MELSEC-L CPU Module (Built-in I/O Function) FB Library

Reference Manual

< CONTENTS >

Reference Manual Revision History 2
1. Overview 3
1.1 Overview of the FB Library 3
1.2 Function of the FB Library 3
1.3 System Configuration Example 3
1.4 Relevant manual 4
1.5 Note 4
2. Details of the FB Library 5
2.1 M+LCPU_FKRCMP(16 bit block data range compare) 5
2.2 M+LCPU_AENCCMP(Absolute encoder value comparison) 11
2.3 M+LCPU_IENCCMP1(High-speed counter CH1 incremental encoder comparison) 18
2.4 M+LCPU_IENCCMP2(High-speed counter CH2 incremental encoder comparison) 26
Appendix 1 - FB Library Application examples 34

Reference Manual Revision History

Reference Manual Number	Date	Description
FBM-M029-A	2010/06/28	First edition
FBM-M029-B	2011/04/30	Added "Reference Manual Revision History", "Overview", "Chinese version of GX Works2".

1. Overview

1.1 Overview of the FB Library

This FB library is for using the MELSEC-L CPU module.

1.2 Function of the FB Library

Item	Description
M+LCPU_FKRCMP	Compare a 16 bit value to two or more data ranges.
M+LCPU_AENCCMP	Compare the value of an absolute encoder with two or more data ranges.
M+LCPU_IENCCMP1	Compare the LCPU built-in high-speed counter CH1 current value with two or more data ranges.
M+LCPU_IENCCMP2	Compare the LCPU built-in high-speed counter CH2 current value with two or more data ranges.

1.3 System Configuration Example

Power Supply Module	**L26CPU-BT** **(Input : X00~X0F)** **(Output : Y00~Y0F)**

Module	Description
L series programmable controller	Use power supply module, and L series programming controller CPU module.

1.4 Relevant manual

MELSEC-L CPU Module User's Manual (Built-in I/O Function)

1.5 Note

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

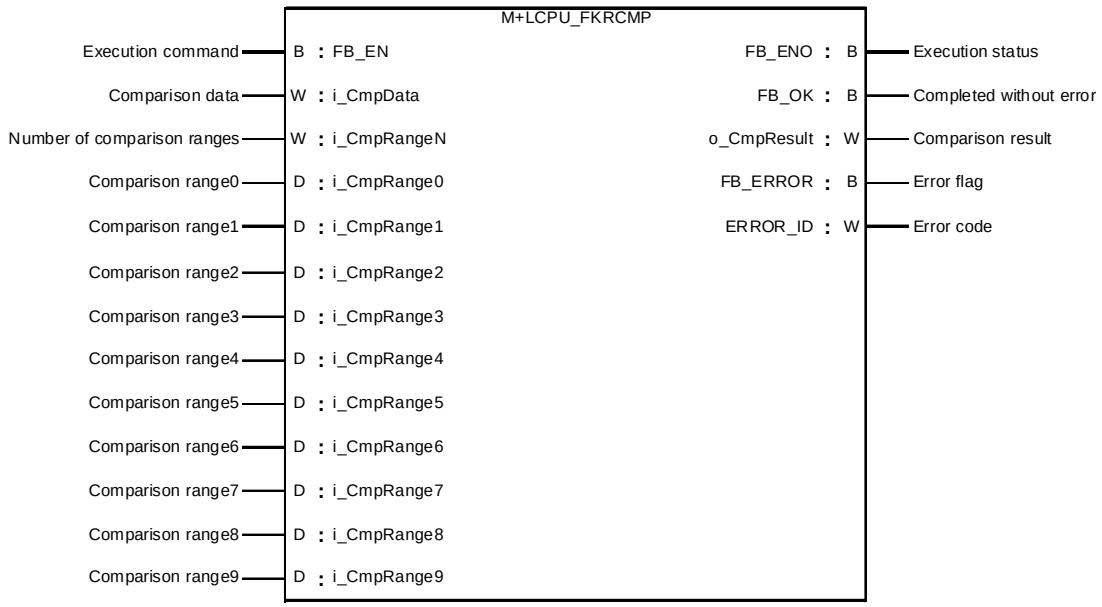
2. Details of the FB Library

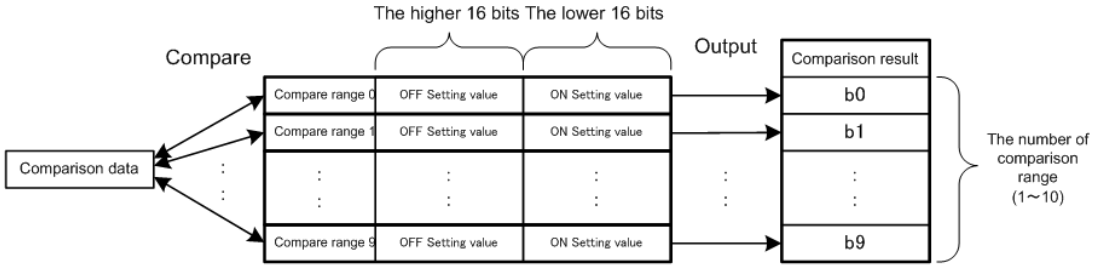
2.1 M+LCPU_FKRCMP(16 bit block data range compare)

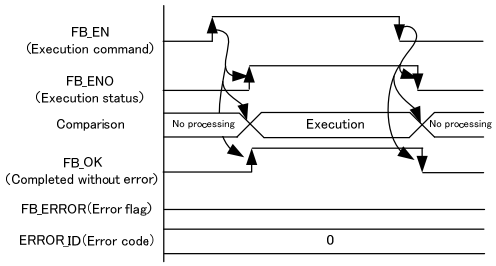
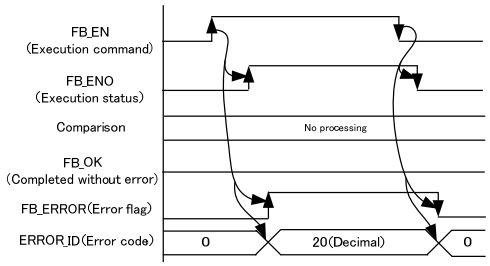
FB Name

M+LCPU_FKRCMP

Function Description

<table>
<tr><th>Item</th><th colspan="2">Description</th></tr>
<tr><td>Function overview</td><td colspan="2">Compare a 16 bit value to two or more data ranges.</td></tr>
<tr><td>Symbol</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Applicable hardware and software</td><td>CPU module</td><td><table><tr><th>Series</th><th>Model</th></tr><tr><td>MELSEC-L Series</td><td>LCPU</td></tr></table></td></tr>
<tr><td>Engineering software</td><td>GX Works2<table><tr><th>Series</th><th>Language</th><th>Software version</th></tr><tr><td rowspan="2">MELSEC-L Series</td><td>English</td><td>Ver 1.31H or later</td></tr><tr><td>Chinese</td><td>Ver 1.49B or later</td></tr></table></td></tr>
<tr><td>Programming language</td><td colspan="2">Ladder</td></tr>
</table>

Item	Description
Number of steps (maximum value)	L Series model CPU: 339* * This value represents the number of steps in a program using labels, and is only a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	1) Perform comparison operations by turning on the FB_EN (execution command) input. 2) Comparison operations can be done using the following data types: Binary ON / OFF values and signed 16 bit data.  Comparer content ・The case of OFF setting value > ON setting value In the case of「OFF Setting valuse＞Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value < ON setting value In the case of「OFF Setting valuse＞Comparison data」or「Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value = ON setting value The correspondence bit of the comparison result is always turning off. 3) When the comparison range number is out of range, the FB_ERROR output turns on, processing is interrupted, and the error code is stored in ERROR_ID. Refer to the error code explanation section for details.
Compiling method	Macro type
Restrictions and precautions	1) The FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation. 2) The FB cannot be used in an interrupt program. 3) When FB_OK (completed without error) turns ON, o_CmpResult (comparison result) is valid. 4) o_CmpResult (comparison result) is cleared to zero when FB_EN turns OFF.
FB operation type	Real-time execution
Application example	Refer to Appendix 1 - FB Library Application examples

Item	Description
Timing chart	[When operation completes without error] [When an error occurs]  
Relevant manuals	MELSEC-L CPU Module User's Manual (Built-in I/O Function)

Error Codes

■ Error code list

Error code	Description	Action
20(Decimal)	Number of comparison ranges setting is not valid. The number of comparisons is not within the range of 1 to 10.	Please try again after confirming the setting.

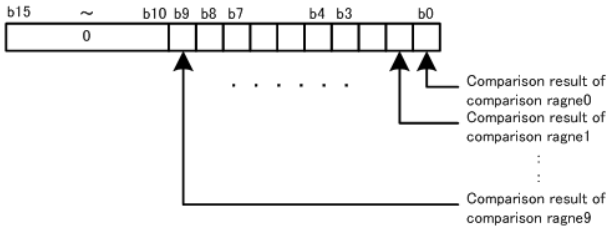
Labels

■ Input labels

Name	Variable name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Comparison data	i_CmpData	W	-32,768 ~ 32,767	Specify a device (containing a value within the setting range) to compare with the comparison range data.
Number of comparison ranges	i_CmpRangeN	W	1 ~ 10	Specify the number of comparisons. For example, when the setting is five, comparison numbers 0 to 4 are used and numbers 5 to 9 are not used.
Comparison range 0	i_CmpRange0	D	H0 ~ HFFFFFFFF	Specify a comparison range. The upper 16 bits correspond to the OFF setting value; and the lower 16 bits to the ON setting value. Each setting value is a signed number.
Comparison range 1	i_CmpRange1	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 2	i_CmpRange2	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 3	i_CmpRange3	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 4	i_CmpRange4	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 5	i_CmpRange5	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

Name	Variable name	Data type	Setting range	Description
Comparison range 6	i_CmpRange6	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 7	i_CmpRange7	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 8	i_CmpRange8	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
Comparison range 9	i_CmpRange9	D	H0~HFFFFFFFF	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

■ Output labels

Name	Variable name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution instruction is ON. OFF: Execution instruction is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the comparison operation was successful.
Comparison result	o_CmpResult	W	H0	This area stores the comparison results. The bits used for comparison will either be ON or OFF depending on the result, and all other (unused) bits will be OFF. 
Error flag	FB_ERROR	B	OFF	When ON, it indicates that an error has occurred.
Error code	ERROR_ID	W	0	FB error code output.

FB Version Upgrade History

Version	Date	Description
1.00A	2010/06/28	First edition

Note

This chapter includes information related to the M+LCPU_FKRCMP function block.

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

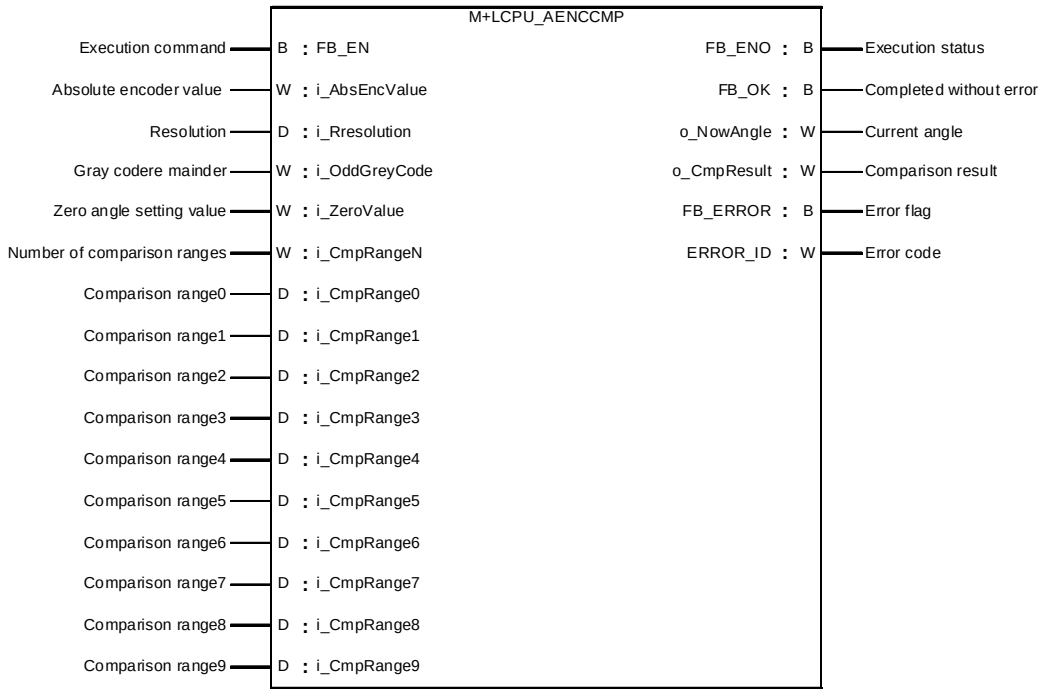
Before using any Mitsubishi products, please read all relevant manuals.

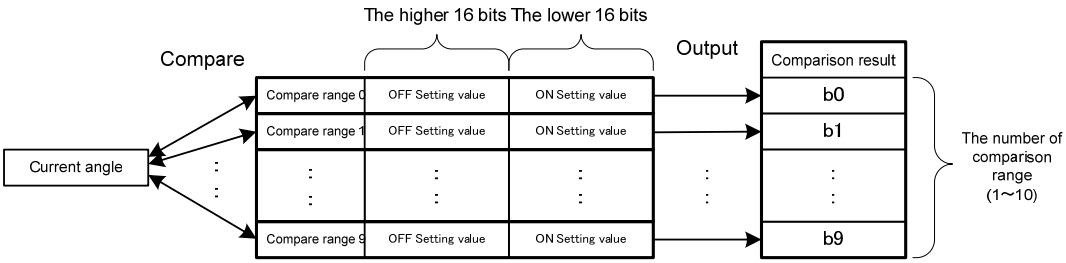
2.2 M+LCPU_AENCCMP(Absolute encoder value comparison)

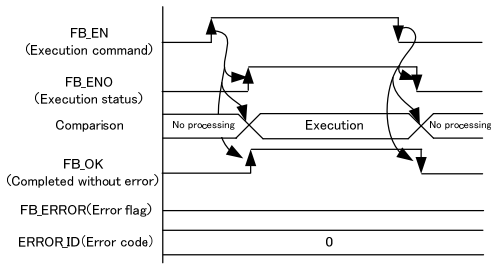
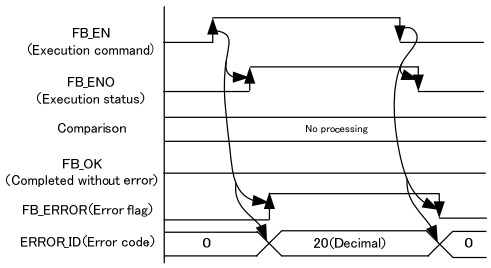
FB Name

M+LCPU_AENCCMP

Function Description

<table>
<tr><th>Item</th><th colspan="2">Description</th></tr>
<tr><td>Function overview</td><td colspan="2">Compare the value of an absolute encoder with two or more data ranges.</td></tr>
<tr><td>Symbol</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Applicable hardware and software</td><td>CPU module</td><td>
<table>
<tr><td>Series</td><td>Model</td></tr>
<tr><td>MELSEC-L Series</td><td>LCPU</td></tr>
</table>
</td></tr>
<tr><td>Engineering software</td><td>GX Works2
<table>
<tr><td>Series</td><td>Language</td><td>Software version</td></tr>
<tr><td rowspan="2">MELSEC-L Series</td><td>English</td><td>Ver 1.31H or later</td></tr>
<tr><td>Chinese</td><td>Ver 1.49B or later</td></tr>
</table>
</td></tr>
<tr><td>Programming language</td><td colspan="2">Ladder</td></tr>
</table>

Item	Description
Number of steps (maximum value)	L Series model CPU: 603* * This value represents the number of steps in a program using labels, and is only a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	1) When the FB_EN (execution command) input is turned on, the absolute encoder value is converted to an angle value in units of 0.1degree and the comparison operation is performed. 2) The current angle is calculated using the following method. Current angle (o_NowAngle) calculation method: ・When (i_AbsEncValue - i_OddGreyCode) is greater than or equal to i_ZeroValue (3600 / i_Resolution) * (i_AbsEncValue - i_OddGreyCode - i_ZeroValue) ・When (i_AbsEncValue - i_OddGreyCode) is less than i_ZeroValue (3600 / i_Resolution) * (i_Resolution + i_AbsEncValue - i_OddGreyCode - i_ZeroValue) 3) The comparison operation is performed using data with the following restriction: The current angle, OFF Setting value, and ON Setting value range is 0~3599(0~359.9degree).  Comparer content ・The case of OFF setting value > ON setting value In the case of「OFF Setting valuse＞Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value < ON setting value In the case of「OFF Setting valuse＞Comparison data」or「Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value = ON setting value The correspondence bit of the comparison result is always turning off. 4) When the comparison range number is out of range, the FB_ERROR output turns on, processing is interrupted, and the error code is stored in ERROR_ID. Refer to the error code explanation section for details.
Compiling method	Macro type

Item	Description
Restrictions and precautions	1) The FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation. 2) The FB cannot be used in an interrupt program. 3) When FB_OK (completed without error) turns ON, o_NowAngle (current angle) and o_CmpResult (comparison result) are valid. 4) When FB_EN turns OFF, o_NowAngle (current angle) and o_CmpResult (comparison result) are cleared to zero.
FB operation type	Real-time execution type
Application example	Refer to Appendix 1 - FB Library Application examples
Timing chart	[When operation completes without error] [When an error occurs]  
Relevant manuals	MELSEC-L CPU Module User's Manual (Built-in I/O Function)

Error Codes

■ Error code list

Error code	Description	Action
20(Decimal)	Number of comparison ranges setting is not valid. The number of comparisons is not within the range of 1 to 10.	Please try again after confirming the setting.
21(Decimal)	The comparison range value is not valid. At least one of the OFF/ON setting values is not within the range of H0 to H0E0F.	Please try again after confirming the setting.
30(Decimal)	The resolution setting is not valid. The resolution is not within the range of 10 to 32768.	Please try again after confirming the setting.
31(Decimal)	The gray code remainder setting is not valid. The gray code remainder setting is not within the range of 0 to 16384.	Please try again after confirming the setting.
32(Decimal)	The zero angle setting value is out of range. The zero angle setting is not within the range of 0 to (i_Resolution-1).	Please try again after confirming the setting.
33(Decimal)	The current angle cannot be calculated. The calculated current angle is outside the range of 0 to 3599.	Please try again after confirming the settings.

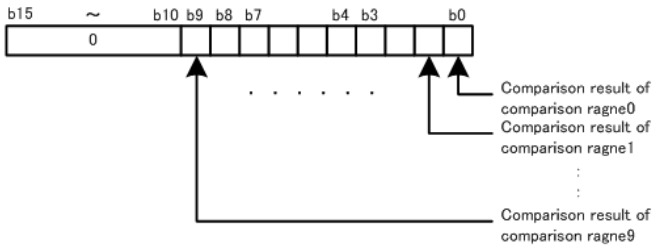
Labels

■ Input labels

Name	Variable name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated OFF: The FB is not activated.
Absolute encoder value	i_AbsEncValue	W	H0~H7FFF	Value of the absolute encoder (in gray code)
Resolution	i_Resolution	D	10~32,768	Encoder resolution
Gray code remainder	i_OddGreyCode	W	0~16,384	Specify the gray code remainder. For example, if the resolution is a power of 2, it is 0. If the resolution is 36, it is 14.
Zero angle setting value	i_ZeroValue	W	0~(i_Resolution-1)	The value assumed to be 0 degrees.
Number of comparison ranges	i_CmpRangeN	W	1~10	Specify the number of comparisons. For example, when the setting is five, comparison numbers 0 to 4 are used and numbers 5 to 9 are not used.
comparison range 0	i_CmpRange0	D	H0~H0E0F0E0F (Upper / lower 16 bits each, H0~H0E0F)	Specify a comparison range. The upper 16 bits correspond to the OFF setting value and the lower 16 bits to the ON setting value, with each OFF / ON setting being in the range of 0 to 3599 (H0 ~ H0EOF).
comparison range 1	i_CmpRange1	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 2	i_CmpRange2	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 3	i_CmpRange3	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

Name	Variable name	Data type	Setting range	Description
comparison range 4	i_CmpRange4	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 5	i_CmpRange5	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 6	i_CmpRange6	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 7	i_CmpRange7	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 8	i_CmpRange8	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 9	i_CmpRange9	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

■ Output labels

Name	Variable name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: The FB is active. OFF: The FB is not active.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the comparison operation was successful.
Current angle	o_NowAngle	W	0	The angle calculated from the absolute encoder value within the range 0~3599.
Comparison result	o_CmpResult	W	H0	This area stores the comparison results. The bits used for comparison will either be ON or OFF depending on the result, and all other (unused) bits will be OFF. 
Error flag	FB_ERROR	B	OFF	When ON, it indicates that an error has occurred.
Error code	ERROR_ID	W	0	FB error code output.

FB Version Upgrade History

Version	Date	Description
1.00A	2010/06/28	First edition

Note

This chapter includes information related to the M+LCPU_AENCCMP function block.

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

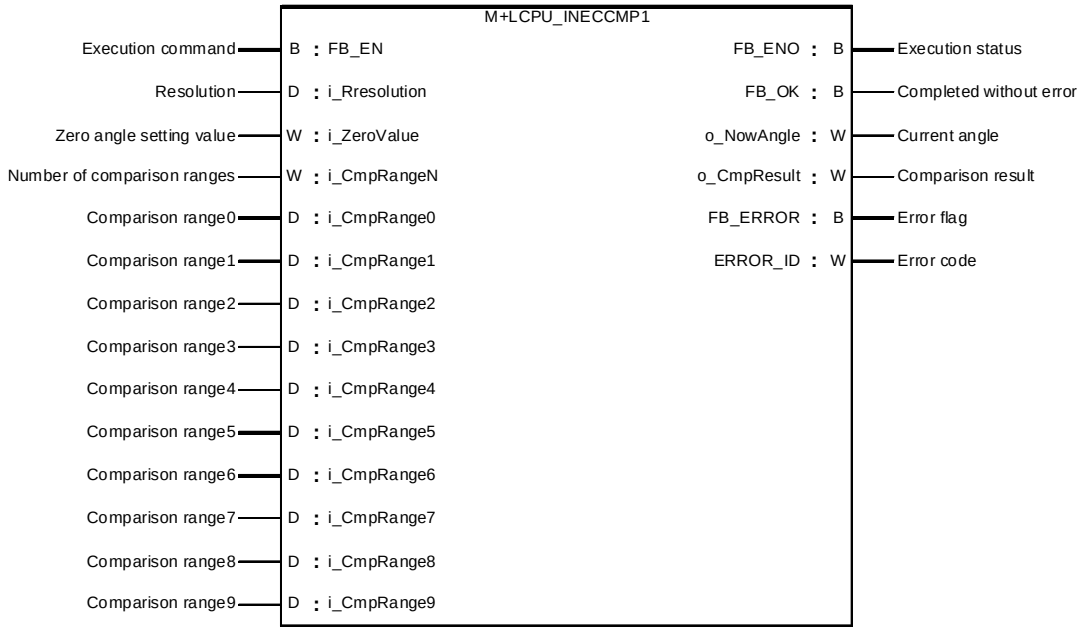
Before using any Mitsubishi products, please read all relevant manuals.

2.3 M+LCPU_IENCCMP1(High-speed counter CH1 incremental encoder comparison)

FB Name

M+LCPU_IENCCMP1

Function Description

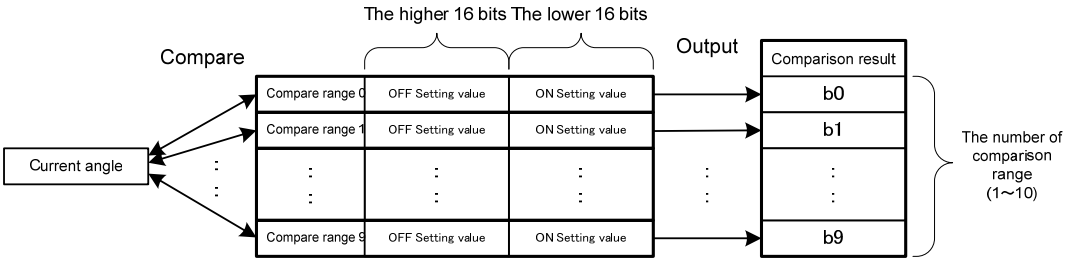
Item	Description
Function overview	Compare the LCPU built-in high-speed counter CH1 current value with two or more data ranges.
Symbol	
Applicable hardware and software	CPU module
	Engineering software
Programming language	Ladder

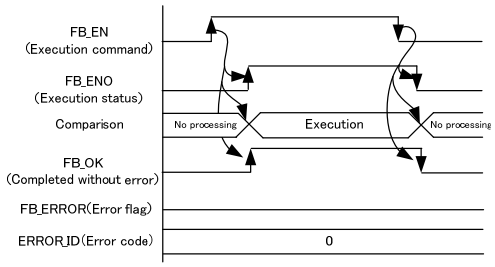
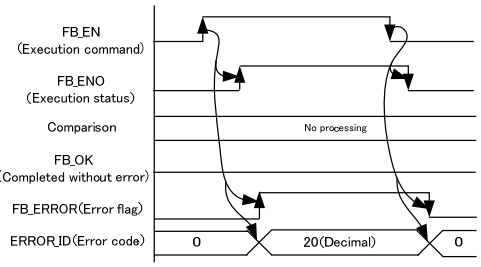
Series	Model
MELSEC-L Series	LCPU

GX Works2

Series	Language	Software version
MELSEC-L Series	English	Ver 1.31H or later
	Chinese	Ver 1.49B or later

Item	Description
Number of steps (maximum value)	L Series model CPU: 603* * This value represents the number of steps in a program using labels, and is only a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	1) When the FB_EN (Execution command) is turned ON, the following operations occur: The upper and lower limits of the ring counter are set as the encoder resolution and 0 respectively. The counter enable command (SM1895) is set to ON and the counter is started. Finally, the current value of the high-speed counter (SD1880~1881) is converted to an angle value in units of 0.1degree and the comparison operation is performed. When the FB_EN (Execution command) changes from ON to OFF, the counter enable command (SM1895) is set to OFF, and the counter is stopped. 2) The current angle is calculated using the following method. Current angle (o_NowAngle) calculation method: ・When [SD1880～1881] is greater than or equal to i_ZeroValue (3600 / i_Resolution) * ([1880～1881] - i_ZeroValue) ・When [SD1880～1881] is less than i_ZeroValue (3600 / i_Resolution) * (i_Resolution + [1880～1881] - i_ZeroValue) 3) The comparison operation is performed using data with the following restriction: The current angle, OFF Setting value, and ON Setting value range is 0~3599(0~359.9degree).  Comparer content ・The case of OFF setting value > ON setting value In the case of「OFF Setting valuse＞Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value < ON setting value In the case of「OFF Setting valuse＞Comparison data」or「Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value = ON setting value The correspondence bit of the comparison result is always turning off. 4) When the comparison range number is out of range, the FB_ERROR output turns on, processing is interrupted, and the error code is stored in ERROR_ID. Refer to the error code explanation section for details. 5) If more than ten comparison ranges are required, combine with the M+LCPU_FKRCMP (16 bit block data range compare) FB. Refer to the application examples for details.
Compiling method	Macro type

Item	Description
Restrictions and precautions	1) The FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation. 2) The FB cannot be used in an interrupt program. 3) The FB can only be executed once per scan. 4) The following CH1 high-speed counter parameters are necessary for FB operation: Set the operation mode monitor (SD1884) to 1 (Normal mode), and the counter type monitor (SD1885) to 1 (Ring counter). 5) The FB modifies the counter enable command (SM1895) and the upper/lower limits of the ring counter. Therefore, if the values are changed by other means, the ladder program may not operate as expected. 6) When FB_OK (completed without error) turns ON, o_NowAngle (current angle) and o_CmpResult (comparison result) are valid. 7) When FB_EN turns OFF, o_NowAngle (current angle) and o_CmpResult (comparison result) are cleared to zero.
FB operation type	Real-time execution type
Application example	Refer to Appendix 1 - FB Library Application examples
Timing chart	[When operation completes without error] [When an error occurs]  
Relevant manuals	MELSEC-L CPU Module User's Manual (Built-in I/O Function)

Error Codes

■ Error code list

Error code	Description	Action
20(Decimal)	Number of comparison ranges setting is not valid. The number of comparisons is not within the range of 1 to 10.	Please try again after confirming the setting.
21(Decimal)	The comparison range value is not valid. At least one of the OFF/ON setting values is not within the range of H0 to H0E0F.	Please try again after confirming the setting.
30(Decimal)	The resolution setting is not valid. The resolution is not within the range of 10 to 32768.	Please try again after confirming the setting.
32(Decimal)	The zero angle setting value is out of range. The zero angle setting is not within the range of 0 to (i_Resolution-1).	Please try again after confirming the setting.
33(Decimal)	The current angle cannot be calculated. The calculated current angle is outside the range of 0 to 3599.	Please try again after confirming the settings.
34(Decimal)	The conditions for FB execution have not been met. Either the CH1 operation mode monitor (SD1884) is not set to 1 (Normal mode), or the CH1 counter type monitor (SD1885) is not set to 1 (Ring counter).	Please try again after confirming the settings.

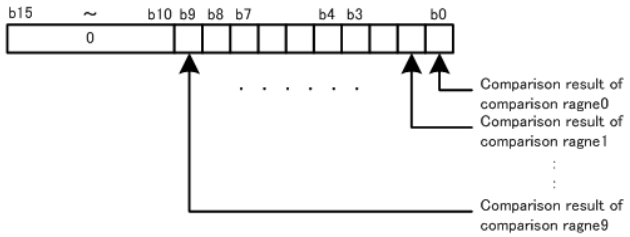
Labels

■ Input labels

Name	Variable name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Resolution	i_Resolution	D	10~32,768	The resolution of the encoder
Zero angle setting value	i_ZeroValue	W	0~(i_Resolution-1)	The value assumed to be 0 degrees.
Number of comparison ranges	i_CmpRangeN	W	1~10	Specify the number of comparisons. For example, when the setting is five, comparison numbers 0 to 4 are used and numbers 5 to 9 are not used.
comparison range 0	i_CmpRange0	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The upper 16 bits correspond to the OFF setting value and the lower 16 bits to the ON setting value, with each OFF / ON setting being in the range of 0 to 3599 (H0 ~ H0EOF).
comparison range 1	i_CmpRange1	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 2	i_CmpRange2	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 3	i_CmpRange3	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 4	i_CmpRange4	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 5	i_CmpRange5	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

Name	Variable name	Data type	Setting range	Description
comparison range 6	i_CmpRange6	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 7	i_CmpRange7	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 8	i_CmpRange8	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 9	i_CmpRange9	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

■ Output labels

Name	Variable name	Data type	The initial value	Description
Execution status	FB_ENO	B	OFF	ON: The FB is active. OFF: The FB is not active.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the comparison operation was successful.
Current angle	o_NowAngle	W	0	Angle value calculated from SD1880~1881, the high speed counter current value, within the range 0~3599.
Comparison result	o_CmpResult	W	H0	This area stores the comparison results. The bits used for comparison will either be ON or OFF depending on the result, and all other (unused) bits will be OFF. 
Error flag	FB_ERROR	B	OFF	When ON, it indicates that an error has occurred.
Error code	ERROR_ID	W	0	FB error code output.

FB Version Upgrade History

Version	Date	Description
1.00A	2010/06/28	First edition

Note

This chapter includes information related to the M+LCPU_IENCCMP1 function block.

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

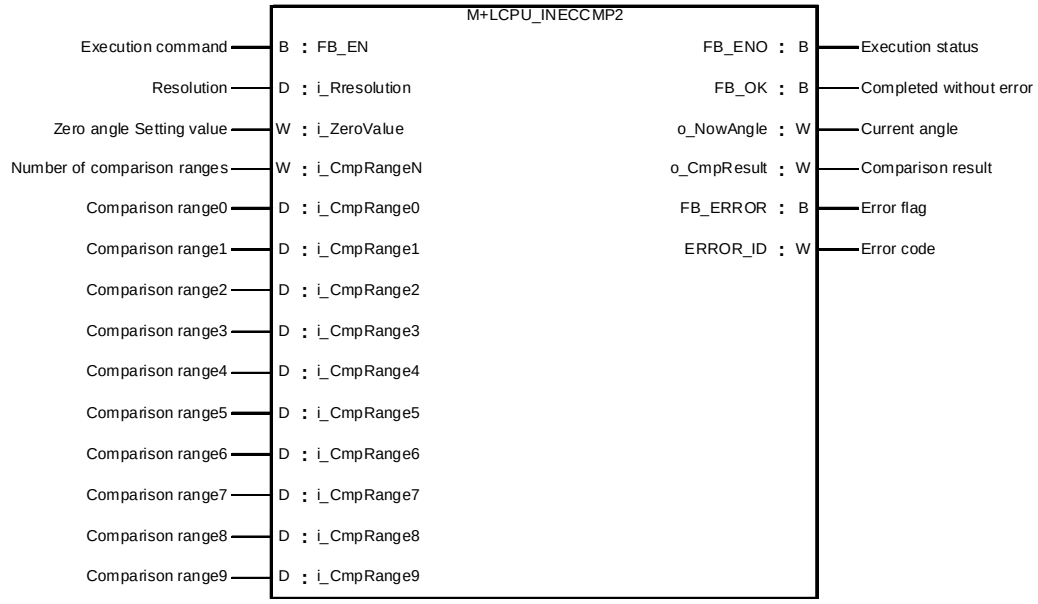
Before using any Mitsubishi products, please read all relevant manuals.

2.4 M+LCPU_IENCCMP2(High-speed counter CH2 incremental encoder comparison)

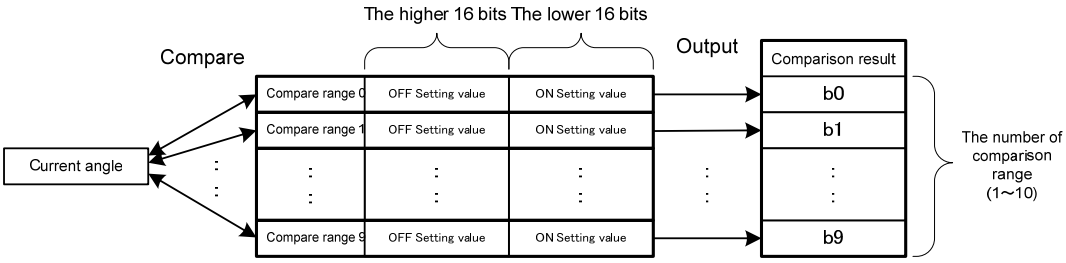
FB Name

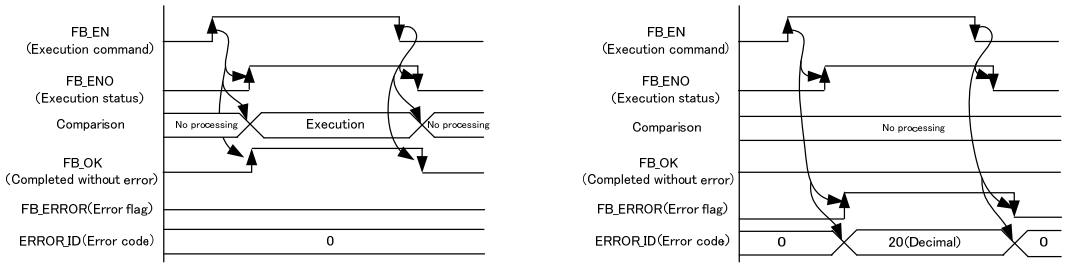
M+LCPU_IENCCMP2

Function Description

<table>
<tr><td>Item</td><td colspan="2">Description</td></tr>
<tr><td>Function overview</td><td colspan="2">Compare the LCPU built-in high-speed counter CH2 current value with two or more data ranges.</td></tr>
<tr><td>Symbol</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Applicable hardware and software</td><td>CPU module</td><td><table><tr><td>Series</td><td>Model</td></tr><tr><td>MELSEC-L Series</td><td>LCPU</td></tr></table></td></tr>
<tr><td>Engineering software</td><td>GX Works2<table><tr><td>Series</td><td>Language</td><td>Software version</td></tr><tr><td rowspan="2">MELSEC-L Series</td><td>English</td><td>Ver 1.31H or later</td></tr><tr><td>Chinese</td><td>Ver 1.49B or later</td></tr></table></td></tr>
<tr><td>Programming language</td><td colspan="2">Ladder</td></tr>
</table>

Item	Description
Number of steps (maximum value)	L Series model CPU: 603* * This value represents the number of steps in a program using labels, and is only a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	1) When the FB_EN (Execution command) is turned ON, the following operations occur: The upper and lower limits of the ring counter are set as the encoder resolution and 0 respectively. The counter enable command (SM1915) is set to ON and the counter is started. Finally, the current value of the high-speed counter (SD1900~1901) is converted to an angle value in units of 0.1degree and the comparison operation is performed. When the FB_EN (Execution command) changes from ON to OFF, the counter enable command (SM1915) is set to OFF, and the counter is stopped. 2) The current angle is calculated using the following method. Current angle (o_NowAngle) calculation method: ・When [SD1900~1901] is greater than or equal to i_ZeroValue (3600 / i_Resolution) * ([1900~1901] - i_ZeroValue) ・When [SD1900~1901] is less than i_ZeroValue (3600 / i_Resolution) * (i_Resolution + [1900~1901] - i_ZeroValue) 3) The comparison operation is performed using data with the following restriction: The current angle, OFF Setting value, and ON Setting value range is 0~3599(0~359.9degree).  Comparer content ・The case of OFF setting value > ON setting value In the case of「OFF Setting valuse＞Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value < ON setting value In the case of「OFF Setting valuse＞Comparison data」or「Comparison data≧ON Setting value」, the correspondence bit of the comparison result is turned on. ・The case of OFF setting value = ON setting value The correspondence bit of the comparison result is always turning off. 4) When the comparison range number is out of range, the FB_ERROR output turns on, processing is interrupted, and the error code is stored in ERROR_ID. Refer to the error code explanation section for details. 5) If more than ten comparison ranges are required, combine with the M+LCPU_FKRCMP (16 bit block data range compare) FB. Refer to the application examples for details.
Compiling method	Macro type

Item	Description
Restrictions and precautions	1) The FB does not include error recovery processing. Program the error recovery processing separately in accordance with the required system operation. 2) The FB cannot be used in an interrupt program. 3) The FB can only be executed once per scan. 4) The following CH2 high-speed counter parameters are necessary for FB operation: Set the operation mode monitor (SD1904) to 1 (Normal mode), and the counter type monitor (SD1905) to 1 (Ring counter). 5) The FB modifies the counter enable command (SM1915) and the upper/lower limits of the ring counter. Therefore, if the values are changed by other means, the ladder program may not operate as expected. 6) When FB_OK (completed without error) turns ON, o_NowAngle (current angle) and o_CmpResult (comparison result) are valid. 7) When FB_EN turns OFF, o_NowAngle (current angle) and o_CmpResult (comparison result) are cleared to zero.
FB operation type	Real-time execution type
Application example	Refer to Appendix 1 - FB Library Application examples
Timing chart	[When operation completes without error] [When an error occurs] 
Relevant manuals	MELSEC-L CPU Module User's Manual (Built-in I/O Function)

Error Codes

■ Error code list

Error code	Description	Action
20(Decimal)	Number of comparison ranges setting is not valid. The number of comparisons is not within the range of 1 to 10.	Please try again after confirming the setting.
21(Decimal)	The comparison range value is not valid. At least one of the OFF/ON setting values is not within the range of H0 to H0E0F.	Please try again after confirming the setting.
30(Decimal)	The resolution setting is not valid. The resolution is not within the range of 10 to 32768.	Please try again after confirming the setting.
32(Decimal)	The zero angle setting value is not valid. The zero angle setting is not within the range of 0 to (i_Resolution-1).	Please try again after confirming the setting.
33(Decimal)	The current angle cannot be calculated because the CH2 current value is outside of the range 0 to (i_Resolution-1).	Please try again after confirming the settings.
34(Decimal)	The conditions for FB execution have not been met. Either the CH2 operation mode monitor (SD1904) is not set to 1 (Normal mode), or the CH2 counter type monitor (SD1905) is not set to 1 (Ring counter).	Please try again after confirming the settings.

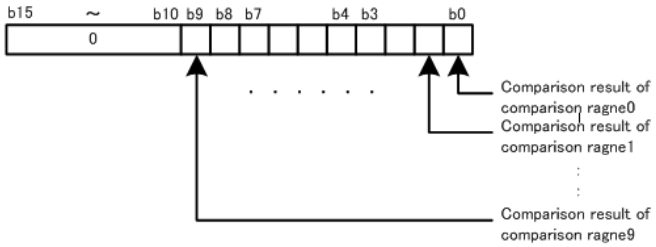
Labels

■ Input labels

Name	Variable name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Resolution	i_Resolution	D	10~32,768	The resolution of the encoder.
Zero angle Setting value	i_ZeroValue	W	0~(i_Resolution-1)	The value assumed to be 0 degrees.
Number of comparison ranges	i_CmpRangeN	W	1~10	Specify the number of comparisons. For example, when the setting is five, comparison numbers 0 to 4 are used and numbers 5 to 9 are not used.
comparison range 0	i_CmpRange0	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The upper 16 bits correspond to the OFF setting value and the lower 16 bits to the ON setting value, with each OFF / ON setting being in the range of 0 to 3599 (H0 ~ H0EOF).
comparison range 1	i_CmpRange1	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 2	i_CmpRange2	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 3	i_CmpRange3	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 4	i_CmpRange4	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 5	i_CmpRange5	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

Name	Variable name	Data type	Setting range	Description
comparison range 6	i_CmpRange6	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 7	i_CmpRange7	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 8	i_CmpRange8	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.
comparison range 9	i_CmpRange9	D	H0~H0E0F0EOF (Upper / lower 16 bits each,H0~H0E0F)	Specify a comparison range. The same conditions apply to this setting as to comparison range 0.

■ Output labels

Name	Variable name	Data type	The initial value	Description
Execution status	FB_ENO	B	OFF	ON: The FB is active. OFF: The FB is not active.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the comparison operation was successful.
Current angle	o_NowAngle	W	0	Angle value calculated from SD1900~1901, the high speed counter current value, within the range 0~3599.
Comparison result	o_CmpResult	W	H0	This area stores the comparison results. The bits used for comparison will either be ON or OFF depending on the result, and all other (unused) bits will be OFF. 
Error flag	FB_ERROR	B	OFF	When ON, it indicates that an error has occurred.
Error code	ERROR_ID	W	0	FB error code output.

FB Version Upgrade History

Version	Date	Description
1.00A	2010/06/28	First edition

Note

This chapter includes information related to the M+LCPU_IENCCMP2 function block.

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

Before using any Mitsubishi products, please read all relevant manuals.

Appendix 1 - FB Library Application examples

Note

This chapter provides some FB programming examples.

It does not include restrictions on the usage or combination of intelligent function modules and programmable controller CPUs.

Before using the products, please read the relevant manuals.

System Configuration Example

Power Supply Module	**L26CPU-BT** **(Input : X00~X0F)** **(Output : Y00~Y0F)**

Reminder

1) Every input must be provided with a value for proper FB operation.
   If not set, the values will be unspecified.
2) Abbreviations may be used in the label comments due to the limitation on the number of the characters to display in GX Works2.

List of Devices

External input (commands)

Device	Item name of FB	Application (ON details)
M0	16 bit block data range compare	The commannd of FB execution
M10	Absolute encoder value comparison	The commannd of FB execution
M20	High-speed counter CH1 incremental encoder comparison	The commannd of FB execution
M30	High-speed counter CH2 incremental encoder comparison	The commannd of FB execution

Data register

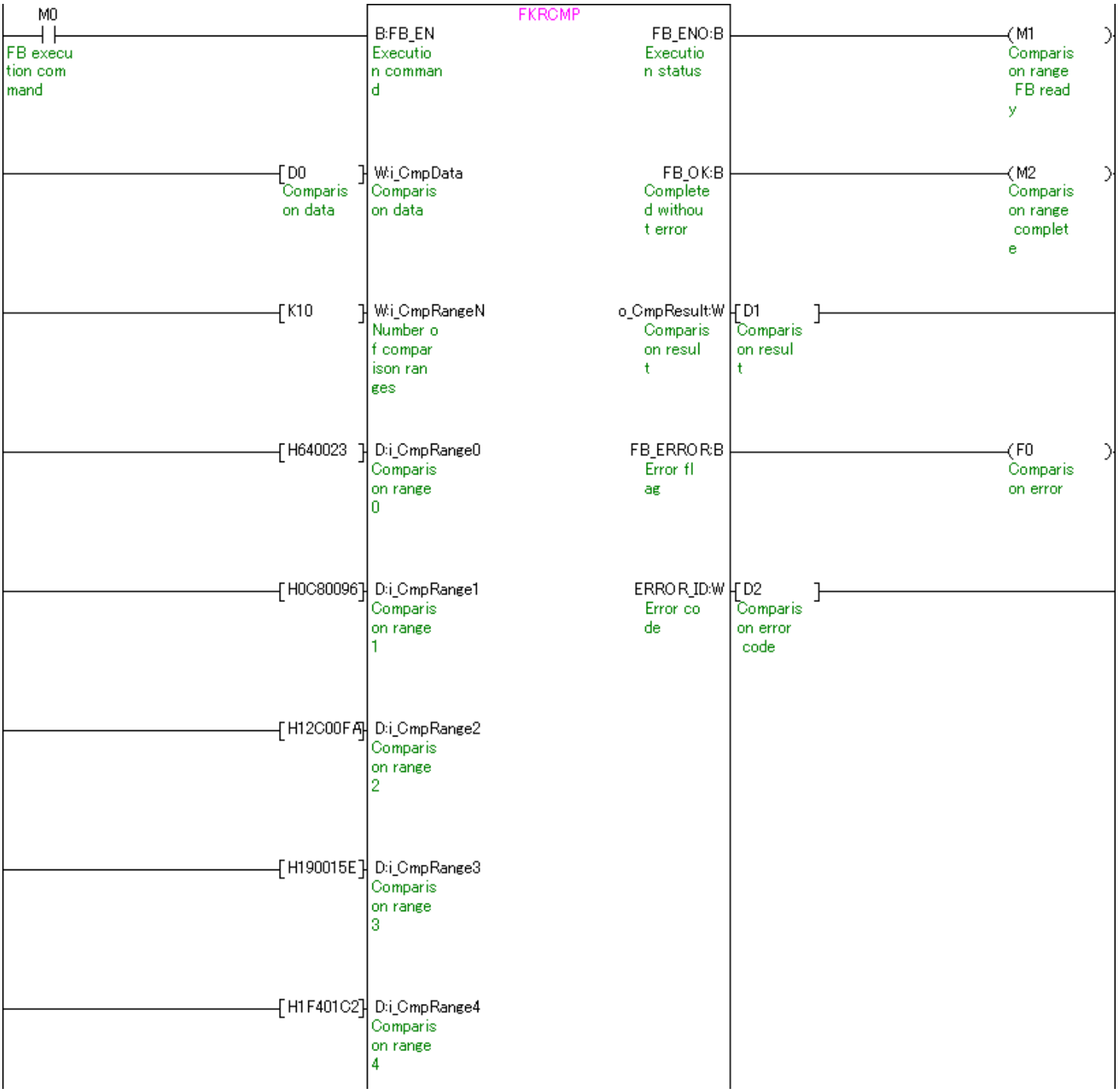
Device	FB name	Application
D0	16 bit block data range compare	Comparison data
D1		Comparison result
D2		Comparison error code
D10	Absolute encoder value comparison	Absolute encoder value
D11		Comparison current angle
D12		Comparison result
D13		Comparison error code
D20	High-speed counter CH1 incremental encoder comparison	Current angle
D21		Comparison result
D22		Comparison error code
D30	High-speed counter CH2 incremental encoder comparison	Current angle
D31		Comparison result
D32		Comparison error code

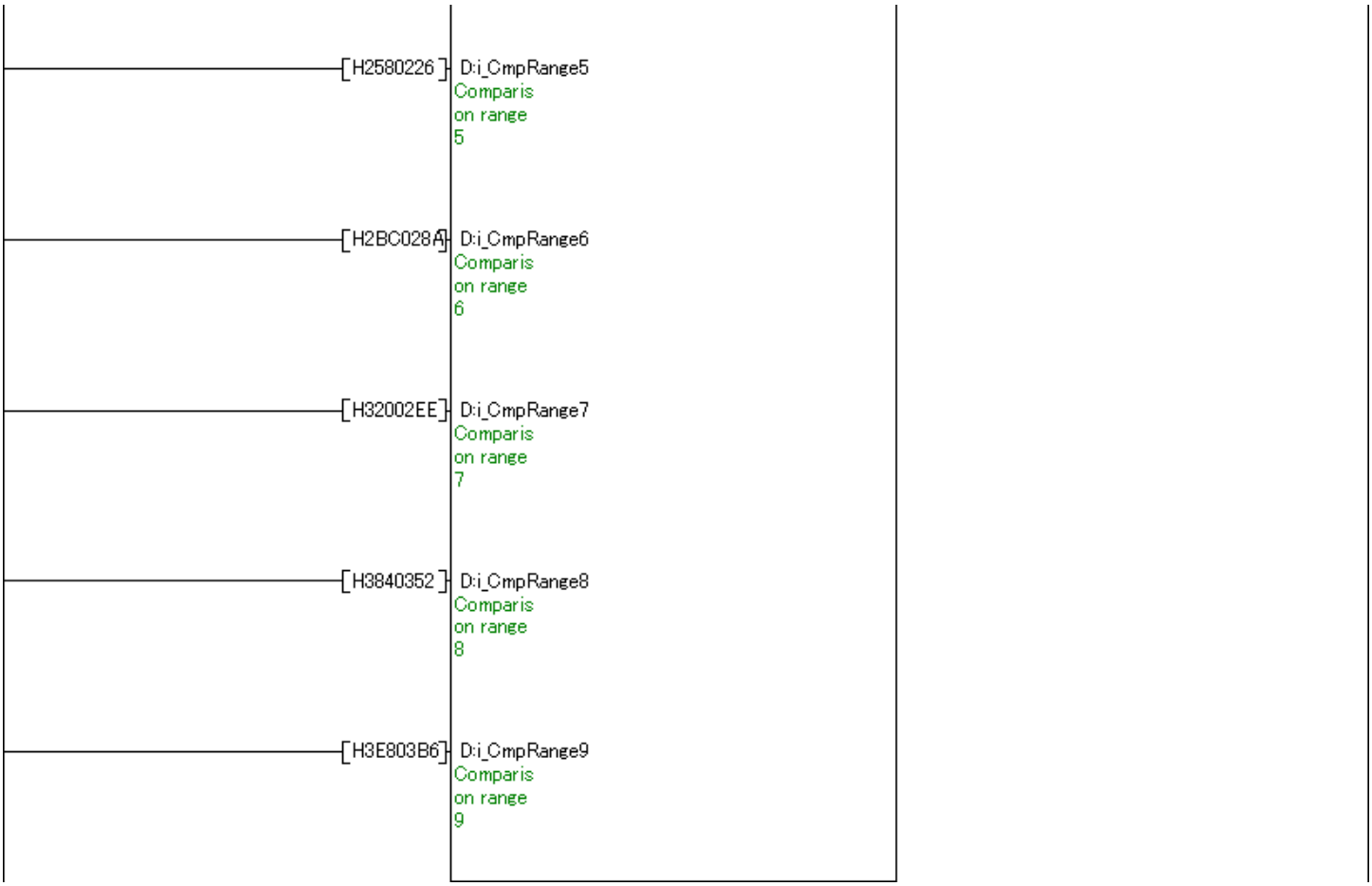
External output (checks)

Device	Item name of FB	Application (ON details)
M1	16 bit block data range compare	Comparison range FB ready
M2		Comparison range complete
F0		Comparison error
M11	Absolute encoder value comparison	Perform comparative FB Ready
M12		Comparison normal completion
F5		Comparison error
M21	High-speed counter CH1 incremental encoder comparison	Perform comparative FB Ready
M22		Comparison normal completion
F10		Comparison error
M31	High-speed counter CH2 incremental encoder comparison	Perform comparative FB Ready
M32		Comparison normal completion
F15		Comparison error

Program

M+LCPU_FKRCMP(16 bit block data range compare)

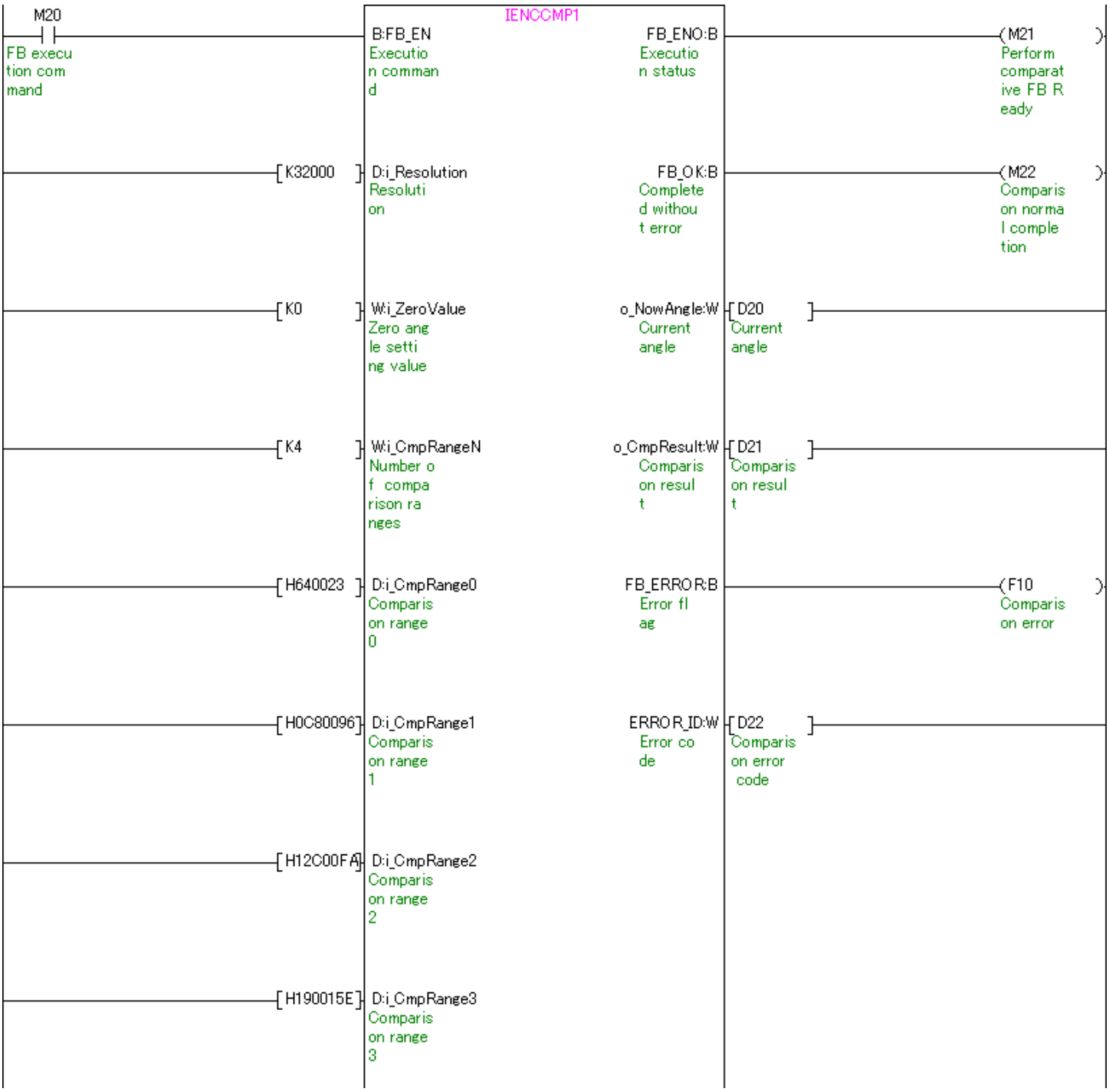


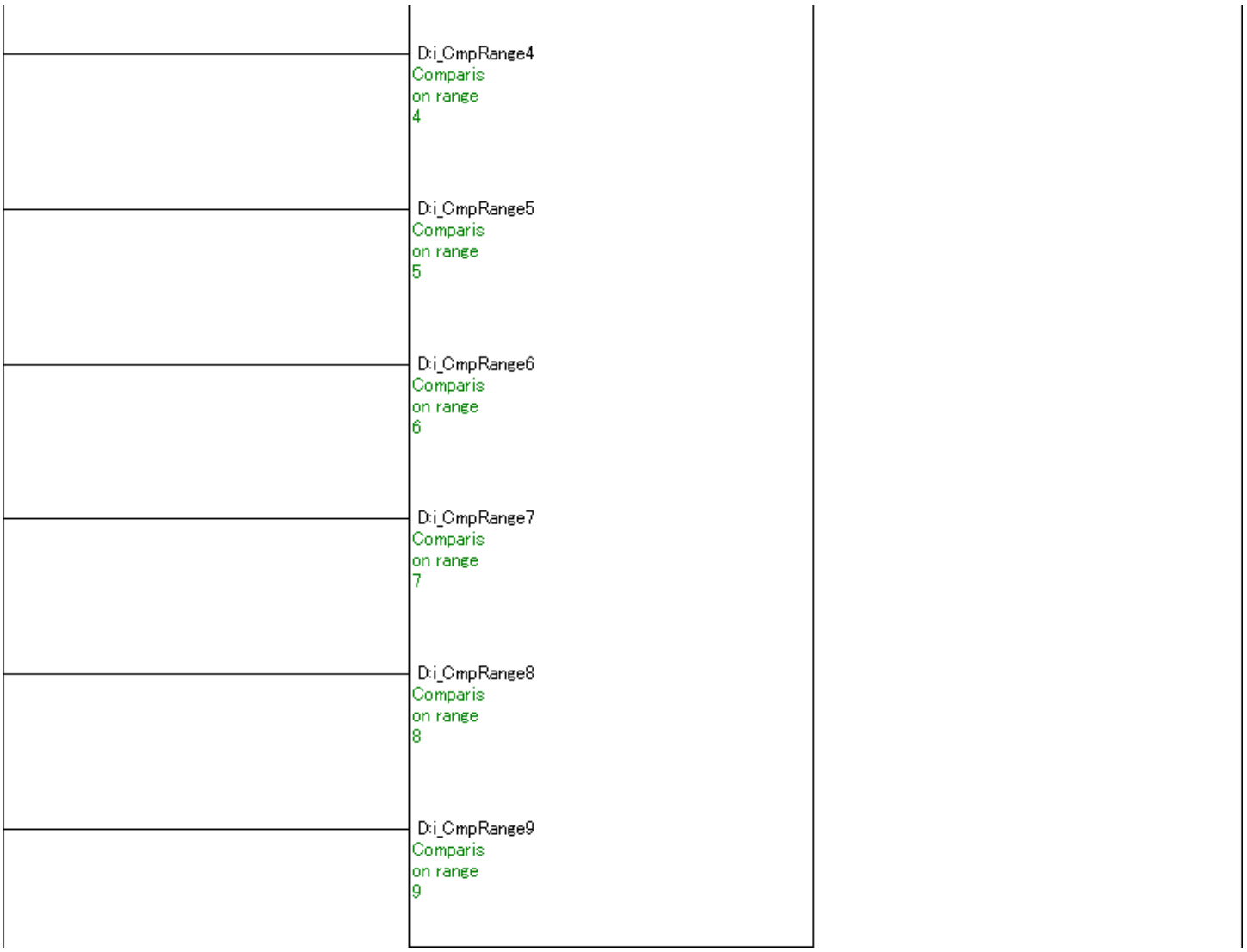

H2580226
D:i_CmpRange5
Comparis
on range
5
H2BC028A
D:i_CmpRange6
Comparis
on range
6
H32002EE
D:i_CmpRange7
Comparis
on range
7
H3840352
D:i_CmpRange8
Comparis
on range
8
H3E803B6
D:i_CmpRange9
Comparis
on range
9

M+LCPU_AENCCMP(Absolute encoder value comparison)

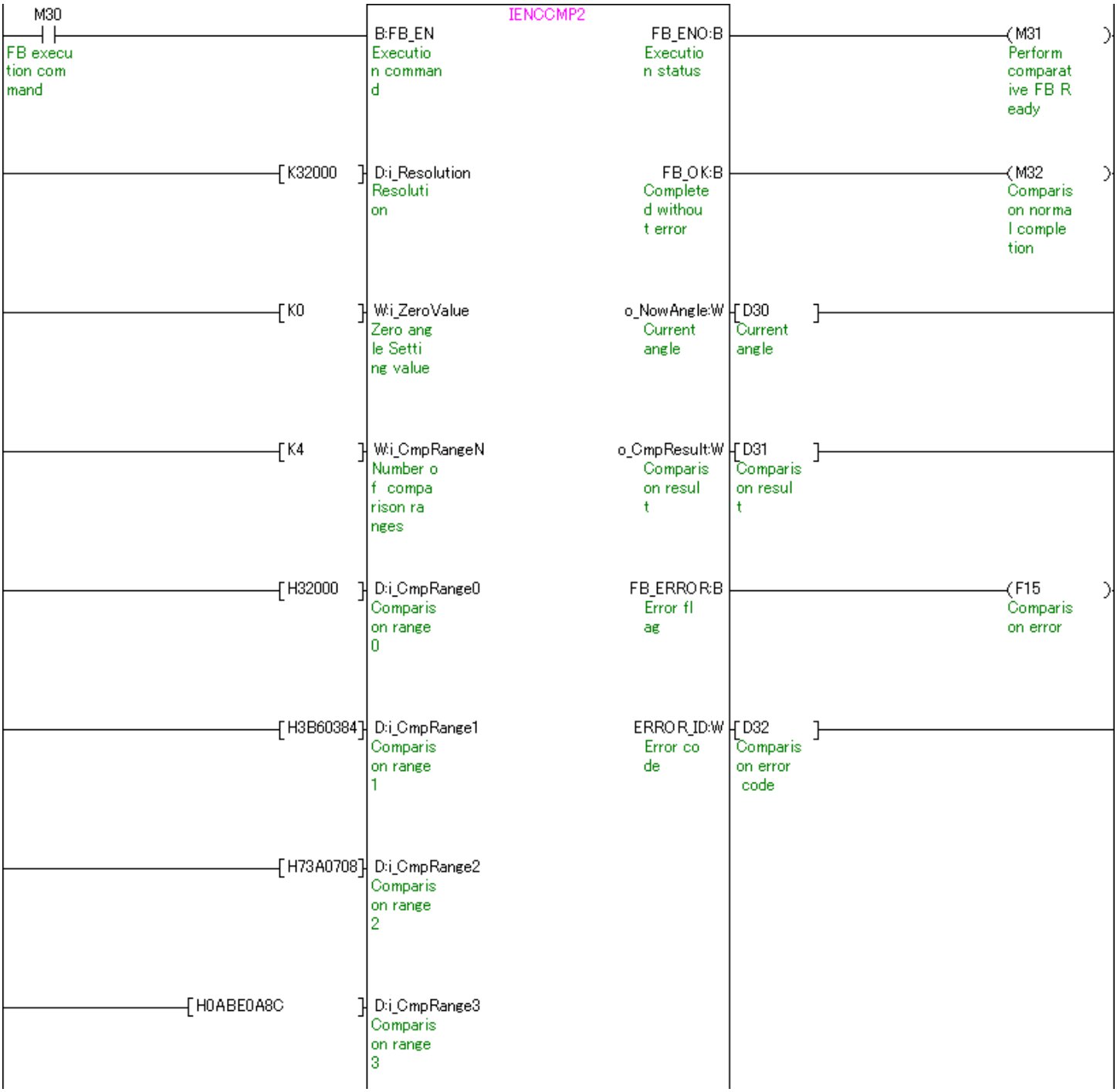
H4C404B0
D:i_CmpRange2
Comparis
on range
2
H6540640
D:i_CmpRange3
Comparis
on range
3
H7E407D4
D:i_CmpRange4
Comparis
on range
4
H9740960
D:i_CmpRange5
Comparis
on range
5
H0B040AF0
D:i_CmpRange6
Comparis
on range
6
H0CE40C80
D:i_CmpRange7
Comparis
on range
7
D:i_CmpRange8
Comparis
on range
8
D:i_CmpRange9
Comparis
on range
9

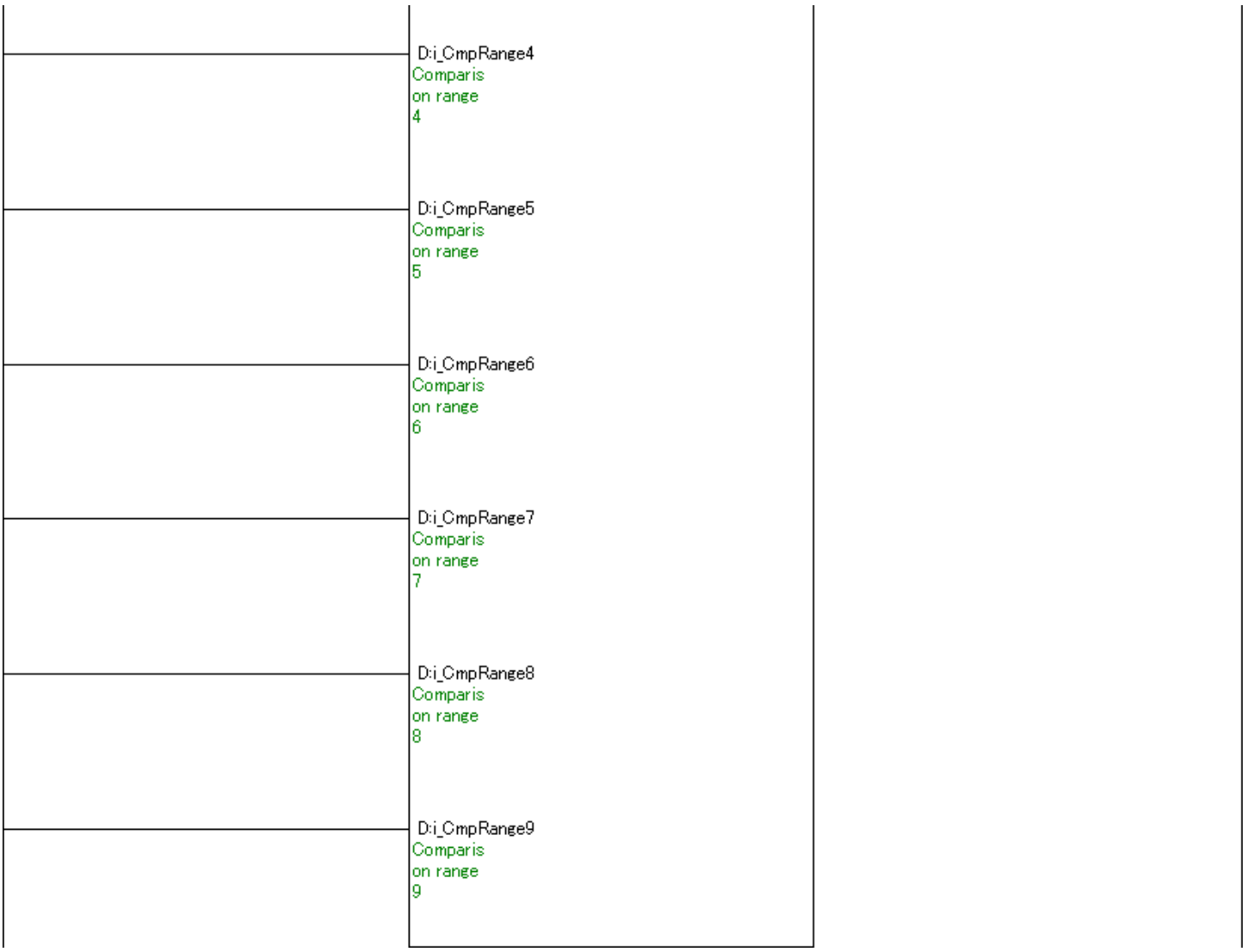
M+LCPU_IENCCMP1(High-speed counter CH1 incremental encoder comparison)



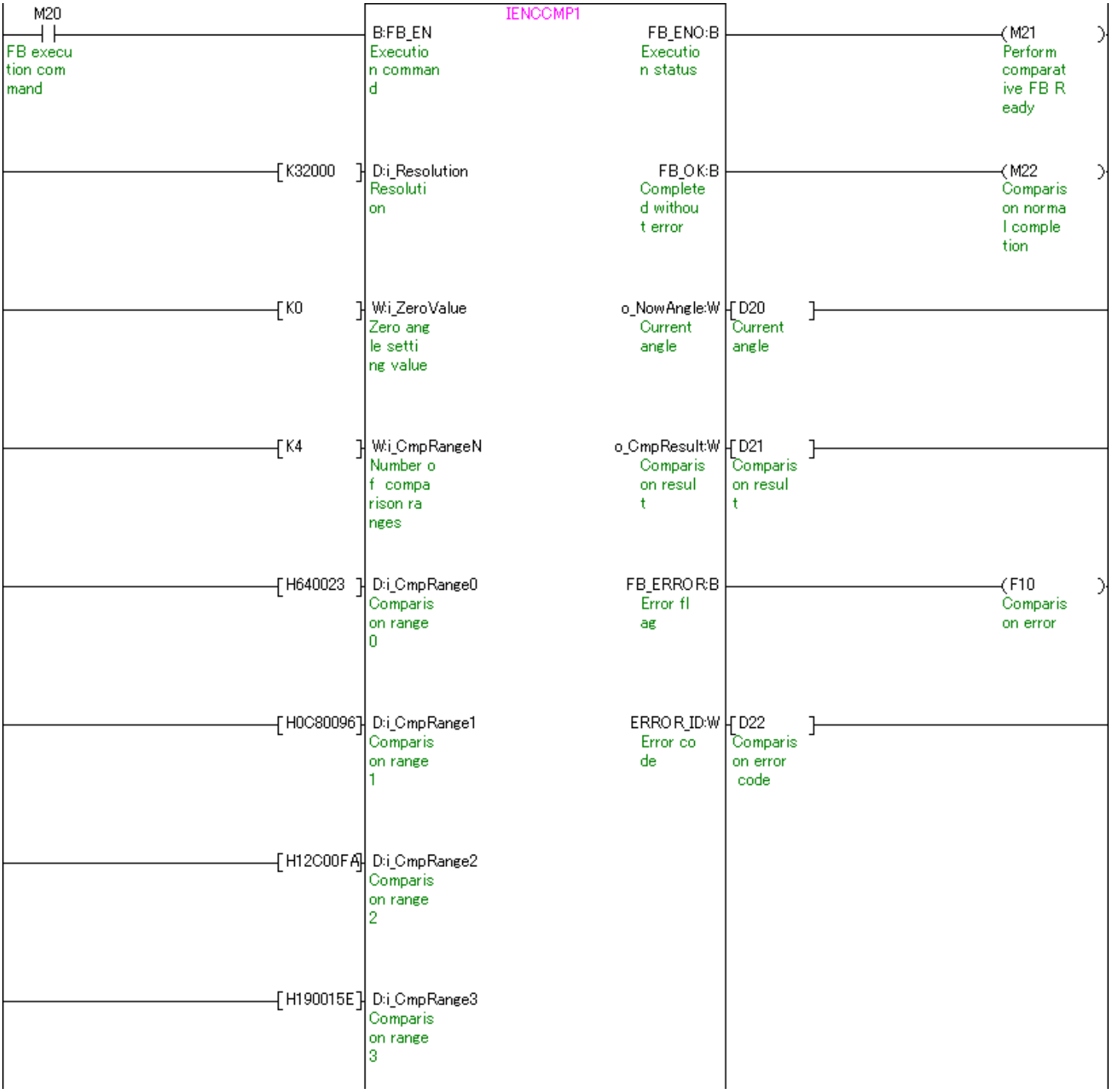

D:i_CmpRange4
Comparison range 4
D:i_CmpRange5
Comparison range 5
D:i_CmpRange6
Comparison range 6
D:i_CmpRange7
Comparison range 7
D:i_CmpRange8
Comparison range 8
D:i_CmpRange9
Comparison range 9

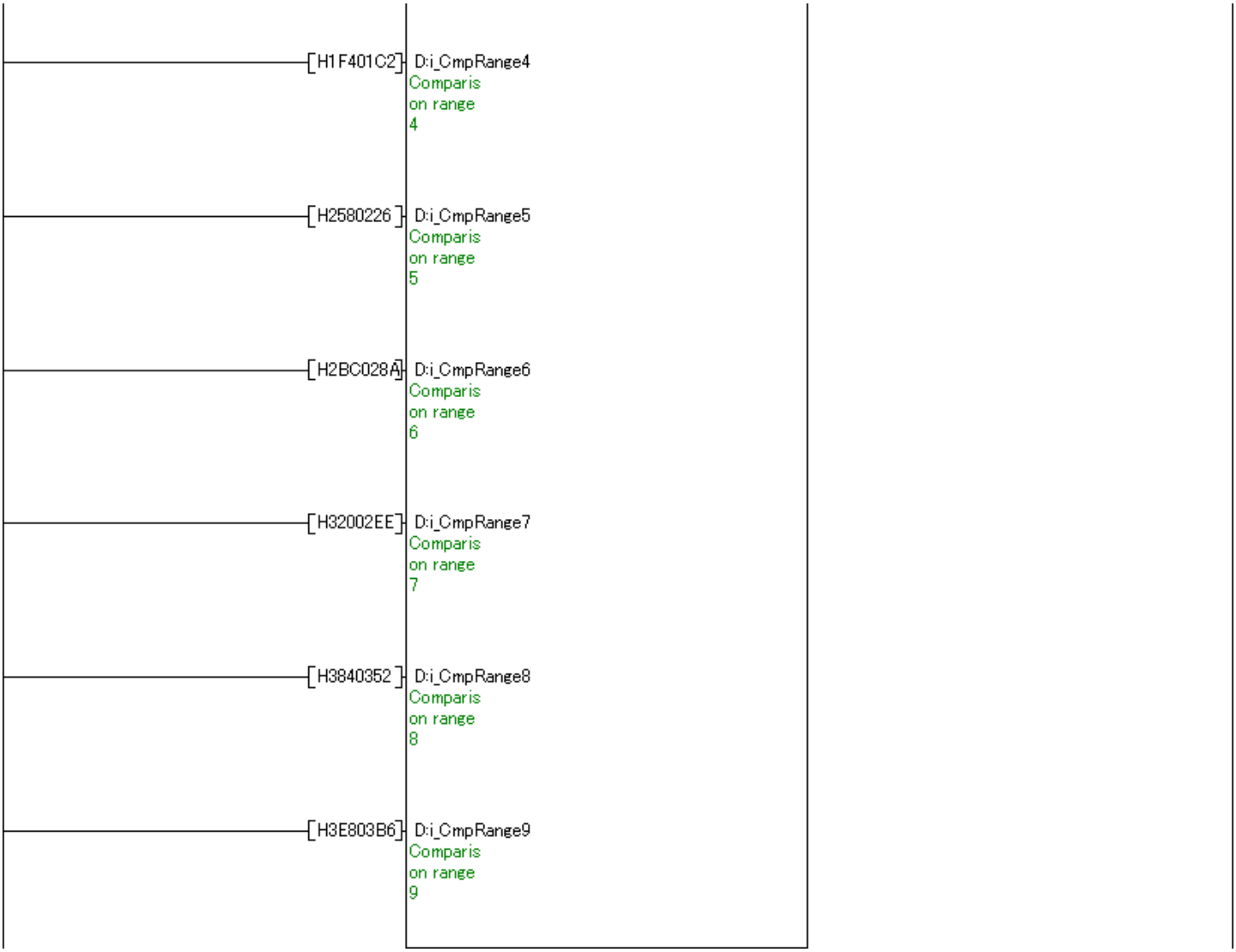
M+LCPU_IENCCMP2(High-speed counter CH2 incremental encoder comparison)

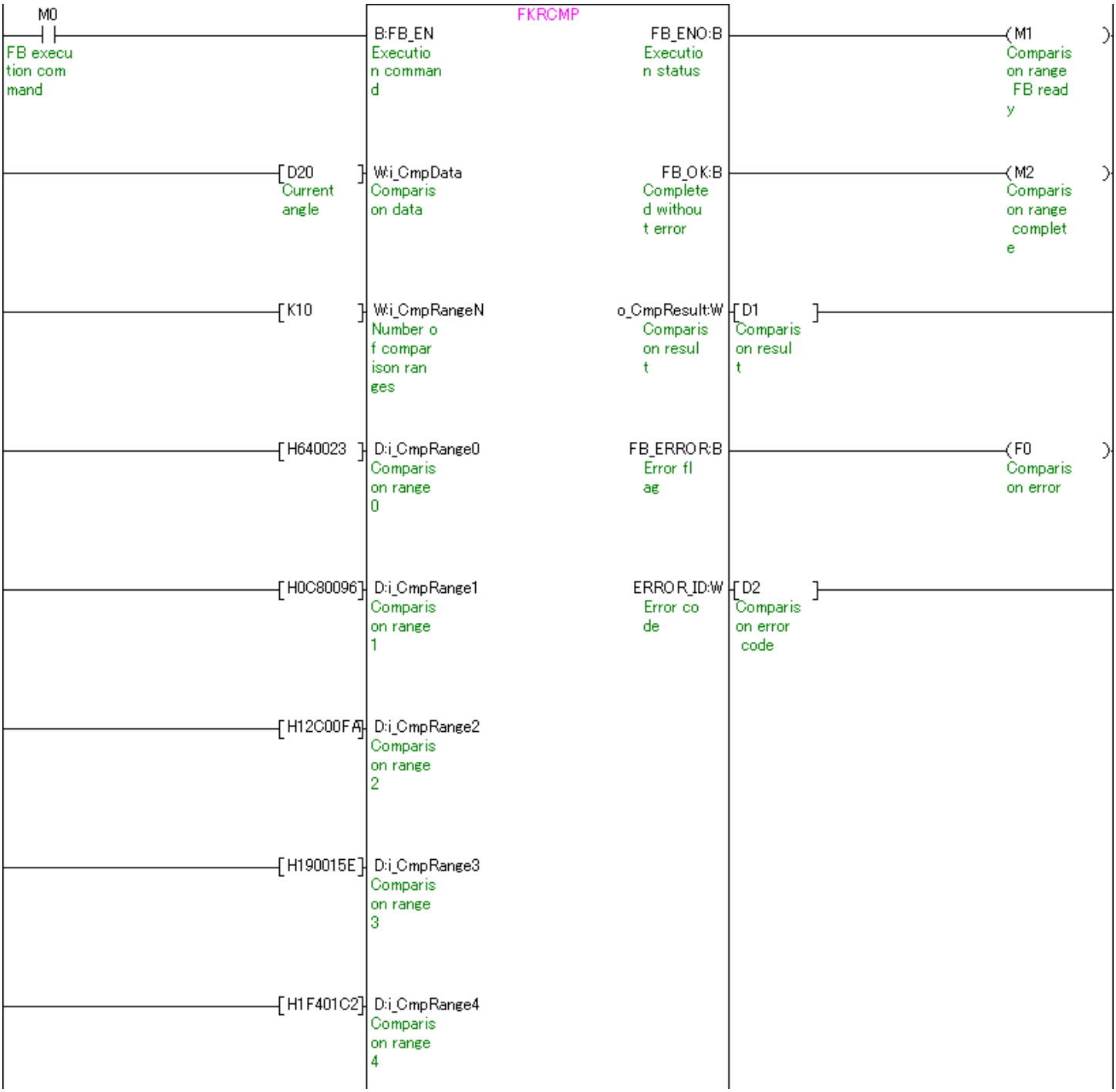


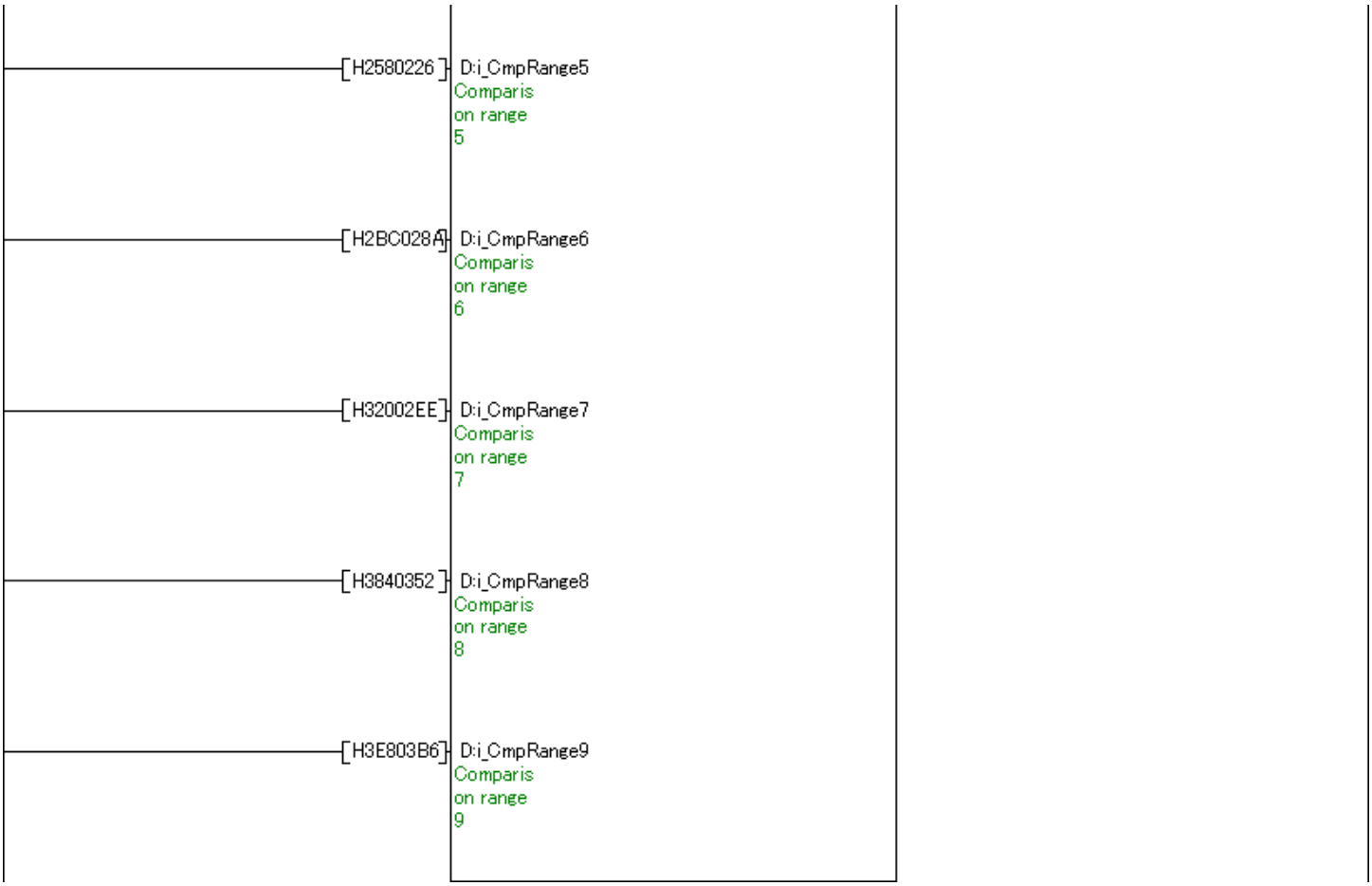

D:i_CmpRange4
Comparison range 4
D:i_CmpRange5
Comparison range 5
D:i_CmpRange6
Comparison range 6
D:i_CmpRange7
Comparison range 7
D:i_CmpRange8
Comparison range 8
D:i_CmpRange9
Comparison range 9

M+LCPU_IENCCMP1(Example where more than 10 points are compared)




H1F401C2
D:i_CmpRange4
Comparis
on range
4
H2580226
D:i_CmpRange5
Comparis
on range
5
H2BC028A
D:i_CmpRange6
Comparis
on range
6
H32002EE
D:i_CmpRange7
Comparis
on range
7
H3840352
D:i_CmpRange8
Comparis
on range
8
H3E803B6
D:i_CmpRange9
Comparis
on range
9


M0
FB execu
tion com
mand
FKRCMP
B:FB_EN
Executio
n comman
d
FB_ENO:B
Executio
n status
M1
Comparis
on range
FB read
y
D20
Current
angle
W:i_CmpData
Comparis
on data
FB_OK:B
Complete
d withou
t error
M2
Comparis
on range
complet
e
K10
W:i_CmpRangeN
Number o
f compar
ison ran
ges
o_CmpResult:W
Comparis
on resul
t
D1
Comparis
on resul
t
H640023
D:i_CmpRange0
Comparis
on range
0
FB_ERROR:B
Error fl
ag
F0
Comparis
on error
H0C80096
D:i_CmpRange1
Comparis
on range
1
ERROR_ID:W
Error co
de
D2
Comparis
on error
code
H12C00FA
D:i_CmpRange2
Comparis
on range
2
H190015E
D:i_CmpRange3
Comparis
on range
3
H1F401C2
D:i_CmpRange4
Comparis
on range
4


H2580226
D:i_CmpRange5
Comparis
on range
5
H2BC028A
D:i_CmpRange6
Comparis
on range
6
H32002EE
D:i_CmpRange7
Comparis
on range
7
H3840352
D:i_CmpRange8
Comparis
on range
8
H3E803B6
D:i_CmpRange9
Comparis
on range
9