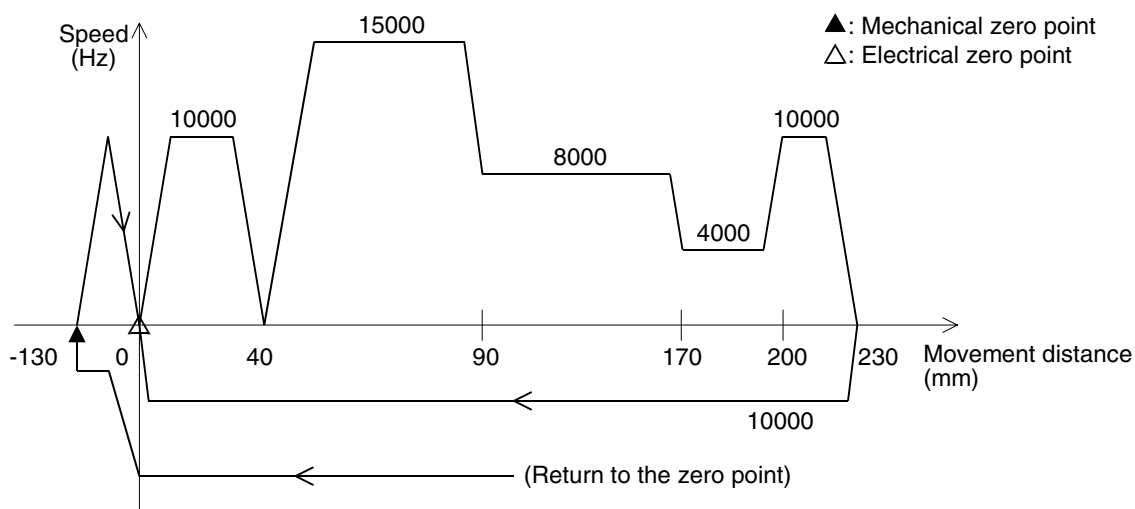
1) Outline of positioning

While positioning a workpiece, the machine changes the operation speed.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The machine stops in the address "40 mm", stops in the address "230 mm", then moves to the address "0 mm".
- ③ While moving from the address "40 mm" to "230 mm", the machine changes the speed in accordance with the specification in the positions "90 mm", "170 mm" and "200 mm".

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0 *	FNC02(CALL) P127;	Calls the subroutine for return to the zero point.
N1	cod00(DRV) x400 f10000;	
N2	cod01(LIN) x900 f15000;	Specifies continuous passes, and adopts operation at multi-step speed.
N3	cod01(LIN) x1700 f8000;	
N4	cod01(LIN) x2000 f4000;	
N5	cod01(LIN) x2300 f10000;	
N6	cod09(CHK);	
N7	cod00(DRV) x0 f10000;	Confirms completion of positioning by the servo end check, then proceeds to the next operation.
N8	m02(END);	
N9	P127;	Subroutine for return to the zero point.
N10	LD M9057;	
N11	FNC00(CJ) P126;	Jumps to P126 if the zero point return completion flag M9057 is ON.
N12	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = -130).
N13	cod00(DRV) x0;	Moves the machine to the address "0".
N14	cod29(SETR);	Sets the electrical zero point.
N15	P126;	Subroutine return (Specifies the end of the subroutine.)
N16	FNC03(RET);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "-130". For other parameters, refer to Paragraph 9.2.4.

- * When performing operation at multi-step speed in the FX_{2N}-20GM, set "O0, N0" then use the program above as it is.

In actual operation, however, the machine performs continuous pass operation, the speed change points are different from those shown above, and the composite speed is adopted.

9.4 Simultaneous 2-Axis Position Control Operation (FX2N-10GM)

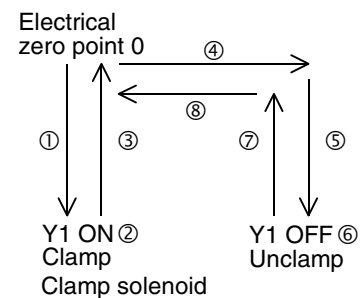
9.4.1 Positioning by constant quantity of reciprocating motion (FX2N-20GM)

1) Outline of positioning

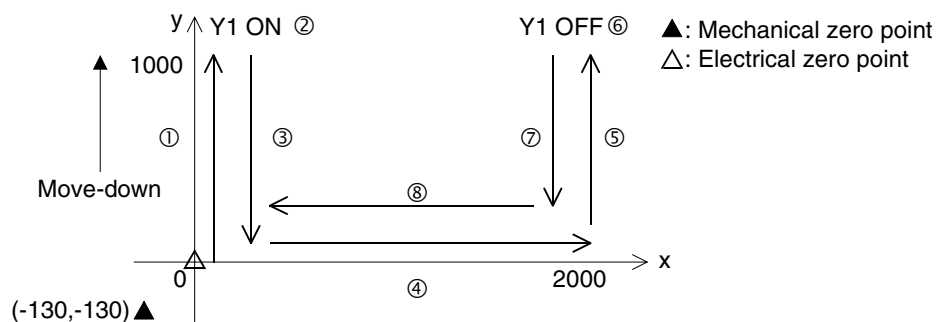
The machine moves a workpiece from the left table to the right table. Suppose that the left-and-right direction is the X axis, and the up-and-down direction is the Y axis.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The machine moves down. When the clamp solenoid Y1 turns on, the machine clamps a workpiece.
- ③ The machine moves up, and moves to the right table.
- ④ The machine moves down. When the clamp solenoid Y1 turns off, the machine releases the workpiece.
- ⑤ The machine moves up, and returns to the left table.



3) Operation chart



4) Program

Line No.	Instruction	Description
O0, N0	LD M9057;	
N1	FNC00(CJ) P0;	Jumps to P0 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = -130 (X), -130 (Y)).
N3	cod00(DRV) x0 y0;	Moves the machine to the address "0, 0".
N4	P0;	
N5	cod00(DRV) y1000;	Moves down the machine.
N6	SET Y1;	Makes the machine clamp a workpiece.
N7	cod04(TIM) K150;	Sets the clamp wait time to "1.5 sec".
N8	cod00(DRV) y0;	Moves up the machine.
N9	cod00(DRV) x2000;	Moves the machine to the right.
N10	cod00(DRV) y1000;	Moves down the machine.
N11	RST Y1;	Makes the machine unclamp (= release) the workpiece.
N12	cod04(TIM) K150;	Sets the unclamp wait time to "1.5 sec".
N13	cod00(DRV) y0;	Moves up the machine.
N14	cod00(DRV) x0;	Moves the machine to the left.
N15	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "-130" for both the X and Y axes. For other parameters, refer to Paragraph 9.2.4.

9.4.2 Linear interpolation (FX_{2N}-20GM)

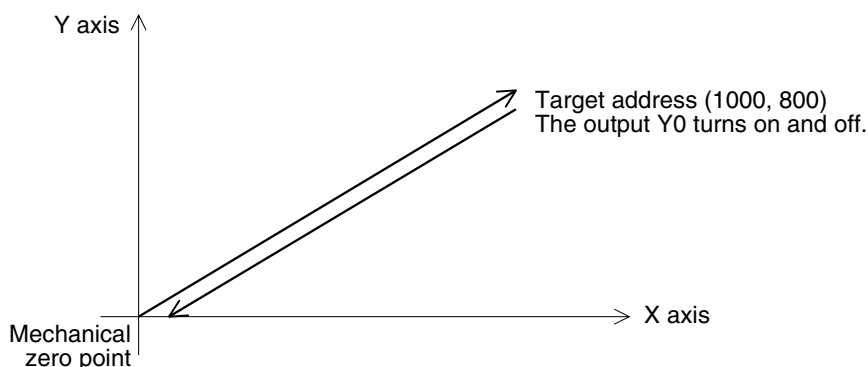
1) Outline of positioning

The machine moves to the target address in a linear route, waits until an auxiliary unit finishes its work, then returns to the zero point.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The machine moves to the target address in a linear route.
- ③ The output Y0 turns on and off.
- ④ The machine returns to the zero point (0, 0).

3) Operation chart



4) Program

Line No.	Instruction	Description
O0, N0	LD M9057;	
N1	FNC00(CJ) P254;	Jumps to P254 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = 0, 0).
N3	P254;	
N4	cod01(LIN) x1000 y800 f1200;	Moves the machine to the target address (1,000, 800) in a linear route.
N5	SET Y0;	Turns on Y0.
N6	cod04(TIM) K150;	Sets the operation wait time to "1.5 sec".
N7	RST Y0;	Turns off Y0.
N8	cod04(TIM) K150;	Sets the OFF wait time to "1.5 sec".
N9	cod01(LIN) x0 y0 f1200;	Moves the machine to the zero point in a linear route.
N10	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0" for both the X and Y axes. For other parameters, refer to Paragraph 9.2.4.

9.4.3 Circular interpolation (true circle) (FX_{2N}-20GM)

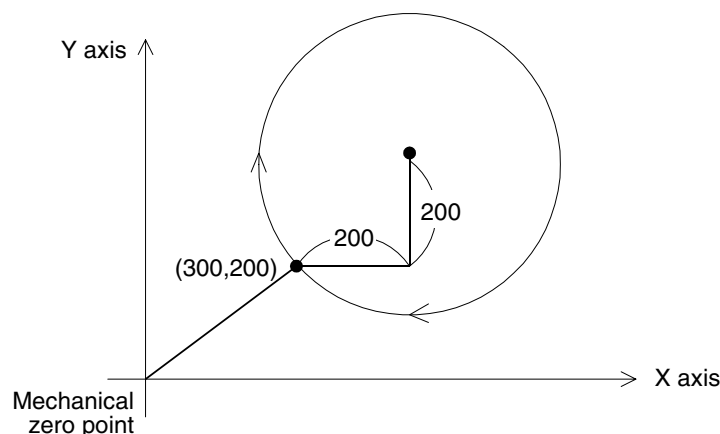
1) Outline of positioning

The machine moves in a true circular route.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The machine moves to the target address in a linear route.
- ③ The output Y0 turns on, and the machine moves in a true circular route.
- ④ The output Y0 turns off, and the machine returns to the zero point address (0, 0).

3) Operation chart



4) Program

Line No.	Instruction	Description
O0, N0	LD M9057;	
N1	FNC00(CJ) P254;	Jumps to P254 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point. (mechanical zero point address = 0, 0)
N3	P254;	
N4	cod01(LIN) x300 y200 f1200;	Moves the machine to the target address (300, 200).
N5	SET Y0;	Turns on Y0.
N6	cod04(TIM) K150;	Sets the operation wait time to "1.5 sec".
N7	cod02(CW) i200 j200 f1200;	Sets a true circular route because the end coordinates (target position) are not specified. The center coordinates (i, j) are always treated as an incremental address. If the radius (r) is specified, a true circular route cannot be realized.
N8	RST Y0;	Turns off Y0.
N9	cod04(TIM) K150;	Sets the OFF wait time to "1.5 sec".
N10	cod01(LIN) x0 y0 f1200;	Moves the machine to the zero point in a linear route.
N11	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0" for both the X and Y axes. For other parameters, refer to Paragraph 9.2.4.

9.4.4 Interrupt stop (FX_{2N}-20GM)

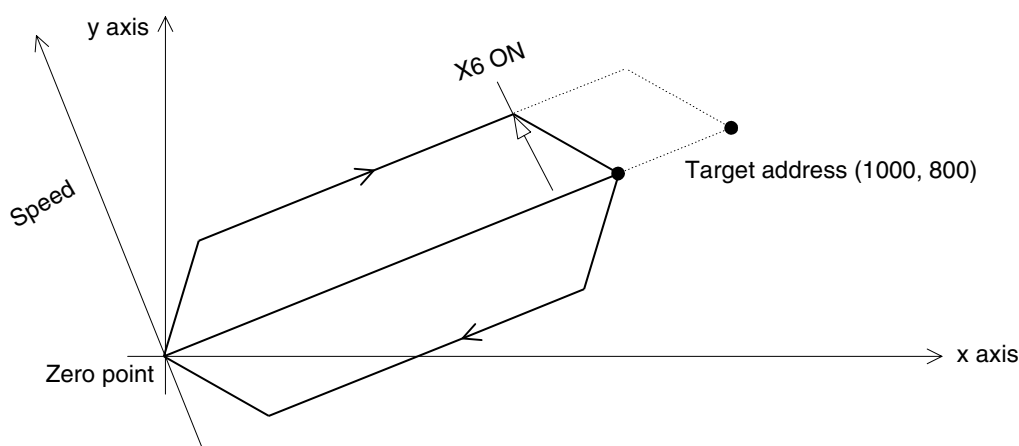
1) Outline of positioning

When the interrupt input X6 turns on while the machine is performing linear interpolation operation toward the target position, the machine decelerates and stops, then proceeds to the next step while ignoring the remaining distance.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time. The machine performs linear interpolation operation toward the target position.
- ② When the interrupt input X6 turns on during linear interpolation operation, the machine decelerates and stops. Then, the machine ignores the remaining distance, and proceeds to the next step.
- ③ After the output Y0 turns on and off, the machine returns to the address "0".

3) Operation chart



4) Program

Line No.	Instruction	Description
O0, N0	LD M9057;	
N1	FNC00(CJ) P254;	Jumps to P254 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = 0,0).
N3	P254;	
N4	cod31(INT) x1000 y800 f1200;	Sets the target address to "1,000, 800".
N5	SET Y0;	Turns on Y0.
N6	cod04(TIM) K150;	Sets the operation wait time to "1.5 sec".
N7	RST Y0;	Turns off Y0.
N8	cod04(TIM) K150;	Sets the OFF wait time to "1.5 sec".
N9	cod01(LIN) x0 y0 f1200;	Returns the machine to the zero point in a linear route.
N10	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0" for both the X and Y axes. For other parameters, refer to Paragraph 9.2.4.

9.4.5 Continuous pass operation (FX2N-20GM)

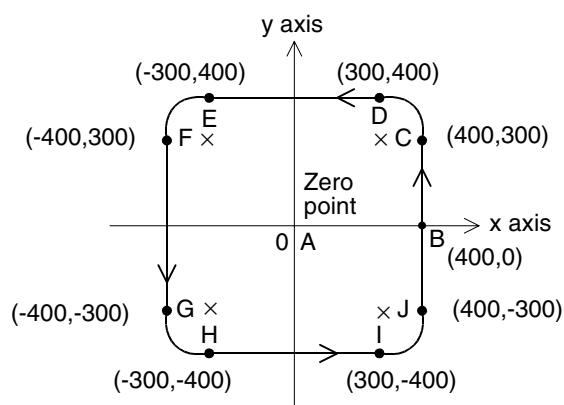
1) Outline of positioning

The machine repeats locus operation at a constant speed without stop.

2) Operating procedure

- ① The machine returns to the zero point by the start command only at the first time.
- ② The machine moves to the target address in a linear route.
- ③ The output Y0 turns on, and the machine repeats locus operation 10 times.
- ④ The output Y0 turns off, and the machine returns to the zero point.

3) Operation chart



4) Program

Line No.	Instruction	Description
O0,N0	LD M9057;	
N1	FNC00(CJ) P254;	Jumps to P254 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point (mechanical zero point address = 0, 0).
N3	➤ P254;	
N4	cod01(LIN) x400;	Moves the machine from the point A to the point B.
N5	SET Y00;	Turns on Y00.
N6	cod04(TIM) K150;	Sets the operation wait time to "1.5 sec".
N7	➤ FNC08(RPT) K10;	Sets the number of times of repetition to "10".
N8	cod01(LIN) y300 f1200;	Moves the machine from the point B to the point C.
N9	cod03(CCW) x300 y400 i-100;	The center coordinate "j" is omitted because it is incremental address. "f" is omitted because it is equivalent to that in the cod01.
N10	cod01(LIN) x-300;	Moves the machine from the point D to the point E.
N11	cod03(CCW) x-400 y300 j-100;	Moves the machine from the point E to the point F.
N12	cod01(LIN) y-300;	Moves the machine from the point F to the point G.
N13	cod03(CCW) x-300 y-400 i100;	Moves the machine from the point G to the point H.
N14	cod01(LIN) x300;	Moves the machine from the point H to the point I.
N15	cod03(CCW) x400 y-300 j100;	Moves the machine from the point I to the point J.
N16	cod01(LIN) y0;	Moves the machine from the point J to the point B. (The machine moves among point s "J → B → C" at a constant speed without stop.)
N17	FNC09(RPE);	
N18	RST Y00;	Turns off Y00.
N19	cod04(TIM) K150;	Sets the OFF wait time to "1.5 sec".
N20	cod01(LIN) x0 y0;	Returns the machine to the zero point.
N21	m02 (END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

9.5 Combination with PLC (FX2N-64MT)

9.5.1 Quantitative positioning (FX2N-10GM, FX2N-20GM)

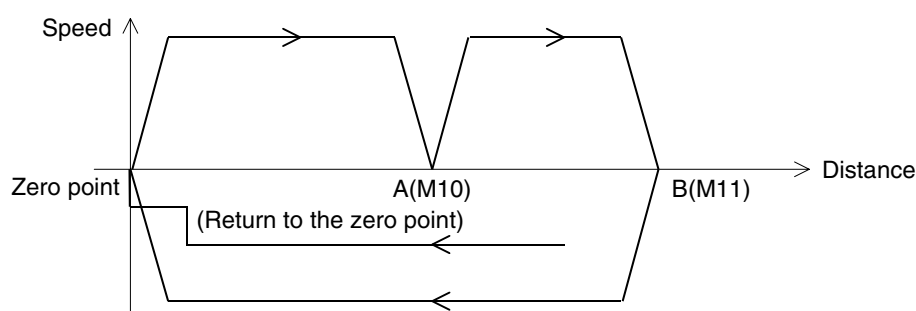
1) Outline of positioning

When positioning is completed, the positioning unit transfers the m code signal to the FX2N Series PLC, and the PLC performs an auxiliary unit operation corresponding to the m code.

2) Operating procedure

- ① When the start command (X000) is input, the machine returns to the zero point only at the first time, and regards that position as the electrical zero point.
- ② When the machine stops at the first point (A), the positioning unit transfers the m10 code to the PLC. When receiving the M10 code, the PLC makes the auxiliary unit No. 1 (Y010) operate. When operation of the auxiliary unit No. 1 is finished, the PLC turns off Y010, and transfers the m code OFF command to the positioning unit.
- ③ When receiving the m code OFF command, the positioning unit turns off the m code, and the machine moves to the second point (B). When the machine reaches the point B, the positioning unit transfers the m11 code to the PLC. When receiving the m11 code, the PLC makes the auxiliary unit No. 2 (Y011) operate. When operation of the auxiliary unit No. 2 is finished, the PLC turns off Y011 and transfers the m code OFF command to the positioning unit.
- ④ When receiving the m code OFF command, the positioning unit turns off the m code, and the machine moves to the electrical zero point. Now, operation is finished.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	LD M9057;	
N1	FNC00(CJ) P0;	Jumps to P0 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point.
N3	cod29(SETR);	Sets the electrical zero point.
N4	P0;	
N5	cod00(DRV) x5000;	Moves the machine to the point A.
N6	m10;	Outputs the m code 10.
N7	cod00(DRV) x9000;	Moves the machine to the point B.
N8	m11;	Outputs the m code 11.
N9	cod30(DRVR);	Moves the machine to the electrical zero point.
N10	m02(END);	

5) Parameter

Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

6) Program in PLC (FX_{2N}-64MT)

External signal X000: START PB

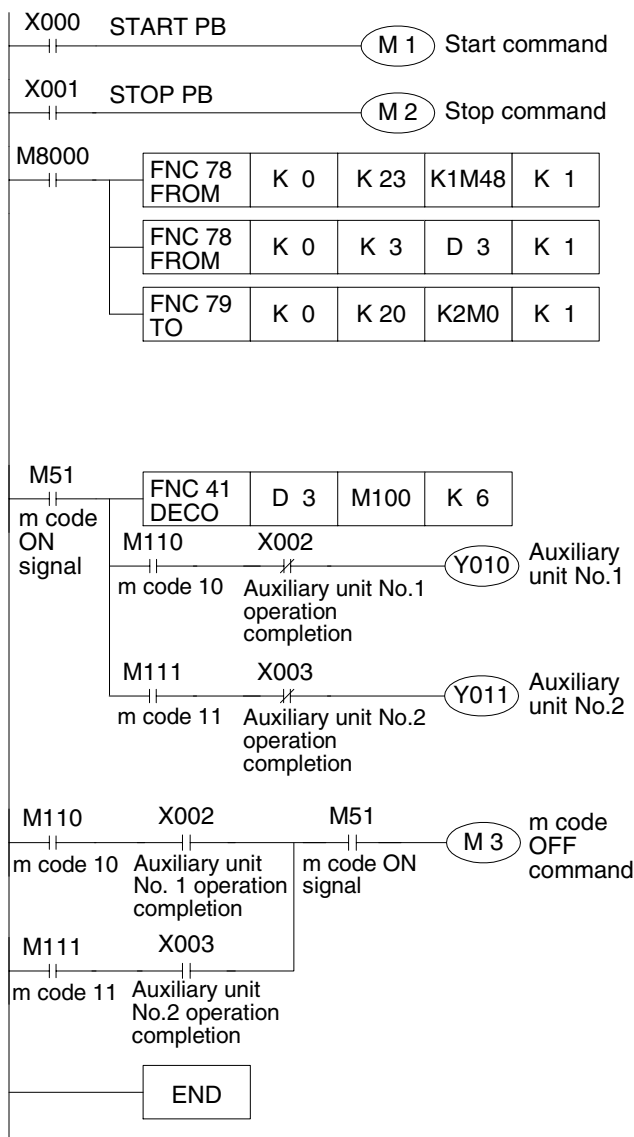
X001: STOP PB

X002: Auxiliary unit No. 1 operation completion input

X003: Auxiliary unit No. 2 operation completion input

Y010: m code 10 auxiliary unit No. 1 output

Y010: m code 11 auxiliary unit No. 2 output



Transfers "BFM #23 (M9051 to M9048)" to "M51 to M48".

M51: M9051 Turns on the m code.

Transfers "BFM #3 (D9003)" to "D3".
m code

Transfers "M7 to M0" to "BFM #20 (M9007 to M9000)".

M1: M9001 Start command

M2: M9002 Stop command

M3: M9003 m code OFF command

Decodes "m codes 0 to 63" to "M100 to M163".

9.5.2 Positioning in which movement quantity is variable (FX_{2N}-10GM, FX_{2N}-20GM)

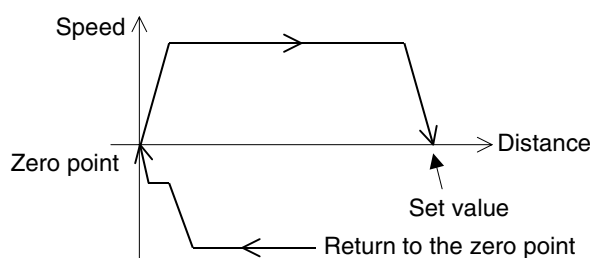
1) Outline of positioning

A digital switch is connected to the FX_{2N} Series PLC, the PLC transfers an arbitrary positioning address input via the digital switch to the positioning unit, then the positioning unit performs positioning.

2) Operating procedure

- ① An arbitrary address (absolute value) for positioning is set via a digital switch.
- ② When the START signal (X010) is input, the machine returns to the zero point only at the first time, then moves to the specified position.

3) Operation chart



4) Program

Line No.	Instruction	Description
Ox0, N0	LD M9057;	
N1	FNC00(CJ) P0;	Jumps to P0 if the zero point return completion flag M9057 is ON.
N2	cod28(DRVZ);	Returns the machine to the zero point.
N3	P0;	
N4	cod00(DRV) xDD100;	Moves the machine to the position specified by D101 and D100.
N5	m02(END);	D101 and D100 correspond to the buffer memories #101 and #100, and the data is transferred from the PLC by the T0 instruction.

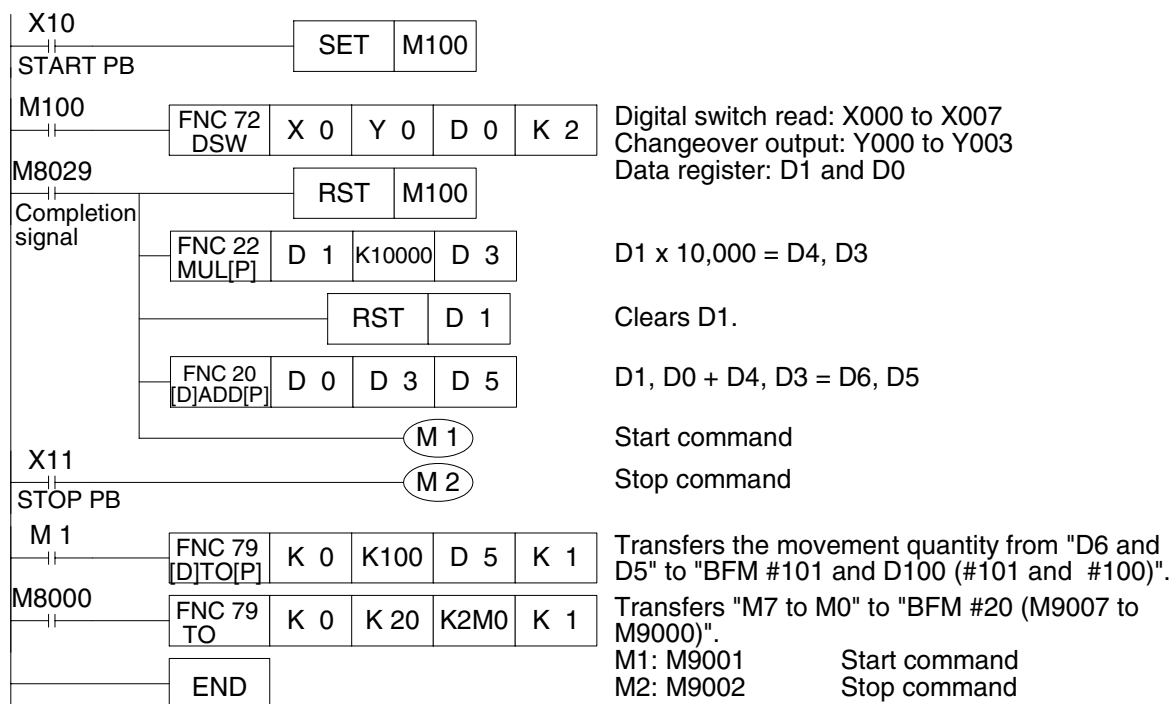
5) Parameter

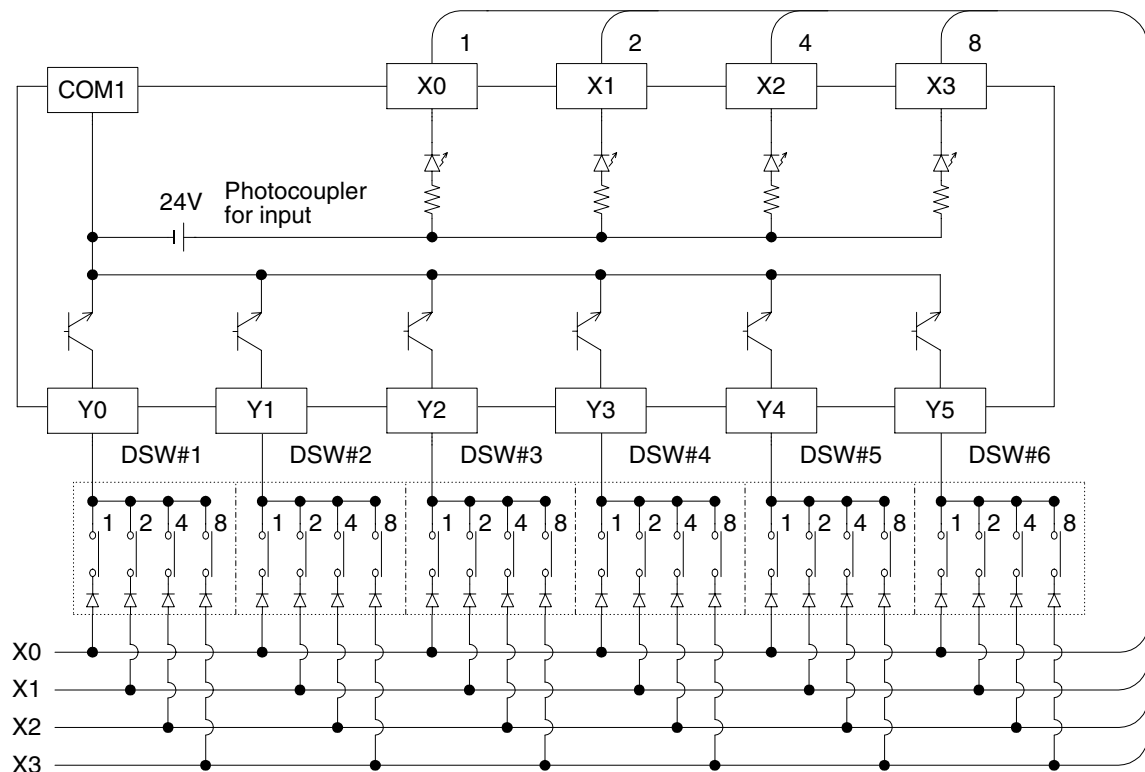
Set the positioning parameter No. 16 (mechanical zero point address) to "0". For other parameters, refer to Paragraph 9.2.4.

6) Program in FX_{2N} Series PLC

External signal

- Connect a 6-digit digital switch to X000 to X007 and Y000 to Y003. (For a connection example, refer to the attached connection diagram.)
- X010: START PB
- X011: STOP PB



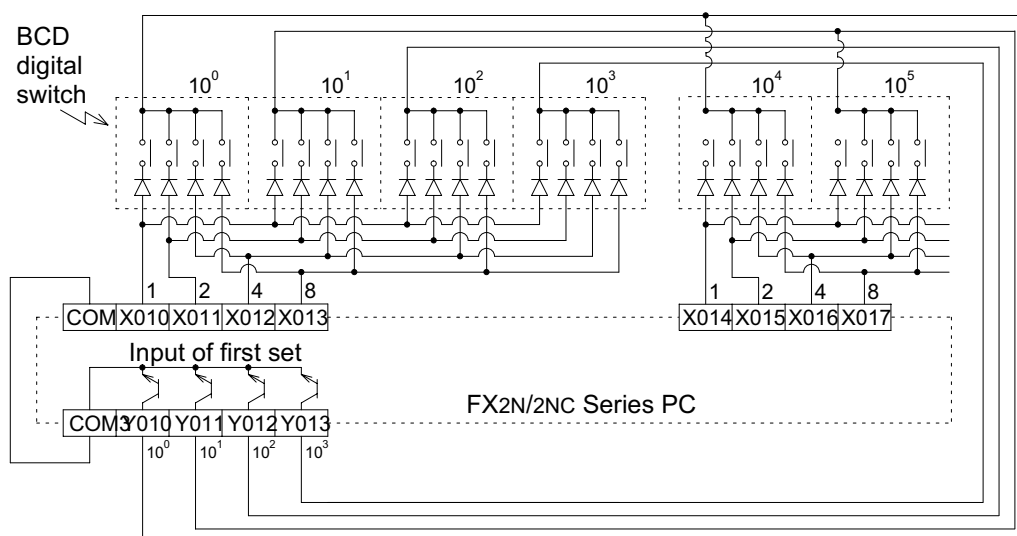
Attachment 1: When a digital switch is connected to the FX₂N-10GM / 20GM

There are commercial digital switches which can be attached to diodes.

SDG4101DX (FUJISOKU)

31J52M (JAE)

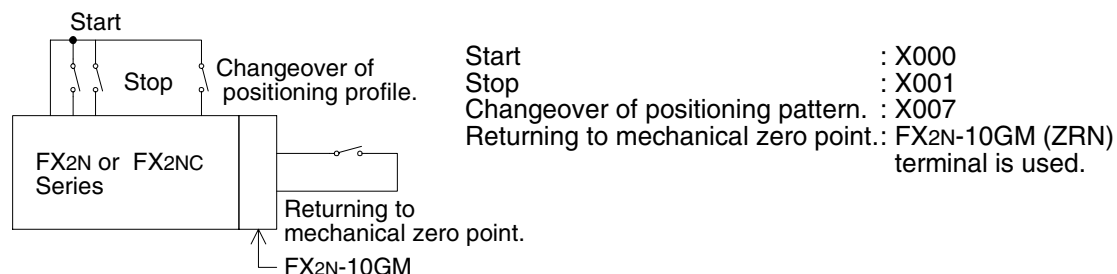
A7AS-207 (OMRON)

Attachment 2: When a digital switch is connected to the FX₂N/2NC Series PLC, and the FX₂N/2NC Series PLC gives instructions on the movement quantity, etc. to the FX₂N-10GM/ 20GM

9.5.3 Positioning by table method

An example program using the table method is described below.

System configuration



FX2NC-CNV-IF is necessary when connection to the FX2NC Programmable controller.

Contents of operation

The positioning control profiles 1 or 2 shown below can be performed.

When the profile change over input X007 is OFF, profile 1 is executed. When the X007 is ON, profile 2 is executed.

Return to mechanical zero point should be done by manual operation (External ZRN terminal input: ON) before the table program is executed.

Profile 1: Operation in the incremental drive method.

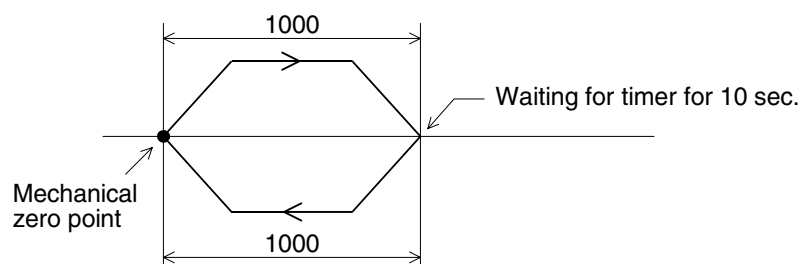
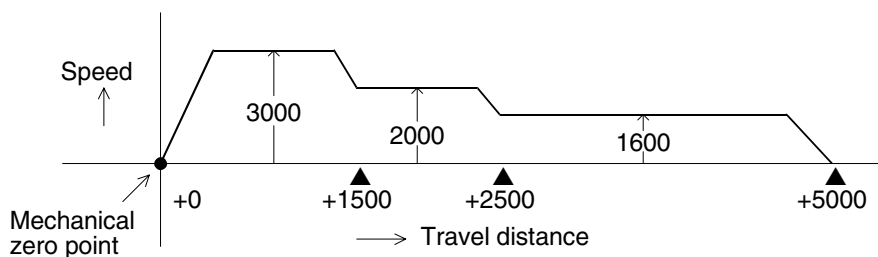


Table 9.2: Table

Entry No.		Command code	Position data	Speed data	m code
0	Data register	D1001, D1000	D1003, D1002	D1005, D1004	D1007, D1006
	Set value	K91 (INC)	K0 (Undefined.)	K0 (Undefined.)	K0 (Not required to be set.)
1	Data register	D1011, D1010	D1013, D1012	D1015, D1014	D1017, D1016
	Set value	K0 (DRV)	K1000 Address + 1000	K2000 Speed: 2000	K0 (Not required to be set.)
2	Data register	D1021, D1020	D1023, D1022	D1025, D1024	D1027, D1026
	Set value	K4 (TIM)	K1000 Waiting time: 10 [s]	K0 (Undefined.)	K110 m code 10 is output simultaneously.
3	Data register	D1031, D1030	D1033, D1032	D1035, D1034	D1037, D1036
	Set value	K0 (DRV)	K - 1000 Address - 1000	K2000 Speed: 2000	K0 (Not required to be set.)
4	Data register	D1041, D1040	D1043, D1042	D1045, D1044	D1047, D1046
	Set value	K204 (TIM) The operation enters the state of END after waiting time.	K500 Waiting time: 5 [s]	K0 (Undefined.)	K0 (Not required to be set.)

Profile 2: Operation in the absolute drive method

**Table 9.3: Table**

Entry No.		Command code	Position data	Speed data	m code
10	Data register	D1101, D1100	D1103, D1102	D1105, D1104	D1107, D1106
	Set value	K90 (ABS)	K0 (Undefined.)	K0 (Undefined.)	K0 (Not required to be set.)
11	Data register	D1111, D1110	D1113, D1112	D1115, D1114	D1117, D1116
	Set value	K1 (LIN)	K1500 Address + 1500	K3000 Speed: 3000	K0 (Not required to be set.)
12	Data register	D1121, D1120	D1123, D1122	D1125, D1124	D1127, D1126
	Set value	K1 (LIN)	K2500 Address + 2500	K2000 Speed: 2000	K0 (Not required to be set.)
13	Data register	D1131, D1130	D1133, D1132	D1135, D1134	D1137, D1136
	Set value	K201 (LIN) The operation enters the state of END after the multi-step operation ends.	K5000 Address + 5000	K1600 Speed: 1600	K0 (Not required to be set.)

Declaring the table method.

Turn ON the special auxiliary relay M9165 so that positioning control using the table method becomes valid.

M8002	FNC 79 TO	K 0	K 30	H0020	K 1
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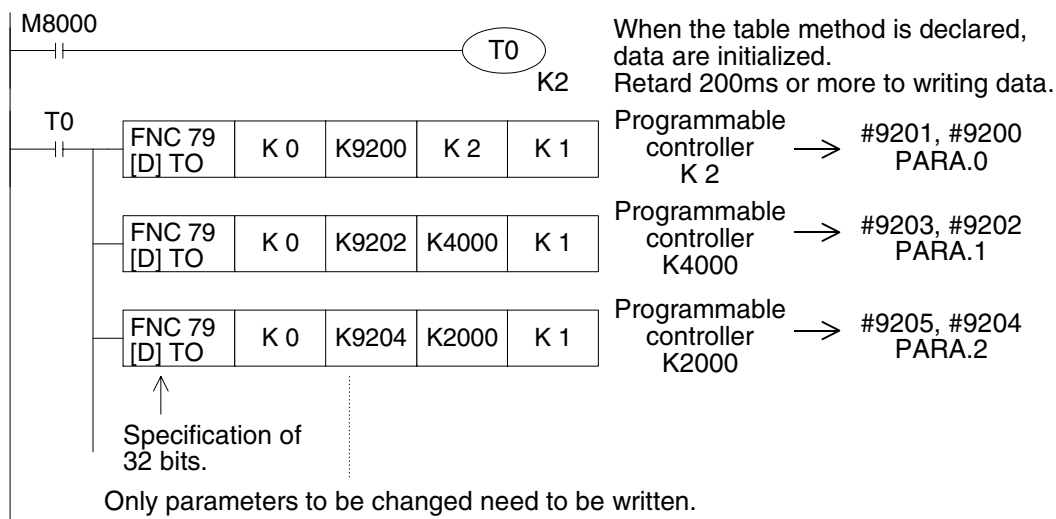
Change of parameters

Change the set values of the positioning parameters (Nos. 0 to 26) if required.

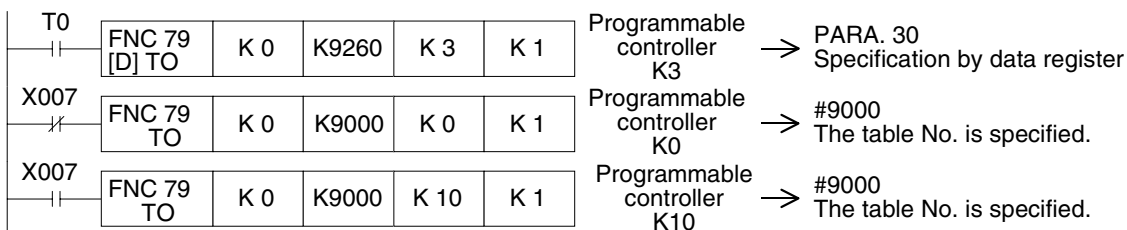
When the power is turned on, the initial value (shown in Paragraph 4.2) is stored in each parameter.

However, when you have changed a parameter using a peripheral unit dedicated to the positioning unit, the value after change is stored.

Write only the parameters which have to be changed using the TO instruction.



Specifying the start point

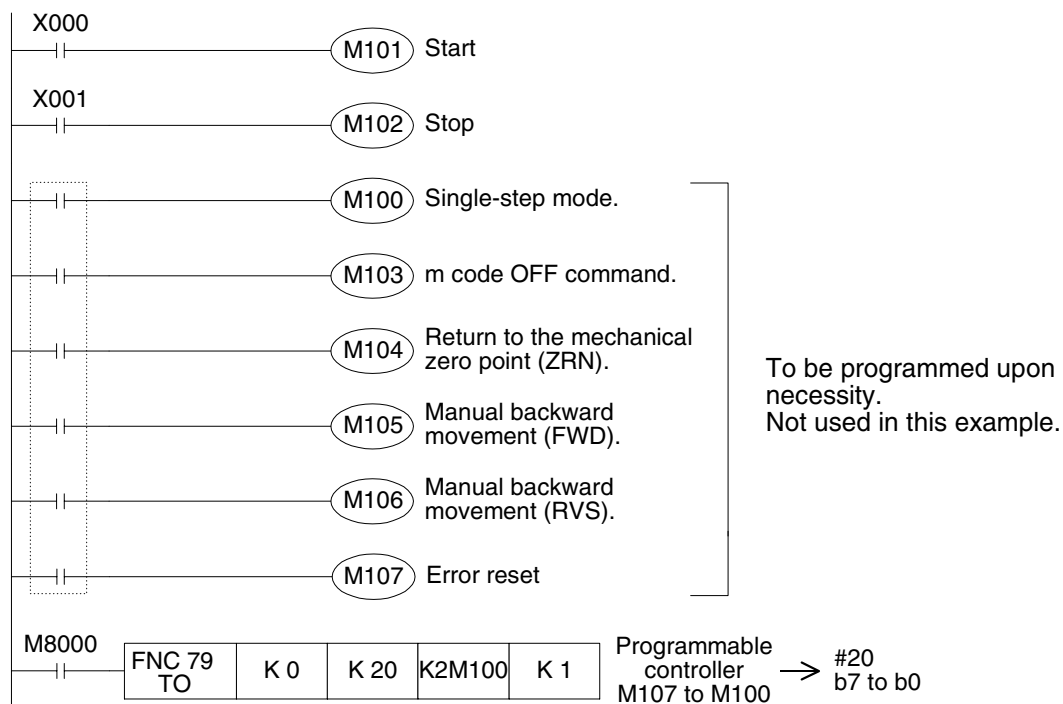


Setting the operation mode.

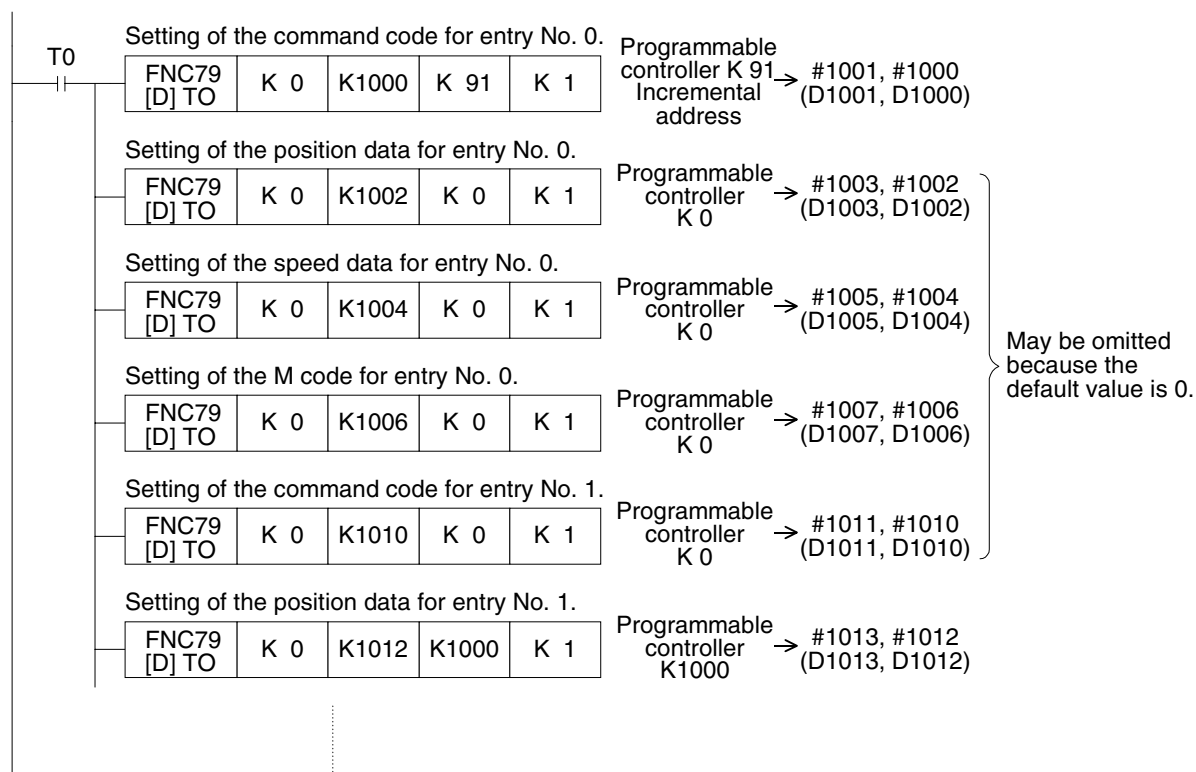
Set the commands for start/stop, return to the mechanical zero point (ZRN), manual forward movement (FWD) and manual backward movement (RVS).

These commands can also be given from the input terminal of the FX_{2N}-10GM.

Both the commands from the program and the commands from the input terminal are processed in parallel and become valid inside the FX_{2N}-10GM.



Setting the table entries



While the table is initialised, the watchdog timer (WDT) may be activated and a CPU error may occur. In this case, set a large value to the register D8000 (watchdog timer) and insert the FNC 07 (WDT) instruction in the program so that the WDT is refreshed within 100 ms.

MEMO

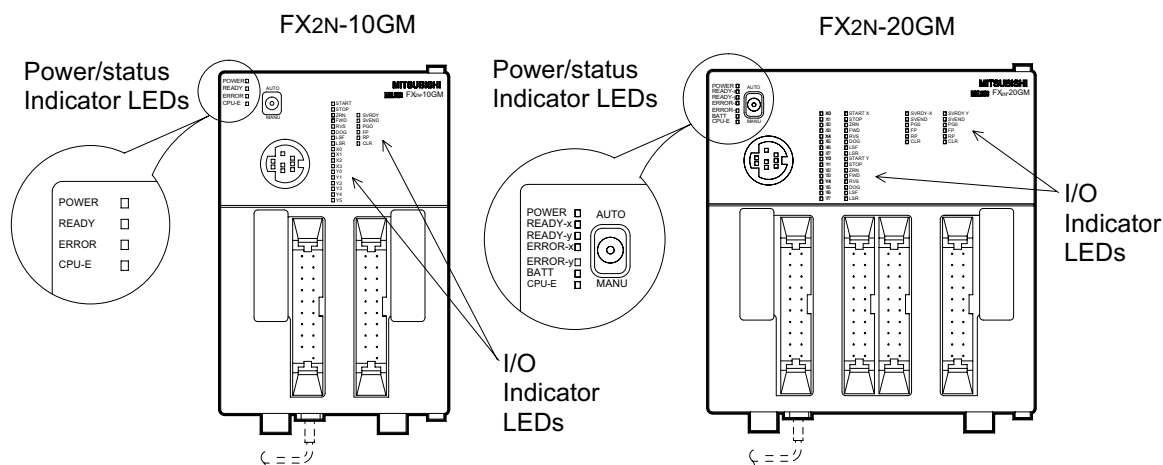
10. Troubleshooting

When an error has occurred first, check whether or not the supply voltage is correct and whether or not loose terminal screws or imperfect contact of connectors can be found on the positioning unit or the I/O units.

10.1 Troubleshooting using LEDs

The error condition can be found by checking the status of the various LEDs provided on the positioning unit.

LED names



Power indication

"POWER" LED DISPLAY

- If the POWER LED is not lit when the power is turned ON, disconnect the various I/O units. If the POWER LED is lit correctly with the units disconnected,
 - 1) The 24V DC service power supply exceeds its capacity (with the FX2N-20GM).
- With the FX2N-20GM, a fuse inside the unit may be blown out when conductive objects have entered or another error has occurred. In this case, replacement of the fuse is not sufficient. Contact the Mitsubishi Service Center.

Ready status

"READY" LED OFF

- The READY LED is lit without regard to the mode (MANU or AUTO) while the positioning unit is ready for accepting various operation commands (Refer to Section 8.1.7.). If the READY LED is OFF,
 - 1) While positioning is performed (pulses are being output).
 - Enter the stop command or change over the mode from AUTO to MANU to stop the operation and light this LED.
 - 2) When an error has occurred.
 - Check the reason for the error, and remove the cause.

Error indication

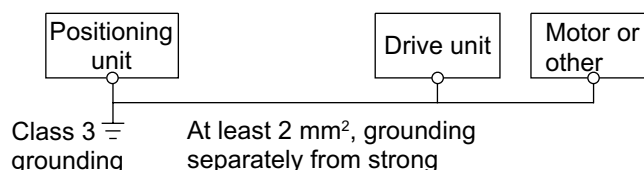
"ERROR" LED lit

- When an error has occurred during operation, the ERROR LED is lit or flashes. In this case, read the error code using a peripheral unit, refer to "10.2.3 Error code list" to find the reason for the error, then remove the cause. The common errors are as follows.
 - 1) Parameter error
 Error code: 2004 (maximum speed)
 → If the unit system adopted is the mechanical system, the setting can be 200 kHz or more when converted into pulses.
 - 2) Program error
 Error code: 3000 (no program No.)
 → This error occurs when an attempt is made to execute a program whose program No. does not exist. Monitor PARA 30 (program No. specification) as well as D9261/D9260 (X axis) and D9461/9460 (Y axis) to make sure that a correct program No. is specified.
 - 3) Program error
 Error code 3001 (no m02 (END) command)
 → "m02 (M102 in a subtask)" is not programmed at the end of the program specified to be executed.
 - 4) External error
 Error code: 4004 (limit switch actuation)
 → Check PARA 20 (limit switch logic).

CPU error

"CPU-E" LED lit

- If the CPU-E LED is lit when the power of the positioning unit is turned ON in MANU mode, a watchdog timer error has occurred. In this case, check whether the battery voltage is low, whether abnormal noise sources are present, or whether inductive foreign objects are present.
 It is recommended to perform grounding resistance of 100Ω or less of as short a distance as possible using a wire of 2 mm² or more as described in Section 3.



BATT error

"BATT" LED lit (FX_{2N}-20GM)

- If the battery voltage is low, the BATT LED is lit by the 5 V power supply when the power is turned ON; the special auxiliary relay M9143 is actuated. When approximately 1 month has passed after low battery voltage is detected and the BATT LED lit, programs (when RAM memory is used) and various memories backed up by the battery cannot be held during power interruptions.
 Make sure the battery is replaced soon.

Remarks

- While the special relay M9127 is driven, this LED is not lit even if the battery voltage is low. The special auxiliary relay M9143 is still actuated.
- When data registers are used for set values, the contents of the data registers could become unstable and the set values could be changed when the battery voltage is low; even if the EEPROM is used as the program memory. Be careful.
- The FX_{2N}-10GM is a batteryless unit and incorporates EEPROM memory.

I/O indication

LED for Various I/O indication

- If an I/O indicator LED does not flash when the input switch is turned ON and OFF, check the input wiring of the positioning unit. Especially, check if the input switch connections are secure, if the input switch cannot be turned OFF because the input switch is in parallel with another line, etc. If the load does not turn ON or OFF when an output indicator LED flashes, check the output wiring. Especially, the output transistor of the positioning unit may be damaged by a short-circuited load or an excessive load.

Pulse output indication

- The pulse output indicator LEDs (FP and RP) usually seem to be lit dimly during normal operation status (while pulses are output) because they are flashing at a high frequency.

10.2 Error Code List

When any of the errors shown below occur, the ERROR-x or ERROR-y LED on the front panel of the positioning unit is lit.

Note that the LED will flash if any of the external errors shown in the table below occur. Also note that in the case of error code 9002 the CPU-E LED will be lit.

10.2.1 Confirmation of error

The error code can be confirmed by monitoring the error with an E-20TP-E teaching panel, FX-PCS-KIT/GM-EE or FX-PCS-VPS/WIN-E personal computer software or by using the special auxiliary relays (M) and special data registers (D) shown in the table below.

When an FX_{2N}/FX_{3U}/FX_{2NC}/FX_{3UC} Series programmable controller is connected, the error code can be checked in the programmable controller by reading the buffer memory (BFM) with the FROM instruction.

Table 10.1: Confirmation of error

	Error detection		Error code	
	Special M	BFM	Special D	BFM
X axis	M9050	#23 (b3)	D9061	#9061
Y axis	M9082	#25 (b2)	D9081	#9081
Subtask	M9129	#28 (b1)	D9102	#9102
Operation	Turns ON when an error is detected.		Saves the error code.	

10.2.2 Error resetting method

The error can be reset by removing the cause of the error and performing the following operation.

- Perform an error reset operation with a peripheral unit such as the E-20TP-E, the personal computer software, etc. (For details, refer to the appropriate manual.)
- Set the operation mode to MANU and give the STOP command (by turning ON the input terminal [STOP] or the special M).
- Turn ON the special M or the BFM shown in the table below.

Table 10.2: Error resetting method

	Error detection	
	Special M	BFM
X axis	M9007	#20 (b7)
Y axis *1	M9023	#21 (b7)
Subtask	M9115	#27 (b3)

*1: The Y axis is not defined in the FX_{2N}-10GM.

10.2.3 Error code list

Table 10.3: Error code list

Error category	Error code	Details	Reset	Simultaneous 2-axis mode	Independent 2-axis mode
No error	0000	No error	—	—	—
System parameter	1100 to 1111	If one of the parameters 100 to 111 has been set incorrectly, the corresponding error code 1100 to 1111 is displayed.	Make sure that the parameter setting evaluated as error is within the set range.	Global error	Global error
Parameter setting errors	2000 to 2056	If one of the positioning parameters 0 to 24 or the I/O control parameters 30 to 56 is set incorrectly, the corresponding error code 2000 to 2056 is displayed.		Local error	Local error
Program error	3000	Program No. does not exist. When the start command is given in the AUTO mode, the specified program No. does not exist.	Change the program No. or create the program.	Global error	Local error
	3001	"m02(END)" is not provided in the program. The m02 (END) command is not provided at the end of the specified program.	Add "m02 (END)" at the end of the specified program.		
	3003	Set value register overflow When the set value exceeds 32 bits.	Change the set value to the value of 32 bits or less.	Local error	Local error
	3004	The set value is defective. When you input the value outside a set range.	Change the set value to the value within the range of setting.		
	3005	The imperative type is defective. When setting (moved distance and speed) which cannot be omitted is omitted or the set value of another axis is input.	Confirm the program form after of each instruction.	Global error	
	3006	The label to the CALL and the JUMP instruction is absent.	Program the label at the jump destination the call ahead.		
	3007	The CALL instruction is defective. Nest levels exceeds 15 piles. Or, the CALL does not correspond to the label of the RET.	Adjust nest levels to 15 piles or less. Moreover, please confirm the label number.		

Table 10.3: Error code list

Error category	Error code	Details	Reset	Simultaneous 2-axis mode	Independent 2-axis mode
Program error	3008	Repeat instruction fault Nest levels exceeds 15 piles. Or, the RPT does not correspond to the label of the RPTEND.	Adjust nest levels to 15 piles or less. Moreover, please confirm the repetition instruction.	Global error	Local error
	3009	O.N.P The number is defective. The O.N.P number outside a set range is specified.	Confirm whether there is same number.		
	3010	Axis set defect Two axes exist together to the program of two independent axes simultaneously.	Unite programs.		Global error
External errors (LED flashes.)	4002	Servo end error The positioning completion signal is not received from the motor amplifier.	Check PARA 21 and the wiring.	Local error	Local error
	4003	Servo ready error The preparation completion signal is not received from the motor amplifier.	Check PARA 22 and the wiring.		
	4004	Limit switch actuated	Check PARA 20, check the limit logic, then check the wiring.		
	4006	ABS data transfer error	Confirm PARA.50 to 52 and wiring.	Local error	Local error
Critical error	9000	Memory error	If the same error occurs again even after turning OFF and ON the power, repair is required. Contact the Mitsubishi Service Center.	Global error	Global error
	9001	Sum check error			
	9002	Watchdog timer error (CPU-E LED is lit.)			
	9003	Hardware error			

Global error : The error indication is performed for the both axes even if the error has occurred in only either the X or Y axis. And the both axes stop.

Local error : The error indication is performed for only the axis in which the error has occurred. During simultaneous 2-axis operation, the both axes stop.
During independent 2-axis operation, only the axis in which the error has occurred stops.

11. Maintenance

Periodical maintenance

Most of the parts incorporated in the positioning unit will never need to be replaced. However, the service life of the battery is approximately 3 years, and it should be replaced periodically using the following procedure. Purchase batteries when they are required.

The FX₂N-10GM is batteryless, and programs and parameters are saved in built-in EEPROM. Also check the following items when inspecting other equipment.

- Is the temperature inside the panel abnormally high due to heat radiating bodies in the vicinity or to direct sunlight?
- Has any dust or conductive material entered inside the panel?
- Are there any loose or rusted terminals, or damaged wires?

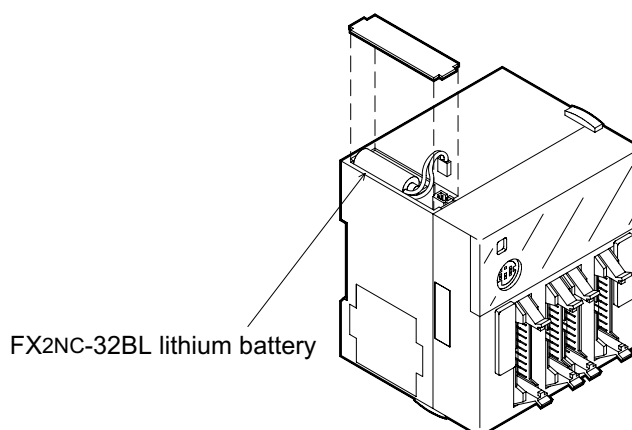
Replacement of battery

If the battery voltage is low, the BATT LED on the front panel is lit when the power is turned ON. Although memory data will be retained for approximately 1 month after this LED is lit for the first time, the battery should be replaced as soon as possible and power should be kept ON as much as possible until it is replaced.

Note that even if an EEPROM cassette is used as the program memory, the battery is still required to protect data saved in battery-backed memory.

Battery replacement procedure

- 1) Turn OFF the power of the FX₂N-20GM.
- 2) Lift up the upper part of the panel cover using your fingertips or the blade of a screwdriver, and open the cover.
- 3) Remove the old battery from its holder and remove the connector.
- 4) Insert the connector of a new battery immediately (within 30 sec. after removal of the old battery).
- 5) Fit the new battery into the holder and attach the panel cover.



Precautions for battery transportation

When transporting lithium batteries, make sure to treat them based on the transport regulations.

The FX₂NC-32BL battery is classified as shown in table.

Product name	Model	Product supply status	Classification for transportation
Battery	FX ₂ NC-32BL	Lithium battery	Non-dangerous goods

Transport guidelines

Comply with IATA Dangerous Goods Regulations, IMDG code and the local transport regulations when transporting products after unpacking or repacking, while Mitsubishi ships products with packages to comply with the transport regulations.

Also, contact the transporters.

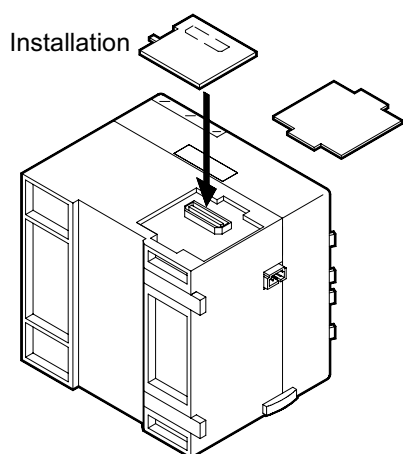
Memory board

The program of FX₂N-20GM can be made ROM by using an optional memory board (FX₂NC-EEPROM-16).

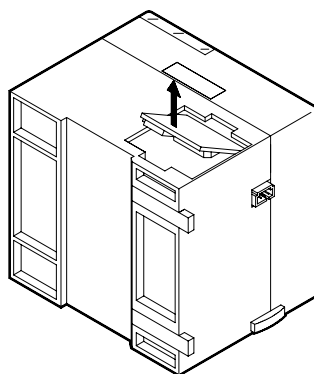
The program capacity is 7.8 k steps.

The memory board with the clock function cannot be used.

Detaching of memory board



Removal



- ① Turn off the power of the FX₂N-20GM.
- ② Remove the cover from the memory board mounting area.
- ③ Securely connect the memory board to the connector. (When disconnecting the memory board, slowly disconnect it from the bottom.)
- ④ Attach the cover, then turn on the power.



- Battery and memory cassettes to specified connectors. Imperfect contact may cause malfunction.
- Make sure to turn off the power, then connect/disconnect a memory cassette in the FX₂N-20GM.
If you connect/disconnect a memory cassette while the power is turned on, the data saved the memory cassette or the memory cassette itself may be damaged.

12. Appendix

12.1 Instruction list

Table 12.1: Instruction list

Instruction	Description	FX2N-10GM	FX2N-20GM	Reference page
Positioning instructions				
cod00 DRV	Positioning at high speed	✓	✓	5-20
cod01 LIN	Linear interpolation positioning	✓	✓	5-22
cod02 CW	Circular interpolation positioning (clockwise)	×	✓	5-24
cod03 CCW	Circular interpolation positioning (counterclockwise)	×	✓	5-24
cod04 TIM	Settling time (dwell time)	✓	✓	5-28
cod09 CHK	Servo end check	✓	✓	5-29
cod28 DRVZ	Return to mechanical zero point	✓	✓	5-30
cod29 SETR	Electrical zero point setting	✓	✓	5-31
cod30 DRVR	Return to electrical zero point	✓	✓	5-31
cod31 INT	Interrupt stop (Remaining distance is ignored.)	✓	✓	5-32
cod71 SINT	Interrupt stop at 1-step speed	✓	✓	5-34
cod72 DINT	Interrupt stop at 2-step speed	✓	✓	5-35
cod73 MOVC	Movement quantity correction	✓	✓	5-37
cod74 CNTC	Center position correction	×	✓	5-38
cod75 RADC	Radius correction	×	✓	5-38
cod76 CANC	Correction cancel	✓	✓	5-39
cod90 ABS	Absolute address specification	✓	✓	5-40
cod91 INC	Incremental address specification Incremental address specification	✓	✓	5-40
cod92 SET	Current value setting	✓	✓	5-41
Sequence basic instructions				
LD	Arithmetic operation start (a-contact)	✓	✓	5-46
LDI	Arithmetic operation start (b-contact)	✓	✓	5-46
AND	Series connection (a-contact)	✓	✓	5-46
ANI	Series connection (b-contact)	✓	✓	5-46
OR	Parallel connection (a-contact)	✓	✓	5-46
ORI	Parallel connection (b-contact)	✓	✓	5-46
ANB	Series connection between circuit blocks	✓	✓	5-46
ORB	Parallel connection between circuit blocks	✓	✓	5-46
SET	Drive of operation holding type coil	✓	✓	5-46
RST	Reset of driven operation holding type coil	✓	✓	5-46
NOP	No processing	✓	✓	5-46

Table 12.1: Instruction list

Instruction	Description	FX2N-10GM	FX2N-20GM	Reference page
Sequence control instructions				
FNC00 CJ	Conditional jump	✓	✓	5-49
FNC01 CJN	Negated conditional jump	✓	✓	5-49
FNC02 CALL	Subroutine call	✓	✓	5-50
FNC03 RET	Subroutine return	✓	✓	5-50
FNC04 JMP	Unconditional jump	✓	✓	5-50
FNC05 BRET	Return to bus line	✓	✓	5-51
FNC08 RPT	Repetition start	✓	✓	5-52
FNC09 RPE	Repetition end	✓	✓	5-52
FNC10 CMP	Comparison	✓	✓	5-54
FNC11 ZCP	Zone comparison	✓	✓	5-54
FNC12 MOV	Transfer	✓	✓	5-55
FNC13 MMOV	Magnifying transfer with sign extension	✓	✓	5-55
FNC14 RMOV	Reducing transfer with sign holding	✓	✓	5-56
FNC18 BCD	Conversion from binary into binary-coded decimal	✓	✓	5-57
FNC19 BIN	Conversion from binary-coded decimal into binary	×	✓	5-57
FNC20 ADD	Binary addition	×	✓	5-58
FNC21 SUB	Binary subtraction	✓	✓	5-58
FNC22 MUL	Binary multiplication	✓	✓	5-59
FNC23 DIV	Binary division	✓	✓	5-59
FNC24 INC	Binary increment	✓	✓	5-60
FNC25 DEC	Binary decrement	✓	✓	5-60
FNC26 WAND	Logical product (AND)	✓	✓	5-60
FNC27 WOR	Logical sum (OR)	✓	✓	5-60
FNC28 WXOR	Exclusive logical sum (XOR)	✓	✓	5-60
FNC29 NEG	Complement	✓	✓	5-61
FNC72 EXT	Time division read of digital switch	✓	✓	5-62
FNC74 SEGL	Seven-segment display with latch	✓	✓	5-64
FNC90 OUT	Output	✓	✓	5-67
FNC92 XAB	X axis absolute position detection	✓	✓	5-68
FNC93 YAB	Y axis absolute position detection	×	✓	5-68

12.2 Parameter recording

Table 12.2: Positioning parameters

PARA No.	Description	X axis set value	Y axis set value
0	System of units		
1	Pulse rate		
2	Feed rate		
3	Minimum command unit		
4	Maximum speed		
5	JOG speed		
6	Bias speed		
7	Backlash compensation		
8	Acceleration time		
9	Deceleration time		
10	Interpolation time constant		
11	Pulse output format		
12	Rotation direction		
13	Zero return direction		
14	Creep speed		
15	Zero return direction		
16	Machine zero point address		
17	Zero point signal count		
18	Zero point signal count start timing		
19	DOG switch input logic		
20	Limit switch logic		
21	Error evaluation time		
22	Servo ready check		
23	Stop mode		
24	Electrical zero point address		
25	Software limit (upper)		
26	Software limit (lower)		

Table 12.3: I/O control parameters

PARA No.	Description	X axis set value	Y axis set value
30	Program No. specification method		
31	Head input No. for DSW time- sharing reading		
32	Head output No. for DSW time- sharing reading		
33	DSW reading interval		
34	RDY output valid		
35	RDY output No.		
36	m code external output valid		
37	m code external output No.		
38	m code OFF specification input No.		
39	Manual pulse generator		
40	Multiplying factor per pulse gene- rated by manual pulse generator		
41	Division rate for multiplied result		
42	Head input No. for manual pulse generator enable		
43 to 49	Vacant		
50	ABS interface		
51	Head input No. for ABS		
52	Head output No. for ABS control		
53	Single-step operation		
54	Single-step mode input No.		
55	Vacant		
56	General purpose input declaration for FWD/RVS/ZRN		

Table 12.4: System parameters

PARA No.	Description	Value
100	Memory size	
101	File registers	
102	Battery status	
103	Battery status output No.	
104	Subtask start	
105	Subtask start input No.	
106	Subtask stop	
107	Subtask stop input No.	
108	Subtask error	
109	Subtask error output	
110	Subtask single-step/cyclic operation	
111	Subtask single-step/cyclic operation input No.	

12.3 Program recording

Program No.[illegible]

12.4 Table information list

Table 12.5: Table information list

Entry No.	Command code	Position data	Speed data	m code
0	D1001,D1000	D1003,D1002	D1005,D1004	D1007,D1006
1	D1011,D1010	D1013,D1012	D1015,D1014	D1017,D1016
2	D1021,D1020	D1023,D1022	D1025,D1024	D1027,D1026
3	D1031,D1030	D1033,D1032	D1035,D1034	D1037,D1036
4	D1041,D1040	D1043,D1042	D1045,D1044	D1047,D1046
5	D1051,D1050	D1053,D1052	D1055,D1054	D1057,D1056
6	D1061,D1060	D1063,D1062	D1065,D1064	D1067,D1066
7	D1071,D1070	D1073,D1072	D1075,D1074	D1077,D1076
8	D1081,D1080	D1083,D1082	D1085,D1084	D1087,D1086
9	D1091,D1090	D1093,D1092	D1095,D1094	D1097,D1096
10	D1101,D1100	D1103,D1102	D1105,D1104	D1107,D1106
11	D1111,D1110	D1113,D1112	D1115,D1114	D1117,D1116
12	D1121,D1120	D1123,D1122	D1125,D1124	D1127,D1126
13	D1131,D1130	D1133,D1132	D1135,D1134	D1137,D1136
14	D1141,D1140	D1143,D1142	D1145,D1144	D1147,D1146
15	D1151,D1150	D1153,D1152	D1155,D1154	D1157,D1156
16	D1161,D1160	D1163,D1162	D1165,D1164	D1167,D1166
17	D1171,D1170	D1173,D1172	D1175,D1174	D1177,D1176
18	D1181,D1180	D1183,D1182	D1185,D1184	D1187,D1186
19	D1191,D1190	D1193,D1192	D1195,D1194	D1197,D1196
20	D1201,D1200	D1203,D1202	D1205,D1204	D1207,D1206
21	D1211,D1210	D1213,D1212	D1215,D1214	D1217,D1216
22	D1221,D1220	D1223,D1222	D1225,D1224	D1227,D1226
23	D1231,D1230	D1233,D1232	D1235,D1234	D1237,D1236
24	D1241,D1240	D1243,D1242	D1245,D1244	D1247,D1246
25	D1251,D1250	D1253,D1252	D1255,D1254	D1257,D1256
26	D1261,D1260	D1263,D1262	D1265,D1264	D1267,D1266
27	D1271,D1270	D1273,D1272	D1275,D1274	D1277,D1276
28	D1281,D1280	D1283,D1282	D1285,D1284	D1287,D1286
29	D1291,D1290	D1293,D1292	D1295,D1294	D1297,D1296
30	D1301,D1300	D1303,D1302	D1305,D1304	D1307,D1306
31	D1311,D1310	D1313,D1312	D1315,D1314	D1317,D1316
32	D1321,D1320	D1323,D1322	D1325,D1324	D1327,D1326
33	D1331,D1330	D1333,D1332	D1335,D1334	D1337,D1336
34	D1341,D1340	D1343,D1342	D1345,D1344	D1347,D1346
35	D1351,D1350	D1353,D1352	D1355,D1354	D1357,D1356
36	D1361,D1360	D1363,D1362	D1365,D1364	D1367,D1366
37	D1371,D1370	D1373,D1372	D1375,D1374	D1377,D1376
38	D1381,D1380	D1383,D1382	D1385,D1384	D1387,D1386

Table 12.5: Table information list

Entry No.	Command code	Position data	Speed data	m code
39	D1391,D1390	D1393,D1392	D1395,D1394	D1397,D1396
40	D1401,D1400	D1403,D1402	D1405,D1404	D1407,D1406
41	D1411,D1410	D1413,D1412	D1415,D1414	D1417,D1416
42	D1421,D1420	D1423,D1422	D1425,D1424	D1427,D1426
43	D1431,D1430	D1433,D1432	D1435,D1434	D1437,D1436
44	D1441,D1440	D1443,D1442	D1445,D1444	D1447,D1446
45	D1451,D1450	D1453,D1452	D1455,D1454	D1457,D1456
46	D1461,D1460	D1463,D1462	D1465,D1464	D1467,D1466
47	D1471,D1470	D1473,D1472	D1475,D1474	D1477,D1476
48	D1481,D1480	D1483,D1482	D1485,D1484	D1487,D1486
49	D1491,D1490	D1493,D1492	D1495,D1494	D1497,D1496
50	D1501,D1500	D1503,D1502	D1505,D1504	D1507,D1506
51	D1511,D1510	D1513,D1512	D1515,D1514	D1517,D1516
52	D1521,D1520	D1523,D1522	D1525,D1524	D1527,D1526
53	D1531,D1530	D1533,D1532	D1535,D1534	D1537,D1536
54	D1541,D1540	D1543,D1542	D1545,D1544	D1547,D1546
55	D1551,D1550	D1553,D1552	D1555,D1554	D1557,D1556
56	D1561,D1560	D1563,D1562	D1565,D1564	D1567,D1566
57	D1571,D1570	D1573,D1572	D1575,D1574	D1577,D1576
58	D1581,D1580	D1583,D1582	D1585,D1584	D1587,D1586
59	D1591,D1590	D1593,D1592	D1595,D1594	D1597,D1596
60	D1601,D1600	D1603,D1602	D1605,D1604	D1607,D1606
61	D1611,D1610	D1613,D1612	D1615,D1614	D1617,D1616
62	D1621,D1620	D1623,D1622	D1625,D1624	D1627,D1626
63	D1631,D1630	D1633,D1632	D1635,D1634	D1637,D1636
64	D1641,D1640	D1643,D1642	D1645,D1644	D1647,D1646
65	D1651,D1650	D1653,D1652	D1655,D1654	D1657,D1656
66	D1661,D1660	D1663,D1662	D1665,D1664	D1667,D1666
67	D1671,D1670	D1673,D1672	D1675,D1674	D1677,D1676
68	D1681,D1680	D1683,D1682	D1685,D1684	D1687,D1686
69	D1691,D1690	D1693,D1692	D1695,D1694	D1697,D1696
70	D1701,D1700	D1703,D1702	D1705,D1704	D1707,D1706
71	D1711,D1710	D1713,D1712	D1715,D1714	D1717,D1716
72	D1721,D1720	D1723,D1722	D1725,D1724	D1727,D1726
73	D1731,D1730	D1733,D1732	D1735,D1734	D1737,D1736
74	D1741,D1740	D1743,D1742	D1745,D1744	D1747,D1746
75	D1751,D1750	D1753,D1752	D1755,D1754	D1757,D1756
76	D1761,D1760	D1763,D1762	D1765,D1764	D1767,D1766
77	D1771,D1770	D1773,D1772	D1775,D1774	D1777,D1776
78	D1781,D1780	D1783,D1782	D1785,D1784	D1787,D1786
79	D1791,D1790	D1793,D1792	D1795,D1794	D1797,D1796

Table 12.5: Table information list

Entry No.	Command code	Position data	Speed data	m code
80	D1801,D1800	D1803,D1802	D1805,D1804	D1807,D1806
81	D1811,D1810	D1813,D1812	D1815,D1814	D1817,D1816
82	D1821,D1820	D1823,D1822	D1825,D1824	D1827,D1826
83	D1831,D1830	D1833,D1832	D1835,D1834	D1837,D1836
84	D1841,D1840	D1843,D1842	D1845,D1844	D1847,D1846
85	D1851,D1850	D1853,D1852	D1855,D1854	D1857,D1856
86	D1861,D1860	D1863,D1862	D1865,D1864	D1867,D1866
87	D1871,D1870	D1873,D1872	D1875,D1874	D1877,D1876
88	D1881,D1880	D1883,D1882	D1885,D1884	D1887,D1886
89	D1891,D1890	D1893,D1892	D1895,D1894	D1897,D1896
90	D1901,D1900	D1903,D1902	D1905,D1904	D1907,D1906
91	D1911,D1910	D1913,D1912	D1915,D1914	D1917,D1916
92	D1921,D1920	D1923,D1922	D1925,D1924	D1927,D1926
93	D1931,D1930	D1933,D1932	D1935,D1934	D1937,D1936
94	D1941,D1940	D1943,D1942	D1945,D1944	D1947,D1946
95	D1951,D1950	D1953,D1952	D1955,D1954	D1957,D1956
96	D1961,D1960	D1963,D1962	D1965,D1964	D1967,D1966
97	D1971,D1970	D1973,D1972	D1975,D1974	D1977,D1976
98	D1981,D1980	D1983,D1982	D1985,D1984	D1987,D1986
99	D1991,D1990	D1993,D1992	D1995,D1994	D1997,D1996

HARDWARE / PROGRAMMING MANUAL

FX2N-10GM, FX2N-20GM



HEAD OFFICE: TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
HIMEJI WORKS: 840, CHIYODA CHO, HIMEJI, JAPAN

MODEL	FX2N10/20GM-H-E
MODEL CODE	09R612

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(MEE)

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Specification are subject to change without notice.