

Programmable Controller

**MELSEC iQ-F**  
series

MELSEC iQ-F  
FX5 CPU Module Function Block Reference

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# SAFETY PRECAUTIONS

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(Read these precautions before use.)

Before using this product, please read this reference and the relevant manuals introduced in this reference carefully and pay full attention to safety in order to handle the product correctly.

The precautions given in this reference are concerned with this product only. For the safety precautions of the programmable controller system, refer to the User's Manual (Hardware) of the CPU module used.

This reference classifies the safety precautions into two categories: "⚠️ WARNING" and "⚠️ CAUTION".

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 <b>WARNING</b>	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
 <b>CAUTION</b>	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

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Depending on the circumstances, procedures indicated by "⚠️ CAUTION" may also cause severe injury

It is important to follow all precautions for personal safety.

Store this reference in a safe place so that it can be read whenever necessary. Always forward it to the end user.

# INTRODUCTION

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Thank you for purchasing the Mitsubishi MELSEC iQ-F series programmable controllers.

This reference will guide the reader in module FBs for following target modules.

Before using this product, please read this manual and the relevant manuals introduced in this specifications carefully and pay attention to safety in order to handle the product correctly.

Always forward it to the end user.

## Relevant products

- FX5UJ CPU module
- FX5U CPU module
- FX5UC CPU module

## Regarding use of this product

- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult Mitsubishi Electric.
- This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions into the system.

## Note

- If in doubt at any stage during the installation of the product, always consult a professional electrical engineer who is qualified and trained to the local and national standards. If in doubt about the operation or use, please consult your local Mitsubishi Electric representative.
- Mitsubishi Electric will not accept responsibility for actual use of the product based on these illustrative examples. Please use it after confirming the function and safety of the equipment and system.
- The content, specification etc. of this manual may be changed, for improvement, without notice.
- The information in this manual has been carefully checked and is believed to be accurate; however, if you notice a doubtful point, an error, etc., please contact your local Mitsubishi Electric representative.

# MEMO

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# RELEVANT MANUALS

Manual name <manual number>	Description
MELSEC iQ-F FX5 User's Manual (Startup) <JY997D58201>	Performance specifications, procedures before operation, and troubleshooting of the CPU module.
MELSEC iQ-F FX5UJ User's Manual (Hardware) <SH-082206ENG>	Describes the details of hardware of the FX5UJ CPU module, including input/output specifications, wiring, installation, and maintenance.
MELSEC iQ-F FX5U User's Manual (Hardware) <JY997D55301>	Describes the details of hardware of the FX5U CPU module, including input/output specifications, wiring, installation, and maintenance.
MELSEC iQ-F FX5UC User's Manual (Hardware) <JY997D61401>	Describes the details of hardware of the FX5UC CPU module, including input/output specifications, wiring, installation, and maintenance.
MELSEC iQ-F FX5 User's Manual (Application) <JY997D55401>	Describes basic knowledge required for program design, functions of the CPU module, devices/labels, and parameters.
MELSEC iQ-F FX5 Programming Manual (Program Design) <JY997D55701>	Describes specifications of ladders, ST, FBD/LD, and other programs and labels.
MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks) <JY997D55801>	Describes specifications of instructions and functions that can be used in programs.
MELSEC iQ-F FX5 User's Manual (Positioning Control - Intelligent function module) <SH-081805ENG>	Describes the positioning module.
GX Works3 Operating Manual <SH-081215ENG>	System configuration, parameter settings, and online operations of GX Works3.

## TERMS

Unless otherwise specified, this manual uses the following terms.

For details on the FX3 devices that can be connected with the FX5, refer to the User's Manual (Hardware) of the CPU module to be used.

Terms	Description
FX5	Generic term for FX5UJ, FX5U and FX5UC PLCs
FX5 CPU module	Generic term for FX5UJ CPU module, FX5U CPU module and FX5UC CPU module
FX5UJ CPU module	Generic term for FX5UJ-24MR/ES, FX5UJ-24MT/ES, FX5UJ-24MT/ESS, FX5UJ-40MR/ES, FX5UJ-40MT/ES, FX5UJ-40MT/ESS, FX5UJ-60MR/ES, FX5UJ-60MT/ES, and FX5UJ-60MT/ESS
FX5U CPU module	Generic term for FX5U-32MR/ES, FX5U-32MT/ES, FX5U-32MT/ESS, FX5U-64MR/ES, FX5U-64MT/ES, FX5U-64MT/ESS, FX5U-80MR/ES, FX5U-80MT/ES, FX5U-80MT/ESS, FX5U-32MR/DS, FX5U-32MT/DS, FX5U-32MT/DSS, FX5U-64MR/DS, FX5U-64MT/DS, FX5U-64MT/DSS, FX5U-80MR/DS, FX5U-80MT/DS, and FX5U-80MT/DSS
FX5UC CPU module	Generic term for FX5UC-32MT/D, FX5UC-32MT/DSS, FX5UC-64MT/D, FX5UC-64MT/DSS, FX5UC-96MT/D, FX5UC-96MT/DSS, FX5UC-32MT/DS-TS, FX5UC-32MT/DSS-TS, and FX5UC-32MR/DS-TS
Engineering tool	A tool used for setting up programmable controllers, programming, debugging, and maintenance.
Module label	A label that represents one of memory areas (I/O signals and buffer memory areas) specific to each module in a given character string. For the module used, GX Works3 automatically generates this label, which can be used as a global label.
Failsafe	To take appropriate action to operate on the safe side when a failure occurs.
Servo amplifier	A control device for rotating the servo motor according to the command from a higher-level device, such as a PLC, positioning module or motion controller.
Communication protocol	The communication protocol refers to the rules and procedures for communication with a target device.
Dead band	The dead band refers to the range indicating the distance between a reference and the output start position. In the case of a model provided with heating/cooling control operation, the dead band can be obtained by setting the heating/cooling output value to the positive value.
Dead zone	A dead band. When the controlled object makes mechanical movements, the dead band may be required
Hysteresis	A phenomenon where the status is affected not only by the current conditions but also by the past conditions. The characteristics of a device whose output values vary depending on the directionality of applied input values.
Feedback value	The value returned to confirm whether the device has acted as a command given by the automatic control.

Terms	Description
PID characteristics	Characteristics for setting a target value and automatically adjusting the output to make it close to the target value. P: Proportional I: Integral D: Differential
Two-position control	In the two-position control (on/off control), one of two predetermined manipulated variables is used. The control is the simplest type of control in which the operating part is fully closed/stopped or is fully opened/started when the controlled variable deviates from the target value. The controlled variable increases and decreases from the target value and fluctuates periodically.
Three-position control	The three-position control (floating control) is a combination of control methods in which the two-position control on the cooling side and the two-position control on the heating side can be automatically performed. The control is characterized by the creation of stopped state by setting an OFF point in any intermediate position between two ON points.

## GENERIC TERMS AND ABBREVIATIONS

Unless otherwise specified, this manual uses the following generic terms and abbreviations.

Generic terms and abbreviations	Description
FB	FB is the abbreviation for function block, in which the circuit blocks used repeatedly in a sequence program are broken down into parts so that the parts can be used for other purposes in the sequence program. This improves the program development efficiency, reduces program errors and improves the program quality.

# 1 OVERVIEW

The FBs listed in this reference are module FBs (for GX Works3) to use the MELSEC iQ-F series FX5UJ, FX5U, and FX5UC CPU module.

## 1.1 Function Block (FB) List

Shown below is the list of the module FBs cited in this reference.

### Point

Note that this reference does not describe the FB version information which is displayed such as "\_00A" at the end of FB name.

### Input/Output FB

○: Required —: Not required

Name	Description	Necessity of parameter setting
M+FX5UCPU-IO_OutputOnTimes (Counting the number of relay output ON times)	This FB counts (cumulatively) the number of ON times of the specified relay device number within the range from 0 to 4294967295.	—
M+FX5UCPU-IO_CompareRelayOnTimes (Counting the number of relay output ON times with comparison function)	<ul style="list-style-type: none"><li>This FB counts (cumulatively) the number of ON times of the specified relay device number within the range from 0 to 4294967295.</li><li>This FB compares the counted number of ON times with the set value, and outputs the comparison result.</li></ul>	—

### Positioning FB

○: Required —: Not required

Name	Description	Necessity of parameter setting
M+FX5UCPU-Positioning_ABRST (Absolute position restoration)	This FB reads the absolute position (ABS) data from the servo amplifier, and writes the read value to the current address (pulse unit) of the target axis.	—
M+FX5UCPU-Positioning_StartPositioning (Positioning activation)	This FB uses the table data set using the module parameters to activate the positioning operation.	○

### Serial Communication FB

○: Required —: Not required

Name	Description	Necessity of parameter setting
M+FX5UCPU-SerialComm_InputOutput (Sending and receiving non-protocol data)	This FB stores the received data and sends the specified number of data points using non-protocol in serial communication.	○
M+FX5UCPU-SerialComm_Input (Receiving of non-protocol data)	This FB stores the data received using non-protocol in serial communication.	○
M+FX5UCPU-SerialComm_Output (Sending of non-protocol data)	This FB sends the specified number of data points using non-protocol in serial communication.	○
M+FX5UCPU-SerialComm_ExeCommonProtocol (Sending and receiving communication protocol support function data)	This FB executes the protocol registered with GX Works3.	○

### High-speed Counter FB

○: Required —: Not required

Name	Description	Necessity of parameter setting
M+FX5UCPU-Counter_PulseMeasure (Pulse measurement)	This FB starts the pulse measurement function, and stores the pulse measured value.	○

## Temperature Control FB

○: Required —: Not required


Name	Description	Necessity of parameter setting
M+FX5UCPU- TemperatureCtrl_TwoPositionControl (Two-position control)	This FB performs two-position control to turn the control output ON/OFF based on the input of the measured value, target value, and dead band.	—
M+FX5UCPU- TemperatureCtrl_TwoPositionControlPd (Two-position control with a PD characteristic)	This FB performs two-position control with a PD characteristic to turn the control output ON/OFF based on the input of the measured value, target value, dead band, delay time, and maximum feedback value.	—
M+FX5UCPU- TemperatureCtrl_TwoPositionControlPi (Two-position control with a PI characteristic)	This FB performs two-position control with a PI characteristic to turn the control output ON/OFF and output the output time based on the input of the measured value, target value, proportional band, integral band, dead band, and integral time.	—
M+FX5UCPU- TemperatureCtrl_ThreePositionControl (Three-position control)	This FB performs three-position control to turn the control output + side and control output - side ON/OFF individually based on the input of the measured value, target value, dead band, and adjustment sensitivity.	—
M+FX5UCPU- TemperatureCtrl_ThreePositionControlPd (Three-position control with a PD characteristic)	This FB performs three-position control with a PD characteristic to turn the control output + side and control output - side ON/OFF individually based on the input of the measured value, target value, dead band, delay time of the control output + side, maximum feedback value of the control output + side, delay time of the control output - side, and maximum feedback value of the control output - side.	—
M+FX5UCPU- TemperatureCtrl_ThreePositionControlPi (Three-position control with a PI characteristic)	This FB performs three-position control with a PI characteristic to turn the control output + side and control output - side ON/OFF individually and output the control time based on the input of the measured value, target value, proportional band, integral band, dead band, and integral time.	—

## Precautions

If upgrading module FB versions updates instructions, adds a new instruction, or adds a new device, please use the GX Works3 corresponding to the latest module FB.

# 1.2 How to Obtain

The input/output FB, the positioning FB, the serial communication FB, high-speed counter FB, and the temperature control FB described in this reference manual are incorporated into GX Works3<sup>\*1</sup>.

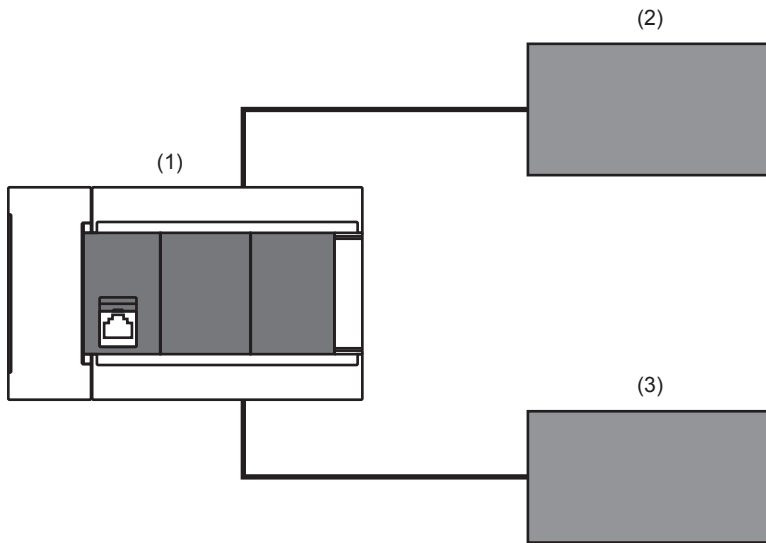
For using the module FBs, refer to the  GX Works3 Operating Manual.

\*1 Use appropriate GX Works3 compatible with the module FB used.

# 1.3 System Configuration

This shows the system configurations to use the module FBs for this reference.

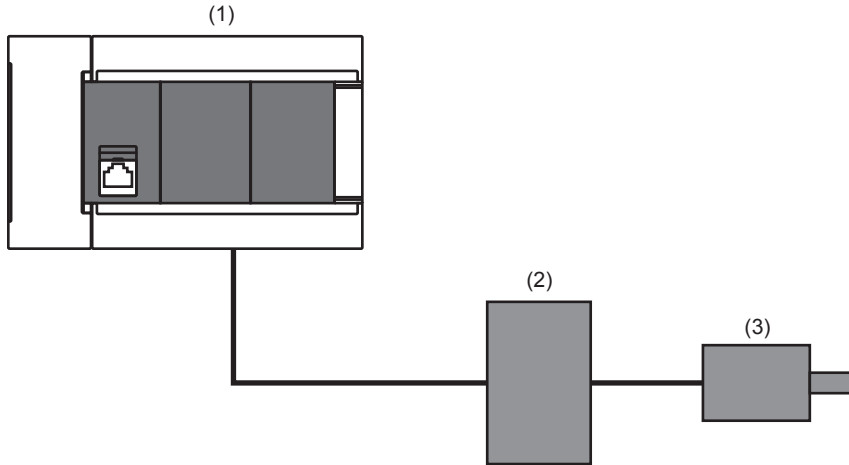
## Input/Output FB



- (1) FX5 CPU module
- (2) Switch
- (3) Load

For specifications of the module used, refer to the user's manual of each module.

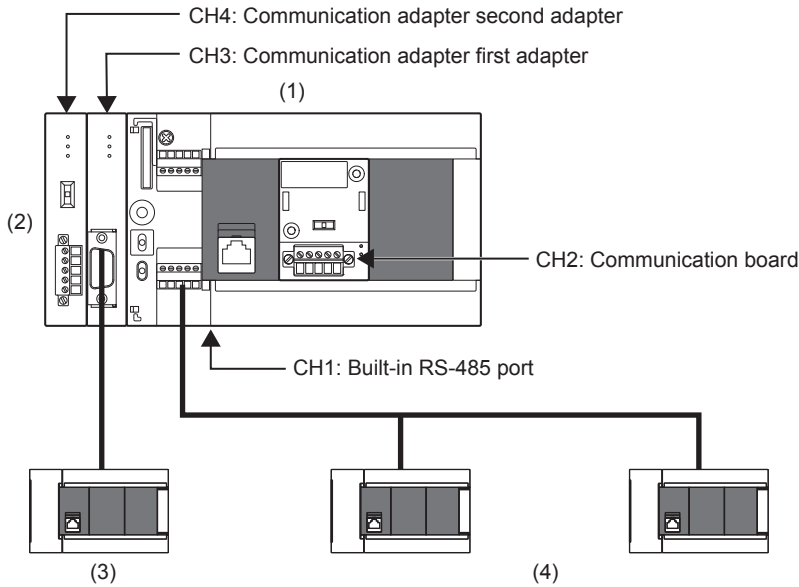
## Positioning FB



- (1) FX5 CPU module
- (2) AC Servo
- (3) Servomotor

For specifications of the module used, refer to the user's manual of each module.

## Serial Communication FB



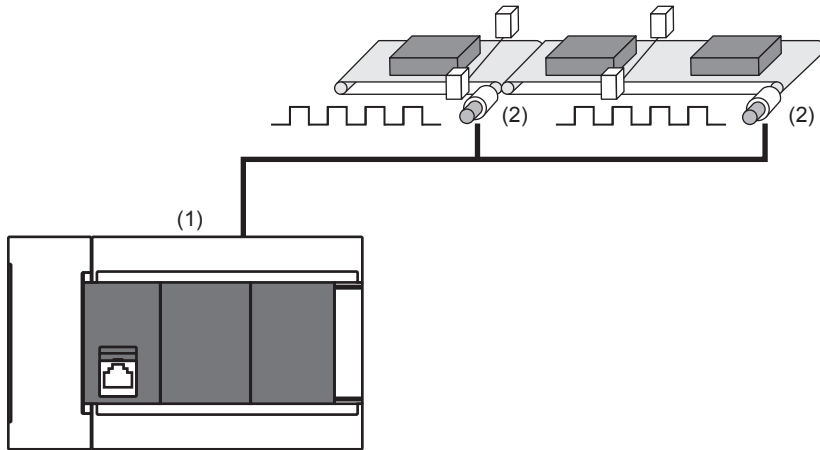
- (1) FX5 CPU module
- (2) Communication adapter
- (3) RS-232C communication equipment
- (4) RS-485 communication equipment

FX5UJ CPU does not have serial communication port ch1.

FX5UC CPU does not have serial communication port ch2.

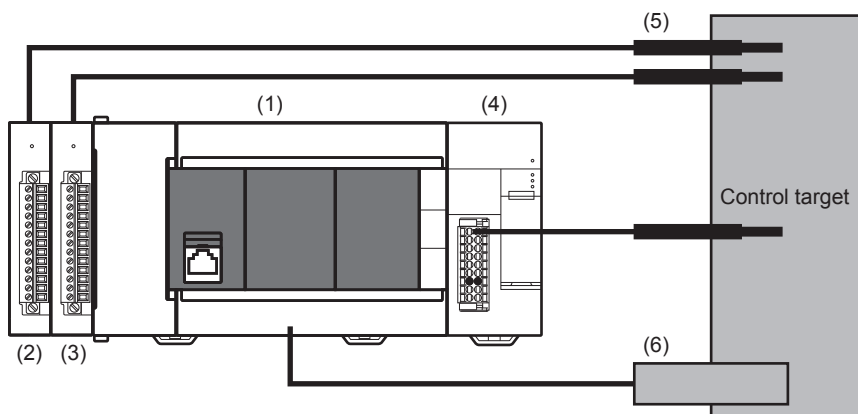
For specifications of the module used, refer to the user's manual of each module.

## High-speed Counter FB



- (1) FX5 CPU module
- (2) Sensor

## Temperature Control FB



- (1) FX5 CPU module
- (2) FX5-4AD-PT-ADP
- (3) FX5-4AD-TC-ADP
- (4) Multiple input module (FX5-8AD)
- (5) Thermocouple, Resistance temperature etc.
- (6) Heater

For specifications of the module used, refer to the user's manual of each module.

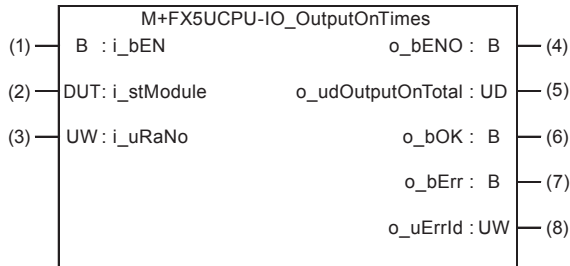


# 2 INPUT/OUTPUT FB

## 2.1 M+FX5UCPU-IO\_OutputOnTimes (Counting the number of relay output ON times)

### Overview

This FB counts (cumulatively) the number of ON times of the specified relay device number within the range from 0 to 4294967295.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	The setting range differs depending on the module label.	Specify the module label of the CPU module.
(3)	i_uRaNo	Target relay device number)	Word [Unsigned]/ Bit String [16-bit]	0 to the value in Y device size*1	Specify the relay device number for counting the number of ON times. For example, specify "10 (octal)*2" to specify the output Y010.

\*1 The set value of SD262 and SD263 (32 bit) shall be the upper limit.

\*2 In GX Works3, program with 8#10.

#### Output label

No.	Variable name	Name	Data type	Default value	Description
(4)	o_bENO	Execution status	Bit	OFF	ON: The execution command is ON. OFF: The execution command is OFF.
(5)	o_udOutputOnTotal	Integration value of number of relay ON times	Double Word [Unsigned]/ Bit String [32-bit]	0	Stores the counted integration value of the number of times the specified relay device number has turned ON.*1
(6)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the FB is counting the relay ON times.
(7)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(8)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code that occurred in the FB.

\*1 Note that if o\_udOutputOnTotal (Integration value of number of relay ON times) exceeds "4294967295", the integration value returns to 0.


# FB details

## Available device


### ■CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.014 or later	GX Works3 Version 1.007H or later

## Basic specifications

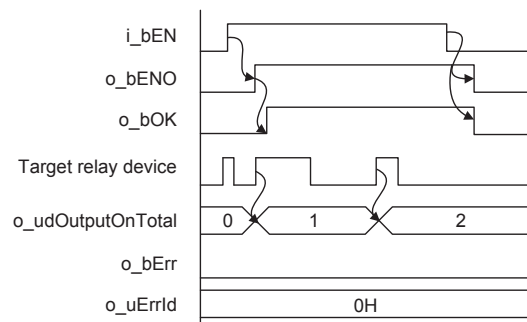
Item	Description
Language	Ladder diagram
Number of steps	102 steps The number of steps of the FB in a program depends on the CPU module used and input and output definition.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0.01 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 1 point (Number of the device using Z9)</li> <li>Long index register: 0 point</li> </ul> When using an interrupt program, do not use this index register in the interrupt program.
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- This FB starts counting when i\_bEN (Execution command) turns ON.
- If the setting value of i\_uRaNo (Target relay device number) is out of the setting range, o\_bErr (Error completion) turns ON and the processing of this FB is aborted. o\_uErrId (Error code) stores the error code "100 (hexadecimal)". For the error code, refer to  Page 17 Error code.

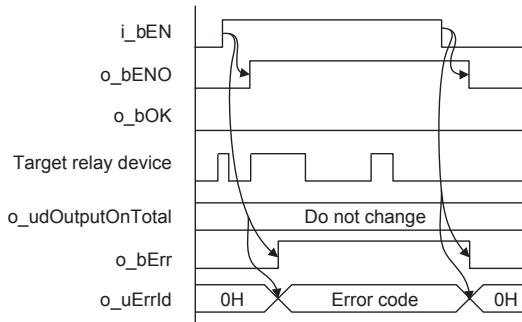
## Timing chart of I/O signals

### ■When the operation is completed successfully



## ■When the operation is completed with an error

When the target relay device number is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because i\_bEN (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off i\_bEN (Execution command).
- When this FB is used twice or more, precaution must be taken to avoid duplication of the relay device number.
- This FB uses the index register Z9. When using an interrupt program, do not use this index register in the interrupt program.
- Every input must be provided with a value for proper FB operation.
- When clearing current value of o\_udOutputOnTotal (Integration value of No. of relay ON times), write K0 to "Instance name .o\_udOutputOnTotal (Integration value of No. of relay ON times)" by DMOV instruction.
- Because the target relay device is counted in ladder, the FB cannot count correctly if the target relay device is turned ON and OFF twice or more in 1 scan.
- This FB uses latch labels. If the latch label area capacity is insufficient for the contents of the program, a message is displayed in GX Works3 when the program is compiled. In such a case, correct the program in accordance with the contents of the message.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Target relay device number: 1	0.29300 ms	0.634 ms	1 scan
FX5U, FX5UC <sup>*1,2</sup>	Target relay device number: 1	0.00931 ms	0.466 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

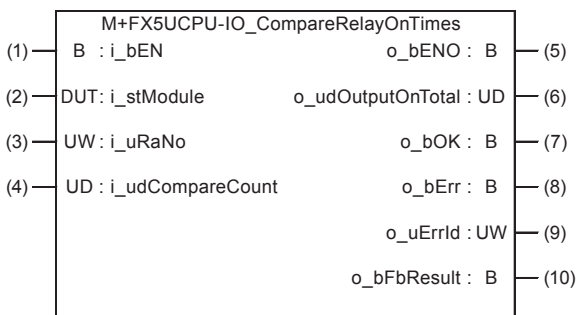
## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uRaNo (target relay device number) is out of the range. The target relay device number is not within the range of 0 to the value in Y device size.	Try again after checking the setting.

## 2.2 M+FX5UCPU-IO\_CompareRelayOnTimes (Counting the number of relay output ON times with comparison function)

### Overview

- This FB counts (cumulatively) the number of ON times of the specified relay device number within the range from 0 to 4294967295.
- This FB compares the counted number of ON times with the set value, and outputs the comparison result.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	The setting range differs depending on the module label.	Specify the module label of the CPU module.
(3)	i_uRaNo	Target relay device number)	Word [Unsigned]/ Bit String [16-bit]	0 to the value in Y device size <sup>*1</sup>	Specify the relay device number for counting the ON times. For example, specify "10 (octal) <sup>*2</sup> " for specifying the output Y010.
(4)	i_udCompareCount	Number of comparisons	Double Word [Unsigned]/Bit String [32-bit]	0 to 4294967295 <sup>*3*4</sup>	Set the value to be compared with the integration value of the number of relay ON times.

\*1 The set value of SD262 and SD263 (32 bit) shall be the upper limit.

\*2 In GX Works3, program with 8#10.

\*3 Setting method

1 to 2147483647: Set a desired value in decimal.

2147483648 to 4294967295: Set a desired value converted into hexadecimal.

\*4 Refer to "Product life of relay output contacts" in the following manual and specify a contact switching life suitable for the usage environment including switching current.

MELSEC iQ-F FX5UJ User's Manual (Hardware).

MELSEC iQ-F FX5U User's Manual (Hardware).

MELSEC iQ-F FX5UC User's Manual (Hardware).

## Output label

No.	Variable name	Name	Data type	Default value	Description
(5)	o_bENO	Execution status	Bit	OFF	ON: The execution command is ON. OFF: The execution command is OFF.
(6)	o_udOutputOnTotal	Integration value of number of relay ON times	Double Word [Unsigned]/Bit String [32-bit]	0	Stores the counted integration value of the number of times the specified relay device number has turned ON.*1
(7)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the FB is counting the relay ON times.
(8)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(9)	o_uErrId	Error code	Word [Unsigned]/Bit String [16-bit]	0	Stores the error code that occurred in the FB.
(10)	o_bFbResult	Comparison operation result	Bit	OFF*1	When this label is ON, it indicates that o_udOutputOnTotal (Integration value of number of relay ON times) is larger than i_udCompareCount (Number of comparisons).

\*1 Note that if o\_udOutputOnTotal (Integration value of number of relay ON times) exceeds "4294967295", the integration value returns to 0, and o\_bFbResult (Comparison operation result) turns ON→OFF.


## FB details

### Available device


#### ■CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.014 or later	GX Works3 Version 1.007H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	118 steps The number of steps of the FB in a program depends on the CPU module used and input and output definition.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0.01 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 1 point (Number of the device using Z9)</li> <li>Long index register: 0 point</li> </ul> When using an interrupt program, do not use this index register in the interrupt program.
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

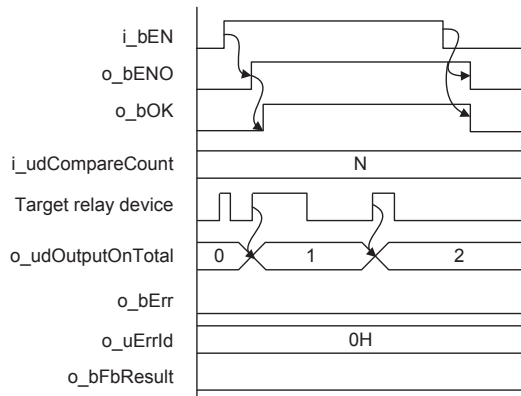
### Processing

- This FB outputs the integration value of the number of output ON times of the relay specified by i\_uRaNo (Target relay device number) in the module specified by i\_stModule (Module label) to o\_udOutputOnTotal (Integration value of number of relay ON times) when i\_bEN (Execution command) turns ON.
- If o\_udOutputOnTotal (Integration value of number of relay ON times) exceeds the value set by i\_udCompareCount (Number of comparisons), o\_bFbResult (Comparison operation result) turns ON.
- If the setting value of i\_uRaNo (Target relay device number) is out of the setting range, o\_bErr (Error completion) turns ON and the processing of this FB is aborted. o\_uErrId (Error code) stores the error code "100 (hexadecimal)". For the error code, refer to  Page 21 Error code.

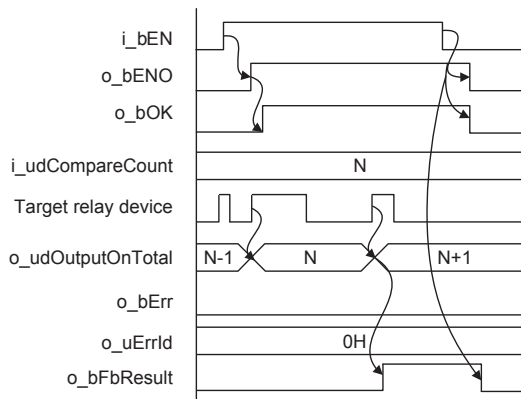
## Timing chart of I/O signals

### ■When the operation is completed successfully

In the case of "o\_udOutputOnTotal (Integration value of number of relay ON times)  $\leq$  i\_udCompareCount (Number of comparisons)"

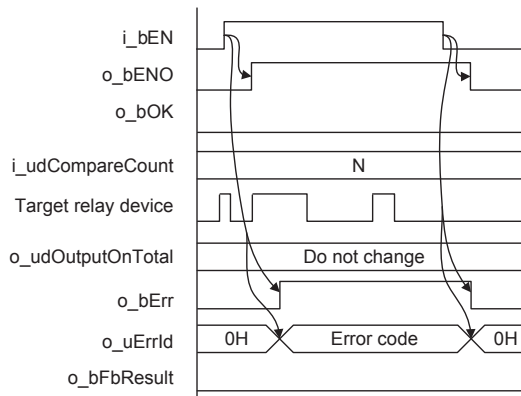


In the case of "o\_udOutputOnTotal (Integration value of number of relay ON times)  $>$  i\_udCompareCount (Number of comparisons)"



### ■When the operation is completed with an error

When the target relay device number is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because i\_bEN (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off i\_bEN (Execution command).
- When this FB is used twice or more, precaution must be taken to avoid duplication of the relay device number.
- This FB uses the index register Z9. When using an interrupt program, do not use this index register in the interrupt program.
- Every input must be provided with a value for proper FB operation.
- When clearing current value of o\_udOutputOnTotal (Integration value of No. of relay ON times), write K0 to "Instance name .o\_udOutputOnTotal (Integration value of No. of relay ON times)" by DMOV instruction.
- Because the target relay device is counted in the ladder, normal counting is disabled if the target relay device is turned ON and OFF twice or more in 1 scan.
- This FB uses the latch label. If the latch label area capacity is insufficient for the contents of the program, a message is displayed in GX Works3 while the program is converted. In such a case, correct the program in accordance with the contents of the message.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Target relay device number: 1 Number of comparisons: 1	0.1490 ms	0.648 ms	1 scan
FX5U, FX5UC <sup>*1*2</sup>	Target relay device number: 1 Number of comparisons: 1	0.0107 ms	0.464 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

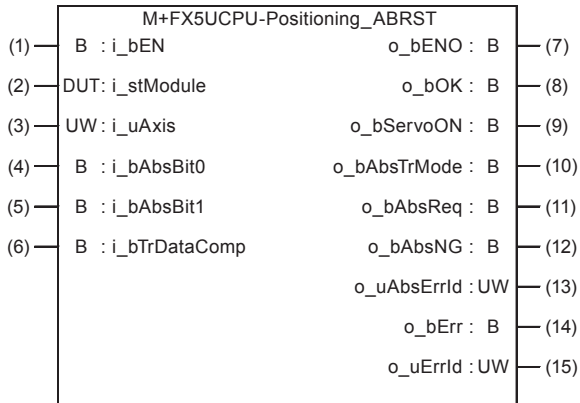
Error code (hexadecimal)	Description	Action
100H	The set value of i_uRaNo (Target relay device number) is out of the range. The target relay device number is not within the range of 0 to the value in Y device size.	Try again after checking the setting.

# 3 POSITIONING FB

## 3.1 M+FX5UCPU-Positioning\_ABRST (Absolute position restoration)

### Overview

This FB reads the absolute position (ABS) data from the servo amplifier, and writes the read value to the current address (pulse unit) of the target axis.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	The setting range differs depending on the module label.	Specify the module label of the CPU module.
(3)	i_uAxis	Target axis	Word [Unsigned]/ Bit String [16-bit]	1 to 12 <sup>*1</sup>	Specify the axis number.
(4)	i_bAbsBit0	ABS data bit 0	Bit	ON, OFF	The lower bit of the data received from the servo amplifier.
(5)	i_bAbsBit1	ABS data bit 1	Bit	ON, OFF	The upper bit of the data received from the servo amplifier.
(6)	i_bTrDataComp	ABS transmission data ready	Bit	ON: Ready OFF: In preparation	The ready signal from the servo amplifier.

\*1 The target axis can be set from axis 1 to axis 4 for the built-in input/output in a CPU module and from axis 5 to axis 12 for the high-speed pulse input/output module.



## Output label

No.	Variable name	Name	Data type	Default value	Description
(7)	o_bENO	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(8)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that absolute position restoration (ABS current value read) is completed.
(9)	o_bServoON	Servo ON signal	Bit	OFF	Servo ON signal is on while this label is on.
(10)	o_bAbsTrMode	ABS transmission mode	Bit	OFF	The servo amplifier is in the ABS transmission mode while this label is on.
(11)	o_bAbsReq	ABS request flag	Bit	OFF	The ABS data is requested while this label is on.
(12)	o_bAbsNG	ABS error	Bit	OFF	When this label is on, it indicates that the absolute position restoration has been completed with an error.
(13)	o_uAbsErrId	ABS error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code of the ABS current value read (DABS) instruction.
(14)	o_bErr	Error completion	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(15)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code that occurred in the FB.



## FB details

### Available device

#### ■CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.030 or later	GX Works3 Version 1.007H or later

### Basic specifications

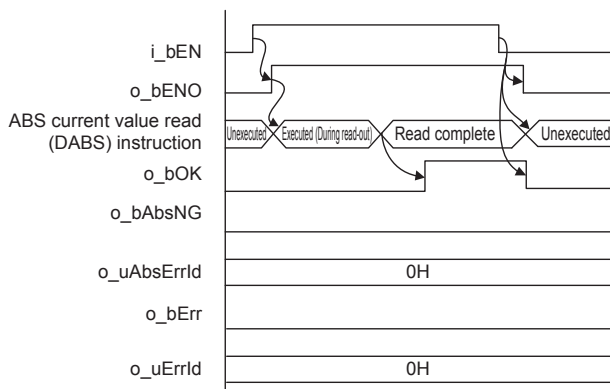
Item	Description
Language	Ladder diagram
Number of steps	240 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- By turning on i\_bEN (Execution command), the absolute position is restored.
- When the absolute position restoration (ABS current value read) is completed with an error, o\_bAbsNG (ABS error) turns ON and an error code is stored in o\_uAbsErrId (ABS error code). For the error codes, refer to MELSEC iQ-F FX5 User's Manual (Positioning Control - CPU module built-in, High-speed pulse input/output module).
- If the set value of the target axis is outside the setting range, o\_bErr (Error completion) turns ON and the processing of this FB is aborted. In addition, the error code 100 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to Page 26 Error code.
- If absolute position restoration (ABS current value read) is not completed in 6 seconds, o\_bErr (Error completion) turns ON and the processing of this FB is aborted. In addition, the error code 200 (hexadecimal) is stored in o\_uErrId (Error code). For error codes, refer to Page 26 Error code.

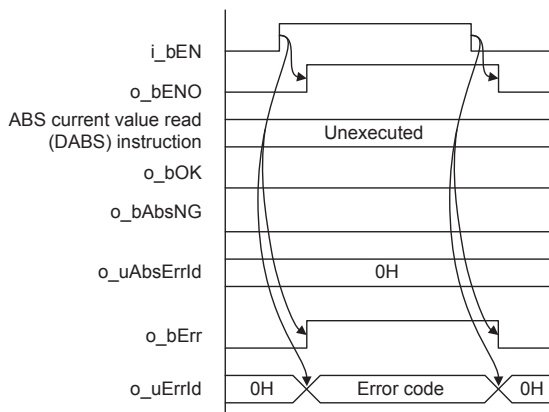
## Timing chart of I/O signals

### ■When the operation is completed successfully

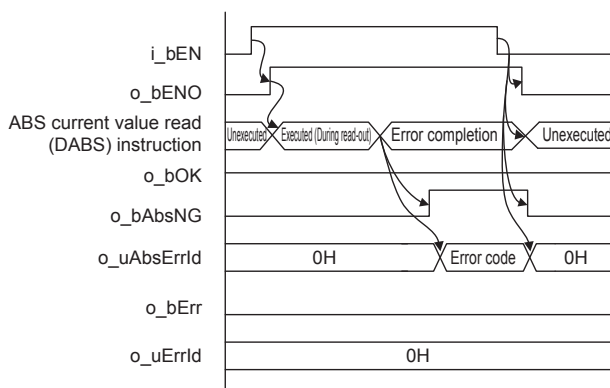


### ■When the operation is completed with an error

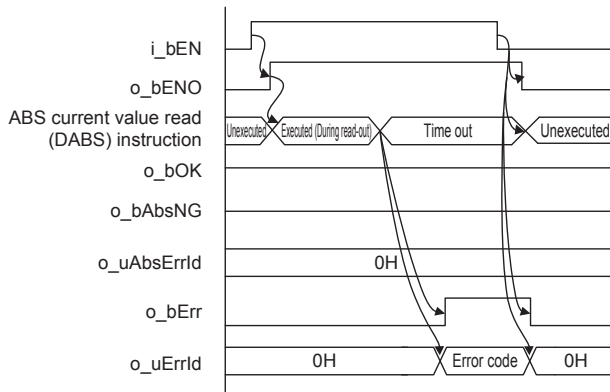
Out of the target axis setting range



When the ABS current value read (DABS) instruction completes with an error



When the ABS current value read (DABS) instruction times out



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB uses the ABS current value read (DABS) instruction. Executing this instruction 17 or more times at the same time will cause an error.
- When using an interrupt program, use the DI/EI instruction before and after executing this FB so that this FB is executed in the interrupt disabled status.
- This FB cannot be used in interrupt programs.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because `i_bEN` (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off `i_bEN` (Execution command).
- When this FB is used twice or more, precaution must be taken to avoid duplication of the target axis.
- Every input must be provided with a value for proper FB operation.
- When this FB is used, `i_bEN` (Execution command) must remain ON even after absolute position restoration (ABS current value reading) is completed.
- Do not turn OFF `i_bEN` (Execution command) during absolute position restoration (ABS current value reading). If `i_bEN` (Execution command) is turned OFF before absolute position restoration (ABS current value read) is completed, reset the CPU module and servo amplifier, and then turn OFF and ON `i_bEN` (Execution command) again.
- The number of available axes varies depending on the setting of the pulse output mode. Select a proper axis in accordance with the system.
- When the servo ON signal is required in the first zero point detection, create a program that sets and resets the output connected to the servo ON signal (`o_ServoON`) of this FB.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Axis 1 ABS data bit 0: ON ABS data bit 1: ON ABS transmission data ready: ON	745 ms	0.779 ms	2810 scan
FX5U, FX5UC <sup>*1*2</sup>	Axis 1 ABS data bit 0: ON ABS data bit 1: ON ABS transmission data ready: ON	735 ms	0.596 ms	3369 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uAxis (Target axis) is outside the setting range. The target axis is set to a value outside the range from 1 to 12.	Try again after checking the setting.
200H	Absolute position restoration (ABS current value read) was not completed in 6 seconds (timeout).	Review the system configuration, servo amplifier parameters and wiring, and then execute the FB again.

## Version upgrade history

Version	Date	Description
00A	January 2015	First edition
01A	July 2015	Some of the label names and data type for the module label used in the FB program were changed. <sup>*1</sup>
02A	May 2016	The target axis was changed to a value from 1 to 12.

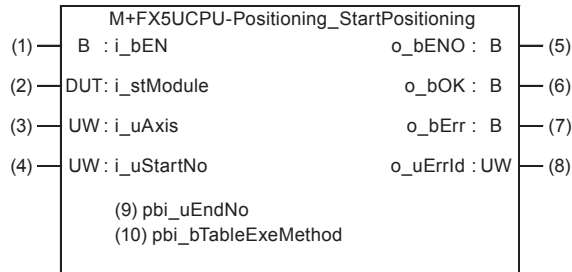
\*1 The label name for the following module label and data type used in the FB program were changed. As needed, delete the module label (structured data types) used in the GX Works3 project, and add (import) it again, and then replace with the latest version of the FB in the program. (Does not replace automatically.)

		Before the change	After the change
Positioning current address (user unit)	Label name	udCurrentAddressU	dCurrentAddressU
	Data type	Double Word [Unsigned]	Double Word [Signed]
Positioning current address (pulse unit)	Label name	udCurrentAddressP	dCurrentAddressP
	Data type	Double Word [Unsigned]	Double Word [Signed]
Positioning zero-point address	Label name	udZeroPointAddress	dZeroPointAddress
	Data type	Double Word [Unsigned]	Double Word [Signed]

## 3.2 M+FX5UCPU-Positioning\_StartPositioning (Positioning activation)

### Overview

This FB uses the table data set using the module parameters to activate the positioning operation.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	<code>i_bEN</code>	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	<code>i_stModule</code>	Module label	Structure	The setting range differs depending on the module label.	Specify the module label of the CPU module.
(3)	<code>i_uAxis</code>	Target axis	Word [Unsigned]/ Bit String [16-bit]	1 to 12 <sup>*1</sup>	Specify the axis number.
(4)	<code>i_uStartNo</code>	Positioning activation number	Word [Unsigned]/ Bit String [16-bit]	1 to 100 <sup>*2</sup>	Specify the table data to begin activation.

\*1 The target axis can be set from axis 1 to axis 4 for the built-in input/output in a CPU module and from axis 5 to axis 12 for the high-speed pulse input/output module.

\*2 If the table data is not set to use device by parameter, the range for the built-in input/output in a CPU module will be a value from 1 to 32. (The range for the high-speed pulse input/output module is fixed to a value from 1 to 100.)

#### Output label

No.	Variable name	Name	Data type	Default value	Description
(5)	<code>o_bENO</code>	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(6)	<code>o_bOK</code>	Normal completion	Bit	OFF	When this label is on, it indicates that the positioning operation has been completed.
(7)	<code>o_bErr</code>	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(8)	<code>o_uErrId</code>	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code that occurred in the FB.

#### Public label

No.	Variable name	Name	Data type	Range	Description
(9)	<code>pbi_uEndNo</code>	Last table number	Word [Unsigned]/ Bit String [16-bit]	1 to 100 <sup>*1</sup>	Specify the table data to stop activation.
(10)	<code>pbi_bTableExeMethod</code>	Table execution method	Bit	ON, OFF	ON: Continuous operation is executed. OFF: Stepping operation is executed.

\*1 If the table data is not set to use device by parameter, the range for the built-in input/output in a CPU module will be a value from 1 to 32. (The range for the high-speed pulse input/output module is fixed to a value from 1 to 100.)

# FB details

## Available device

### ■CPU module

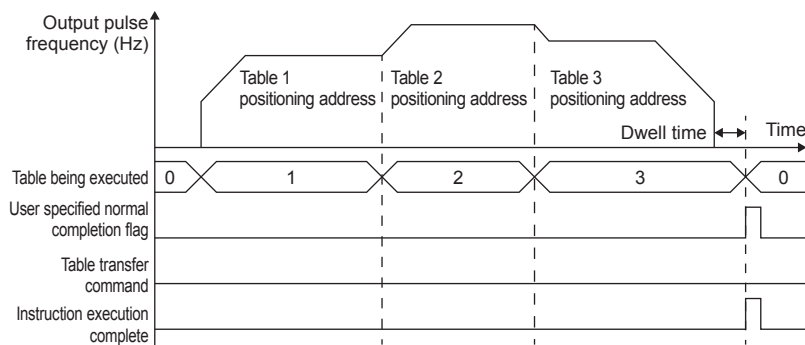
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.030 or later	GX Works3 Version 1.025B or later

## Basic specifications

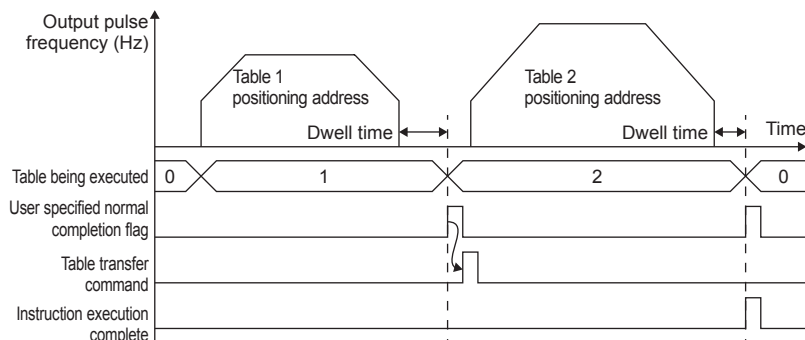
Item	Description
Language	Ladder diagram
Number of steps	187 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to <a href="#">GX Works3 Operating Manual</a> .
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to <a href="#">GX Works3 Operating Manual</a> .
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Pulsed execution (multiple scan execution type)

## Processing

- Activates from the table data specified by i\_uStartNo (Positioning activation number) using the multiple table operation (DRVTBL) instruction, by turning i\_bEN (Execution command) on.
- If pbi\_bTableExeMethod (Table execution method) is on, continuous operation of the multiple table operation (DRVTBL) instruction is performed.



- If pbi\_bTableExeMethod (Table execution method) is off, stepping operation of the multiple table operation (DRVTBL) instruction is performed together with an added function for automatic table transfer.



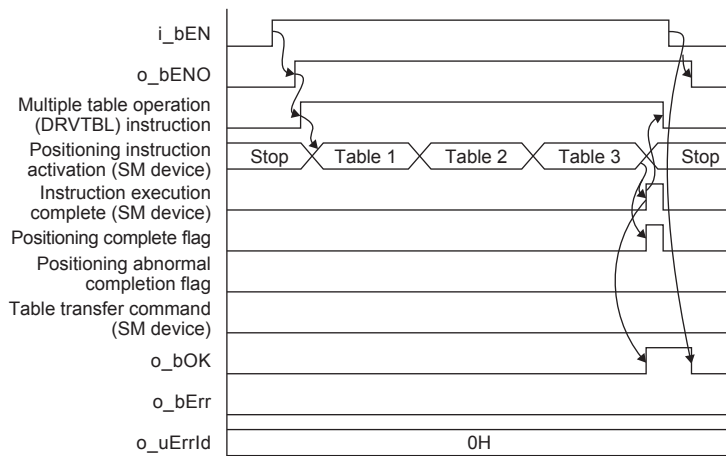
- If the set value of the target axis is outside the setting range, o\_bErr (Error completion) turns on and the processing of this FB is aborted. In addition, the error code 100 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 32 Error code](#).
- If the set value of the positioning activation number is outside the setting range, o\_bErr (Error completion) turns on and the processing of this FB is aborted. In addition, the error code 101 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 32 Error code](#).
- If positioning has been activated for the target axis, o\_bErr (Error completion) turns on and the processing of this FB is aborted. In addition, the error code 201 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 32 Error code](#).
- If an error occurs when positioning is activated or has been activated, o\_bErr (Error completion) turns on and the processing of this FB is aborted. In addition, the error code is stored in o\_uErrId (Error code). For the error codes, refer to [MELSEC iQ-F FX5 User's Manual \(Positioning Control - CPU module built-in, High-speed pulse input/output module\)](#).
- Set the module parameters in GX Works3 in accordance with the connected equipment and system. For the module parameters, refer to [Page 31 Parameter setting](#).
- To set or monitor public labels, add a program for setting or monitoring as shown below. Designate a public label as "FB instance"."public label". The following program is designed to assign K1 to the last table number (M\_FX5UCPU\_Positioning\_StartPositioning\_00A\_1.pbi\_uEndNo).



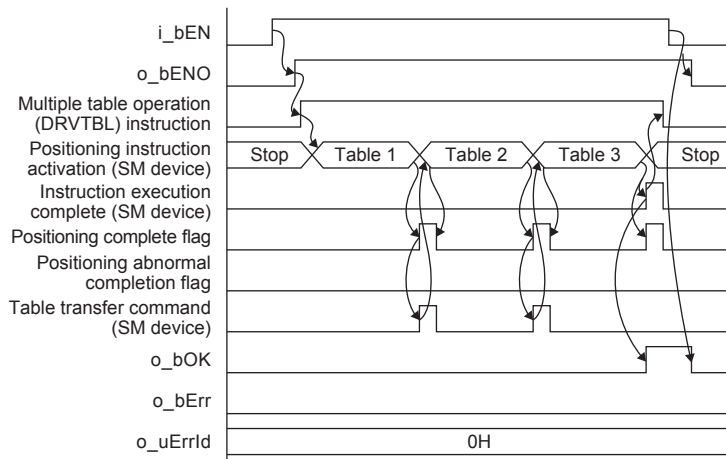
## Timing chart of I/O signals

### ■When the operation is completed successfully

For continuous operation

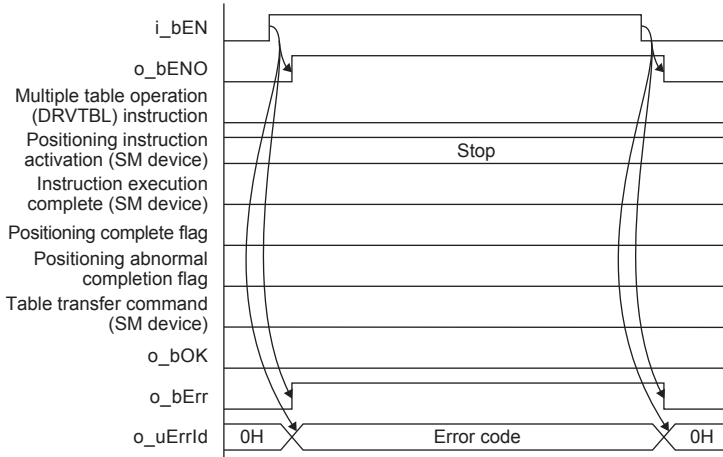


For stepping operation

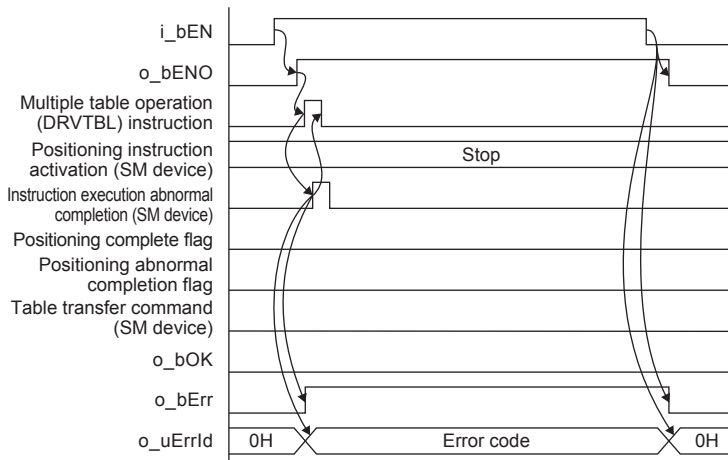


## ■When the operation is completed with an error

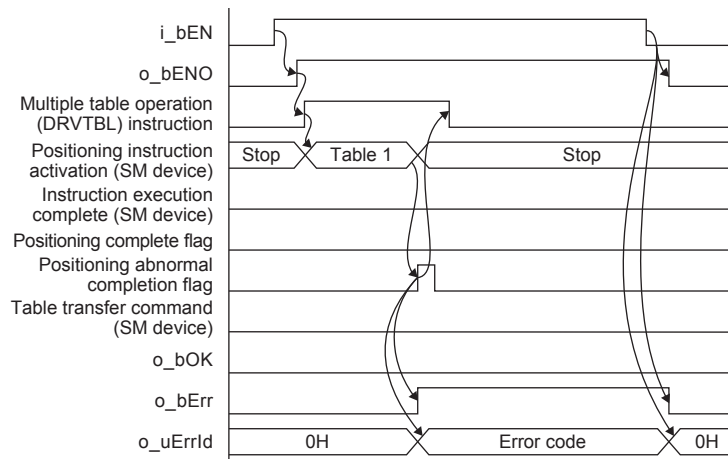
Out of setting range for target axis, etc.



Multiple table operation (DRV/TBL) instruction completes abnormally



Positioning completes abnormally





## Restrictions or precautions

- This FB does not include error recovery processing. Program error recovery processing separately in accordance with the system or required behavior.
- Configure appropriate set values for the i\_uStartNo (positioning activation number) and pbi\_uEndNo (last table number) according to the parameter settings.
- Use a user program when the table shift command is controlled by the user in the stepping operation of the DRVTBL instruction.
- When the same axis number is used both inside and outside this FB, precautions must be taken in regards to duplicate coils in the table transfer command. It is recommended to use the SET/RST instruction to control the table transfer command.
- In the parameter setting, set the external start signal "enable/disable" to "disable".
- To control the system, input the required signal to the input terminal by the set control method or use a user program. For the required signals, refer to the MELSEC iQ-F FX5 User's Manual (Positioning Control - CPU module built-in, High-speed pulse input/output module).
- Turn i\_bEN (Execution command) off after o\_bOK (Normal completion) or o\_bErr (Error completion) is turned on. If i\_bEN (Execution command) is turned off when positioning has been activated, it will decelerate and stop.
- This FB cannot be used in interrupt programs.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), i\_bEN (Execution command) cannot be turned off and normal operation will become impossible. Therefore, use this FB in programs that can turn i\_bEN (Execution command) off.
- When this FB is used twice or more, precaution must be taken to avoid duplicating the target axis.
- Every input must be provided with a value for proper FB operation.
- The number of available axes varies depending on the setting of the pulse output mode. Select a proper target axis in accordance with the system.

## Parameter setting

The pulse output mode, external I/O signal logic, etc. must be set in accordance with the connected equipment and system. Set the module parameters for GX Works3 in accordance with the application. For the module parameter setting method, refer to the MELSEC iQ-F FX5 User's Manual (Positioning Control - CPU module built-in, High-speed pulse input/output module).

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Axis 1 Positioning activation number: 1	0.925 ms	0.665 ms	2 scan
FX5U, FX5UC <sup>*1*2</sup>	Axis 1 Positioning activation number: 1	0.807 ms	0.513 ms	2 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uAxis (Target axis) is out of range. The target axis is not within the range of 1 to 12.	Try again after checking the setting.
200H	The set value of i_uStartNo (Cd.3: Positioning start No.) is out of range. The positioning start No. is not within the range of 1 to 100.	Review the system configuration, servo amplifier parameters and wiring, and then execute the FB again.
201H	Positioning has been activated for the target axis.	Try executing the FB again after stopping activation of the target axis.
Positioning error code	This is the same as the error code that occurs in the multiple table operation (DRVTBL) instruction.	Refer to the <a href="#">MELSEC iQ-F FX5 User's Manual (Positioning Control - CPU module built-in, High-speed pulse input/output module)</a> .
Self-diagnostics error	This may occur in the multiple table operation (DRVTBL) instruction.*1	Refer to the <a href="#">MELSEC iQ-F FX5 User's Manual (Application)</a> .

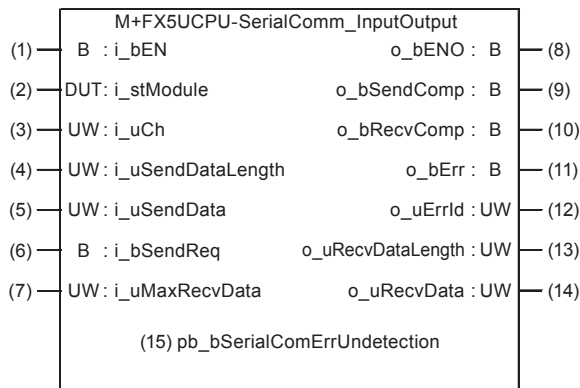
\*1 When the same self-diagnosis error as another instruction occurs in this FB, this FB may not detect the error.

# 4 SERIAL COMMUNICATION FB

## 4.1 M+FX5UCPU-SerialComm\_InputOutput (Sending and receiving non-protocol data)

### Overview

This FB sends the specified number of data points using the non-protocol in serial communication.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	—	Specify the module label of the CPU module.
(3)	i_uCh	Communication channel	Word [Unsigned]/ Bit String [16-bit]	<ul style="list-style-type: none"> <li>■FX5UJ CPU 2 to 4 (without CH1)</li> <li>■FX5U CPU 1 to 4</li> <li>■FX5UC CPU 1, 3 and 4 (without CH2)</li> </ul>	Specify the send/receive channel number. <ul style="list-style-type: none"> <li>• 1: Channel 1 (CH1 side)</li> <li>• 2: Channel 2 (CH2 side)</li> <li>• 3: Channel 3 (CH3 side)</li> <li>• 4: Channel 4 (CH4 side)</li> </ul>
(4)	i_uSendDataLength	Number of send data points	Word [Unsigned]/ Bit String [16-bit]	0 to 4096	Specify the number of bytes of the send data.
(5)	i_uSendData	Send data storage device	Word [Unsigned]/ Bit String [16-bit]	Available devices: D, W, SD, SW and R	Specify the head address of the device which stores the send data.*1*2
(6)	i_bSendReq	Send request	Bit	ON, OFF	ON: Request data sending OFF: Not request data sending
(7)	i_uMaxRecvData	Allowable number of receive data points	Word [Unsigned]/ Bit String [16-bit]	0 to 4096	Specify the allowable number of bytes of receive data that can be stored in the receive data storage device.*1*2

\*1 The data storage position in the word device varies depending on the 8-bit/16-bit mode setting.

\*2 The number of required word devices varies depending on the 8-bit/16-bit mode setting.

## Output label

No.	Variable name	Name	Data type	Default value	Description
(8)	o_bENO	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(9)	o_bSendComp	Send completion	Bit	OFF	When this bit is ON, it indicates that data sending is completed.
(10)	o_bRecvComp	Receive completion	Bit	OFF	When this bit is ON, it indicates that data receiving is completed.
(11)	o_bErr	Error completion	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(12)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code that occurred in the FB.
(13)	o_uRecvDataLength	Number of receive data points	Word [Unsigned]/ Bit String [16-bit]	0	Stores the number of bytes of data received.
(14)	o_uRecvData	Receive data storage device	Word [Unsigned]/ Bit String [16-bit]	0	Specify the head address of the device which stores the received data.*1*2

\*1 The data storage position in the word device varies depending on the 8-bit/16-bit mode setting.

\*2 The number of required word devices varies depending on the 8-bit/16-bit mode setting.

## Public label

No.	Variable name	Name	Data type	Range	Description
(15)	pb_bSerialComErrUndetection	Serial communication error undetection mode	Bit	ON, OFF	ON: FB does not detect serial communication error.*1 OFF: FB detects serial communication error.

\*1 Even if a serial communication error occurs in the used communication channel, error completion and error code are not output and the FB does not stop. Use a user program to detect the error. For serial communication error and serial communication error code, refer to the following manual.

📖 MELSEC iQ-F FX5 User's Manual (Serial Communication)

## FB details

### Available device

#### ■ CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.014 or later	GX Works3 Version 1.007H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	713 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to 📖 GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.02 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to 📖 GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 1 point (Number of the device using Z9)</li> <li>Long index register: 0 point</li> </ul> When using an interrupt program, do not use this index register in the interrupt program.
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed



## Processing

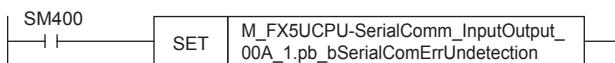
- When i\_bEN (Execution command) turns ON, serial data transfer goes into sending/receiving standby state.
- In data sending standby state, this FB sends the send data specified by i\_uSendData (Send data storage device) and i\_uSendDataLength (Number of send data points) using non-protocol triggered by the serial data transfer (RS2) instruction when i\_bSendReq (Sending request) turns ON. When sending is completed, o\_bSendComp (Sending complete) turns ON.
- In data receiving standby state, when the FB receives the data, the FB writes the number of the received data to o\_uRecvDataLength (Number of receive data points), writes the received data to o\_uRecvData (Receive data storage device) and then o\_bRecvComp (Receiving complete) turns ON.
- This FB checks the following input values when started up. If an error occurs, o\_bErr (Error completion) turns ON, and o\_uErrId (Error code) stores the error code.

(1) Send/receive channel number

(2) Allowable number of receive data points

(3) Number of send data points (Only when sending request)

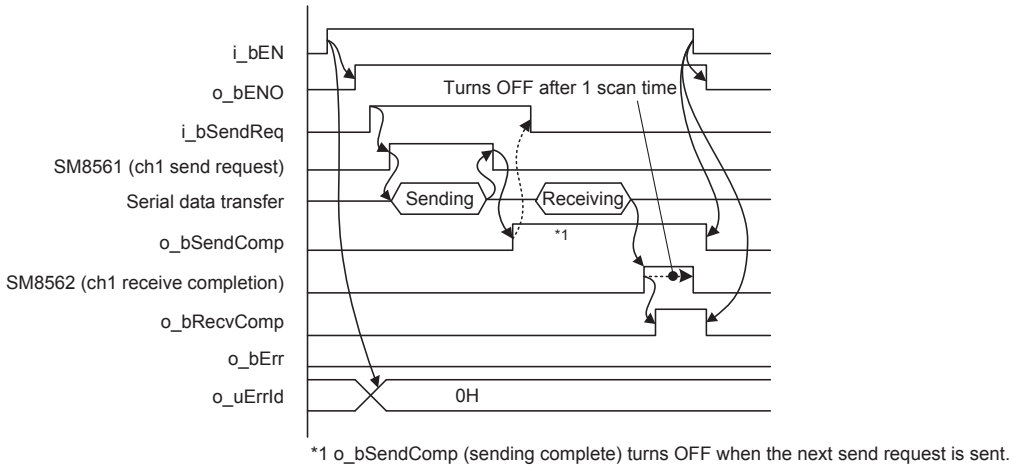
- If an error occurs during data communication processing, o\_bErr (Error completion) turns ON, and o\_uErrId (Error code) stores the serial communication error code. For error codes, refer to  Page 38 Error code. When pb\_bSerialComErrUndetection (Serial communication error undetection mode) is turned ON by a user program, this FB does not detect serial communication error. Detect serial communication error by a user program.
- When data receiving is suspended and the time-out time elapses, time-out occurs, and then o\_bRecvComp (Receiving complete) turns ON.
- Set the module parameters in GX Works3 in accordance with the connected equipment and system. For the module parameters, refer to  Page 38 Parameter setting.
- To set or monitor public labels, add a program for setting or monitoring as shown below. Designate a public label as "FB instance"."public label". The following program is designed to turn on the serial communication error undetection mode (M\_FX5UCPU\_SerialComm\_InputOutput\_00A\_1.pb\_bSerialComErrUndetection).



## Timing chart of I/O signals

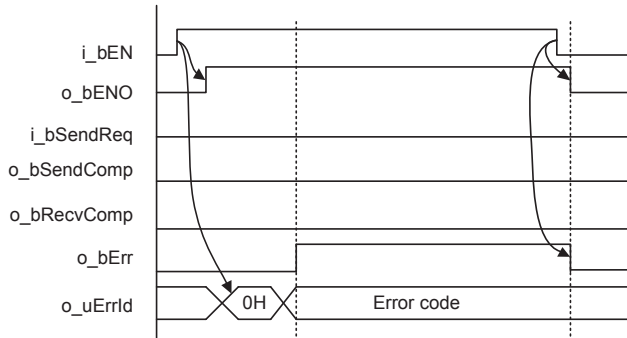
### ■When the operation is completed successfully

<ch1 example>

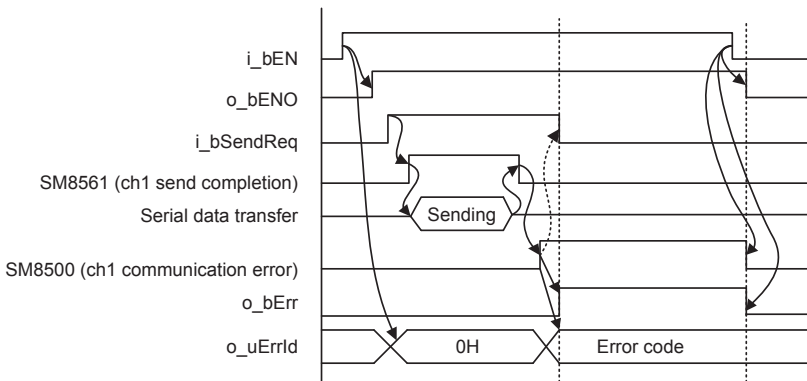


### ■When the operation is completed with an error

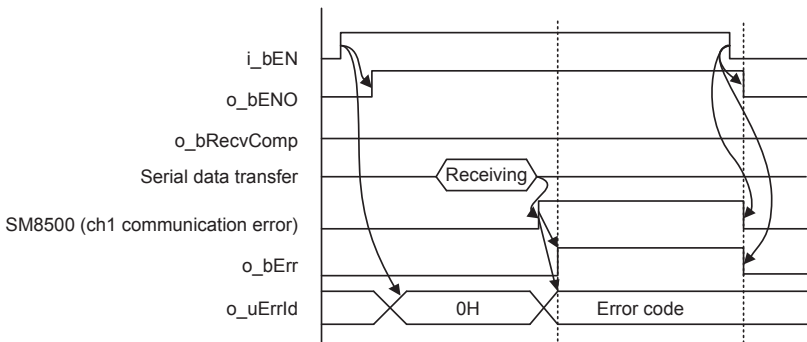
FB error (When the send/receive channel number is outside the setting range)




Module error (Serial communication sending error) <ch1 example>



Module error (Serial communication receiving error) <ch1 example>



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- This FB uses the serial communication (RS2) instruction.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because i\_bEN (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off i\_bEN (Execution command).
- When switching the "M+FX5UCPU-SerialComm\_InputOutput" FB (this FB), "M+FX5UCPU-SerialComm\_Input" FB, "M+FX5UCPU-SerialComm\_Output" FB, and RS2 instruction using the same communication channel, turn OFF unused target FBs and RS2 instruction for at least 1 scan.
- This FB uses the index register Z9. When using an interrupt program, do not use this index register in the interrupt program.
- When using an interrupt program, use the DI/EI instruction before and after executing this FB so that this FB is executed in the interrupt disabled status. If executing this FB in the interrupt enabled status, a self-diagnosis error that occurs in an interrupt program is detected as an error that occurred in the FB.
- When keeping the sending/receiving standby state of serial data using this FB, it is necessary to let i\_bEN (Execution command) remain ON even after sending and receiving are completed.
- Turn off i\_bEN (Execution command) after o\_bOK (Normal completion) or o\_bErr (Error completion) is turned on. By turning off i\_bEN (Execution command), o\_bOK (Normal completion) and o\_bErr (Error completion) are turned off.
- Receiving complete flag of the corresponding channel (SM8562, SM8572, SM8582, and SM8592) are reset after one operation cycle. Receive the data of o\_uRecvDataLength (Number of receive data points) and o\_uRecvData (Receive data storage device) within one operation cycle.
- Set the module parameters of the used communication channel in GX Works3 in accordance with the application. For the module parameter setting method, refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
- To validate the change of the setting value of allowable number of receive data, restart this FB.
- FX5UJ CPU does not have serial communication port ch1. When using this FB in FX5UJ CPU, set channel to ch2, ch3, or ch4.
- FX5UC CPU does not have serial communication port ch2. When using this FB in FX5UC CPU, set channel to ch1, ch3, or ch4.
- This FB does not support the SM/SD devices of FX3 series compatibility. When using this FB in communication channel ch1 or ch2, set the SM/SD devices of FX3 series compatibility of the module parameters of the used communication channel in GX Works3 to "Disable."

## Parameter setting

For the parameter setting, refer to  MELSEC iQ-F FX5 User's Manual (Serial Communication).



## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Communication channel: 2 Send request: OFF	11.0 ms	0.772 ms	27 scan
	Communication channel: 2 Send request: ON Number of send data points: 2048 byte Allowable number of receive data points: 2048 byte	359.0 ms	0.775 ms	1166 scan
	Communication channel: 2 Send request: ON Number of send data points: 4096 byte Allowable number of receive data points: 4096 byte	714.0 ms	0.770 ms	2324 scan
FX5U, FX5UC <sup>*1,2</sup>	Communication channel: 1 Send request: OFF	12.4 ms	0.555 ms	37 scan
	Communication channel: 1 Send request: ON Number of send data points: 2048 byte Allowable number of receive data points: 2048 byte	357.0 ms	0.566 ms	1423 scan
	Communication channel: 1 Send request: ON Number of send data points: 4096 byte Allowable number of receive data points: 4096 byte	713.0 ms	0.551 ms	2843 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uCh (communication channel) is outside the setting range. The target channel is set to a value outside the range from 1 to 4.	Try again after checking the setting.
101H	The set value of i_uMaxRecvData (Allowable number of receive data) is outside the setting range. The allowable number of receive data is set to a value outside the range from 0 to 4,096.	Try again after checking the setting.
102H	The set value of i_uSendDataLength (Send data length) is outside the setting range. The send data length is set to a value outside the range from 0 to 4,096.	Try again after checking the setting.
103H	The serial communication operation mode is set to an invalid mode. The serial communication operation mode is not set to "Non-protocol communication".	Try again after checking the setting.
Serial communication error	The contents are same as the error code that occurred in the serial communication (RS2) instruction.	Refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
Self-diagnostics error	This error may occur in the serial communication (RS2) instruction.*1	Refer to the  MELSEC iQ-F FX5 User's Manual (Application).

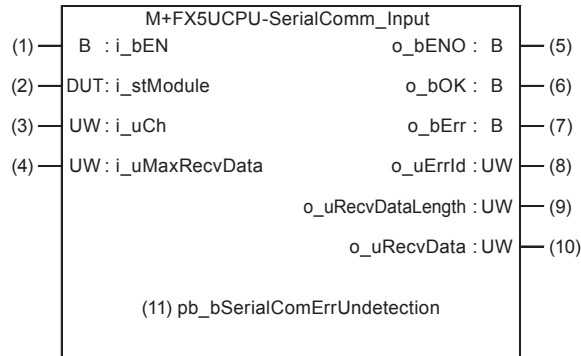
\*1 When the same self-diagnosis error as another instruction occurs in this FB, this FB may not detect the error.



## 4.2 M+FX5UCPU-SerialComm\_Input (Receiving of non-protocol data)

### Overview

This FB stores the data received using the non-protocol in serial communication.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	—	Specify the module label of the CPU module.
(3)	i_uCh	Receive channel	Word [Unsigned]/ Bit String [16-bit]	<ul style="list-style-type: none"> <li>■FX5UJ CPU 2 to 4 (without CH1)</li> <li>■FX5U CPU 1 to 4</li> <li>■FX5UC CPU 1, 3 and 4 (without CH2)</li> </ul>	Set the channel that receives the data. <ul style="list-style-type: none"> <li>• 1: Channel 1 (CH1 side)</li> <li>• 2: Channel 2 (CH2 side)</li> <li>• 3: Channel 3 (CH3 side)</li> <li>• 4: Channel 4 (CH4 side)</li> </ul>
(4)	i_uMaxRecvData	Allowable number of receive data points	Word [Unsigned]/ Bit String [16-bit]	1 to 4096	Specify the allowable number of bytes of the receive data that can be stored in the receive data storage device.*1*2

\*1 The data storage position in the word device varies depending on the 8-bit/16-bit mode setting.

\*2 The number of required word devices varies depending on the 8-bit/16-bit mode setting.

## Output label

No.	Variable name	Name	Data type	Default value	Description
(5)	o_bENO	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(6)	o_bOK	Normal completion	Bit	OFF	When this bit is ON, it indicates that data receiving is completed normally.
(7)	o_bErr	Error completion	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(8)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code occurred in the FB.
(9)	o_uRecvDataLength	Number of receive data points	Word [Unsigned]/ Bit String [16-bit]	0	Stores the number of bytes which received the data.
(10)	o_uRecvData	Receive data storage device	Word [Unsigned]/ Bit String [16-bit]	0	Specify the head address of the device which stores the received data. <sup>*1*2</sup>

\*1 The data storage position in the word device varies depending on the 8-bit/16-bit mode setting.

\*2 The number of required word devices varies depending on the 8-bit/16-bit mode setting.

## Public label

No.	Variable name	Name	Data type	Range	Description
(11)	pb_bSerialComErrUndetection	Serial communication error undetection mode	Bit	ON, OFF	ON: FB does not detect serial communication error. <sup>*1</sup> OFF: FB detects serial communication error.

\*1 Even if a serial communication error occurs in the used communication channel, error completion and error code are not output and the FB does not stop. Use a user program to detect the error. For serial communication error and serial communication error code, refer to the following manual.

📖 MELSEC iQ-F FX5 User's Manual (Serial Communication)

## FB details

### Available device

#### ■ CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.014 or later	GX Works3 Version 1.007H or later

### Basic specifications



Item	Description
Language	Ladder diagram
Number of steps	496 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to 📖 GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to 📖 GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 1 point (Number of the device using Z9)</li> <li>Long index register: 0 point</li> </ul> When using an interrupt program, do not use this index register in the interrupt program.
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Pulsed execution (multiple scan execution type)

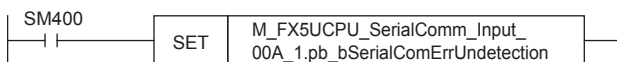
## Processing

- When i\_bEN (Execution command) turns ON, serial data transfer goes into receiving standby state.
- In data receiving standby state, when the FB receives the data, the FB writes the number of received data to o\_uRecvDataLength (Number of receive data points) and writes the received data to o\_uRecvData (Receive data storage device). When receiving is completed, o\_bRecvComp (Normal completion) turns ON.
- This FB checks the following input values when started up. If an error occurs, o\_bErr (Error completion) turns ON, and o\_uErrId (Error code) stores the error code.

(1) Receive channel number

(2) Allowable number of receive data points

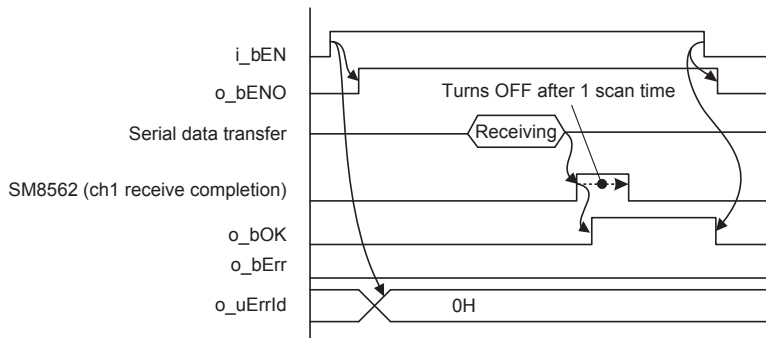
- If an error occurs during the data communication processing, o\_bErr (Error completion) turns ON, and the serial communication error code is stored to o\_uErrId (Error code). For error codes, refer to  Page 44 Error code. When pb\_bSerialComErrUndetection (Serial communication error undetection mode) is turned ON by a user program, this FB does not detect serial communication error. Detect serial communication error by a user program.
- When data receiving is suspended and passes time-out time, time-out occurs, and then o\_bRecvComp (Receiving complete) turns ON.
- Set the module parameters in GX Works3 in accordance with the connected equipment and system. For the module parameters, refer to  Page 38 Parameter setting.
- To set or monitor public labels, add a program for setting or monitoring as shown below. Designate a public label as "FB instance"."public label". The following program is designed to turn on the serial communication error undetection mode (M\_FX5UCPU\_SerialComm\_Input\_00A\_1.pb\_bSerialComErrUndetection).



## Timing chart of I/O signals

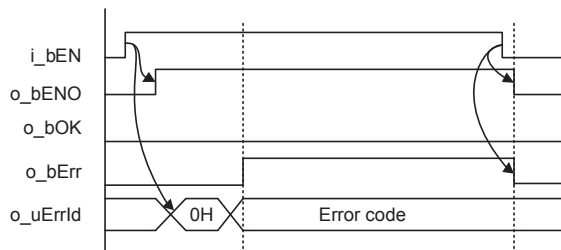
### ■When the operation is completed successfully

<ch1 example>

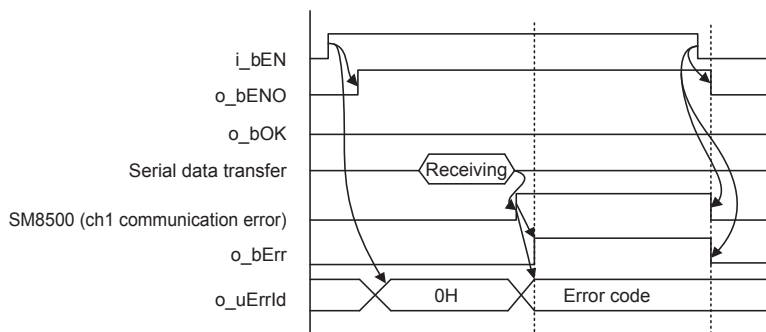


### ■When the operation is completed with an error


FB error (When the receive channel number is outside the setting range)



Module error (Serial communication error) <ch1 example>



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- This FB uses the serial communication (RS2) instruction.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because i\_bEN (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off i\_bEN (Execution command).
- When switching the "M+FX5UCPU-SerialComm\_InputOutput" FB, "M+FX5UCPU-SerialComm\_Input" FB (this FB), "M+FX5UCPU-SerialComm\_Output" FB, and RS2 instruction using the same communication channel, turn OFF unused target FBs and RS2 instruction for at least 1 scan.
- This FB uses the index register Z9. When using an interrupt program, do not use this index register in the interrupt program.
- When using an interrupt program, use the DI/EI instruction before and after executing this FB so that this FB is executed in the interrupt disabled status. If executing this FB in the interrupt enabled status, a self-diagnosis error that occurs in an interrupt program is detected as an error that occurred in the FB.
- The following FB does not support full-duplex bi-directional communication, interlink mode, communication using control line. To perform full-duplex bi-directional communication, interlink mode, communication using control line, please use "M+FX5UCPU-SerialComm\_InputOutput" FB.
  - M+FX5UCPU-SerialComm\_Input (this FB)
  - M+FX5UCPU-SerialComm\_Output
- Turn off i\_bEN (Execution command) after o\_bOK (Normal completion) or o\_bErr (Error completion) is turned on. By turning off i\_bEN (Execution command), o\_bOK (Normal completion) and o\_bErr (Error completion) are turned off.
- This FB can receive data only once. To receive the next data, restart the FB after the previous receiving is completed.
- Receiving complete flag of the corresponding channel (SM8562, SM8572, SM8582, and SM8592) are reset after one operation cycle. Receive the data of o\_uRecvDataLength (Number of receive data points) and o\_uRecvData (Receive data storage device) within one operation cycle.
- Set the module parameters of the used communication channel in GX Works3 in accordance with the application. For the module parameter setting method, refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
- Restart this FB to allow changes to the number of allowable receive data points.
- FX5UJ CPU does not have serial communication port ch1. When using this FB in FX5UJ CPU, set channel to ch2, ch3, or ch4.
- FX5UC CPU does not have serial communication port ch2. When using this FB in FX5UC CPU, set channel to ch1, ch3, or ch4.
- This FB does not support the SM/SD devices of FX3 series compatibility. When using this FB in communication channel ch1 or ch2, set the SM/SD devices of FX3 series compatibility of the module parameters of the used communication channel in GX Works3 to "Disable."

## Parameter setting

For the parameter setting, refer to  MELSEC iQ-F FX5 User's Manual (Serial Communication).



## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Communication channel: 2 Allowable number of receive data points: 1 byte	12.0 ms	0.681 ms	33 scan
	Communication channel: 2 Allowable number of receive data points: 2048 byte	190.0 ms	0.716 ms	602 scan
	Communication channel: 2 Allowable number of receive data points: 4096 byte	367.0 ms	0.712 ms	1188 scan
FX5U, FX5UC <sup>*1,2</sup>	Communication channel: 1 Allowable number of receive data points: 1 byte	11.3 ms	0.658 ms	40 scan
	Communication channel: 1 Allowable number of receive data points: 2048 byte	190.0 ms	0.505 ms	759 scan
	Communication channel: 1 Allowable number of receive data points: 4096 byte	370.0 ms	0.567 ms	1519 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

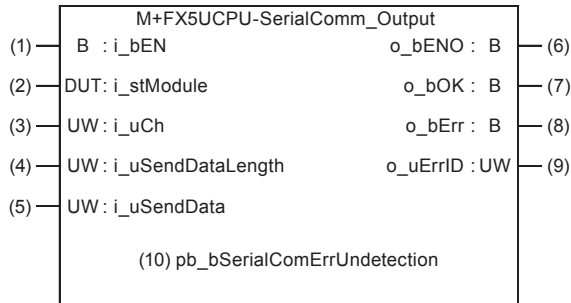
Error code (hexadecimal)	Description	Action
100H	The set value of i_uCh (Receive channel) is outside the setting range. The target channel is set to a value outside the range from 1 to 4.	Try again after checking the setting.
101H	The set value of i_uMaxRecvData (Allowable number of receive data) is outside the setting range. The allowable number of receive data is set to a value outside the range from 1 to 4,096.	Try again after checking the setting.
103H	The serial communication operation mode is set to an unavailable mode. The serial communication operation mode is not set to "Non-protocol communication".	Try again after checking the setting.
Serial communication error	The contents are same as the error code occurred in the serial communication (RS2) instruction.	Refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
Self-diagnostics error	This error may occur in the serial communication (RS2) instruction.*1	Refer to the  MELSEC iQ-F FX5 User's Manual (Application).

\*1 When the same self-diagnosis error as another instruction occurs in this FB, this FB may not detect the error.

## 4.3 M+FX5UCPU-SerialComm\_Output (Sending of non-protocol data)

### Overview

This FB sends the specified number of data points using the non-protocol in serial communication.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	—	Specify the module label of the MELSEC iQ-F CPU module.
(3)	i_uCh	Send channel	Word [Unsigned]/ Bit String [16-bit]	<ul style="list-style-type: none"> <li>■FX5UJ CPU 2 to 4 (without CH1)</li> <li>■FX5U CPU 1 to 4</li> <li>■FX5UC CPU 1, 3 and 4 (without CH2)</li> </ul>	Specify the send channel number. <ul style="list-style-type: none"> <li>• 1: Channel 1 (CH1 side)</li> <li>• 2: Channel 2 (CH2 side)</li> <li>• 3: Channel 3 (CH3 side)</li> <li>• 4: Channel 4 (CH4 side)</li> </ul>
(4)	i_uSendDataLength	Number of send data points	Word [Unsigned]/ Bit String [16-bit]	1 to 4096	Specify the number of bytes of the send data.
(5)	i_uSendData	Send data storage device	Word [Unsigned]/ Bit String [16-bit]	Available devices: D, W, SD, SW and R	Specify the head address of the device which stores the send data.*1*2

\*1 The data storage position in the word device varies depending on the 8-bit/16-bit mode setting.

\*2 The number of required word devices varies depending on the 8-bit/16-bit mode setting.

#### Output label

No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(7)	o_bOK	Normal completion	Bit	OFF	When this bit is ON, it indicates that data sending is completed normally.
(8)	o_bErr	Error completion	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(9)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code occurred in the FB.

## Public label

No.	Variable name	Name	Data type	Range	Description
(10)	pb_bSerialComErrUndetection	Serial communication error undetection mode	Bit	ON, OFF	ON: FB does not detect serial communication error.*1 OFF: FB detects serial communication error.

\*1 Even if a serial communication error occurs in the used communication channel, error completion and error code are not output and the FB does not stop. Use a user program to detect the error. For serial communication error and serial communication error code, refer to the following manual.

📖 MELSEC iQ-F FX5 User's Manual (Serial Communication)

## FB details

### Available device

#### ■CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.014 or later	GX Works3 Version 1.007H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	508 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to 📖 GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to 📖 GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 1 point (Number of the device using Z9)</li> <li>Long index register: 0 point</li> </ul> When using an interrupt program, do not use this index register in the interrupt program.
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Pulsed execution (multiple scan execution type)

### Processing

- This FB sends the data specified by `i_uSendData` (Send data storage device) and `i_uSendDataLength` (Number of send data points) using the non-procedural protocol triggered by the serial data transfer (RS2) instruction when `i_bEN` (Execution command) turns ON. When sending is completed, `o_bOK` (Normal completion) turns ON.
- This FB checks the following input values when started up. If an error occurs, `o_bErr` (Error completion) turns ON, and `o_uErrId` (Error code) stores the error code.

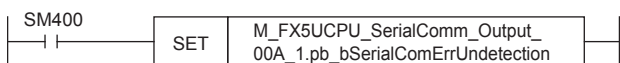
(1) Send channel number

(2) Number of send data points

- If an error occurs during the data communication processing, `o_bErr` (Error completion) turns ON, and the serial communication error code is stored to `o_uErrId` (Error code). For the error code, refer to 📖 Page 49 Error code. When `pb_bSerialComErrUndetection` (Serial communication error undetection mode) is turned ON by a user program, this FB does not detect serial communication error. Detect serial communication error by a user program.
- Set the module parameters in GX Works3 in accordance with the connected equipment and system. For the module parameters, refer to 📖 Page 38 Parameter setting.



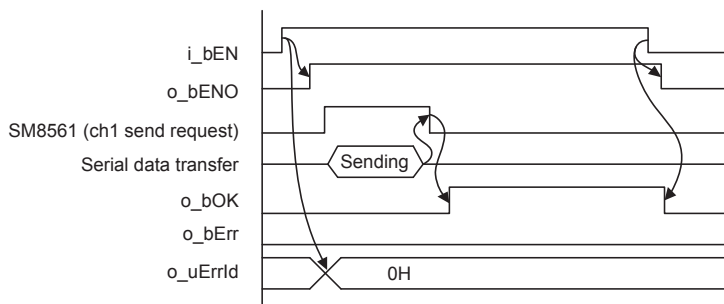
- To set or monitor public labels, add a program for setting or monitoring as shown below. Designate a public label as "FB instance"."public label". The following program is designed to turn on the serial communication error undetection mode (M\_FX5UCPU\_SerialComm\_Output\_00A\_1.pb\_bSerialComErrUndetection).



## Timing chart of I/O signals

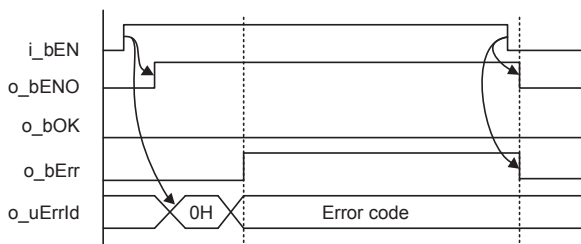
### When the operation is completed successfully

<ch1 example>

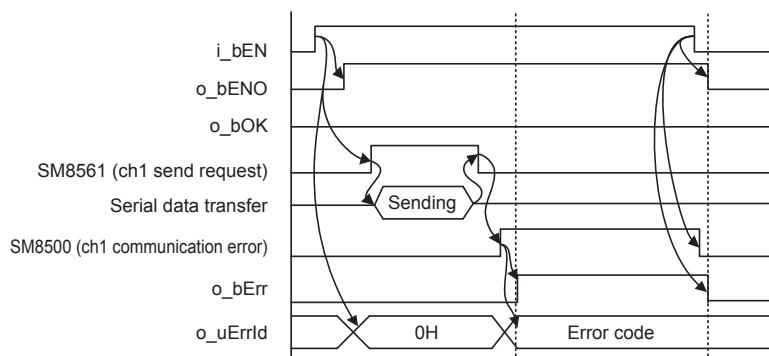


### When the operation is completed with an error


FB error (When the send channel number is outside the setting range)



Module error (Serial communication error) <ch1 example>



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- This FB uses the serial communication (RS2) instruction.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because i\_bEN (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off i\_bEN (Execution command).
- When switching the "M+FX5UCPU-SerialComm\_InputOutput" FB, "M+FX5UCPU-SerialComm\_Input" FB, "M+FX5UCPU-SerialComm\_Output" FB (this FB), and RS2 instruction using a same communication channel, turn OFF unused target FBs and RS2 instruction for at least 1 scan.
- This FB uses the index register Z9. When using an interrupt program, do not use this index register in the interrupt program.
- When using an interrupt program, use the DI/EI instruction before and after executing this FB so that this FB is executed in the interrupt disabled status. If executing this FB in the interrupt enabled status, a self-diagnosis error that occurs in an interrupt program is detected as an error that occurred in the FB.
- The following FB does not support full-duplex bi-directional communication, interlink mode, communication using control line. To perform full-duplex bi-directional communication, interlink mode, communication using control line, please use "M+FX5UCPU-SerialComm\_InputOutput" FB.
  - M+FX5UCPU-SerialComm\_Input
  - M+FX5UCPU-SerialComm\_Output (this FB)
- Turn off i\_bEN (Execution command) after o\_bOK (Normal completion) or o\_bErr (Error completion) is turned on. By turning off i\_bEN (Execution command), o\_bOK (Normal completion) and o\_bErr (Error completion) are turned off.
- Set the module parameters of the used communication channel in GX Works3 in accordance with the application. For the module parameter setting method, refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
- FX5UJ CPU does not have serial communication port ch1. When using this FB in FX5UJ CPU, set channel to ch2, ch3, or ch4.
- FX5UC CPU does not have serial communication port ch2. When using this FB in FX5UC CPU, set channel to ch1, ch3, or ch4.
- This FB does not support the SM/SD devices of FX3 series compatibility. When using this FB in communication channel ch1 or ch2, set the SM/SD devices of FX3 series compatibility of the module parameters of the used communication channel in GX Works3 to "Disable."

## Parameter setting

For the parameter setting, refer to  MELSEC iQ-F FX5 User's Manual (Serial Communication).

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Communication channel: 2 Number of send data points: 1 byte	0.950 ms	0.674 ms	2 scan
	Communication channel: 2 Number of send data points: 2048 byte	179.000 ms	0.683 ms	592 scan
	Communication channel: 2 Number of send data points: 4096 byte	357.000 ms	0.689 ms	1182 scan
FX5U, FX5UC <sup>*1,2</sup>	Communication channel: 1 Number of send data points: 1 byte	0.638 ms	0.496 ms	2 scan
	Communication channel: 1 Number of send data points: 2048 byte	179.000 ms	0.496 ms	76 scan
	Communication channel: 1 Number of send data points: 4096 byte	357.000 ms	0.496 ms	1534 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

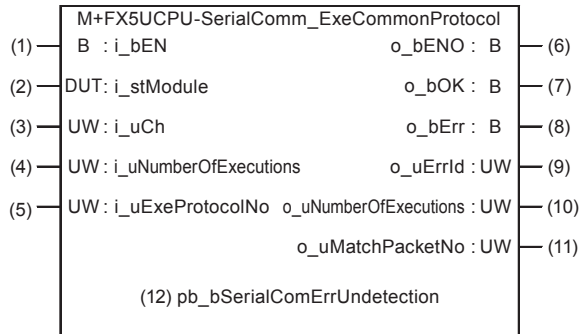
Error code (hexadecimal)	Description	Action
100H	The set value of i_uCh (Send channel) is outside the setting range. The target channel is set to a value outside the range from 1 to 4.	Try again after checking the setting.
102H	The set value of i_uSendDataLength (Send data length) is outside the setting range. The send data length is set to a value outside the range from 1 to 4,096.	Try again after checking the setting.
103H	The serial communication operation mode is set to an unavailable mode. The serial communication operation mode is not set to "Non-protocol communication".	Try again after checking the setting.
Serial communication error	The contents are same as the error code occurred in the serial communication (RS2) instruction.	Refer to the <a href="#">MELSEC iQ-F FX5 User's Manual (Serial Communication)</a>
Self-diagnostics error	This error may occur in the serial communication (RS2) instruction. <sup>*1</sup>	Refer to the <a href="#">MELSEC iQ-F FX5 User's Manual (Application)</a>

\*1 When the same self-diagnosis error as another instruction occurs in this FB, this FB may not detect the error.

# 4.4 M+FX5UCPU-SerialComm\_ExecCommonProtocol (Sending and receiving communication protocol support function data)

## Overview

This FB executes the protocol registered with GX Works3.



## Labels

### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	—	Specify the module label of the CPU module.
(3)	i_uCh	Communication channel	Word [Unsigned]/ Bit String [16-bit]	<ul style="list-style-type: none"> <li>■FX5UJ CPU 2 to 4 (without CH1)</li> <li>■FX5U CPU 1 to 4</li> <li>■FX5UC CPU 1, 3 and 4 (without CH2)</li> </ul>	Specify the communication channel number. <ul style="list-style-type: none"> <li>• 1: Channel 1 (CH1 side)</li> <li>• 2: Channel 2 (CH2 side)</li> <li>• 3: Channel 3 (CH3 side)</li> <li>• 4: Channel 4 (CH4 side)</li> </ul>
(4)	i_uNumberOfExecutions	Number of consecutive protocol executions	Word [Unsigned]/ Bit String [16-bit]	1 to 8	Specify number of continuous executions of the protocol.
(5)	i_uExeProtocolNo	Execution protocol number	Word [Unsigned]/ Bit String [16-bit] (0..7)	1 to 64	Specify the protocol number to be executed. Protocols are executed in the specified order of the execution protocol numbers. 1st word: Execution protocol number 1 : 8th word: Execution protocol number 8 When it is specified using a label, use "ARRAY" for the data type.

## Output label

No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(7)	o_bOK	Normal completion	Bit	OFF	When this bit is ON, it indicates that data communication is completed normally.
(8)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(9)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code that occurred in the FB.
(10)	o_uNumberOfExecutions	Number of protocol executions	Word [Unsigned]/ Bit String [16-bit]]	0	The number of protocol executions is stored. The protocol in which an error has occurred is included in the number of executions. If the setting data and the setting details of the control data are incorrect, 0 is stored.
(11)	o_uMatchPacketNo	Matched receive packet number	Word [Unsigned]/ Bit String [16-bit] (0..7)	0	1st word: Matched receive packet No. 1 : 8th word: Matched receive packet No. 8 A value is stored in the area corresponding to the execution protocol number. When the communication type of the executed protocol is "Send only" or "Send and receive", the receive packet number that matches with the executed protocol, is stored. In the following cases, 0 is stored. <ul style="list-style-type: none"> <li>• When the communication type is "Receive only"</li> <li>• When an error occurs in the executed protocol</li> <li>• The area is greater than or equal to the number of protocol executions</li> </ul> When it is specified using a label, use "ARRAY" for the data type.

## Public label

No.	Variable name	Name	Data type	Range	Description
(12)	pb_bSerialComErrUndetection	Serial communication error undetection mode	Bit	ON, OFF	ON: FB does not detect serial communication error.*1 OFF: FB detects serial communication error.

\*1 Even if a serial communication error occurs in the used communication channel, error completion and error code are not output and the FB does not stop. Use a user program to detect the error. For serial communication error and serial communication error code, refer to the following manual.

 MELSEC iQ-F FX5 User's Manual (Serial Communication)

# FB details

## Available device

### ■CPU module

Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.015 or later	GX Works3 Version 1.015R or later

## Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	216 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.04 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Pulsed execution (multiple scan execution type)

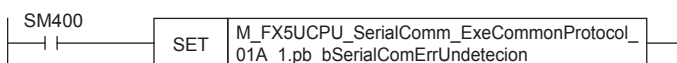
## Processing

- Executes the registered protocol by the communication protocol support function (predefined protocol support function) on GX Works3 using the communication protocol support (SP.CPRTCL) instruction, by turning i\_bEN (Execution command) on. After executing the protocols specified with i\_uExeProtocolNo (Execution protocol number) and i\_uNumberOfExecutions (Number of consecutively-executed protocols), o\_bOK (Normal completion) turns on.
- This FB checks the following input values when started up. If an error occurs, o\_bErr (Error completion) turns on, and o\_uErrId (Error code) stores the error code.

(1) Communication channel

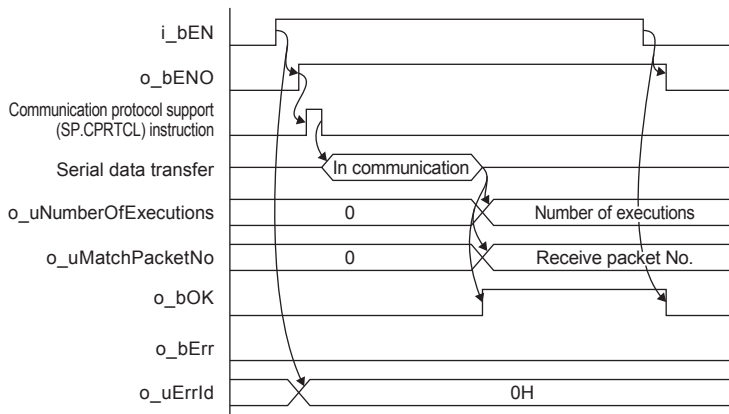
(2) Number of consecutive protocol executions

- If an error occurs during data communication processing, o\_bErr (Error completion) turns on, and the serial communication error code is stored to o\_uErrId (Error code). For the error code, refer to Page 55 Error code. When pb\_bSerialComErrUndetection (Serial communication error undetection mode) is turned on by a user program, this FB does not detect serial communication errors for error codes 7F67H to 7F6AH (the FB continues to operate). Detect serial communication errors using a user program.
- Set the module parameters in GX Works3 in accordance with the connected equipment and system. For the module parameters, refer to Page 38 Parameter setting.
- To set or monitor public labels, add a program for setting or monitoring as shown below. Designate a public label as "FB instance"."public label". The following program is designed to turn on the serial communication error undetection mode (M\_FX5UCPU\_SerialComm\_ExeCommonProtocol\_01A\_1.pb\_bSerialComErrUndetecion).



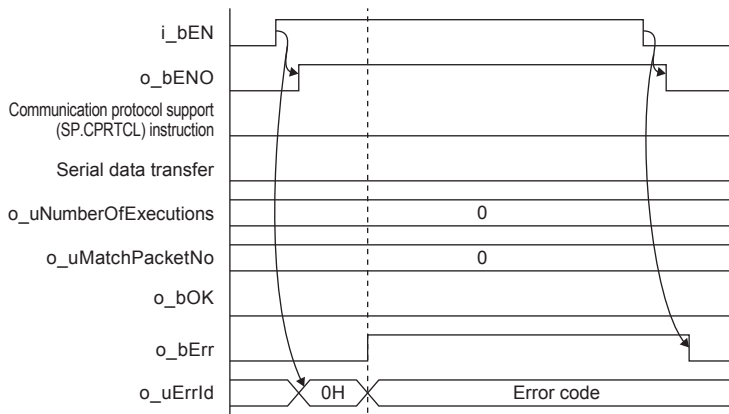
## Timing chart of I/O signals

### ■When the operation is completed successfully

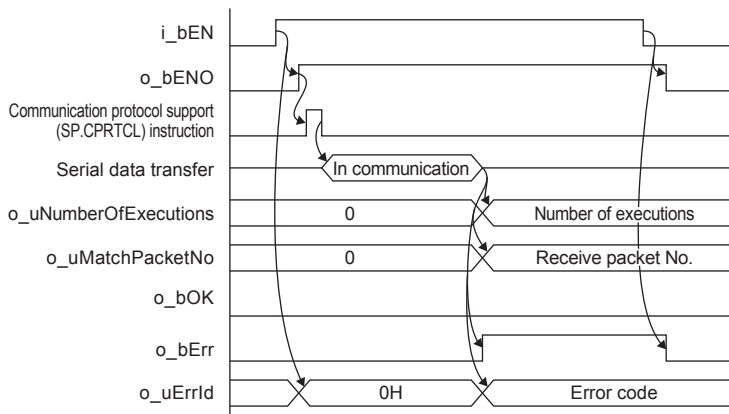


### ■When the operation is completed with an error


FB error (Send channel is outside the setting range, etc.)



Module error (Serial communication error)



## Restrictions or precautions

- This FB does not include error recovery processing. Program error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in interrupt programs.
- This FB uses the communication protocol support (SP.CPRTCL) instruction.
- In communication protocol support function (predefined protocol support function), up to two channels are available to use in one CPU module.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because i\_bEN (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off i\_bEN (Execution command).
- When using an interrupt program, use the DI/EI instruction before and after executing this FB so that this FB is executed in the interrupt disabled status. If executing this FB in the interrupt enabled status, a self-diagnosis error that occurs in an interrupt program is detected as an error that occurred in the FB.
- Turn off i\_bEN (Execution command) after o\_bOK (Normal completion) or o\_bErr (Error completion) is turned on. By turning off i\_bEN (Execution command), o\_bOK (Normal completion) and o\_bErr (Error completion) are turned off. However, because the SP.CPRTCL instruction which is a pulse instruction in the FB is used, if a write is performed while the FB is executed, the instruction may not be executed, and o\_bOK (Normal completion) and o\_bErr (Error completion) may not turn on. If this happens, turn i\_bEN (Execute command) from off to on again.
- Set the module parameters of the used communication channel in GX Works3 in accordance with the application. For the module parameter setting method, refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
- FX5UJ CPU does not have serial communication port ch1. When using this FB in FX5UJ CPU, set channel to ch2, ch3, or ch4.
- FX5UC CPU does not have serial communication port ch2. When using this FB in FX5UC CPU, set channel to ch1, ch3, or ch4.

## Parameter setting

For the parameter setting, refer to  MELSEC iQ-F FX5 User's Manual (Serial Communication).

## Performance value



CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Communication channel: 2 Number of consecutive protocol executions: 1	65.8 ms	1.470 ms	210 scan
	Communication channel: 2 Number of consecutive protocol executions: 4	260.0 ms	1.480 ms	842 scan
	Communication channel: 2 Number of consecutive protocol executions: 8	518.0 ms	1.460 ms	1679 scan
FX5U, FX5UC <sup>*1*2</sup>	Communication channel: 1 Number of consecutive protocol executions: 1	65.1 ms	0.853 ms	275 scan
	Communication channel: 1 Number of consecutive protocol executions: 4	259.0 ms	0.958 ms	1104 scan
	Communication channel: 1 Number of consecutive protocol executions: 8	516.0 ms	0.881 ms	2202 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.



## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uCh (Communication channel) is outside the setting range. The target channel is set to a value outside the range from 1 to 4.	Try again after checking the setting.
104H	The set value for i_uNumberOfExecutions (Number of continuous protocol executions) is outside the setting range. The number of continuous protocol executions is set to a value outside the range from 1 to 8.	Try again after checking the setting.
105H	The serial communication operation mode is set to an unavailable mode. The serial communication operation mode is not set to "communication protocol support (predefined protocol support)".	Try again after checking the setting.
Serial communication error	The contents are same as the error code occurred in the communication protocol support (SP.CPRTCL) instruction.	Refer to the  MELSEC iQ-F FX5 User's Manual (Serial Communication).
Self-diagnostics error	This may occur in the communication protocol support (SP.CPRTCL) instruction.*1	Refer to the  MELSEC iQ-F FX5 User's Manual (Application).

\*1 When the same self-diagnosis error as another instruction occurs in this FB, this FB may not detect the error.

## Version upgrade history

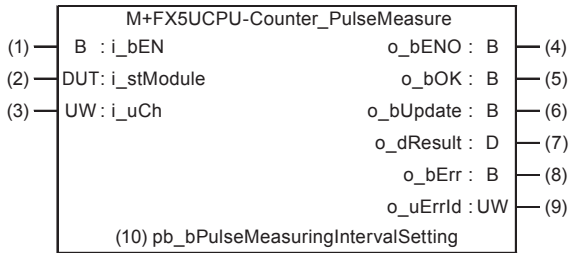
Version	Date	Description
00A	July 2015	First edition
01A	May 2016	Changed so that if o_bOK (Normal completion) and o_bErr (Error completion) do not turn on, the FB can be executed again by turning i_bEN (Execute command) from off to on.

# 5 HIGH-SPEED COUNTER FB

## 5.1 M+FX5UCPU-Counter\_PulseMeasure (Pulse measurement)

### Overview

This FB starts the pulse measurement function, and stores the pulse measured value.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_stModule	Module label	Structure	The setting range differs depending on the module label.	Specify the module label of the CPU module.
(3)	i_uCh	Target channel	Word [Unsigned]/ Bit String [16-bit]	1 to 12 <sup>*1</sup>	Specify the channel number.

\*1 The target channel can be set from CH1 to CH4 for the built-in input/output in a CPU module and from CH5 to CH12 for the high-speed pulse input/output module.

#### Output label

No.	Variable name	Name	Data type	Default value	Description
(4)	o_bENO	Execution status	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(5)	o_bOK	Normal completion	Bit	OFF	When this label is on, it indicates that pulses are being measured.
(6)	o_bUpdate	Measured pulse value update flag	Bit	OFF	When this label is on, it indicates that measured pulse value has been updated.
(7)	o_dResult	Measured pulse value	Double word [signed]	0	Stores the measured pulse value. The following intervals can be measured by combining the public label's pulse measurement interval with the logic switch parameter. <ul style="list-style-type: none"> <li>• ON width</li> <li>• OFF width</li> <li>• Interval between rises of the edge</li> <li>• Interval between falls of the edge</li> </ul>
(8)	o_bErr	Error completion	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(9)	o_uErrId	Error code	Word [Unsigned]/ Bit String [16-bit]	0	Stores the error code that occurred in the FB.

## Public label

No.	Variable name	Name	Data type	Range	Description
(10)	pb_bPulseMeasuringIntervalSetting	Pulse measurement interval	Bit	ON, OFF	ON: Pulse period measurement OFF: Pulse width measurement

## FB details

### Available device

#### ■CPU module

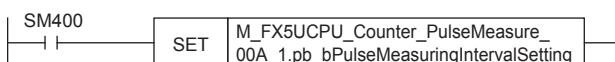
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.030 or later	GX Works3 Version 1.025B or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	250 steps The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the setting options of GX Works3, refer to <a href="#">GX Works3 Operating Manual</a> .
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.01 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to <a href="#">GX Works3 Operating Manual</a> .
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

### Processing

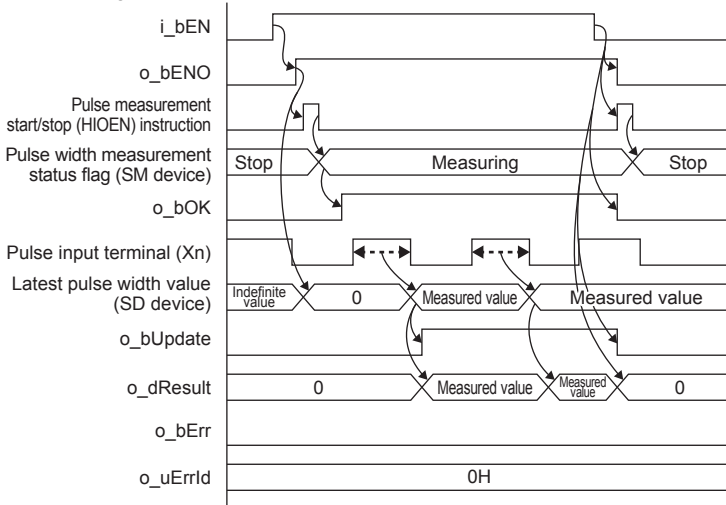
- Starts pulse measurement by turning i\_bEN (Execution command) on.
- If the set value of the target channel is outside the setting range, o\_bErr (Error completion) turns on and the processing of this FB is aborted. In addition, the error code 100 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 59 Error code](#).
- If an error occurs when starting pulse measurement, o\_bErr (Error completion) turns on and the processing of this FB is aborted. In addition, the error code is stored in o\_uErrId (Error code). For the error codes, refer to [MELSEC iQ-F FX5 User's Manual \(Application\)](#).
- When executing the pulse measurement function, set the module parameters in GX Works3 in accordance with the connected equipment and system. For the module parameters, refer to [Page 59 Parameter setting](#).
- To set or monitor public labels, add a program for setting or monitoring as shown below. Designate a public label as "FB instance"."public label". The following program is designed to turn on the pulse measurement interval (M\_FX5UCPU\_Counter\_PulseMeasure\_00A\_1.pb\_bPulseMeasuringIntervalSetting).



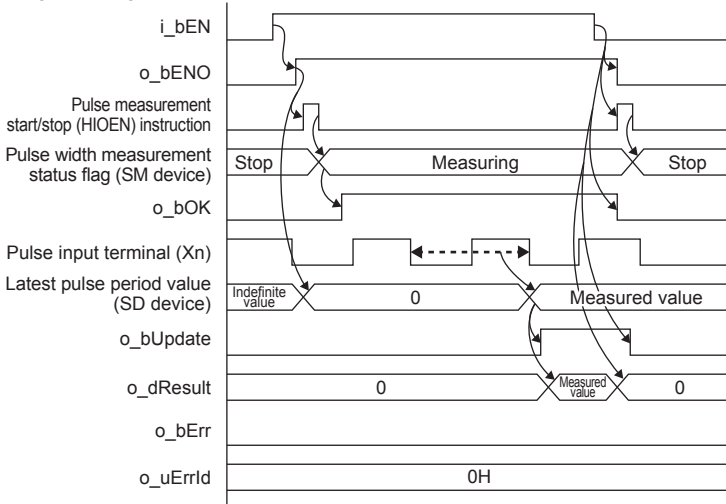
## Timing chart of I/O signals

### ■When the operation is completed successfully

Positive logic, pulse width measurement, consecutive measurement mode

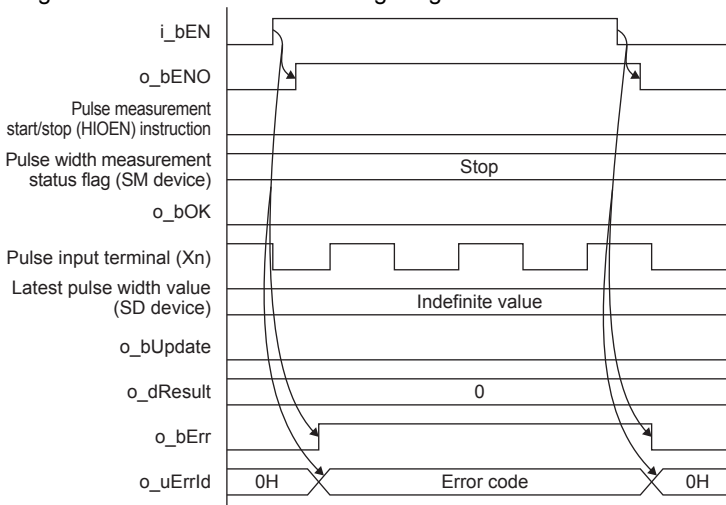


Negative logic, pulse period measurement, consecutive measurement mode

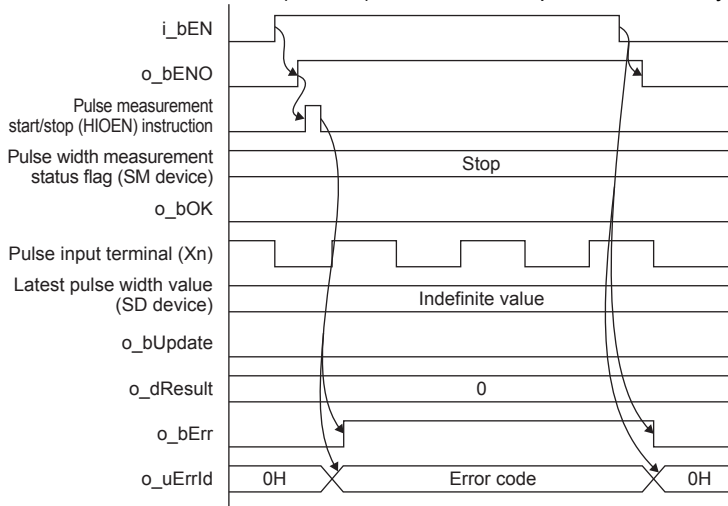


### ■When the operation is completed with an error

Target channel is outside the setting range



### Pulse measurement start (HIOEN) instruction completes abnormally



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- Do not use this FB in programs that are executed only once, such as a subroutine program or FOR-NEXT loop, because *i\_bEN* (Execution command) cannot be turned off and the normal operation cannot be acquired. Always use this FB in programs that can turn off *i\_bEN* (Execution command).
- When this FB is used twice or more, precaution must be taken to avoid duplicating the target channel.
- Every input must be provided with a value for proper FB operation.
- If the measurement interval of the measurement target is quicker than the scan time, normal measurement may not be possible. Adjust the measurement interval so that it is at least double the scan time.
- This FB operates with the parameters (SM) set when *i\_bEN* (Execution command) is turned on. Do not modify parameter (SM) settings related to the pulse measurement function by a user program when the FB is operating.
- This FB supports only consecutive measurement mode. Set the measurement mode to consecutive measurement mode.

## Parameter setting

When executing the pulse measurement function, set the parameters from GX Works3.

For the parameter setting, refer to [MELSEC iQ-F FX5 User's Manual \(Application\)](#).

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	CH2	0.064 ms	0.680 ms	1 scan
FX5U, FX5UC <sup>*1,2</sup>	CH1	0.610 ms	0.496 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of <i>i_uAxis</i> (Target channel) is outside the setting range. The target channel is set to a value outside the range from 1 to 12.	Try again after checking the setting.
Self-diagnostics error	This may occur in the pulse measurement start (HIOEN) instruction. <sup>*1</sup>	Refer to the <a href="#">MELSEC iQ-F FX5 User's Manual (Application)</a> .

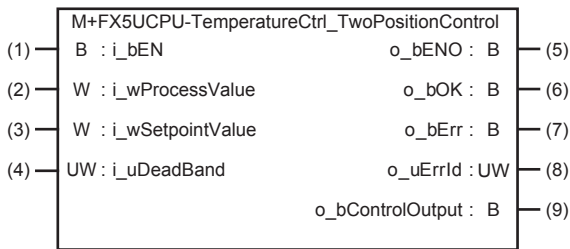
\*1 When the same self-diagnosis error as another instruction occurs in this FB, this FB may not detect the error.

# 6 TEMPERATURE CONTROL FB

## 6.1 M+FX5UCPU- TemperatureCtrl\_TwoPositionControl (Two- position control)

### Overview

This FB performs two-position control to turn the control output ON/OFF based on the input of the measured value, target value, and dead band.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_wProcessValue	Measured value	Word [Signed]	-32768 to +32767	Enter the measured value to be controlled.
(3)	i_wSetpointValue	Target value	Word [Signed]	-32768 to +32767	Set the target value to be controlled.
(4)	i_uDeadBand	Dead band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output is not switched. The value should be within the following ranges: <ul style="list-style-type: none"> <li>Target value + Dead band ≤ 32767</li> <li>Target value - Dead band ≥ -32768</li> </ul>

#### Output label

No.	Variable name	Name	Data type	Default value	Description
(5)	o_bENO	Execution status	Bit	OFF	Outputs the execution status of the FB. ON: The FB has been executed. OFF: The FB has not been executed.
(6)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the processing of the FB has completed normally.
(7)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(8)	o_uErrId	Error code	Word [Unsigned]/ Bit string [16 bits]	0	Stores the error code that occurred in the FB.
(9)	o_bControlOutput	Control output	Bit	OFF	Turns ON/OFF the control output of the two-position control.

# FB details

## Available device

### ■CPU module

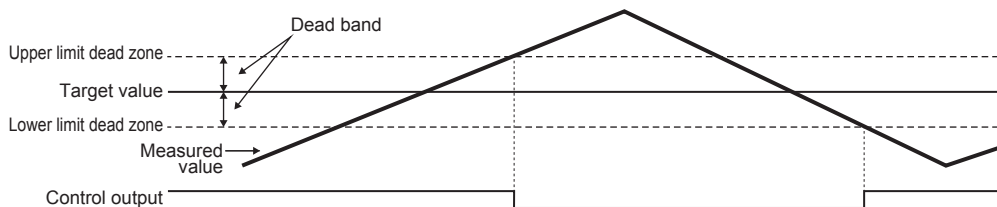
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.110 or later	GX Works3 Version 1.055H or later

## Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	108 steps The number of steps of the FB in a program depends on the CPU module used, input and output definition, and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.02 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

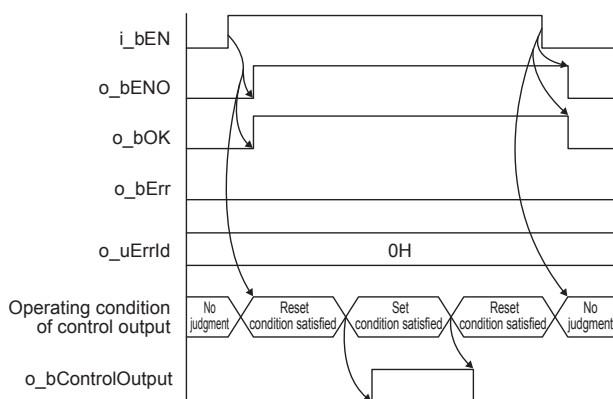
- Control details of the two-position control



- This FB starts the two-position control when `i_bEN` (Execution command) turns ON.
- The operating conditions of the control output are as follows.  
 Condition where the control output is set:  $\text{Measured value} < \text{Lower limit dead zone (Target value - Dead band)}$   
 Condition where the control output is reset:  $\text{Measured value} > \text{Upper limit dead zone (Target value + Dead band)}$
- `o_bControlOutput` (Control output) turns ON or OFF according to the operating condition of the control output.
- If `i_uDeadBand` (Dead band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 100 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to Page 63 Error code.
- To interrupt the processing of the FB by error completion, turn OFF `o_bControlOutput` (Control output).

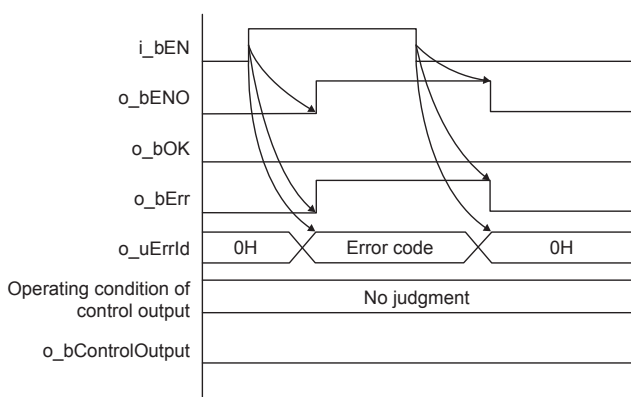
## Timing chart of I/O signals

### ■When the operation is completed successfully



### ■When the operation is completed with an error

When the set value is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), i\_bEN (Execution command) cannot be turned OFF and normal operation will become impossible. Therefore, use this FB in programs that can turn i\_bEN (Execution command) OFF.
- Every input must be provided with a value for proper FB operation.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Measured value: 30 Target value: 50 Dead band: 10	0.009 ms	0.638 ms	1 scan
FX5U, FX5UC <sup>*1*2</sup>	Measured value: 30 Target value: 50 Dead band: 10	0.008 ms	0.456 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.



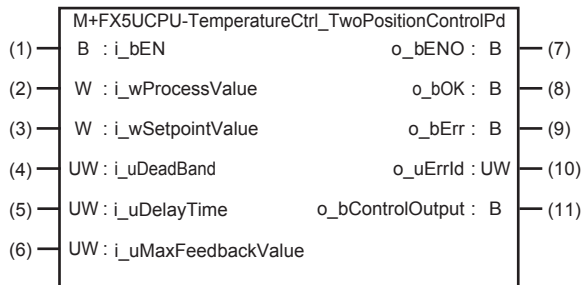
## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uDeadBand (Dead band) is invalid.	Reset the set value of i_uDeadBand (Dead band) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"><li>• Target value + Dead band <math>\leq</math> 32767</li><li>• Target value - Dead band <math>\geq</math> -32768</li></ul>

## 6.2 M+FX5UCPU- TemperatureCtrl\_TwoPositionControlPd (Two- position control with a PD characteristic)

### Overview

This FB performs two-position control with a PD characteristic to turn the control output ON/OFF based on the input of the measured value, target value, dead band, delay time, and maximum feedback value.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_wProcessValue	Measured value	Word [Signed]	-32768 to +32767	Enter the measured value to be controlled.
(3)	i_wSetpointValue	Target value	Word [Signed]	-32768 to +32767	Set the target value to be controlled.
(4)	i_uDeadBand	Dead band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output is not switched. The value should be within the following ranges: <ul style="list-style-type: none"> <li>Target value + Dead band ≤ 32767</li> <li>Target value - Dead band ≥ -32768</li> </ul>
(5)	i_uDelayTime	Delay time	Word [Unsigned]/ Bit string [16 bits]	0 to 32767 (× 100 ms)	Specify the delay time for the feedback.
(6)	i_uMaxFeedbackValue	Maximum feedback value	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the maximum value of the feedback.

#### Output label

No.	Variable name	Name	Data type	Default value	Description
(7)	o_bENO	Execution status	Bit	OFF	Outputs the execution status of the FB. ON: The FB has been executed. OFF: The FB has not been executed.
(8)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the processing of the FB has completed normally.
(9)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(10)	o_uErrId	Error code	Word [Unsigned]/ Bit string [16 bits]	0	Stores the error code that occurred in the FB.
(11)	o_bControlOutput	Control output	Bit	OFF	Turns ON/OFF the control output of the two-position control with a PD characteristic.

# FB details

## Available device

### ■ CPU module

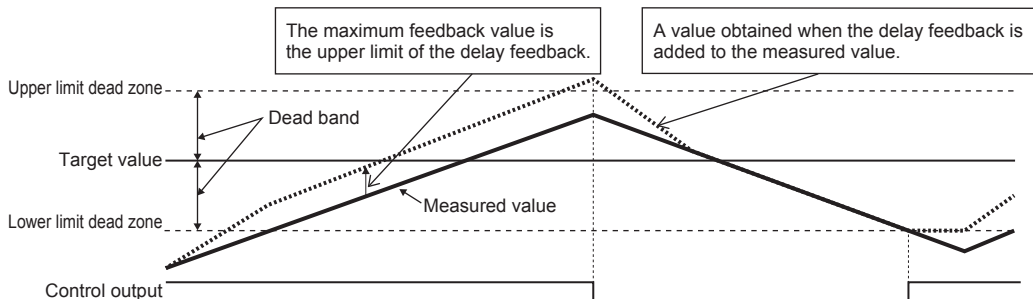
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.110 or later	GX Works3 Version 1.055H or later

## Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	194 steps The number of steps of the FB in a program depends on the CPU module used, input and output definition, and the option setting of GX Works3. For the option setting of GX Works3, refer to <a href="#">GX Works3 Operating Manual</a> .
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.03 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to <a href="#">GX Works3 Operating Manual</a> .
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- Control details of the two-position control with a PD characteristic.



- This FB starts the two-position control with a PD characteristic when `i_bEN` (Execution command) turns ON.
- Based on the input of `i_wProcessValue` (Measured value), `i_wSetpointValue` (Target value), and `i_uDelayTime` (Delay time), the delay feedback used for the two-position control with a PD characteristic is calculated.
- The delay feedback is specified as follows.
  - Initial value `K0`
  - While the control output is ON, the value is incremented at every delay time.
  - While the control output is OFF, the value is decremented at every delay time.
  - If the value goes below `K0`, it is fixed to `K0`.
  - The maximum feedback value is used as the upper limit.
- The operating conditions of the control output are as follows.

Condition where the control output is set:  $\text{Measured value} + \text{Delay feedback} < \text{Lower limit dead zone} (\text{Target value} - \text{Dead band})$

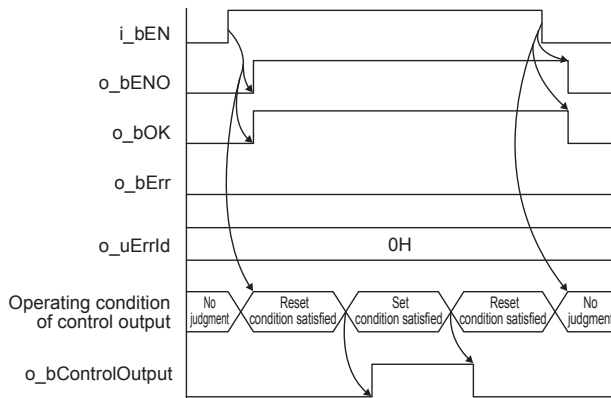
Condition where the control output is reset:  $\text{Measured value} + \text{Delay feedback} > \text{Upper limit dead zone} (\text{Target value} + \text{Dead band})$

- If the delay feedback exceeds `i_uMaxFeedbackValue` (Maximum feedback value), the value of `i_uMaxFeedbackValue` (Maximum feedback value) is assigned to the delay feedback.

- o\_bControlOutput (Control output) turns ON or OFF according to the operating condition of the control output.
- If i\_uDeadBand (Dead band) is outside the setting range, o\_bOK (Normal completion) turns OFF, o\_bErr (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 100 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 67 Error code](#).
- If i\_uDelayTime (Delay time) is outside the setting range, o\_bOK (Normal completion) turns OFF, o\_bErr (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 101 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 67 Error code](#).
- If i\_uMaxFeedbackValue (Maximum feedback value) is outside the setting range, o\_bOK (Normal completion) turns OFF, o\_bErr (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 102 (hexadecimal) is stored in o\_uErrId (Error code). For the error code, refer to [Page 67 Error code](#).
- To interrupt the processing of the FB by error completion, turn OFF o\_bControlOutput (Control output).

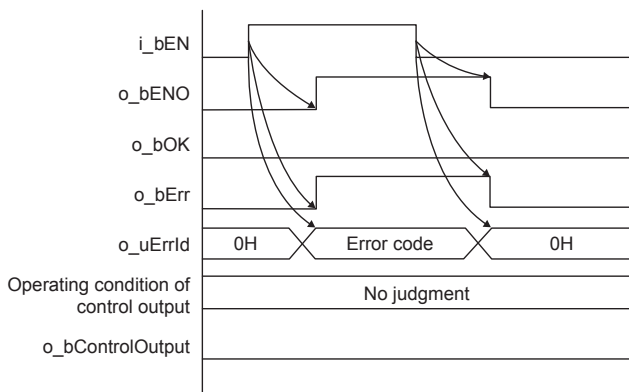
## Timing chart of I/O signals

### ■When the operation is completed successfully



### ■When the operation is completed with an error

When the set value is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), i\_bEN (Execution command) cannot be turned OFF and normal operation will become impossible. Therefore, use this FB in programs that can turn i\_bEN (Execution command) OFF.
- Every input must be provided with a value for proper FB operation.
- This FB uses a timer.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Measured value: 30 Target value: 50 Dead band: 10 Delay time: 50 Maximum feedback value: 100	0.018 ms	0.650 ms	1 scan
FX5U, FX5UC <sup>*1*2</sup>	Measured value: 30 Target value: 50 Dead band: 10 Delay time: 50 Maximum feedback value: 100	0.015 ms	0.485 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

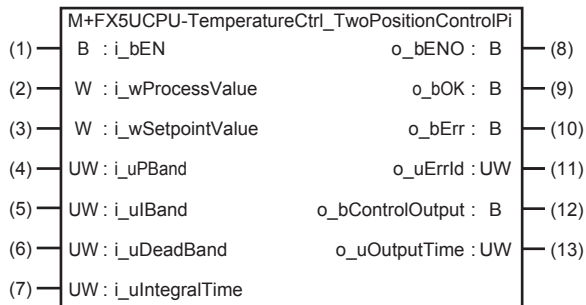
## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of <code>i_uDeadBand</code> (Dead band) is invalid.	Reset the set value of <code>i_uDeadBand</code> (Dead band) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>• Target value + Dead band <math>\leq</math> 32767</li> <li>• Target value - Dead band <math>\geq</math> -32768</li> </ul>
101H	The set value of <code>i_uDelayTime</code> (Delay time) is invalid.	Reset the set value of <code>i_uDelayTime</code> (Delay time) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>• 0 to 32767 (<math>\times</math> 100 ms)</li> </ul>
102H	The set value of <code>i_uMaxFeedbackValue</code> (Maximum feedback value) is invalid.	Reset the set value of <code>i_uMaxFeedbackValue</code> (Maximum feedback value) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>• 0 to 32767</li> </ul>

## 6.3 M+FX5UCPU- TemperatureCtrl\_TwoPositionControlPi (Two- position control with a PI characteristic)

### Overview

This FB performs two-position control with a PI characteristic to turn the control output ON/OFF and output the output time based on the input of the measured value, target value, proportional band, integral band, dead band, and integral time.



### Labels

#### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_wProcessValue	Measured value	Word [Signed]	-32768 to +32767	Enter the measured value to be controlled.
(3)	i_wSetpointValue	Target value	Word [Signed]	-32768 to +32767	Set the target value to be controlled.
(4)	i_uPBand	Proportional band	Word [Unsigned]/ Bit string [16 bits]	1 to 32767	A proportional band is a range of measured values or a band area where a proportional operation is performed. The value should be within the following ranges: <ul style="list-style-type: none"> <li>• Target value + Proportional band ≤ 32767</li> <li>• Target value - Proportional band ≥ -32768</li> </ul>
(5)	i_ulBand	Integral band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	An integral band is a range of measured values or a band area where an integral operation is performed. The value should be within the following ranges: <ul style="list-style-type: none"> <li>• (Measured value - Target value) × Integral band = -32768 to 32767</li> </ul> When the value is outside the setting range, it is fixed to the maximum or minimum value obtained with the calculation above.
(6)	i_uDeadBand	Dead band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output is not switched. The value should be within the following ranges: <ul style="list-style-type: none"> <li>• Target value + Dead band ≤ 32767</li> <li>• Target value - Dead band ≥ -32768</li> </ul>
(7)	i_uIntegralTime	Integral time	Word [Unsigned]/ Bit string [16 bits]	0 to 32767 (× 100 ms)	Specify the period during which an integral operation is active in increments of 100 ms.

## Output label

No.	Variable name	Name	Data type	Default value	Description
(8)	o_bENO	Execution status	Bit	OFF	Outputs the execution status of the FB. ON: The FB has been executed. OFF: The FB has not been executed.
(9)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the processing of the FB has completed normally.
(10)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [Unsigned]/ Bit string [16 bits]	0	Stores the error code that occurred in the FB.
(12)	o_bControlOutput	Control output	Bit	OFF	Turns ON/OFF the control output of the two-position control with a PI characteristic.
(13)	o_uOutputTime	Output time	Word [Unsigned]/ Bit string [16 bits]	0	Duration of the output signal specified in increments of 100 ms.



## FB details

### Available device

#### ■ CPU module

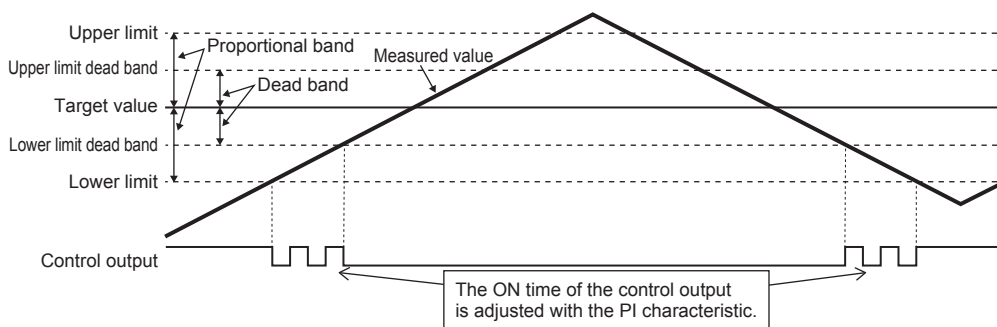
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.110 or later	GX Works3 Version 1.055H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	267 steps The number of steps of the FB in a program depends on the CPU module used, input and output definition, and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.04 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- Control details of the two-position control with a PI characteristic



- This FB starts the two-position control with a PI characteristic when `i_bEN` (Execution command) turns ON.
- Based on the input of `i_wProcessValue` (Measured value), `i_wSetpointValue` (Target value), `i_uPBand` (Proportional band), and `i_ulBand` (Integral band), the output time used for the two-position control with a PI characteristic is calculated.

- Output time = (Target value - Measured value) × Integral band ÷ Proportional band

- The operating conditions of the control output are as follows.

Condition where the control output turns ON: When either of the following (1) or (2) is satisfied

(1) Lower limit (Target value - Proportional band) > Measured value

(2) When all of the following conditions are satisfied

- Lower limit (Target value - Proportional band) ≤ Measured value ≤ Upper limit (Target value + Proportional band)

- Measured value < Lower limit dead zone (Target value - Dead band)

- Output time > Integral time

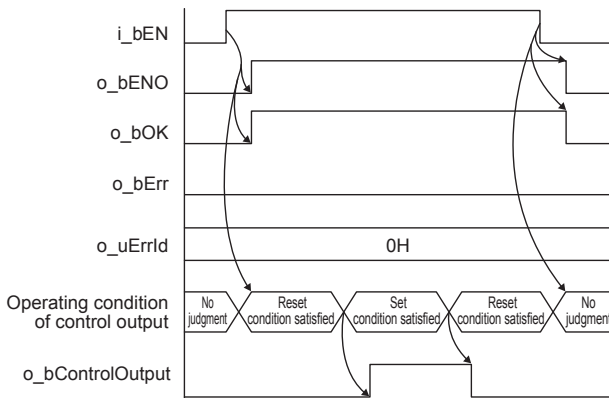
Condition where the control output turns OFF: Any state other than the condition where the control output turns ON

- `o_bControlOutput` (Control output) turns ON or OFF according to the operating condition of the control output.
- If `i_uDeadBand` (Dead band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 100 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 72 Error code](#).
- If `i_uPBand` (Proportional band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 103 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 72 Error code](#).
- If `i_uIntegralTime` (Integral time) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 104 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 72 Error code](#).
- If `i_uDeadBand` (Dead band) and `i_uPBand` (Proportional band) are within the setting range and `i_uDeadBand` (Dead band) ≥ `i_uPBand` (Proportional band), `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 110 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 72 Error code](#).
- To interrupt the processing of the FB by error completion, turn OFF `o_bControlOutput` (Control output).



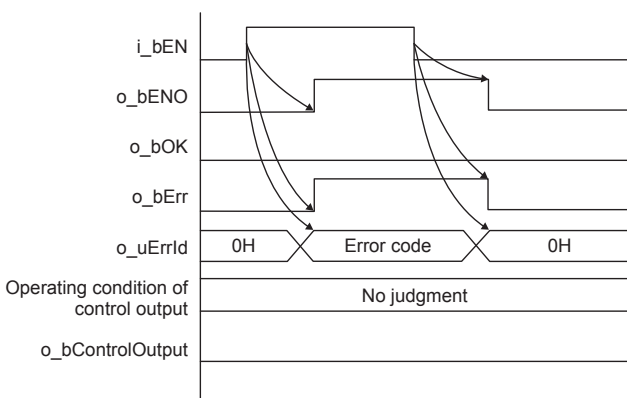
## Timing chart of I/O signals

### ■When the operation is completed successfully



### ■When the operation is completed with an error

When the set value is outside the setting range



6

## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), i\_bEN (Execution command) cannot be turned OFF and normal operation will become impossible. Therefore, use this FB in programs that can turn i\_bEN (Execution command) OFF.
- Every input must be provided with a value for proper FB operation.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Measured value: 30 Target value: 50 Proportional band: 15 Integral band: 15 Dead band: 10 Integral time: 10	0.029 ms	0.668 ms	1 scan
FX5U, FX5UC <sup>*1*2</sup>	Measured value: 30 Target value: 50 Proportional band: 15 Integral band: 15 Dead band: 10 Integral time: 10	0.023 ms	0.497 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

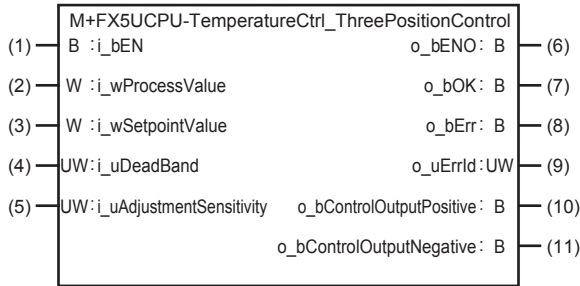
## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uDeadBand (Dead band) is invalid.	Reset the set value of i_uDeadBand (Dead band) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Target value + Dead band ≤ 32767</li> <li>Target value - Dead band ≥ -32768</li> </ul>
103H	The set value of i_uPBand (Proportional band) is invalid.	Reset the set value of i_uPBand (Proportional band) to a value that satisfies all the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Target value + Proportional band ≤ 32767</li> <li>Target value - Proportional band ≥ -32768</li> <li>Proportional band: 1 to 32767</li> </ul>
104H	The set value of i_uIntegralTime (Integral time) is invalid.	Reset the set value of i_uIntegralTime (Integral time) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>0 to 32767 (× 100 ms)</li> </ul>
110H	The set value of i_uDeadBand (Dead band) or i_uPBand (Proportional band) is invalid.	Reset the set values of i_uDeadBand (Dead band) and i_uPBand (Proportional band) to values that satisfy the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Dead band &lt; Proportional band</li> </ul>

# 6.4 M+FX5UCPU- TemperatureCtrl\_ThreePositionControl (Three- position control)

## Overview

This FB performs three-position control to turn the control output + side and control output - side ON/OFF individually based on the input of the measured value, target value, dead band, and adjustment sensitivity.



## Labels

### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_wProcessValue	Measured value	Word [Signed]	-32768 to +32767	Enter the measured value to be controlled.
(3)	i_wSetpointValue	Target value	Word [Signed]	-32768 to +32767	Set the target value to be controlled.
(4)	i_uDeadBand	Dead band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output + side is not switched. The value should be within the following ranges: <ul style="list-style-type: none"> <li>Target value + Dead band ≤ 32767</li> <li>Target value - Dead band ≥ -32768</li> </ul>
(5)	i_uAdjustmentSensitivity	Adjustment sensitivity	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output - side is not switched. The value should be within the following ranges: <ul style="list-style-type: none"> <li>Target value + Adjustment sensitivity ≤ 32767</li> <li>Target value - Adjustment sensitivity ≥ -32768</li> </ul>

### Output label

No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	OFF	Outputs the execution status of the FB. ON: The FB has been executed. OFF: The FB has not been executed.
(7)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the processing of the FB has completed normally.
(8)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(9)	o_uErrId	Error code	Word [Unsigned]/ Bit string [16 bits]	0	Stores the error code that occurred in the FB.
(10)	o_bControlOutputPositive	Control output + side	Bit	OFF	Turns ON/OFF the control output on the + side of the three-position control.
(11)	o_bControlOutputNegative	Control output - side	Bit	OFF	Turns ON/OFF the control output on the - side of the three-position control.



## FB details

### Available device

#### ■CPU module

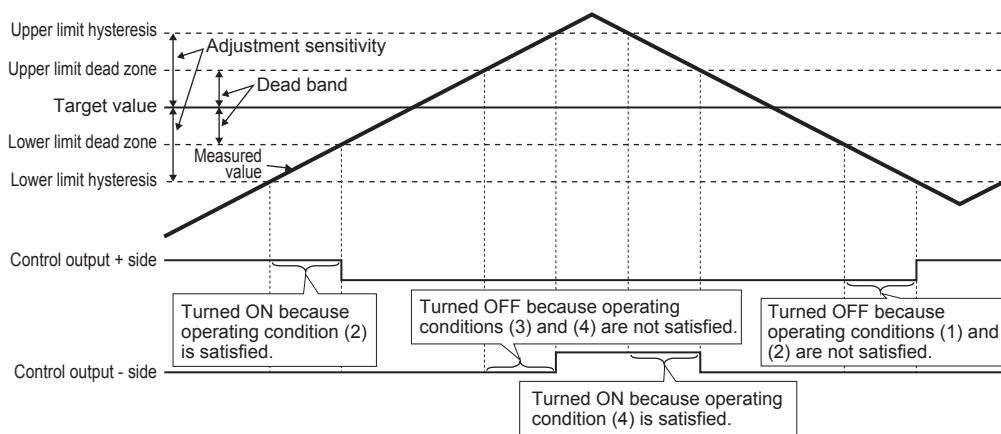
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.110 or later	GX Works3 Version 1.055H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	243 steps The number of steps of the FB in a program depends on the CPU module used, input and output definition, and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"><li>• Label: 0.02 K point (Word)</li><li>• Latch label: 0 K point (Word)</li></ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"><li>• Index register: 0 point</li><li>• Long index register: 0 point</li></ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- Control details of the three-position control



- This FB starts the three-position control when `i_bEN` (Execution command) turns ON.
- The operating conditions of the control output are as follows.
 

Condition where the control output + side is set: When either (1) or (2) is satisfied

(1) Measured value < Lower limit hysteresis (Target value - Adjustment sensitivity)

(2) When all of the following conditions are satisfied

  - Measured value  $\geq$  Lower limit hysteresis (Target value - Adjustment sensitivity)
  - Measured value < Lower limit dead zone (Target value - Dead band)
  - Condition (1) has been satisfied immediately before the point.

Condition where the control output + side is reset: Any state other than the conditions where the control output + side is set

Condition where the control output - side is set: When either (3) or (4) is satisfied

(3) Measured value > Upper limit hysteresis (Target value + Adjustment sensitivity)

(4) When all of the following conditions are satisfied

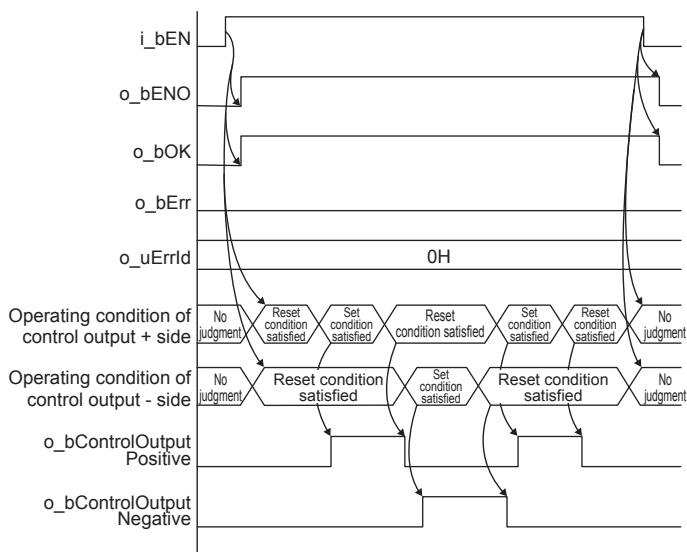
  - Measured value > Upper limit dead zone (Target value + Dead band)
  - Measured value  $\leq$  Upper limit hysteresis (Target value + Adjustment sensitivity)
  - Condition (3) has been satisfied immediately before the point.

Condition where the control output - side is reset: Any state other than the conditions where the control output - side is set

  - `o_bControlOutputPositive` (Control output + side) and `o_bControlOutputNegative` (Control output - side) turn ON or OFF according to the operating condition of the control output.
  - If `i_uDeadBand` (Dead band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 100 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 77 Error code](#).
  - If `i_uAdjustmentSensitivity` (Adjustment sensitivity) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 109 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 77 Error code](#).
  - If `i_uDeadBand` (Dead band) and `i_uAdjustmentSensitivity` (Adjustment sensitivity) are within the setting range and `i_uDeadBand` (Dead band)  $\geq$  `i_uAdjustmentSensitivity` (Adjustment sensitivity), `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 111 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 77 Error code](#).
  - To interrupt the processing of the FB by error completion, turn OFF `o_bControlOutputPositive` (Control output + side) and `o_bControlOutputNegative` (Control output - side).

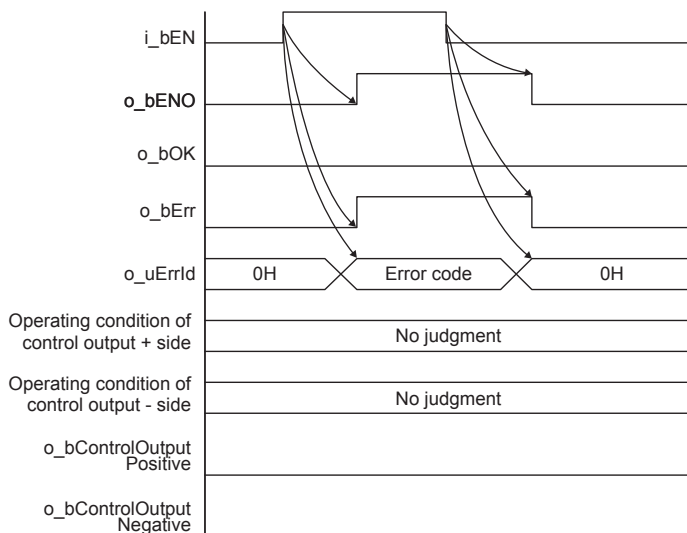
## Timing chart of I/O signals

### ■When the operation is completed successfully



### ■When the operation is completed with an error

When the set value is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), **i\_bEN** (Execution command) cannot be turned OFF and normal operation will become impossible. Therefore, use this FB in programs that can turn **i\_bEN** (Execution command) OFF.
- Every input must be provided with a value for proper FB operation.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Measured value: 30 Target value: 50 Dead band: 10 Adjustment sensitivity: 15	0.020 ms	0.655 ms	1 scan
FX5U, FX5UC <sup>*1*2</sup>	Measured value: 30 Target value: 50 Dead band: 10 Adjustment sensitivity: 15	0.014 ms	0.479 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

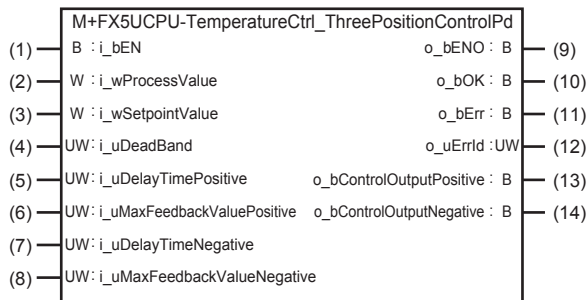
## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uDeadBand (Dead band) is invalid.	Reset the set value of i_uDeadBand (Dead band) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Target value + Dead band <math>\leq</math> 32767</li> <li>Target value - Dead band <math>\geq</math> -32768</li> </ul>
109H	The set value of i_uAdjustmentSensitivity (Adjustment sensitivity) is invalid.	Reset the set value of i_uAdjustmentSensitivity (Adjustment sensitivity) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Target value + Adjustment sensitivity <math>\leq</math> 32767</li> <li>Target value - Adjustment sensitivity <math>\geq</math> -32768</li> </ul>
111H	The set value of i_uDeadBand (Dead band) or i_uAdjustmentSensitivity (Adjustment sensitivity) is invalid.	Reset the set values of i_uDeadBand (Dead band) and i_uAdjustmentSensitivity (Adjustment sensitivity) to values that satisfy the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Dead band &lt; Adjustment sensitivity</li> </ul>

# 6.5 M+FX5UCPU- TemperatureCtrl\_ThreePositionControlPd (Three- position control with a PD characteristic)

## Overview

This FB performs three-position control with a PD characteristic to turn the control output + side and control output - side ON/OFF individually based on the input of the measured value, target value, dead band, delay time of the control output + side, maximum feedback value of the control output + side, delay time of the control output - side, and maximum feedback value of the control output - side.



## Labels

### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_wProcessValue	Measured value	Word [Signed]	-32768 to +32767	Enter the measured value to be controlled.
(3)	i_wSetpointValue	Target value	Word [Signed]	-32768 to +32767	Set the target value to be controlled.
(4)	i_uDeadBand	Dead band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output + side is not switched. The value should be within the following ranges: <ul style="list-style-type: none"> <li>Target value + Dead band ≤ 32767</li> <li>Target value - Dead band ≥ -32768</li> </ul>
(5)	i_uDelayTimePositive	Delay time of the control output + side	Word [Unsigned]/ Bit string [16 bits]	0 to 32767 (× 100 ms)	Specify the delay time of the control output + side.
(6)	i_uMaxFeedbackValuePositive	Maximum feedback value of the control output + side	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the maximum value of the delay feedback of the control output + side.
(7)	i_uDelayTimeNegative	Delay time of the control output - side	Word [Unsigned]/ Bit string [16 bits]	0 to 32767 (× 100 ms)	Specify the delay time of the control output - side.
(8)	i_uMaxFeedbackValueNegative	Maximum feedback value of the control output - side	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the maximum value of the delay feedback of the control output - side.



## Output label

No.	Variable name	Name	Data type	Default value	Description
(9)	o_bENO	Execution status	Bit	OFF	Outputs the execution status of the FB. ON: The FB has been executed. OFF: The FB has not been executed.
(10)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the processing of the FB has completed normally.
(11)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(12)	o_uErrId	Error code	Word [Unsigned]/ Bit string [16 bits]	0	Stores the error code that occurred in the FB.
(13)	o_bControlOutputPositive	Control output + side	Bit	OFF	Turns ON/OFF the control output on the + side of the three-position control with a PD characteristic.
(14)	o_bControlOutputNegative	Control output - side	Bit	OFF	Turns ON/OFF the control output on the - side of the three-position control with a PD characteristic.



## FB details

### Available device

#### ■ CPU module

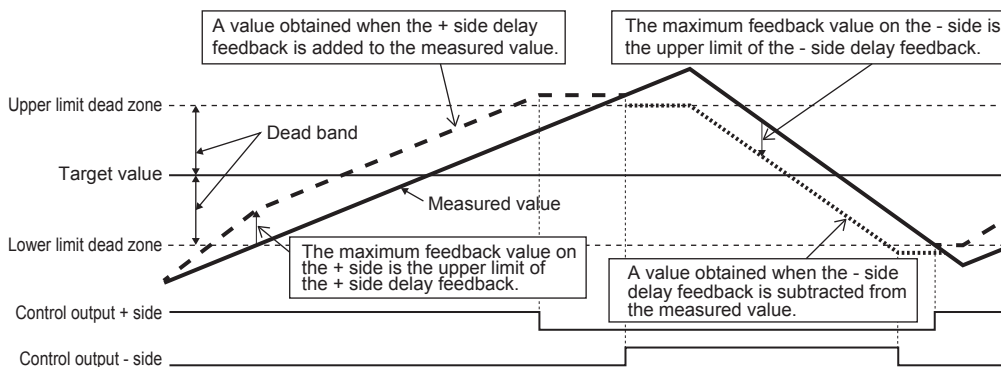
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.110 or later	GX Works3 Version 1.055H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	295 steps The number of steps of the FB in a program depends on the CPU module used, input and output definition, and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.04 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- Control details of the three-position control with a PD characteristic



- This FB starts the three-position control with a PD characteristic when `i_bEN` (Execution command) turns ON.
- Based on the input of `i_wProcessValue` (Measured value), `i_wSetpointValue` (Target value), `i_uDelayTimePositive` (Delay time of the control output + side), and `i_uDelayTimeNegative` (Delay time of the control output - side), the +/- side delay feedback used for the three-position control with a PD characteristic is calculated.

- The +/- side delay feedback is specified as follows.

- Initial value `K0`
- While the control output +/- side is ON, the value is incremented at every delay time of the control output + side.
- While the control output +/- side is OFF, the value is decremented at every delay time of the control output + side.
- If the value goes below `K0`, it is fixed to `K0`.
- The upper limit will be the maximum feedback value of the control output +/- side.

- The operating conditions of the control output are as follows.

Condition where the control output + side is set:  $\text{Measured value} + \text{"+" side delay feedback"} < \text{Lower limit dead zone (Target value - Dead band)}$

Condition where the control output + side is reset:  $\text{Measured value} + \text{"+" side delay feedback"} > \text{Upper limit dead zone (Target value + Dead band)}$

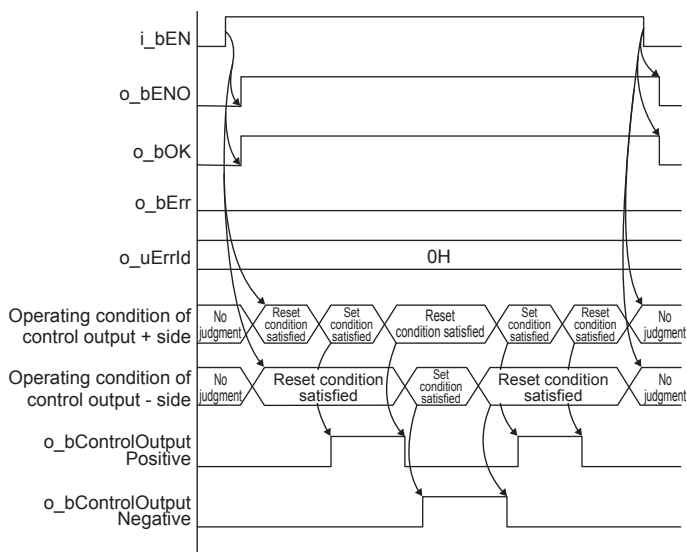
Condition where the control output - side is set:  $\text{Measured value} - \text{"-" side delay feedback"} > \text{Upper limit dead zone (Target value + Dead band)}$

Condition where the control output - side is reset:  $\text{Measured value} - \text{"-" side delay feedback"} < \text{Lower limit dead zone (Target value - Dead band)}$

- `o_bControlOutputPositive` (Control output + side) and `o_bControlOutputNegative` (Control output - side) turn ON or OFF according to the operating condition of the control output.
- If `i_uDeadBand` (Dead band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 100 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 82 Error code](#).
- If `i_uDelayTimePositive` (Delay time of the control output + side) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 105 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 82 Error code](#).
- If `i_uMaxFeedbackValuePositive` (Maximum feedback value of the control output + side) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 106 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 82 Error code](#).
- If `i_uDelayTimeNegative` (Delay time of the control output - side) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 107 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 82 Error code](#).
- If `i_uMaxFeedbackValueNegative` (Maximum feedback value of the control output - side) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 108 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 82 Error code](#).
- To interrupt the processing of the FB by error completion, turn OFF `o_bControlOutputPositive` (Control output + side) and `o_bControlOutputNegative` (Control output - side).

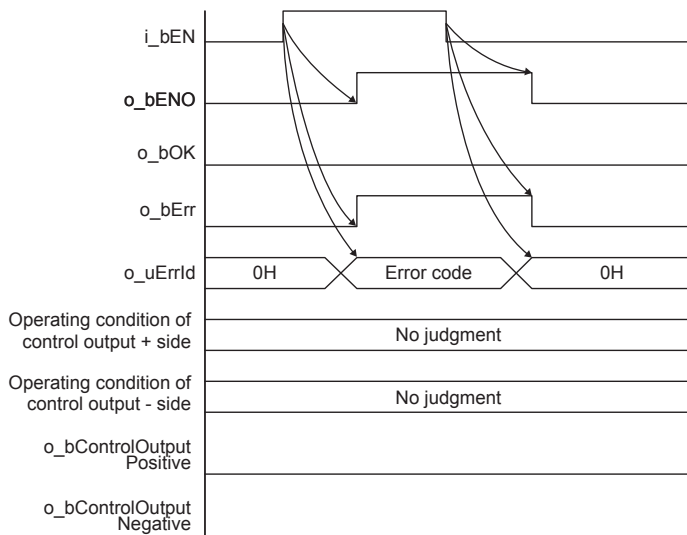
## Timing chart of I/O signals

### ■When the operation is completed successfully



### ■When the operation is completed with an error

When the set value is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), i\_bEN (Execution command) cannot be turned OFF and normal operation will become impossible. Therefore, use this FB in programs that can turn i\_bEN (Execution command) OFF.
- Every input must be provided with a value for proper FB operation.
- This FB uses a timer.

## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Measured value: 30 Target value: 50 Dead band: 10 Delay time of the control output + side: 50 Maximum feedback value of the control output + side: 100 Delay time of the control output - side: 50 Maximum feedback value of the control output - side: 100	0.030 ms	0.697 ms	1 scan
FX5U, FX5UC <sup>*1*2</sup>	Measured value: 30 Target value: 50 Dead band: 10 Delay time of the control output + side: 50 Maximum feedback value of the control output + side: 100 Delay time of the control output - side: 50 Maximum feedback value of the control output - side: 100	0.023 ms	0.504 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

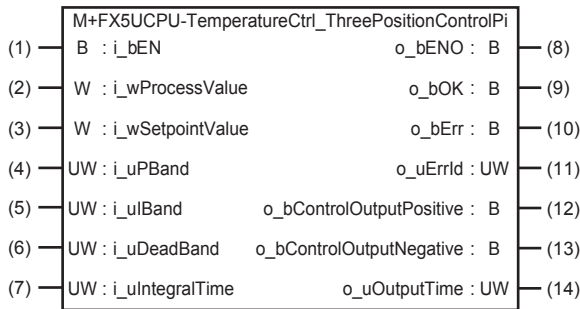
## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of <code>i_uDeadBand</code> (Dead band) is invalid.	Reset the set value of <code>i_uDeadBand</code> (Dead band) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>• Target value + Dead band <math>\leq</math> 32767</li> <li>• Target value - Dead band <math>\geq</math> -32768</li> </ul>
105H	The set value of <code>i_uDelayTimePositive</code> (Delay time of the control output + side) is invalid.	Reset the set value of <code>i_uDelayTimePositive</code> (Delay time of the control output + side) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>• 0 to 32767 (<math>\times</math> 100 ms)</li> </ul>
106H	The set value of <code>i_uMaxFeedbackValuePositive</code> (Maximum feedback value of the control output + side) is invalid.	Reset the set value of <code>i_uMaxFeedbackValuePositive</code> (Maximum feedback value of the control output + side) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>• 0 to 32767</li> </ul>
107H	The set value of <code>i_uDelayTimeNegative</code> (Delay time of the control output - side) is invalid.	Reset the set value of <code>i_uDelayTimeNegative</code> (Delay time of the control output - side) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>• 0 to 32767 (<math>\times</math> 100 ms)</li> </ul>
108H	The set value of <code>i_uMaxFeedbackValueNegative</code> (Maximum feedback value of the control output - side) is invalid.	Reset the set value of <code>i_uMaxFeedbackValueNegative</code> (Maximum feedback value of the control output - side) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>• 0 to 32767</li> </ul>

# 6.6 M+FX5UCPU- TemperatureCtrl\_ThreePositionControlPi (Three- position control with a PI characteristic)

## Overview

This FB performs three-position control with a PI characteristic to turn the control output + side and control output - side ON/ OFF individually and output the control time based on the input of the measured value, target value, proportional band, integral band, dead band, and integral time.



## Labels

### Input label

No.	Variable name	Name	Data type	Range	Description
(1)	i_bEN	Execution command	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	i_wProcessValue	Measured value	Word [Signed]	-32768 to +32767	Enter the measured value to be controlled.
(3)	i_wSetpointValue	Target value	Word [Signed]	-32768 to +32767	Set the target value to be controlled.
(4)	i_uPBand	Proportional band	Word [Unsigned]/ Bit string [16 bits]	1 to 32767	A proportional band is a range of measured values or a band area where a proportional operation is performed. The value should be within the following ranges: • Target value + Proportional band ≤ 32767 • Target value - Proportional band ≥ -32768
(5)	i_uIBand	Integral band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	An integral band is a range of measured values or a band area where an integral operation is performed. The value should be within the following ranges: • (Measured value - Target value) × Integral band = -32768 to 32767 When the value is outside the setting range, it is fixed to the maximum or minimum value obtained with the calculation above.
(6)	i_uDeadBand	Dead band	Word [Unsigned]/ Bit string [16 bits]	0 to 32767	Specify the range in which the control output + side is not switched. The value should be within the following ranges: • Target value + Dead band ≤ 32767 • Target value - Dead band ≥ -32768
(7)	i_uIntegralTime	Integral time	Word [Unsigned]/ Bit string [16 bits]	0 to 32767 (× 100 ms)	Specify the period during which an integral operation is active in increments of 100 ms.

## Output label

No.	Variable name	Name	Data type	Default value	Description
(8)	o_bENO	Execution status	Bit	OFF	Outputs the execution status of the FB. ON: The FB has been executed. OFF: The FB has not been executed.
(9)	o_bOK	Normal completion	Bit	OFF	When this label is ON, it indicates that the processing of the FB has completed normally.
(10)	o_bErr	Error completion	Bit	OFF	When this label is ON, it indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [Unsigned]/ Bit string [16 bits]	0	Stores the error code that occurred in the FB.
(12)	o_bControlOutputPositive	Control output + side	Bit	OFF	Turns ON/OFF the control output on the + side of the three-position control with a PI characteristic.
(13)	o_bControlOutputNegative	Control output - side	Bit	OFF	Turns ON/OFF the control output on the - side of the three-position control with a PI characteristic.
(14)	o_uOutputTime	Output time	Word [Unsigned]/ Bit string [16 bits]	0	Duration of the output signal specified in increments of 100 ms.



## FB details

### Available device

#### ■CPU module

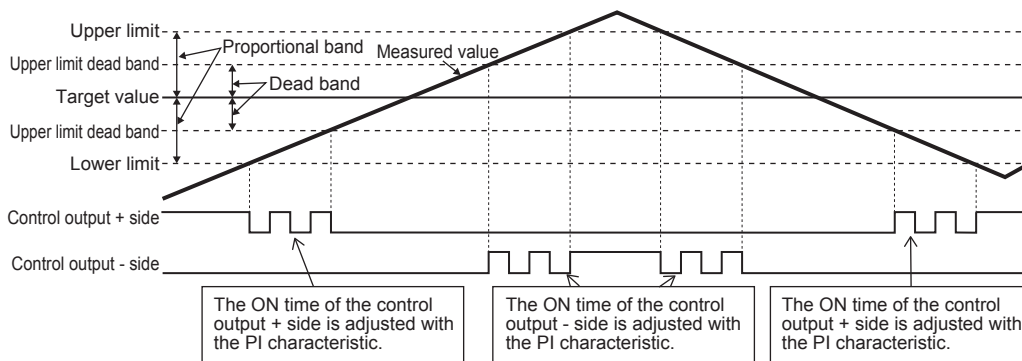
Target module	Firmware Version	Engineering tool
FX5UJ	—	GX Works3 Version 1.060N or later
FX5U, FX5UC	Version 1.110 or later	GX Works3 Version 1.055H or later

### Basic specifications

Item	Description
Language	Ladder diagram
Number of steps	307 steps The number of steps of the FB in a program depends on the CPU module used, input and output definition, and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The amount of label usage	<ul style="list-style-type: none"> <li>Label: 0.04 K point (Word)</li> <li>Latch label: 0 K point (Word)</li> </ul> The amount of labels used in the program varies depending on the CPU module used, the device specified in an argument and the option setting of GX Works3. For the option setting of GX Works3, refer to  GX Works3 Operating Manual.
The number of index register usage	<ul style="list-style-type: none"> <li>Index register: 0 point</li> <li>Long index register: 0 point</li> </ul>
The amount of file register usage	0 point
FB dependence	No dependence
FB compilation method	Macro type
FB operation	Always executed

## Processing

- Control details of the three-position control with a PI characteristic



- This FB sets the three-position control with a PI characteristic when `i_bEN` (Execution command) turns ON.
- Based on the input of `i_wProcessValue` (Measured value), `i_wSetpointValue` (Target value), `i_uPBand` (Proportional band), and `i_ulBand` (Integral band), the output time used for the three-position control with a PI characteristic is calculated.

Output time = (Target value - Measured value) × Integral band ÷ Proportional band

- The operating conditions of the control output are as follows.

Condition where the control output + side turns ON: When either of the following (1) or (2) is satisfied

(1) Lower limit (Target value - Proportional band) > Measured value

(2) When all of the following conditions are satisfied

- Lower limit (Target value - Proportional band) ≤ Measured value ≤ Upper limit (Target value + Proportional band)

- Measured value < Lower limit dead zone (Target value - Dead band)

- Output time > Integral time

Condition where the control output + side turns OFF: Any state other than the condition where the control output + side turns ON

Condition where the control output - side turns ON: When either of the following (1) or (2) is satisfied

(1) Upper limit (Target value + Proportional band) < Measured value

(2) When all of the following conditions are satisfied

- Lower limit (Target value - Proportional band) ≤ Measured value ≤ Upper limit (Target value + Proportional band)

- Measured value > Upper limit dead zone (Target value + Dead band)

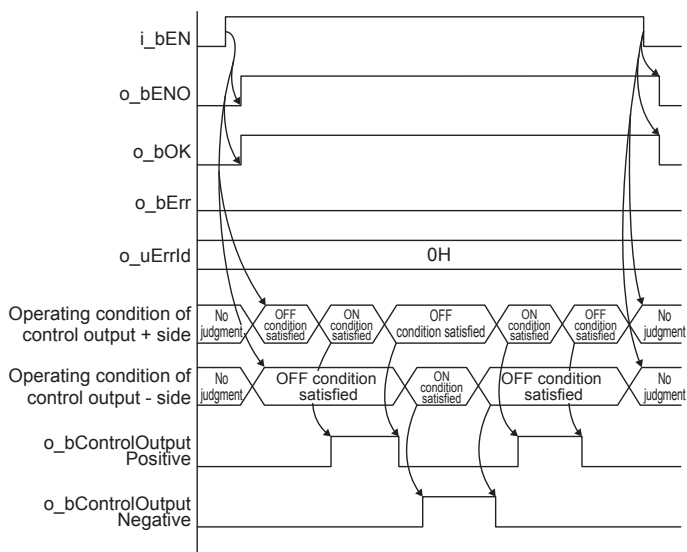
- Output time > Integral time

Condition where the control output - side turns OFF: Any state other than the condition where the control output - side turns ON

- `o_bControlOutputPositive` (Control output + side) and `o_bControlOutputNegative` (Control output - side) turn ON or OFF according to the operating condition of the control output.
- If `i_uDeadBand` (Dead band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 100 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 87 Error code](#).
- If `i_uPBand` (Proportional band) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 103 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 87 Error code](#).
- If `i_ulIntegralTime` (Integral time) is outside the setting range, `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 104 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 87 Error code](#).
- If `i_uDeadBand` (Dead band) and `i_uPBand` (Proportional band) are within the setting range and `i_uDeadBand` (Dead band) ≥ `i_uPBand` (Proportional band), `o_bOK` (Normal completion) turns OFF, `o_bErr` (Error completion) turns ON, and the processing of this FB is interrupted. In addition, 110 (hexadecimal) is stored in `o_uErrId` (Error code). For the error code, refer to [Page 87 Error code](#).
- To interrupt the processing of the FB by error completion, turn OFF `o_bControlOutputPositive` (Control output + side) and `o_bControlOutputNegative` (Control output - side).

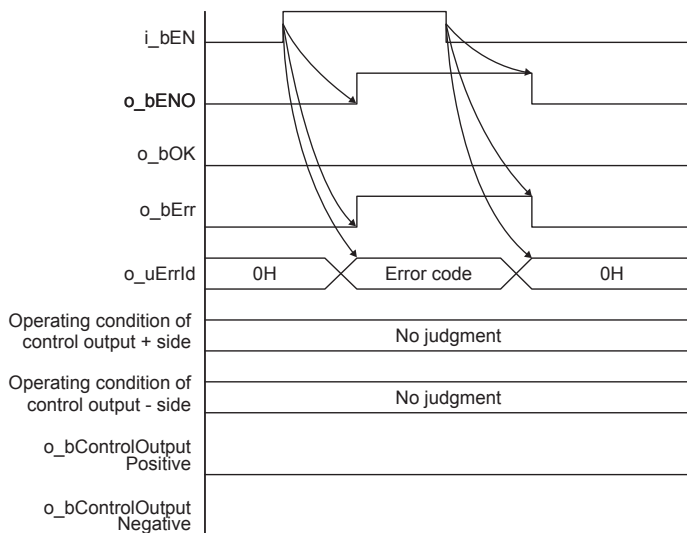
## Timing chart of I/O signals

### ■When the operation is completed successfully



### ■When the operation is completed with an error

When the set value is outside the setting range



## Restrictions or precautions

- This FB does not include the error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
- This FB cannot be used in an interrupt program.
- If this FB is used in a program that is executed only once (such as a subroutine program or FOR-NEXT loop), **i\_bEN** (Execution command) cannot be turned OFF and normal operation will become impossible. Therefore, use this FB in programs that can turn **i\_bEN** (Execution command) OFF.
- Every input must be provided with a value for proper FB operation.



## Parameter setting

No parameters are required to use this FB.

## Performance value

CPU	Measurement conditions	Performance value		Number of scans
		Processing time	Maximum scan time	
FX5UJ	Measured value: 30 Target value: 50 Proportional band: 15 Integral band: 15 Dead band: 10 Integral time: 10	0.032 ms	0.702 ms	1 scan
FX5U, FX5UC <sup>*1,2</sup>	Measured value: 30 Target value: 50 Proportional band: 15 Integral band: 15 Dead band: 10 Integral time: 10	0.025 ms	0.504 ms	1 scan

\*1 When the program capacity is set to 128 K steps, the processing speed may be reduced.

\*2 The labels in the standard area are used.

## Error code

Error code (hexadecimal)	Description	Action
100H	The set value of i_uDeadBand (Dead band) is invalid.	Reset the set value of i_uDeadBand (Dead band) to a value that satisfies the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Target value + Dead band ≤ 32767</li> <li>Target value - Dead band ≥ -32768</li> </ul>
103H	The set value of i_uPBand (Proportional band) is invalid.	Reset the set value of i_uPBand (Proportional band) to a value that satisfies all the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Target value + Proportional band ≤ 32767</li> <li>Target value - Proportional band ≥ -32768</li> <li>Proportional band: 1 to 32767</li> </ul>
104H	The set value of i_uIntegralTime (Integral time) is invalid.	Reset the set value of i_uIntegralTime (Integral time) to the following value and then execute the FB again. <ul style="list-style-type: none"> <li>0 to 32767 (× 100 ms)</li> </ul>
110H	The set value of i_uDeadBand (Dead band) or i_uPBand (Proportional band) is invalid.	Reset the set values of i_uDeadBand (Dead band) and i_uPBand (Proportional band) to values that satisfy the following conditions and then execute the FB again. <ul style="list-style-type: none"> <li>Dead band &lt; Proportional band</li> </ul>



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# MEMO

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# REVISIONS

Revision date	Revision	Description
January 2015	A	First Edition
April 2015	B	A part of the cover design is changed.
July 2015	C	■Added or modified parts Chapter 1, Section 3.1, 4.1, 4.2, 4.3, 4.4
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January 2019	F	■Added or modified parts Chapter 1, 6
October 2019	G	■Added or modified parts SAFETY PRECAUTIONS, INTRODUCTION, RELEVANT MANUALS, TERMS, Generic terms and abbreviations, Chapter 1, 2, 3, 4, 5, 6, TRADEMARKS

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