MITSUBISHI ELECTRIC

Programmable Controller

MELSEC iQ-F series

MELSEC iQ-F Roll to Roll Control Function Block Library Reference

SAFETY PRECAUTIONS

(Read these precautions before using Mitsubishi Electric programmable controllers.)
Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.
In this manual, the safety precautions are classified into two levels: "⚠WARNING" and "⚠CAUTION".

⚠ **WARNING**	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ **CAUTION**	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under "⚠CAUTION" may lead to serious consequences.
Observe the precautions of both levels because they are important for personal and system safety.
Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

INTRODUCTION

Thank you for purchasing the MELSEC iQ-F series programmable controllers.
This manual describes the module function blocks for the relevant products listed below.
It should be read and understood before attempting to install or use the module.
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 in 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 in the local and national standards. If in doubt about the operation or use, please consult the nearest Mitsubishi Electric representative.
- The examples in this manual, technical bulletin, or catalog are provided for reference only and do not guarantee operation. Please use these examples after confirming the functions and safety of the equipment and system.
- The content in this manual, including the specifications, is subject to change without notice for improvement purposes.
- The information in this manual has been carefully checked and is believed to be accurate; however, if you have any questions or find any errors, please consult your local Mitsubishi representative. When doing so, please provide the manual number indicated at the end of this manual.

CONTENTS

RELEVANT MANUALS

Manual name	Description
MELSEC iQ-F FX5S/FX5UJ/FX5U/FX5UC User's Manual (Hardware) <SH-082452ENG>	Details of hardware of the CPU module, including I/O specifications, wiring, installation, and maintenance
MELSEC iQ-F FX5 User's Manual (Application) <JY997D55401>	Basic knowledge about programming, functions of the CPU module, devices/labels, and parameter settings
MELSEC iQ-F FX5 Programming Manual (Program Design) <JY997D55701>	Program specifications (ladder, ST, FBD/LD, and SFC programs) and labels
MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks) <JY997D55801>	Specifications of the instructions and functions that can be used in a program
MELSEC iQ-F FX5 Motion Module/Simple Motion Module User's Manual (Startup) <IB-0300251ENG>	Specifications, procedures before operation, system configuration, wiring, and operation examples of the motion module/simple motion module
MELSEC iQ-F FX5 Motion Module/Simple Motion Module User's Manual (Application) <IB-0300253ENG>	Functions, I/O signals, buffer memory, parameter settings, programming, and troubleshooting of the motion module/simple motion module
MELSEC iQ-F FX5 Motion Module User's Manual (CC-Link IE TSN) <IB-0300568ENG>	Functions, parameter settings, troubleshooting, and buffer memory of CC-Link IE TSN Network
GX Works3 Operating Manual <SH-081215ENG>	Explanation of system configuration, parameter settings, and online operations of GX Works3

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Dancer	A component used to control the tension in the web
Engineering tool	A tool used for setting up programmable controllers, programming, debugging, and maintenance
Inertia	A physical amount that indicates the magnitude at which an object tries to maintain its state
Servo amplifier	A device responsible for servo motor control
Web	A sheet-like material

GENERIC TERMS AND ABBREVIATIONS

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

Generic term/abbreviation	Description
Amp	An abbreviation for servo amplifier, which is responsible for controlling servo motors
FB	An abbreviation for "Function Block". A function block is created from a ladder block repeatedly used in a sequence program so that it can be used as a component in a sequence program. Using FBs helps to develop programs more efficiently, reduce mistakes, and improve quality of programs.
FX5-SSC-G	A generic term for the FX5-40SSC-G and the FX5-80SSC-G motion modules
FX5-SSC-S	A generic term for the FX5-40SSC-S and the FX5-80SSC-S simple motion modules
Motion module	An abbreviation for the MELSEC iQ-F series motion modules (FX5-40SSC-G/FX5-80SSC-G)
Simple motion module	An abbreviation for the MELSEC iQ-F series simple motion modules (FX5-40SSC-S/FX5-80SSC-S)

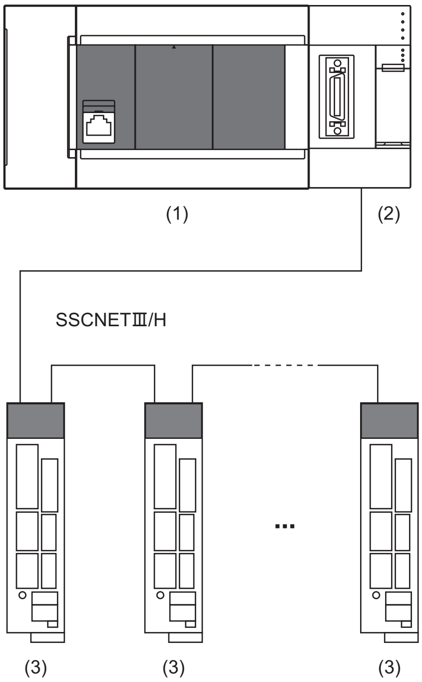
1 OVERVIEW

The function blocks described in this reference manual are the FB libraries for setting the roll to roll control devices in the MELSEC iQ-F series.
These FBs are for the MELSEC iQ-F series simple motion modules (FX5-40SSC-S/FX5-80SSC-S) and motion module (FX5-40SSC-G/FX5-80SSC-G).
They reduces software design man-hours and improve the control accuracy of roll to roll control devices.

1.1 System Configuration

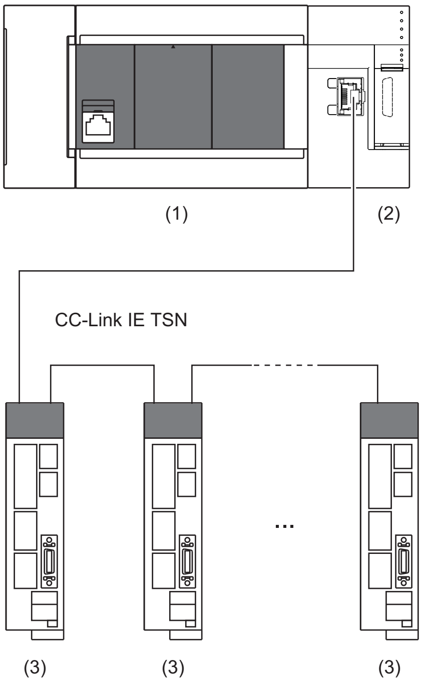
The following figure shows an example of system configuration for using the FB libraries in this reference manual.

System configuration using the FX5-SSC-S



(1) A programmable controller (FX5UJ/FX5U/FX5UC CPU module) that executes programs using the FB libraries
(2) Simple motion module (FX5-SSC-S)
(3) Servo amplifier (MR-J4-B)

System configuration using the FX5-SSC-G

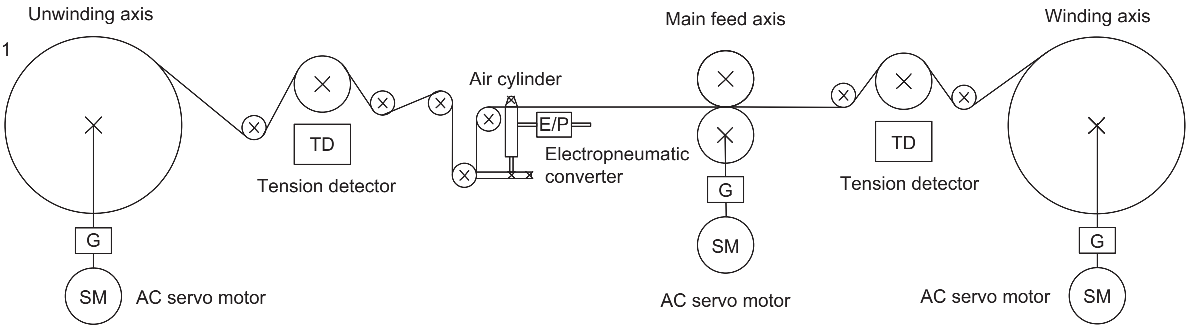


(1) A programmable controller (FX5UJ/FX5U/FX5UC CPU module) that executes programs using the FB libraries
(2) Motion module (FX5-SSC-G)
(3) Servo amplifier (MR-J5-G)

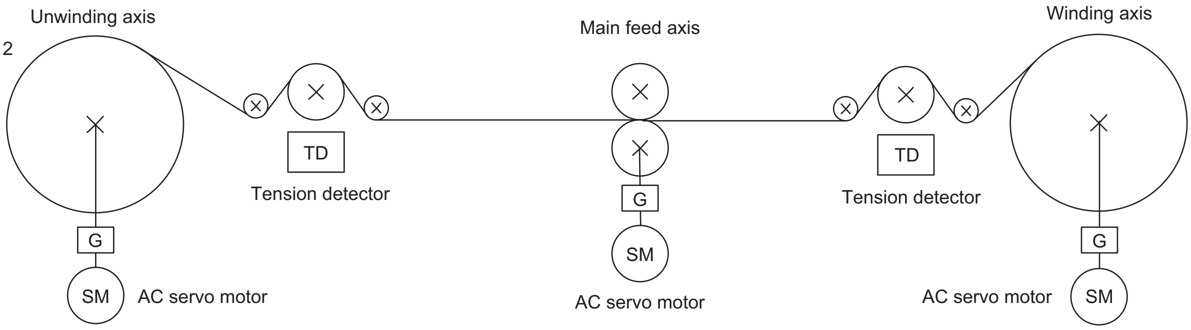
2 EXAMPLE OF DEVICE CONFIGURATION

Typical configurations of the devices are shown below.

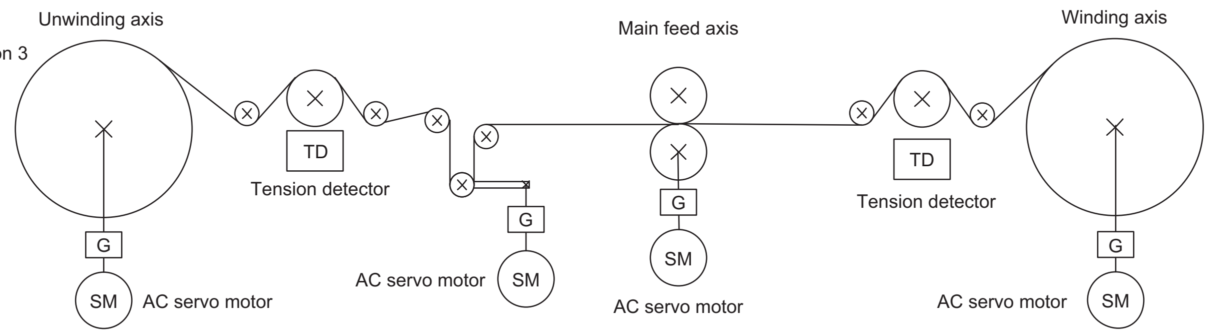
Configuration 1



Configuration 2



Configuration 3



system	control axis	control style	tension detector	Dancer roll	Driving actuator
1	Unwinding	Speed	Installed	Air cylinder pressurized	AC servo motor
	Winding	Torque/Speed	Installed	—	AC servo motor
	Main feed	Speed	—	—	—
2	Unwinding	Torque/Speed	Installed	—	AC servo motor
	Winding	Torque/Speed	Installed	—	AC servo motor
	Main feed	Speed	—	—	—
3	Unwinding	Speed	Installed	AC servo motor-pressurized	AC servo motor
	Winding	Torque/Speed	Installed	—	—
	Main feed	Speed	—	—	—

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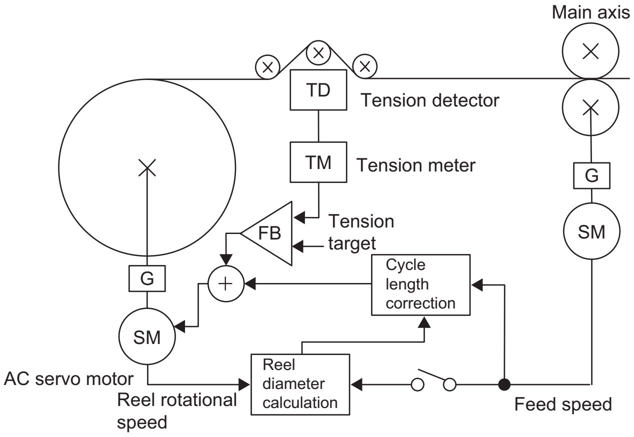
3 CONTROL METHOD

For the control of the unwinding and winding axes, this FB offers three types: tension sensor feedback speed control, dancer feedback speed control, and tension sensor feedback torque control.
This chapter describes the six possible control styles by using these FBs.

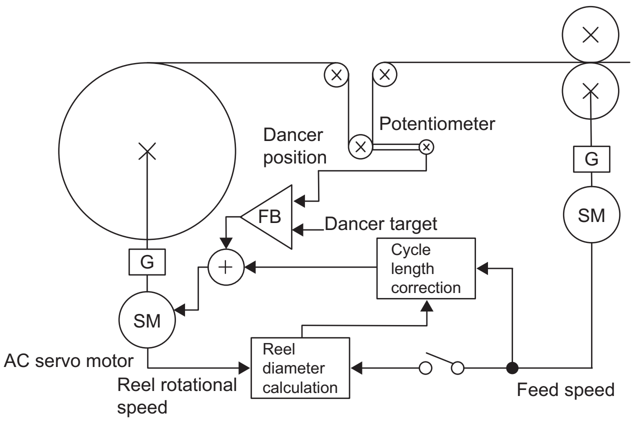
3.1 Tension Sensor Feedback Speed Control

The tension is controlled to match the target by correcting the difference in the circumferential length between the reel diameter and the feed roll diameter against the feed speed of the web and adding the difference in the tension target actual tension to the calculated rotational speed of the reel axis.
The control tension is stable against acceleration/deceleration and mechanical loss, and attention must be paid to gain tuning because the feedback gain varies greatly with the Young's modulus of the web.



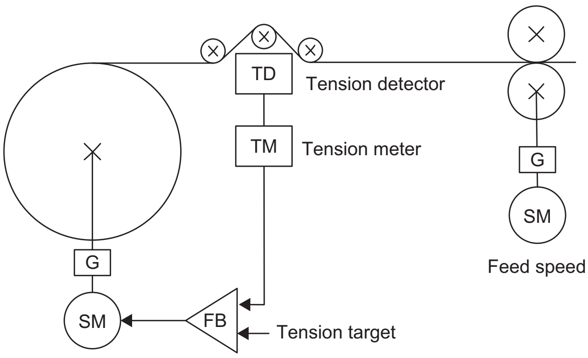
3.2 Dancer Feedback Speed Control

The deviation of the dancer from the target position can be detected as the difference between the reel axial speed and the feed speed. Speed matching control is performed by correcting the difference between the circumference of the reel diameter and the feed roll diameter against the feed speed of the web, calculating the rotational speed of the reel axis, and adding the deviation of the above dancer position to this. In this control style, the control tension is due to the downward pushing pressure of the dancer, so the tension is maintained by making the pushing pressure constant control.
In this control style, the dancer acts as a buffer, so control can be performed in response to sudden acceleration and deceleration. However, the accuracy of tension control depends on the force of the pushing pressure of the dancer. Generally, the pushing pressure is controlled by an air cylinder, but recently, it is sometimes controlled by an AC servo motor or a linear motor.



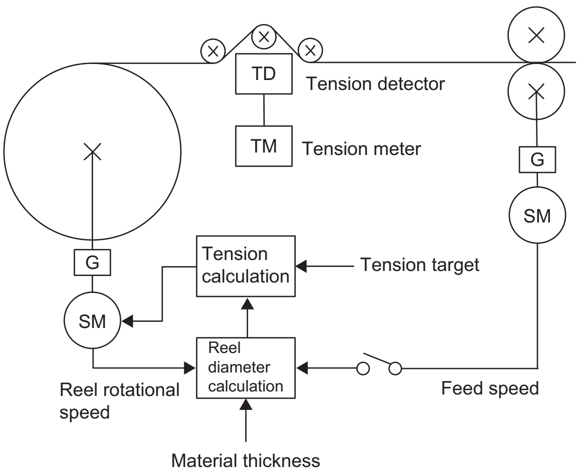
3.3 Tension Sensor Feedback Torque Control

This style uses feedback to control the difference between the tension target and the tension monitor for the driving torque of the reel axis. The brake torque and winding torque of the reel axis are proportional to the operating tension. The style of directly controlling the torque of the reel axis enables stable tension control under constant speed.
Since the width of the feedback control gain does not change significantly with respect to the speed control, the control gain is easy to tune. However, since it reacts slightly late to the change in the feed speed, fluctuation of the tension tends to appear during acceleration and deceleration.



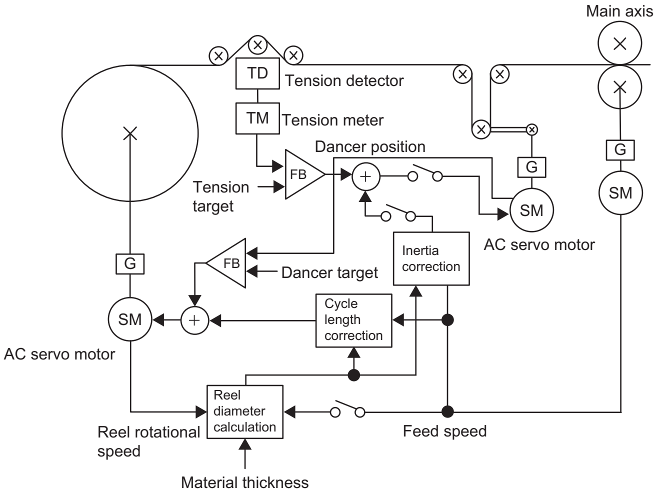
3.4 Tension Sensorless Torque Control

The accuracy of tension control depends on the accuracy of torque calculation, but this system for tension control is more stable than any other control system style.
The control style is based on the principle that the brake torque and the winding torque of the reel axis are proportional to the product of the target tension and the radius of the reel.
Torque calculation accuracy differs depending on the style of calculating the reel diameter.
In the following figure, the structure supports two types of reel diameter calculation styles: the material thickness accumulation style and the rotation speed ratio calculation style.



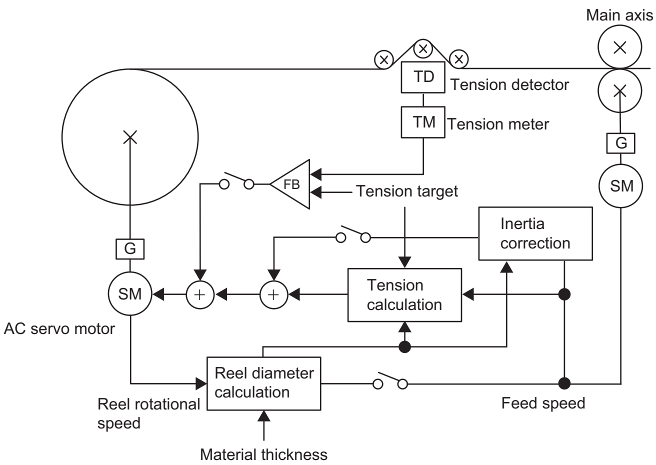
3.5 Combination of Dancer Feedback Speed Control and Tension Sensor Feedback Control

This style uses dual-loop control to combine dancer feedback speed control and tension sensor feedback control.
Dancer feedback speed control is a control style that prioritizes line stability, but tension fluctuations depend on the dancer pushing pressure.
The accuracy of tension control can be improved by feeding back the difference between the tension target and the tension detector value for the dancer pushing pressure.



3.6 Combination of Tension Sensor Feedback Torque Control and Tension Sensorless Torque Control

This is the most complicated torque control style. The tension sensorless control calculates the basic reel axis torque and adds the tension feedback to this. In addition, the inertia compensation torque of the reel axis due to acceleration and deceleration is calculated, and then everything is combined.
Even with torque control, strong control can be obtained for acceleration and deceleration, and stable tension control can be achieved because the tension control gain is suppressed.
However, adding an inertial compensation calculation is difficult, and adjustment know-how is also required.



4 AUXILIARY FUNCTION FOR TENSION CONTROL

The following FBs are provided as functions to assist the six control styles.

Application	Function name	Description	Reference
Reel diameter	Cumulative thickness reel diameter calculation	This function sets the reel axis preset diameter and material thickness, and calculates material thickness according to the direction of reel diameter change of winding and unwinding as the reel axis rotates.	Page 32 M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation)
	Ratio operation type winding diameter operation	This function calculates the reel diameter from the rotation ratio of the reel axis rotation speed and the major roll rotation speed. Use the reel axis preset diameter until the reel axis is rotated by a constant rotation angle.	Page 35 M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation)
Inertia compensation	Inertial compensation torque calculation	This function calculates the inertial compensation torque from the ratio of the reference reel diameter to the actual reel diameter and the line acceleration/deceleration.	Page 39 M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation)
Friction compensation	Friction compensation correction	This function compensates for changes in friction at startup.	Page 59 M+R2R_FrictionTrq_F (Friction compensation correction)
Line speed	Reference Line Velocity Generation	This function generates the acceleration and deceleration patterns of the main axis that serves as the reference for the entire line.	Page 42 M+R2R_LineVelocityGenerator_F (Reference line velocity generation)
Taper	Taper calculation	This function changes the target tension according to the actual value of the reel diameter along the set pattern of the reel diameter and the tapered tension rate.	Page 45 M+R2R_TaperTension_F (Taper calculation)
Measuring length	length measurement calculation	This function counts the change from the preset length and calculates the web length that flowed to the line from the circumference and the rotation of the major roll.	Page 50 M+R2R_CalcFeedLength_F (Length measurement calculation)
	Residual length operation	This function calculates the length of the material remaining on the unwinding axis from the initial diameter and the current unwinding reel diameter.	Page 53 M+R2R_CalcRemainingLength_F (Residual length operation)

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5 FUNCTION BLOCK

The following table lists the FB libraries in this reference manual.

Name	Description	Reference
M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control)	Performs speed control by using PID so that the monitored value from the tension detector matches the specified tension.	Page 23 M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control)
M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control)	Detects the position of the dancer roll and controls the speed to achieve the target position.	Page 26 M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control)
M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control)	Performs torque control by using PID so that the monitored value from the tension detector matches the specified tension.	Page 29 M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control)
M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation)	Calculates the reel diameter from the initial reel diameter, material thickness, and the change in reel axis rotation from the initial reel diameter.	Page 32 M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation)
M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation)	Calculates the reel diameter from the relationship between the reel axis revolution and the feed amount of the measurement axis (main axis).	Page 35 M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation)
M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation)	Calculates the torque compensation value during acceleration and deceleration from the material and mechanical inertia, motor inertia, and acceleration/deceleration.	Page 39 M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation)
M+R2R_LineVelocityGenerator_F (Reference line velocity generation)	Generates the speed control pattern for the reference axis (main axis) in a roll to roll line device.	Page 42 M+R2R_LineVelocityGenerator_F (Reference line velocity generation)
M+R2R_TaperTension_F (Taper calculation)	Calculates the tapered tension factor according to the reel diameter of the winding axis.	Page 45 M+R2R_TaperTension_F (Taper calculation)
M+R2R_CalcFeedLength_F (Length measurement calculation)	Outputs the length of material delivered from the line axis.	Page 50 M+R2R_CalcFeedLength_F (Length measurement calculation)
M+R2R_CalcRemainingLength_F (Residual length operation)	Calculates the remaining length of the material from the cross-sectional area of the unwinding axis.	Page 53 M+R2R_CalcRemainingLength_F (Residual length operation)
M+R2R_PID_Control_F (PID control)	Performs PID control by calculating the deviation between the set value and the current value.	Page 56 M+R2R_PID_Control_F (PID control)
M+R2R_FrictionTrq_F (Friction compensation correction)	Calculates friction compensation based on the rising state of the drive axis rotation speed at start-up, and outputs the result.	Page 59 M+R2R_FrictionTrq_F (Friction compensation correction)
M+R2R_DroopCtrl_F (Droop control for roll press)	Controls the peripheral speed of the upper and lower press rolls in a tandem drive roll press machine.	Page 62 M+R2R_DroopCtrl_F (Droop control for roll press)
M+R2R_EdgePositionCtrl_F (Meandering correction control)	The edge sensor detects the position of the material, and speed control is used to move the material into the target position.	Page 65 M+R2R_EdgePositionCtrl_F (Meandering correction control)
M+R2R_Table16Interpolation_F (Table interpolation)	Calculates the output value (Y) that corresponds to the input value (X) from the X and Y point tables.	Page 68 M+R2R_Table16Interpolation_F (Table interpolation)

5.1 Common Specifications

FB library specifications

The following table lists the specifications of this FB library.

Item	Description
FB library name	R2R_F.mslm
Number of steps in a project	31.42K steps
Label capacity of a project	2.02K points
Latch label capacity of a project	0.60K points
Compatible CPU modules	FX5UJ CPU module*1, FX5U CPU module, and FX5UC CPU module
Compatible motion modules*2	FX5-SSC-S, FX5-SSC-G
Maximum number of controlled axes*3	8 axes

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.
*3 This FB library can also control more than eight axes in a system configuration. However, check that the performance values are satisfied before use.

Project performance values

The performance values*1*2*3 of the project data for this FB library are shown below.

- Minimum scan time (ms): 1.183
- Maximum scan time (ms): 4.180

*1 The performance values for the program are as follows.
☞ Page 75 USAGE PROCEDURE
*2 When the program capacity is set to 128K steps, the processing speed may become slow.
*3 The standard area is used for labels.

List of structures

The following table lists the structures used in the FB libraries in this reference.

Name	Description
WINDER_REF	Stores the winder control settings.
AXIS_REF	Stores the reel axis settings.
DIA_CALC_REF	Stores the reel diameter calculation settings.
XY_TABLE16_REF	Stores the table-point settings.
EDGE_POS_REF	Stores the meandering correction control setting.

WINDER_REF

This structure sets the winder control.

Label	Label name	Data Type	Incorporation	Scope of validity	Description
wWinderType	Reel rotation	Word [signed]	Always enabled	0 to 3	Sets unwinding and winding. 0: Forward unwinding 1: Forward winding 2: Reverse unwinding 3: Reverse winding For details, refer to the following. Page 69 Orientation Setting
eWinderGearRatio	Gear ratio*1	Single-precision real number	At FB startup	0.0<	Gear ratio (motor side/load side)
eWinderRatedTrq	Rated torque*1	Single-precision real number	At FB startup	0.0<	Rated motor torque [N·m]
eKp	Proportional gain	Single-precision real number	Always enabled	—	PID control proportional gain*3
eKi	Integral gain	Single-precision real number	Always enabled	—	PID control integral gain*3 Any value other than 0 is valid as the gain of the integral term. (Switch from proportional gain)
eTi	Integration time	Single-precision real number	Always enabled	0.0≤	PID control integral time [ms]
eTd	Differential time	Single-precision real number	Always enabled	0.0≤	PID control differential time [ms]
ePidUpperLimit	Upper limit of calculation	Single-precision real number	Always enabled	Lower limit <	PID output upper limit [m/min]*4
ePidLowerLimit	Lower limit of calculation	Single-precision real number	Always enabled	Upper limit >	PID output lower limit [m/min]*4
ePidDeadBand	Dead-band setting	Single-precision real number	Always enabled	0.0≤	PID control dead-band setting [N]*5
bDancerDir	Dancer axial direction*2	Bit	Always enabled	—	Off: + when ascending On: + when descending
bIntInit	Integral initialization	Bit	Always enabled	—	On: Resets the amount of calculation in integral control
bIntFreeze	Integral retention	Bit	Always enabled	—	On: Keeps the amount of calculation in integral control
bIntPreset	Integration presets	Bit	Always enabled	—	On: Presets the integration value
eIntPresetValue	Integration preset values	Single-precision real number	Always enabled	—	Integration preset values

*1 Not used in FBs other than M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control).

*2 Not used in FBs other than M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control).

*3 The unit for each FB is as follows.
M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control): [(m/min)/N]
M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control): [(m/min)/mm or (m/min)/degree]
M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control): [N/N]

*4 The unit of M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control) is [N].

*5 The unit of M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control) is [mm or degree].

AXIS_REF

This structure sets the reel axis.

Label	Label name	Data Type	Incorporation	Scope of validity	Description
uAxisNo	Axis No.	Word [unsigned]	At FB startup	0 to the maximum number of axes of the module to be used	Axis No. (If the number is set to 0, only command calculations are performed and nothing is output from the simple motion module/motion module to the amplifier.*1)
uStartIO	Module number	Word [unsigned]	At FB startup	1H to 10H	Simple motion module/motion module implementation address (If a value with no connected module is specified, an Invalid module specification error (error code: 2801H) occurs on the CPU module.)

*1 For M+R2R_DroopCtrl_F (Droop control for roll press) and M+R2R_EdgePositionCtrl_F (Meandering correction control), axis number 0 cannot be set.

DIA_CALC_REF

This structure sets the reel diameter calculation.

Label	Label name	Data Type	Incorporation	Scope of validity	Description
eMaxDia	Maximum reel diameter*1	Single-precision real number	At FB startup	0.0 ≤ minimum diameter < maximum diameter	Maximum and minimum reel diameters [mm]
eMinDia	Minimum reel diameter	Single-precision real number	At FB startup		
eMinWinderVelocity	Minimum reel speed*2	Single-precision real number	At FB startup	0.0≤	Minimum reel axis speed where reel diameter is calculated [r/min]
eDiaVariationLimit	Variation limit value*3	Single-precision real number	Always enabled	0.0≤	Variation limit value of calculation result for each revolution [mm]. If the value is 0, the variation limiter is disabled.
wDiaCalcDiv	Calculation frequency*3	Word [signed]	At FB startup	0≤, ≤16	Specifies the number of calculations to be performed during one turn of the reel axis. If the value is 0, it is assumed to be once.
wAverageNum	Moving average points*3	Word [signed]	At FB startup	0≤, ≤16	Specify the number of points for applying a moving average filter to the calculation result. To not use the filter, enter 0.
eLineENCValCnv	External encoder variation coefficient*3	Single-precision real number	Always enabled	0.0≤	This is the coefficient [mm/UNIT] for unit conversion when inputting the current value of the major axis externally
eDancerCoeff	Dancer axis variation coefficient*3	Single-precision real number	Always enabled	0.0<	This is the factor for converting the amount of change in the dancer axis into the amount of material feed.
bDancerDir	Dancer axial direction*3	Bit	Always enabled	—	Off: + when ascending On: + when descending

*1 Not used in FBs other than M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation) and M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation).
*2 Not used in FBs other than M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation)
*3 Not used in FBs other than M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation)

XY_TABLE16_REF

This structure sets table points.

Label	Label name	Data Type	Incorporation	Scope of validity	Description
eNumPoint	Number of points	Single-precision real number	At FB startup	2 to 16	Number of points
enTableX[0]	X coordinate (reel diameter)*1	Single-precision real number	At FB startup	—	X coordinate 1st point [mm]
enTableX[1]		Single-precision real number	At FB startup	enTableX[0]<	X coordinate 2nd point [mm]
⋮		Single-precision real number	At FB startup	⋮	⋮
enTableX[NumPoint-1]		Single-precision real number	At FB startup	enTableX[NumPoint-2] <	X coordinate n-th point [mm]
enTableY[0]	Y coordinate (taper ratio)	Single-precision real number	At FB startup	—	Y coordinate 1st point [1.0 = 100%]
enTableY[1]		Single-precision real number	At FB startup	—	Y coordinate 2nd point [1.0 = 100%]
⋮		Single-precision real number	At FB startup	⋮	⋮
enTableY[NumPoint-1]		Single-precision real number	At FB startup	—	Y coordinate n-th point [1.0 = 100%]

*1 Set the X coordinates (reel diameter) in ascending order.

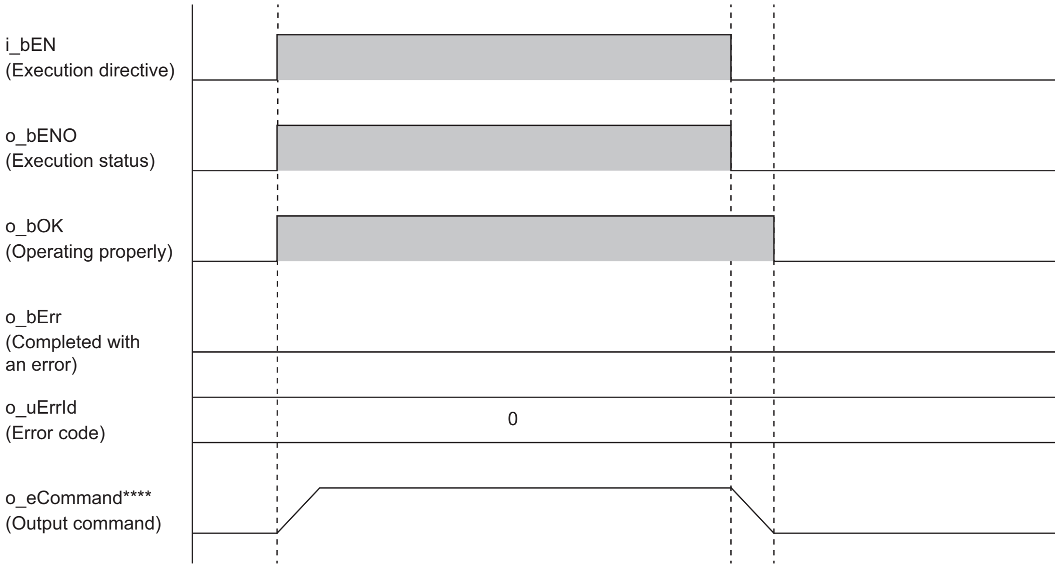
EDGE_POS_REF

This structure sets the meandering correction control.

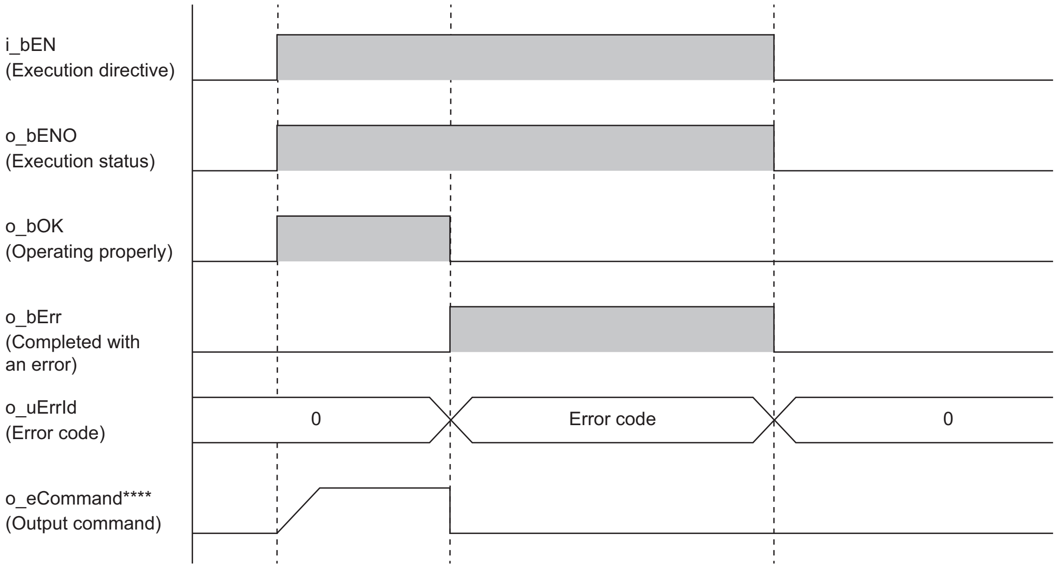
Label	Label name	Data Type	Incorporation	Scope of validity	Description
bDirection	Operating direction	Bit	At FB startup	—	Off: Sensor value + → Command speed - On: Sensor value + → Command speed +
eKp	Proportional gain	Single-precision real number	Always enabled	—	PID control proportional gain [(mm/s)/mm]
eKi	Integral gain	Single-precision real number	Always enabled	—	PID control integral gain [(mm/s)/mm] Any value other than 0 is valid as the gain of the integral term. (Switch from proportional gain)
eTi	Integration time	Single-precision real number	Always enabled	0.0≤	PID control integral time [ms]
eTd	Differential time	Single-precision real number	Always enabled	0.0≤	PID control differential time [ms]
ePidUpperLimit	Upper limit of calculation	Single-precision real number	Always enabled	Lower limit <	PID output upper limit [mm/s]
ePidLowerLimit	Lower limit of calculation	Single-precision real number	Always enabled	Upper limit >	PID output lower limit [mm/s]
ePidDeadBand	Dead-band setting	Single-precision real number	Always enabled	0.0≤	PID control dead-band setting [mm]
bIntInit	Integral initialization	Bit	Always enabled	—	On: Resets the amount of calculation in integral control
bIntFreeze	Integral retention	Bit	Always enabled	—	On: Keeps the amount of calculation in integral control
bIntPreset	Integration presets	Bit	Always enabled	—	On: Presets the integration value
eIntPresetValue	Integration preset values	Single-precision real number	Always enabled	—	Integration preset values

Timing chart of I/O signals

Completed successfully

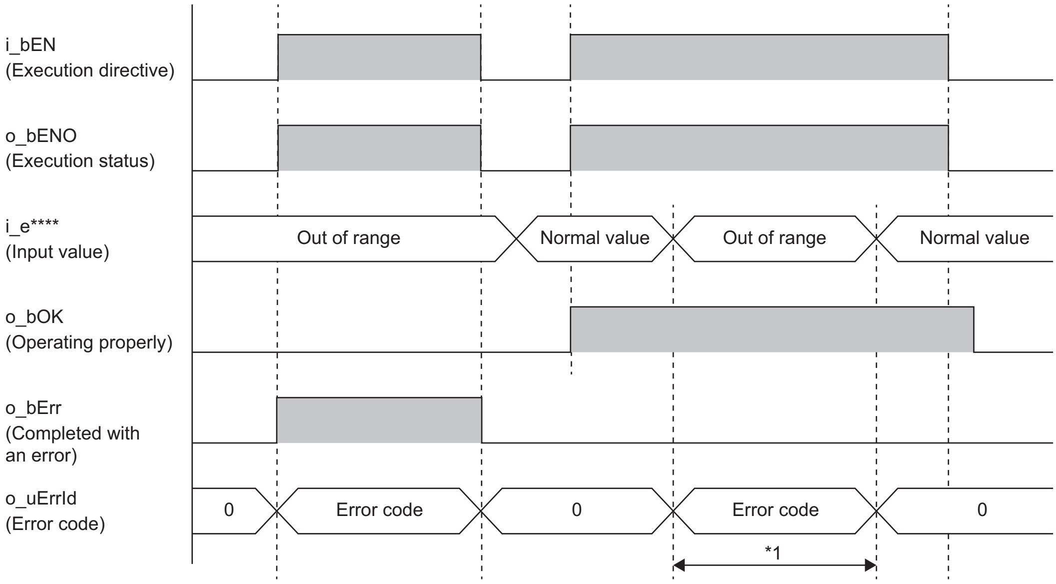


Completed with an error



o_bOK turns off after the axis operation stops.

If the FB input value is out of range



*1 If an out-of-range value is input during normal operation, an error code is output, but operation continues with the previous normal value. The error code is then cleared when the normal value is entered.

5

Precautions

Before using the FB libraries in this reference manual, check the following precautions.

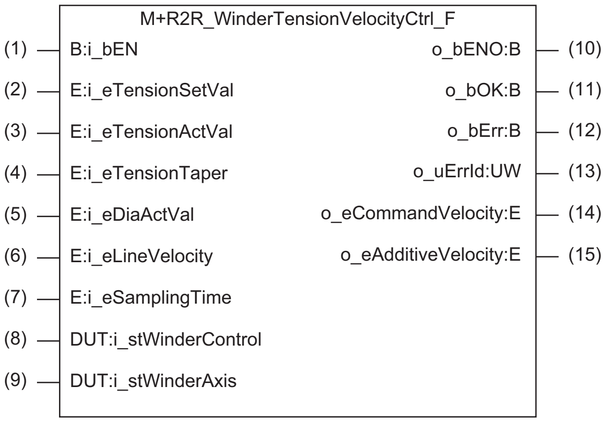
Description
FB stop processing is not performed due to a programmable controller CPU error. FB does not stop due to a CPU error if the CPU parameter is set to "Continue" (default: "Continue") for the action setting when an error is detected. To stop FB when a CPU error occurs, set the CPU parameter to "Stop" for the action setting when an error is detected.
These FBs require circuit setting for input labels, unless the ability to omit it is specified in the description of the FB.
Change the memory/device settings of the CPU parameter so that the capacity is sufficient to use these FBs. Otherwise, an error might occur in GX Works3.
The FBs in this reference manual do not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation.
For input labels, a CPU error may occur depending on the calculation result in the FB even if the set values are within the effective range. In this case, check the error details of the CPU module and correct the setting values.

5.2 Individual Specifications

M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control)

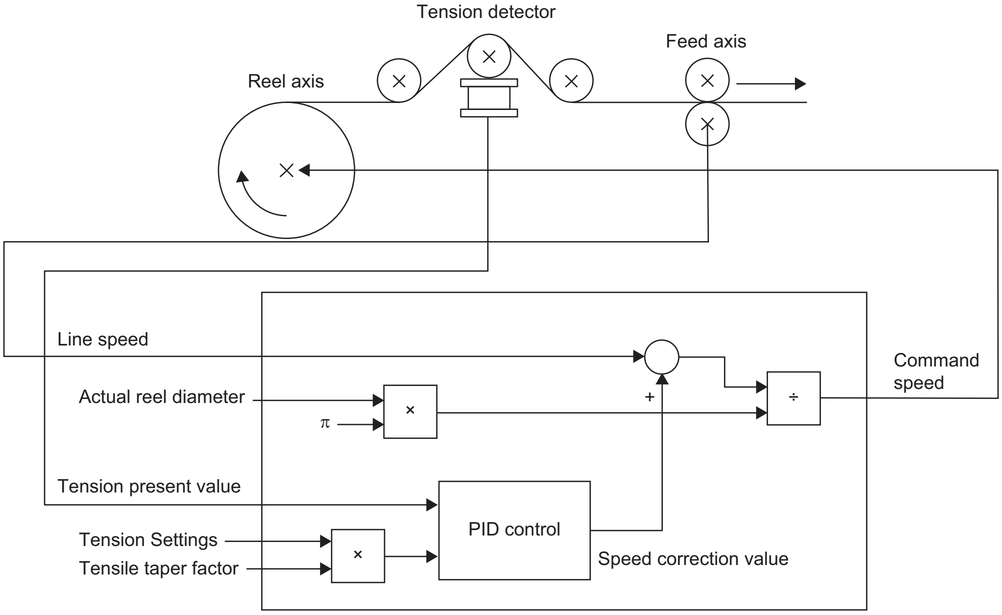
Overview

This function block performs speed control by using PID so that the monitored value from the tension detector matches the specified tension.



■Function description

The speed correction value is calculated by PID control based on the deviation between the tension setting value and the tension monitor value. The total line speed is then converted to a rotation speed according to the reel diameter and output as the command speed.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eTensionSetVal	Tension setting value	Single-precision real number	Always enabled	0.0≤	Enter the target value for tension. [N]
(3)	i_eTensionActVal	Actual tension value	Single-precision real number	Always enabled	—	Enter the tension detector value [N].
(4)	i_eTensionTaper	Taper tension factor	Single-precision real number	Always enabled	0.0≤	Set the taper factor for tension setting. (1.0=100%) If the value is 0.0, it is executed at 1.0.
(5)	i_eDiaActVal	Actual reel diameter	Single-precision real number	Always enabled	0.0<	Enter the current value of reel diameter. [mm]
(6)	i_eLineVelocity	Line speed	Single-precision real number	Always enabled	—	Enter the current value of line speed. [m/min]
(7)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle. [ms] If the value is 0.0 [ms], it is executed at the scan time.
(8)	i_stWinderControl	Winder control settings	WINDER_REF	Always enabled	—	For information on the structure, refer to the following. Page 17 WINDER_REF
(9)	i_stWinderAxis	Reel axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(10)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(11)	o_bOK	Completed successfully	Bit	—	The on state indicates that the FB has been completed successfully.
(12)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(13)	o_uErrId	Error code	Word [unsigned]/bit string [16 bits]	—	Stores the error code that occurred in the FB.
(14)	o_eCommandVelocity	Speed command value	Single-precision real number	—	Stores the speed command value of FB calculation result. [r/min]
(15)	o_eAdditiveVelocity	Speed correction value	Single-precision real number	—	Stores the speed correction value obtained by PID calculation. [r/min]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	3977 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.24K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	M+R2R_WinderTensionVelocityCtrl_F └M+R2R_PID_Control_F
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Tension setting value = 5 [N] • Actual tension value = 4 [N] • Actual reel diameter = 180 [mm] • Line speed = 10 [m/min] • Proportional gain = 0.02 [(m/min)/N] • Integration time = 280 [ms] • Upper limit of calculation = 30 [m/min] • Lower limit of calculation = -30 [m/min] • Axis No. = 1 • Module number = 1 • Others = 0	8.50ms	1.01ms	11 scans

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

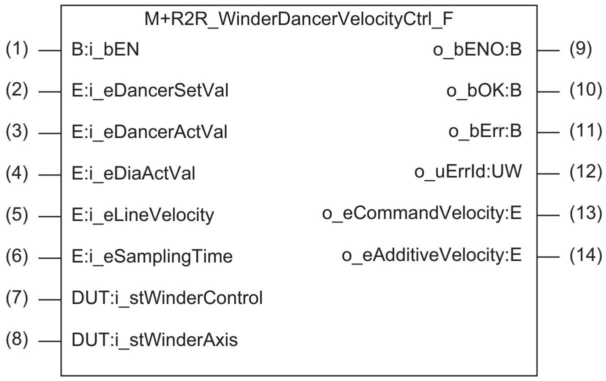
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control)

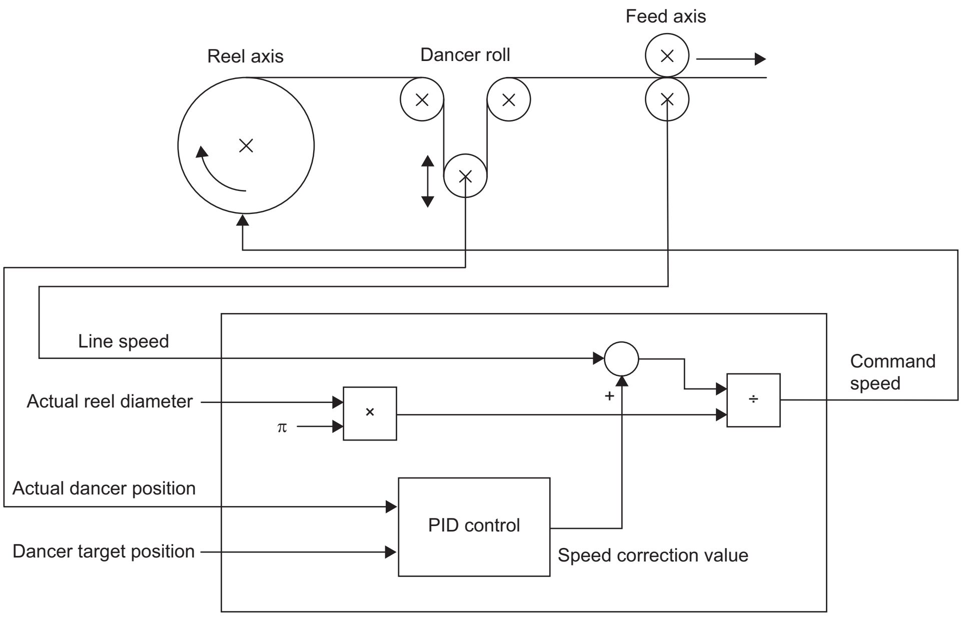
Overview

This function block detects the position of the dancer roll and controls the speed to achieve the target position.



■Function description

The speed correction value is calculated by PID control based on the deviation between the target position of the dancer and the actual value of the dancer. The total line speed is then converted to a rotation speed according to the reel diameter and output as the command speed.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eDancerSetVal	Dancer target position	Single-precision real number	Always enabled	—	Enter the target position of the dancer roll. [mm or degree]
(3)	i_eDancerActVal	Actual dancer value	Single-precision real number	Always enabled	—	Enter the current value of the dancer roll. [mm or degree]
(4)	i_eDiaActVal	Actual reel diameter	Single-precision real number	Always enabled	0.0<	Enter the current value of reel diameter. [mm]
(5)	i_eLineVelocity	Line speed	Single-precision real number	Always enabled	—	Enter the current value of line speed. [m/min]
(6)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle [ms]. If the value is 0.0 [ms], it is executed at the scan time.
(7)	i_stWinderControl	Winder control settings	WINDER_REF	Always enabled	—	For information on the structure, refer to the following. Page 17 WINDER_REF
(8)	i_stWinderAxis	Reel axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(9)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(10)	o_bOK	Completed successfully	Bit	—	The on state indicates that the FB has been completed successfully.
(11)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(12)	o_uErrId	Error code	Word [unsigned]/bit string [16 bits]	—	Stores the error code that occurred in the FB.
(13)	o_eCommandVelocity	Speed command value	Single-precision real number	—	Stores the speed command value of FB calculation result. [r/min]
(14)	o_eAdditiveVelocity	Speed correction value	Single-precision real number	—	Stores the speed correction value obtained by PID calculation. [r/min]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	3878 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.24K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	M+R2R_WinderDancerVelocityCtrl_F └M+R2R_PID_Control_F
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Dancer target position = 500 [mm] • Actual dancer position = 498 [mm] • Actual reel diameter = 180 [mm] • Line speed = 10 [m/min] • Proportional gain = 0.02 [(m/min)/mm] • Integration time = 280 [ms] • Upper limit of calculation = 30 [m/min] • Lower limit of calculation = -30 [m/min] • Axis No. = 1 • Module number = 1 • Others = 0	8.99ms	0.98ms	11 scans

*1 When the program capacity is set to 128K steps, the processing speed may become slow.

*2 The standard area is used for labels.

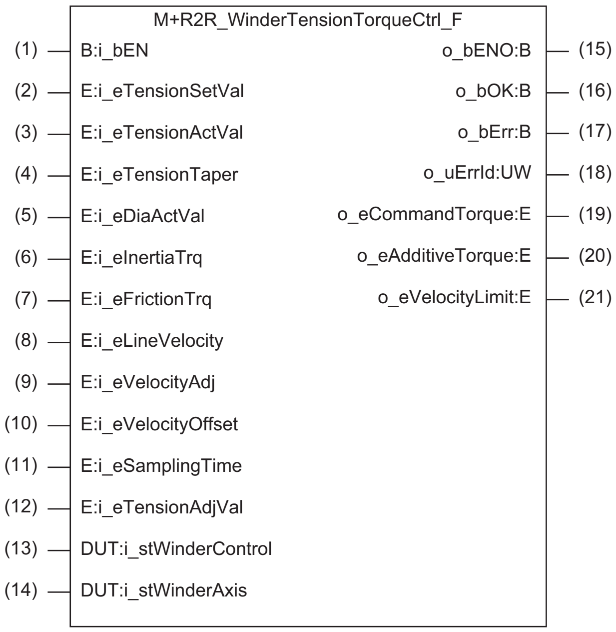
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control)

Overview

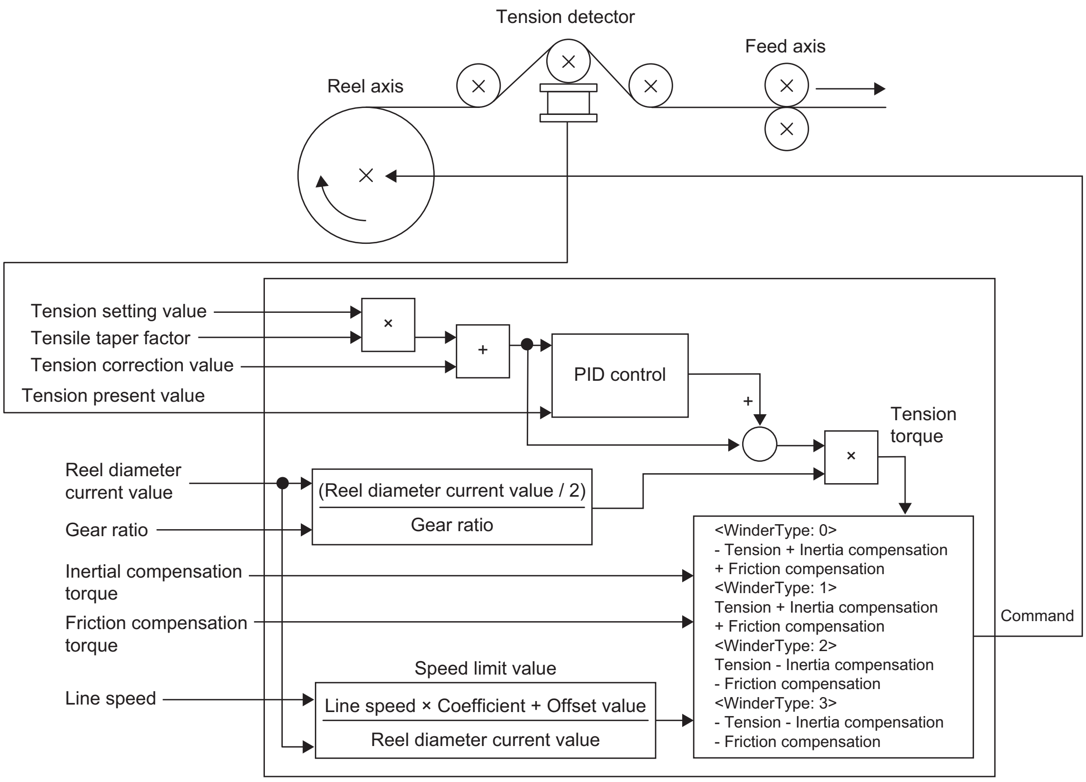
This function block performs torque control by using PID so that the monitored value from the tension detector matches the specified tension.



■Function description

The tension torque corresponding to the outside diameter of the reel is calculated, and the tension correction value by PID control based on the deviation between the tension setting value and the tension detector value is multiplied and output as the command torque to the servo amplifier.

When the proportional gain is set to 0, the output of PID control is lost, and tension sensorless torque control is used.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eTensionSetVal	Tension setting value	Single-precision real number	Always enabled	0.0≤	Enter the target value for tension. [N]
(3)	i_eTensionActVal	Actual tension value	Single-precision real number	Always enabled	—	Enter the tension detector value. [N]
(4)	i_eTensionTaper	Taper tension factor	Single-precision real number	Always enabled	0.0≤	Set the taper factor for tension setting. (1.0=100%) If the value is 0.0, it is executed at 1.0.
(5)	i_eDiaActVal	Actual reel diameter	Single-precision real number	Always enabled	0.0<	Enter the current value of reel diameter. [mm]
(6)	i_eInertiaTrq	Inertial compensation torque	Single-precision real number	Always enabled	—	Inertial compensation torque (N·m) (motor axis conversion)
(7)	i_eFrictionTrq	Friction compensation torque	Single-precision real number	Always enabled	—	Friction compensation torque [N·m] (motor axis conversion)
(8)	i_eLineVelocity	Line speed	Single-precision real number	Always enabled	—	Enter the current value of line speed. [m/min]
(9)	i_eVelocityAdj	Speed limit factor	Single-precision real number	Always enabled	0.0≤	Speed limit factor (1.0 = line speed × 100%)
(10)	i_eVelocityOffset	Speed limit offset value	Single-precision real number	Always enabled	0.0≤	Speed limit offset value [m/min]
(11)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle [ms]. If the value is 0.0 [ms], it is executed at the scan time.
(12)	i_eTensionAdjVal	Tension correction value	Single-precision real number	Always enabled	—	Enter the correction value for tension deviation by free rollers. [N]
(13)	i_stWinderControl	Winder control settings	WINDER_REF	Always enabled	—	For information on the structure, refer to the following. Page 17 WINDER_REF
(14)	i_stWinderAxis	Reel axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(15)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(16)	o_bOK	Completed successfully	Bit	—	The on state indicates that the FB has been completed successfully.
(17)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(18)	o_uErrId	Error code	Word [unsigned]/bit string [16 bits]	—	Stores the error code that occurred in the FB.
(19)	o_eCommandTorque	Torque command value	Single-precision real number	—	Stores the torque command value of FB calculation result. [N·m] (motor axis conversion)
(20)	o_eAdditiveTorque	Torque correction value	Single-precision real number	—	Stores the tension correction value obtained by PID calculation. [N]
(21)	o_eVelocityLimit	Speed limit value	Single-precision real number	—	Stores the speed limit value of FB calculation result. [r/min] (motor axis conversion)

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	4612 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. 📖GX Works3 Operating Manual
Points of labels used	• Label: 0.28K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. 📖GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	M+R2R_WinderTensionTorqueCtrl_F └M+R2R_PID_Control_F
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Tension setting value = 5 [N] • Actual tension value = 4 [N] • Actual reel diameter = 180 [mm] • Line speed = 10 [m/min] • Speed limit factor = 1 • Gear ratio = 1.2 • Rated torque = 1.3 [N·m] • Proportional gain = 0.5 [N/N] • Integration time = 280 [ms] • Upper limit of calculation = 30 [N] • Lower limit of calculation = -30 [N] • Axis No. = 1 • Module number = 1 • Others = 0	8.88ms	1.15ms	10 scans

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

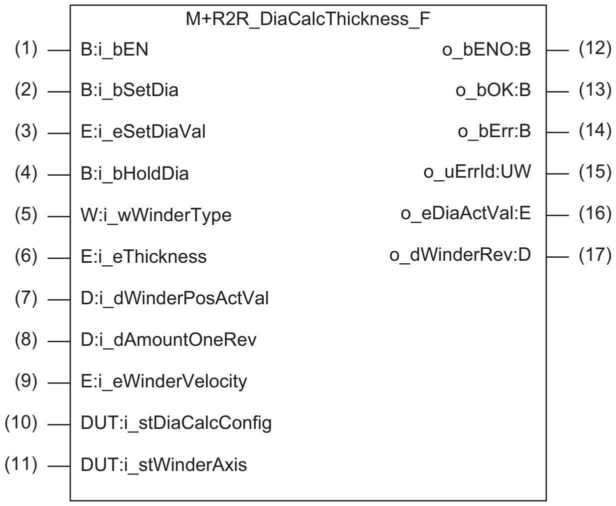
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation)

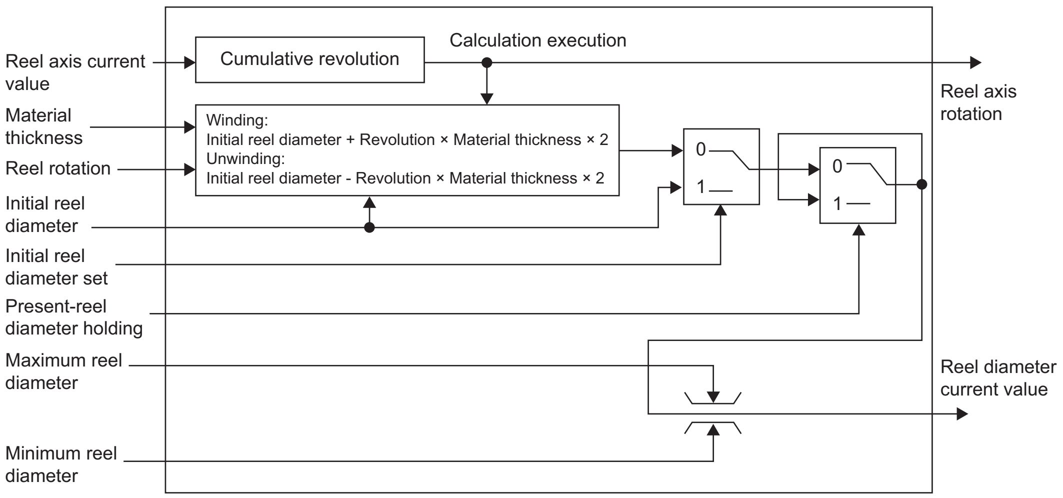
Overview

This function block calculates the reel diameter from the initial reel diameter, material thickness, and the change in reel axis rotation from the initial reel diameter.



■Function description

It calculates the reel diameter by adding and subtracting the following from the initial reel diameter: Cumulative number of revolutions of reel axis × Material thickness × 2.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_bSetDia	Initial reel diameter set	Bit	Always enabled	—	On: Initial reel diameter → Actual reel diameter Off: Cumulative value of material thickness → Actual reel diameter
(3)	i_eSetDiaVal	Initial reel diameter	Single-precision real number	Always enabled	Minimum reel diameter to maximum reel diameter	Initial reel diameter [mm]
(4)	i_bHoldDia	Current reel diameter holding	Bit	Always enabled	—	On: Stops material thickness accumulation calculation (holding current value) Off: Cumulative value of material thickness → Actual reel diameter
(5)	i_wWinderType	Winding method	Word [signed]	Always enabled	0 to 3	Unwinding/winding setting. 0: Forward unwinding 1: Forward winding 2: Reverse unwinding 3: Reverse winding For details, refer to the following. ☞ Page 69 Orientation Setting
(6)	i_eThickness	Material thickness	Single-precision real number	Always enabled	0.0<	Material thickness [mm]
(7)	i_dWinderPosActVal	Reel axis current value	Double word [signed]	Always enabled	—	Current rotation position of the reel axis (Input is required only for axis No.0.)
(8)	i_dAmountOneRev	One turn of reel axis	Double word [signed]	At FB startup	0<	Amount of movement per revolution of the reel (Input is required only for axis No.0.)
(9)	i_eWinderVelocity	Reel axis speed	Single-precision real number	Always enabled	—	Current reel axis speed [r/min] (Input is required only for axis No.0.)
(10)	i_stDiaCalcConfig	Reel diameter calculation setting	DIA_CALC_REF	—	—	For information on the structure, refer to the following. Page 18 DIA_CALC_REF
(11)	i_stWinderAxis	Reel axis setting	AXIS_REF	—	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(12)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(13)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(14)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(15)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(16)	o_eDiaActVal	Actual reel diameter	Single-precision real number	○	Stores the result of the reel diameter calculation. [mm]
(17)	o_dWinderRev	Reel axis rotation	Double word [signed]	○	Stores the rotation count of the reel axis. [rev]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	2129 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.09K points (Word) • Latch label: 0.01K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Initial reel diameter = 800 [mm] • Material thickness = 0.01 [mm] • Maximum reel diameter = 1000 [mm] • Minimum reel diameter = 150 [mm] • Axis No. = 1 • Module number = 1 • Others = 0	0.21ms	0.63ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

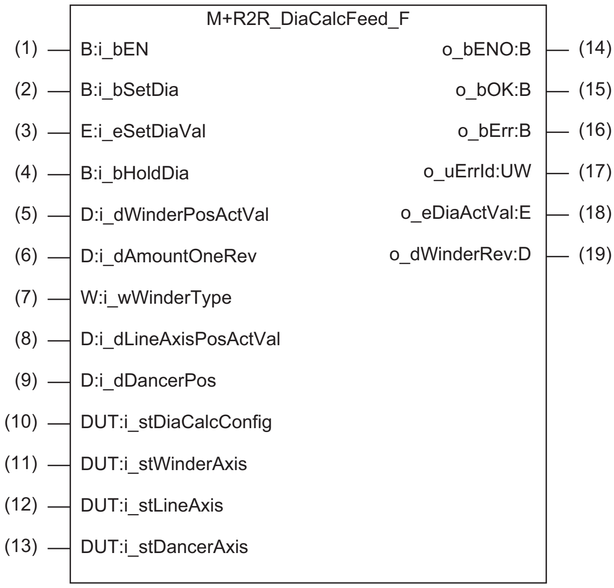
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation)

Overview

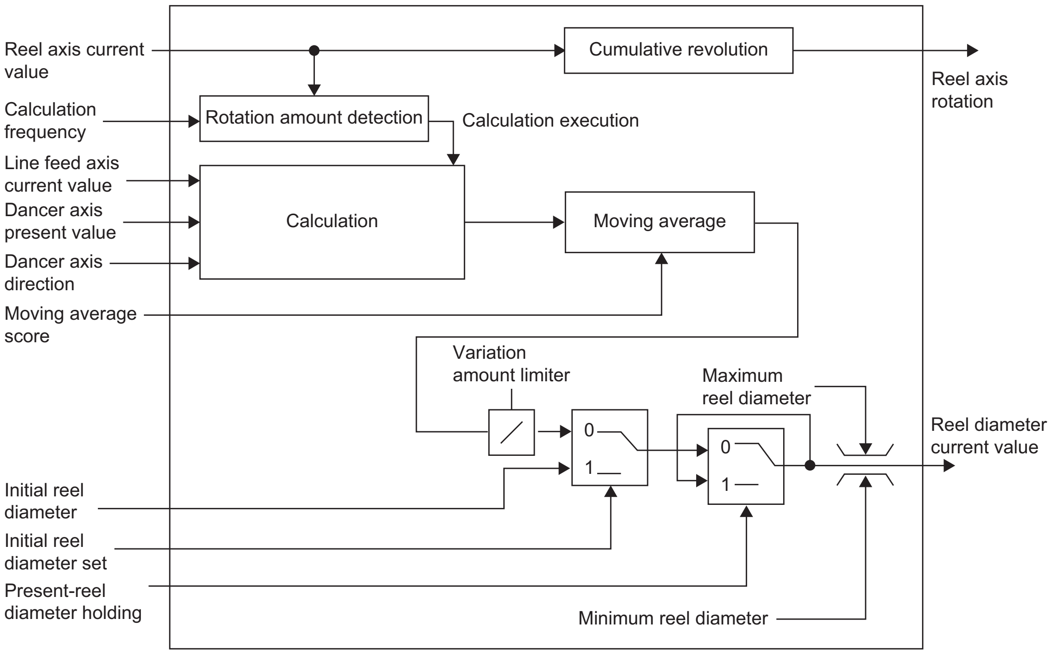
This function block calculates the reel diameter from the relationship between the reel axis revolution and the measurement axis (main axis).



5

■Function description

It measures the reel perimeter (outer circumference) from the feed amount of the measurement axis for each turn of the reel axis and calculates the reel diameter.



The following table lists the calculation details.

Variable name	Description
W	Reel axis unwinding amount/winding amount [mm]
L_1	Line axis actual value [mm]
L_2	Line axis previous value [mm]
D_1	Dancer axis actual value [mm]
D_2	Dancer axis previous value [mm]
DC	Dancer axis variation coefficient
N	Calculation frequency
R	Actual reel diameter

- Reel axis unwinding amount + when raising dancer axis, or winding amount + when lowering dancer axis

$W = N (|L_1 - L_2| - DC (D_1 - D_2))$

- Reel axis winding amount + when raising dancer axis, or unwinding amount + when lowering dancer axis

$W = N (|L_1 - L_2| + DC (D_1 - D_2))$

- Actual reel diameter

$$R = \frac{W}{\pi}$$

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_bSetDia	Initial reel diameter set	Bit	Always enabled	On, off	On: Initial reel diameter → Actual reel diameter Off: Feedrate calculation result → Actual reel diameter
(3)	i_eSetDiaVal	Initial reel diameter	Single-precision real number	Always enabled	Minimum reel diameter to maximum reel diameter	Initial reel diameter [mm]
(4)	i_bHoldDia	Current reel diameter holding	Bit	Always enabled	On, off	On: Feedrate calculation stop (keep current value) Off: Feedrate calculation result → Actual reel diameter
(5)	i_dWinderPosActVal	Reel axis current value	Double word [signed]	Always enabled	—	Current rotation position of the reel axis (Input is required only for axis No.0.)
(6)	i_dAmountOneRev	One turn of reel axis	Double word [signed]	At FB startup	0<	Amount of movement per revolution of the reel (Input is required only for axis No.0.)
(7)	i_wWinderType	Winding method	Word [signed]	Always enabled	0 to 3	Unwinding/winding setting. 0: Forward unwinding 1: Forward winding 2: Reverse unwinding 3: Reverse winding For details, refer to the following. Page 69 Orientation Setting
(8)	i_dLineAxisPosActVal	Line axis current value	Double word [signed]	Always enabled	—	Line axis current value [mm] (Input is required only for axis No.0.)
(9)	i_dDancerPos	Dancer axis current value	Double word [signed]	Always enabled	—	Current value of dancer axis [mm] (Input is required only for axis No.0.)
(10)	i_stDiaCalcConfig	Reel diameter calculation setting	DIA_CALC_REF	—	—	For information on the structure, refer to the following. Page 18 DIA_CALC_REF
(11)	i_stWinderAxis	Reel axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF
(12)	i_stLineAxis	Line axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF
(13)	i_stDancerAxis	Dancer axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(14)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(15)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(16)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(17)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(18)	o_eDiaActVal	Actual reel diameter	Single-precision real number	○	Stores the result of the reel diameter calculation. [mm]
(19)	o_dWinderRev	Reel axis rotation	Double word [signed]	○	Stores the rotation count of the reel axis. [rev]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	3314 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.17K points (Word) • Latch label: 0.01K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Initial reel diameter = 800 [mm] • Maximum reel diameter = 1000 [mm] • Minimum reel diameter = 150 [mm] • Moving average points = 8 • Dancer axis variation coefficient = 1 • Reel axis setting is axis No. = 1 • Module number = 1 • Line axis setting is axis No. = 2 • Module number = 1 • Dancer axis setting is axis No. = 3 • Module number = 1 • Others = 0	0.36ms	0.84ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

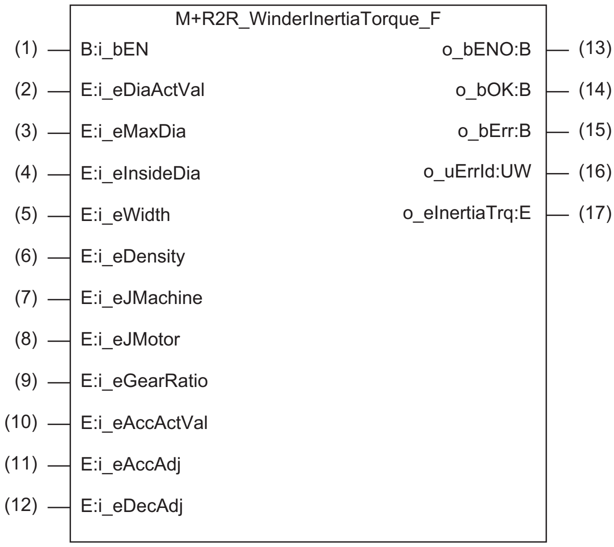
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation)

Overview

This function block calculates the torque compensation value during acceleration and deceleration from the material and mechanical inertia, motor inertia, and acceleration/deceleration.



■Function description

The total inertia and reel angular acceleration are obtained from the following formula to calculate the inertial compensation torque during acceleration and deceleration.

$$\text{Reel axis material mass [kg]} = \frac{\pi \times \text{Specific gravity} \times \text{Reel width} \times (\text{Reel diameter current value}^2 - \text{Reel core Diameter}^2)}{4}$$

$$\text{Material inertia [kgm}^2\text{]} = \text{Reel axis material mass} \times \frac{(\text{Reel diameter current value}^2 + \text{Reel core Diameter}^2)}{8 \times \text{Gear ratio}^2}$$

$$\text{Total inertia [kgm}^2\text{]} = \frac{\text{Machine inertia}}{\text{Gear ratio}^2} + \text{Material inertia} + \text{Motor inertia}$$

$$\text{Axis angular acceleration [rad/s}^2\text{]} = 2 \times \frac{\text{Line acceleration} \times \text{Gear ratio}}{\text{Reel diameter current value}}$$

$$\text{Inertial compensation torque [N}\cdot\text{m]} = \text{Total inertia} \times \text{Axis angular acceleration}$$

- Input values are calculated using unit conversion. [mm] → [m], [ms] → [s], [mm/s] → [m/s]
- When the line acceleration is positive, the acceleration compensation adjustment factor is applied to the inertia compensation torque, and when the line acceleration is negative, the deceleration compensation adjustment factor is applied to the inertia compensation torque.

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eDiaActVal	Actual reel diameter	Single-precision real number	Always enabled	Reel core outside diameter to maximum reel diameter	Actual reel diameter [mm]
(3)	i_eMaxDia	Maximum reel diameter	Single-precision real number	At FB startup	Reel core outside diameter <	Maximum reel diameter [mm]
(4)	i_eInsideDia	Reel core outside diameter	Single-precision real number	At FB startup	0.0 < Reel core outside diameter < Maximum reel diameter	Reel core outside diameter [mm]
(5)	i_eWidth	Reel material width	Single-precision real number	Always enabled	0.0<	Reel material width [mm]
(6)	i_eDensity	Reel material specific gravity	Single-precision real number	Always enabled	0.0<	Reel material specific gravity [kg/m^3]
(7)	i_eJMachine	Mechanical inertia	Single-precision real number	Always enabled	0.0≤	Mechanical inertia [kgm^2]
(8)	i_eJMotor	Motor inertia	Single-precision real number	Always enabled	0.0≤	Motor inertia [kgm^2]
(9)	i_eGearRatio	Gear ratio	Single-precision real number	Always enabled	0.0<	Gear ratio (motor side/load side)
(10)	i_eAccActVal	Line acceleration	Single-precision real number	Always enabled	—	line acceleration [m/s^2]
(11)	i_eAccAdj	Acceleration compensation adjustment factor	Single-precision real number	Always enabled	0.0≤	Correction factor for inertial compensation torque at acceleration [1.0 = 100%]
(12)	i_eDecAdj	Deceleration compensation adjustment factor	Single-precision real number	Always enabled	0.0≤	Correction factor for inertial compensation torque at deceleration [1.0 = 100%]

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(13)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(14)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(15)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(16)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(17)	o_eInertiaTrq	Inertial compensation torque	Single-precision real number	—	The result of the inertial compensation torque calculation is stored. N.m. (motor axis conversion)

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module[*1]	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.

■Basic specifications

Item	Description
Language	ST
Number of steps	1489 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.06K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2	• Actual reel diameter = 450 [mm] • Maximum reel diameter = 1000 [mm] • Reel core diameter = 150 [mm] • Reel width = 200 [mm] • Reel material specific gravity = 1000 [kg/m³] • Gear ratio = 5 • line acceleration = 1 [m/s²] • Acceleration compensation adjustment factor = 1 • Deceleration compensation adjustment factor = 1 • Others = 0	0.23ms	0.69ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

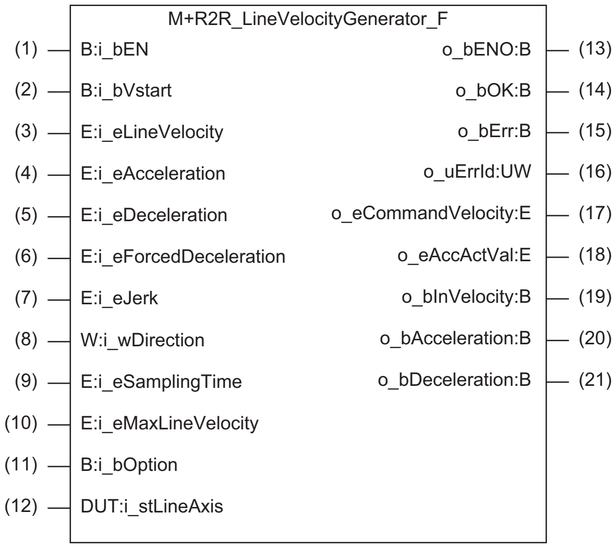
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_LineVelocityGenerator_F (Reference line velocity generation)

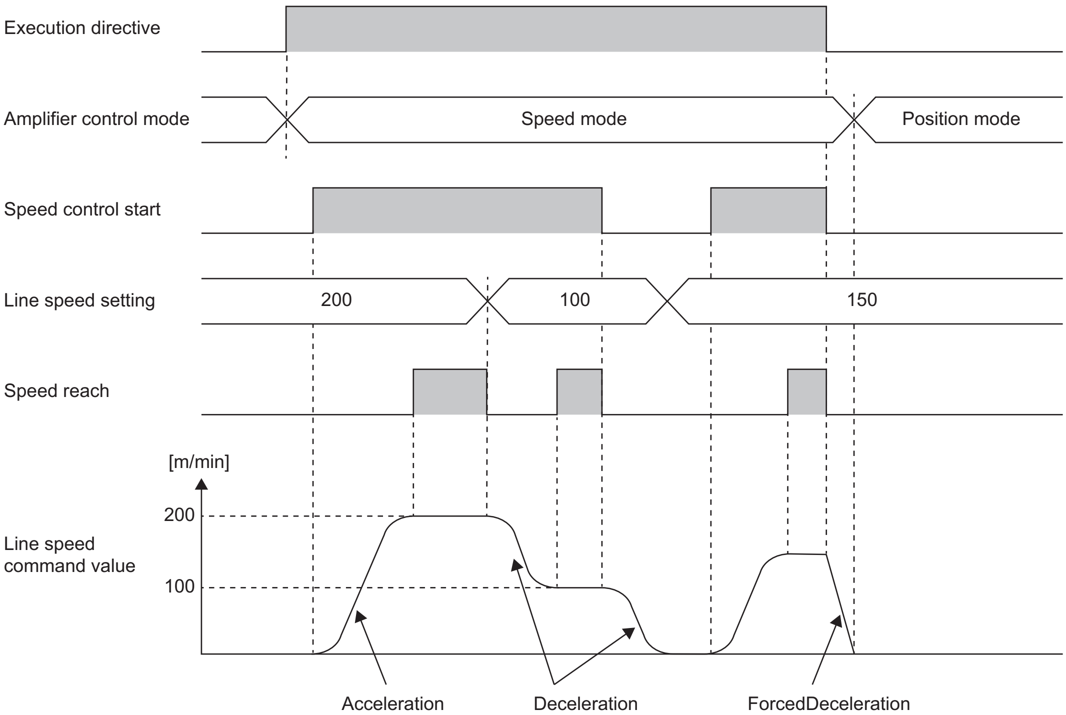
Overview

This function block generates the speed control pattern for the reference axis (main axis) in a roll to roll line device.



■Function description

- If the corresponding axis is other than 0, the axis is set to the speed mode by the execution command (i_bEN) turning on.
- Speed control is executed by the setting line speed from starting speed control.



If no line axis is set, only speed generation is performed.

The acceleration time, deceleration time, and emergency stop deceleration time are converted to acceleration, deceleration, and sudden stop deceleration, based on the maximum line speed. The acceleration change time is converted to an acceleration change rate based on the above acceleration/deceleration. Therefore, if an acceleration change time is set, the actual acceleration/deceleration time becomes longer than the set value.

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_bVstart	Speed control start	Bit	Always enabled	On, off	On: Starts speed control. Off: Stops speed control.
(3)	i_eLineVelocity	Line speed	Single-precision real number	Always enabled	—	Line speed setting [m/min]
(4)	i_eAcceleration	Acceleration	Single-precision real number	Always enabled	0.0<	Option ON: Acceleration time [s] Option OFF: Acceleration setting [(m/min)/s]
(5)	i_eDeceleration	Deceleration	Single-precision real number	Always enabled	0.0<	Option ON: Deceleration time [s] Option OFF: Deceleration setting [(m/min)/s]
(6)	i_eForcedDeceleration	Emergency stop deceleration	Single-precision real number	Always enabled	0.0<	Option ON: Emergency stop deceleration time [s] Option OFF: Emergency stop deceleration setting [(m/min)/s]
(7)	i_eJerk	Acceleration change rate	Single-precision real number	Always enabled	0.0≤	Option ON: Acceleration change time [s] Option OFF: Acceleration change rate setting [(m/min)/s2]
(8)	i_wDirection	Rotation direction	Word [signed]	Always enabled	0, 1	0: Positive direction 1: Negative direction
(9)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle [ms]. If the value is 0.0 [ms], it is executed at the scan time.
(10)	i_eMaxLineVelocity	Maximum line speed	Single-precision real number	Always enabled	0.0<	This parameter is valid when the acceleration time/deceleration time setting mode is selected (option is turned on). Maximum line speed setting [m/min]
(11)	i_bOption	Option	Bit	At FB startup	On, off	On: Acceleration time/deceleration time setting mode Off: Acceleration/deceleration setting mode
(12)	i_stLineAxis	Line axis setting	AXIS_REF	At FB startup	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(13)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(14)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(15)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(16)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(17)	o_eCommandVelocity	Line speed command value	Single-precision real number	—	Stores the line speed command value. [m/min]
(18)	o_eAccActVal	Current acceleration value	Single-precision real number	—	Stores the current acceleration value. [m/s2]
(19)	o_bInVelocity	Speed reached	Bit	—	Turns on when the set speed is reached.
(20)	o_bAcceleration	Accelerating	Bit	—	Turns on during acceleration.
(21)	o_bDeceleration	Decelerating	Bit	—	Turns on during deceleration.

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	4461 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.12K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	• The line speed setting is always captured, but it cannot be changed directly between positive direction and negative direction. If performed, it is controlled by the line speed setting before the change. When changing the line speed setting between positive direction and negative direction, set the line speed setting to 0 first. • If the values of acceleration, deceleration, or sudden stop deceleration are too low relative to the line speed, the line speed command value may not change due to an operation error in the FB.

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Speed control start = On • Line speed = 100 [m/min] • Acceleration = 10 [(m/min)/s] • Deceleration = 10 [(m/min)/s] • Emergency stop deceleration = 100 [(m/min)/s] • Acceleration changing rate = 5 [(m/min)/s2] • Axis No. = 1 • Module number = 1 • Others = 0	9.15ms	0.94ms	12 scans

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_TaperTension_F (Taper calculation)

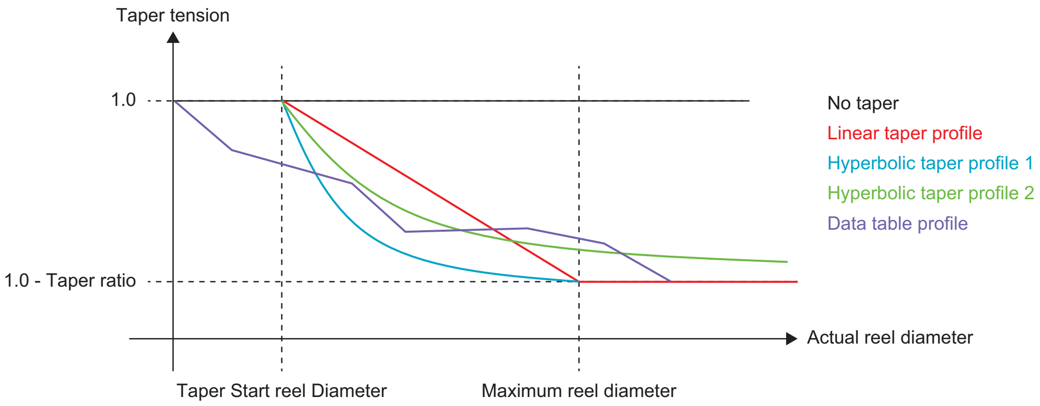
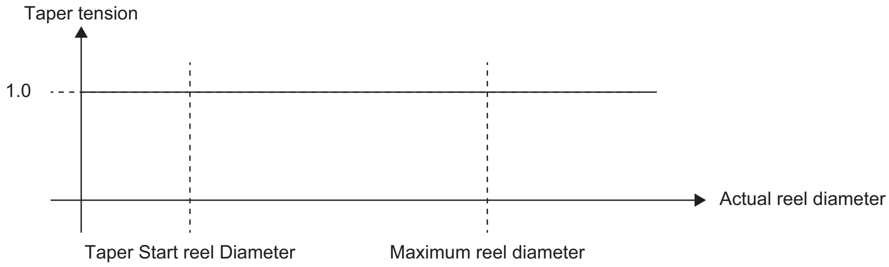
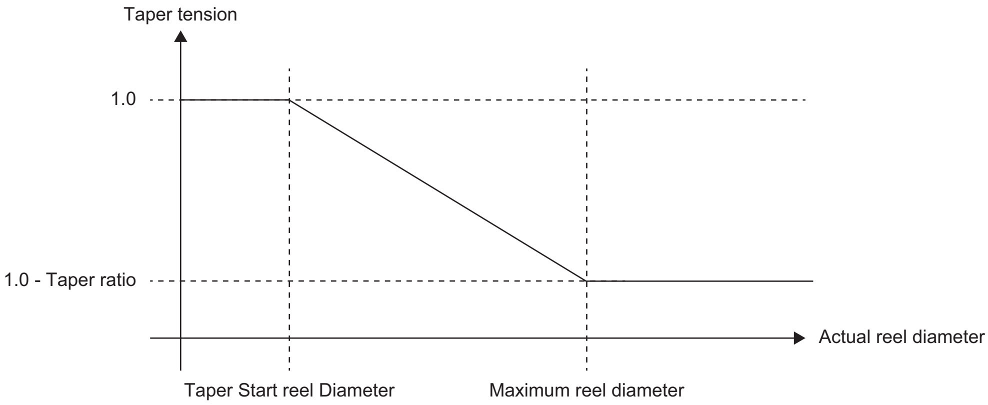
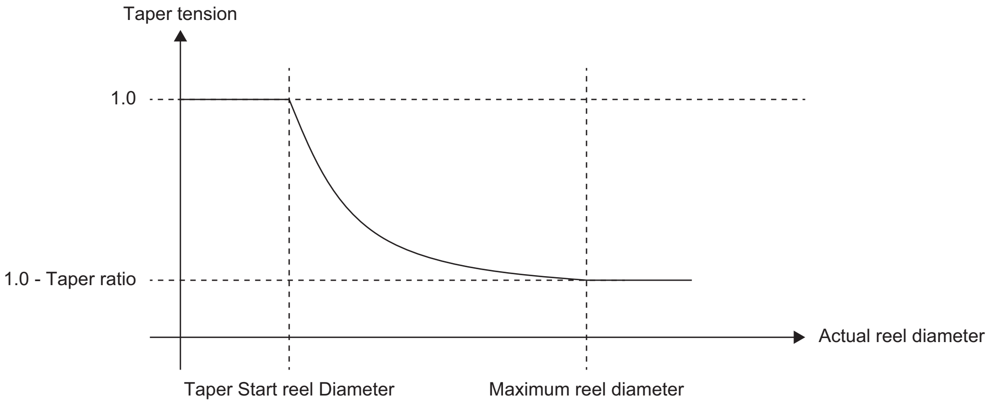
Overview

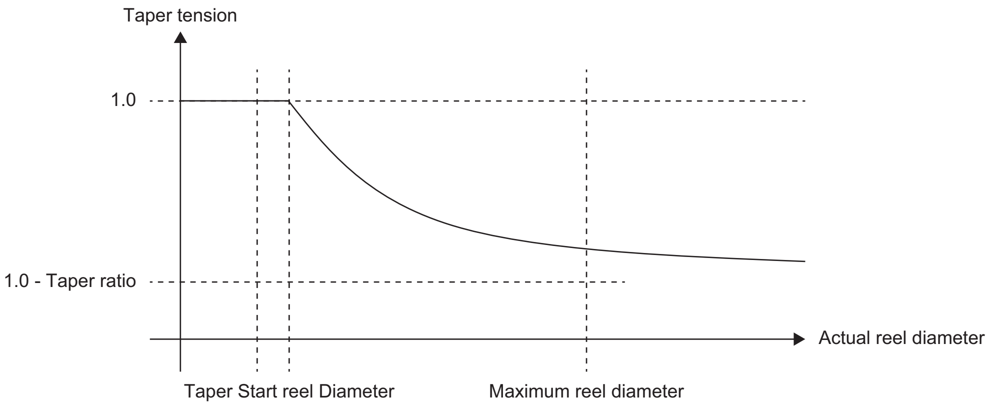
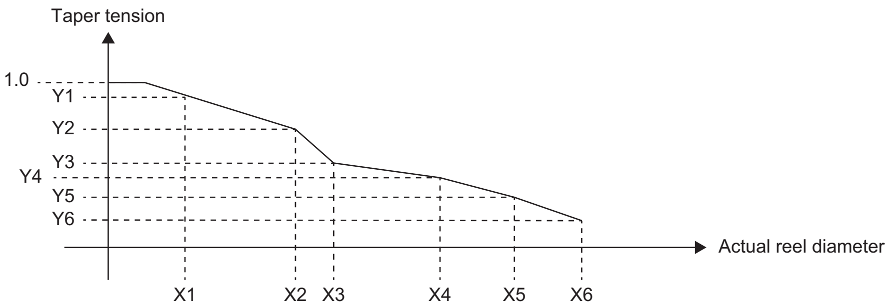
This function block calculates the tapered tension factor according to the reel diameter of the winding axis.

	M+R2R_TaperTension_F		
(1)	B:i_bEN	o_bENO:B	(10)
(2)	UW:i_uTaperMode	o_bOK:B	(11)
(3)	E:i_eDiaActVal	o_bErr:B	(12)
(4)	E:i_eUpperLimit	o_uErrId:UW	(13)
(5)	E:i_eLowerLimit	o_eTensionTaper:E	(14)
(6)	E:i_eTaperRatio		
(7)	E:i_eStartDia		
(8)	E:i_eMaxDia		
(9)	DUT:i_stTaperTabl		

■Function description

Taper mode	Description
0: No taper	Taper tension = 1.0
1: Linear taper characteristics	■When actual reel diameter < taper start reel diameter Taper tension = 1.0 ■When taper start reel diameter ≤ actual reel diameter ≤ maximum reel diameter $\text{Taper tension} = \left(1.0 - \text{Taper ratio} \times \left(\frac{\text{Actual reel diameter - Taper Start reel Diameter}}{\text{Maximum reel diameter - Taper Start reel Diameter}}\right)\right)$ ■When maximum reel diameter < actual reel diameter Taper tension = 1.0 - Taper ratio
2: Hyperbolic taper characteristic 1	■When actual reel diameter < taper start reel diameter Taper tension = 1.0 ■When taper start reel diameter ≤ actual reel diameter ≤ maximum reel diameter $\text{Taper tension} = \left(1.0 - \text{Taper ratio} \times \left(\frac{\text{Actual reel diameter - Taper Start reel Diameter}}{\text{Actual reel diameter}}\right) \times \left(\frac{\text{Maximum reel diameter}}{\text{Maximum reel diameter - Taper Start reel Diameter}}\right)\right)$ ■When maximum reel diameter < actual reel diameter Taper tension = 1.0 - Taper ratio
3: Hyperbolic taper characteristic 2	■When actual reel diameter < taper start reel diameter Taper tension = 1.0 ■When taper start reel diameter < actual reel diameter $\text{Taper tension} = \left(1.0 - \text{Taper ratio} \times \left(1.0 - \frac{\text{Taper Start reel Diameter}}{\text{Actual reel diameter}}\right)\right)$
4: Data table characteristics	Taper tension = configuration data table characteristics X1: Actual reel diameter 1, Y1: Taper rate 1 X2: Actual reel diameter 2, Y1: Taper rate 2 ⋮ X16: Actual reel diameter 2, Y16: Taper rate 2

Taper mode	Description
	
0: No taper	
1: Linear taper characteristics	
2: Hyperbolic taper characteristic 1	

Taper mode	Description
3: Hyperbolic taper characteristic 2	
4: Data table characteristics	

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_uTaperMode	Taper mode	Word [unsigned]	At FB startup	On, off	0: No taper 1: Linear taper characteristics 2: Hyperbolic taper characteristic 1 3: Hyperbolic taper characteristic 2 4: Data table characteristics
(3)	i_eDiaActVal	Actual reel diameter	Single-precision real number	Always enabled	—	Actual reel diameter [mm]
(4)	i_eUpperLimit	Taper maximum	Single-precision real number	At FB startup	0.0<	Taper maximum [1.0 = 100%]
(5)	i_eLowerLimit	Taper minimum	Single-precision real number	At FB startup	0.0<	Taper minimum [1.0 = 100%]
(6)	i_eTaperRatio	Taper ratio	Single-precision real number	At FB startup	0.0<	Taper ratio [1.0 = 100%]
(7)	i_eStartDia	Taper start reel diameter	Single-precision real number	At FB startup	0.0≤	Taper start reel diameter [mm]
(8)	i_eMaxDia	Maximum reel diameter	Single-precision real number	At FB startup	0, 1	Maximum reel diameter [mm]
(9)	i_stTaperTabl	Table-point settings	XY_TABLE16_REF	At FB startup	0.0≤	For information on the structure, refer to the following. Page 19 XY_TABLE16_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(10)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(11)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(12)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(13)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(14)	o_eTensionTaper	Tapered tension factor	Single-precision real number	—	Stores the tapered tension factor. [1.0=100%]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module[*1]	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.

■Basic specifications

Item	Description
Language	ST
Number of steps	2290 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. 📖GX Works3 Operating Manual
Points of labels used	• Label: 0.43K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. 📖GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	M+R2R_TaperTension_F └M+R2R_Table16Interpolation_F
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2	• Taper mode = 4 • Actual reel diameter = 450 [mm] • Taper maximum value = 1 • The number of points for the table-point settings = 8 • X coordinate (reel diameter) = 100, 200 ... 800 • Y coordinate (taper ratio) = 1, 0.9 ... 0.3 • Others = 0	0.38ms	0.90ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

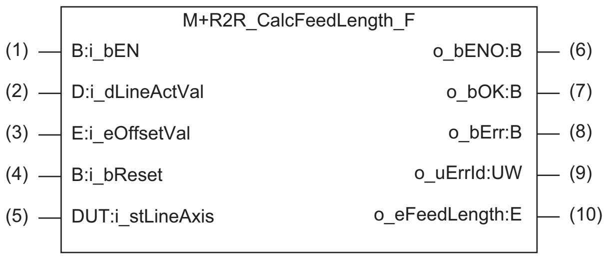
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_CalcFeedLength_F (Length measurement calculation)

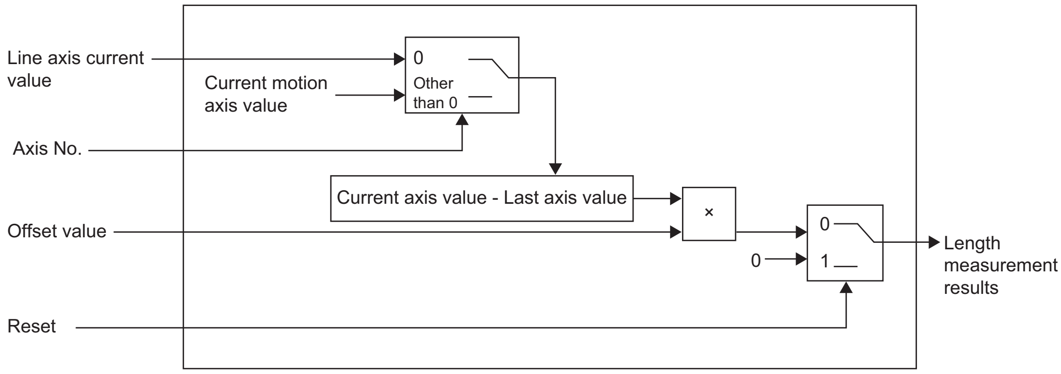
Overview

This function block outputs the length of material delivered from the line axis.



■Function description

- It outputs the measurement result from the current value of the line axis.
- If the length to be measured is not from the line axis, adjust it with an offset value.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_dLineActValue	Line axis current value	Double word [signed]	Always enabled	On, off	Line axis current value [mm] (Input is required only for axis No.0.)
(3)	i_eOffsetValue	Offset value	Single-precision real number	Always enabled	—	Adjusting [mm]
(4)	i_bReset	Reset	Bit	Always enabled	0.0<	Resets the output value to 0.
(5)	i_stLineAxis	Line axis setting	AXIS_REF	At FB startup	0.0<	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(6)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(7)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(8)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(9)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(10)	o_eFeedLength	Length measurement result	Single-precision real number	—	Length measurement result output [m]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	968 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.04K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Axis No. = 1 • Module number = 1 • Others = 0	0.12ms	0.54ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

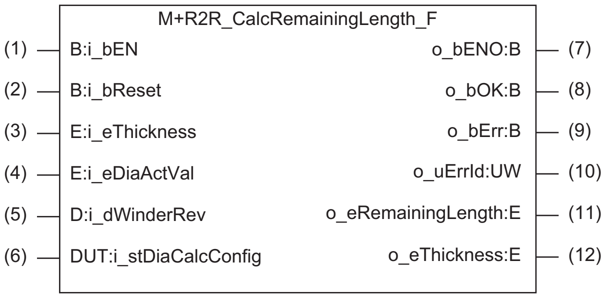
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_CalcRemainingLength_F (Residual length operation)

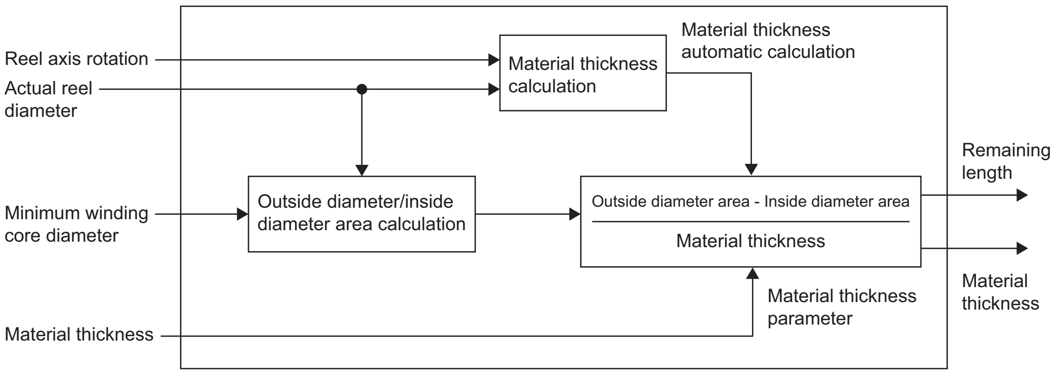
Overview

This function block calculates the remaining length of the material from the cross-sectional area of the unwinding axis.



■Function description

It calculates the remaining length by dividing the cross-sectional area of the material on the unwinding axis by the material thickness.



Material thickness calculation

- T: Material thickness [mm]
- L: Reel diameter at 10 revolutions of reel axis after execution instruction is turned on [mm]
- Ln: Reel diameter after 10 revolutions (20 revolutions after execution instruction is turned on) [mm]
- N: Number of reel revolutions after execution instruction is on

$$T = \frac{L - L_n}{2N}$$

Precautions

When the material thickness is automatically calculated, the material thickness cannot be calculated until 20 revolutions of the reel axis. Therefore, the remaining length is output as an outlier (-1.0).

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_bReset	Remaining amount reset	Bit	Always enabled	—	When ON, the remaining length is initialized.
(3)	i_eThickness	Material thickness	Single-precision real number	Always enabled	—	material thickness [mm] If the value is 0.0, automatic calculation is executed.
(4)	i_eDiaActVal	Actual reel diameter	Single-precision real number	Always enabled	—	Current value of reel diameter [mm]
(5)	i_dWinderRev	Cumulative number of revolutions of reel axis	Double word [signed]	At FB startup	0.0≤	number of turns on the reel axis [rev]
(6)	i_stDiaCalcConfig	Reel diameter calculation setting	DIA_CALC_REF	—	—	For information on the structure, refer to the following. Page 18 DIA_CALC_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(7)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(8)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(9)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(10)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(11)	o_eRemainingLength	Remaining length	Single-precision real number	○	The result of the calculation on the remaining length is stored. [m]
(12)	o_eThickness	Material thickness	Single-precision real number	—	Stores the material thickness. [mm]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.

■Basic specifications

Item	Description
Language	ST
Number of steps	809 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.05K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2	• Actual reel diameter = 250 [mm] • Minimum reel diameter = 150 [mm] • Others = 0	0.06ms	0.49ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

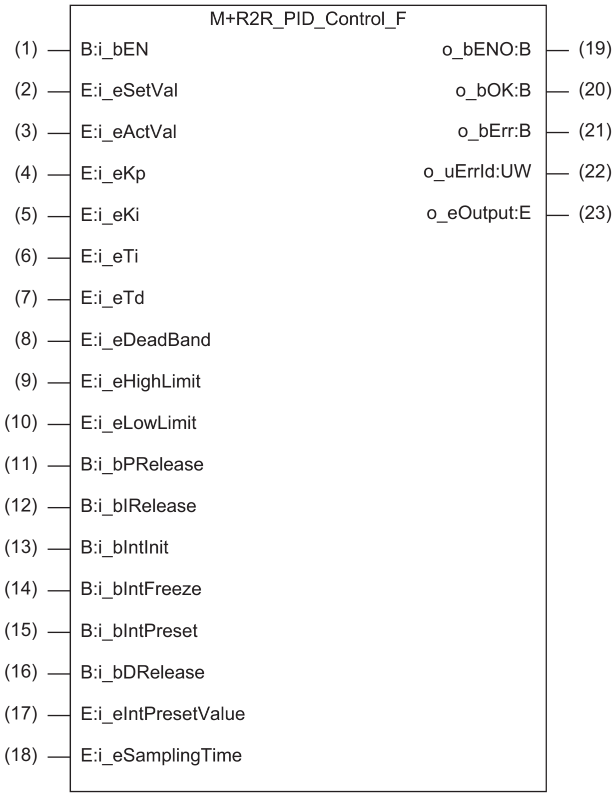
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_PID_Control_F (PID control)

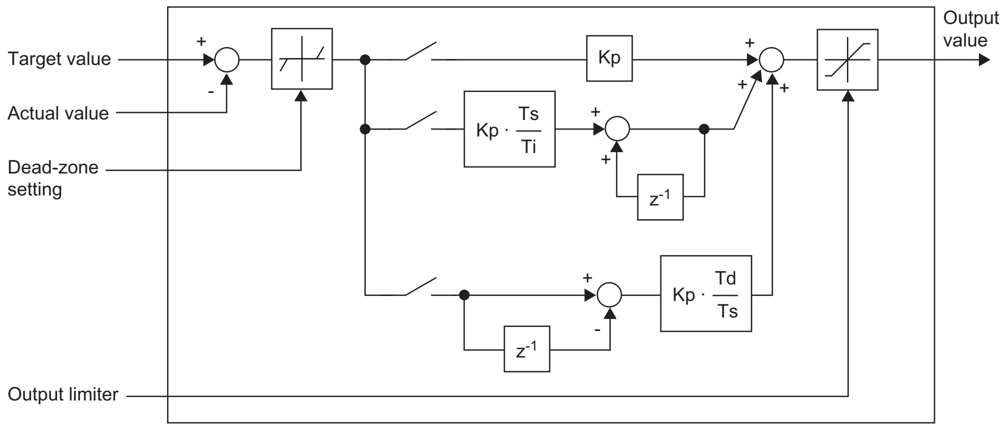
Overview

This function block performs PID control by calculating the deviation between the set value and the current value.



■Function description

It performs the following PID control.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eSetVal	Set value	Single-precision real number	Always enabled	—	Set value
(3)	i_eActVal	Actual value	Single-precision real number	Always enabled	—	Actual value
(4)	i_eKp	Proportional gain	Single-precision real number	Always enabled	—	Proportional gain
(5)	i_eKi	Integral gain	Single-precision real number	Always enabled	—	Integral gain Any value other than 0.0 is valid as the gain of the integral term. (Switch from proportional gain)
(6)	i_eTi	Integration time	Single-precision real number	Always enabled	0.0≤	Integration time [ms]
(7)	i_eTd	Differential time	Single-precision real number	Always enabled	0.0≤	Differential time [ms]
(8)	i_eDeadBand	Dead-band setting	Single-precision real number	Always enabled	0.0≤	Dead-band setting
(9)	i_eHighLimit	Output upper limit	Single-precision real number	Always enabled	Lower limit <	Output upper limit
(10)	i_eLowLimit	Output lower limit	Single-precision real number	Always enabled	Upper limit >	Output lower limit
(11)	i_bPRelease	Proportional Control Effective	Bit	Always enabled	—	On: Proportional control enabled
(12)	i_bIRelease	Integral Control Effective	Bit	Always enabled	—	On: Integral control enabled
(13)	i_bIntInit	Integral initialization	Bit	Always enabled	—	On: Resets the amount of calculation in integral control
(14)	i_bIntFreeze	Integral retention	Bit	Always enabled	—	On: Keeps the amount of calculation in integral control While it is kept, the proportional and differential components are invalid.
(15)	i_bIntPreset	Integration presets	Bit	Always enabled	—	On: Presets the integration value
(16)	i_bDRelease	Differential control effective	Bit	Always enabled	—	On: Differential control enabled
(17)	i_eIntPresetValue	Integration preset values	Single-precision real number	Always enabled	—	Integration preset values
(18)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle [ms]. If the value is 0.0 [ms], it is executed at the scan time.

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(19)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(20)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(21)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(22)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(23)	o_eOutput	PID output	Single-precision real number	—	Contains the PID control output value.

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.

■Basic specifications

Item	Description
Language	ST
Number of steps	1762 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.08K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2	• Target value = 5 • Current value = 4 • Proportional gain = 0.02 • Integration time = 280 [ms] • Output upper limit = 30 • Output lower limit = -30 • Proportional control effective = On • Integral control effective = On • Differential control effective = On • Others = 0	0.23ms	0.67ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

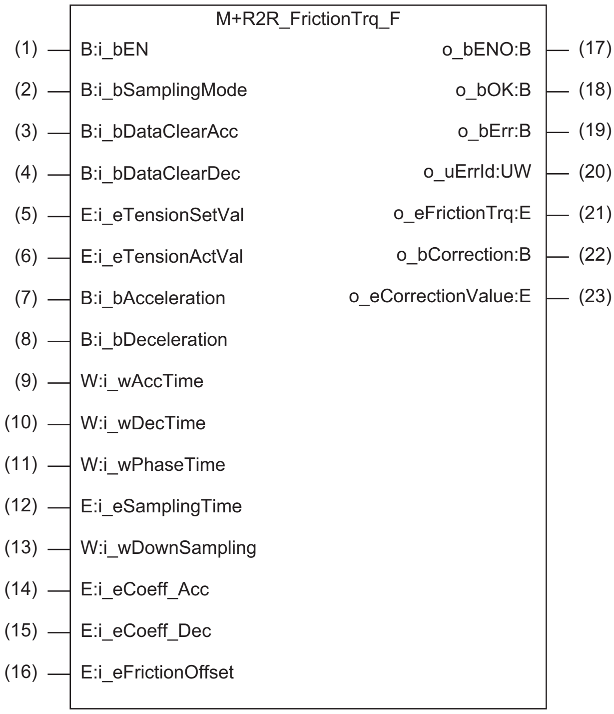
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_FrictionTrq_F (Friction compensation correction)

Overview

This function block calculates friction compensation based on the rising state of the drive axis rotation speed at start-up, and outputs the result.



■Function description

When the execution command is ON, friction compensation is output.

This FB has a function to correct the friction compensation value.

It performs tension control while the measurement mode is on, collecting tension errors during acceleration/deceleration at every program calculation cycle. In measurement mode, tension errors are added to the collected data at each acceleration/deceleration. By repeatedly collecting data, the correction value is adjusted to the optimal value.

The upper limit value of acceleration/deceleration compensation time is program calculation cycle [ms] × number of collection points × (execution frequency + 1). *1

The collected tension error is reflected at the next acceleration/deceleration, and the output correction value can be adjusted by gain and phase.

*1 To change the program calculation cycle, change the constant scan or periodic interval setting of the CPU parameter. To change the number of collection points, change the constant c_wSamplPoints (number of collection points) in the FB local label and the number of array elements in dwAccData (acceleration compensation value table) and dwDecData (deceleration compensation value table). If the capacity of the latch label area is insufficient, reduce the number of collection points or change the memory/device setting in the CPU parameter.

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_bSamplingMode	Measurement mode	Bit	Always enabled	—	On: Collect tension data.
(3)	i_bDataClearAcc	Acceleration data deletion	Bit	Always enabled	—	On: Delete data collected in the acceleration section.
(4)	i_bDataClearDec	Deceleration data deletion	Bit	Always enabled	—	On: Delete data collected in the deceleration section.
(5)	i_eTensionSetVal	Tension setting value	Single-precision real number	Always enabled	—	Enter the target value for tension. [N]
(6)	i_eTensionActVal	Actual tension value	Single-precision real number	Always enabled	—	Enter the tension detector value. [N]
(7)	i_bAcceleration	Accelerating	Bit	Always enabled	—	On: Accelerating
(8)	i_bDeceleration	Decelerating	Bit	Always enabled	—	On: Decelerating
(9)	i_wAccTime	Acceleration correction time	Word [signed]	At FB startup	0<	Enter the data collection time for the acceleration section. [ms]
(10)	i_wDecTime	Deceleration correction time	Word [signed]	At FB startup	0<	Enter the data collection time for the deceleration section. [ms]
(11)	i_wPhaseTime	Phase	Word [signed]	At FB startup	0≤	Enter the phase of the output data. [ms]
(12)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle [ms]. If the value is 0.0 [ms], it is executed at the scan time.
(13)	i_wDownSampling	Execution frequency	Word [signed]	At FB startup	0≤	Enter the frequency at which data collection will be performed in measurement mode. Data is collected each time the program calculation cycle × (execution frequency + 1) elapses. When 0 is set, execution is performed in program calculation cycles.
(14)	i_eCoeff_Acc	Gain for acceleration	Single-precision real number	Always enabled	—	Enter the gain for acceleration.
(15)	i_eCoeff_Dec	Gain for deceleration	Single-precision real number	Always enabled	—	Enter the gain for deceleration.
(16)	i_eFrictionOffset	Friction compensation offset	Single-precision real number	Always enabled	—	Enter the offset value. [N]

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(17)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(18)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(19)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(20)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(21)	o_eFrictionTrq	Friction compensation value	Single-precision real number	—	Stores the corrected friction compensation value. [N]
(22)	o_bCorrection	Correcting	Bit	—	Turned on during correction. Turned off during output for offset only
(23)	o_eCorrectionValue	Correction value	Single-precision real number	—	Outputs the correction value without offset. [N]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.

■Basic specifications

Item	Description
Language	ST
Number of steps	1945 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.06K points (Word) • Latch label: 0.59K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2	• Measurement mode = On • Accelerating = On • Tension setting value = 5 [N] • Actual tension value = 4 [N] • Accelerating = On • Acceleration correction time = 80 [ms] • Deceleration correction time = 80 [ms] • Gain for acceleration = 1 • Gain for deceleration = 1 • Others = 0	0.22ms	0.64ms	1 scan

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

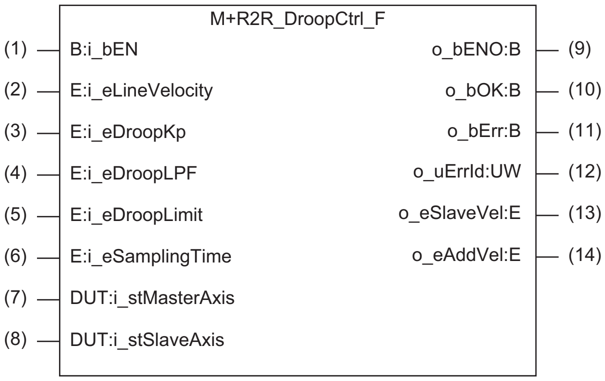
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_DroopCtrl_F (Droop control for roll press)

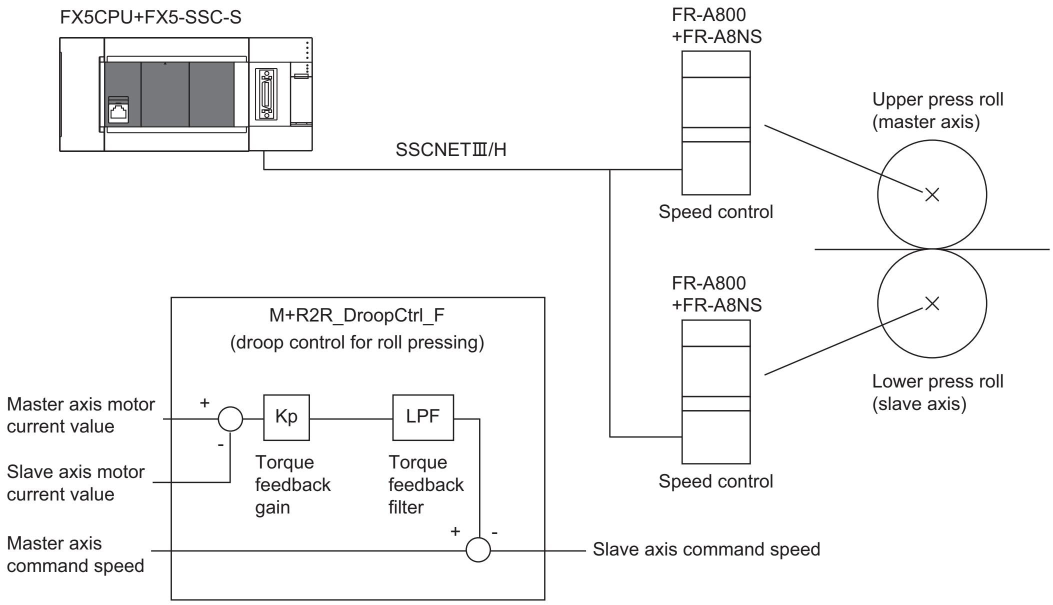
Overview

This function block controls the peripheral speed of the upper and lower press rolls in a tandem drive roll press machine.



■Function description

The upper and lower press rolls are tandem driven (speed synchronized) by two motors, and the speed of the slave axis is corrected by the torque deviation generated between the master and slave, thereby achieving torque-balanced tandem drive between the master and slave. Interference torque at high speeds and speed fluctuations at low speeds can be handled.



Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eLineVelocity	Line speed	Single-precision real number	Always enabled	—	Enter the speed correction ratio based due to torque deviation. [(m/min)/%]
(3)	i_eDroopKp	Droop gain	Single-precision real number	Always enabled	0.0≤	Enter a low-pass filter value for the speed correction ratio result. [ms]
(4)	i_eDroopLPF	Droop filter	Single-precision real number	Always enabled	0.0≤	Enter the upper/lower clamp value for the speed correction value. [m/min]
(5)	i_eDroopLimit	Droop limits	Single-precision real number	Always enabled	0.0<	Execution cycle of the program that executes FB [ms]
(6)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	If the value is 0.0 [ms], it is executed at the scan time.
(7)	i_stMasterAxis	Master axis setting	AXIS_REF	—	—	For information on the structure, refer to the following. Page 18 AXIS_REF
(8)	i_stSlaveAxis	Slave axis setting	AXIS_REF	—	—	For information on the structure, refer to the following. Page 18 AXIS_REF The module specification is the same as i_stMasterAxis.uStartIO. (i_stSlaveAxis.uStartIO is not used.)

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(9)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(10)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(11)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(12)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(13)	o_eSlaveVel	Slave axis speed	Single-precision real number	—	The command speed after speed correction of the slave axis is output. [m/min]
(14)	o_eAddVel	Speed correction value	Single-precision real number	—	The speed correction due to torque deviation is output. [m/min]

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	2946 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.12K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	No dependency
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	—

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module*1*2 FX5-80SSC-G	• Line speed = 1.2 [m/min] • Droop gain = 0.15 [(m/min)/%] • Droop limits = 2 [m/min] • Axis No. of the master axis setting = 1 • Module number = 1 • Axis No. of the slave axis setting = 2 • Others = 0	8.86ms	0.97ms	13 scans

*1 When the program capacity is set to 128K steps, the processing speed may become slow.

*2 The standard area is used for labels.

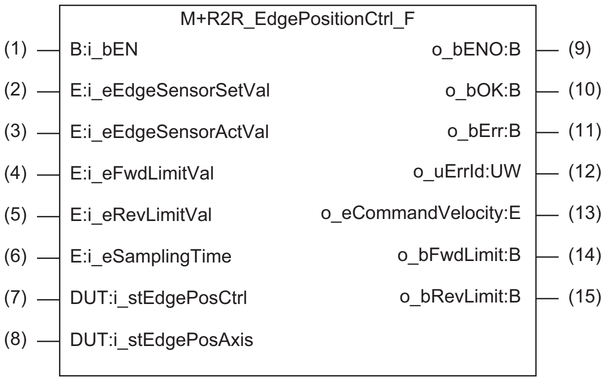
Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_EdgePositionCtrl_F (Meandering correction control)

Overview

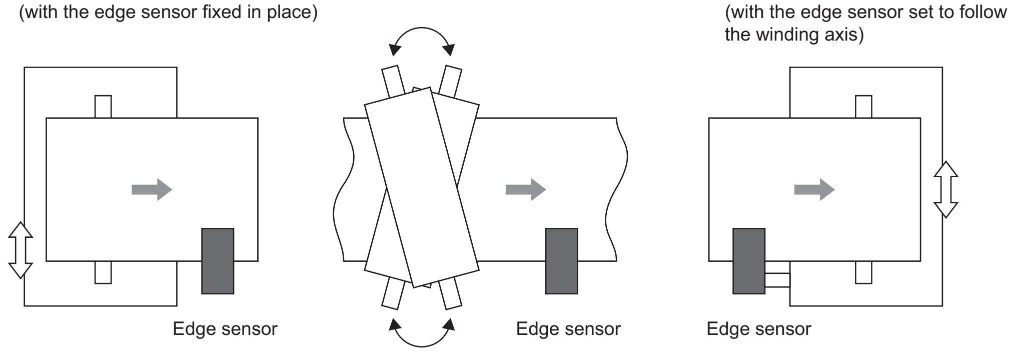
The edge sensor detects the position of the material, and speed control is used to move the material into the target position.

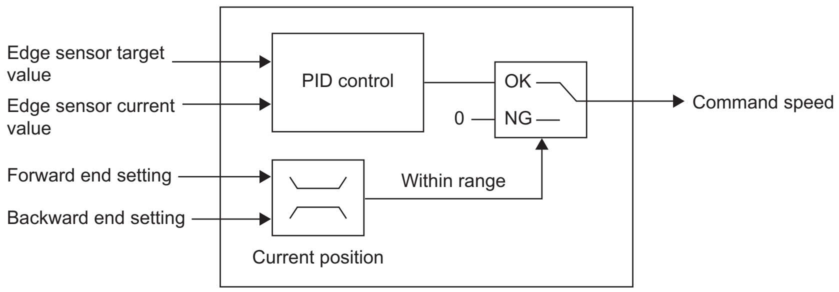


■Function description

The speed for position correction is calculated by PID control so that the edge of the material reaches the midpoint (target) of the edge sensor, and the command speed in speed mode is output to the servo amplifier.

- When the unwinding axis moves (with the edge sensor fixed in place)
- When the intermediate axis moves
- When the winding axis moves (with the edge sensor set to follow the winding axis)





Precautions

Use "0: mm" as the electronic gear unit setting when compensating with the roller angle of the middle axis.

Ex.

When rotating 45 degrees per motor revolution (4194304 pulses)

Pr.2: Number of pulses per revolution is 4194304 pulses. Pr.3: Movement amount per revolution is 45000.0μm.

Labels

■Input label

No.	Label	Label name	Data Type	Incorporation	Scope of validity	Description
(1)	i_bEN	Execution command	Bit	Always enabled	On, off	On: Start FB. Off: Do not start FB.
(2)	i_eEdgeSensorSetVal	Edge sensor target value	Single-precision real number	Always enabled	—	Enter the target position of the edge sensor. [mm]
(3)	i_eEdgeSensorActVal	Edge sensor current value	Single-precision real number	Always enabled	—	Enter the current value of the edge sensor. [mm]
(4)	i_eFwdLimitVal	Forward end setting	Single-precision real number	Always enabled	Backward end <	Meandering correction forward end position. [mm] Speed control is stopped in the + direction.
(5)	i_eRevLimitVal	Backward end setting	Single-precision real number	Always enabled	Forward end >	Meandering correction backward end position. [mm] Speed control is stopped in the - direction.
(6)	i_eSamplingTime	Execution cycle	Single-precision real number	At FB startup	0.0≤	Enter the execution cycle [ms]. If the value is 0.0 [ms], it is executed at the scan time.
(7)	i_stEdgePosCtrl	Meandering correction control setting	EDGE_POS_REF	—	—	For information on the structure, refer to the following. Page 19 EDGE_POS_REF
(8)	i_stEdgePosAxis	Meandering correction axis setting	AXIS_REF	—	—	For information on the structure, refer to the following. Page 18 AXIS_REF

■Output label

○: Keep value after FB stop, —: Clear value after FB stop

No.	Label	Label name	Data Type	Keep	Description
(9)	o_bENO	Execution status	Bit	—	On: Execution command is on. Off: Execution command is off.
(10)	o_bOK	Operating properly	Bit	—	The on state indicates that the FB is operating normally.
(11)	o_bErr	Completed with an error	Bit	—	The on state indicates that an error has occurred in the FB.
(12)	o_uErrId	Error code	Word [unsigned]	—	Stores the error code that occurred in the FB.
(13)	o_eCommandVelocity	Command speed	Single-precision real number	—	Stores the speed command value of FB calculation result. [mm/s]
(14)	o_bFwdLimit	Forward end	Bit	—	Indicates that the meandering correction axis is at the forward end.
(15)	o_bRevLimit	Backward end	Bit	—	Indicates that the meandering correction axis is at the backward end.

FB details

■Applicable hardware and software

Target module	Firmware version	Engineering tool
FX5UJ CPU module*1	1.060 or later	GX Works3 Version 1.101F or later
FX5U/FX5UC CPU module	1.300 or later	GX Works3 Version 1.101F or later
FX5-SSC-S*2	1.009 or later	GX Works3 Version 1.101F or later
FX5-SSC-G*2	1.004 or later	GX Works3 Version 1.101F or later

*1 The FX5-SSC-G cannot be mounted. It is only compatible with the FX5-SSC-S.
*2 For information on compatible drive units and the number of controlled axes, refer to the motion module manual.

■Basic specifications

Item	Description
Language	ST
Number of steps	4076 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of labels used	• Label: 0.24K points (Word) • Latch label: 0K points (Word) The points of labels embedded in a program depends on the CPU module used, the devices specified for arguments, and the option setting of GX Works3. For the option setting of GX Works3, refer to the following. GX Works3 Operating Manual
Points of index registers used	• Index register: 0 points • Long index register: 0 points
Points of file registers used	0 points
FB dependency	M+R2R_EdgePositionCtrl_F └M+R2R_PID_Control_F
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	Set values equal to or greater than 0 for the proportional gain and integral gain in the meandering correction control setting. If a negative value is set, the PID control may not be performed. To change the rotation direction, use the operating direction.

Performance values

The following shows the measurement result of the time from when the execution command is turned on until the normal operation is turned on under the following measurement conditions. The performance values may vary depending on the setting values and the module types to be used.

Module	Measurement condition	Processing time	Maximum scan time	Number of scans
FX5U/FX5UC CPU module[*1*2] FX5-80SSC-G	• Edge sensor target value = 10 [mm] • Edge sensor current value = 5 [mm] • Forward end setting = 20 [mm] • Backward end setting = -20 [mm] • Proportional gain = 0.02 [(mm/s)/mm] • Integration time = 280 [ms] • Upper limit of calculation = 30 [mm/s] • Lower limit of calculation = -30 [mm/s] • Axis No. = 1 • Module number = 1 • Others = 0	8.69ms	1.04ms	10 scans

*1 When the program capacity is set to 128K steps, the processing speed may become slow.
*2 The standard area is used for labels.

Version upgrade history

Version	Date	Description
00A	January 2025	First edition

M+R2R_Table16Interpolation_F (Table interpolation)

Overview

This function block calculates the output value (Y) that corresponds to the input value (X) from the X and Y point tables.

■Function description

This FB is called from M+R2R_TaperTension_F (Taper calculation) and calculates the output value (Y) that corresponds to the input value (X) from the X and Y point tables.

FB details

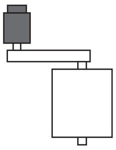
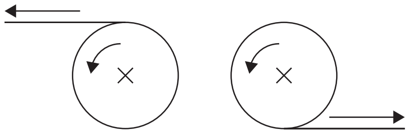
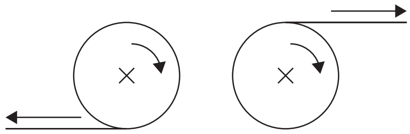
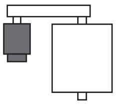
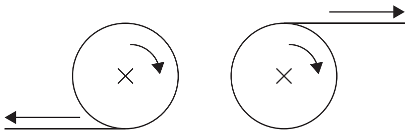
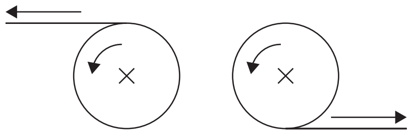
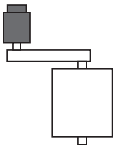
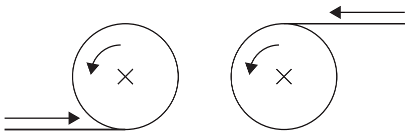
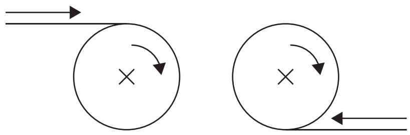
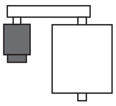
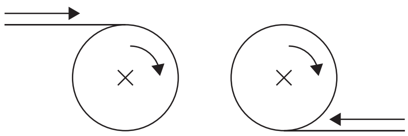
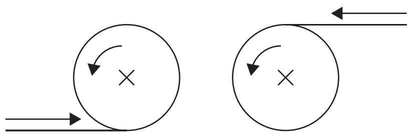
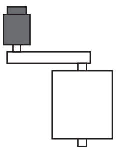
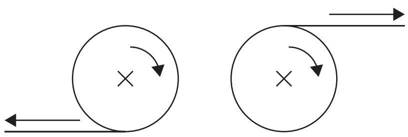
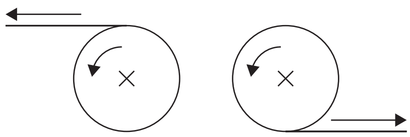
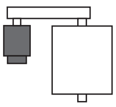
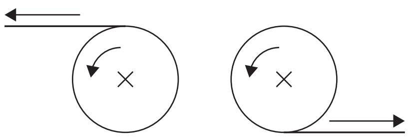
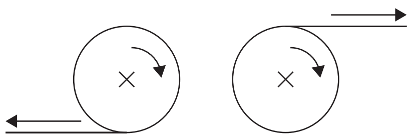
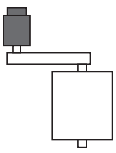
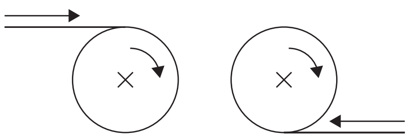
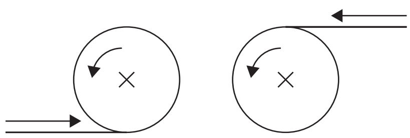
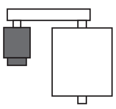
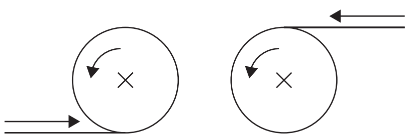
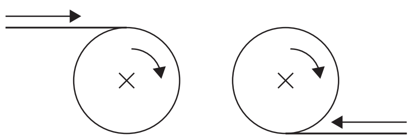
■Basic specifications

Item	Description
FB compilation method	Subroutine type
FB calculation	Ad hoc type
Restrictions and precautions	This FB is used within another FB, so do not use it in the program of the user.

5.3 Orientation Setting

Set the rotation direction of the servo parameters so that unwinding/winding occurs in the forward rotation direction according to the device, and set the unwinding axis to WinderType: 0, and the winding axis to WinderType: 1. When switching between upper unwinding and lower unwinding or upper winding and lower winding on the same device, switch with WinderType: 0 ↔ WinderType: 2 or WinderType: 1 ↔ WinderType: 3.

When winding with an unwinding axis or unwinding with a winding axis, enter a negative (-) speed command in the line speed input.

Settings	Motor Mounting direction	Servo parameter PA 14 (POL) Rotation direction selection	
		0 (forward: CCW counterclockwise)	1 (forward: CW clockwise)
WinderType: 0 (forward unwinding)			
			
WinderType: 1 (forward winding)			
			
WinderType: 2 (reverse unwind)			
			
WinderType: 3 (reverse winding)			
			

5.4 Error Code

FB library warning (out of input range)

If it occurs when FB is started, it will not work. If it occurs during FB calculation, it will continue to operate at the previous value.

Error code	Description	Treatment method
100H	The axis number (station number) setting is out of range.	After reviewing the settings, execute FB again.
101H	The tension setting value is out of range.	After reviewing the settings, execute FB again.
102H	The tension taper factor is a negative value.	After reviewing the settings, execute FB again.
103H	The actual reel diameter is out of range. (0.0 or less, outside the range of minimum diameter (inside diameter) to maximum diameter, and so on)	After reviewing the settings, execute FB again.
105H	The speed limit factor is a negative value.	After reviewing the settings, execute FB again.
106H	The speed limit offset value is a negative value.	After reviewing the settings, execute FB again.
107H	The execution cycle is less than 0.0.	After reviewing the settings, execute FB again.
108H	The winding method is other than 0 to 3.	After reviewing the settings, execute FB again.
109H	The gear ratio is 0.0 or less.	After reviewing the settings, execute FB again.
10AH	The rated torque is 0.0 or less.	After reviewing the settings, execute FB again.
10CH	The integration time is a negative value.	After reviewing the settings, execute FB again.
10DH	The differential time is a negative value.	After reviewing the settings, execute FB again.
10EH	The upper limit of calculation is less than or equal to the lower limit of calculation.	After reviewing the settings, execute FB again.
10FH	The dead-band setting is a negative value.	After reviewing the settings, execute FB again.
115H	Acceleration is 0.0 or less.	After reviewing the settings, execute FB again.
116H	Deceleration is 0.0 or less.	After reviewing the settings, execute FB again.
117H	The emergency stop deceleration is 0.0 or less.	After reviewing the settings, execute FB again.
118H	The acceleration change rate is a negative value.	After reviewing the settings, execute FB again.
119H	The rotation direction is other than 0 or 1.	After reviewing the settings, execute FB again.
11AH	The initial reel diameter is out of range (0.0 or less or outside the range of minimum diameter to maximum diameter), or the minimum reel diameter or maximum reel diameter is out of range (Minimum diameter is negative, or the minimum reel diameter is greater than or equal to the maximum reel diameter).	After reviewing the settings, execute FB again.
11CH	The minimum reel speed is a negative value.	After reviewing the settings, execute FB again.
11DH	The material thickness is 0.0 or less.	After reviewing the settings, execute FB again.
11EH	The reel material width is 0.0 or less.	After reviewing the settings, execute FB again.
11FH	The reel material specific gravity is 0.0 or less.	After reviewing the settings, execute FB again.
120H	The mechanical inertia is a negative value.	After reviewing the settings, execute FB again.
121H	The motor inertia is a negative value.	After reviewing the settings, execute FB again.
122H	The acceleration compensation adjustment factor is a negative value.	After reviewing the settings, execute FB again.
123H	The deceleration compensation adjustment factor is a negative value.	After reviewing the settings, execute FB again.
12CH	The taper mode is other than 0 to 4.	After reviewing the settings, execute FB again.
12DH	The taper minimum is a negative value.	After reviewing the settings, execute FB again.
12EH	Taper maximum < Taper minimum	After reviewing the settings, execute FB again.
12FH	The taper ratio is other than 0.0 to 1.0.	After reviewing the settings, execute FB again.
130H	The taper start reel diameter is a negative value.	After reviewing the settings, execute FB again.
131H	The maximum reel diameter is less than or equal to the taper start reel diameter.	After reviewing the settings, execute FB again.
136H	The number of table interpolation points is out of range.	After reviewing the settings, execute FB again.
137H	The table interpolation X coordinates are not set in ascending order.	After reviewing the settings, execute FB again.
140H	The amount of movement per revolution of the reel is 0 or less. (Only for axis No.0)	After reviewing the settings, execute FB again.

Error code	Description	Treatment method
14AH	The acceleration correction time is out of range.	After reviewing the settings, execute FB again.
14BH	The deceleration correction time is out of range.	After reviewing the settings, execute FB again.
14CH	The line speed exceeds the maximum line speed.	After reviewing the settings, execute FB again.
14DH	The maximum line speed is 0.0 or less.	After reviewing the settings, execute FB again.
14EH	The phase is a negative value.	After reviewing the settings, execute FB again.
14FH	The execution frequency is a negative value.	After reviewing the settings, execute FB again.
1FFH	The specified calculation frequency is out of range.	After reviewing the settings, execute FB again.
3103H	The meandering correction is changed as follows so that forward end ≤ backward end.	After reviewing the settings, execute FB again.
3106H	The variation limiter is a negative value.	After reviewing the settings, execute FB again.
310CH	The line speed setting was changed between the positive direction and the negative direction.	When changing the line speed setting between the positive direction and the negative direction, set the line speed setting to 0 first.
3110H	The droop filter is out of range.	After reviewing the settings, execute FB again.
3111H	The droop gain is out of range.	After reviewing the settings, execute FB again.
3112H	The droop limit value is less than or equal to 0.0.	After reviewing the settings, execute FB again.

FB library errors

Stops FB calculation when it occurs.

Error code	Description	Treatment method
200H	FB was activated while the target axis was operating.	Stop the target axis and FB again.
201H	The target axis is not in the servo on state.	After servo ON of the target axis, execute FB again.
202H	A motion error occurred on the target axis.	Check the error content by "[Md.23] axis error number" of the target axis, and execute FB again after recovery.
203H	The speed mode was turned off during calculation.	Check that the speed mode has not been switched from the speed mode to another mode during calculation, or that the speed mode has not been turned off due to an axis error, or other factors, and execute FB again after recovery.
204H	The torque mode was turned off during calculation.	Check that the torque mode has not been switched from the torque mode to another mode during calculation, or that the torque mode has not been turned off due to an axis error, or other factors, and execute FB again after recovery.
208H	Data clear was executed while friction compensation was being output during acceleration.	Execute FB again.
209H	Data clear was executed while friction compensation was being output during deceleration.	Execute FB again.
F002H	The module number is out of range.	After reviewing the settings, execute FB again.
F003H	The module specified in the module number setting is not a simple motion module or motion module.	Specify a simple motion module or motion module.

5.5 Introductory Steps

FB library registration and copying

To use FBs, use the following FB library contained in the following zip file. For the FB library, please contact your local Mitsubishi representative.

Name	File name
MELSEC iQ-F Roll to Roll Control Function Block Library Reference	fb-r2r_f_v100.zip

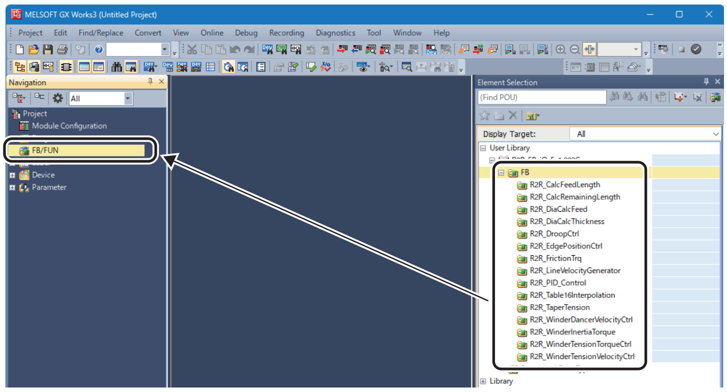
FB library registration

For the operating procedure to register the FB library into GX Works3, refer to the following.

📖GX Works3 Operating Manual

Pasting into the navigation window

1. Select program elements from the [Library] tab of the Element Selection window. (Multiple selections can be made.)
2. Drag and drop program elements to [FB/FUN] in the navigation window.



Copying reused program elements (FB)

Since a program in an FB registered from the FB library cannot be changed, the FB must be copied before the program can be changed.

The following steps describe how to reuse and copy library program elements (FB) and change the program after FB library registration.

1. Select an FB from [FB/FUN] in the Navigation window and copy it.

[FB name] ⇨ Right-click ⇨ [Copy Data]

2. Duplicate the copied FB in the FB file.

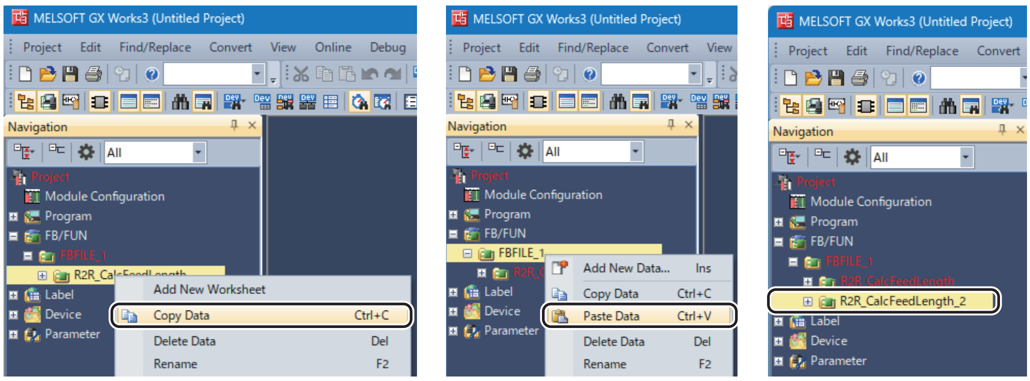
[FB file name] ⇨ Right-click ⇨ [Paste Data]

After copying, the "+" in the data name of the reused program element is changed to "_".

3. Change the program of the copied FB.

[FB name] ⇨ Double-click [ProgramBody]

Open the copied FB program in an editor and modify it.



Electronic Gear Settings

In this FB, the speed of the winding axis and the winding axis is calculated in units of r/min, and the speed of the line axis and the intermediate axis is calculated in units of m/min.

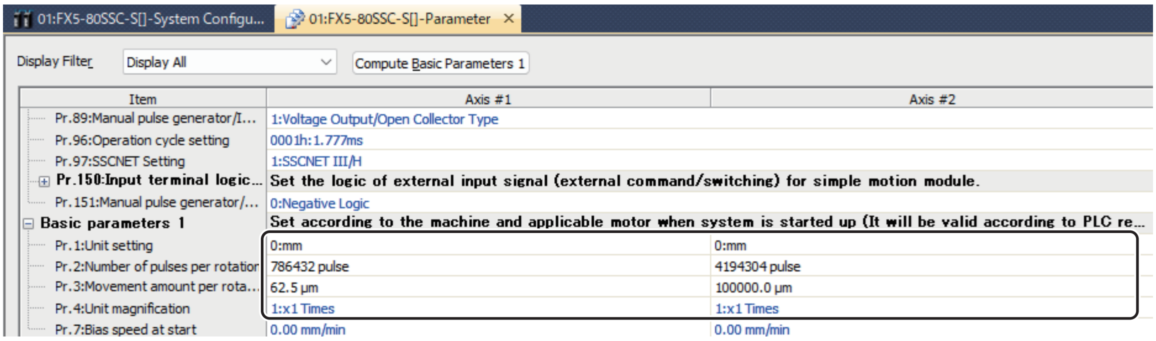
Set the electronic gear of the simple motion module/motion module as described below.

- Unwinding axis, winding axis: 1 [mm] (1000.00 [μm]) per revolution of the device
- Axes including line axis and middle axis: Amount of movement in one rotation of motor [μm] (roller circumference/gear ratio)

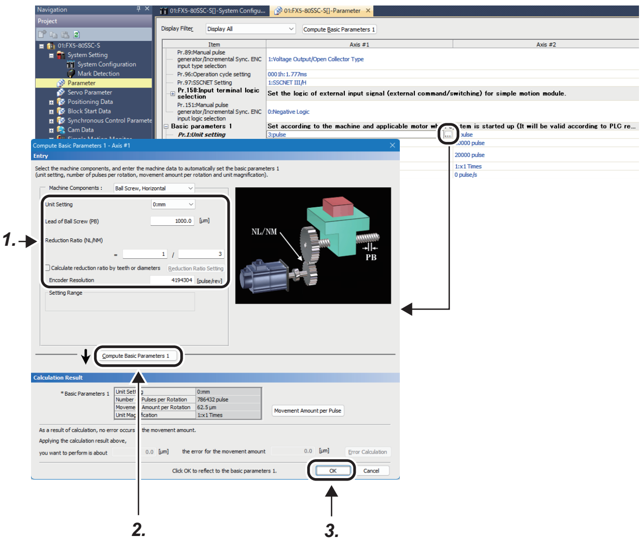
Ex.

Unwinding axis (Axis 1): Machine/motor deceleration ratio is 1/3 (motor 4194304 [pulse/rev]).

Line axis (Axis 2): Feed roll circumference 500 [mm] / motor reduction ratio 1/5 (motor 4194304 [pulse/rev])



Setting procedure



1. Enter the mechanical specifications.

2. Click the [Compute Basic Parameters 1] button to perform calculation.

3. Click the [OK] button to reflect the parameter.

■Unit of command

- Unwinding axis 1.00 [r/min] → Motion command 1.00 [mm/min]
- Line axis 1.00 [m/min] → Motion command 1000.00 [mm/min]

Precautions

For information on connection settings for motion modules or servo amplifiers other than the electronic gear, refer to the respective manuals.

6 USAGE PROCEDURE

6.1 Roll to Roll Control Using a Simple Motion Module

This section describes the procedure for performing roll to roll control on a system that uses a simple motion module as an example.

In this example, the following FBs are used.

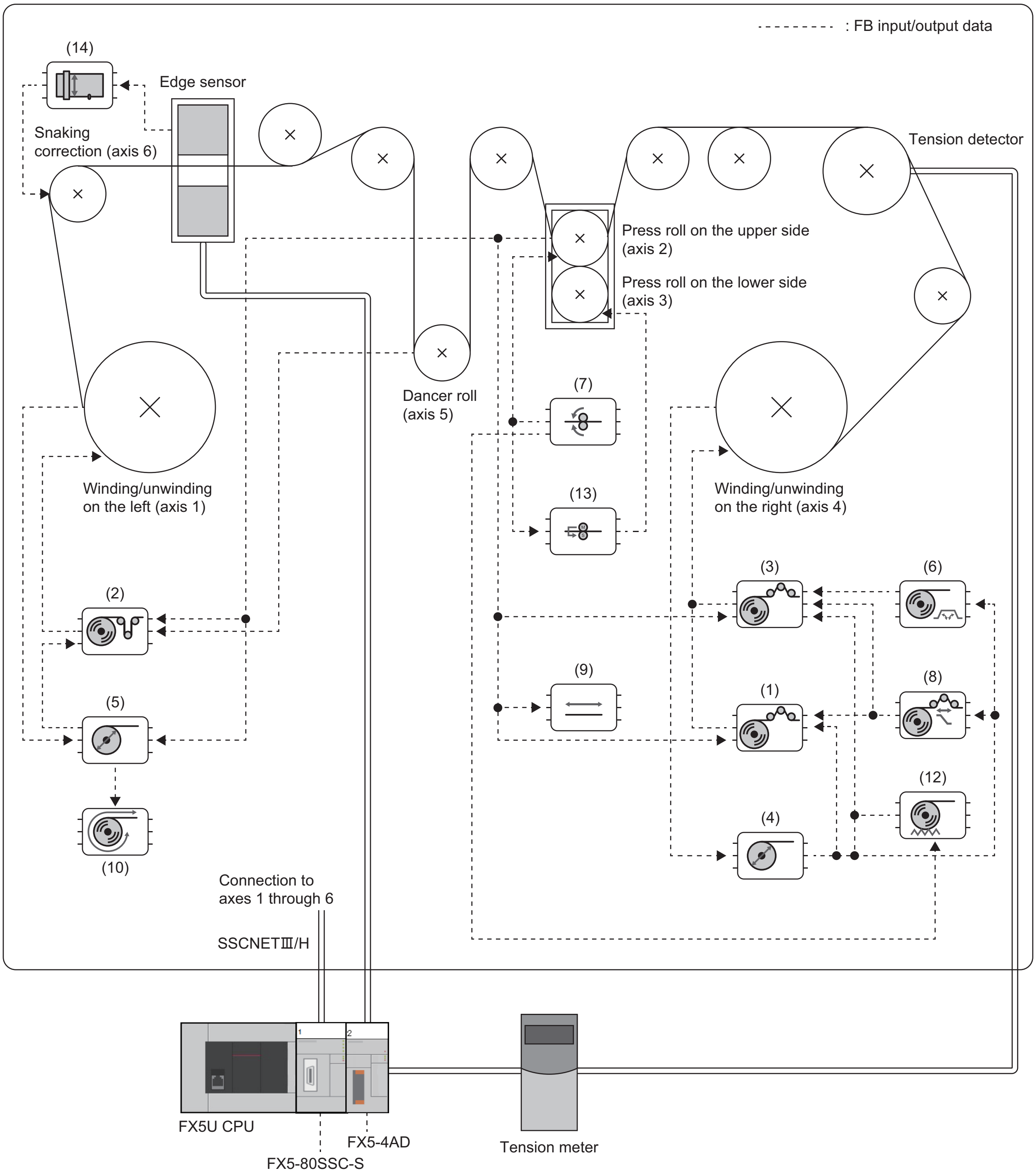
FB name	Function name
M+R2R_WinderTensionVelocityCtrl_F	Tension sensor feedback speed control
M+R2R_WinderDancerVelocityCtrl_F	Dancer feedback speed control
M+R2R_WinderTensionTorqueCtrl_F	Tension sensor feedback torque control
M+R2R_DiaCalcThickness_F	Cumulative thickness reel diameter calculation
M+R2R_DiaCalcFeed_F	Ratio operation type winding diameter operation
M+R2R_WinderInertiaTorque_F	Inertial compensation torque calculation
M+R2R_LineVelocityGenerator_F	Reference line velocity generation
M+R2R_TaperTension_F	Taper calculation
M+R2R_CalcFeedLength_F	Length measurement calculation
M+R2R_CalcRemainingLength_F	Residual length operation
M+R2R_PID_Control_F*1	PID control
M+R2R_FrictionTrq_F	Friction compensation correction
M+R2R_DroopCtrl_F	Droop control for roll press
M+R2R_EdgePositionCtrl_F	Meandering correction control
M+R2R_Table16Interpolation_F*1	Table interpolation

*1 Used for calling from other FBs

6

Overview

The following figure shows an example of using this FB library to control a roll press device. Signals from the edge sensor and tension meter are input to the programmable controller via the analog input module, and the simple motion module controls six axes.



No.	FB name	Process description
(1)	M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control)	When the speed control switching mode turns on, the line speed is input from the upper side of the press roll, the actual tension value is input from the tension meter, the tension taper coefficient is input from (8) M+R2R_TaperTension_F (Taper calculation), and the actual reel diameter value is input from (4) M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation). Then the speed command value is output to the right side of the winding/unwinding (Axis 4).

No.	FB name	Process description
(2)	M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control)	The line speed is input from the upper side of the press roll, the actual dancer value is input from the dancer roll (Axis 5), and the actual reel diameter is input from (5) MR2R_DiaCalcFeed_F (Ratio operation type winding diameter operation) Then the speed command value is output to the left side of the winding/unwinding (Axis 1).
(3)	M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control)	When the speed control switching mode turns off, the line speed is input from the upper side of the press roll, the actual tension value is input from the tension meter, the tension taper coefficient is input from (8) M+R2R_TaperTension_F (Taper calculation), the inertial compensation torque is input from (6) M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation), the friction compensation value torque is input from (12) M+R2R_FrictionTrq_F (Friction compensation correction), and the actual reel diameter is input from (4) M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation). Then the torque command value is output to the right side of the winding/unwinding (Axis 4).
(4)	M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation)	The reel axis current value is input from the right side of the winding/unwinding (Axis 4), and the actual reel diameter is output.
(5)	M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation)	The reel axis current value is input from the left side of the winding/unwinding (Axis 1), the line axis current value is input from the upper side of the press roll (Axis 2), and the actual reel diameter is output.
(6)	M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation)	The actual reel diameter value is input from (4) M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation) and the inertial compensation torque is output.
(7)	M+R2R_LineVelocityGenerator_F (Reference line velocity generation)	The line speed command value is output to the upper side of the press roll (Axis 2).
(8)	M+R2R_TaperTension_F (Taper calculation)	The actual reel diameter value is input from (4) M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation), and the tapered tension factor is output.
(9)	M+R2R_CalcFeedLength_F (Length measurement calculation)	The line axis current value is input from the upper side of the press roll (Axis 2), and the length measurement result is output.
(10)	M+R2R_CalcRemainingLength_F (Residual length operation)	The actual reel diameter and the cumulative number of revolutions of reel axis are input from (5) MR2R_DiaCalcFeed_F (Ratio operation type winding diameter operation), and the remaining length is output.
(11)	M+R2R_PID_Control_F (PID control)	Called from (1) M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control), (2) M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control), (3) M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) (Tension sensorless torque control), and (14) M+R2R_EdgePositionCtrl_F (Meandering correction control) to perform PID control.
(12)	M+R2R_FrictionTrq_F (Friction compensation correction)	During acceleration and deceleration from (7) M+R2R_LineVelocityGenerator_F (Reference line velocity generation), the actual tension value is input from the tension meter, and the friction compensation value is output.
(13)	M+R2R_DroopCtrl_F (Droop control for roll press)	The line speed is input from (7) M+R2R_LineVelocityGenerator_F (Reference line velocity generation), and the slave axis speed is output to the lower side of the press roll (Axis 3).
(14)	M+R2R_EdgePositionCtrl_F (Meandering correction control)	The edge sensor current value is input from the edge sensor, and the command speed is output to the meandering compensation (Axis 6).
(15)	M+R2R_Table16Interpolation_F (Table interpolation)	Called from (8) M+R2R_TaperTension_F (Taper calculation) to calculate the output value (Y) that corresponds to the input value (X) from the X and Y point tables.

Process flow

The following steps describe the workflow from setting parameters and wiring for each device to using FBs for roll to roll control devices.

1. FB library registration

Register the FB library.

For the operating procedure, refer to the following.

☞ Page 72 FB library registration and copying

2. Wiring

Configure the wiring.

For details on the wiring method, refer to the manual for each device used.

3. Settings of each device

- Rotation direction setting

For the setting method, refer to the following.

☞ Page 69 Orientation Setting

- Electronic Gear Settings

For the setting method, refer to the following.

☞ Page 74 Electronic Gear Settings

- Other settings

For details on other setting methods, refer to the manual for each device used.

4. Programmable controller setting

Use GX Works3 to set the program calculation cycle and label area capacity.

For the setting method, refer to the following.

☞ Page 59 Function description

5. Programming

Create programs. (☞ Page 79 Programming)

Programming

This section describes programs used in the application example.

Precautions

In these programs, only the circuits required to operate each function are described, and safety circuits such as interlocks are not included. Add interlocks according to the device of the user.

Data name in the sample program	Execution type	Description
Initial	Initial	Performs input of initial value for each label.
PreOperation	Scan	Prepares for operation, such as turning on the servo of each axis or resetting errors.
Operation	Scan	This FB library is used for roll to roll control.

Label list

■Global labels

- M+Global

	Label Name	Data Type	Class	Assign (Device/Label)	Initial Value	Constant
1	FX5SSC_1	M+FX5SSC	VAR_GLOBAL	Detailed Setting		
2	FX5_4AD_1	M+FX5_4AD	VAR_GLOBAL	Detailed Setting		

- Global

	Label Name	Data Type	Class	Assign (Device/Label)	Initial Value	Constant
1	G_eEdgeSensorActVal	FLOAT [Single Precision]	VAR_GLOBAL			
2	G_eEdgeSensorSetVal	FLOAT [Single Precision]	VAR_GLOBAL			
3	G_unErrId_FB	Word [Unsigned]/Bit String [16-bit](1..15)	VAR_GLOBAL			
4	G_bErrReset	Bit	VAR_GLOBAL			
5	G_eOffsetVal	FLOAT [Single Precision]	VAR_GLOBAL			
6	G_eWdGearRatio	FLOAT [Single Precision]	VAR_GLOBAL			
7	G_stSlaveAxis	AXIS_REF	VAR_GLOBAL	Detailed Setting		
8	G_eDroopSlaveVel	FLOAT [Single Precision]	VAR_GLOBAL			
9	G_bUnwdDancerCtrl	Bit	VAR_GLOBAL			
10	G_eDancerPosAct	FLOAT [Single Precision]	VAR_GLOBAL			
11	G_eDancerPosSet	FLOAT [Single Precision]	VAR_GLOBAL			
12	G_bDancerSvTrqMod	Bit	VAR_GLOBAL			
13	G_bDancerHPR	Bit	VAR_GLOBAL			
14	G_stDancerAxis	AXIS_REF	VAR_GLOBAL	Detailed Setting		
15	G_uTaperMode	Word [Unsigned]/Bit String [16-bit]	VAR_GLOBAL			
16	G_eUpperLimit	FLOAT [Single Precision]	VAR_GLOBAL			
17	G_eLowerLimit	FLOAT [Single Precision]	VAR_GLOBAL			
18	G_eTaperRatio	FLOAT [Single Precision]	VAR_GLOBAL			
19	G_eStartDia	FLOAT [Single Precision]	VAR_GLOBAL			
20	G_uFwdTorqueTime	Word [Unsigned]/Bit String [16-bit]	VAR_GLOBAL			
21	G_uNegTorqueTime	Word [Unsigned]/Bit String [16-bit]	VAR_GLOBAL			
22	G_eAdditiveTorque	FLOAT [Single Precision]	VAR_GLOBAL			
23	G_eDroopKp	FLOAT [Single Precision]	VAR_GLOBAL			
24	G_eDroopLPF	FLOAT [Single Precision]	VAR_GLOBAL			
25	G_eDroopLimit	FLOAT [Single Precision]	VAR_GLOBAL			
26	G_eWdMotorInartia	FLOAT [Single Precision]	VAR_GLOBAL			
27	G_bInLineVelocity	Bit	VAR_GLOBAL			
28	G_eLineJerk	FLOAT [Single Precision]	VAR_GLOBAL			
29	G_eLineAcceleration	FLOAT [Single Precision]	VAR_GLOBAL			
30	G_bLineOpeOK	Bit	VAR_GLOBAL			
31	G_eLineDeceleration	FLOAT [Single Precision]	VAR_GLOBAL			
32	G_bLineOpeStart	Bit	VAR_GLOBAL			
33	G_eWdRollWidth	FLOAT [Single Precision]	VAR_GLOBAL			
34	G_eWdRollDencity	FLOAT [Single Precision]	VAR_GLOBAL			
35	G_stAxis0	AXIS_REF	VAR_GLOBAL	Detailed Setting		
36	G_stLineAxis	AXIS_REF	VAR_GLOBAL	Detailed Setting		
37	G_eLineAccActVal	FLOAT [Single Precision]	VAR_GLOBAL			
38	G_bLineAxisStart	Bit	VAR_GLOBAL			
39	G_eLineSpdCmd	FLOAT [Single Precision]	VAR_GLOBAL			
40	G_eLineSpdAct	FLOAT [Single Precision]	VAR_GLOBAL			
41	G_eLineSpdSet	FLOAT [Single Precision]	VAR_GLOBAL			
42	G_wPhaseTime	Word [Signed]	VAR_GLOBAL			
43	G_bWdLineStpDia	Bit	VAR_GLOBAL			
44	G_eUnwdDiaIni	FLOAT [Single Precision]	VAR_GLOBAL			
45	G_eWdDiaIni	FLOAT [Single Precision]	VAR_GLOBAL			
46	G_bFwdLimit	Bit	VAR_GLOBAL			
47	G_bDataClearAcc	Bit	VAR_GLOBAL			
48	G_bAcceleration	Bit	VAR_GLOBAL			
49	G_eCoeff_Acc	FLOAT [Single Precision]	VAR_GLOBAL			
50	G_eAccAdj	FLOAT [Single Precision]	VAR_GLOBAL			
51	G_wAccTime	Word [Signed]	VAR_GLOBAL			
52	G_wLineDirection	Word [Signed]	VAR_GLOBAL			
53	G_eWdRatedTrq	FLOAT [Single Precision]	VAR_GLOBAL			
54	G_eOperationCycle	FLOAT [Single Precision]	VAR_GLOBAL			
55	G_bnENO_FB	Bit(1..15)	VAR_GLOBAL			
56	G_wDownSampling	Word [Signed]	VAR_GLOBAL			
57	G_bUnwdIniDiaSet	Bit	VAR_GLOBAL			
58	G_stUnWinderCtrl	WINDER_REF	VAR_GLOBAL	Detailed Setting		

	Label Name	Data Type		Class	Assign (Device/Label)	Initial Valu	Constant
59	G_eVelocityOffset	FLOAT [Single Precision]	...	VAR_GLOBAL			
60	G_dUnwdRev	Double Word [Signed]	...	VAR_GLOBAL			
61	G_eUnwdAddVelocity	FLOAT [Single Precision]	...	VAR_GLOBAL			
62	G_eLineSpdCmd	FLOAT [Single Precision]	...	VAR_GLOBAL			
63	G_eWdAddVelocity	FLOAT [Single Precision]	...	VAR_GLOBAL			
64	G_eUnwdDiaAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
65	G_eUnwdSpdAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
66	G_eDancerPosAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
67	G_eDancerPosSet	FLOAT [Single Precision]	...	VAR_GLOBAL			
68	G_eUnwdDiaIni	FLOAT [Single Precision]	...	VAR_GLOBAL			
69	G_eLineSpdAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
70	G_eLineSpdSet	FLOAT [Single Precision]	...	VAR_GLOBAL			
71	G_eWdLineStpDia	FLOAT [Single Precision]	...	VAR_GLOBAL			
72	G_eWdDiaAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
73	G_eWdSpdAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
74	G_eWdTensionAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
75	G_eWdTensionTaperAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
76	G_eWdTorqueAct	FLOAT [Single Precision]	...	VAR_GLOBAL			
77	G_eWdTensionSetVal	FLOAT [Single Precision]	...	VAR_GLOBAL			
78	G_eWdDiaIni	FLOAT [Single Precision]	...	VAR_GLOBAL			
79	G_eWebThickness	FLOAT [Single Precision]	...	VAR_GLOBAL			
80	G_eWdMotorInartia	FLOAT [Single Precision]	...	VAR_GLOBAL			
81	G_eWdMechaInartia	FLOAT [Single Precision]	...	VAR_GLOBAL			
82	G_eWdGearRatio	FLOAT [Single Precision]	...	VAR_GLOBAL			
83	G_eWdRollWidth	FLOAT [Single Precision]	...	VAR_GLOBAL			
84	G_eWdRollDencity	FLOAT [Single Precision]	...	VAR_GLOBAL			
85	G_eWdRatedTrq	FLOAT [Single Precision]	...	VAR_GLOBAL			
86	G_eLineAcceleration	FLOAT [Single Precision]	...	VAR_GLOBAL			
87	G_eLineDeceleration	FLOAT [Single Precision]	...	VAR_GLOBAL			
88	G_eLineJerk	FLOAT [Single Precision]	...	VAR_GLOBAL			
89	G_eOperationCycle	FLOAT [Single Precision]	...	VAR_GLOBAL			
90	G_bUnwdIniDiaSet	Bit	...	VAR_GLOBAL			
91	G_bWdIniDiaSet	Bit	...	VAR_GLOBAL			
92	G_eLineAccActVal	FLOAT [Single Precision]	...	VAR_GLOBAL			
93	G_eWdInertiaTrq	FLOAT [Single Precision]	...	VAR_GLOBAL			
94	G_eWdFrictionTrq	FLOAT [Single Precision]	...	VAR_GLOBAL			
95	G_bCorrection	Bit	...	VAR_GLOBAL			
96	G_eCorrectionValue	FLOAT [Single Precision]	...	VAR_GLOBAL			
97	G_eEdgeSensorSetVal	FLOAT [Single Precision]	...	VAR_GLOBAL			
98	G_eEdgeSensorActVal	FLOAT [Single Precision]	...	VAR_GLOBAL			
99	G_eEgPosCtrlFwdLimit	FLOAT [Single Precision]	...	VAR_GLOBAL			
100	G_eEgPosCtrlRevLimit	FLOAT [Single Precision]	...	VAR_GLOBAL			
101	G_bInLineVelocity	Bit	...	VAR_GLOBAL			
102	G_wCmdTorque	Word [Signed]	...	VAR_GLOBAL			
103	G_uFwdTorqueTime	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL			
104	G_uNegTorqueTime	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL			
105	G_udTorqueSpdLimit	Double Word [Unsigned]/Bit String [32-bit]	...	VAR_GLOBAL			
106	G_bOpeReady	Bit	...	VAR_GLOBAL			
107	G_bLineOpeOK	Bit	...	VAR_GLOBAL			
108	G_bErrReset	Bit	...	VAR_GLOBAL			
109	G_bLineOpeStart	Bit	...	VAR_GLOBAL			
110	G_bLineAxisStart	Bit	...	VAR_GLOBAL			
111	G_bWdLineStpDia	Bit	...	VAR_GLOBAL			
112	G_bDancerHPR	Bit	...	VAR_GLOBAL			
113	G_bEpcHPR	Bit	...	VAR_GLOBAL			
114	G_bUnwdDancerCtrl	Bit	...	VAR_GLOBAL			
115	G_bVelocityCtrl	Bit	...	VAR_GLOBAL			
116	G_bVelocityMode	Bit	...	VAR_GLOBAL			
117	G_bWdTensionCtrl	Bit	...	VAR_GLOBAL			
118	G_bDancerSvTrqMod	Bit	...	VAR_GLOBAL			

■Local labels

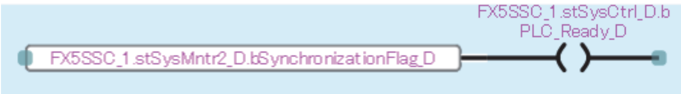
- Operation

	Label Name	Data Type		Class	Initial Value	Constant
1	M_R2R_WinderTensionVelocityCtrl_F_00A_1	M+R2R_WinderTensionVelocityCtrl_F_00A	...	VAR		
2	M_R2R_WinderDancerVelocityCtrl_F_00A_1	M+R2R_WinderDancerVelocityCtrl_F_00A	...	VAR		
3	M_R2R_WinderTensionTorqueCtrl_F_00A_1	M+R2R_WinderTensionTorqueCtrl_F_00A	...	VAR		
4	M_R2R_DiaCalcThickness_F_00A_1	M+R2R_DiaCalcThickness_F_00A	...	VAR		
5	M_R2R_DiaCalcFeed_F_00A_1	M+R2R_DiaCalcFeed_F_00A	...	VAR		
6	M_R2R_WinderInertiaTorque_F_00A_1	M+R2R_WinderInertiaTorque_F_00A	...	VAR		
7	M_R2R_LineVelocityGenerator_F_00A_1	M+R2R_LineVelocityGenerator_F_00A	...	VAR		
8	M_R2R_TaperTension_F_00A_1	M+R2R_TaperTension_F_00A	...	VAR		
9	M_R2R_CalcFeedLength_F_00A_1	M+R2R_CalcFeedLength_F_00A	...	VAR		
10	M_R2R_CalcRemainingLength_F_00A_1	M+R2R_CalcRemainingLength_F_00A	...	VAR		
11	M_R2R_FrictionTrq_F_00A_1	M+R2R_FrictionTrq_F_00A	...	VAR		
12	M_R2R_DroopCtrl_F_00A_1	M+R2R_DroopCtrl_F_00A	...	VAR		
13	M_R2R_EdgePositionCtrl_F_00A_1	M+R2R_EdgePositionCtrl_F_00A	...	VAR		

Program examples (PreOperation)

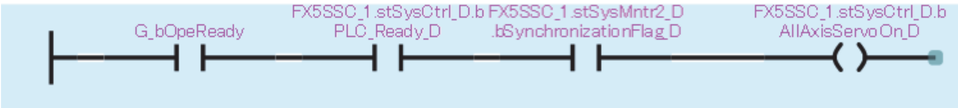
■Simple motion module startup process

When the system starts up, the programmable controller ready signal of the simple motion module automatically turns on.



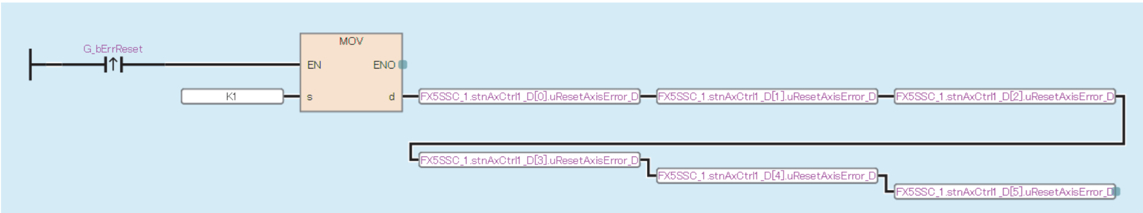
■Servo-on process

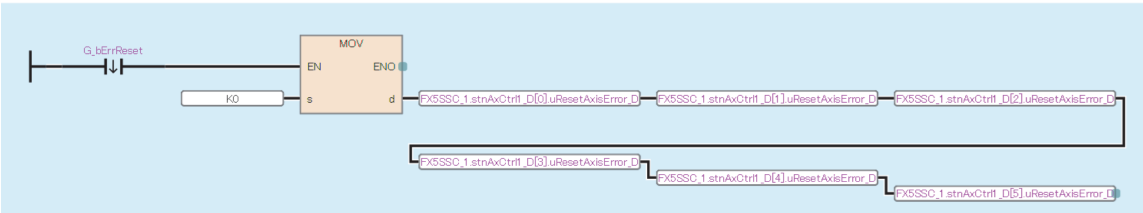
When G_bOpeReady turns on, the servos of all axes turn on.



■Error reset process

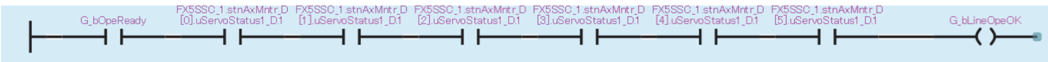
When G_bErrReset turns on, axis error reset is performed on the motion module for all axes used in the system.





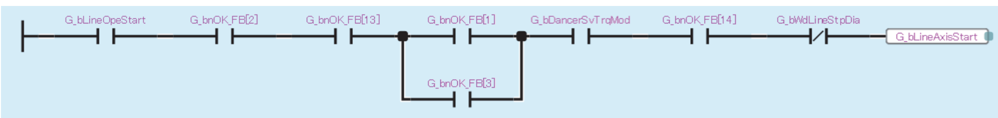
■Line operation process

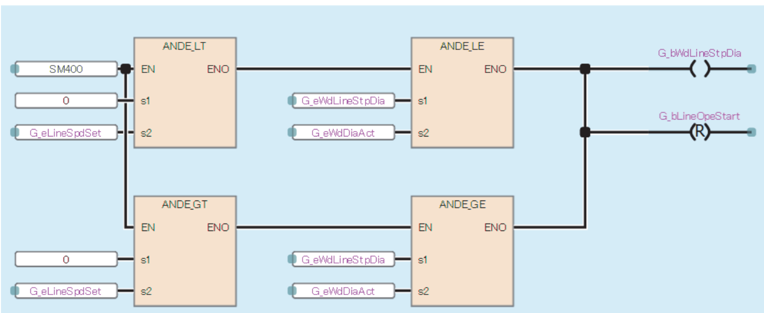
In conjunction with the servo-on processing, after G_bOpeReady turns on and the servos for all axes turn on, M+R2R_LineVelocityGenerator_F (Reference line velocity generation) starts.



■Line operation start/stop process

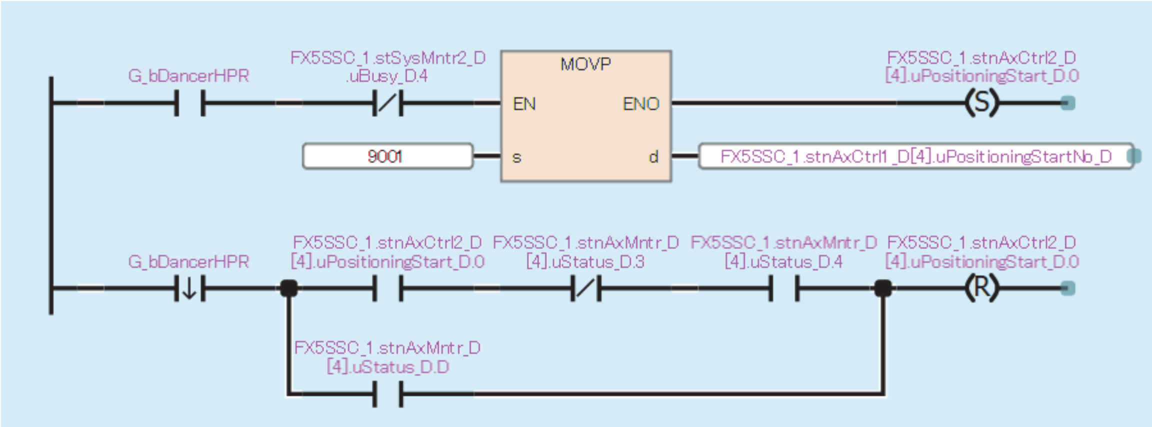
When G_bLineOpeStart is turned on, whether each axis is operating normally is checked, and speed control via M+R2R_LineVelocityGenerator_F (Reference line velocity generation) starts. In addition, if the main axis speed setting is not 0 and the actual reel diameter reaches the operation stop winding diameter, the speed control of M+R2R_LineVelocityGenerator_F (Reference line velocity generation) stops.



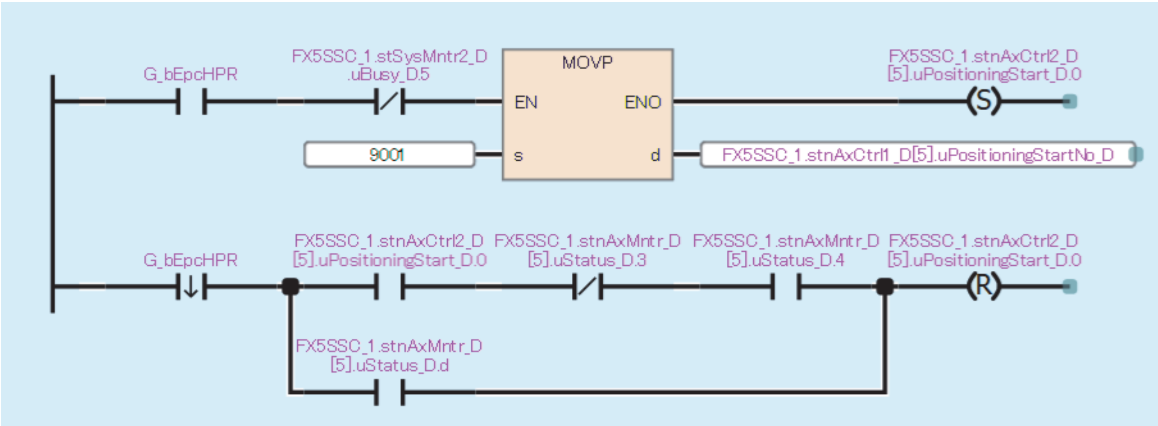


■Homing process

By turning on G_bDancerHPR, homing is performed on the dancer roll (Axis 5).

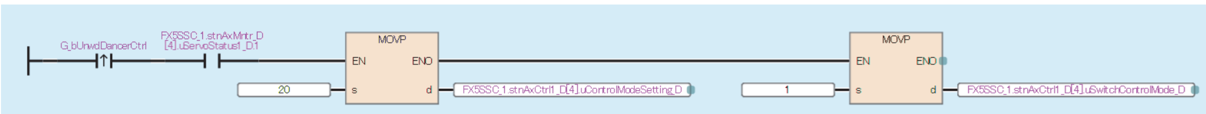


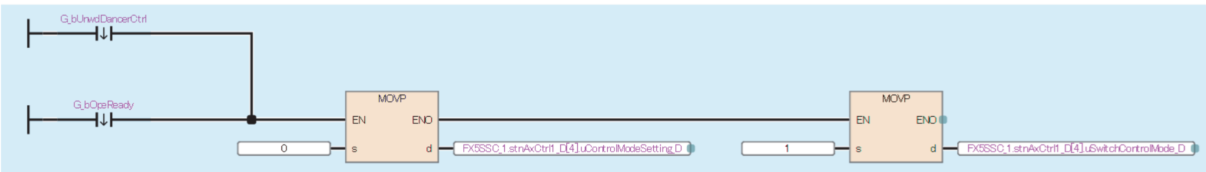
By turning on G_bEpcHPR, homing is performed for the meandering compensation (Axis 6).

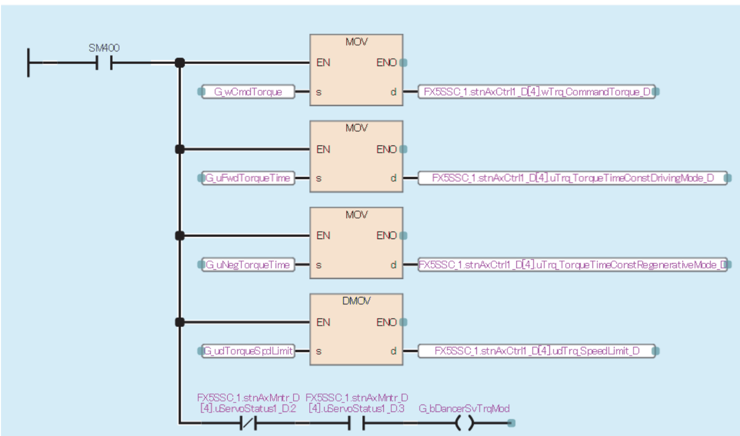


■Dancer roll (Axis 5) torque control mode switching process

By turning on G_bUnwdDancerCtrl, the dancer roll (Axis 5) switches to torque control mode.

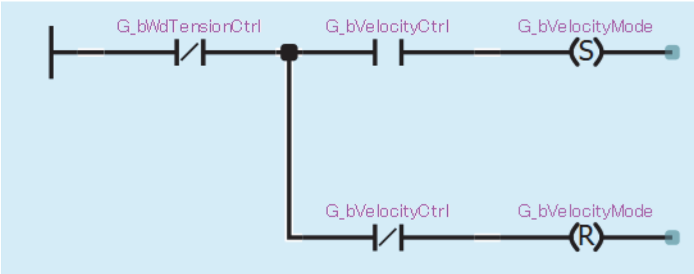






■Control mode switching process

While the winding tension control is stopped, turning on G_bVelocityCtrl switches the winding tension control from tension sensor feedback torque control to tension sensor feedback speed control.

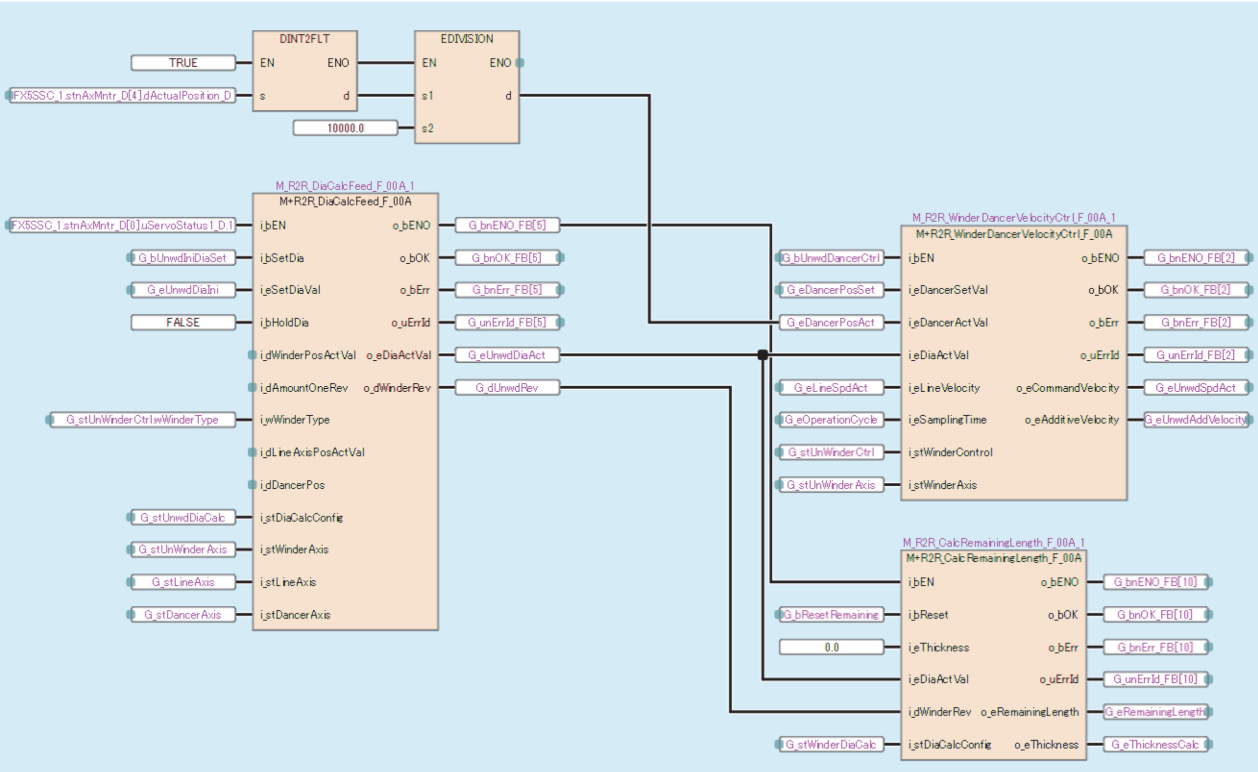


Program examples (Operation)

■Left side winding/unwinding (Axis 1) control

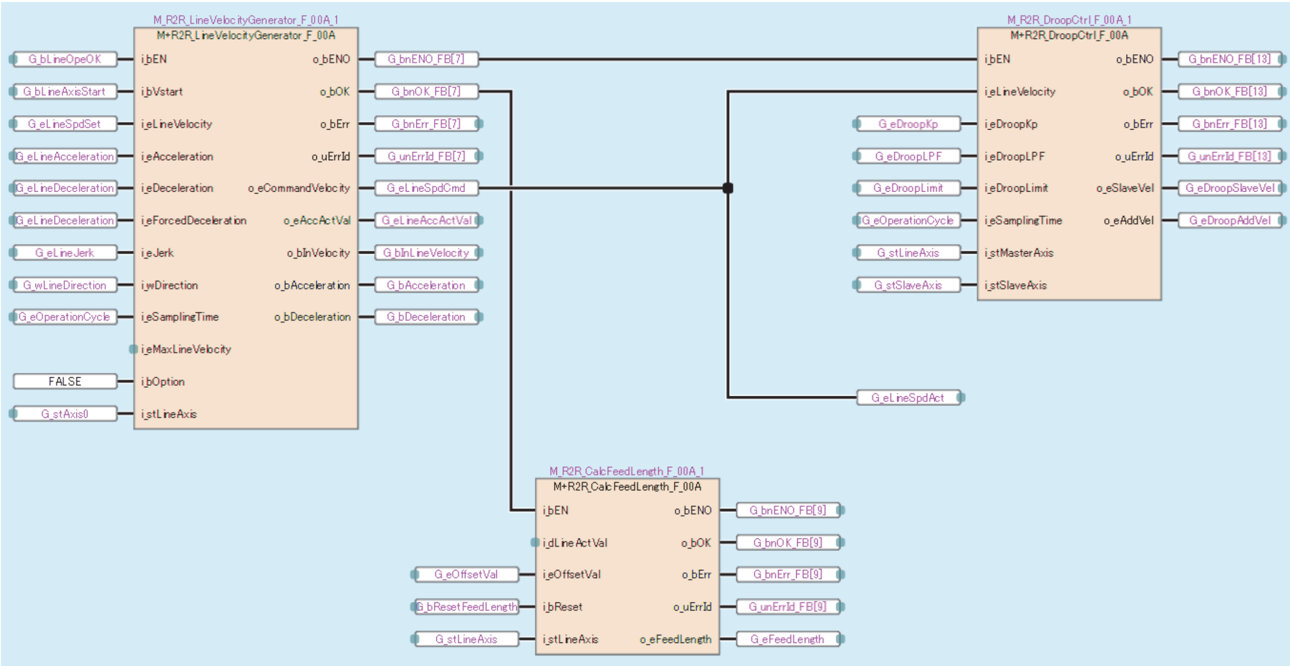
Turning on the servo for axis 1 starts M+R2R_DiaCalcFeed_F (Ratio operation type winding diameter operation) and M+R2R_CalcRemainingLength_F (Residual length operation). Also, when it is linked to the dancer axis torque control mode switching process in the example program (PreOperation), turning on G_bUnwdDancerCtrl starts M+R2R_WinderDancerVelocityCtrl_F (Dancer feedback speed control), and the actual dancer value is obtained from the actual current value of the simple motion module.

Turning on G_bUnwdIniDiaSet sets the initial reel diameter to the actual reel diameter, and turning on G_bResetRemaining initializes the remaining length.



■Press roll upper side (Axis 2) control / Press roll lower side (Axis 3) control

From the line operation processing in the example program (PreOperation), turning on G_bLineOpeOK starts M+R2R_LineVelocityGenerator_F (Reference line velocity generation) and M+R2R_DroopCtrl_F (Droop control for roll press). In addition, while M+R2R_LineVelocityGenerator_F (Reference line velocity generation) is operating normally, M+R2R_CalcFeedLength_F (Length measurement calculation) starts.



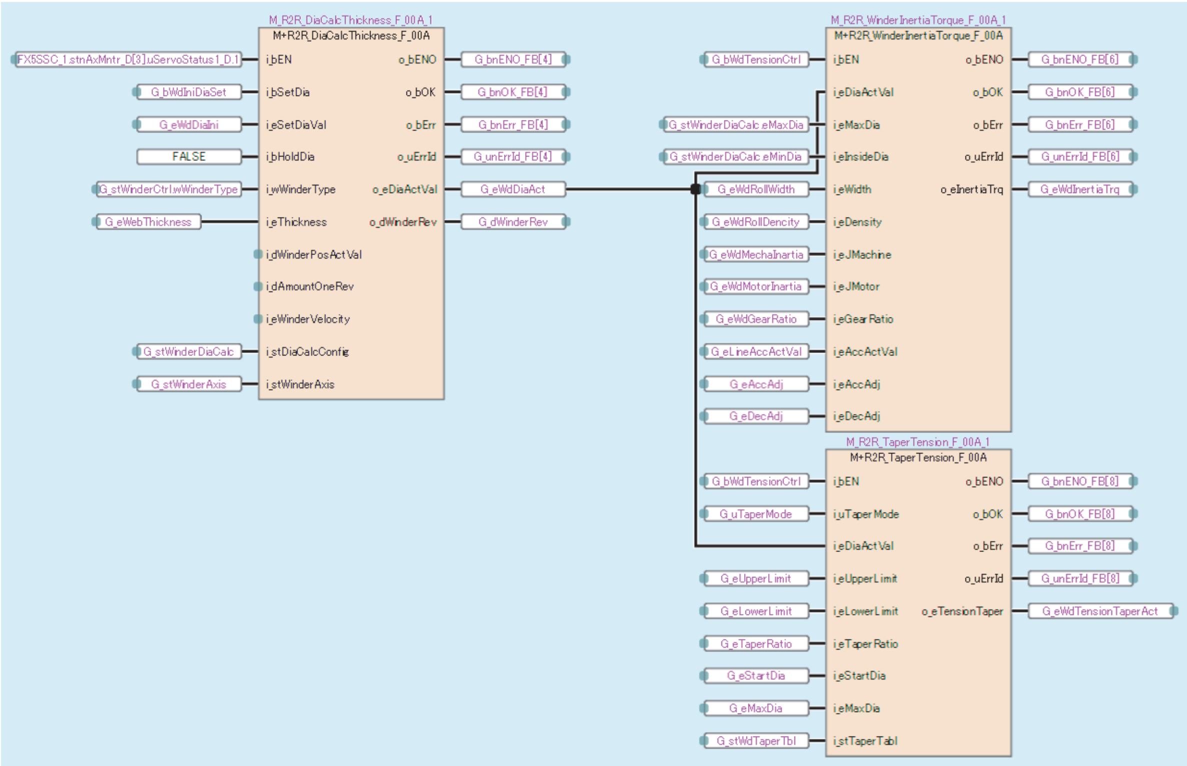
Point

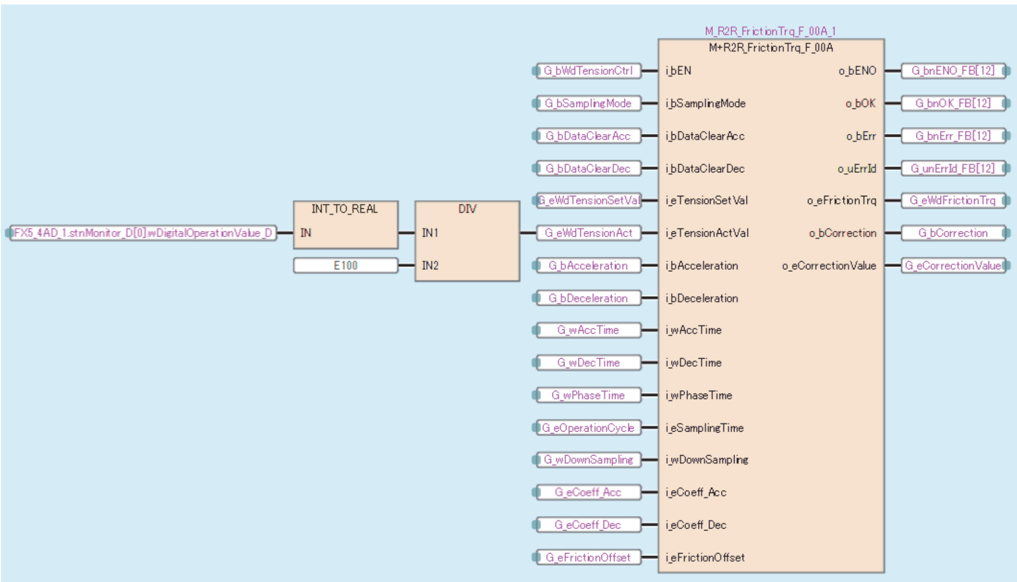
In this program, the command value is set to the current speed value to simplify processing. Change it to a suitable value according to the system of the user.

■Right side winding/unwinding (Axis 4) control

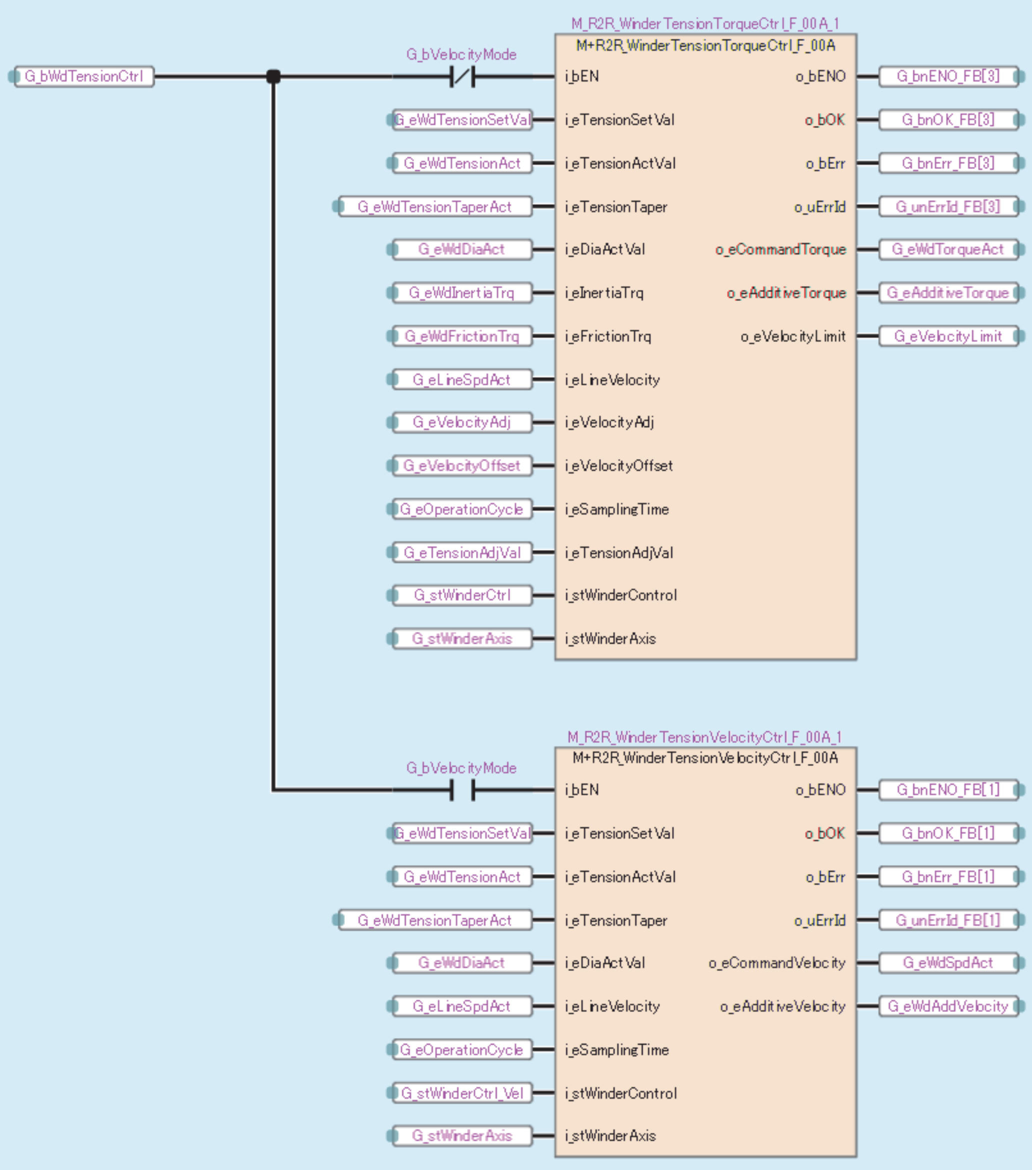
Turning on the servo of axis 4 starts M+R2R_DiaCalcThickness_F (Cumulative thickness reel diameter calculation). In addition, turning on G_bWdTensionCtrl starts M+R2R_WinderInertiaTorque_F (Inertial compensation torque calculation), M+R2R_TaperTension_F (Taper calculation), and M+R2R_FrictionTrq_F (Friction compensation correction). The actual tension value is obtained from the digital calculation value of the analog input module.

Turning on G_bWdIniDiaSet sets the initial reel diameter to the actual reel diameter, and by turning on G_bSamplingMode tension data is collected by M+R2R_FrictionTrq_F (Friction compensation correction).



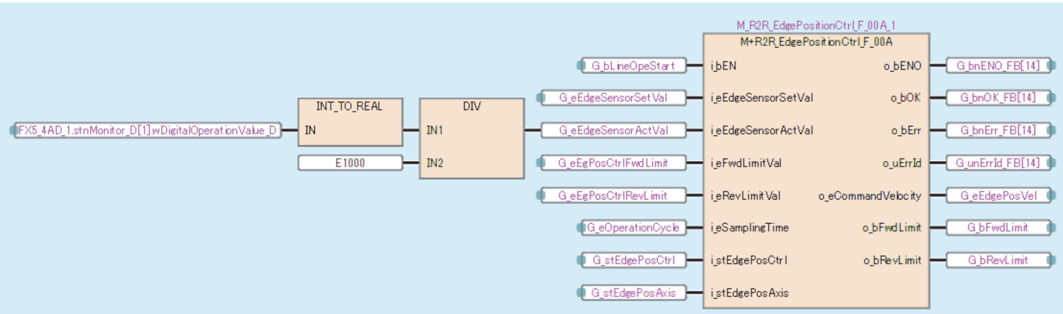


Turning on G_bWdTensionCtrl starts M+R2R_WinderTensionTorqueCtrl_F (Tension sensor feedback torque control) when the speed control switching mode is off, or starts M+R2R_WinderTensionVelocityCtrl_F (Tension sensor feedback speed control) when the speed control switching mode is on.



■Meandering correction (Axis 6) control

In conjunction with the line operation start/stop process in the example program (PreOperation), turning on G_bLineOpeStart starts M+R2R_EdgePositionCtrl_F (Meandering correction control). In addition, the edge sensor current value is obtained from the digital calculation value of the analog input module.



MEMO

INSTRUCTION INDEX

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REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Description
January 2025	SH(NA)-082718ENG-A	First edition

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MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA 461-8670, JAPAN