General Specifications

GS 34M6H51-01E

FA-M3
High-speed Counter Modules and Positioning Modules

FA-M3

Contents

YOKOGAWA
Yokogawa Electric Corporation

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General Specifications

F3XP01-0H and F3XP02-0H
High-speed Counter Modules

FA-M3

General

The F3XP01-0H and F3XP02-0H High-speed Counter Modules connect to sensors such as incremental encoders, and receive and count the number of pulse signals up to a speed of 100 kpps.

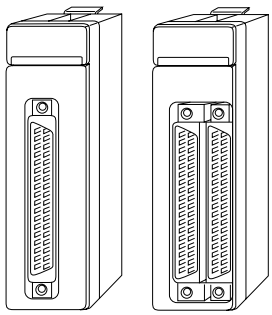
- It can count pulses as high speed as 100 kpps using a 32-bit counter.
- It contains two external coincidence outputs for each channel (two independent set values are allowed).
- The F3XP02 allows four external coincidence outputs to be specified for each channel (in this case, the other channel has no external coincidence output).
- It is provided with three counter modes (phase difference, pulse + direction, and count-up/count-down) to accommodate a variety of sensors.
- It offers the 2- and 4-time multiplication functions for improved resolution in the phase difference mode.

Specifications

■ Standard Specifications

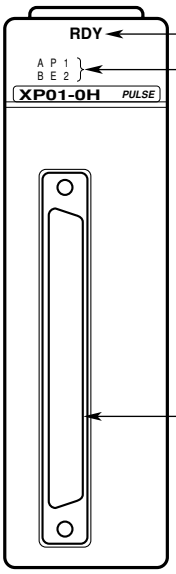
Item		Specification	
		F3XP01-0H	F3XP02-0H
Counter	Number of channels	1	2
	Count range	$00000000 to $FFFFFFFF (32 bits)	
	Input frequency	0 - 100 kpps (400 kpps with 4-time multiplication in phase-difference mode)	
Mode	Operating mode	Linear, ring and up/down counters	
	Counter mode	Phase difference, pulse + direction and count-up/count-down	
	Multiplication mode	1-, 2- and 4-times multiplication (available only in the phase-difference mode)	
Input signal	Phases A and B, preset (phase Z), and counter enable	5 V, 12 V and 24 V DC (photocoupler insulation) (Connectable to RS-422 line driver signals.)	
Output signal	External coincidence output	2 points for each channel (turned on when counter value equals preset value.)	
Internal comparison		Counter value > Set value Counter value = Set value Counter value < Set value	
Current consumption		100 mA (5 V DC)	150 mA (5 V DC)
External connection		One 40-pin connector	Two 40-pin connectors
External dimensions		28.9 (W) × 100 (H) × 83.2 (D) mm*	
Weight		150 g	

*: Excluding protrusions (see external dimensions for details).



Components and Functions

● **F3XP01-0H (1-channel model)**

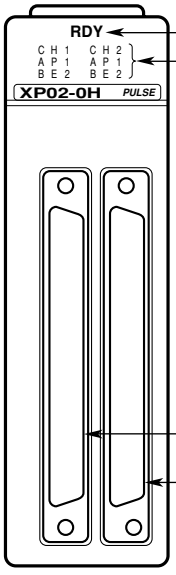


RDY indicator
Lit when the internal circuit is functioning normally.

Channel indicator
The following indicators light up when the corresponding condition occurs:
A: Phase-A pulse input signal goes on.
B: Phase-B pulse input signal goes on.
P: The external preset input signal goes on.
E: The module is in the counter enabled state.
1: The external coincidence output 1 (OUT1) goes on.
2: The external coincidence output 2 (OUT2) goes on.

40-pin connector

● **F3XP02-0H (2-channel model)**



RDY indicator
Lit when the internal circuit is functioning normally.

Channel 1 and 2 indicator
The following indicators light up for each channel when the corresponding condition occurs:
A: Phase-A pulse input signal goes on.
B: Phase-B pulse input signal goes on.
P: The external preset input signal goes on.
E: The module is in the counter enabled state.
1: The external coincidence output 1 (OUT1) goes on.
2: The external coincidence output 2 (OUT2) goes on.

CH1 and CH2 connectors:
Two 40-pin connectors

■ Input/Output Signal Specifications

All input/output signals are isolated by photocouplers.

● External input signals

A : Phase-A pulse input signal
B : Phase-B pulse input signal
PST : External preset input signal
The preset value is loaded into the counter on the rising edge of the signal.
EN : External counter enable input signal
The module performs counting and comparison operations while this signal is on.

● External Output Signals

OUT1 and OUT2 : External coincidence signals

● Electrical Data

1. Input Signals

Signal	Ter-minal	Input Type	Rated Input Voltage (Operating Voltage Range)	Rated Input Current	Operating Voltage/Current	
					ON	OFF
A, B and PST	5 V	DC voltage	5 V DC (4.25 to 5.5 V DC)	16.8 mA	3.5 V min. 10 mA min.	1.5 V max. 2 mA max.
	12 V		12 V DC (10.2 to 13.2 V DC)	15.5 mA	8 V min. 10 mA min.	2.4 V max. 2 mA max.
	24 V		24 V DC (20.4 to 26.4 V DC)	15.8 mA	16 V min. 10 mA min.	4.8 V max. 2 mA max
EN	5 V		5 V DC (4.25 to 5.5 V DC)	4.6 mA	3.5 V min. 3.2 mA min.	1.5 V max. 0.9 mA max.
	12 V		12 V DC (10.2 to 13.2 V DC)	4.6 mA	8 V min. 3.2 mA min.	2.4 V max. 0.9 mA max.
	24 V		24 V DC (20.4 to 26.4 V DC)	4.9 mA	16 V min. 3.2 mA min.	4.8 V max. 0.9 mA max.

2. Output Signals

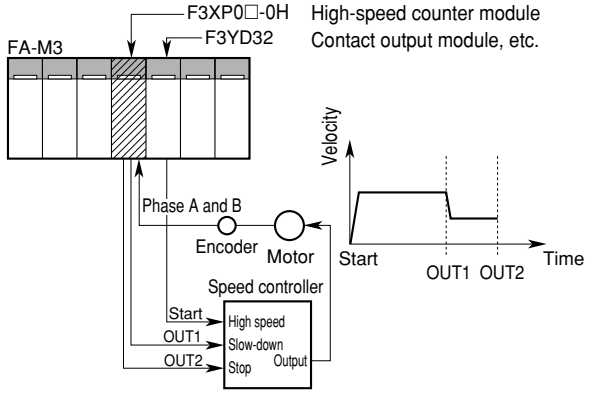
Signal	Output	Rated Load Voltage (Maximum Load Voltage)	Maximum Load Current	Residual Voltage at ON	Leakage Current at OFF	Surge Protector	Response (Pulse Input → Output On)	Common Format
OUT1 and OUT2	Transistor contact	5 - 24 V DC (26.4 V DC)	0.1 A/point	1.5 V DC max.	0.1 mA max.	None	0.1 ms max.	All points independent.

Configuration Example

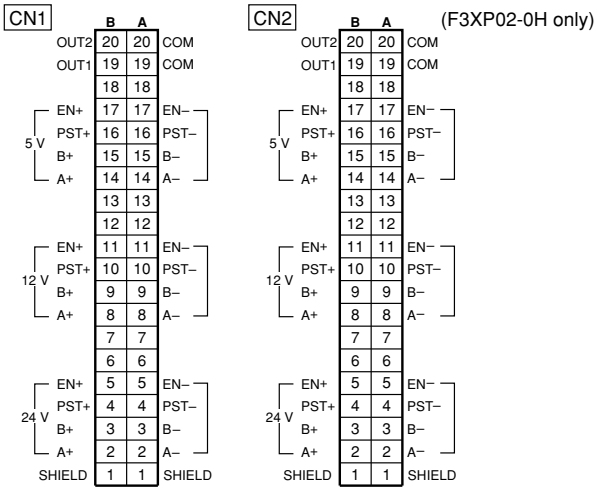
This example accomplishes high-speed positioning of a motor using two external coincidence outputs of channel 1.

Settings : Set preset values 1 and 2 of channel 1 to the following values:
Preset value 1 : Pulse value for the slow-down command
Preset value 2 : Pulse value for the stop command

Operating : When the output relay in a contact output module (e.g., F3YD32) turns on, the motor is actuated and starts high-speed operation. It starts slowing down when the counter value coincides with preset value 1 and stops when the counter value coincides with preset value 2.



External Connection Diagram



■ Applicable External Connectors

Connection Method	Applicable Connector	Remarks
Soldered type	Fujitsu:FCN-361J040-AU connector FCN-360C040-B connector cover	Supplied by the user.
Solderless type	Fujitsu:FCN-363J040 housing FCN-363J-AU contact FCN-360C040-B connector cover	
Pressure-welded type	Fujitsu:FCN-367J040-AU/F	

Operating Environment

There is no restriction on the type of CPU modules that can be used with these modules.

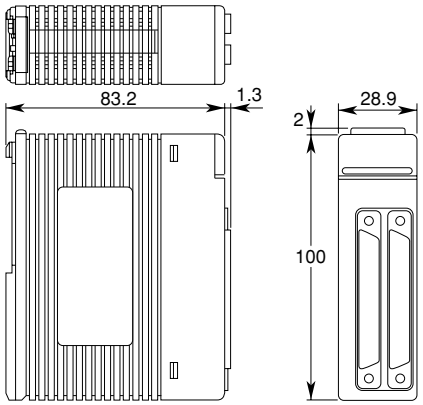
Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3XP01	- 0H	· · · · · ·	· · · · · ·	0-100 Kpps, 1 point, 32 bits
F3XP02	- 0H	· · · · · ·	· · · · · ·	0-100 Kpps, 2 points, 32 bits

Note: See the section on spare parts in the FA-M3 Universal-range Multi-controller (GS 34M6A01-01E) for information on connectors.

External Dimensions

Unit: mm



Note: This figure is for the F3XP02-0H.

General Specifications

F3NC11-0N and F3NC12-0N Positioning Modules (with Advanced Positioning Pulse Output)

FA-M3

General

The F3NC11-0N and F3NC12-0N are positioning modules with advanced positioning pulse output in the FA-M3 series.

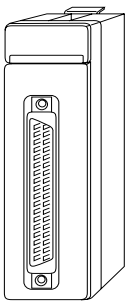
- One module can control both 1- and 2-axis motors. Being of pulse output type, these modules are well suited for position command type servo motors and drivers, or pulse motors and drivers.
- The modules are provided with simultaneous multi-axis control functions. When activated by a CPU module, these modules can perform a variety of smooth position control functions including multi-axis linear interpolation, velocity control functions and velocity/position control mode switching.
- The modules feature a short startup time of 6 ms maximum, on-route mode operation, and external-trigger-driven wait operation. These functions allow the modules to start at high speed and synchronize their operation with that of peripheral devices.

Specifications

■ Standard Specifications

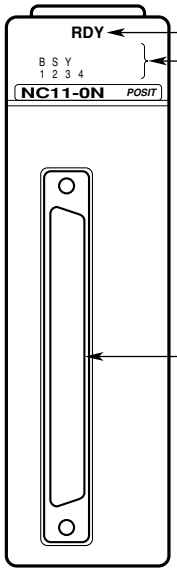
Item		Specification	
		F3NC11-0N	F3NC12-0N
Number of axes		1	2
Control	Control system	Open-loop control using a position command pulse output	
	Output pulse	• RS-422A compliant difference output (249,750 pulses/s max.) • Open-collector output (maximum pulse rate is limited by load capacitance and other factors; 50,000 pulses/s or lower is recommended.)	
Control mode		Position control, velocity control and velocity/position control switching	
Position control	Interpolation system	Independent axis operation, multi-axis linear interpolation operation (set up by the CPU) and 2-axis arc interpolation (set up by the CPU)	
	Command position	-8,388,608 to 8,388,608 pulses	
	Command speed	0.1 to 249,750 pulses/s	
	Function	On-route operation, change in target position or velocity during operation	
Velocity control	Command speed	-249,750 to 249,750 pulses/s	
	Function	Change in velocity during operation	
Acceleration/ deceleration	Acceleration/ deceleration system	Trapezoidal	
	Acceleration/ deceleration time	0 to 32,767 ms acceleration/deceleration independently programmable	
Home position search	Search mode	Selectable from home position input, proximity-to-home position input and limit input Encoder Z-phase available	
	Search speed	Arbitrarily programmable	
External contact input		Limit switch, home position, proximity to home position, external trigger and emergency stop	
Data backup		Backup using the CPU module	
Startup time		6 ms max.	
Current consumption		180 mA (5 V DC)	
External power supply		5 V DC, 200 mA	
External connection		One 40-pin connector	
External dimensions		28.9 (W) × 100 (H) × 83.2 (D) mm*	
Weight		100 g	

*: Excluding protrusions (see external dimensions for details).



Components and Functions

● **F3NC11-0N (1-axis model)**

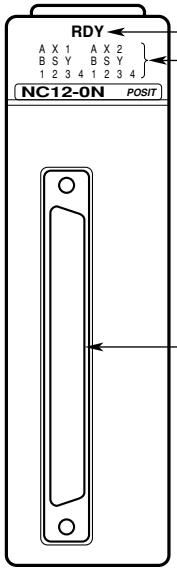


RDY indicator
Lit when the internal circuit is functioning normally.

Axis indicator
Indicates the state of the axis.
BSY: Lit when the module is in positioning operation.
1-4 : Lit when an error occurs.

External I/O connector
Connects to external inputs/outputs such as servo motors and limit switches.

● **F3NC12-0N (2-axis model)**

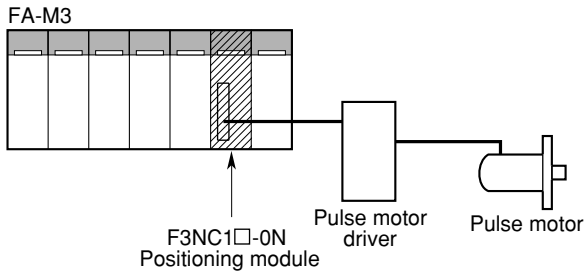


RDY indicator
Lit when the internal circuit is functioning normally.

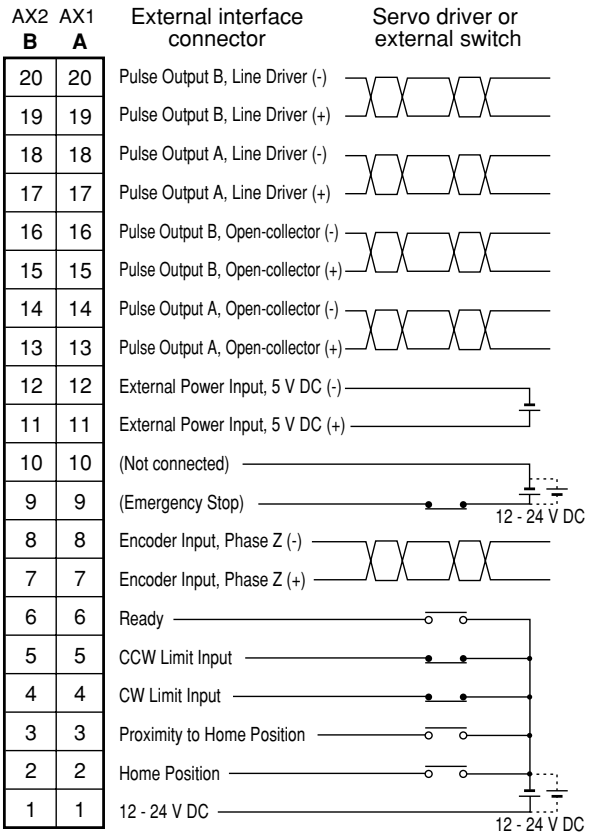
AX1/AX2 indicator
Indicates the state of each axis.
BSY: Lit when the module is in positioning operation.
1-4 : Lit when an error occurs.

External I/O connector
Connects to external inputs/outputs such as servo motors and limit switches.

Configuration Example



External Connection Diagram



- AX2 has the same external connection configuration as in AX1.
- AX1 and AX2 have their own circuits except for 9A/9B, 11A/11B and 12A/12B.
- 11A and 11B, 12A and 12B are short-circuited internally.
- The Emergency Stop input (between 9A and 9B) is common input to both AX1 and AX2.
- The F3NC01-0N does not have AX2.
- One of the following two pulse output formats can be selected for each axis:

Pulse output format	Pulse output A	Pulse output B
CW / CCW output	CCW pulse	CW pulse
Pulse/polarity output	Pulse	Polarity (ON in CW direction)

■ Applicable External Connectors

Connection Method	Applicable Connector	Remarks
Soldered type	Fujitsu:FCN-361J040-AU connector FCN-360C040-B connector cover	Supplied by the user.
Solderless type	Fujitsu:FCN-363J040 housing FCN-363J-AU contact FCN-360C040-B connector cover	
Pressure-welded type	Fujitsu:FCN-367J040-AU/F	

Operating Environment

There is no restriction on the type of CPU modules that can be used with these modules.

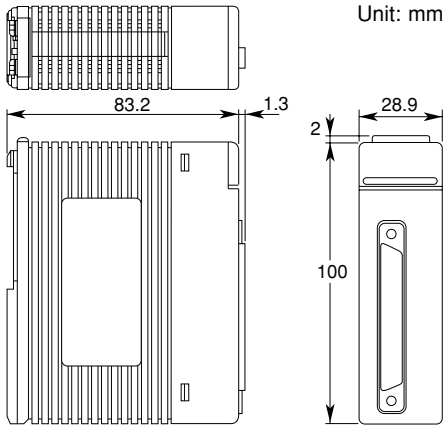
Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3NC11	- 0N	·····	·····	1-axis, -8,388,608 to + 8,388,608 pulses, 0.1 to 249,750 pps
F3NC12	- 0N	·····	·····	2-axis, -8,388,608 to + 8,388,608 pulses, 0.1 to 249,750 pps

Note: See the section on spare parts in the FA-M3 Range-free Multi-controller (GS 34M6A01-01E) for information on connectors.

External Dimensions

Unit: mm



Electrical Data

1. Input Signals

Signal	Input	Rated Input Voltage (Operating Voltage Range)	Rated Input Current	Operating Voltage/Current	
				ON	OFF
External contact input	DC voltage	12 - 24 V DC (10.2 to 26.4 V DC)	3.3 mA (12 V) 6.9 mA (24 V)	8 V min. 2.1 mA min.	1 V max. 0.8 mA max.
Encoder Z-phase input	DC voltage	5 - 12 V DC (3.5 to 13.2 V DC)	4.6 mA (5 V) 13.2 mA (12 V)	3.5 V min. 3 mA min.	3.4 V max. 0.8 mA max.

2. Output Signals

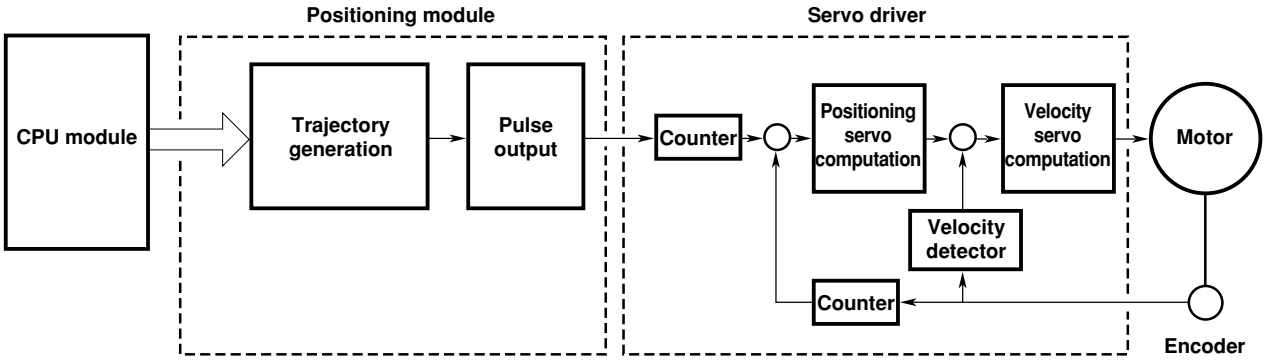
Signal		Output	Rated Load Voltage (Maximum Load Voltage)	Maximum Load Current	ON-time Residual Voltage	OFF-time Leakage Current
Pulse output*	Open-collector	Transistor contact	12 - 24 V DC (26.4 V DC)	50 mA/point	1 V DC max.	0.1 mA max.
	Line driver	RS-422 compliant difference signal	—	—	—	—

*: Pulse outputs require an external power supply ±5 V DC 65%, 200 mA).

Function Overview

1. Positioning System

This is a positioning module with positioning pulse outputs for the FA-M3 series. It generates positioning trajectory data and position command values in the pulse train according to commands from a CPU module.



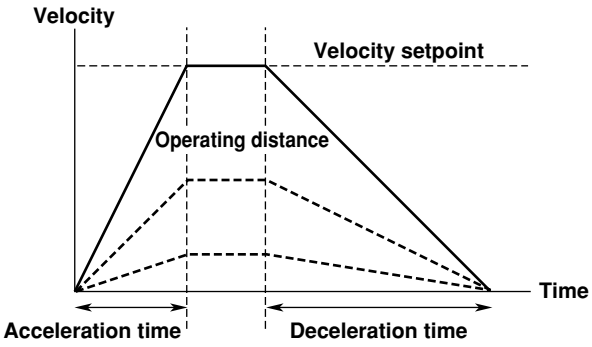
2. Position Control

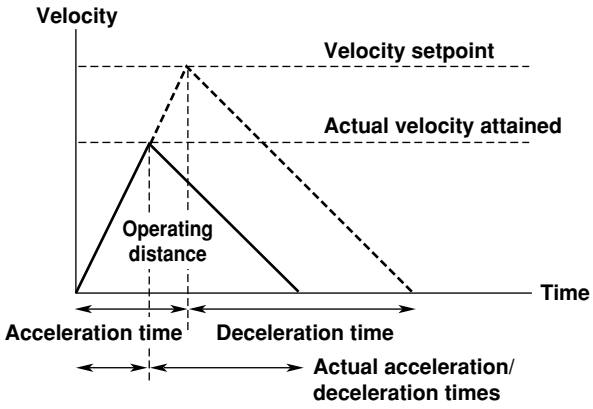
2.1 Positioning Operation

A positioning operation is started by writing the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms), and deceleration time (ms) from the CPU module and turning on the operation start relay. The positioning completion relay turns on when the output of position command pulses ends.

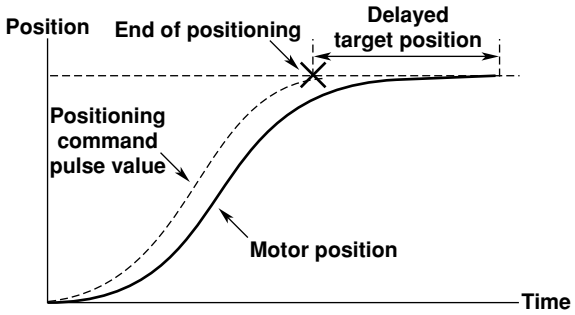
• The acceleration/deceleration curve forms a trapezoid. The acceleration and deceleration times must be set separately.

Velocity and Acceleration/Deceleration Times in the Trapezoidal Drive/Triangular Drive Mode





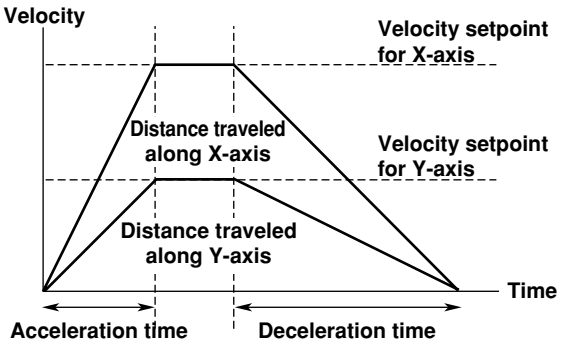
End-of-positioning Timing and Actual Motor Operation

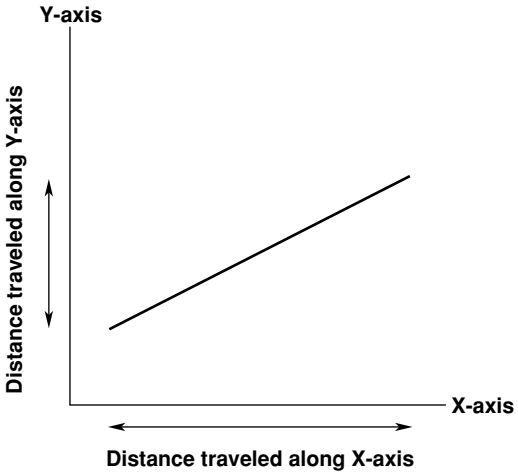


2.2 Multi-axis Linear Interpolation Operation

A linear interpolation operation is started by writing the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms), and deceleration time (ms) from the CPU module and turning on the operation start relays for all axes at the same time. When the output of position command pulses for an axis ends, the positioning completion relay associated with that axis turns on. The acceleration time (ms) and deceleration time (ms) must be set to the the same values for all axes that are subject to linear interpolation processing. The velocity setpoint (pulses/ms) for the axes must be calculated and preset so that it is equal to the ratio of the distances traveled along the axes.

Multi-axis Linear Interpolation Operation (2-axis)





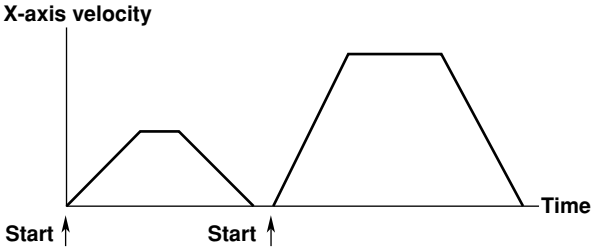
2.3 On-route Operation

When the next positioning operation is started while the execution of the current positioning operation is in progress, the positioning module keeps on combining the two positioning operations until the preceding positioning operation ends. This mode of operation is called an on-route operation and the interval during which the two positioning operations overlap is called an on-route interval. The on-route operation allows the positioning module to continue its operation toward the next target position without stopping at the preceding target position.

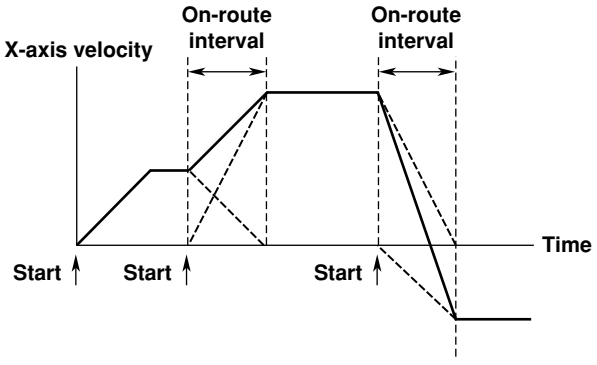
• The direction of movement may be changed during an on-route operation.

Normal Positioning Operation and On-route Operation

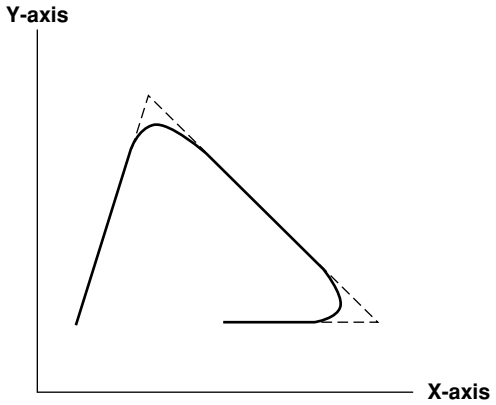
● **Normal Positioning Operation**



● **On-route Operation**



● **Example of an On-route Operation Using 2-axis Linear Interpolation**

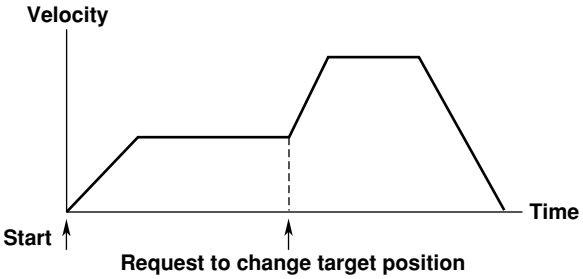


2.4 Changing the Target Position during Positioning

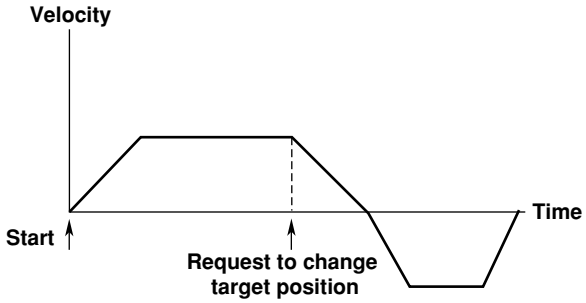
The positioning module changes the target position when the user turns on a relay to change the target position by writing new positioning parameters during positioning operation. The user can also change the traveling velocity at the same time. In addition, the user can change the target position in such a way that the direction of movement is also changed (in this case, the positioning module decelerates and stops promptly and starts positioning to the new target position.)

Target Position Change Operation

● **When Direction Change Is Not Involved**



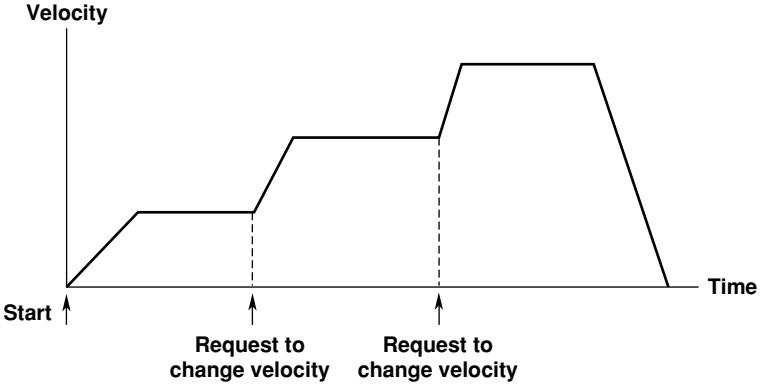
● **When a Direction Change Is Involved**



2.5 Changing the Velocity during Positioning

The positioning module changes the traveling velocity when the user turns on a relay to change the velocity by writing a new velocity (pulses/ms) during a positioning operation.

Change Velocity Operation

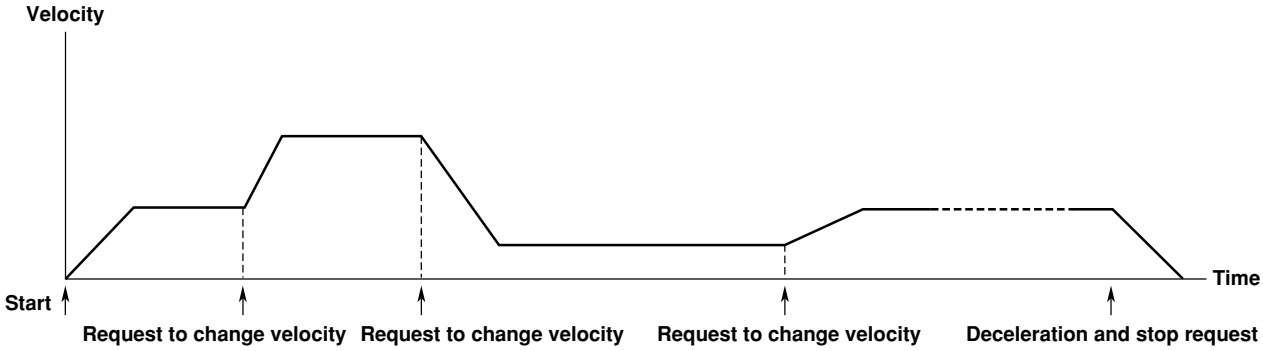


3. Velocity Control

A velocity control operation is executed by writing the velocity setpoint (pulses/ms, specify a negative value to drive the target in the negative direction), acceleration time (ms), and deceleration time (ms) from the CPU module and turning on the operation startup relay.

• The velocity can be changed while the positioning module is running.

Velocity Control and Change Operations



4. Velocity/Position Control Switching Control

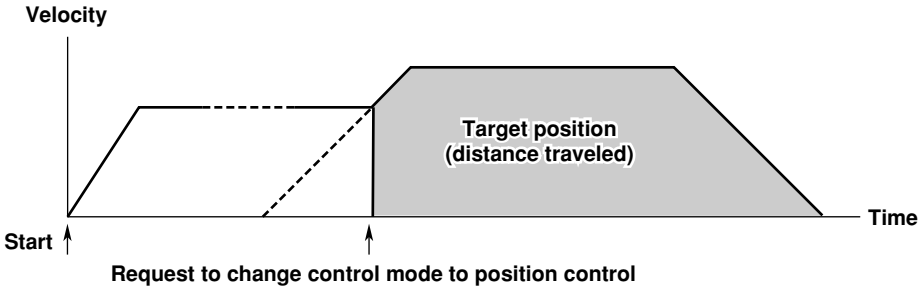
4.1 Velocity/Position Control Switching

The module starts positioning operation from scratch if the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms) and deceleration time (ms) are written from the CPU module, and then the control mode is changed to position control.

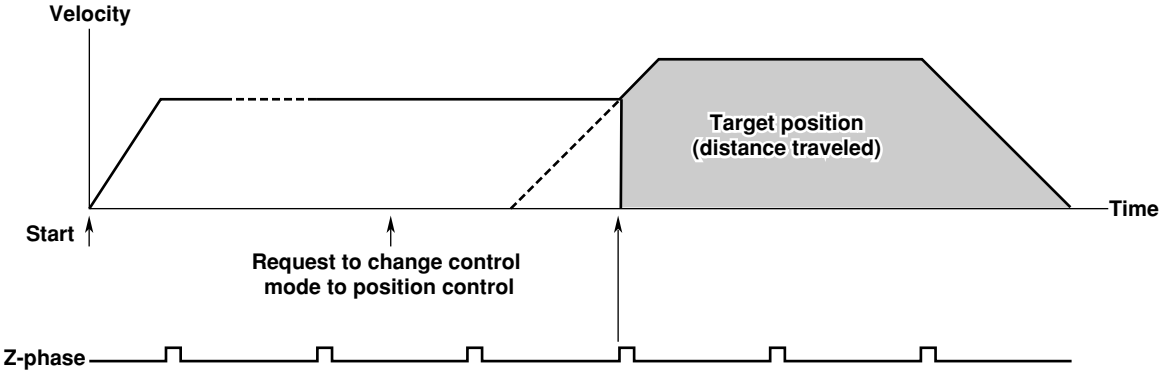
- The user can switch from velocity to position control mode in normal transfer operation as well as with remote triggering features.
- The user can set edges and counts when the Z-phase count is selected.

Switching Velocity to Position Control Operation

● **No Z-phase Count Is Specified**



● **A Z-phase Count Is Specified (Rising Edge, 2 Times)**



4.2 Switching Position to Velocity Control

When the control mode is switched from position to velocity control during positioning operation, the positioning module performs velocity control operation while maintaining the velocity that was set before the control mode switching occurs.

General Specifications

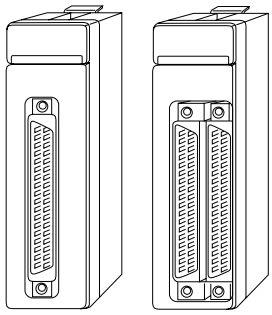
F3NC51-0N and F3NC52-0N Positioning Modules (with Analog Voltage Output)

FA-M3

General

The F3NC51-0N and F3NC52-0N are positioning modules with voltage output for velocity control for the FA-M3 series.

- One module can control both 1- and 2-axis motors. The modules support incremental and absolute encoder inputs.
- The modules are provided with simultaneous multi-axis control functions. When activated by a CPU module, these modules can perform a variety of smooth position control functions including multi-axis linear interpolation, velocity control functions and velocity/position control mode switching.
- The modules feature a short startup time of 6 ms maximum, on-route mode operation, internal-/external-trigger-driven wait operation and position detection/positioning completion interrupt. These functions allow the modules to start at high speed and synchronize their operation with that of peripheral devices.



Specifications

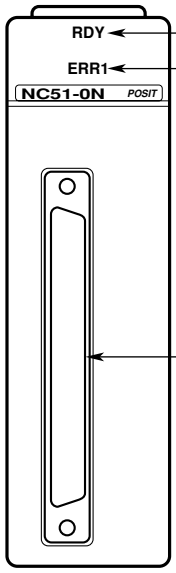
■ Standard Specifications

Item		Specification	
		F3NC51-0N	F3NC52-0N
Number of axes		1	2
Control	Control system	Semi-closed loop control (with voltage output for velocity control) based on encoder feedback	
	Velocity control output	-10 to 10 V	
	Encoder	Incremental encoder (phaseA/B): Line driver in 2M pps max. /4-time multiplication mode Absolute encoder: See the section on the next page for applicable encoding systems.	
Control mode		Position control, velocity control and velocity/position control switching	
Position control	Interpolation system	Independent axis operation, multi-axis linear interpolation operation (set up by the CPU) and 2-axis arc interpolation (set up by the CPU)	
	Command position	-134,217,728 to 134,217,727 pulses	
	Command speed	0.1 to 2 M pulses/s	
	Function	Absolute and relative positioning, on-route operation, change in target position or velocity during operation, axis stepping using a manual pulser	
Velocity control	Command speed	-2 M to 2 M pulses/s	
	Function	Change in velocity during operation	
Acceleration/deceleration	Acceleration/deceleration system	Trapezoidal, 2-line segment or S-shape (3-line segment)	
	Acceleration/deceleration time	0 to 32,767 ms acceleration/deceleration independently programmable	
Home position search	Search mode	Selectable from home position input, external trigger input and limit input	
	Search speed	Arbitrarily programmable	
External contact output		Servo on, driver reset and brake off	
External contact input		Limit switch, driver alarm, home position, external trigger, general-purpose input and emergency stop	
Data backup		Backup using the CPU module	
Startup time		6 ms max.	
Current consumption		390 mA (5 V DC)	400 mA (5 V DC)
External power supply		24 V DC, 10 mA	24 V DC, 10 mA
External connection		One 40-pin connector	Two 40-pin connectors
External dimensions		28.9 (W) × 100 (H) × 83.2 (D) mm*	
Weight		130 g	140 g

*: Excluding any protrusions (see External Dimensions for details.)

Components and Functions

● **F3NC51-0N (1-axis model)**

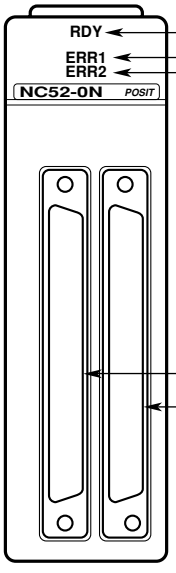


RDY indicator
Lit when the internal circuit is functioning normally.

ERR1 indicator
Lit when an error occurs.

External I/O connector (40-pin)
Connect to exteranl inputs/outputs such as servomotors and limit switches.

● **F3NC52-0N (2-axis model)**



RDY indicator
Lit when the internal circuit is functioning normally.

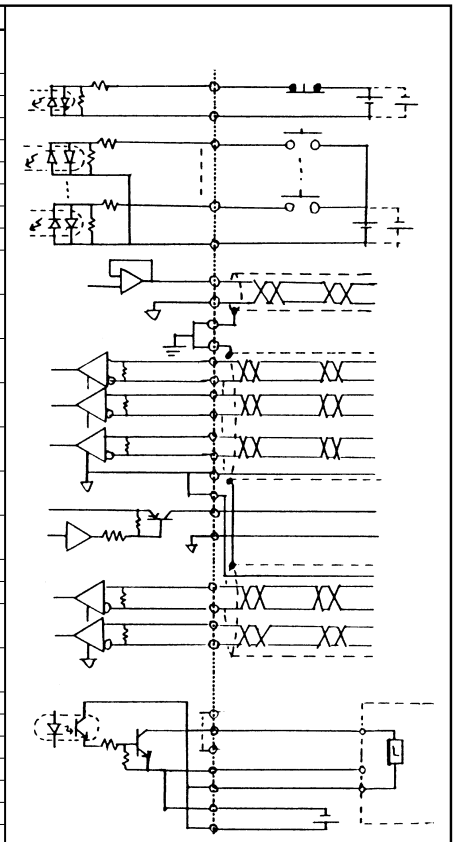
ERR1 indicator
Lit when an error occurs in axis 1.

ERR2 indicator
Lit when an error occurs in axis 2.

Axes 1 and 2 external I/O connectors
Connects to external inputs/outputs such as servomotors and limit switches.

External Connection Diagram

Pin No.		Signal Name	Electrical Specification
20b		Emergency stop input*1	24 V DC, 4.1 mA
	20a	Emergency stop input*1	
19b		External contact input 6*2	24 V DC, 4.1 mA
	19a	External contact input 5 (external trigger)*2	24 V DC, 4.1 mA
18b		External contact input 4 (home position)*2	24 V DC, 4.1 mA
	18a	External contact input 3 (driver alarm)*2	24 V DC, 4.1 mA
17b		External contact input 2 (negative direction limit)*2	24 V DC, 4.1 mA
	17a	External contact input 1 (positive direction limit)*2	24 V DC, 4.1 mA
16b		External contact input (COM)	
	16a		
15b		Voltage output for velocity control	-10 to 10 V DC, 5 mA
	15a	Voltage output for velocity control (GND)	
14b		Shield (FG)	
	14a	Shield (FG)	
13b		Encoder Z-phse input Z	RS-422A compliant differential signal, terminated by 220 Ω
	13a	Encoder Z-phse input *Z	
12b		Encoder B-phse input B	RS-422A compliant differential signal, terminated by 220 Ω
	12a	Encoder B-phse input *B	
11b		Encoder A-phse input A	RS-422A compliant differential signal, terminated by 220 Ω
	11a	Encoder A-phse input *A	
10b		Encoder/manual pulser signal ground	
	10a	Encoder/manual pulser signal ground	
9b		SEN (For Yaskawa Electric absolute encoder)	5 V DC, 10 mA
	9a	SEN_0V(GND)	
8b		Reserved	
	8a	Reserved	
7b		Manual pulser input B-phase B*3	RS-422A compliant differential signal, terminated by 220 Ω
	7a	Manual pulser input B-phase *B*3	
6b		Manual pulser input A-phase A*3	RS-422A compliant differential signal, terminated by 220 Ω
	6a	Manual pulser input A-phase *A*3	
5b			
	5a		
4b			
	4a	External contact output (closed OFF)	24 V DC, 0.1 A
3b		External contact output (driver reset)	24 V DC, 0.1 A
	3a	External contact output (servo ON)	24 V DC, 0.1 A
2b		External contact output (COM)	
	2a	External contact output (24 V)	
1b		External contact output (0 V-in)	
	1a	External contact output (24 V-in)	



*1: The emergency stop input is only for axis-1 connector. This pin in axis-2 connector is not connected internally. The signal from axis-1 connector is shared by two connectors.

*2: External contact inputs (1-6) can be programmed for general-purpose inputs.

*3: The manual pulser input is only for axis-1 connector. This pin in axis-2 connector is not connected internally. The signal from axis-1 connector is shared by two connectors.

Applicable External Connectors

Connection Method	Applicable Connector	Remarks
Soldered type	Fujitsu:FCN-361J040-AU connector FCN-360C040-B connector cover	Supplied by the user.
Solderless type	Fujitsu:FCN-363J040 housing FCN-363J-AU contact FCN-360C040-B connector cover	
Pressure-welded type	Fujitsu:FCN-367J040-AU/F	

Operating Environment

There is no restriction on the type of CPU modules that can be used with these modules.

Applicable Absolute Encoders

- Yaskawa Electric serial absolute encoder (Yaskawa S series)
- Sanyo Electric serial absolute encoders and compatibles (Manchester coded serial transmission system, Sanyo Electric P series, and Matsushita Electric MINAS series)

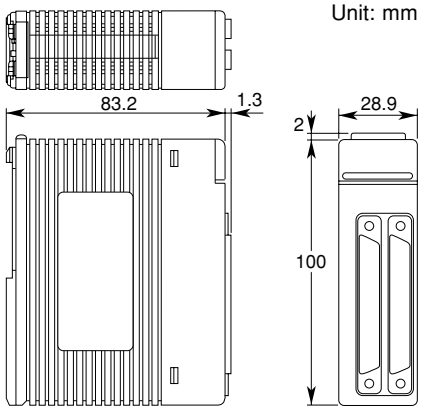
Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3NC51	- 0N	.....	.....	1-axis, position loop control, -10 V to 10 V output for velocity control, 2 Mpps maximum velocity
F3NC52	- 0N	.....	.....	2-axis, position loop control, -10 V to 10 V output for velocity control, 2 Mpps maximum velocity

Note: See the section on spare parts in the FA-M3 Range-free Multi-controller (GS 34M6A01-01E) for information on connectors.

External Dimensions

Unit: mm

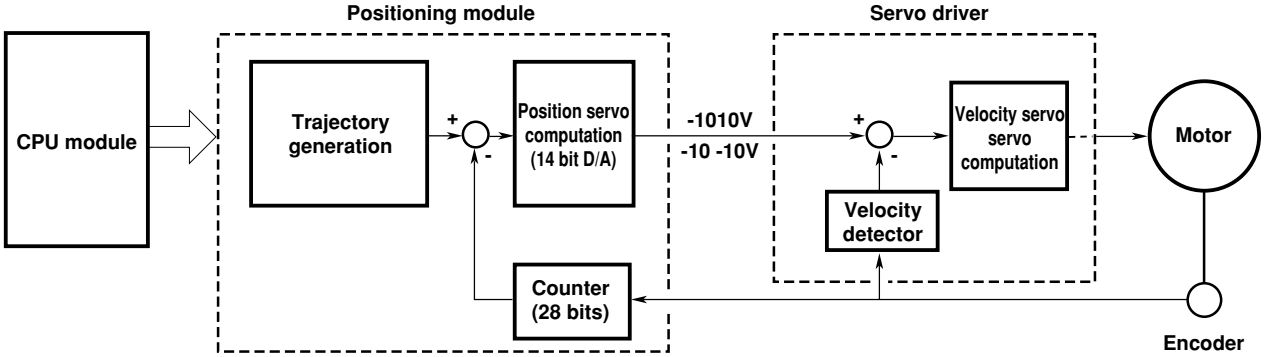


Note: This figure is for the F3NC52-0N.

Function Overview

1. Positioning System

This is a positioning module with voltage output for velocity control for the FA-M3 series. It generates positioning trajectory data, performs position-loop computations based on the feedback signal from an external position detector (incremental encoder or absolute encoder), and generates velocity command values in the form of an analog voltage, according to commands from a CPU module.



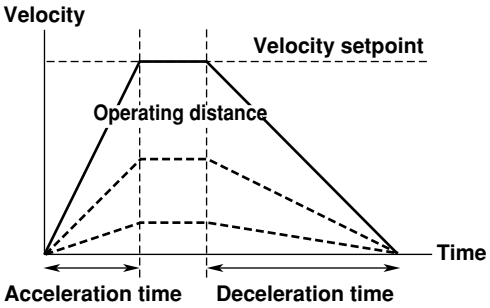
2. Position Control

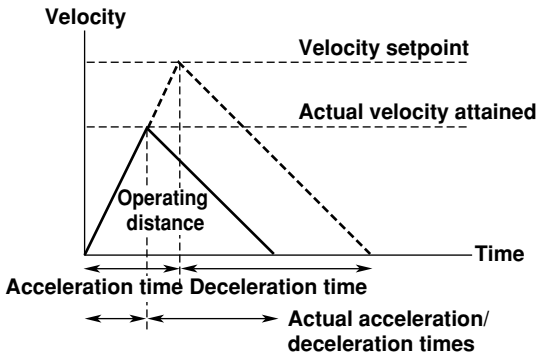
2.1 Positioning Operation

A positioning operation is started by writing the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms), and deceleration time (ms) from the CPU module and turning on the operation start relay. The positioning completion relay turns on when the output of position command pulses ends.

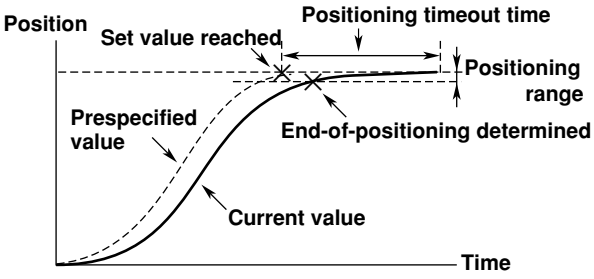
- The user can specify, as the target position, an absolute, relative position (with reference to the encoder position) or a relative position (with reference to the preceding target position).
- The acceleration/deceleration curve forms a trapezoid, 2-line segment, or S-shape (3-line segment). The acceleration and deceleration time must be set separately.
- A positioning range (pulses) and positioning timeout value (ms) must be specified to identify the end of positioning.
- The user can set up the positioning module so that positioning can be started up in normal operation as well as with remote/local triggering features.

Velocity and Acceleration/Deceleration Times in the Trapezoidal Drive/Triangular Drive Mode





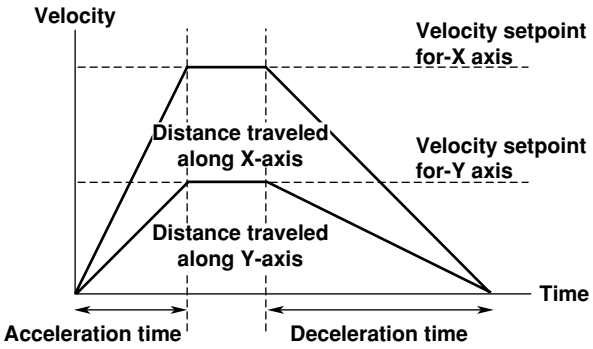
End-of-positioning timing

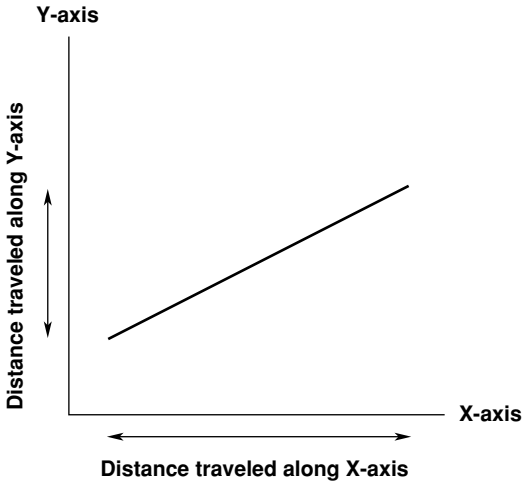


2.2 Multi-axis Linear Interpolation Operation

A linear interpolation operation is started by writing the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms) and deceleration time (ms) from the CPU module and turning on the operation start relays for all axes at the same time. When the output of position command pulses for an axis ends, the positioning completion relay associated with that axis turns on. The acceleration time (ms), deceleration time (ms) and acceleration/deceleration pattern must be set to the same values for all axes that are subject to linear interpolation processing. The velocity setpoint (pulses/ms) for the axes must be calculated and preset so that it is equal to the ratio of the distances traveled along the axes.

Multi-axis Linear Interpolation Operation (2-axis)





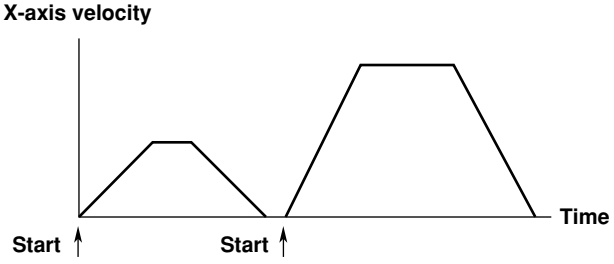
2.3 On-route Operation

When the next positioning operation is started while the execution of the current positioning operation is in progress, the positioning module keeps on combining the two positioning operations until the preceding positioning operation ends. This mode of operation is called an on-route operation and the interval during which the two positioning operations overlap is called an on-route interval. The on-route operation allows the positioning module to continue its operation toward the next target position without stopping at the preceding target position.

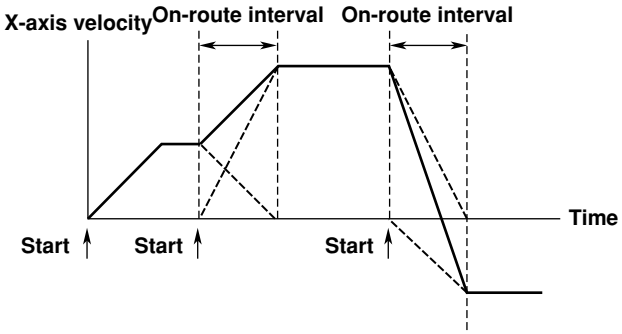
- The direction of movement may be changed during an on-route operation.

Normal Positioning Operation and On-route Operation

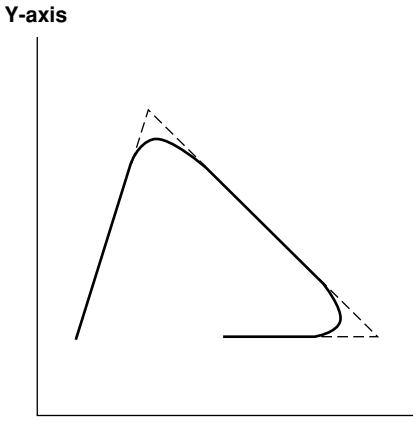
● **Normal Positioning Operation**



● **On-route Operation**



● **Example of an On-route Operation Using 2-axis Linear Interpolation**

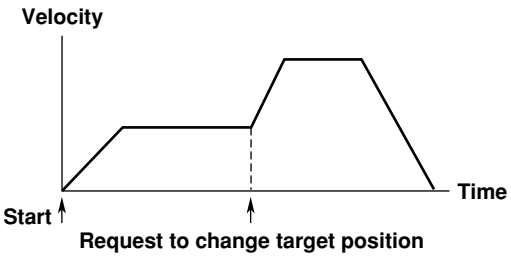


2.4 Changing the Target Position during Positioning

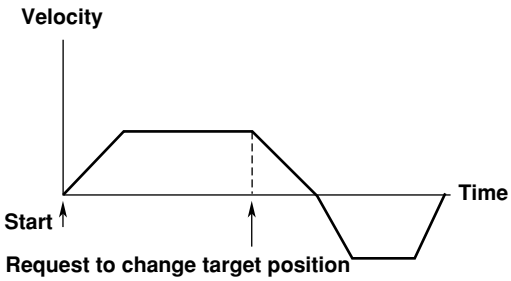
The positioning module changes the target position when the user turns on a relay to change the target position by writing new positioning parameters during positioning operation. The user can also change the target position in such a way that the direction of movement is also changed (in this case, the positioning module decelerates and stops promptly and starts positioning to the new target position.)

Target Position Change Operation

● **When Direction Change Is Not Involved**



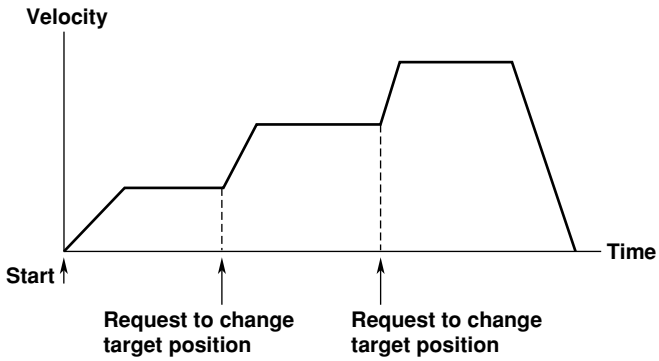
● **When a Direction Change Is Involved**



2.5 Changing the Velocity during Positioning

The positioning module changes the traveling velocity when the user turns on a relay to change the velocity by writing a new velocity (pulses/ms) during the positioning operation.

Change Velocity Operation

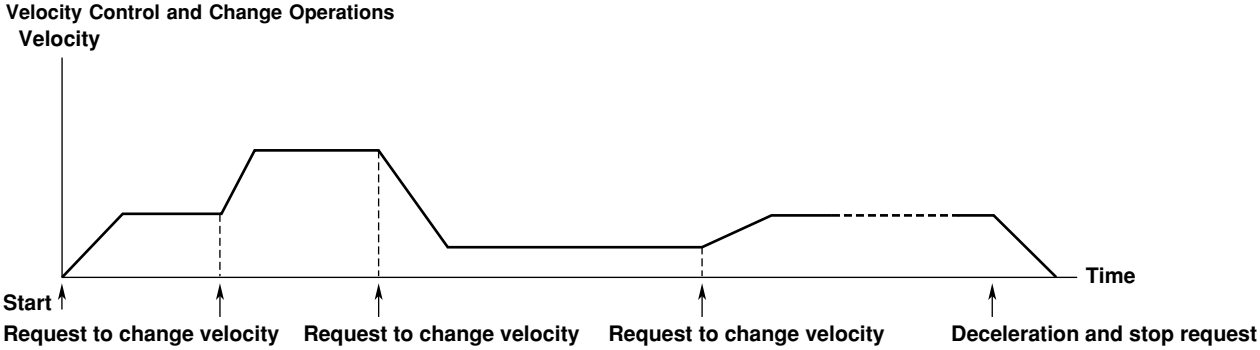


3. Velocity Control

A velocity control operation is executed by writing the velocity setpoint (pulses/ms, specify a negative value to drive the target in a negative direction), acceleration time (ms) and deceleration time (ms) from the CPU module and turning on the operation startup relay.

- The velocity can be changed while the positioning module is running.
- The acceleration/deceleration curve forms a trapezoid, 2-line segment or S-shape (3-line segment). The acceleration and deceleration times must be set separately.
- A positioning range (pulses) and positioning timeout value (ms) must be specified to identify the end of positioning.
- The user can set up the positioning module so that positioning can be started up in normal operaion as well as with remote /local triggering features.

Velocity Control and Change Operations



4. Velocity/Position Control Switching Control

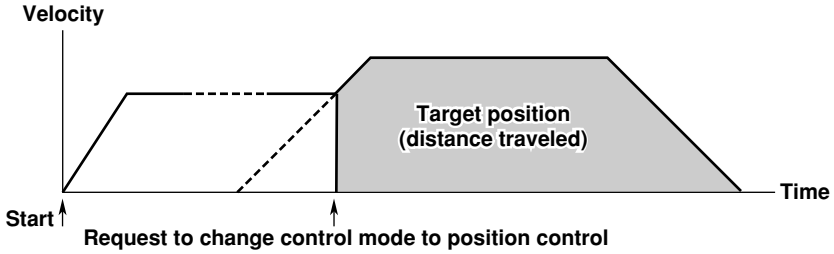
4.1 Velocity/Position Control Switching

The module starts positioning operation from scratch if the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms) and deceleration time (ms) are written from the CPU module, and then the control mode is changed to position control.

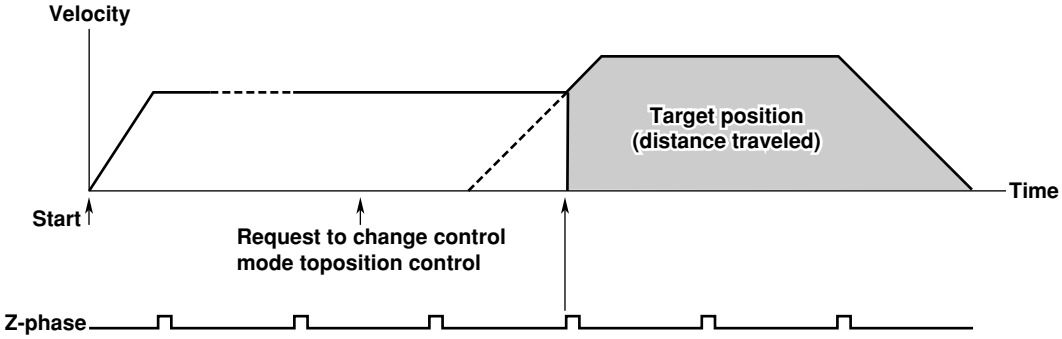
- The acceleration/deceleration curve forms a trapezoid, 2-line segment or S-shape (3-line segment). The acceleration and deceleration times must be set separately.
- A positioning range (pulses) and positioning timeout value (ms) must be specified to identify the end of positioning.
- The user can switch from velocity to position control mode in normal transfer operation as well as with remote triggering features.
- The user can set edges and counts when the Z-phase count is selected.

Velocity to Position Control Switching Operation

● **No Z-phase Count is Specified**



● **A Z-phase Count is Specified (Rising Edge, 2 Times)**



4.2 Position to Velocity Control Switching

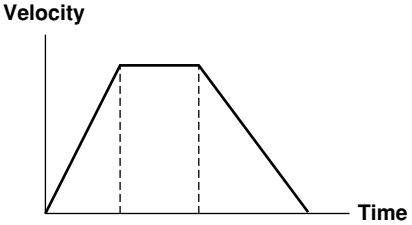
When the control mode is switched from position to velocity control during positioning operation, the positioning module performs velocity control operation while maintaining the velocity that was set before the control mode switching occurs.

5. Acceleration / Decleration

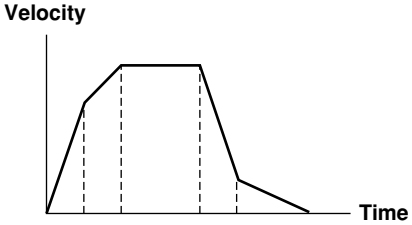
The legitimate position/velocity control acceleration/deceleration modes are trapezoid, 2-line segment and S-shape (3-line segment). The user can specify the mode and time separately for both acceleration and deceleration. Neither 2-line segment nor S-shape is formed, however, when the target setpoint or velocity is changed during the positioning operation.

Acceleration/Deceleration Methods in Position and Velocity Control Operation

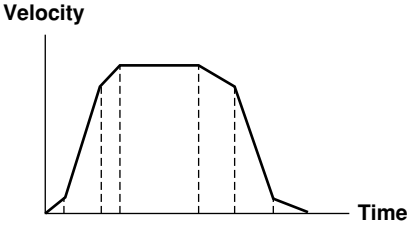
● **Trapezoid**



● **2-line Segment**



● **S-shape (3-line segment)**



General Specifications

F3YP04-0N and F3YP08-0N
Positioning Modules
(with Multi-channel Pulse Output)

FA-M3

General

The F3YP04-0N and F3YP08-0N are positioning modules with multi-channel pulse outputs for the FA-M3 series. A single module can control 4- and 8-axis of motors. Being of pulse output type, these modules are well suited for servo motors/drivers or pulse motors/drivers of position command type.

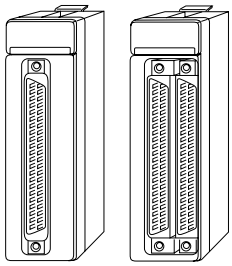
- Some of the less frequently used functions of the modules have been trimmed down and the number of axes that they can control has been increased to 8 axes (conventionally 2 axes per slot). This makes it possible to configure multi-axis positioning systems with as many as 288 axes (when the base unit is extended and 36 F3YP08-0N modules are used).
- The modules feature a short startup time of 6 ms maximum, allowing for high speed operation and synchronous operation with that of peripheral devices.

Specifications

■ Standard Specifications

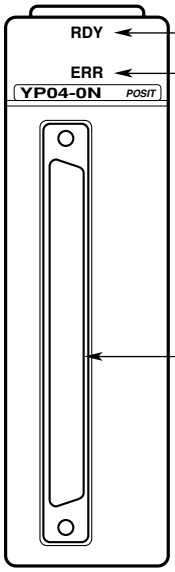
Item	Specification	
	F3YP04-0N	F3YP08-0N
Number of axes	4	8
Number of simultaneous -controlled axes	4	8
Control system	Open-loop position control using a positioning pulse output	
Output pulse system	RS-422A compliant difference signal, forward/reverse pulse outputs for each axis.	
Maximum velocity	250,000 pulses/s	
Acceleration/ deceleration system	Automatic trapezoidal acceleration/ deceleration (starting velocity programmable)	
Acceleration/ deceleration time	0 to 32,767 ms acceleration/deceleration independently programmable	
Pulse range	–134,217,728 to 134,217,727 pulses	
Command speed	0.1 - 250,000 pulses/s	
Home position search mode	Selectable from home position input and limit input Encoder Z-phase available	
Home position search speed	Arbitrarily programmable	
External contact input	Positive limit switch, negative limit switch, home position and Z-phase	
External contact output	Deviation pulse clear signal	
Data backup	Backup using the CPU module	
Startup time	6 ms max.	
Current consumption	300 mA	350 mA
External power supply	5 V DC, 350 mA	5 V DC, 700 mA
External connection	One 48-pin connector	Two 48-pin connectors
External dimensions	28.9 (W) × 100 (H) × 83.2 (D) mm*	
Weight	110 g	130 g

*: Excluding protrusions (see external dimensions for details).



Components and Functions

● **F3YP04-0N (4-axis model)**

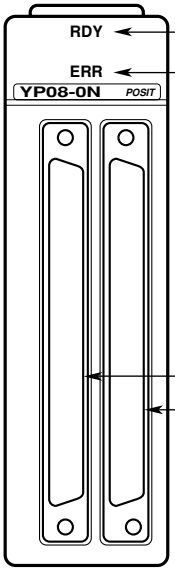


RDY indicator
Lit when the internal circuit is functioning normally.

ERR indicator
Lit when an error occurs.

Axes 1-4 connector (48-pins)
Connect to external inputs/outputs such as servomotors and limit switches.

● **F3YP08-0N (8-axis model)**



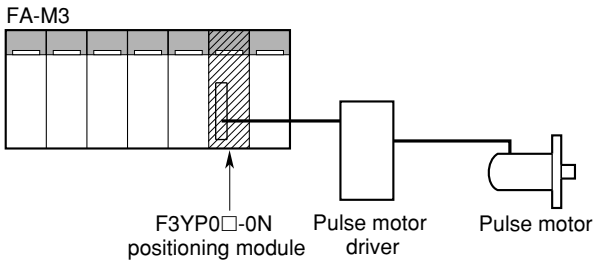
RDY indicator
Lit when the internal circuit is functioning normally.

ERR indicator
Lit when an error occurs.

Axis 1-4 connector (48-pins)

Axis 5-8 connector (48-pins)
Connect to external inputs/outputs such as servomotors and limit switches.

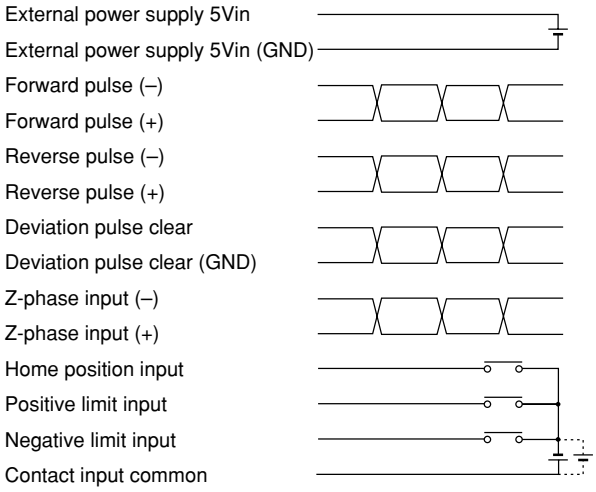
Configuration Example



External Connection Diagram

24b	Axis 4 Z-phase input (–)	24a	Axis 2 Z-phase input (–)
23b	Axis 4 Z-phase input (+)	23a	Axis 2 Z-phase input (+)
22b	Axis 4 forward pulse (+)	22a	Axis 2 forward pulse (+)
21b	Axis 4 forward pulse (–)	21a	Axis 2 forward pulse (–)
20b	Axis 4 reverse pulse (+)	20a	Axis 2 reverse pulse (+)
19b	Axis 4 reverse pulse (–)	19a	Axis 2 reverse pulse (–)
18b	Axis 4 deviation pulse clear	18a	Axis 2 deviation pulse clear
17b	Axis 4 deviation pulse clear (GND)	17a	Axis 2 deviation pulse clear (GND)
16b	Axis 3 Z-phase input (–)	16a	Axis 1 Z-phase input (–)
15b	Axis 3 Z-phase input (+)	15a	Axis 1 Z-phase input (+)
14b	Axis 3 forward pulse (+)	14a	Axis 1 forward pulse (+)
13b	Axis 3 forward pulse (–)	13a	Axis 1 forward pulse (–)
12b	Axis 3 reverse pulse (+)	12a	Axis 1 reverse pulse (+)
11b	Axis 3 reverse pulse (–)	11a	Axis 1 reverse pulse (–)
10b	Axis 3 deviation pulse clear	10a	Axis 1 deviation pulse clear
9b	Axis 3 deviation pulse clear (GND)	9a	Axis 1 deviation pulse clear (GND)
8b	External power supply 5Vin	8a	External power supply 5Vin (GND)
7b	Axis 4 home position input	7a	Axis 2 home position input
6b	Axis 4 positive limit input	6a	Axis 2 positive limit input
5b	Axis 4 negative limit input	5a	Axis 2 negative limit input
4b	Axis 3 home position input	4a	Axis 1 home position input
3b	Axis 3 positive limit input	3a	Axis 1 positive limit input
2b	Axis 3 negative limit input	2a	Axis 1 negative limit input
1b	Contact input common	1a	Contact input common

24b	Axis 8 Z-phase input (–)	24a	Axis 6 Z-phase input (–)
23b	Axis 8 Z-phase input (+)	23a	Axis 6 Z-phase input (+)
22b	Axis 8 forward pulse (+)	22a	Axis 6 forward pulse (+)
21b	Axis 8 forward pulse (–)	21a	Axis 6 forward pulse (–)
20b	Axis 8 reverse pulse (+)	20a	Axis 6 reverse pulse (+)
19b	Axis 8 reverse pulse (–)	19a	Axis 6 reverse pulse (–)
18b	Axis 8 deviation pulse clear	18a	Axis 6 deviation pulse clear
17b	Axis 8 deviation pulse clear (GND)	17a	Axis 6 deviation pulse clear (GND)
16b	Axis 7 Z-phase input (–)	16a	Axis 5 Z-phase input (–)
15b	Axis 7 Z-phase input (+)	15a	Axis 5 Z-phase input (+)
14b	Axis 7 forward pulse (+)	14a	Axis 5 forward pulse (+)
13b	Axis 7 forward pulse (–)	13a	Axis 5 forward pulse (–)
12b	Axis 7 reverse pulse (+)	12a	Axis 5 reverse pulse (+)
11b	Axis 7 reverse pulse (–)	11a	Axis 5 reverse pulse (–)
10b	Axis 7 deviation pulse clear	10a	Axis 5 deviation pulse clear
9b	Axis 7 deviation pulse clear (GND)	9a	Axis 5 deviation pulse clear (GND)
8b	External power supply 5Vin	8a	External power supply 5Vin (GND)
7b	Axis 8 home position input	7a	Axis 6 home position input
6b	Axis 8 positive limit input	6a	Axis 6 positive limit input
5b	Axis 8 negative limit input	5a	Axis 6 negative limit input
4b	Axis 7 home position input	4a	Axis 5 home position input
3b	Axis 7 positive limit input	3a	Axis 5 positive limit input
2b	Axis 7 negative limit input	2a	Axis 5 negative limit input
1b	Contact input common	1a	Contact input common



- All axes are connected to the external devices in the same manner.
- The external power supply 5 V is common to all axes. Connect the power cable to one of the two module connectors, or connect the same power supply to the two module connectors.
- The contact input common pins (4 lines) are internally connected.
- The deviation pulse clear and Z-phase input signals are independently available for each axis.
- The F3YP04-0N does not have axes 5-8. Consequently, it has only one module connector (left side).

■ Applicable External Connectors

Connection Method	Applicable Connector	Remarks
Soldered type	Fujitsu:FCN-361J048-AU connector FCN-360C048-B connector cover	Supplied by the user.
Solderless type	Fujitsu:FCN-363J048 housing FCN-363J-AU contact FCN-360C048-B connector cover	
Pressure-welded type	Fujitsu:FCN-367J048-AU/F	

Operating Environment

There is no restriction on the type of CPU modules that can be used with these module.

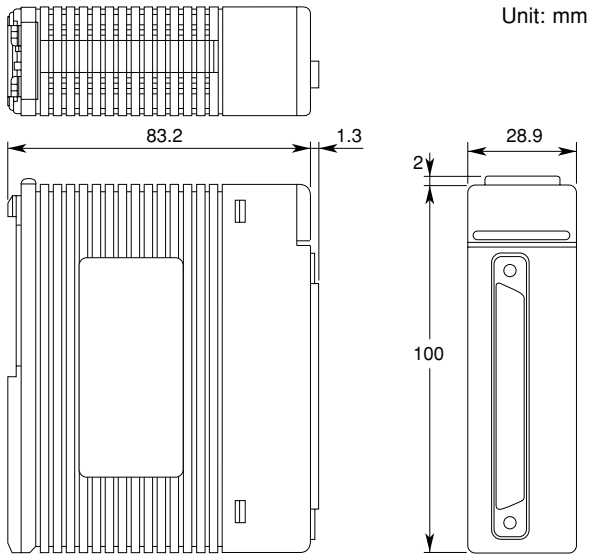
Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3NC51	**- 0N**	·····	·····	4-axis, multichannel pulse output, 250,000 pulses/s max.
F3NC52	**- 0N**	·····	·····	8-axis, multichannel pulse output, 250,000 pulses/s max.

Note: See the section on spare parts in the FA-M3 Range-free Multi-controller (GS 34M6A01-01E) for information on connectors.

External Dimensions

Unit: mm



Note: This figure is for the F3YP04-0N.

Electrical Data

1. Input Signals

Signal	Input	Rated Input Voltage (Operating Voltage Range)	Rated Input Current	Operating Voltage/Current	
				ON	OFF
External contact input	DC voltage	24 V DC (20.4 to 26.4 V DC)	3.1 mA	19.2 V min. 2.4 mA min.	5.8 V max. 0.9 mA max.
Encoder Z-phase input	DC voltage	5 V DC (4.25 to 5.5 V DC)	15.3 mA	3.5 V min. 9 mA min.	1.5 V max. 2 mA max.

2. Output Signals

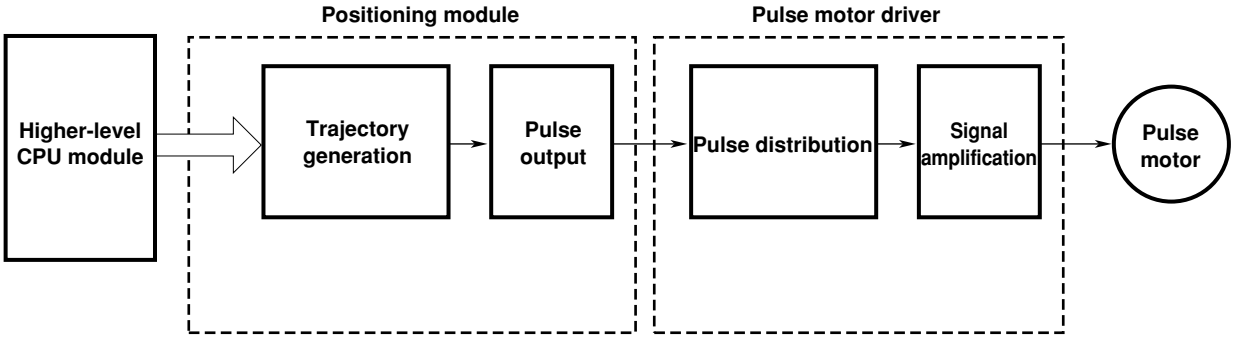
Signal		Output	Rated Load Voltage (Maximum Load Voltage)	Maximum Load Current	ON-time Residual Voltage	OFF-time Leakage Current
Deviation pulse clear	**Open-collector**	Transistor contact	12 - 24 V DC (26.4 V DC)	100 mA/ point	1.5 V DC max.	0.1 mA max.
Pulse output*	**Line driver**	RS-422 compliant difference signal	—	—	—	—

*: Pulse outputs require an external power supply ±5 V DC (5%).

Function Overview

1. Positioning System

This is a positioning module with positioning pulse outputs for the FA-M3 series. It generates positioning trajectory data and position command values in the pulse train according to commands from a CPU module.

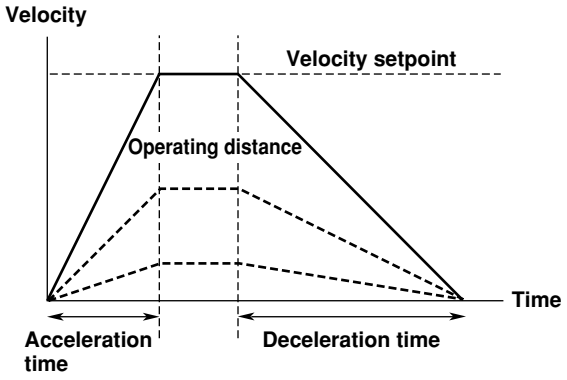


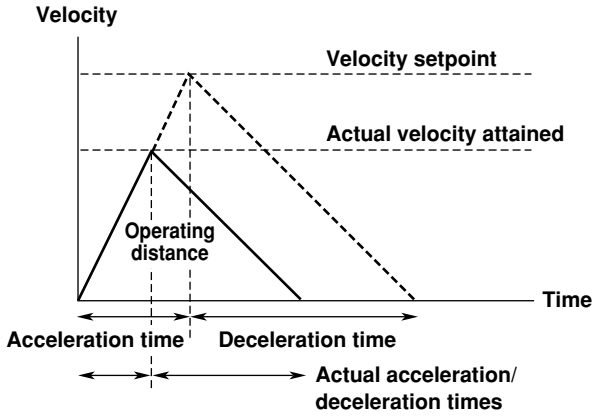
2. Position Control

2.1 Positioning Operation

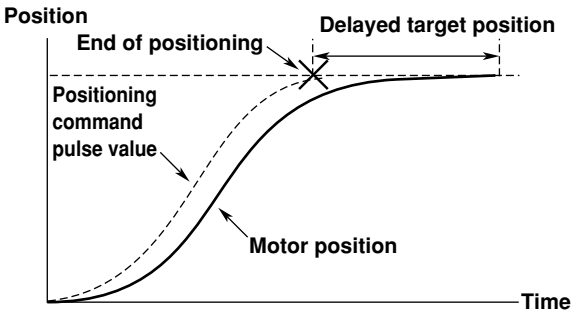
A positioning operation is started by writing the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms) and deceleration time (ms) from the CPU module and issuing a command code of 0 (to turn on the output relay for command execution). The positioning completion relay turns on when the output of position command pulses ends.
The acceleration/deceleration curve forms a trapezoid. The acceleration and deceleration times must be set separately.

Velocity and Acceleration/Deceleration Times in the Trapezoidal Drive/Triangular Drive Mode

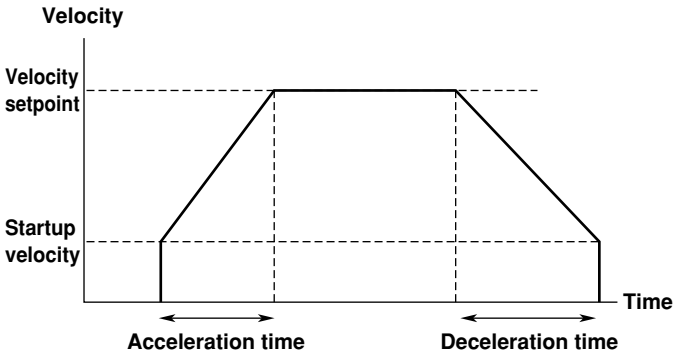




End-of-positioning Timing and Actual Motor Operation



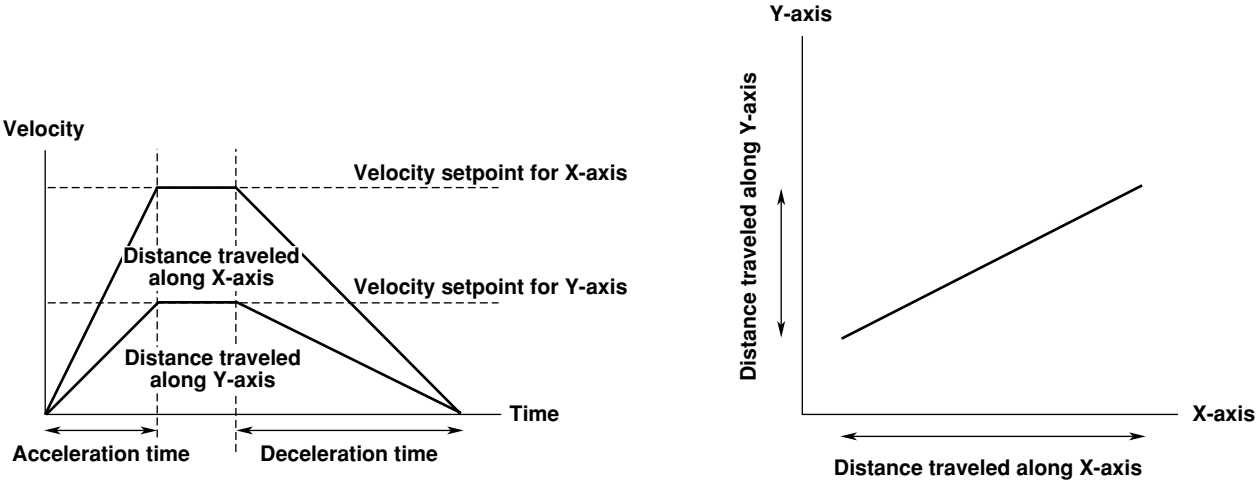
Acceleration/Deceleration Times and Startup Velocity



2.2 Multi-axis Linear Interpolation Operation

A linear interpolation operation is started by writing the velocity setpoint (pulses/ms), target position (pulses), acceleration time (ms) and deceleration time (ms) from the CPU module and issuing a command code of 0 (to turn on the output relays for all axes at the same time). When the output of position command pulses for an axis ends, the positioning completion relay associated with that axis turns on. The acceleration time (ms) and deceleration time (ms) must be set to the same values for all axes that are subject to linear interpolation processing. The velocity setpoint (pulses/ms) for the axes must be calculated and preset so that it is equal to the ratio of the distances traveled along the axes.

Multi-axis Linear Interpolation Operation (2-axis)



Items to Specify When Ordering

1. Model and suffix codes