MITSUBISHI ELECTRIC

Programmable Controller

MELSEC iQ-F series

MELSEC iQ-F Cam Output Control Function Block Reference

CONTENTS

1 OVERVIEW
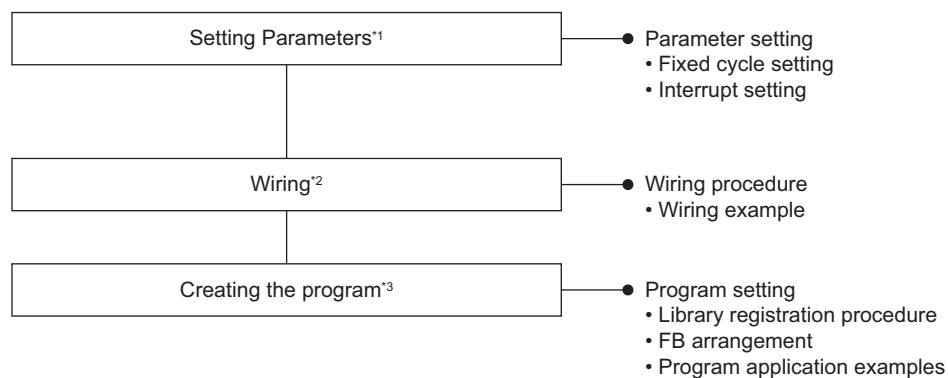
1.1 Function Block (FB) List

The following shows the list of FBs for using the cam output control function.

Item	Description
M+CamCtr_CamOutput_F	Turns on or off the cam output according to the input angle (count value).
M+CamCtr_CamOutputTable_F	Sets the angle for ON/OFF control of the cam output.
M+CamCtr_AngleAdvFunc_F	Sets the automatic angle advance.

1.2 Device Name

Device name	Description
MELSEC iQ-F FX5 CPU module	Use the FX5U/FX5UC CPU module.

1.3 Procedure Overview

```
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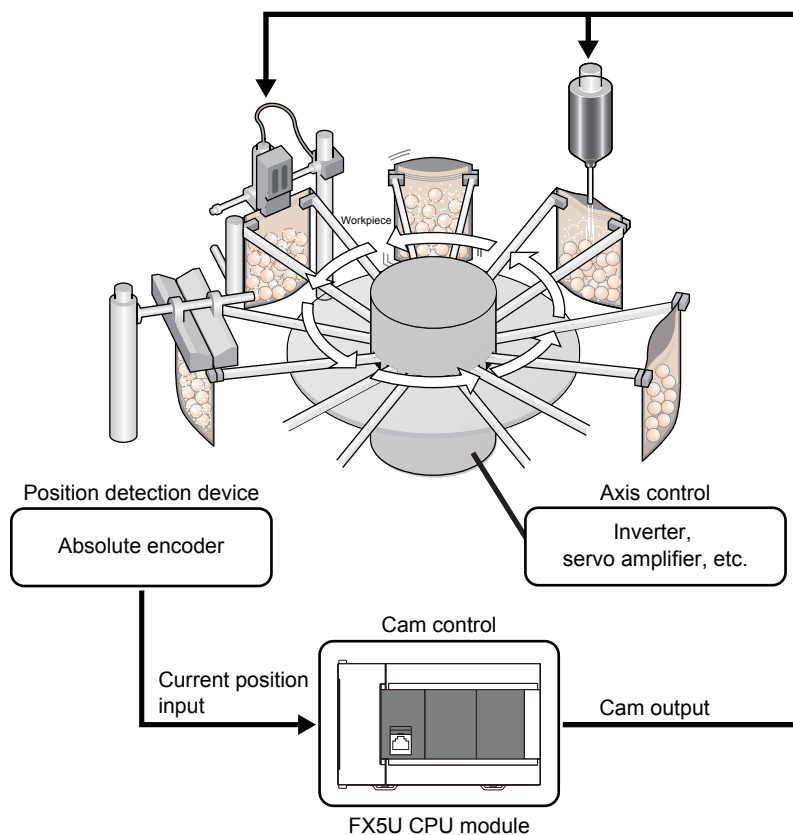
*1 For details, refer to ☞ Page 27 SETTING PARAMETERS.
*2 For details, refer to ☞ Page 29 WIRING.
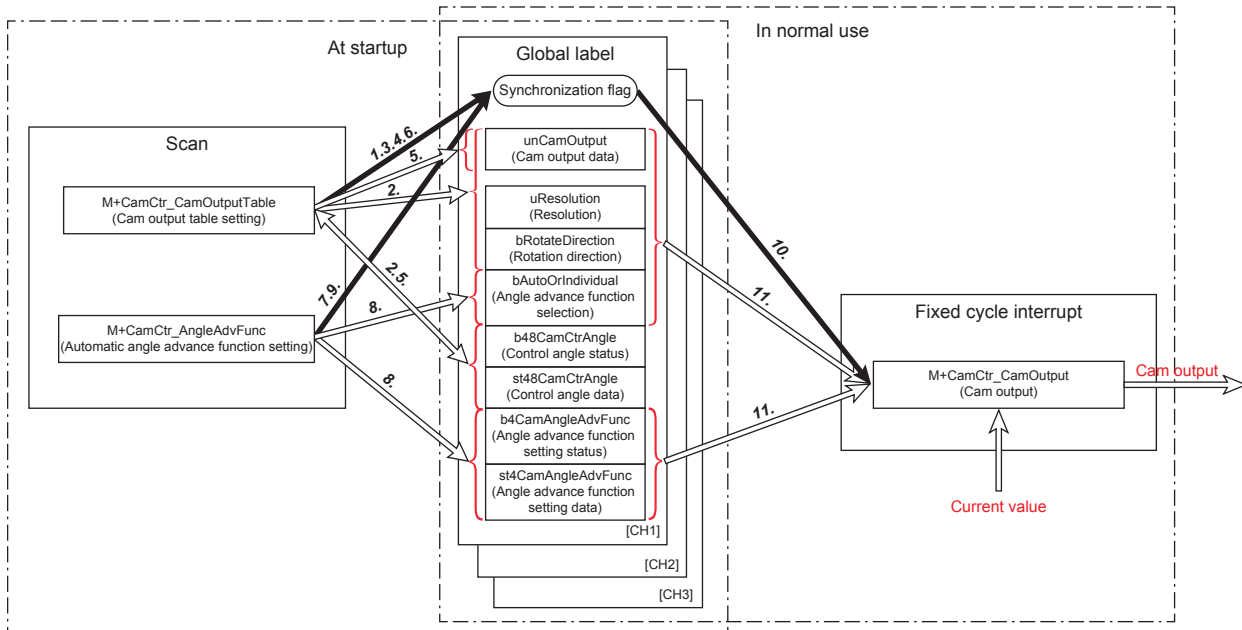*3 For details, refer to ☞ Page 31 CREATING PROGRAMS.

MEMO

2 SYSTEM CONFIGURATION

The following shows the system configuration example for this FB list.
An absolute encoder that supports the gray code is used.

MEMO

3 SPECIFICATION

The following shows an operation overview of the FBs.

At the startup, use M+CamCtr_CamOutputTable (Cam output table setting) and M+CamCtr_AngleAdvFunc (Automatic angle advance function setting) and set each cam output data of the global label.

In normal use, the cam output is performed every 1 ms according to the setting data of the global label by turning on the execution command of M+CamCtr_CamOutput (Cam output).

When using this FB library, set the program capacity of the CPU parameter to 64000 steps.

If it is set to 128000 steps, the operation may not be performed normally.

• Cam output table setting

This FB is executed in the scan processing when the cam output table is set.

(When table data set is off)

1. By turning on i_bEN (Execution command), the synchronization flag of the global label is turned on and becomes read protected.

2. The rotation direction, resolution, and control angle data for the input corresponding to the input channel number and the cam output data of the cap output number are stored in the global label.

3. By turning off i_bEN (Execution command), the synchronization flag of the global label is turned off and reading is enabled.

(When table data set is on)

4. By turning on i_bEN (Execution command), the synchronization flag of the global label is turned on and becomes read protected.

5. The cam output data is set according to the control angle data of all global labels.

6. By turning off i_bEN (Execution command), the synchronization flag of the global label is turned off and reading is enabled.

• Automatic angle advance function setting FB

This FB is executed in the scan processing when the angle advance function is set.

7. By turning on i_bEN (Execution command), the synchronization flag of the global label is turned on and becomes read protected.

8. The angle advance function setting and angle advance function selection for the input corresponding to the input channel number are stored in the global label.

9. By turning off i_bEN (Execution command), the synchronization flag of the global label is turned off and reading is enabled.

• Cam output FB

The cam output is executed in 1 ms cycles.

10. While the synchronization flag of the global label is on, the response from the cam output is delayed.

11. By turning on i_bEN (Execution command), the cam output is executed according to data of the rotation direction, resolution, cam output data, angle advance function selection, and angle advance function setting for the global label corresponding to the input channel number.

The following table shows the structure of the global label used in this FB.

Name	Structure name	Variable name	Data type	Setting range	Latch	Description
Output data structure	M+Global_FX5CPU_CamCtr	—	Structure (0..2)	—	No	Output data of 3CH (Unlatched data)
Synchronization flag		uSemaphore	Word [Unsigned]/Bit string [16-bit]	0 to HFFFF		Sets the synchronization of the data. ON: Data read is disabled. OFF: Data read is enabled.
Cam output data		unCamOutput	Word [Unsigned]/Bit string [16-bit] (0..3,0..2047)	0 to HFFFF		Stores the cam output data for 48 points of resolution.
Setting data structure	M+Global_FX5CPU_CamCtrLatch	—	Structure (0..2)	—	Yes	Setting data of 3CH (Latch data)
Resolution		uResolution	Word [Unsigned]/Bit string [16-bit]	0 to 2048		Stores i_uResolution (Resolution) specified in M+CamCtr_CamOutputTable_F (Cam output table setting).
Rotation direction		bRotateDirection	Bit	ON,OFF		Stores i_bRotateDirection (Rotation direction) specified in M+CamCtr_CamOutputTable_F (Cam output table setting).
Angle advance function selection		bAutoOrIndividual	Bit	ON,OFF		Stores i_bAutoOrIndividual (Angle advance function selection) specified in M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting).
Control angle status		b48CamCtrAngle	Bit (0..47)	ON,OFF		Sets the status where the control angle data has been stored.
Control angle data		st48CamCtrAngle	M+Global_FX5CPU_CtrAngle(0..47)	—		Stores the control angle specified in M+CamCtr_CamOutputTable_F (Cam output table setting).
Angle advance function setting status		b4CamAngleAdvFunc	Bit (0..3)	ON,OFF		Sets the status where the angle advance function setting data has been stored.
Angle advance function setting data		st4CamAngleAdvFunc	M+Global_FX5CPU_AngleAdvFunc(0..3)	—		Stores the data specified in M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting). For the automatic angle advance, only angle advance function setting data 0 is enabled.
Control angle data structure	M+Global_FX5CPU_CtrAngle	—	Structure	—	Yes	Control angle data
Control angle STEP data		st8CtrAngleSet	M+Global_FX5CPU_CtrAngleSet(0..7)	—		Stores i_u16AngleSet (Control angle) specified in M+CamCtr_CamOutputTable_F (Cam output table setting).
Angle advance function setting data structure	M+Global_FX5CPU_AngleAdvFunc	—	Structure	—	Yes	Angle advance function setting data
Angle advance function setting STEP data		st7AngleAdvFuncSet	M+Global_FX5CPU_AngleAdvFuncSet(0..6)	—		Store i_u21AngleAdvFuncSet (Angle advance function setting) specified in M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting).
Control angle STEP data structure	M+Global_FX5CPU_CtrAngleSet	—	Structure	—	Yes	Control angle data of STEP0 to STEP7
Output ON angle		uOutOnAngle	Word [Unsigned]/Bit string [16-bit]	0 to resolution		Stores the output ON angle.
Output OFF angle		uOutOffAngle	Word [Unsigned]/Bit string [16-bit]	0 to resolution		Stores the output OFF angle.

3 SPECIFICATION

Name	Structure name	Variable name	Data type	Setting range	Latch	Description
Angle advance function setting STEP data structure	M+Global_FX5CPU _AngleAdvFuncSet	—	Structure	—	Yes	Angle advance function setting data of STEP0 to STEP6
Rotation speed		uRotationalSpeed	Word [Unsigned]/Bit string [16-bit]	0 to HFFFF		Stores the rotation speed.
ON angle advance amount		uOnAdvanceAmount	Word [Unsigned]/Bit string [16-bit]	0 to resolution		Stores the ON angle advance amount.
OFF angle advance amount		uOffAdvanceAmount	Word [Unsigned]/Bit string [16-bit]	0 to resolution		Stores the OFF angle advance amount.

3.1 Details of the FB Library

M+CamCtr_CamOutputTable_F (Cam output table setting)

Name

M+CamCtr_CamOutputTable_F

Overview

Item	Description
Function overview	Sets the angle for ON/OFF control of the cam output.
Symbol	

```
                   M+CamCtr_CamOutputTable_F
(1) —  B  : i_bEN                    o_bENO :  B  — (9)
(2) — UW  : i_uCh                     o_bOK :  B  — (10)
(3) — UW  : i_uCamNo                  o_bErr :  B  — (11)
(4) —  B  : i_bRotateDirection      o_uErrId : UW  — (12)
(5) — UW  : i_uResolution
(6) — UW  : i_u16AngleSet
(7) —  B  : i_bTableDataClear
(8) —  B  : i_bTableDataSet
```

Label

■Input label

No.	Name	Variable name	Data type	Setting range	Description
(1)	Execution command	i_bEN	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	Channel number	i_uCh	Word [Unsigned]/Bit string [16-bit]	1 to 3	Set the channel to be used.
(3)	Cam output number	i_uCamNo	Word [Unsigned]/Bit string [16-bit]	0 to 47	Specify the cam output number for setting the control angle.
(4)	Rotation direction	i_bRotateDirection	Bit	ON, OFF	Set the rotation direction for the angle detection target. ON: Reverse direction OFF: Forward direction
(5)	Resolution	i_uResolution	Word [Unsigned]/Bit string [16-bit]	1 to 2048	Set the resolution of the encoder to be used.
(6)	Control angle	i_u16AngleSet	Word [Unsigned]/Bit string [16-bit] (0..15) For details of the input label array, refer to ☞ Page 11 Details of the input label array.	0 to i_uResolution (Resolution) - 1	Set digit for the output ON angle and output OFF angle in the target step.
(7)	Table data clear	i_bTableDataClear	Bit	ON, OFF	When i_bEN (Execution command) is turned on while this label is on, the rotation direction, resolution, and control angle settings of all the cam output numbers for the channel specified with i_uCh (Channel number) will be cleared.
(8)	Table data set	i_bTableDataSet	Bit	ON, OFF	When i_bEN (Execution command) is turned on and this label is on, the cam output data for all the channels are generated based on the control angle data of the global data.

■Details of the input label array

Array	Target step	Setting item	Data type	Setting range
0	STEP 0	Output ON angle	Word [Unsigned]/Bit string [16-bit]	0 to the value set in i_uResolution (Resolution)
1		Output OFF angle		
2	STEP 1	Output ON angle		
3		Output OFF angle		
⋮	⋮	⋮		
14	STEP 7	Output ON angle		
15		Output OFF angle		

■Output label

No.	Name	Variable name	Data type	Default value	Description
(9)	Execution status	o_bENO	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(10)	Normal completion	o_bOK	Bit	OFF	When this label is on, it indicates that the cam output table setting is completed normally.
(11)	Error completion	o_bErr	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(12)	Error Code	o_uErrId	Word [Unsigned]/Bit string [16-bit]	0	The error code that occurred in the FB is stored.

■External public label

No.	Name	Variable name	Data type	Default value	Description
None	None	None	None	None	None
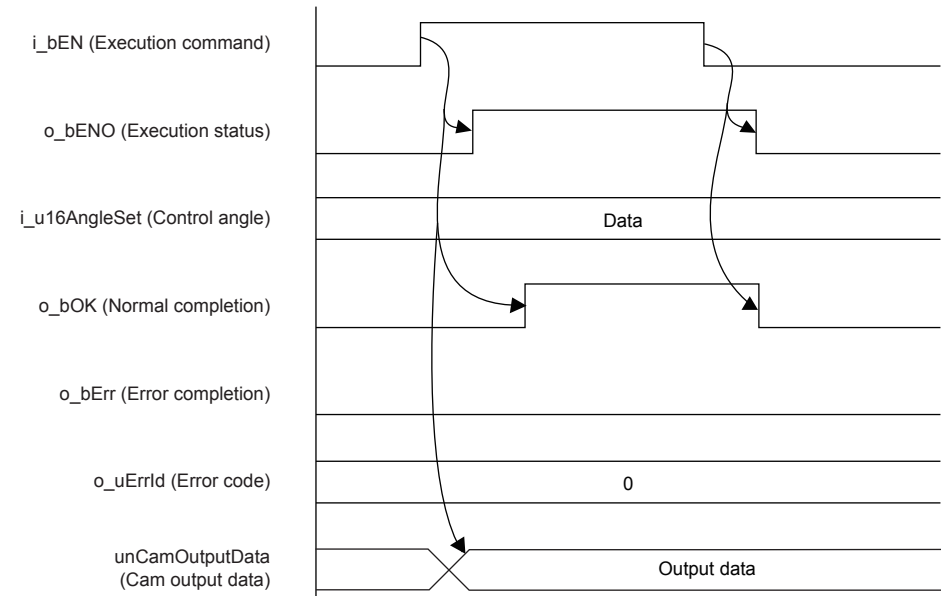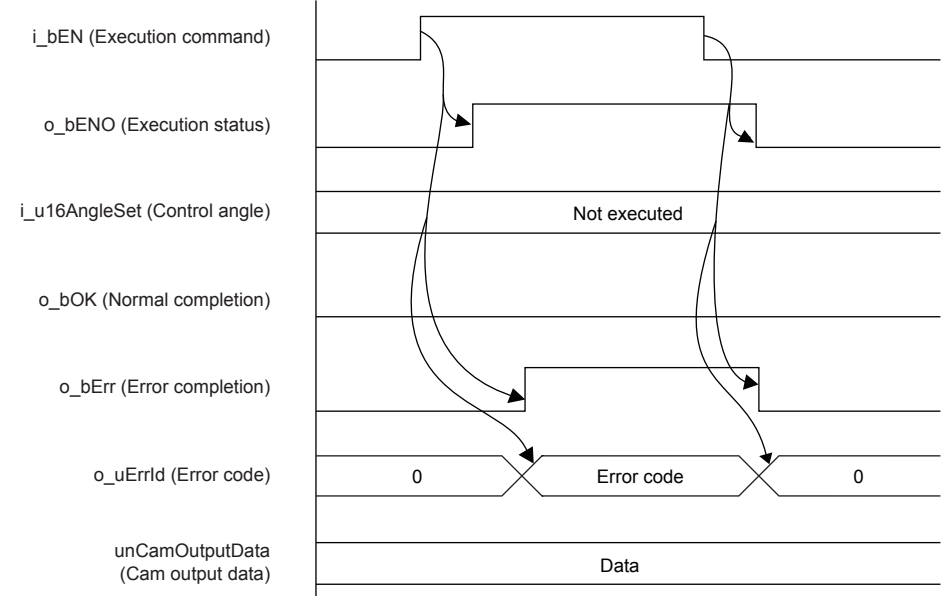
■Global label

Refer to ☞ Page 26 Global Labels.

Function overview

Item	Description	
Applicable hardware and software	Target CPU module	FX5U/FX5UC CPU module
	Applicable engineering tool	GX Works3 Version 1.050C or later
Programming language	Ladder	
Number of basic steps	1,523 step The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the option settings of GX Works3, refer to the ☐GX Works3 Operating Manual.	
Used label amount	■Label 4.16 K point [WORD] ■Latch label 0 K point [WORD] The used label amount integrated in the program varies depending on the device specified in the parameters and the option settings of GX Works3. For the option settings of GX Works3, refer to ☐GX Works3 Operating Manual.	

Item	Description
Function description	(1) By turning on i_bEN (Execution command), unCamOutput (Cam output data) of M+Global_FX5CPU_CamCtr (Output data of 3CH (Unlatched data)) and uResolution (Resolution), bRotateDirection (Rotation direction), and st48CamCtrAngle (Control angle data) of M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data)) are set.

Also, b48CamCtrAngle (Control angle status) for the cam output number is turned on.

unCamOutput (Cam output data) is set according to the setting value specified by i_uCh (Channel number), i_uCamNo (Cam output number), and i_bRotateDirection (Rotation direction). After the setting processing is complete, o_bOK (Normal completion) turns on.

■Setting example of cam output data

When i_uCh (Channel number) = 1, i_uCamNo (Cam output number) = 5, and i_bRotateDirection (Rotation direction) = OFF, the ON/OFF state is sequentially set as follows: unCamOutput[0].bit4 = ON, unCamOutput[3].bit4 = ON, ... , unCamOutput[84].bit4 = OFF, ... , unCamOutput[6141].bit4 = ON.

When the cam output data is not set, the ON angle and OFF angle of STEP 0 to STEP 7 become 0. To prevent the ON output without setting, when the ON angle and OFF angle are the same in a STEP, the corresponding angle outputs OFF.

When the ON angle and OFF angle are the same in different STEPs (for example, when STEP 1 ON angle = STEP 2 OFF angle), the corresponding angle outputs ON.

(2) When i_bEN (Execution command) is turned on while i_bTableDataSet (Table data set) is on, the following operation is performed.
• unCamOutput (Cam output data) is generated for all channels based on st48CamCtrAngle (Control angle data) of M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data)).
• The values set in i_uCh (Channel number), i_uCamNo (Cam output number), i_bRotateDirection (Rotation direction), i_uResolution (Resolution), and i_bTableDataClear (Table data clear) are ignored.
• When the processing of the FB is interrupted before o_bOK (Normal completion) turns on, the generation of unCamOutput (Cam output data) is interrupted.
(3) When i_bEN (Execution command) is turned on while i_bTableDataClear (Table data clear) is on, the followings are cleared.
• unCamOutput (Cam output data) of M+Global_FX5CPU_CamCtr (Output data of 3CH (Unlatched data)) of the channel specified with i_uCh (Used channel)
• uResolution (Resolution), bRotateDirection (Rotation direction), b48CamCtrAngle (Control angle status), st48CamCtrAngle (Control angle data) of M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data))
(4) By turning off i_bEN (Execution command), the FB is stopped and the processing is not performed.
(5) When the setting value of i_uCh (Channel number) is out of range, o_bErr (Error completion) turns on, the error code 100 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops.
  For details of the error code, refer to ☞ Page 14 Error code.
(6) When the setting value of i_uCamNo (Cam output number) is out of range, o_bErr (Error completion) turns on, the error code 102 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops.
  For details of the error code, refer to ☞ Page 14 Error code.
(7) When the setting value of i_uResolution (Resolution) is out of range, o_bErr (Error completion) turns on, the error code 103 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops.
  For details of the error code, refer to ☞ Page 14 Error code.
(8) When the setting value of i_u16AngleSet (Control angle) is out of range, o_bErr (Error completion) turns on, the error code 104 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops.
  For details of the error code, refer to ☞ Page 14 Error code.

FB compiling method	Macro type
FB operation type	Pulsed execution (multiple scan execution type)
Application example	Refer to ☞ Page 33 Program Example.

Item	Description
Timing chart	[For normal completion] i_bEN (Execution command) o_bENO (Execution status) i_u16AngleSet (Control angle) — Data o_bOK (Normal completion) o_bErr (Error completion) o_uErrId (Error code) — 0 unCamOutputData (Cam output data) — Output data [For error completion] i_bEN (Execution command) o_bENO (Execution status) i_u16AngleSet (Control angle) — Not executed o_bOK (Normal completion) o_bErr (Error completion) o_uErrId (Error code) — 0 / Error code / 0 unCamOutputData (Cam output data) — Data

3

Item	Description
Restrictions and precautions	(1) This FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation. (2) This FB uses M+Global_FX5CPU_CamCtr (Output data of 3CH (Unlatched data)) and M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data)). (3) In the setting of i_u16AngleSet (Control angle), when the output ON angle is larger than the output OFF angle in a STEP, the ON section is across the control angle 0. (4) The error check for i_u16AngleSet (Control angle) in this FB does not consider the ON/OFF angle advance amount set in ☞ Page 15 M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting). (5) This FB is required to be called 48 times at a maximum for one channel since the output control can be performed for 48 points at a maximum per channel. (6) Turn off i_bEN (Execution command) after o_bOK (Normal completion) or o_bErr (Error completion) is turned on. By turning off i_bEN (Execution command), o_bOK (Normal completion) and o_bErr (Error completion) are turned off and o_uErrId (Error code) is cleared to 0. (7) When o_bErr (Error completion) is turned on, the values set in the input label are not reflected and thus the settings remain the same as before the FB execution. (8) When the power is turned off, unCamOutput (Cam output data) of M+Global_FX5CPU_CamCtr (Output data of 3CH (Unlatched data)) is cleared. Execute this FB while i_bTableDataSet (Table data set) is on and generate unCamOutput (Cam output data) of M+Global_FX5CPU_CamCtr (Output data of 3CH (Unlatched data)) again. The local label is cleared by STOP → RUN. (9) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (Execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off i_bEN (Execution command). (10) This FB requires the configuration of the ladder for every input label. Set the global label as necessary. (11) The capacity of the latch label must be 5.03 KB or more for using this FB.
Relevant manual	• MELSEC iQ-F FX5S/FX5UJ/FX5U/FX5UC User's Manual (Hardware) • MELSEC iQ-F FX5 User's Manual (Application) • MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks) • MELSEC iQ-F FX5 Programming Manual (Program Design) • GX Works3 Operating Manual
Performance value	(1) When cam output data is set: 3.2 ms (2) When table data is set: 3.0 ms (3) When table data is cleared: 850 µs

Error code

Error code (hexadecimal)	Description	Action
100H	The setting value of i_uCh (Channel number) is out of range.	Review and correct the setting and then execute the FB again.
102H	The setting value of i_uCamNo (Cam output number) is out of range.	Review and correct the setting and then execute the FB again.
103H	The setting value of i_uResolution (Resolution) is out of range.	Review and correct the setting and then execute the FB again.
104H	The setting value of i_u16AngleSet (Control angle) is out of range.	Review and correct the setting and then execute the FB again.

FB version upgrade history

Version	Date	Description
00A	January 2019	First edition

Note

This chapter includes information related to the function block.

It does not include information on restrictions of use such as combination with modules or programmable controller CPUs.

Please make sure to read user's manuals for the corresponding products before using the products.

M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting)

Name

M+CamCtr_AngleAdvFunc_F

Overview

Item	Description
Function overview	Sets the automatic angle advance.
Symbol	

```
                 M+CamCtr_AngleAdvFunc_F
(1) ── B  : i_bEN                    o_bENO :  B ── (7)
(2) ── UW : i_uCh                     o_bOK :  B ── (8)
(3) ── B  : i_bAutoOrIndividual       o_bErr :  B ── (9)
(4) ── UW : i_uCamNo               o_uErrId : UW ── (10)
(5) ── UW : i_u21AngleAdvFuncSet
(6) ── B  : i_bAngleAdvFuncClear
```

Label

■Input label

| No.	Name	Variable name	Data type	Setting range	Description
(1)	Execution command	i_bEN	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	Channel number	i_uCh	Word [Unsigned]/Bit string [16-bit]	1 to 3	Set the channel to be used.
(3)	Angle advance function selection	i_bAutoOrIndividual	Bit	ON, OFF	ON: Individual automatic angle advance OFF: Automatic angle advance
(4)	Cam output number	i_uCamNo	Word [Unsigned]/Bit string [16-bit]	Automatic angle advance: 0 Individual automatic angle advance: 0 to 3	Specify the cam output number for setting the control angle. When the automatic angle advance function is selected, the settings are applied in common to cam output numbers 0 to 15 (16 points) by specifying 0.
(5)	Angle advance function setting	i_u21AngleAdvFuncSet	Word [Unsigned]/Bit string [16-bit] (0..20)	—	The setting data of the automatic angle advance or individual automatic angle advance is stored. For details of the input label array, refer to ☞ Page 16 Details of the input label array.
(6)	Angle advance function clear	i_bAngleAdvFuncClear	Bit	ON, OFF	When i_bEN (Execution command) is turned on while this label is on, all the settings of the angle advance function are cleared.

■Details of the input label array

Array	When the automatic angle advance is specified			When the individual automatic angle advance is specified		
	Setting point	Setting item	Setting range	Setting point	Setting item	Setting range
0	S0	Rotation speed a (rpm)	0 to 1000 rpm	S0	Rotation speed a (rpm)	0 to 1000 rpm
1		ON angle advance amount A (digit)	0 to resolution/2		ON angle advance amount A (digit)	0 to resolution/2 Under the following condition[*2]
2	S1	Rotation speed b (rpm)	S0 rotation speed < S1 rotation speed ≤ 1000 rpm		OFF angle advance amount A (digit)	0 to resolution/2 Under the following condition[*2]
3		ON angle advance amount B (digit)	S0 ON angle advance amount < S1 ON advance amount ≤ resolution/2	S1	Rotation speed b (rpm)	S0 rotation speed < S1 rotation speed ≤ 1000 rpm
4	S2	Rotation speed c (rpm)	S1 rotation speed < S2 rotation speed ≤ 1000 rpm		ON angle advance amount B (digit)	S0 ON angle advance amount < S1 ON advance amount ≤ resolution/2 Under the following condition[*2]
5		ON angle advance amount C (digit)	S1 ON angle advance amount < S2 ON advance amount ≤ resolution/2		OFF angle advance amount B (digit)	S0 OFF angle advance amount < S1 OFF advance amount ≤ resolution/2 Under the following condition[*2]
⋮	⋮	⋮	⋮	⋮	⋮	⋮
12	S6	Rotation speed g (rpm)	S5 rotation speed < S6 rotation speed ≤ 1000 rpm	S4	Rotation speed e (rpm)	S3 rotation speed < S4 rotation speed ≤ 1000 rpm
13		ON angle advance amount G (digit)	S5 ON angle advance amount < S6 ON advance amount ≤ resolution/2		ON angle advance amount E (digit)	S3 ON angle advance amount < S4 ON advance amount ≤ resolution/2 Under the following condition[*2]
14	—[*1]	—[*1]	—[*1]		OFF angle advance amount E (digit)	S3 OFF angle advance amount < S4 OFF advance amount ≤ resolution/2 Under the following condition[*2]
15				S5	Rotation speed f (rpm)	S4 rotation speed < S5 rotation speed ≤ 1000 rpm
16					ON angle advance amount F (digit)	S4 ON angle advance amount < S5 ON advance amount ≤ resolution/2 Under the following condition[*2]
17					OFF angle advance amount F (digit)	S4 OFF angle advance amount < S5 OFF advance amount ≤ resolution/2 Under the following condition[*2]
18				S6	Rotation speed g (rpm)	S5 rotation speed < S6 rotation speed ≤ 1000 rpm
19					ON angle advance amount G (digit)	S5 ON angle advance amount < S6 ON advance amount ≤ resolution/2 Under the following condition[*2]
20					OFF angle advance amount G (digit)	S5 OFF angle advance amount < S6 OFF advance amount ≤ resolution/2 Under the following condition[*2]

*1 This indicates the array of the unused input label.

*2 When the individual automatic angle advance function is specified, set the angle advance amount so that it is 1 digit or more away from the previous ON/OFF.
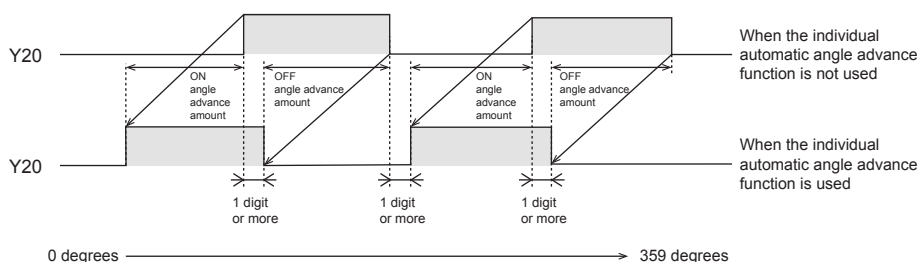
■Explanation of angle advance
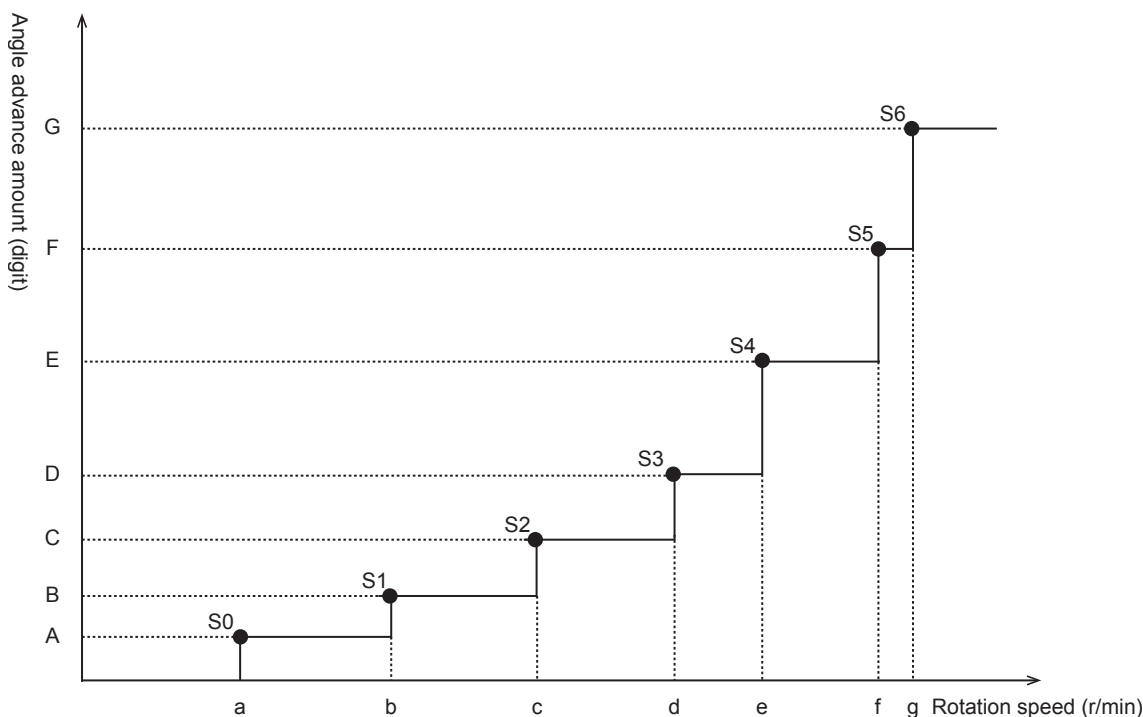
- Automatic angle advance function

In accordance with the rotation speed of the encoder, this function executes the ON/OFF operation faster by the applied arbitrary angle amount (angle advance amount) than the set angle.

By using this function, the mechanical operation delay that occurs during the high-speed rotation can be compensated.

· Configure the automatic angle advance function setting in 7 steps from S0 to S6 and set the value of each rotation speed (a to g) and angle advance amount (A to G).

· When the rotation speed is 0 (initial value), the angle advance amount is treated as zero.

· Set S0 to S6 in ascending order of rotation angle. (S0 < S1 < ... < S6)

· The rotation speed and ON angle advance amount set in i_u21AngleAdvFuncSet (Angle advance function setting) are applied in common to cam output numbers 0 to 15 (16 points).

- Individual automatic angle advance function

This function performs the output ON/OFF operation faster than the angle set as the desired angle (angle advance amount) according to the rotation speed of the encoder.

Since the angle advance can be set for ON and OFF of the output separately, a minor delay in the mechanical operation that occurs during the high-speed rotation can be compensated.

· The rotation speed and ON/OFF angle advance amount set in i_u21AngleAdvFuncSet (Angle advance function setting) are applied to cam output numbers 0 to 3 (4 points).

· Configure the individual automatic angle advance function setting in 7 steps from S0 to S6 and set the value of each rotation speed (a to g) and angle advance amount (A to G).

· When the rotation speed is 0 (initial value), the angle advance amount is treated as zero.

· Set S0 to S6 in ascending order of rotation angle. (S0 < S1 < ... < S6)

■Output label

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

■External public label

No.	Name	Variable name	Data type	Default value	Description
None	None	None	None	None	None

■Global label

Refer to ☞ Page 26 Global Labels.

Function overview

Item	Description	
Applicable hardware and software	Target CPU module	FX5U/FX5UC CPU module
	Applicable engineering tool	GX Works3 Version 1.050C or later
Programming language	Ladder	
Number of basic steps	1,559 step The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the option settings of GX Works3, refer to the 📖GX Works3 Operating Manual.	
Used label amount	■Label 2.15 K point [WORD] ■Latch label 0 K point [WORD] The number of the label used amount integrated in the program varies depending on the device specified as a parameter and the setting options of GX Works3. For the option settings of GX Works3, refer to 📖GX Works3 Operating Manual.	
Function description	(1) The following operations are performed by turning on i_bEN (Execution command). • i_u21AngleAdvFuncSet (Angle advance function setting) is stored in st4CamAngleAdvFunc (Angle advance function setting) of M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data)). After the processing is complete, o_bOK (Normal completion) turns on. (2) By turning off i_bEN (Execution command), the FB is stopped and the processing is not performed. (3) When the setting value of i_uCh (Channel number) is out of range, o_bErr (Error completion) turns on, the error code 100 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops. For details of the error code, refer to ☞ Page 20 Error code. (4) When the setting value of i_uCamNo (Cam output number) is out of range, o_bErr (Error completion) turns on, the error code 102 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops. For details of the error code, refer to ☞ Page 20 Error code. (5) When the setting value of i_u21AngleAdvFuncSet (Advance angle function setting) is not S0 < S1 < ... < S6, or the setting is "resolution/2" or more, o_bErr (Error completion) turns on, the error code 105 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops. For details of the error code, refer to ☞ Page 20 Error code.	
FB compiling method	Macro type	
FB operation type	Pulsed execution (1 scan execution type)	
Application example	Refer to ☞ Page 33 Program Example.	

Item	Description
Timing chart	[When operation completes without error] i_bEN (Execution command) o_bENO (Execution status) i_u21AngleAdvFuncSet (Angle advance function setting) Data o_bOK (Normal completion) o_bErr (Error completion) o_uErrId (Error code) 0 u63AngleAdvFuncSet (Angle advance function setting) Setting data [When an error occurs] i_bEN (Execution command) o_bENO (Execution status) i_u21AngleAdvFuncSet (Angle advance function setting) Not executed o_bOK (Normal completion) o_bErr (Error completion) o_uErrId (Error code) 0 Error code 0 u63AngleAdvFuncSet (Angle advance function setting) Data

3

Item	Description
Restrictions and precautions	(1) This FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation. (2) This FB uses M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data)). (3) The cam output table setting must be completed before the execution of this FB, as the ON/OFF advance angle amount is judged from the maximum value of the ON/OFF advance angle amount set by ☞ Page 10 M+CamCtr_CamOutputTable_F (Cam output table setting). (4) The following shows the number of calls per channel of this FB. • Automatic angle advance: Once for cam output numbers 0 to 15 (16 points) in common • Individual advance angle: Up to 4 times for cam output numbers 0 to 3 (4 points) (5) Turn off i_bEN (Execution command) after o_bOK (Normal completion) or o_bErr (Error completion) is turned on. By turning off i_bEN (Execution command), o_bOK (Normal completion) and o_bErr (Error completion) are turned off and o_uErrId (Error code) is cleared to 0. (6) When o_bErr (Error completion) is turned on, the values set in the input label are not reflected and thus the settings remains the same as before the FB execution. (7) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (Execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off i_bEN (Execution command). (8) This FB requires the configuration of the ladder for every input label. Set the global label as necessary. (9) Do not perform operation in a direction opposite to the rotation direction (i_bRotateDirection) set in ☞ Page 10 M+CamCtr_CamOutputTable_F (Cam output table setting) during operation of this FB. (10)During low-speed rotation in which an encoder value does not change for 50 ms or more, rotation speed may be calculated as 0 rpm. (11)During high-speed rotation, rotation speed may not be calculated properly. (12)The capacity of the latch label must be 5.03 KB or more for using this FB.
Relevant manual	• MELSEC iQ-F FX5S/FX5UJ/FX5U/FX5UC User's Manual (Hardware) • MELSEC iQ-F FX5 User's Manual (Application) • MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks) • MELSEC iQ-F FX5 Programming Manual (Program Design) • GX Works3 Operating Manual
Performance value	(1) When automatic angle advance is set: 52 ms (2) When individual automatic angle advance is set: 52 ms (3) When automatic angle advance is cleared: 420 μs

Error code

Error code (hexadecimal)	Description	Action
100H	The setting value of i_uCh (Channel number) is out of range.	Review and correct the setting and then execute the FB again.
102H	The setting value of i_uwCamNo (Cam output number) is out of range.	Review and correct the setting and then execute the FB again.
105H	The setting value of i_u21AngleAdvFuncSet (Angle advance function setting) is out of range.	Review and correct the setting and then execute the FB again.

FB version upgrade history

Version	Date	Description
00A	January 2019	First edition

Note

This chapter includes information related to the function block.

It does not include information on restrictions of use such as combination with modules or programmable controller CPUs.

Please make sure to read user's manuals for the corresponding products before using the products.

M+CamCtr_CamOutput_F (Cam output)

Name

M+CamCtr_CamOutput_F

Overview

Item	Description
Function overview	Turns on and off the cam output according to the input angle (count value).
Symbol	

```
                    M+CamCtr_CamOutput_F
(1) ——  B  : i_bEN                    o_bENO :  B  —— (5)
(2) —— UW  : i_uCh                     o_bOK :  B  —— (6)
(3) ——  B  : i_b48CamOutputNo          o_bErr :  B  —— (7)
(4) —— UW  : i_uCounterValue          o_uErrId : UW  —— (8)
                                  o_b48CamOutput :  B  —— (9)

            (10): pbo_uRevolvingSpeed
```

Label

■Input label

No.	Name	Variable name	Data type	Setting range	Description
(1)	Execution command	i_bEN	Bit	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
(2)	Channel number	i_uCh	Word [Unsigned]/ Bit string [16-bit]	1 to 3	Set the channel to be used.
(3)	Cam output number	i_b48CamOutputNo	Bit (0..47)	ON, OFF	Set the cam output number to be enabled. ON: The cam output is enabled. OFF: The cam output is stopped.
(4)	Current value	i_uCounterValue	Word [Unsigned]/ Bit string [16-bit]	0 to [Global label] M+Global_FX5CPU_CamCtrLatch: uResolution	Input the current position provided by the encoder. Input a value converted from Gray code to binary. The upper limit is i_uResolution (Resolution) set in M+CamCtr_CamOutputTable_F (Cam output table setting).

■Output label

| No.	Name	Variable name	Data type	Default value	Description
(5)	Execution status	o_bENO	Bit	OFF	ON: The execution command is on. OFF: The execution command is off.
(6)	Normal completion	o_bOK	Bit	OFF	When this label is on, it indicates that the cam output control is in progress.
(7)	Error completion	o_bErr	Bit	OFF	When this label is on, it indicates that an error has occurred in the FB.
(8)	Error code	o_uErrId	Word [Unsigned]/ Bit string [16-bit]	0	The error code that occurred in the FB is stored.
(9)	Cam output	o_b48CamOutput	Bit (0..47)	OFF	The cam output enabled by i_b48CamOutputNo (Cam output number) is turned on or off by comparing the cam output data set in i_uCounterValue (Current value) and M+CamCtr_CamOutputTable_F (Cam output table setting).

■External public label

No.	Name	Variable name	Data type	Default value	Description
(10)	Rotation speed	pbo_uRevolvingSpeed	Word [Unsigned]/ Bit string [16-bit]	0	Stores the calculation result of rotation speed. (Unit: rpm)

■Global label (using latch label)

Refer to ☞ Page 26 Global Labels.

Function overview

| Item	Description	
Applicable hardware and software	Target CPU module	FX5U/FX5UC CPU module
	Applicable engineering tool	GX Works3 Version 1.050C or later
Programming language	Ladder	
Number of basic steps	1,555 step The number of FB steps integrated in the program varies depending on the CPU module used, the input/output definition, and the setting options of GX Works3. For the option settings of GX Works3, refer to the ☐GX Works3 Operating Manual.	
Used label amount	■Label 2.34 K point [WORD] ■Latch label 0 K point [WORD] The used label amount integrated in the program varies depending on the device specified as a parameter and the option settings of GX Works3. For the option settings of GX Works3, refer to the ☐GX Works3 Operating Manual.	
Function description	(1) By turning on i_bEN (Execution command), o_bOK (Normal completion) is turned on when the specified input label is in the setting range. (2) When i_bEN (Execution command) is turned off, o_b48CamOutput (Cam output) is all off and the FB stops. (3) The cam output data at the position of i_dCounterValue (Current value) is output to the specified o_b48CamOutput (Cam output) as follows. • Only the number that is set to ON in i_b48CamOutputNo (Cam output number) is the cam output control target. (When this label is off, the cam output is always off.) • The speed[1] is calculated from the difference between the previous current value and present current value. The cam output data after ON angle advance amount / OFF angle advance amount that is set in st4AngleAdvFunc (Angle advance function setting) from i_dCounterValue (Current value) is output to o_b48CamOutput (Cam output). o_b48CamOutput (Cam output) of each i_uCh (Channel number) is independent. (4) The calculated speed is stored in pbo_uRevolvingSpeed (Rotation speed). (5) When the setting value of i_uCh (Channel number) is out of range, o_bErr (Error completion) turns on, the error code 100 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops. For details of the error code, refer to ☞ Page 25 Error code. (6) When the input value of i_uCounterValue (Current value) is out of range, o_bErr (Error completion) turns on, the error code 101 (hexadecimal) is stored in o_uErrId (Error code), and FB processing stops. For details of the error code, refer to ☞ Page 25 Error code.	
FB compiling method	Macro type	
FB operation type	Real-time execution	
Application example	Refer to ☞ Page 33 Program Example.	

Item	Description
Timing chart	[When operation completes without error]

[When operation completes without error]

- i_bEN (Execution command)
- o_bENO (Execution status)
- o_b48CamOutput (Cam output) — 0 / Output data / 0
- o_bOK (Normal completion)
- o_bErr (Error completion)
- o_uErrId (Error code) — 0

[When an error occurs]

- i_bEN (Execution command)
- o_bENO (Execution status)
- o_b48CamOutput (Cam output) — 0
- o_bOK (Normal completion)
- o_bErr (Error completion)
- o_uErrId (Error code) — 0 / Error code / 0

Item	Description
Restrictions and precautions	(1) Set the program capacity of the CPU parameter to 64000 steps to use this FB library. If it is set to 128000 steps, the operation may not be performed normally.
	(2) This FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation.
	(3) This FB uses M+Global_FX5CPU_CamCtr (Output data of 3CH (Unlatched data)) and M+Global_FX5CPU_CamCtrLatch (Setting data of 3CH (Latch data)). The operations are not guaranteed in the following cases. • When output is ON for the cam output channel or cam output number that has not been set in the cam output table setting or automatic angle advance function FB • When M+Global_FX5CPU_CamCtr or M+Global_FX5CPU_CamCtrLatch is changed in the user program
	(4) Do not change i_uCh (Channel number) during operation of this FB. Do not perform multiple calls of this FB simultaneously for the same channel number.
	(5) Turn off i_bEN (Execution command) after o_bOK (Normal completion) or o_bErr (Error completion) is turned on. By turning off i_bEN (Execution command), o_bOK (Normal completion) and o_bErr (Error completion) are turned off and o_uErrId (Error code) is cleared to 0.
	(6) This FB is recommended to be used in the 1 ms interrupt program. When this FB is used in the main program, it may not operate normally. Do not enable the multiple interruptions. Otherwise, this FB may not be processed in 1 ms cycles and may not operate normally.
	(7) Since the speed is calculated from the change of the current value in 1 ms cycles, the angle advance function setting does not operate correctly when the interrupt cycle becomes 1 ms or more due to interruption prohibition or multiple interruptions. Also, when the operation is suddenly started after a long interval of stop (the current value input from the encoder has not changed), the advance angle amount decreases since the rotation speed is detected slowly for 1 ms after stop at a maximum.
	(8) pbo_uRevolvingSpeed (Rotation speed) is calculated on the basis of i_bRotateDirection (Rotation direction) set in ☞ Page 10 M+CamCtr_CamOutputTable_F (Cam output table setting). When the rotation is judged as opposite to i_bRotateDirection (Rotation direction), pbo_uRevolvingSpeed (Rotation speed) outputs 0 rpm.
	(9) When the rotation speed is more than 1000 rpm, the value of pbo_uRevolvingSpeed (Rotation speed) and cam output may not operate normally.
	(10)When the following functions are used, the speed calculation may not operate correctly since the functions affect the interruption of the 1 ms cycle. • Serial communication function • User fixed cycle interrupt function • High-speed input and output function • Positioning function • High-speed comparison function (High-speed comparison table, multipoint output high-speed comparison)
	(11)The response of cam output delays during execution of ☞ Page 10 M+CamCtr_CamOutputTable_F (Cam output table setting).
	(12)The response of camp output delays during execution of ☞ Page 15 M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting).
	(13)SM8099 and SD8099 are used for the high-speed ring counter. Do not change them in a user program.
	(14)This FB requires the configuration of the ladder for every input label.
	(15)The capacity of the latch label must be 5.03 KB or more for using this FB.
Relevant manual	• MELSEC iQ-F FX5S/FX5UJ/FX5U/FX5UC User's Manual (Hardware) • MELSEC iQ-F FX5 User's Manual (Application) • MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks) • MELSEC iQ-F FX5 Programming Manual (Program Design) • GX Works3 Operating Manual
Performance value	(1) Without angle advance: 195 μs (2) With angle advance, without speed calculation: 195 μs (3) With angle advance and speed calculation: 195 μs

*1 The speed is calculated by using the high-speed ring counter (SD8099) under the following conditions, and the calculation result is displayed in [External public label] rotation speed.

1) The value of the high-speed ring counter (SD8099) is stored every 1 ms from i_bEN (Execution command) on.

2) The value of [input label] current value is stored every 1 ms from i_bEN (Execution command) on.

3) The latest 48 values in 1) and 2) are used for speed calculation. When 48 values do not exist, the speed is not calculated and the rotation speed will be 0 rpm.

4) Among the latest 48 values in 1) and 2), the 1st and 48th values are used for the calculation. The following formula is applied to the calculation.

Travel distance is calculated from the difference between 1st and 48th values of 1), and elapsed time is calculated from the difference between 1st and 48th values of 2).

$$\underset{\text{(Unit: rpm)}}{\underset{\text{Rotation speed}}{\text{Rotation speed}}} = \underset{\text{(Unit: 0.1 ms)}}{\underset{\text{600000}}{\overset{\text{One minute}}{600000}}} \times \underset{\text{(Unit: 0.1 ms)}}{\frac{\overset{\text{Travel distance}}{\text{Travel distance}}}{\text{Elapsed time}}} \div \overset{\text{Distance of one rotation}}{\text{Resolution}}$$

Number of repeated rotations per minute

* The speed rounded to unit is stored in the [external public label] rotation speed.

5) During low-speed rotation, the current value does not change and thus the rotation speed is 0 rpm.

In this FB, rotations are regarded as low-speed rotation when the 1st and 48th current values are the same.

Error code

Error code (hexadecimal)	Description	Action
100H	The setting value of i_uCh (Channel number) is out of range.	Review and correct the setting and then execute the FB again.
101H	The setting value of i_uCounterValue (Current value) is out of range.	Review and correct the setting and then execute the FB again.

FB version upgrade history

Version	Date	Description
00A	January 2019	First edition

Note

This chapter includes information related to the function block.

It does not include information on restrictions of use such as combination with modules or programmable controller CPUs.

Please make sure to read user's manuals for the corresponding products before using the products.

3.2 Global Labels

The following global labels are used in each FB.

The global labels are used in each FB processing. Do not change data.

Global label configuration
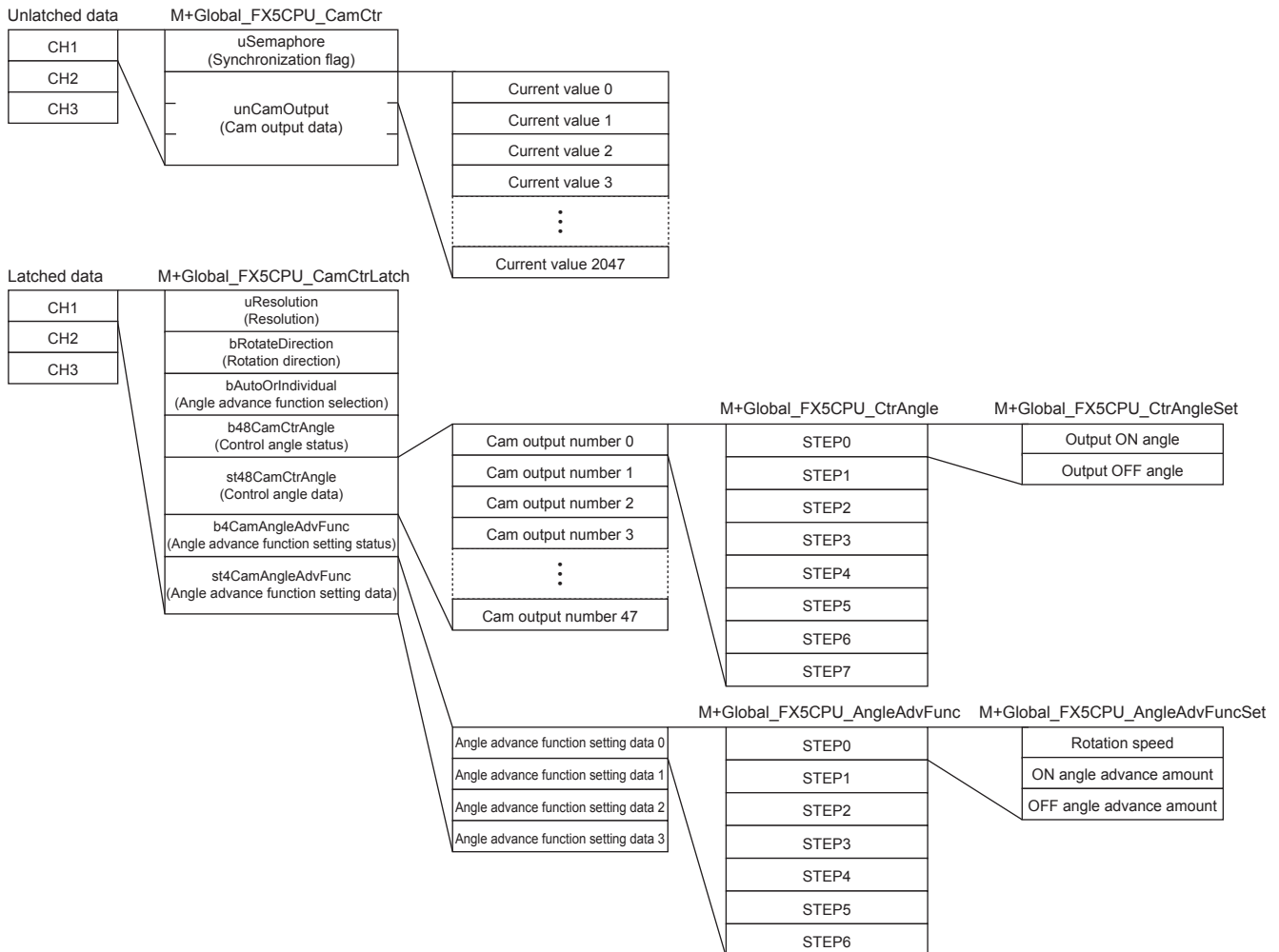
Unlatched size

Date name	Variable name	Data type	Size (word)		Total
Synchronization flag	uSemaphore	Word	3CH × 1 word	3 words	18,435 words
Cam output data	unCamOutput	Word	3CH × 3 words × 2048 points	18,432 words	(36,870 bytes)

Latch size

Date name	Variable name	Data type	Size (word)		Total
Resolution	uResolution	Word	3CH × 1 word	3 words	2,574 words
Rotation direction	bRotateDirection	Bit	3CH × 1 word	3 words	(5,148 bytes)
Angle advance function selection	bAutoOrIndividual	Bit			
Control angle status	b48CamCtrAngle	Bit	3CH × 3 words	9 words	
Control angle data	st48CamCtrAngle	Structure	3CH × 48 structures × 8 arrays × 2 words	2,304 words	
Angle advance function setting status	b4CamAngleAdvFunc	Bit	3CH × 1 word	3 words	
Angle advance function setting data	st4CamAngleAdvFunc	Structure	3CH × 4 structures × 7 arrays × 3 words	252 words	

4 SETTING PARAMETERS

For the fixed cycle interrupt and high-speed counter, set parameters with GX Works3.

4.1 Setting the Fixed Cycle

Set the interrupt program of the 1 ms cycle internal timer.

1. Select [Add New Data] from Navigation window ⇨ [Program] ⇨ [Fixed Scan] and create the fixed scan program.
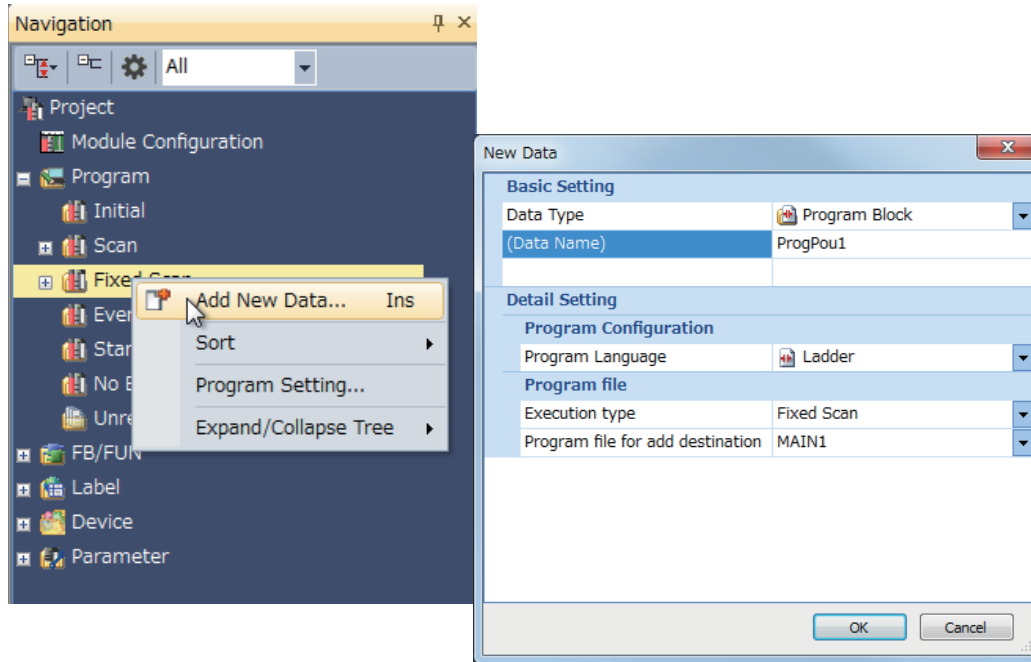
The fixed scan program is registered in interrupt pointer I31.
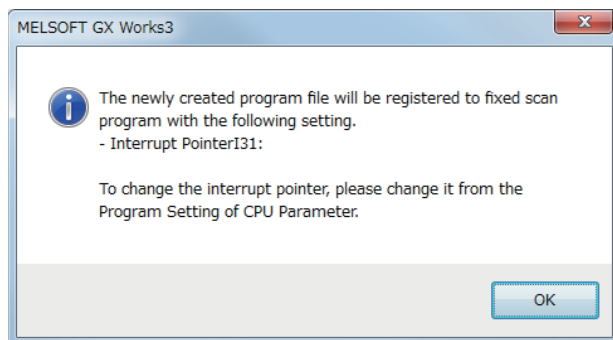
2. Select "Interrupt Settings" from Navigation window ⇨ [Parameter] ⇨ [FX5UCPU] ⇨ [CPU Parameter].
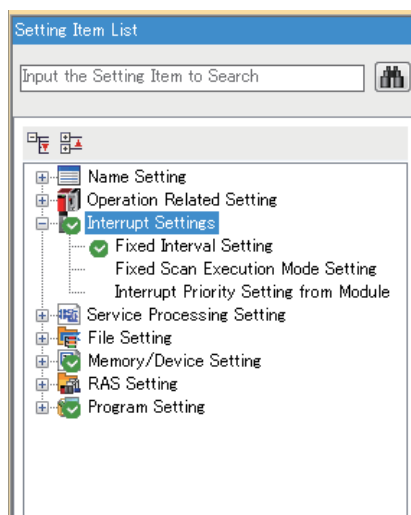
3. Set the fixed cycle interval of I31 in "Interrupt Setting from Internal Timer" to "1 ms".

Item	Setting
Fixed Scan Interval Setting	
Interrupt Setting from Internal Timer	
I28	100 ms
I29	40 ms
I30	20 ms
I31	1 ms
Fixed Scan Execution Mode Setting	
Fixed Scan Execution Mode	Precede Fixed Scan
Priority Setting for Interrupt from Module	
Multiple Interruptions	Disable
Interrupt Priority	<Detailed Setting>
Index Register. Save/Restore Setting	Not Saved/Recovered

Explanation

Set I31 execution interval.

[Setting range]
1 to 60000 [ms](1ms Unit)

5 WIRING

The following shows a wiring example for CPU module, an encoder, and a device.
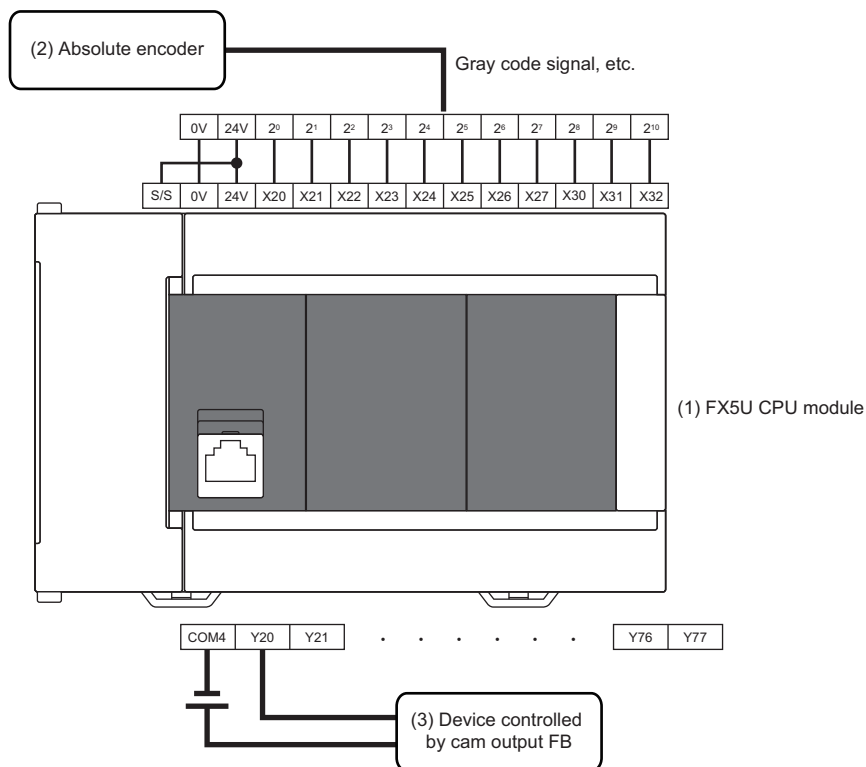
No.	Device	Remarks
(1)	FX5U/FX5UC CPU module	The input number of X20 or later and output number of Y20 or later are recommended.[1]
(2)	Absolute encoder	Resolution: 2048 Output format: sink output
(3)	Device controlled by cam output FB	—

[1] When the filter is used in the input terminal, one-fourth of the constant is added as the difference (delay). Set the input response time (digital filter setting value) to "None". For the setting method, refer to ☐MELSEC iQ-F FX5 User's Manual (Application).

MEMO

6 CREATING PROGRAMS

6.1 Library Registration Procedure

1. Select the library tag in the "Element Selection" window. Click the "Register to Library List" icon and select "Register Library...".
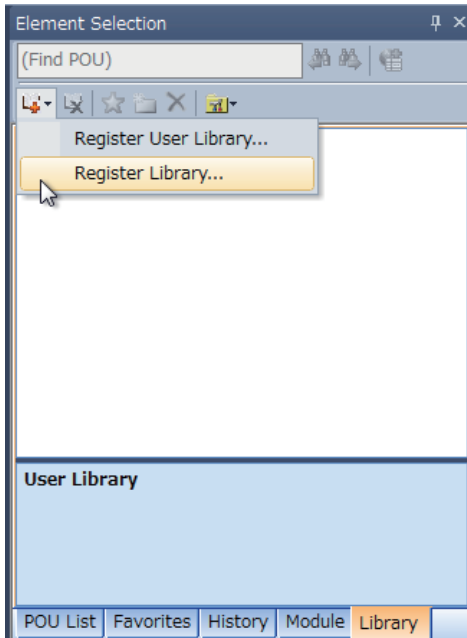
2. The "Register Library to Library List" window appears. Select "M+CamCtr_F.mslm" and click the [Open] button.
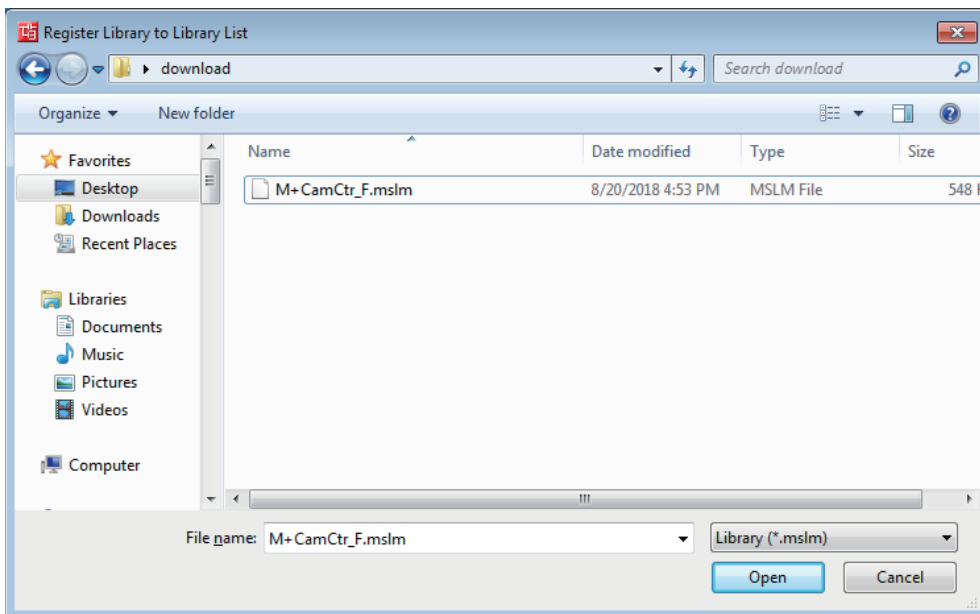
3. The imported FB is displayed in the "Element Selection" window.

6.2 Arranging the FB

1. Select the FB from the "Element Selection" window and arrange it.
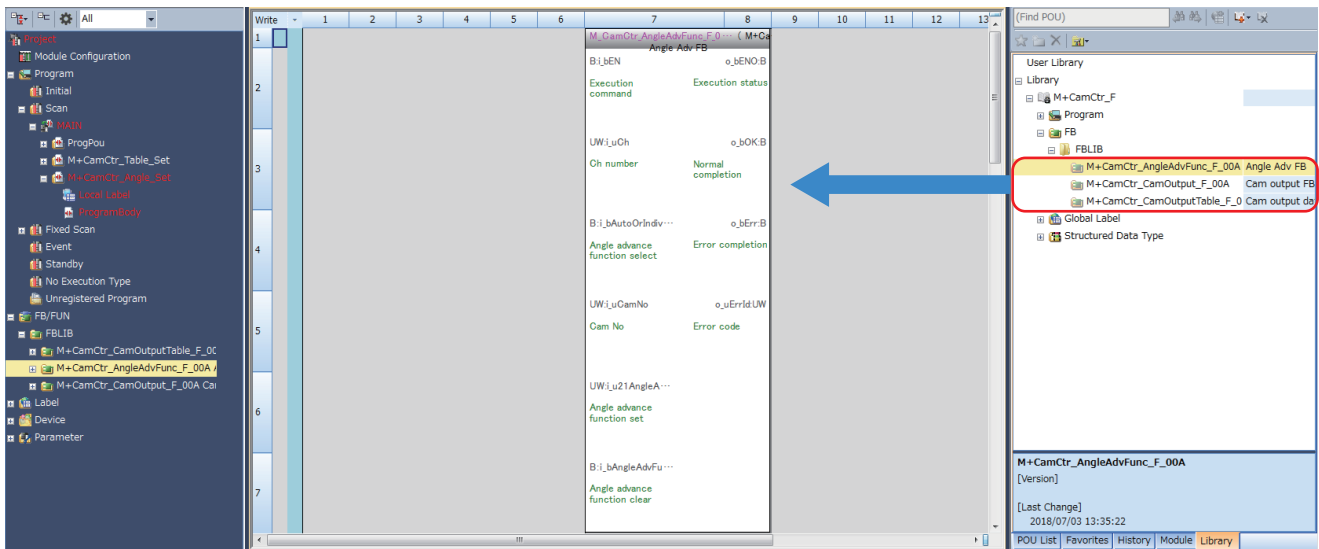
2. Enter the execution commands and setting of the FB.

3. Assign the devices which will store the execution completion state and error codes of the FB.

6.3 Program Example

In the program example, two absolute encoders are used, each treated as CH1/CH2, to control Y devices.

CH	Absolute encoder resolution	Output	Offset
CH1	2048	Y0, Y1	Performs an offset so that the absolute encoder home position plus 30 is treated as the home position in the program.
CH2	360	Y100	Uses the automatic angle advance function to offset the angle moved according to the encoder rotation speed.

CH1 program example

Control is performed so that the absolute encoder home position plus 30 is treated as the home position of the device.
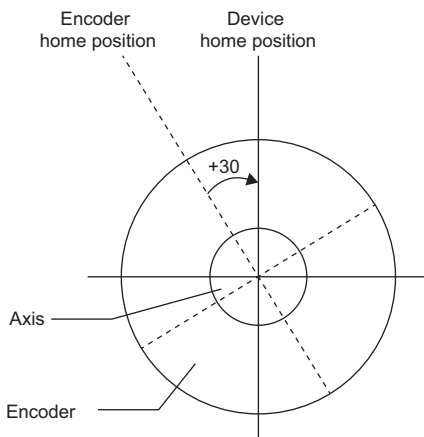
An absolute encoder resolution of 2048 is converted so as to be treated as 360° in the program for easy-to-understand control angles, and the Y devices are controlled as follows.

The values in parentheses are the values when the resolution is 2048.
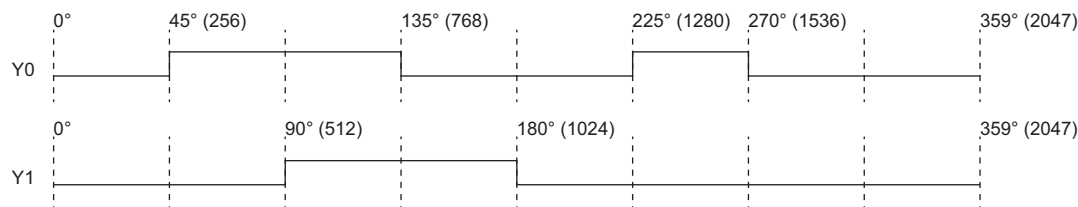
Wire the absolute encoder to X20 through X32.

The program performs the following operations.

1. Execution of 0 degree offset

2. Execution of the cam output table setting (☞ Page 10 M+CamCtr_CamOutputTable_F (Cam output table setting))

3. Execution of the cam output (☞ Page 21 M+CamCtr_CamOutput_F (Cam output))

• Devices used

Device	Description
D100	Offset value storage device
M5, M200	Execution command
M6	Rotation direction
M7	Table data clear
M8	Table data set
M10, M210	Execution status
M11, M211	Normal completion
M12, M212	Error completion
D0	Channel number
D1	Cam output number
D2	Resolution
D10, D210	Error code
D20	Current angle (Gray code)
D21	Current angle (BIN 16-bit)
D200	Current value
D1000, D1001	Control angle
Y20	Cam output status

0 degree offset program

Set the offset value in D100, which considers the CH1 encoder home position plus 30 as the home position of the device.

```
SM402
 ──┤├──                                              ┌────────────────┐
                                                     │       K30  D100│
                                                     │ MOV            │
                                                     └────────────────┘
```

Cam output table setting program

Set the following contents using M+CamCtr_CamOutputTable_F (Cam output table setting).
- Set the rotation direction to forward.
- Set table data clear to off in order to prevent clearing cam output table data before the setting.
- In this program example, set i_bTableDataSet (Table data set) to off not to develop the cam output table from the control angle table of the global label.
- Set i_u16AngleSet (Control angle: Output ON/OFF angle of STEP 0 to STEP 7) in i_uCamNo (Cam output number) 0 and 1. Cam output number 0 is the setting for controlling Y0, and cam output number 1 is the setting for controlling Y1.
- Set i_uResolution (Resolution) to 360.

1. Clear the interrupt disable state.

```
SM400
 ──┤├──                                                        ┌──────┐
                                                               │  EI  │
                                                               └──────┘
```

2. Set the rotation direction to forward, table data clear to off, and table data set to off.

```
M0                                                           ┌──────┐
 ──┤↑├──┬──────────────────────────────────────────────────│   M6 │
        │                                                    │ RST  │
        │                                                    └──────┘
        │                                                    ┌──────┐
        ├──────────────────────────────────────────────────│   M7 │
        │                                                    │ RST  │
        │                                                    └──────┘
        │                                                    ┌──────┐
        └──────────────────────────────────────────────────│   M8 │
                                                             │ RST  │
                                                             └──────┘
```
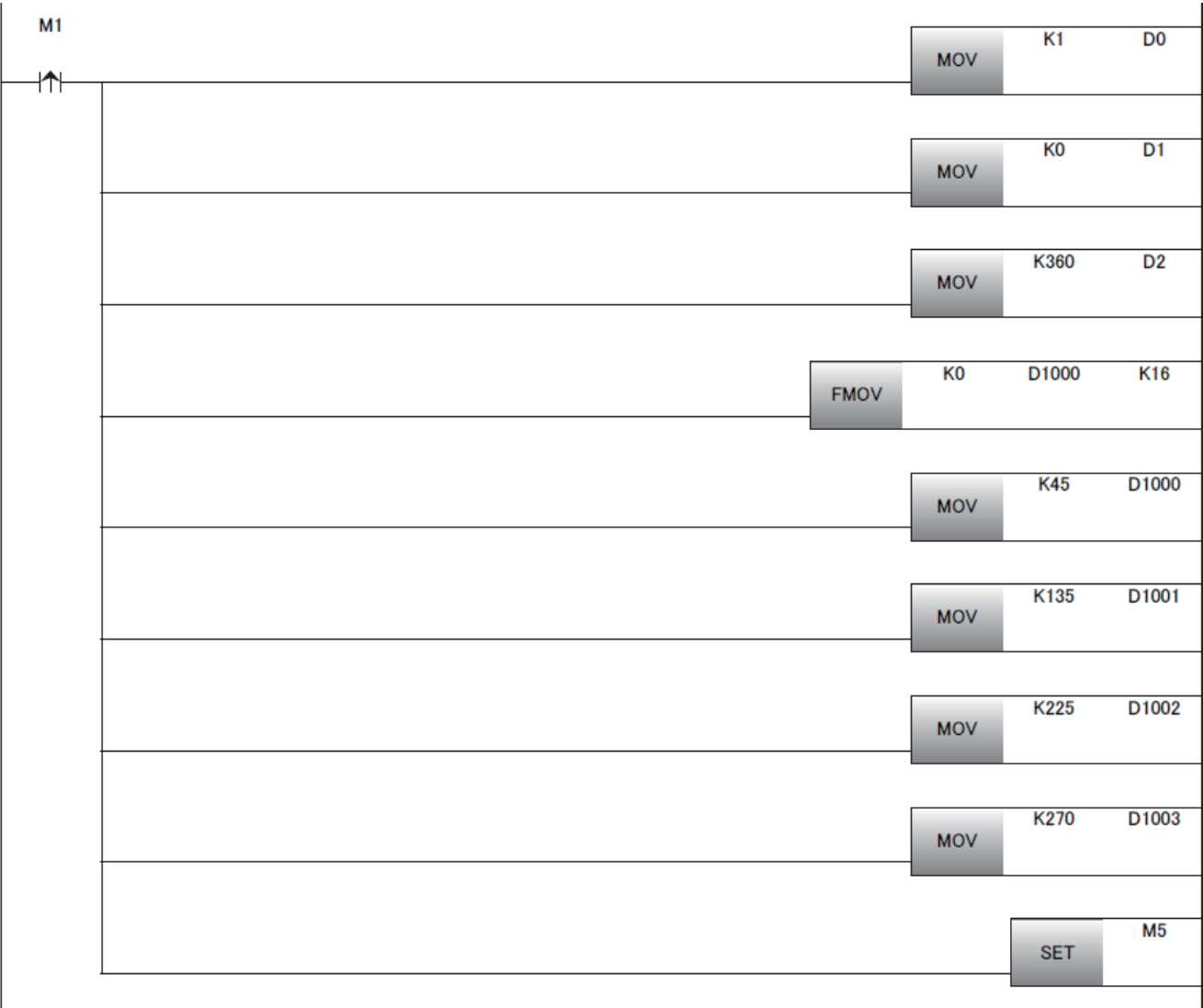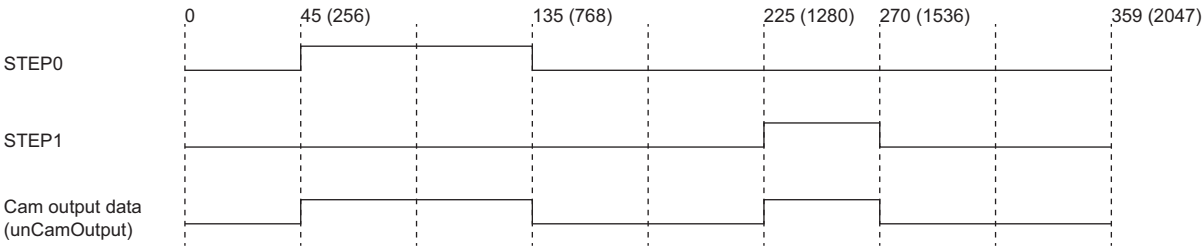
3. Set the control angle data of CH1. The following shows examples of setting cam output numbers 0 and 1.

• Cam output number 0 (Y0)

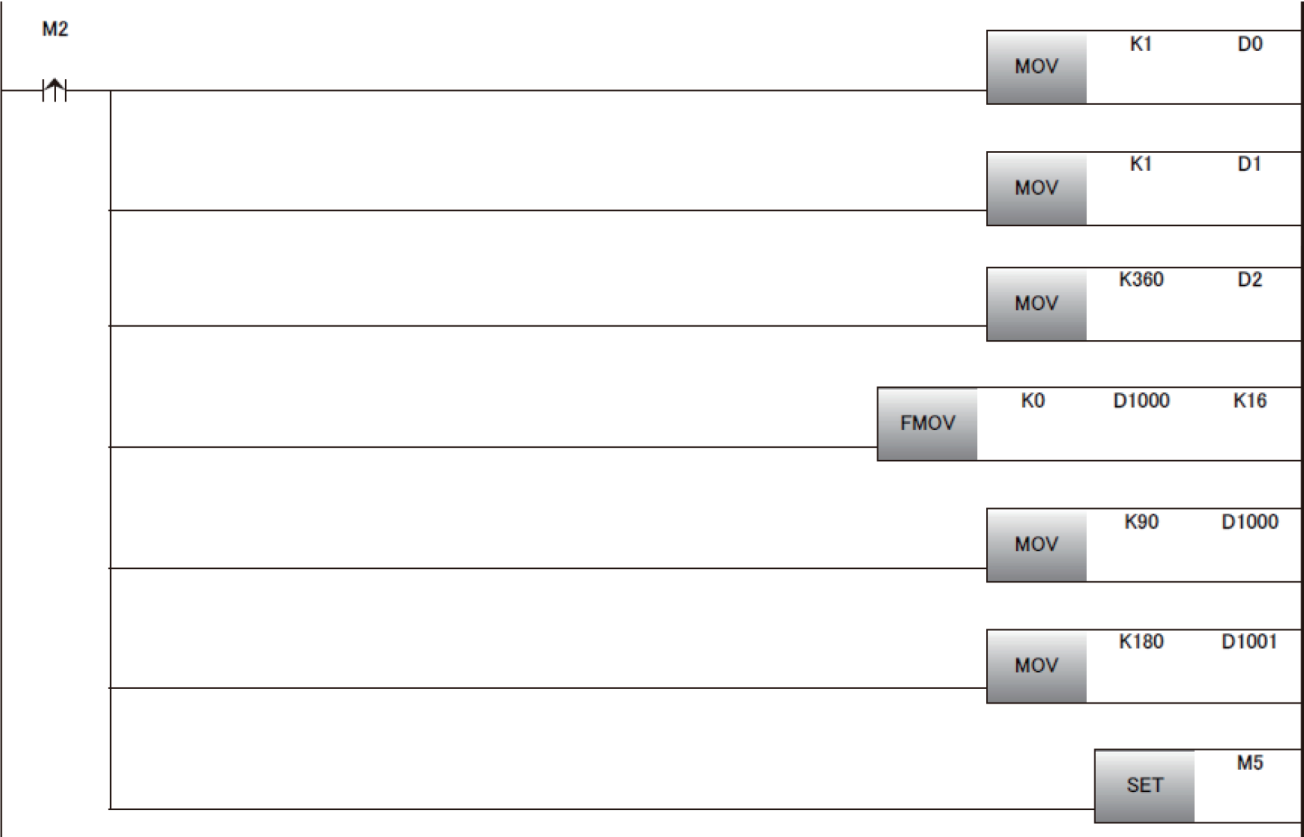STEP 0: Output ON angle = 45, Output OFF angle = 135

STEP 1: Output ON angle = 225, Output OFF angle = 270

6 CREATING PROGRAMS
6.3 Program Example

• Cam output number 1 (Y1)

STEP 0: Output ON angle = 90, Output OFF angle = 180
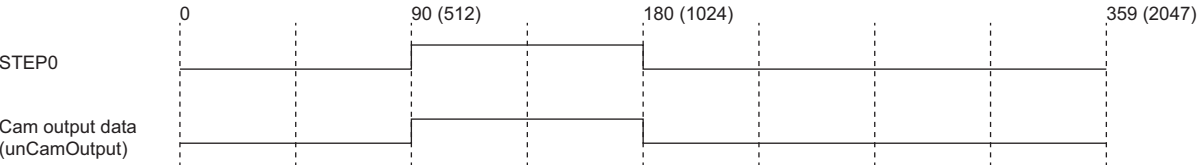
4. Set the cam output table by turning on i_bEN (Execution command).

```
                    ┌──────────────────────────────────────────────────────┐
                    │ M_CamCtr_CamOutputTable_F_00A_1  (M+CamCtr_CamOutputTable_F_00A) │
                    │                   Cam output data FB                  │
   M5               │                                                      │                     M10
───┤├───────────────┤ B: i_bEN                              o_bENO :B ├────────────────────────○
                    │                                                      │                     M11
                    │                                                      │
──────────────[ D0 ]┤ UW: i_uCh                             o_bOK :B ├─────────────────────────○
                    │                                                      │                     M12
                    │                                                      │
──────────────[ D1 ]┤ UW: i_uCamNo                          o_bErr :B ├────────────────────────○
   M6               │                                                      │
───┤├───────────────┤ B: i_bRotateDirection           o_uErrId :UW─[ D10 ]──────────────────────
                    │                                                      │
                    │                                                      │
──────────────[ D2 ]┤ UW: i_uResolution                                    │
                    │                                                      │
                    │                                                      │
────────────[ D1000]┤ UW: i_u16AngleSet                                    │
   M7               │                                                      │
───┤├───────────────┤ B: i_bTableDataClear                                 │
   M8               │                                                      │
───┤├───────────────┤ B: i_bTableDataSet                                   │
                    └──────────────────────────────────────────────────────┘
```
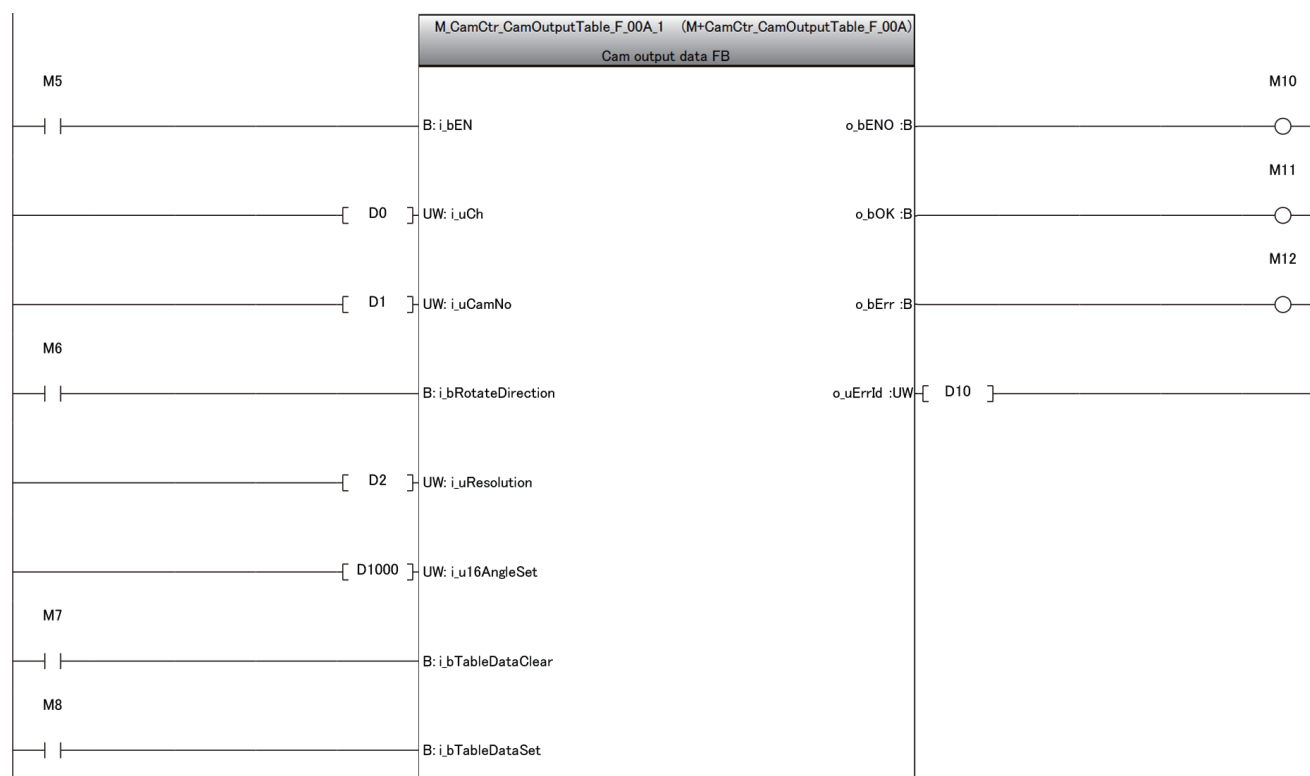
Cam output program

M+CamCtr_CamOutput_F (Cam output) controls the Y devices according to the value of encoder CH1.

Arrange this FB in the 1 ms interrupt processing. (Describe it in the fixed scan execution type program.)

The program example uses the following labels to control Y0 and Y1.

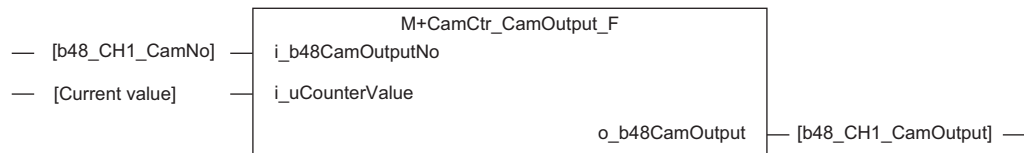| Label name	Date type	Class	Description
b48_CH1_CamNo	Bit (0..47)	VAR	Sets cam output numbers to be enabled for CH1.
b48_CH1_CamOutput	Bit (0..47)	VAR	Stores the on/off results of enabled cam output numbers for CH1.

■Concept of the program that controls Y devices

1. Setting cam output numbers to be controlled by the cam output FB

Cam output number	Description
b48_CH1_CamNo [0]	Enabled (ON)
b48_CH1_CamNo [1]	Enabled (ON)
b48_CH1_CamNo [2]	Disabled (OFF)
⋮	⋮

2. Outputting a cam output number for on/off from the FB according to the current value entered from the encoder

```
                        M+CamCtr_CamOutput_F
── [b48_CH1_CamNo] ──  i_b48CamOutputNo

── [Current value]  ──  i_uCounterValue

                                o_b48CamOutput ── [b48_CH1_CamOutput] ──
```
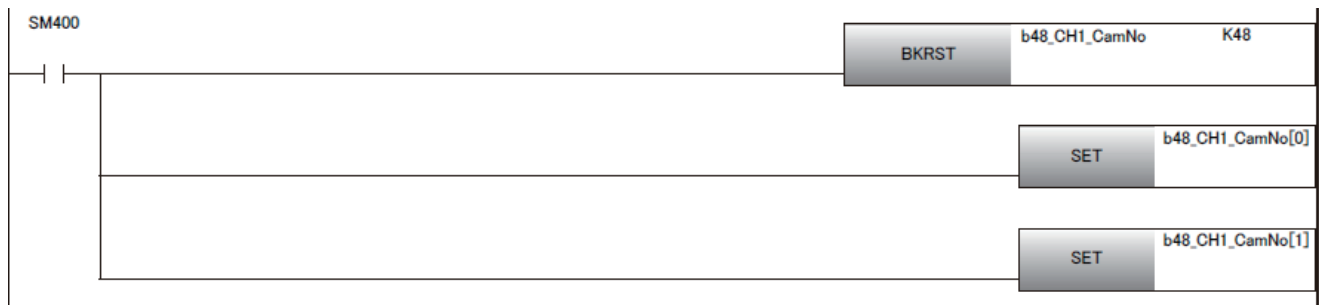
3. Reflecting the control details output from the FB to Y device

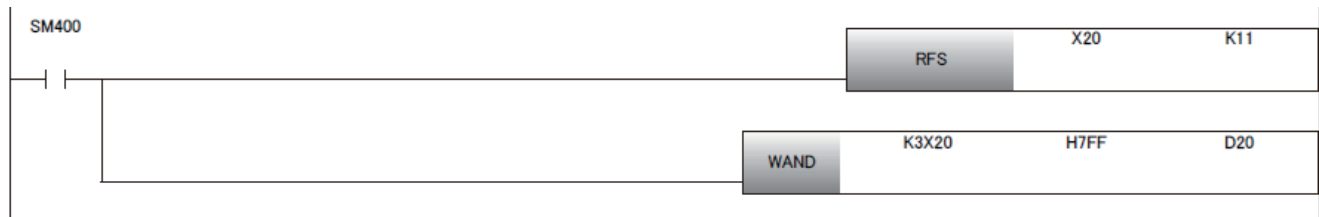| Cam output number	Description
b48_CH1_CamOutput [0]	Reflected to Y0
b48_CH1_CamOutput [1]	Reflected to Y1
b48_CH1_CamOutput [2]	As it is set to disabled, no program required
⋮	⋮

■Program example

1. Set cam output numbers 0 and 1 to enabled.

```
SM400
──┤├──────────────────────────────────────────┤ BKRST │  b48_CH1_CamNo      K48 │
                                                │       │                        │
                                          ┤ SET │  b48_CH1_CamNo[0] │
                                                │       │                        │
                                          ┤ SET │  b48_CH1_CamNo[1] │
```

2. Read the current value of the encoder.

Refresh the status of the X terminal for 11 bits as the resolution is 2048.

```
SM400
──┤├──────────────────────────────────────────┤ RFS │  X20        K11 │
                                                │     │                 │
                                   ┤ WAND │  K3X20      H7FF      D20 │
```

3. Convert the gray code data that is output from the encoder to BIN 16-bit data.

```
SM400
──┤├──────────────────────────────────────────┤ GBIN │  D20        D21 │
```

4. Add (subtract) the offset value D100 saved in the 0 degree offset program to offset the current angle.

```
SM400
──┤├──────────────────────────────────────────┤ + │  D21      D100      D21 │
    ┤ > │ D21   K2048 ┤─────────────────────┤ − │  D21      K2048     D21 │
```
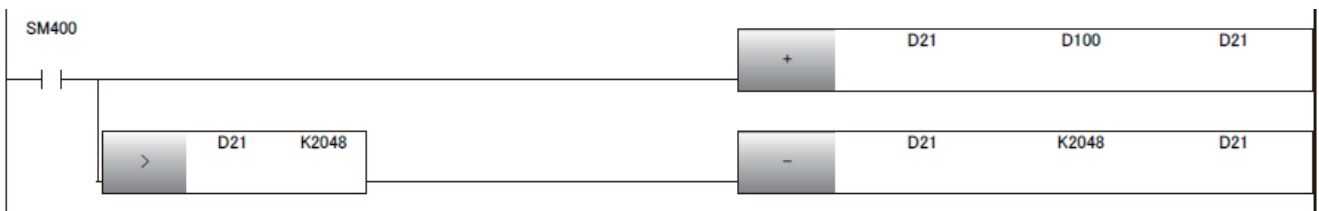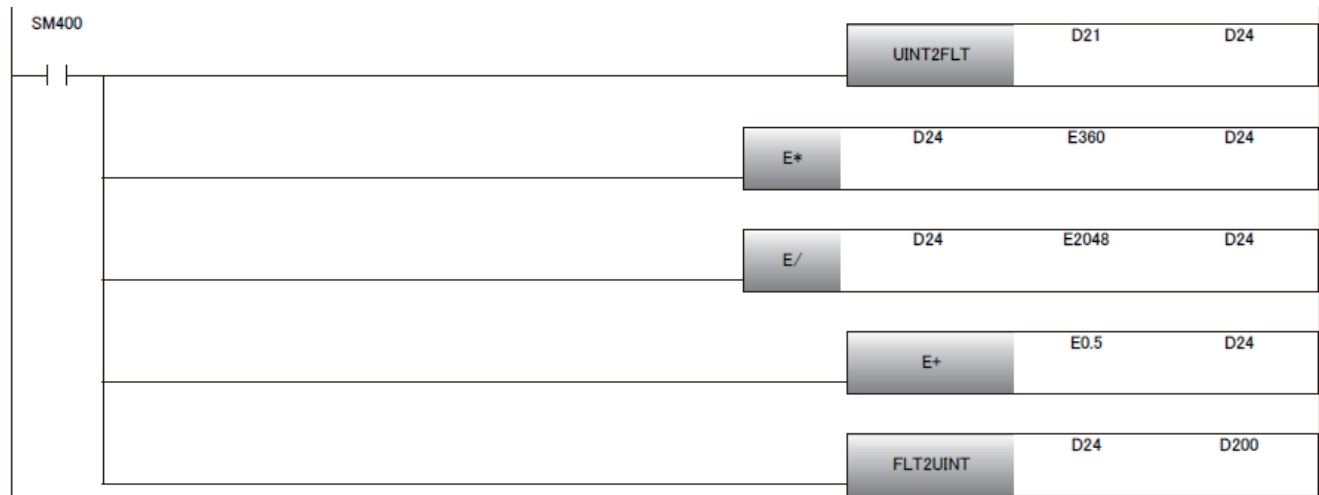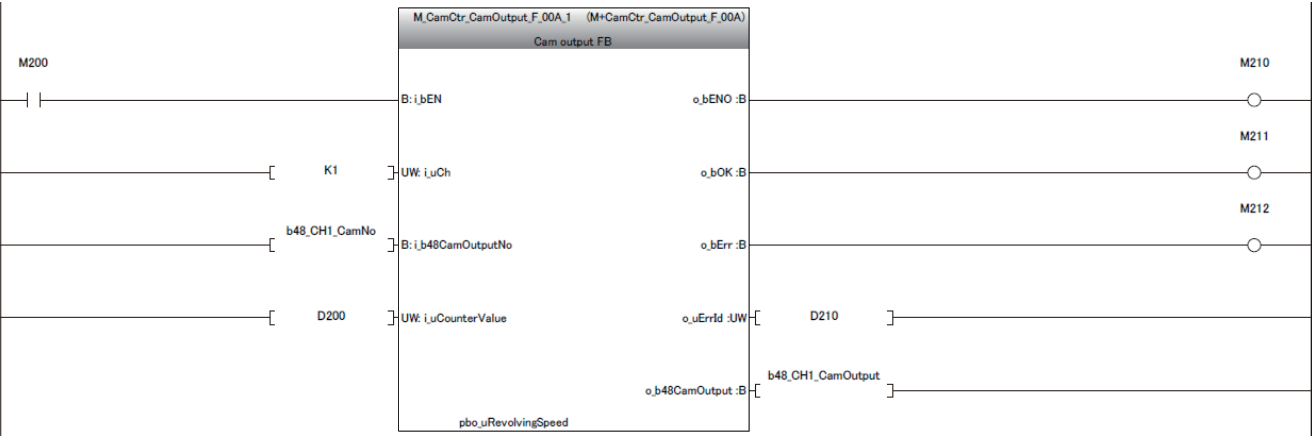
5. Convert the resolution to the specified resolution.

This program example performs calculation with an encoder resolution of 2048 and a resolution of 360 for the cam output program.

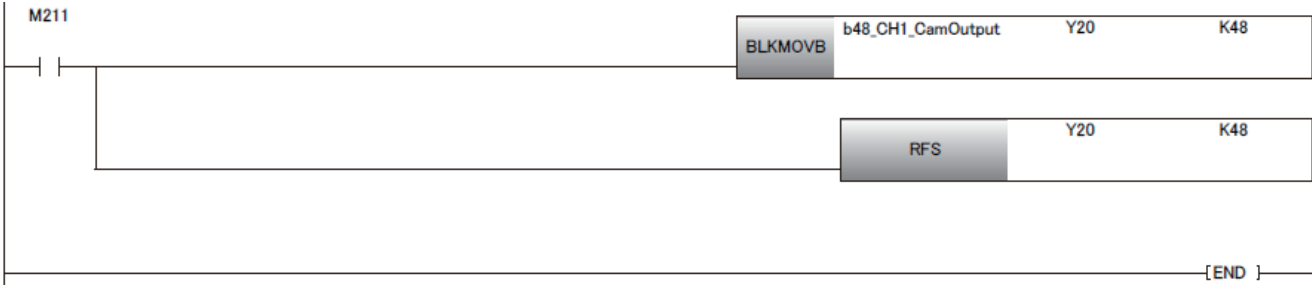Current angle = Encoder current angle $\times$ 360 $\div$ 2048[*1]

*1 Convert (round down) the real number to an integer.

```
SM400
──┤├──────────────────────────────────────────┤ UINT2FLT │  D21        D24 │
                                          ┤ E* │  D24        E360      D24 │
                                          ┤ E/ │  D24        E2048     D24 │
                                          ┤ E+ │             E0.5      D24 │
                                          ┤ FLT2UINT │  D24        D200 │
```

6. Turn on i_bEN (Execution command) in the main scan processing to start the cam output.

```
                    M_CamCtr_CamOutput_F_00A_1   (M+CamCtr_CamOutput_F_00A)
                                      Cam output FB
 M200                                                                              M210
──┤├────────────────────────┤B: i_bEN              o_bENO :B├──────────────────────( )──
                                                                                   M211
──────────────[  K1   ]──────┤UW: i_uCh            o_bOK :B├───────────────────────( )──
                                                                                   M212
        b48_CH1_CamNo
──────────────[          ]───┤B: i_b48CamOutputNo  o_bErr :B├──────────────────────( )──

──────────────[  D200  ]─────┤UW: i_uCounterValue  o_uErrId :UW┤[  D210  ]──────────────

                                        b48_CH1_CamOutput
                                    o_b48CamOutput :B┤[                ]──────────────────

                                      pbo_uRevolvingSpeed
```

7. Reflect the cam output status set by the cam output FB to Y device to refresh it.

```
 M211                                      b48_CH1_CamOutput    Y20        K48
──┤├──────────────────────────┤ BLKMOVB ├──────────────────────────────────────────────
    │
    │                                                           Y20        K48
    │                          ┤  RFS  ├──────────────────────────────────────────────
    │
    └──────────────────────────────────────────────────────────────────────[END]──
```

6

CH2 program example

Control is performed so that the absolute encoder home position is treated as the home position of the device.

The Y device is controlled according to the current value of the absolute encode as follows.
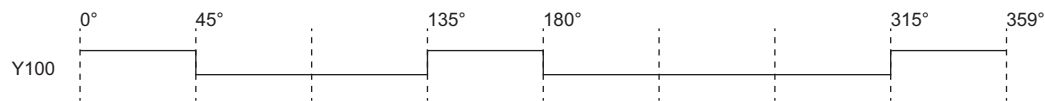
The rotation speed is calculated from the value entered from the absolute encoder[1], and the correction process is performed to add the value to the current value according to the speed as follows.

*1   The rotation speed is calculated with the M+CamCtr_CamOutput_F (Cam output) FB.
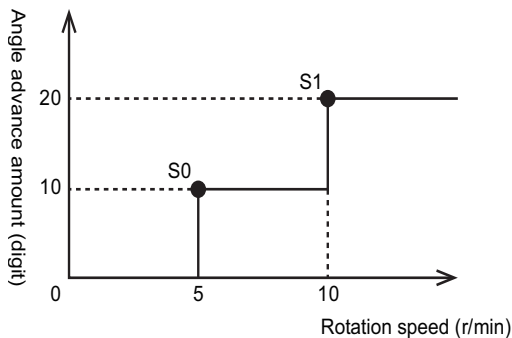
Wire the absolute encoder to X40 through X52.

The program performs the following operations.

1. Execution of the cam output table setting (☞ Page 10 M+CamCtr_CamOutputTable_F (Cam output table setting))

2. Execution of the automatic angle advance function setting (☞ Page 15 M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting))

3. Execution of the cam output (☞ Page 21 M+CamCtr_CamOutput_F (Cam output))

• Devices used

| Device	Description
M305, M352, M400	Execution command
M306	Rotation direction
M307	Table data clear
M308	Table data set
M310, M360, M410	Execution status
M311, M361, M411	Normal completion
M312, M362, M412	Error completion
M353	Angle advance function selection
M354	Angle advance function clear
D300, D350	Channel number
D301, D351	Cam output number
D302	Resolution
D310, D360, D410	Error code
D400	Current angle (Gray code)
D401	Current angle (BIN 16-bit)
D2000 to D2003	Control angle
D2100 to D2103	Angle advance function setting

Cam output table setting program

Set the following contents using M+CamCtr_CamOutputTable_F (Cam output table setting).
- Set the rotation direction to forward.
- Set table data clear to off in order to prevent clearing cam output table data before the setting.
- In this program example, set i_bTableDataSet (Table data set) to off not to develop the cam output table from the control angle table of the global label.
- Set i_u16AngleSet (Control angle: Output ON/OFF angle of STEP 0 to STEP 7) in i_uCamNo (Cam output number) 0. Cam output number 0 is the setting for controlling Y100.
- Set i_uResolution (Resolution) to 360.

1. Clear the interrupt disable state.

2. Set the rotation direction to forward, table data clear to off, and table data set to off.
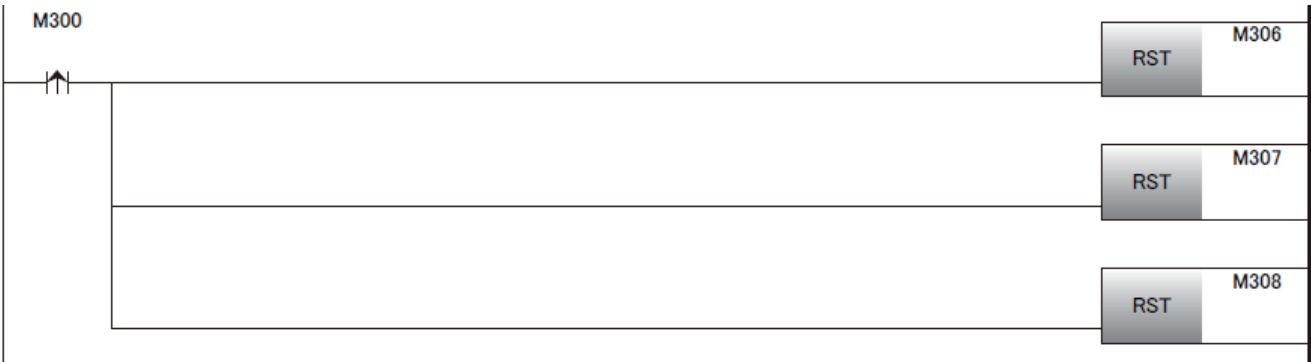
3. Set the control angle data of CH2.

• Cam output number 0 (Y100)

STEP 0: Output ON angle = 135, Output OFF angle = 180

STEP 1: Output ON angle = 315, Output OFF angle = 45
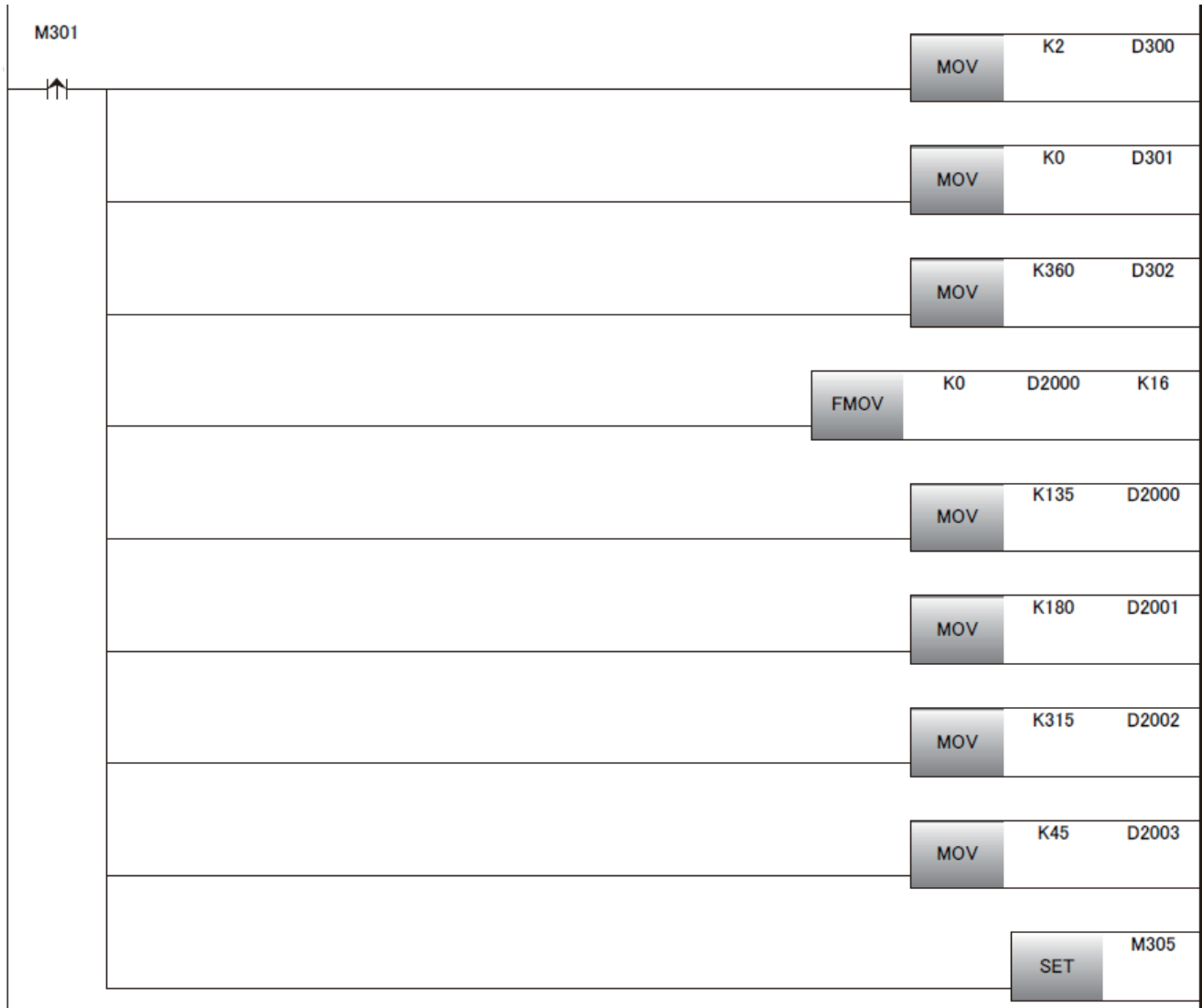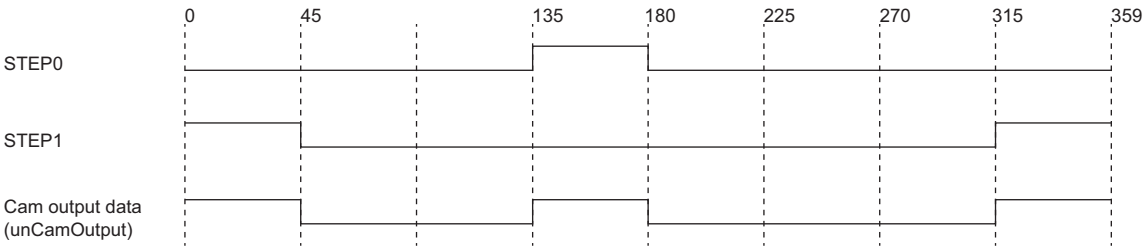
*4.* Set the cam output table by turning on i_bEN (Execution command).
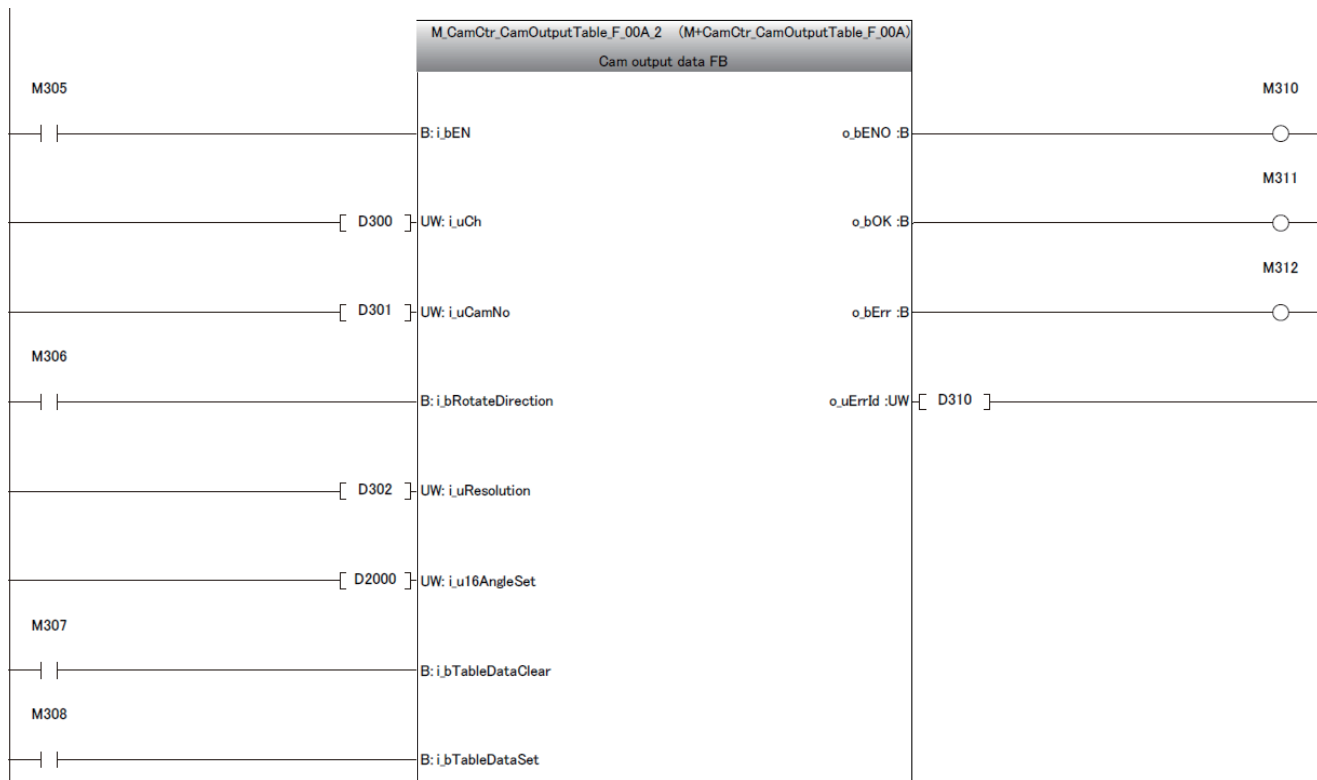
Automatic angle advance function setting program

Set the following contents using M+CamCtr_AngleAdvFunc_F (Automatic angle advance function setting) for CH2.
- Configure the automatic angle advance setting in i_uCamNo (Cam output number) 0.
- In this program example, set i_bAngleAdvFuncClear (Angle advance function clear) to off not to clear the angle advance function setting.

1. Set the angle advance function selection to the automatic angle advance, and the angle advance function clear to off.
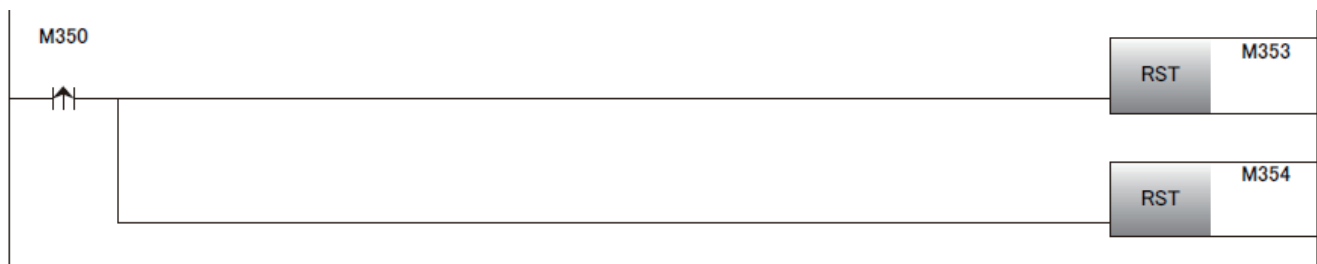
**2.** Set the data of the automatic angle advance in i_u21AngleAdvFuncSet (Angle advance function setting).

Set the angle advance function setting data.

The following setting example shows when 10 is added to the current value of the encoder if the rotation speed is equal to or higher than 5 r/min, and when 20 is added if it is equal to or higher than 10 r/min.

STEP 0: Speed = 5, Angle advance amount = 10

STEP 1: Speed = 10, Angle advance amount = 20
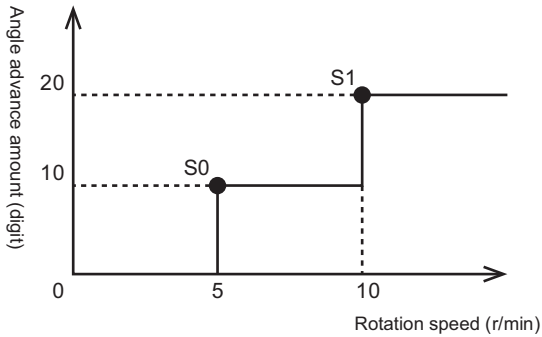
3. Execute the angle advance function setting by turning on i_bEN (Execution command).
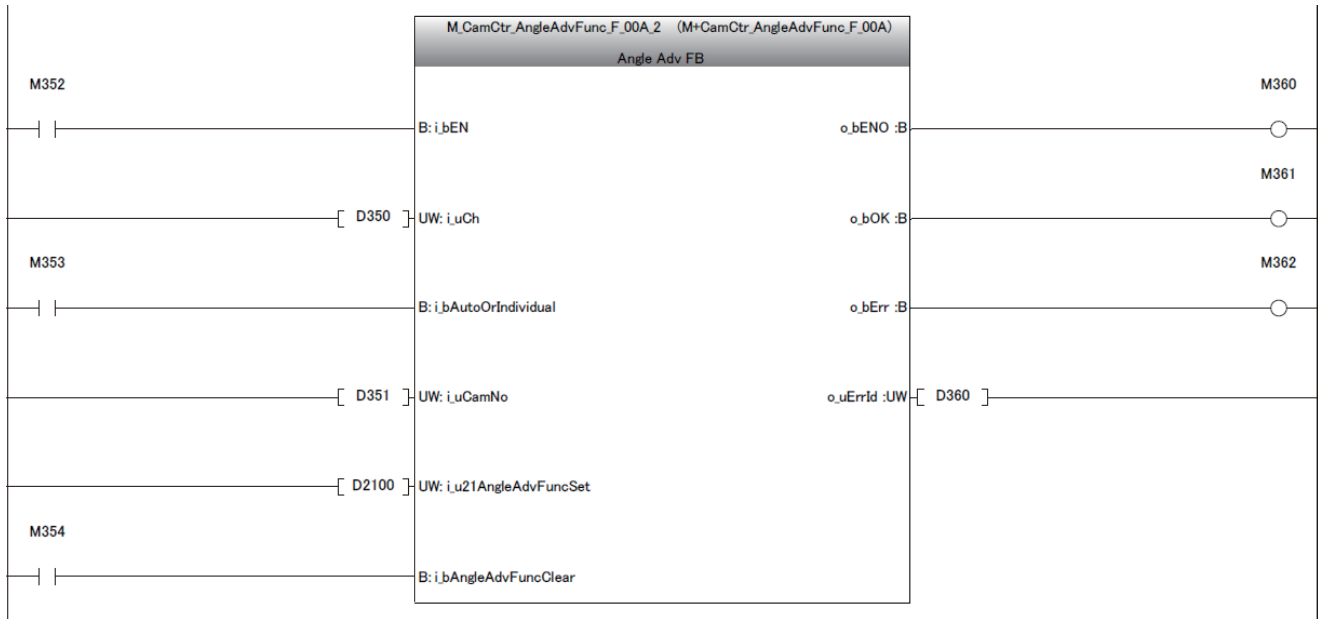
Cam output program

M+CamCtr_CamOutput_F (Cam output) controls Y devices according to the value of absolute encoder CH2.

Arrange this FB in the 1 ms interrupt processing. (Describe it in the fixed scan execution type program.)

The program example uses the following labels.

Label name	Date type	Class	Description
b48_CH2_CamNo	Bit (0..47)	VAR	Sets cam output numbers to be enabled for CH2.
b48_CH2_CamOutput	Bit (0..47)	VAR	Stores the on/off results of enabled cam output numbers for CH2.

■Concept of the program that controls Y devices

1. Setting cam output numbers to be controlled by the cam output FB

Cam output number	Description
b48_CH2_CamNo [0]	Enabled (ON)
b48_CH2_CamNo [1]	Enabled (ON)
b48_CH2_CamNo [2]	Disabled (OFF)
⋮	⋮

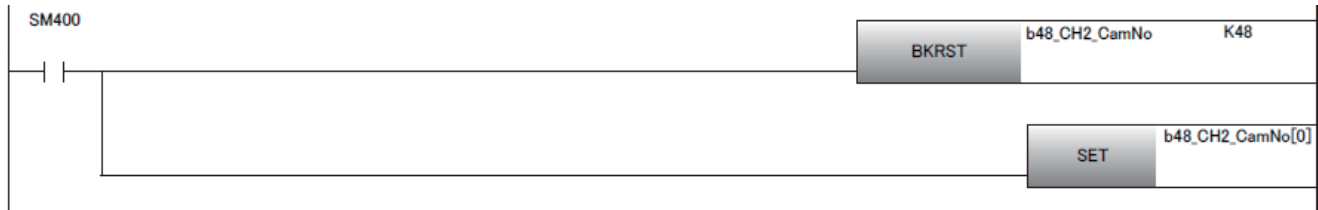***2.*** Outputting a cam output number for on/off from the FB according to the current value entered from the encoder
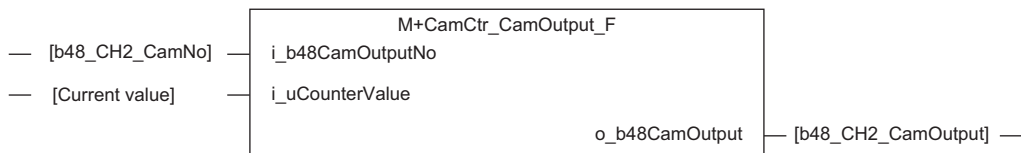
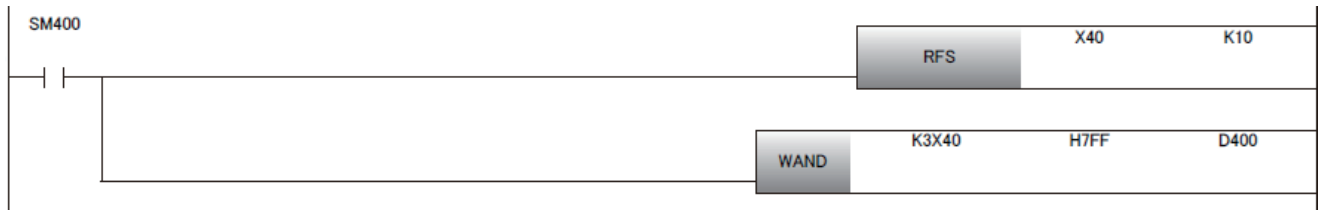***3.*** Reflecting the control details output from the FB to Y device

Cam output number	Description
b48_CH2_CamOutput [0]	Reflected to Y0
b48_CH2_CamOutput [1]	Reflected to Y1
b48_CH2_CamOutput [2]	As it is set to disabled, no program required
⋮	⋮

■Program example

1. Set cam output number 0 to enabled.

```
SM400
──┤ ├──────────────────────────────────────────┤ BKRST │──── b48_CH2_CamNo    K48

                                                 │  SET  │──── b48_CH2_CamNo[0]
```

2. Read the current value of the encoder.

Refresh the status of the X terminal for 10 bits as the resolution is 360.

```
SM400
──┤ ├──────────────────────────────────────┤ RFS │────  X40      K10

                                     │ WAND │────  K3X40    H7FF    D400
```

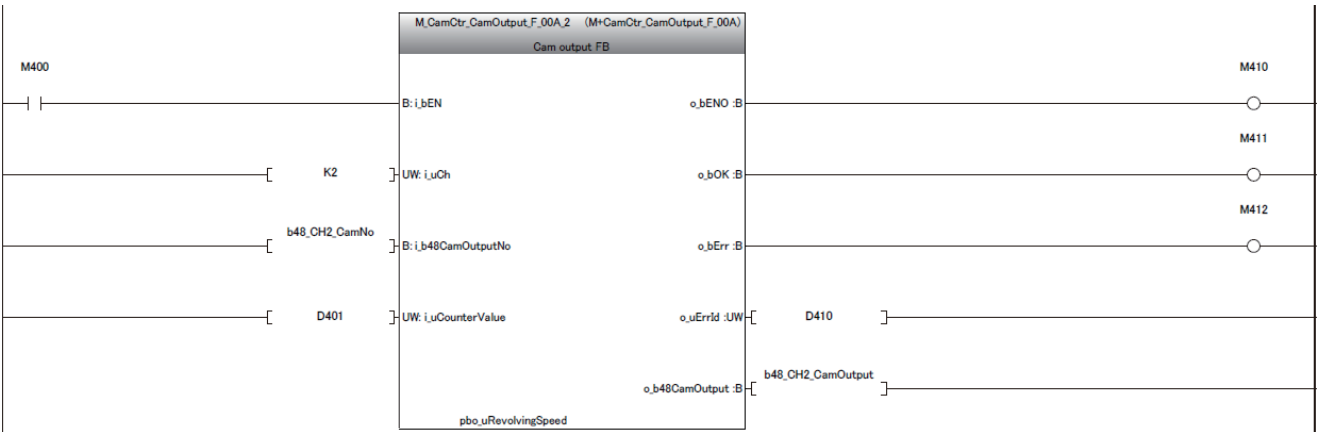**3.** Convert the gray code data that is output from the encoder to BIN 16-bit data, and subtract the remainder gray code[*1].

*1 Regarding the absolute encoder that outputs a gray code, if the resolution is not a multiplier of 2, the remainder gray code needs to be subtracted as follows. For information on subtracted values, check the specifications of the absolute encoder used.
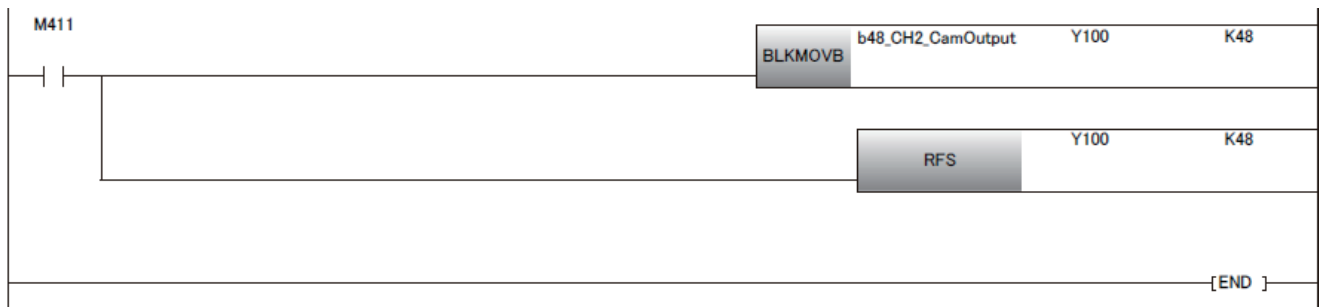
Resolution	Subtracted value
180	38
360	76
720	150

```
SM400
──┤ ├──────────────────────────────────────┤ GBIN │────  D400     D401

                                     │  −  │────  D401     K76     D401
```

4. Turn on i_bEN (Execution command) in the main scan processing to start the cam output.

5. Reflect the cam output status set by the cam output FB to Y device to refresh it.

```
M411
 ┤├──────────────────────────┐         ┌──────────┬─────────────────┬──────────┬──────────┐
                             │         │          │ b48_CH2_CamOutput│   Y100   │   K48    │
                             │         │ BLKMOVB  │                  │          │          │
                             │         └──────────┴─────────────────┴──────────┴──────────┘
                             │
                             │                   ┌──────────┬─────────────────┬──────────┬──────────┐
                             │                   │          │                 │   Y100   │   K48    │
                             └───────────────────┤   RFS    │                 │          │          │
                                                 └──────────┴─────────────────┴──────────┴──────────┘


                                                                                      [END ]
```

MEMO

INSTRUCTION INDEX

I

MEMO

REVISIONS

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