DATA OPERATION FB LIBRARY REFERENCE MANUAL

<CONTENTS>

Reference Manual Revision History

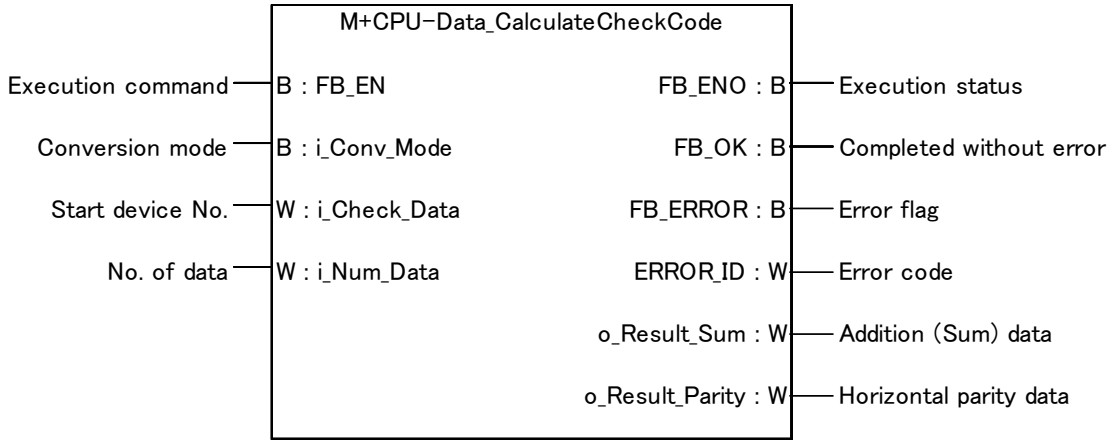
Reference Manual Number	Date	Description
FBM-M047-A	2011/03/22	First edition

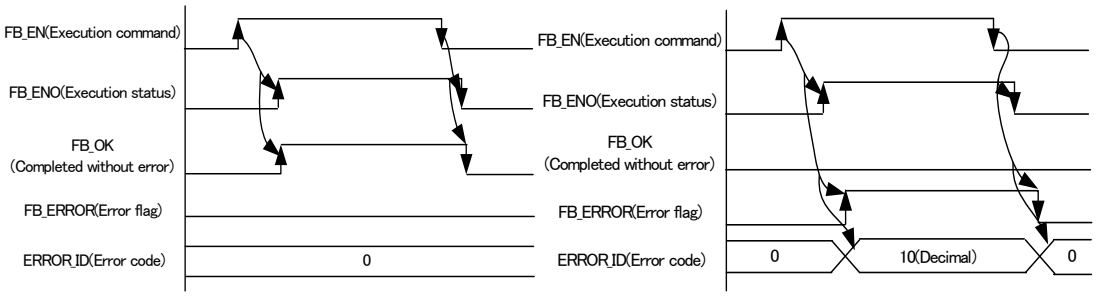
1. M+CPU-Data_CalculateCheckCode (Check code calculation)

FB Name

M+CPU-Data_CalculateCheckCode

Function Overview

Item	Description
Function overview	Calculates the horizontal parity value and addition value (sum), which are used to check for errors in communication, etc.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 258* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	1) By turning ON FB_EN (Execution command), the addition value and horizontal parity value of the check data are calculated. Two types of conversion modes are supported: 16-bit conversion mode and 8-bit conversion mode. In the 8-bit conversion mode, only the lower 8 bits of each check data are valid. 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9 and Z8. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Data (No. of data) is not valid. Set the number of data within the range of 1 to 256, and turn OFF FB_EN and then ON again.

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.
Conversion mode	i_Conv_Mode	B	OFF: 16-bit conversion mode ON: 8-bit conversion mode	Specify the input type for the check data.
Start device No.	i_Check_Data	W	Valid device range	Set the start device of the device to be checked.
No. of data	i_Num_Data	W	1~256	Specify the number of data to be checked.

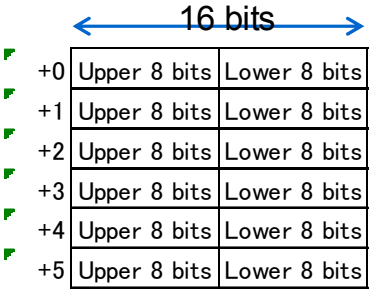
■Output labels

Name	Variable name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Addition (Sum) data	o_Result_Sum	W	0	Return the addition (Sum) data that was calculated.
Horizontal parity data	o_Result_Parity	W	0	Return the horizontal parity data that was calculated.

Processing description

1) Data to be checked in each conversion mode are as follows.

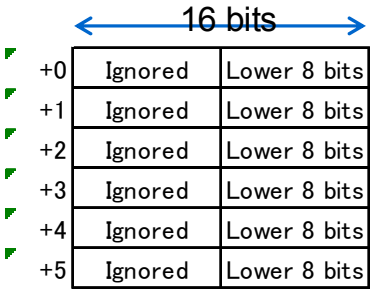
16-bit conversion mode (when i_Num_Data (No. of data) is 6)



	Decimal	Hexadecimal	
		Upper	Lower
D0	24932	H61	H64
D1	4219	H10	H7B
D2	−1333	HFA	HCB
D3	−1	HFF	HFF
D4	32761	H7F	HF9
D5	10000	H27	H10

In the above 16-bit conversion mode example, the 6 bytes shown in the shaded cells are added up. Thus the addition data becomes H315 (789 $_{decimal}$). ---1)

8-bit conversion mode (i_Num_Data (No. of data) is 6)



	Decimal	Hexadecimal	
		Upper	Lower
D0	24932	H61	H64
D1	4219	H10	H7B
D2	−1333	HFA	HCB
D3	−1	HFF	HFF
D4	32761	H7F	HF9
D5	10000	H27	H10

In the above 8-bit conversion mode example, the 6 bytes shown in the shaded cells are added up.Thus the addition data becomes H3B2 (946 $_{decimal}$). --- 2)

2) Stores the total sum value of the target data, which was calculated for every 8 bits, in the addition (sum) data.

•16-bit conversion mode --- 1) •8-bit conversion mode --- 2)

3) The number of ONs of each bit of the target data is calculated for every 8 bits. Ultimately the parity value is calculated so that the horizontal parity value is turned ON when the number of ONs is odd, and the horizontal parity value is turned OFF when the number of ONs is even. Then, the parity value is stored in the horizontal parity data.

<Horizontal parity is ON when No. of ONs is odd> <Horizontal parity is OFF when No. of ONs is even>

•16-

MSB							LSB
0	0	1	1	1	0	0	0

	Decimal	Hexadecimal	
		Upper	Lower
D0	24932	H61	H64
D1	4219	H10	H7B
D2	−1333	HFA	HCB
D3	−1	HFF	HFF
D4	32761	H7F	HF9
D5	10000	H27	H10

The data in the shaded cells are used to calculate the horizontal parity.

•8-bit c

MSB							LSB
0	0	1	0	1	0	0	0

	Decimal	Hexadecimal	
		Upper	Lower
D0	24932	H61	H64
D1	4219	H10	H7B
D2	−1333	HFA	HCB
D3	−1	HFF	HFF
D4	32761	H7F	HF9
D5	10000	H27	H10

The data in the shaded cells are used to calculate the horizontal parity.

The horizontal parity value is calculated as follows.

•16-bit conversion mode

	Upper 8 bits	Lower 8 bits
D0	01100001	01100100
D1	00010000	01111011
D2	11111010	11001011

	b7	b6	b5	b4	b3	b2	b1	b0	
Upper 8 bits of D0	0	1	1	0	0	0	0	1	H61
Lower 8 bits of D0	0	1	1	0	0	1	0	0	H64
Upper 8 bits of D1	0	0	0	1	0	0	0	0	H10
Lower 8 bits of D1	0	1	1	1	1	0	1	1	H7B
Upper 8 bits of D2	1	1	1	1	1	0	1	0	HFA
Lower 8 bits of D2	1	1	0	0	1	0	1	1	HCB
Horizontal parity value (D10)	0	1	0	1	1	1	1	1	H5F

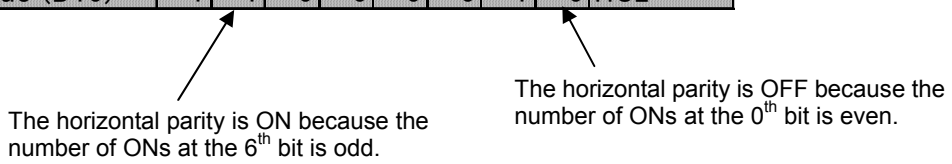
The horizontal parity is OFF because the number of ONs at the 5th bit is even.

The horizontal parity is ON because the number of ONs at the 0th bit is odd.

•8-bit conversion mode

	Lower 8 bits
D0	01100100
D1	01111011
D2	11001011
D3	11111111
D4	11111001
D5	00010000

	b7	b6	b5	b4	b3	b2	b1	b0	
Lower 8 bits of D0	0	1	1	0	0	1	0	0	H64
Lower 8 bits of D1	0	1	1	1	1	0	1	1	H7B
Lower 8 bits of D2	1	1	0	0	1	0	1	1	HCB
Lower 8 bits of D3	1	1	1	1	1	1	1	1	HFF
Lower 8 bits of D4	1	1	1	1	1	0	0	1	HF9
Lower 8 bits of D5	0	0	0	1	0	0	0	0	H10
Horizontal parity value (D10)	1	1	0	0	0	0	1	0	HC2



Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_CalculateCheckCode function block.

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

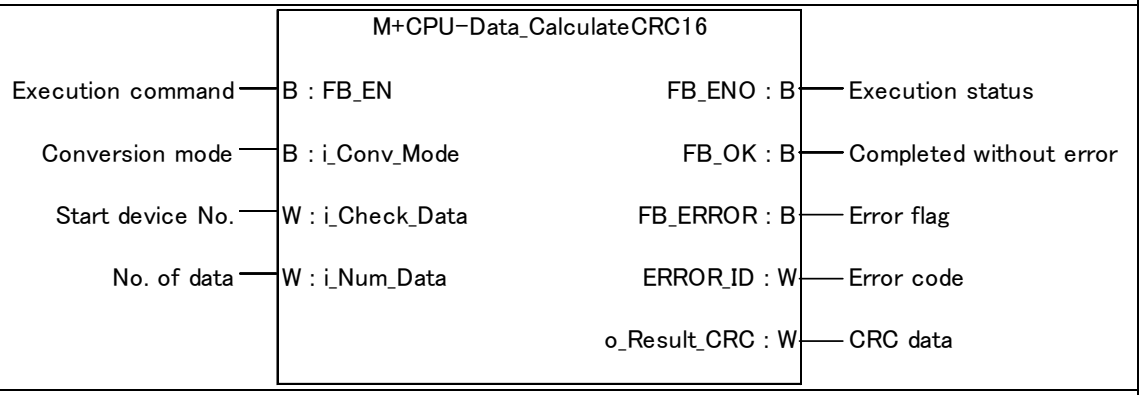
Before using any Mitsubishi products, please read all the relevant manuals.

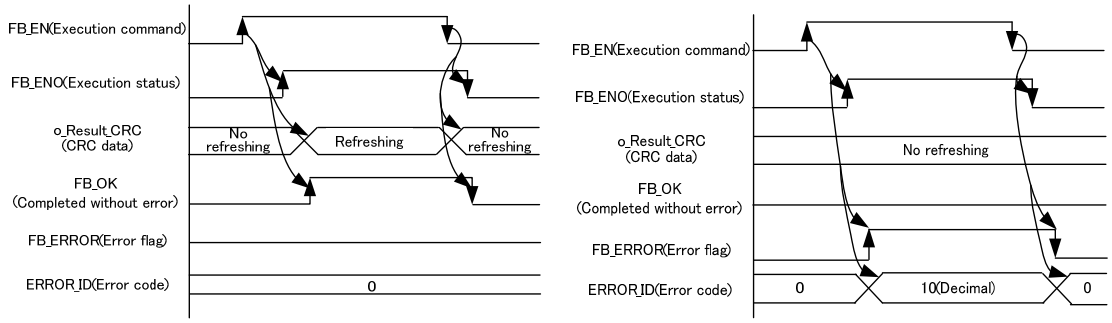
2. M+CPU-Data_CalculateCRC16 (CRC-16 calculation)

FB Name

M+CPU-Data_CalculateCRC16

Function Overview

Item	Description
Function overview	Calculates CRC-16 (Cyclic Redundancy Check) value, which is one of the error check methods used for communication.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 279* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	1) By turning ON FB_EN (Execution command), the CRC-16 value is calculated. Two types of conversion modes are supported: 16-bit conversion mode and 8-bit conversion mode. In the 8-bit conversion mode, only the lower 8 bits of each check data are valid. The calculation is performed in the following polynomial, using CRC-16 as a CRC value. $[X^{16} + X^{15} + X^2 + 1]$ 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9 and Z8. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Data (No. of data) is not valid. Set the number of data within the range of 1 to 256, and turn OFF FB_EN and then ON again.

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.
Conversion mode	i_Conv_Mode	B	OFF: 16-bit conversion mode ON: 8-bit conversion mode	Specify the input type of the check data.
Start device No.	i_Check_Data	W	Valid device range	Set the start device of the device to be checked.
No. of data (in byte units)	i_Num_Data	W	1~256	Specify the number of data to be checked.

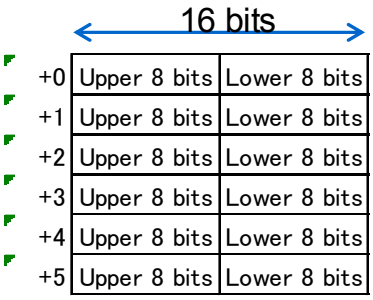
■Output labels

Name	Variable name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
CRC data	o_Result_CRC	W	0	Return the CRC data that was calculated.

Processing description

(1) Data to be checked in each conversion mode are as follows.

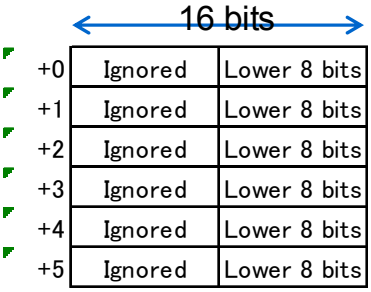
16-bit conversion mode (when i_Num_Data (No. of data) is 6)



	Decimal	Hexadecimal	
		Upper	Lower
D0	24932	H61	H64
D1	4219	H10	H7B
D2	−1333	HFA	HCB
D3	−1	HFF	HFF
D4	32761	H7F	HF9
D5	10000	H27	H10

In the example above, the target data are the 6 bytes shown in the shaded cells of the right table.

8-bit conversion mode (i_Num_Data (No. of data) is 6)



	Decimal	Hexadecimal	
		Upper	Lower
D0	24932	H61	H64
D1	4219	H10	H7B
D2	−1333	HFA	HCB
D3	−1	HFF	HFF
D4	32761	H7F	HF9
D5	10000	H27	H10

In the example above, the target data are the 6 bytes shown in the shaded cells of the right table.

(2) The target data are used as variables in groups of 8 bits when calculating CRC-16. The CRC value is calculated using the following polynomial and is stored in the CRC data.

Polynomial for CRC-16:

$X^{16} + X^{15} + X^2 + 1$

16-bit conversion mode HA57B (-23173 $_{decimal}$)

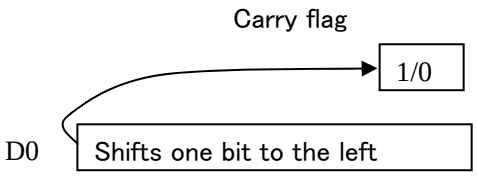
8-bit conversion mode HBDA1 (-16991 $_{decimal}$)

CRC-16 is calculated as follows.

The polynomial is $X^{16} + X^{15} + X^2 + 1$.

A: Internal label

1. Clears A to zero.
2. Loops by the calculated data length (by No. of data).
   (a) Reads one byte of the data.
   (b) Loops 8 times.



   1) Shifts the data one bit to the left (the carry flag is set for overflow).
   2) Rotates A one bit to the left (substitute LSB with the above carry flag).
   3) If overflow occurs when exceeding 16 bits, performs an XOR operation for A using the polynomial.
3. Stores the result A in the CRC data when all data have been processed.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_CalculateCRC16 function block.

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

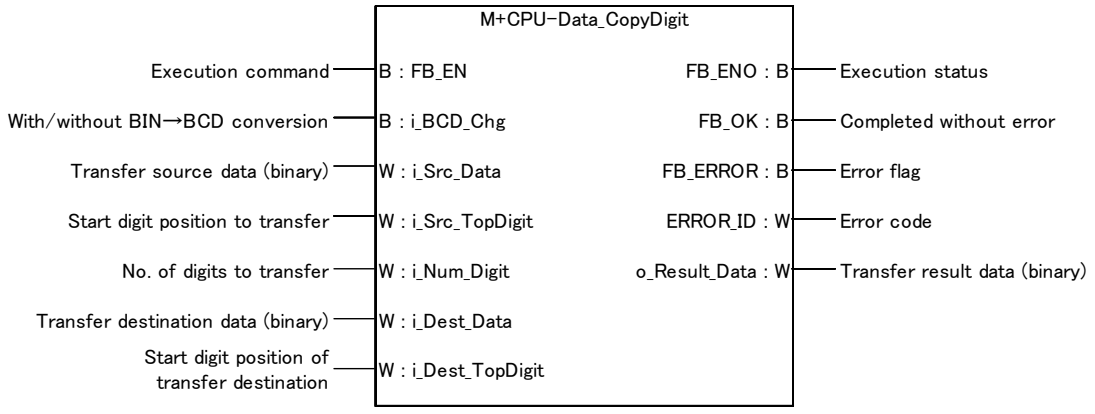
Before using any Mitsubishi products, please read all the relevant manuals.

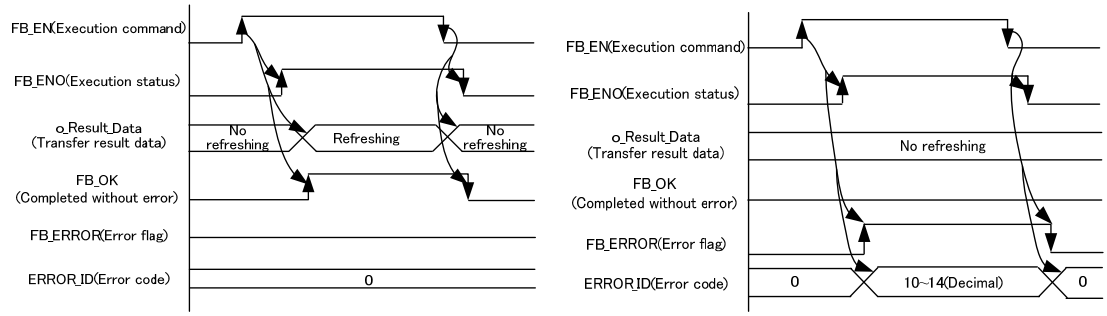
3. M+CPU-Data_CopyDigit (Digit copy)

FB Name

M+CPU-Data_CopyDigit

Function Overview

Item	Description
Function overview	Copies 16-bit data by digits (4 bits per digit).
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 343* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	1) Copy data in digits of 4 bits according to the start position and number of digits to transfer of the source data and the start digit position of the transfer destination. With/without BIN →BCD conversion enables to perform a BIN/BCD conversion. 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). Refer to the error code explanation section for details.

Item	Description
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.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Src_TopDigit (Start digit position to transfer) is not valid. Please try again after confirming the setting. This error occurs when the difference of [Start digit position to transfer] minus [No. of digits to transfer] is smaller than 0.
11	i_Num_Digit (No. of digits to transfer) is not valid. Please try again after confirming the setting.
12	i_Dest_TopDigit (Start digit position of transfer destination) is not valid. Please try again after confirming the setting. This error occurs when the difference of [Start digit position of transfer destination] minus [No. of digits to transfer] is smaller than 0.
13	i_Src_Data (Transfer source data) is not valid. Only when with/without BIN→BCD conversion is enabled. Please try again after confirming the setting.

Error code	Description
14	i_Dest_Data (Transfer destination data) is not valid. Only when with/without BIN→BCD conversion is enabled. Please try again after confirming the setting.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
With/without BIN→BCD conversion	i_BCD_Chg	B	ON, OFF	OFF: Do not perform conversion. ON: Perform conversion.
Transfer source data	i_Src_Data	W	Without BCD conversion: -32768~32767 With BCD conversion: 0~9999	Specify the source data to transfer from.
Start digit position to transfer	i_Src_TopDigit	W	1~4 [Start digit position to transfer]-[No. of digits to transfer]≥0	Specify the start digit position to transfer from.
No. of digits to transfer	i_Num_Digit	W	1~4	Set the number of digits to transfer from.
Transfer destination data	i_Dest_Data	W	Without BCD conversion: -32768~32767 With BCD conversion: 0~9999	Specify the destination data to transfer to.
Start digit position of transfer destination	i_Dest_TopDigit	W	1~4 [Start digit position of transfer destination] – [No. of digits to transfer]≥0.	Set the position of the start digit to transfer to.

■Output labels

Name	Label name	Data type	Initial value	Description

Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Transfer result data	o_Result_Data	W	0	Return the copy result.

Processing description

1. Copies the value, which was converted to BCD, when with/without BIN→BCD conversion is ON.

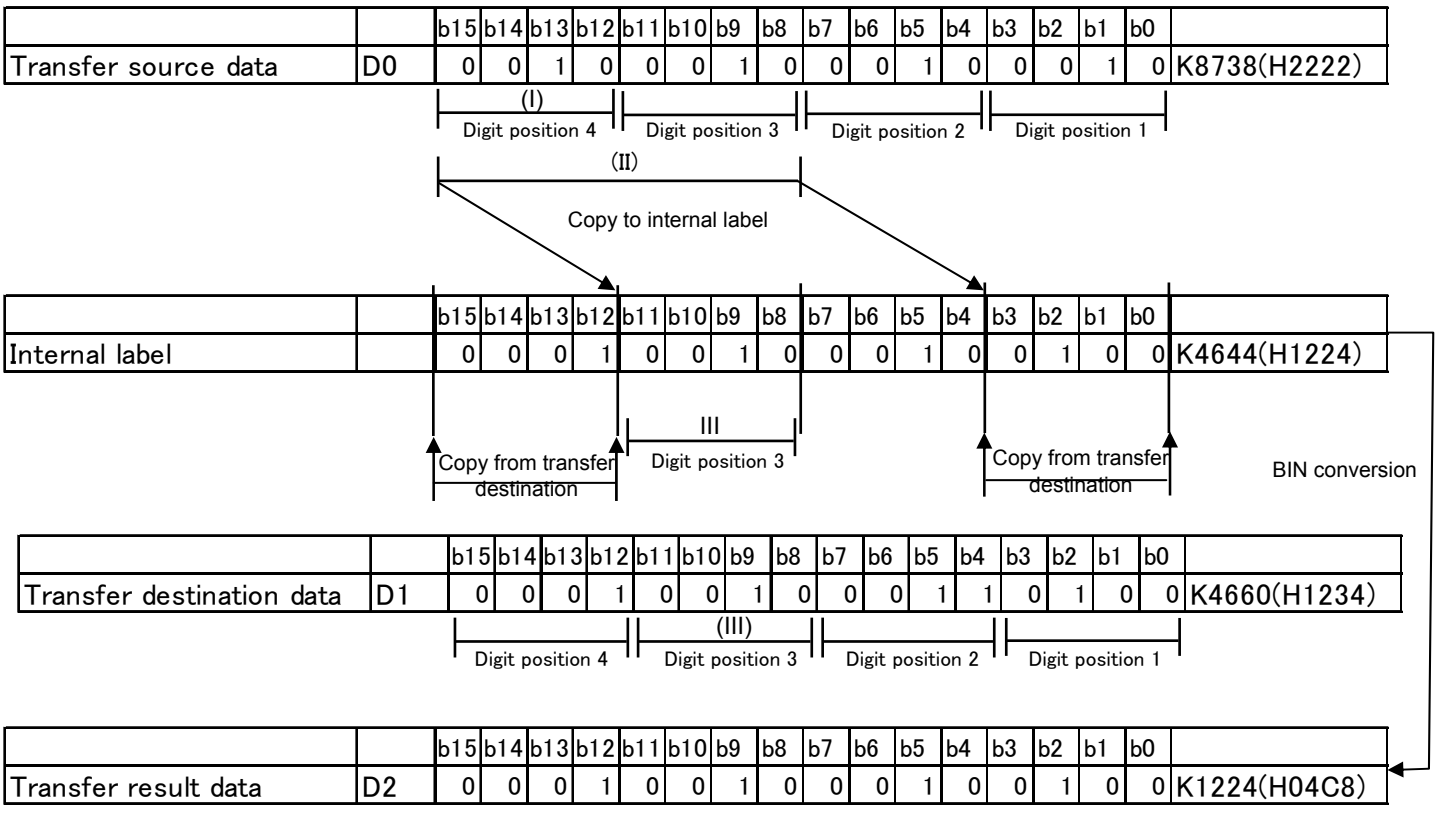
● The transfer source data is K2222 and transfer destination data is K1234:

After BCD conversion, the transfer source data is K8738 (H2222) and transfer destination data K4660 (H1234).

Transfer source data K2222 → (BCD conversion) → Transfer source data H2222

Transfer destination data K1234 → (BCD conversion) → Transfer destination data H1234

● [Start digit position to transfer] is 4 (I), [No. of digits to transfer] is 2 (II), and [Start digit position of transfer destination] is 3 (III):



2. Copies without converting from BIN to BCD when with/without BIN→BCD conversion is OFF.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_CopyDigit function block.

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

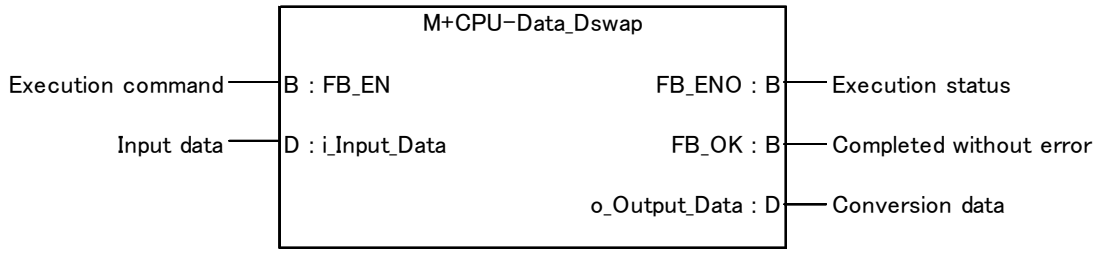
Before using any Mitsubishi products, please read all the relevant manuals.

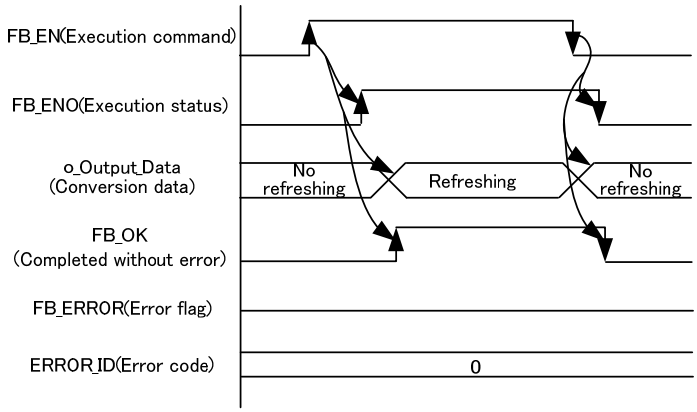
4. M+CPU-Data_DSwap (32-bit upper/lower byte exchange)

FB Name

M+CPU-Data_DSwap

Function Overview

Item	Description
Function overview	Exchanges the upper/lower 8-bit of the input data (32-bit data) in word units.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model / Universal model L series: LCPU *Not applicable for QCPU (A mode)
	Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 55* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	By turning ON FB_EN (Execution command), the upper/lower 8 bits of the input data are exchanged in word units and they are stored in the exchange data.
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.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.

Item	Description
Timing chart	•Operation of I/O signals 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Labels

■Input labels

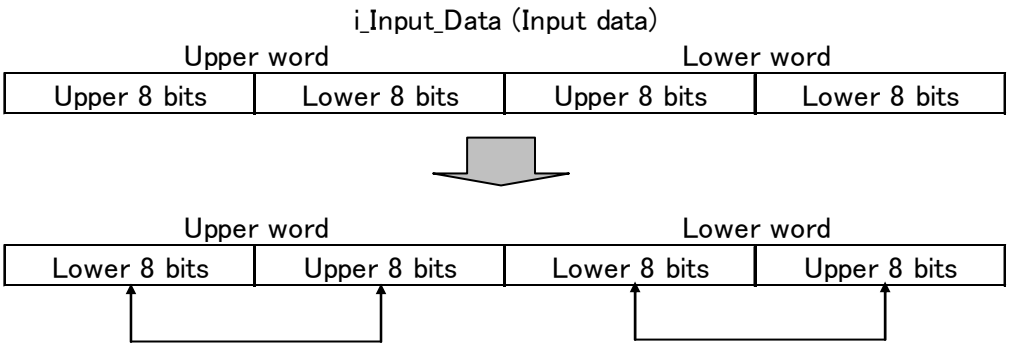
Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Input data	i_Input_Data	D	-2147483648~2147483647	Specify the data whose upper and lower bytes are exchanged.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
Exchange data	o_Output_Data	D	0	Return the result of the exchange of the upper and lower bytes.

Processing description

1) Exchanges the bytes of the input data as follows.



2) Stores the exchange result in the exchange data.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_DSwap function block.

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

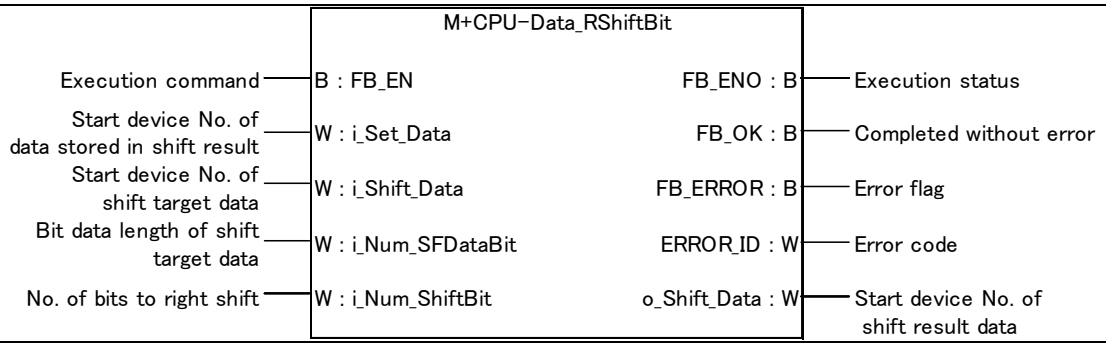
Before using any Mitsubishi products, please read all the relevant manuals.

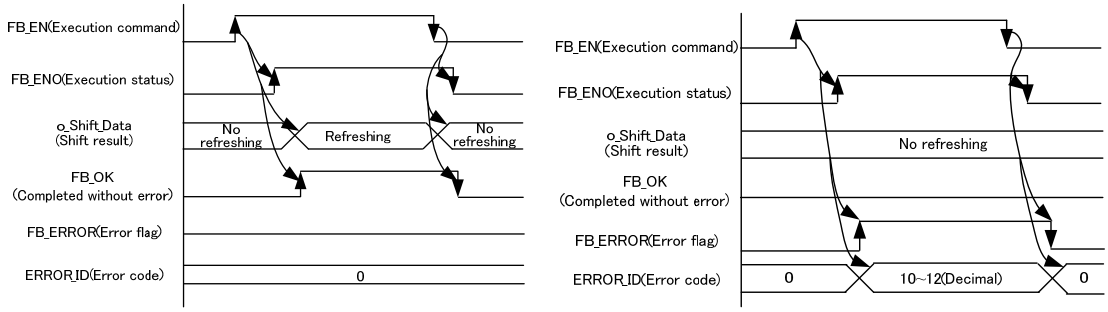
5. M+CPU-Data_RShiftBit (Bit right shift)

FB Name

M+CPU-Data_RShiftBit

Function Overview

Item	Description
Function overview	Shifts the word device data to the right by the specified number of bits. Transfers the data to be stored in the shift result from the most significant bit of the shifted data by the specified number of bits.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 609* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the following processing is performed. 1) Shifts [Shift target data] by [No. of bits to right shift] to the right. 2) Sets the data, which is to be stored in the shift result, from the most significant bit of the shifted data. 3) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9, Z8, Z7, Z6 and Z5. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_SFDataBit (Bit data length of shift target data) is not valid. Set the data within the range of 1 to 1024, and turn OFF FB_EN and then ON again.

Error code	Description
11	i_Num_ShiftBit (No. of bits to right shift) is not valid. Set the data within the range of 1 to 1024, and turn OFF FB_EN and then ON again.
12	The number of bits to shift is too large (i_Num_SFDataBit < i_Num_ShiftBit). Set i_Num_ShiftBit (No. of bits to right shift), which is smaller than i_Num_SFDataBit (Bit data length of shift target data). Then turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data stored in shift result	i_Set_Data	W	Valid device range	Set the device that stores data to be stored in the shift result. Use devices for i_Num_ShiftBit.
Start device No. of shift target data	i_Shift_Data	W	Valid device range	Set the start device of the data to shift. Use devices for i_Num_SFDataBit.
Bit data length of shift target data	i_Num_SFDataBit (n1)	W	1~1024 n2≤n1≤1024	Set the number of bit data of the data to shift.
No. of bits to right shift	i_Num_ShiftBit (n2)	W	1~1024 n2≤n1≤1024	Set the number of bits to shift to the right.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
Error flag	FB_ERROR	B	OFF	When ON, it indicates that an error has occurred.

Name	Label name	Data type	Initial value	Description
Error code	ERROR_ID	W	0	FB error code output.
Start device No. of shift result data	o_Shift_Data	W	0	Store the shift result. Use devices for i_Num_SFDataBit.

Processing description

(1) Shifts [Shift target data] by [No. of bits to right shift] to the right.

(2) Sets the data, which is to be stored in the shift result, from the most significant bit of the shift result (I).

●[Bit data length of shift target data] is 9 (I) and [No. of bits to right shift] is 3 (II)

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Data stored in shift result	D0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	H0002

(II)

Extracts the 3 bits because [No. of bits to right shift] is 3.

b2	b1	b0	
0	1	0	H0002

•Copies the 6 bits, which are calculated as follow, from [Shift target data] to the internal label.

[Bit data length of shift target data] – [No. of bits to right shift] = 6 bits

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Shift target data	D1	0	0	1	1	0	1	1	1	0	1	0	1	0	0	0	1	H3751

Copy 6 bits.

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Internal label		0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	H00AA

•Overwrites the extracted data of the 3 bits and [Bit data length of shift target data] becomes 9.

b8	b7	b6	
0	1	0	H0002

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Shift result data	D2	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	H00AA

(I)

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_RShiftBit function block.

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

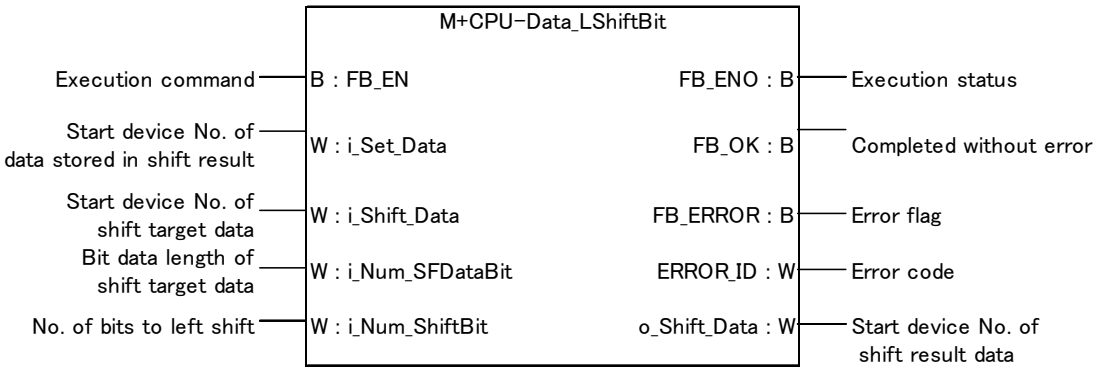
Before using any Mitsubishi products, please read all the relevant manuals.

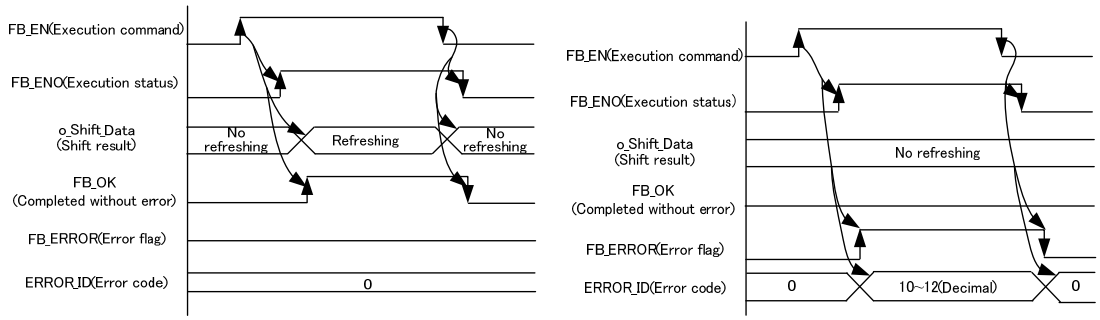
6. M+CPU-Data_LShiftBit (Bit left shift)

FB Name

M+CPU-Data_LShiftBit

Function Overview

Item	Description
Function overview	Shifts the word device data to the left by the specified number of bits. Transfers the data to be stored in the shift result from the least significant bit of the shifted data by the specified number of bits.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 490* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the following processing is performed. 1) Shift [Shift target data] by [No. of bits to left shift] to the left. 2) Sets the bit data, which is to be stored in the shift result, from the least significant bit of the shifted data. 3) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9, Z8, Z7 and Z6. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_SFDataBit (Bit data length of shift target data) is not valid. Set the data within the range of 1 to 1024, and turn OFF FB_EN and then ON again.

Error code	Description
11	i_Num_ShiftBit (No. of bits to left shift) is not valid. Set the data within the range of 1 to 1024, and turn OFF FB_EN and then ON again.
12	The number of bits to shift is too large (i_Num_SFDataBit < i_Num_ShiftBit). Set i_Num_ShiftBit (No. of bits to left shift), which is smaller than i_Num_SFDataBit (Bit data length of shift target data). Then turn OFF FB_EN and ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data stored in shift result	i_Set_Data	W	Valid device range	Set the device that stores data to be stored in the shift result. Use devices for i_Num_ShiftBit.
Start device No. of shift target data	i_Shift_Data	W	Valid device range	Set the start bit device of the data to shift. Use devices for i_Num_SFDataBit.
Bit data length of shift target data	i_Num_SFDataBit (n1)	W	1~1024 n2≤n1≤1024	Set the number of bit data of the data to shift.
No. of bits to left shift	i_Num_ShiftBit (n2)	W	1~1024 n2≤n1≤024	Set the number of bits to shift to the left.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
Error flag	FB_ERROR	B	OFF	When ON, it indicates that an error has occurred.

Name	Label name	Data type	Initial value	Description
Error code	ERROR_ID	W	0	FB error code output.
Start device No. of shift result data	o_Shift_Data	W	0	Return the shift result data. Use devices for i_Num_SFDataBit.

Processing description

(1) Shifts [Shift target data] by [No. of bits to left shift] to the left.

(2) Sets the data, which is to be stored in the shift result, from the least significant bit of the shift result (I).

●[Bit data length of shift target data] is 9 (I) and [No. of bits to left shift] is 3 (II)

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Data stored in shift result	D0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	H0006

(II)

Extracts the 3 bits because [No. of bits to left shift] is 3.

b2	b1	b0	
1	1	0	H0006

•Copies the 6 bits, which are calculated as follow, from [Shift target data] to the internal label.

[Bit data length of shift target data] – [No. of bits to left shift] = 6 bits

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Shift target data	D1	0	1	0	1	0	0	0	1	0	0	1	1	0	1	1	1	H5137

Copy 6 bits

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Internal label		0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	H01BE

•Overwrites the extracted data of the 3 bits and [Bit data length of shift target data] becomes 9.

b2	b1	b0	
1	1	0	H0006

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
Shift result data	D2	0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	H01BE

(I)

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_LShiftBit function block.

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

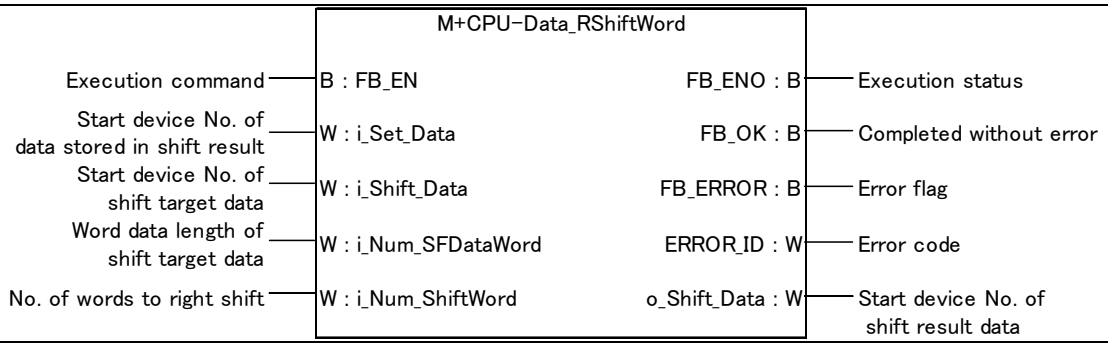
Before using any Mitsubishi products, please read all the relevant manuals.

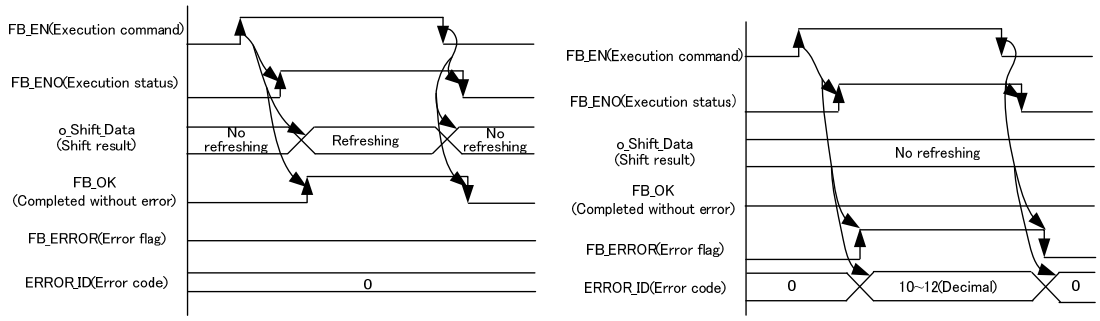
7. M+CPU-Data_RShiftWord (Word right shift)

FB Name

M+CPU-Data_RShiftWord

Function Overview

Item	Description
Function overview	Shifts the word device data to the right by the specified number of words. Transfers the data to be stored in the shift result from the most significant word of the shifted data by the specified number of words.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 255* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the following processing is performed. 1) Shifts [Shift target data] by [No. of bits to right shift] to the right. 2) Sets the word data, which is to be stored in the shift result, from the most significant word of the shifted data. 3) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_SFDataWord (Word data length of shift target data) is not valid. Set the data within the range of 1 to 512, and turn OFF FB_EN and then ON again.
11	i_Num_ShiftWord (No. of words to right shift) is not valid. Set the data within the range of 1 to 512, and turn OFF FB_EN and then ON again.

Error code	Description
12	The number of words to shift is too large. Make sure i_Num_SFDataWord is equal to or greater than i_Num_ShiftWord. Set the data within the range of 1 to 512, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data stored in shift result	i_Set_Data	W	Valid device range	Set the device that stores data to be stored in the shift result. Use devices for i_Num_ShiftBit.
Start device No. of shift target data	i_Shift_Data	W	Valid device range	Set the start word device of the data to shift. Use devices for i_Num_SFDataWord.
Word data length of shift target data	i_Num_SFData Word (n1)	W	1~512 n2≤n1≤512	Set the number of word data of the data to shift.
No. of words to right shift	i_Num_ShiftWor d (n2)	W	1~512 n2≤n1≤512	Set the number of words to shift to the right.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.

Start device No. of shift result data	o_Shift_Data	W	0	Return the shift result data. Use devices for i_Num_SFDataWord.

Processing description

(1) Shifts the [shift target data] by [No. of words to right shift] to the right.

(2) Sets the data, which is to be stored in the shift result, from the most significant word of the shift result (I).

●[Word data length of shift target data] is 9 (I) and [No. of words to right shift] is 3 (II)

•Sets the data, which is to be stored in shift result, to 3 words from D0.

	D2	D1	D0
Data stored in shift result	233	422	1000

•Stores the target data to shift in 9 words in D10 onwards.

•Copies the 6 words, which are calculated as follows, to the array of the internal label.

[Word data length of shift target data] – [No. of bits to right shift] = 6 bits

	D18	D17	D16	D15	D14	D13	D12	D11	D10
Shift target data	233	422	1000	3456	2185	−2000	32767	1	13

Copy 6 words

	(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)	(0)
Internal label (array)	0	0	0	233	422	1000	3456	2185	−2000

	D2	D1	D0
Data stored in shift result	233	422	1000

•Copies the data, which is to be stored in the shift result, by the number of words to right shift to the internal label.

	D28	D27	D26	D25	D24	D23	D22	D21	D20
Shift result data	233	422	1000	233	422	1000	3456	2185	−2000

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_RShiftWord function block.

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

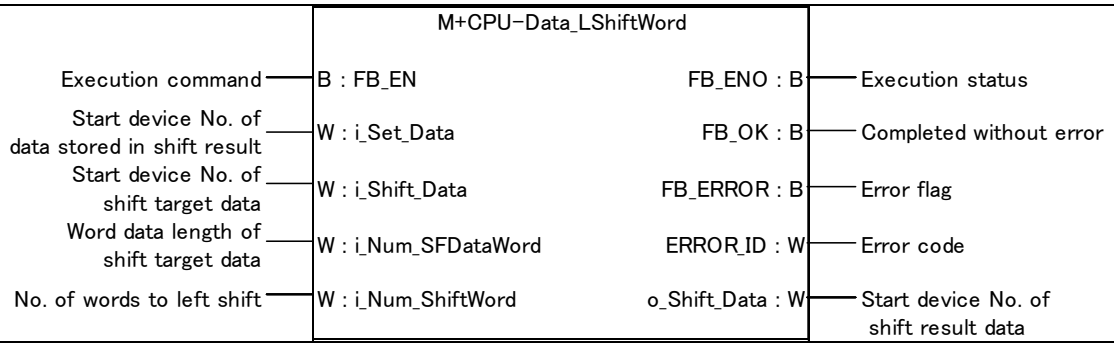
Before using any Mitsubishi products, please read all the relevant manuals.

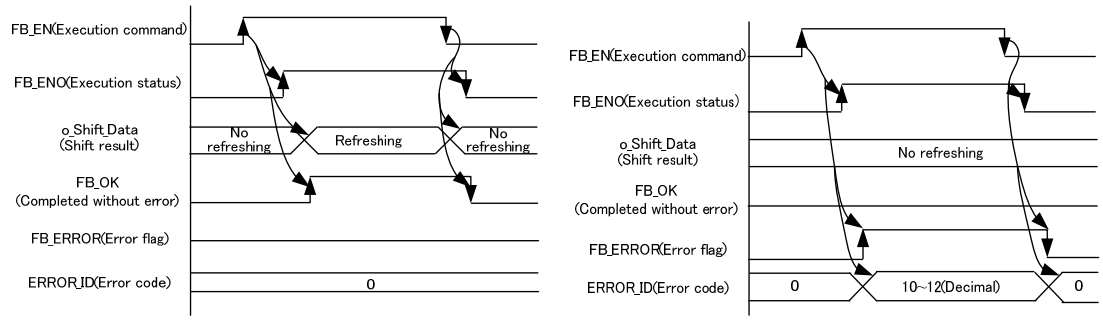
8. M+CPU-Data_LShiftWord (Word left shift)

FB Name

M+CPU-Data_LShiftWord

Function Overview

Item	Description
Function overview	Shifts the word device data by the specified number of words to the left. Transfers the data to be stored in the shift result from the least significant word of the shifted data by the specified number of words.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 222* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the following processing is performed. 1) Shifts [Shift target data] by [No. of words to left shift] to the left. 2) Sets the word data, which is to be stored in the shift result, from the least significant word of the shifted data. 3) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_SFDataWord (Word data length of shift target data) is not valid. Set the data within the range of 1 to 512, and turn OFF FB_EN and then ON again.
11	i_Num_ShiftWord (No. of words to left shift) is not valid. Set the data within the range of 1 to 512, and turn OFF FB_EN and then ON again.

Error code	Description
12	The number of words to shift is too large. Make sure i_Num_SFDataWord is equal to or greater than i_Num_ShiftWord. Set correct data, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data stored in shift result	i_Set_Data	W	Valid device range	Set the device that stores data to be stored in the shift result. Use devices for i_Num_ShiftBit.
Start device No. of shift target data	i_Shift_Data	W	Valid device range	Set the start word device of the data to shift. Use devices for i_Num_SFDataWord.
Word data length of shift target data	i_Num_SFData Word(n1)	W	1~512 n2≤n1≤512	Set the number of word data of the data to shift.
No. of words to left shift	i_Num_ShiftWor d (n2)	W	1~512 n2≤n1≤512	Set the number of words to shift to the left.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Start device No. of shift result data	o_Shift_Data	B	0	Return the shift result data. Use devices for i_Num_SFDataWord.

Processing description

(1) Shifts the [Shift target data] by [No. of words to left shift] to the left.

(2) Sets the data, which is to be stored in the shift result, from the least significant word of the shift result (I).

●[Word data length of shift target data] is 9 (I) and [No. of words to left shift] is 3.

•Sets the data, which is to be stored in the shift result, to 3 words from D0.

	D2	D1	D0
Data stored in shift result	233	422	1000

•Stores the target data to shift in 9 words in D10 onwards.

•Copies the 6 words, which are calculated as follows, to the internal label.

[Word data length of shift target data] – [No. of words to left shift] = 6 words

	D18	D17	D16	D15	D14	D13	D12	D11	D10
Shift target data	233	422	1000	3456	2185	−2000	32767	1	13

Copy 6 words

	(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)	(0)
Internal label (array)	3456	2185	−2000	32767	1	13			

•Overwrites the data, which is to be stored in the shift result, by the number of words to left shift to the internal label.

	D2	D1	D0
Data stored in shift result	233	422	1000

	D28	D27	D26	D25	D24	D23	D22	D21	D20
Shift result data	3456	2185	−2000	32767	1	13	233	422	1000

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_LShiftWord function block.

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

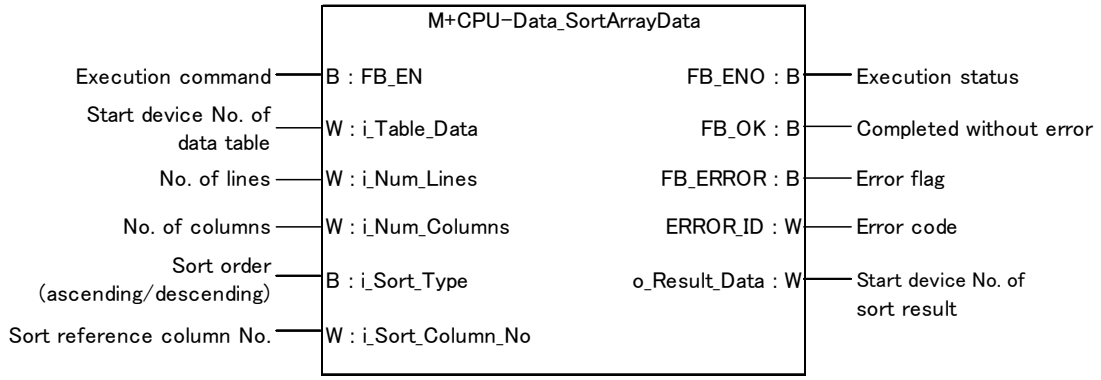
Before using any Mitsubishi products, please read all the relevant manuals.

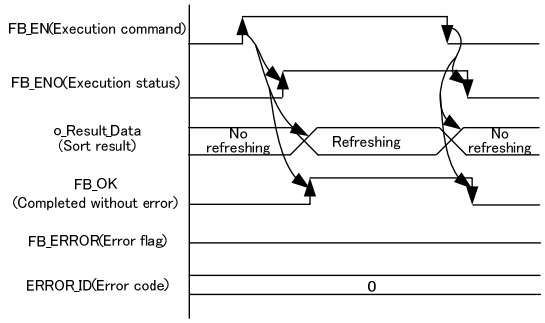
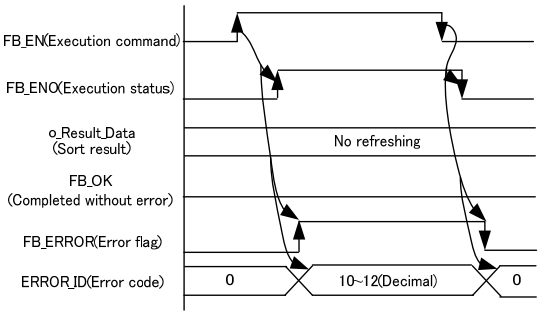
9. M+CPU-Data_SortArrayData (Data sort)

FB Name

M+CPU-Data_SortArrayData

Function Overview

Item	Description
Function overview	Sorts the data table, which consists of lines and columns, by lines in ascending or descending order based on a specified column. The data table stores consecutive values (16-bit data) in columns.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 378* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the sort is performed as follows. 1) Checks if it is necessary to sort the data in the sort reference column in ascending/descending order. 2) If the data sort is performed, the data in the same lines are sorted as well. 3) If the data in the sort reference column are the same, the sort is performed based on the line numbers. 4) If the values in the reference column are the same, the sort result is not changed. 5) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9, Z8, Z7, Z6, Z5 and Z4. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs]  
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Lines (No. of lines) is not valid. Set the data within the range of 1 to 32, and turn OFF FB_EN and then ON again.
11	i_Num_Columns (No. of columns) is not valid. Set the data within the range of 1 to 6, and turn OFF FB_EN and then ON again.
12	i_Sort_Column_No (Sort reference column No.) is not valid. Set the data within the range (1 to i_Num_Columns), and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data table	i_Table_Data	W	Valid device range	Set the start device number of the data to be sorted. Use devices for (No. of lines × No. of columns).
No. of lines	i_Num_Lines	W	1~32	Set the number of lines to construct the data table.
No. of columns	i_Num_Columns	W	1~6	Set the number of columns to construct the data table.
Sort order	i_Sort_Type	B	ON, OFF	ON: Descending order OFF: Ascending order
Sort reference column No.	i_Sort_Column_No	W	1~i_Num_Columns	Set the reference column number for sort.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.

Name	Label name	Data type	Initial value	Description
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Start device No. of sort result	o_Result_Data	W	0	Return the sort result data. The same structure as the data table (No. of lines x No. of columns).

Processing description

1) The data table structure is as follows.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	S	S+5	S+10	S+15
Line 2	S+1	S+6	S+11	S+16
Line 3	S+2	S+7	S+12	S+17
Line 4	S+3	S+8	S+13	S+18
Line 5	S+4	S+9	S+14	S+19

i_Num_Columns=4

i_Num_Lins=5

2) Sorts the data in ascending or descending order based on the data in the reference column.

If the data sort is performed, the data in the same lines are sorted at the same time.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	1	150	45	20
Line 2	2	180	50	40
Line 3	3	160	70	30
Line 4	4	100	20	8
Line 5	5	150	50	45

Sort reference column

Sort result (Ascending order)

	Column 1	Column 2	Column 3	Column 4
Line 1	4	100	20	8
Line 2	1	150	45	20
Line 3	5	150	50	45
Line 4	3	160	70	30
Line 5	2	180	50	40

3) The following table shows the devices for the above data table.

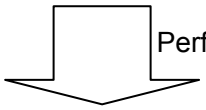
When i_Table_Data (Start device No. of data table) is D100

D100	1
D101	2
D102	3
D103	4
D104	5
D105	150
D106	180
D107	160
D108	100
D109	150
D110	45
D111	50
D112	70
D113	20
D114	50
D115	20
D116	40
D117	30
D118	8
D119	45

Sort reference column

Data in the lines corresponding to the reference column before sort

Value	1	150	45	20
Value	2	180	50	40
Value	3	160	70	30
Value	4	100	20	8
Value	5	150	50	45



Perform data sorting

D100	4
D101	1
D102	5
D103	3
D104	2
D105	100
D106	150
D107	150
D108	160
D109	180
D110	20
D111	45
D112	50
D113	70
D114	50
D115	8
D116	20
D117	45
D118	30
D119	40

Sort reference column

Data in the lines corresponding to the reference column after sort

Value	4	100	20	8
Value	1	150	45	20
Value	5	150	50	45
Value	3	160	70	30
Value	2	180	50	40

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_SortArrayData function block.

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

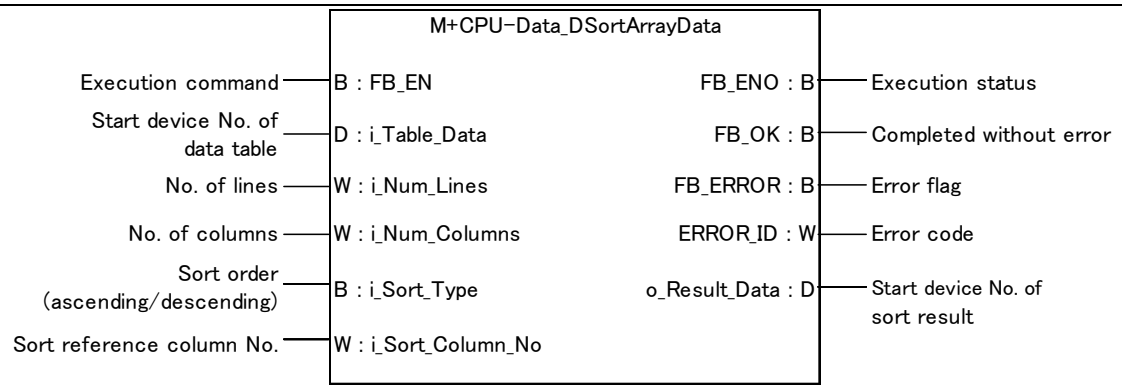
Before using any Mitsubishi products, please read all the relevant manuals.

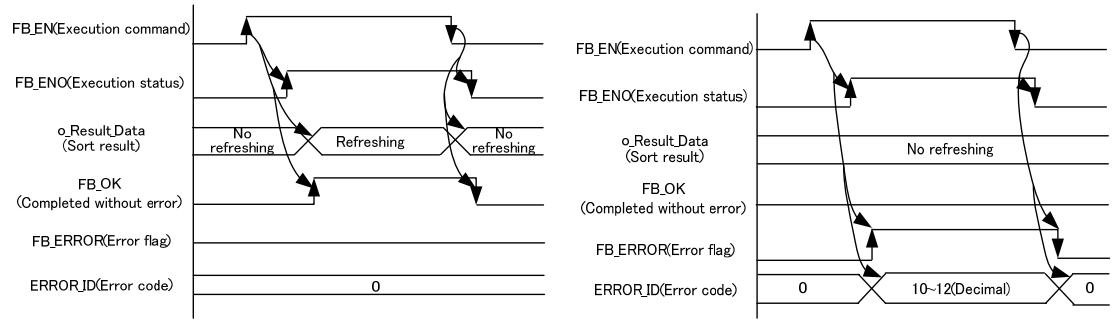
10. M+CPU-Data_DSortArrayData (32-bit data sort)

FB Name

M+CPU-Data_DSortArrayData

Function Overview

Item	Description
Function overview	Sorts the data table, which consists of lines and columns, by lines in ascending or descending order based on a specified column. The data table stores consecutive values (32-bit data) in columns.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 441* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the sort is performed as follows. 1) Checks if it is necessary to sort the data in the sort reference column in ascending/descending order. 2) If the data sort is performed, the data in the same lines are sorted as well. 3) If the data in the sort reference column are the same, the sort is performed based on the line numbers. 4) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9, Z8, Z7, Z6, Z5 and Z4. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Lines (No. of lines) is not valid. Set the data within the range of 1 to 32, and turn OFF FB_EN and then ON again.
11	i_Num_Lines (No. of columns) is not valid. Set the data within the range of 1 to 6, and turn OFF FB_EN and then ON again.
12	i_Sort_Column_No (Sort reference column No.) is not valid. Set the data within the range (1 to i_Num_Columns), and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data table	i_Table_Data	D	Valid device range	Set the start device number of the data to be sorted. Use devices for (No. of lines × No. of columns × 2).
No. of lines	i_Num_Lines	W	1~32	Set the number of lines to construct the data table.
No. of columns	i_Num_Columns	W	1~6	Set the number of columns to construct the data table.
Sort order	i_Sort_Type	B	ON, OFF	ON: Descending order OFF: Ascending order
Sort reference column number	i_Sort_Column_No	W	1~i_Num_Columns	Set the reference column number for sort.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.

Name	Label name	Data type	Initial value	Description
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Start device No. of sort result	o_Result_Data	D	0	Return the sort result data. The same structure as the data table (No. of lines x No. of columns).

Processing description

1) The data table structure is as follows.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	S+1,S	S+11,S+10	S+21,S+20	S+31,S+30
Line 2	S+3,S+2	S+13,S+12	S+23,S+22	S+33,S+32
Line 3	S+5,S+4	S+15,S+14	S+25,S+24	S+35,S+34
Line 4	S+7,S+6	S+17,S+16	S+27,S+26	S+37,S+36
Line 5	S+9,S+8	S+19,S+18	S+29,S+28	S+39,S+38

i_Num_Columns=4

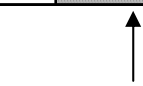
i_Num_Lins=5

2) Sorts the data in ascending or descending order based on the data in the reference column.

If the data sort is performed, the data in the same lines are sorted at the same time.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	1	150	45	20
Line 2	2	180	50	40
Line 3	3	160	70	30
Line 4	4	100	20	8
Line 5	5	150	50	45



Sort reference column

Sort result (Ascending order)

	Column 1	Column 2	Column 3	Column 4
Line 1	4	100	20	8
Line 2	1	150	45	20
Line 3	5	150	50	45
Line 4	3	160	70	30
Line 5	2	180	50	40

3) The following table shows the devices for the above data table.

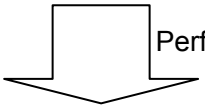
When i_Table_Data (Start device No. of data table) is D100

D100	1
D102	2
D104	3
D106	4
D108	5
D110	150
D112	180
D114	160
D116	100
D118	150
D120	45
D122	50
D124	70
D126	20
D128	50
D130	20
D132	40
D134	30
D136	8
D138	45

Sort reference column

Data in the lines corresponding to the reference column before sort

Value	1	150	45	20
Value	2	180	50	40
Value	3	160	70	30
Value	4	100	20	8
Value	5	150	50	45



Perform data sorting

D100	4
D102	1
D104	5
D106	3
D108	2
D110	100
D112	150
D114	150
D116	160
D118	180
D120	20
D122	45
D124	50
D126	70
D128	50
D130	8
D132	20
D134	45
D136	30
D138	40

Sort reference column

Data in the lines corresponding to the reference column after sort

Value	4	100	20	8
Value	1	150	45	20
Value	5	150	50	45
Value	3	160	70	30
Value	2	180	50	40

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_DSortArrayData function block.

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

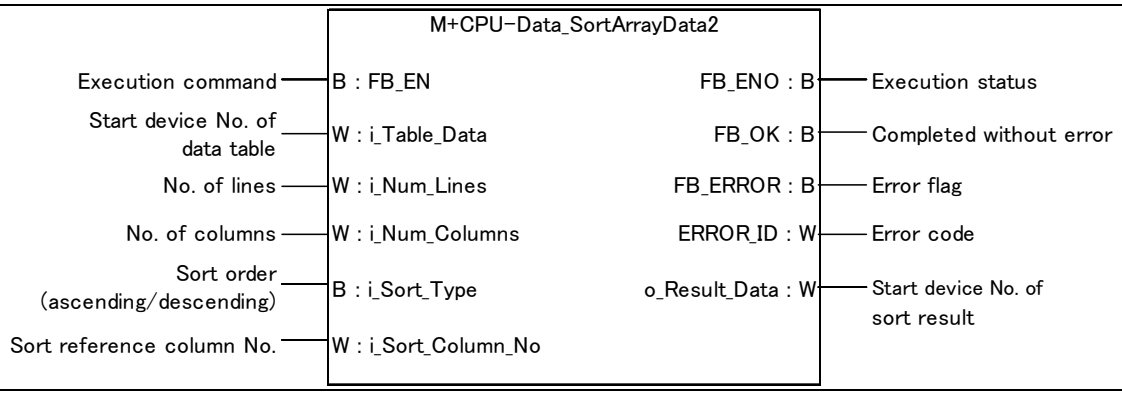
Before using any Mitsubishi products, please read all the relevant manuals.

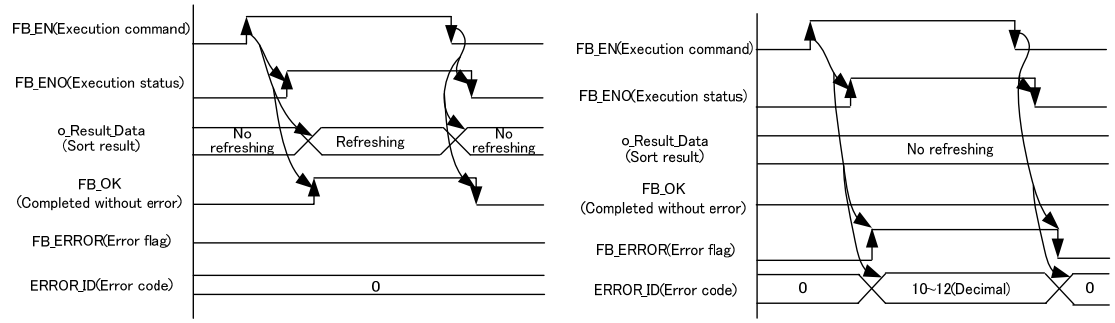
11. M+CPU-Data_SortArrayData2 (Data sort 2)

FB Name

M+CPU-Data_SortArrayData2

Function Overview

Item	Description
Function overview	Sorts the data table, which consists of lines and columns, by lines in ascending or descending order based on a specified column. The data table stores consecutive values (16-bit data) in lines.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 399* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the sort is performed as follows. 1) Checks if it is necessary to sort the data in the sort reference column in ascending/descending order. 2) If the data sort is performed, the data in the same lines are sorted as well. 3) If the data in the sort reference column are the same, the sort is performed based on the line numbers. 4) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9, Z8, Z7, Z6, Z5 and Z4. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Lines (No. of lines) is not valid. Set the data within the range of 1 to 32, and turn OFF FB_EN and then ON again.
11	i_Num_Columns (No. of columns) is not valid. Set the data within the range of 1 to 6, and turn OFF FB_EN and then ON again.
12	i_Sort_Column_No (Sort reference column No.) is not valid. Set the data within the range (1 to i_Num_Columns), and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data table	i_Table_Data	W	Valid device range	Set the start device number of the data to be sorted. Use devices for (No. of lines × No. of columns).
No. of lines	i_Num_Lines	W	1~32	Set the number of lines to construct the data table.
No. of columns	i_Num_Columns	W	1~6	Set the number of columns to construct the data table.
Sort order	i_Sort_Type	B	ON, OFF	ON: Descending order OFF: Ascending order
Sort reference column number	i_Sort_Column_No	W	1~i_Num_Columns	Set the reference column number for sort.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.

Name	Label name	Data type	Initial value	Description
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Start device No. of sort result	o_Result_Data	W	0	Return the sort result data. The same structure as the data table (No. of lines x No. of columns).

Processing description

1) The data table structure is as follows.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	S	S+1	S+2	S+3
Line 2	S+4	S+5	S+6	S+7
Line 3	S+8	S+9	S+10	S+11
Line 4	S+12	S+13	S+14	S+15
Line 5	S+16	S+17	S+18	S+19

i_Num_Columns=4

i_Num_Lins=5

2) Sorts the data in ascending or descending order based on the data in the sort reference column.

If the data sort is performed, the data in the same lines are sorted at the same time.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	1	150	45	20
Line 2	2	180	50	40
Line 3	3	160	70	30
Line 4	4	100	20	8
Line 5	5	150	50	45

Sort reference column

Sort result (ascending order)

	Column 1	Column 2	Column 3	Column 4
Line 1	4	100	20	8
Line 2	1	150	45	20
Line 3	5	150	50	45
Line 4	3	160	70	30
Line 5	2	180	50	40

3) The following table shows the devices for the above data table.

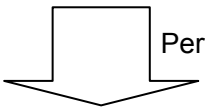
When i_Table_Data (Start device No. of data table) is D100

D100	1
D101	150
D102	45
D103	20
D104	2
D105	180
D106	50
D107	40
D108	3
D109	160
D110	70
D111	30
D112	4
D113	100
D114	20
D115	8
D116	5
D117	150
D118	50
D119	45

Sort reference column

Data in the lines corresponding to the reference column before sort

Value	1	150	45	20
Value	2	180	50	40
Value	3	160	70	30
Value	4	100	20	8
Value	5	150	50	45



Perform data sorting

D100	4
D101	100
D102	20
D103	8
D104	1
D105	150
D106	45
D107	20
D108	5
D109	150
D110	50
D111	45
D112	3
D113	160
D114	70
D115	30
D116	2
D117	180
D118	50
D119	40

Sort reference column

Data in the lines corresponding to the reference column after sort

Value	4	100	20	8
Value	1	150	45	20
Value	5	150	50	45
Value	3	160	70	30
Value	2	180	50	40

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_SortArrayData2 function block.

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

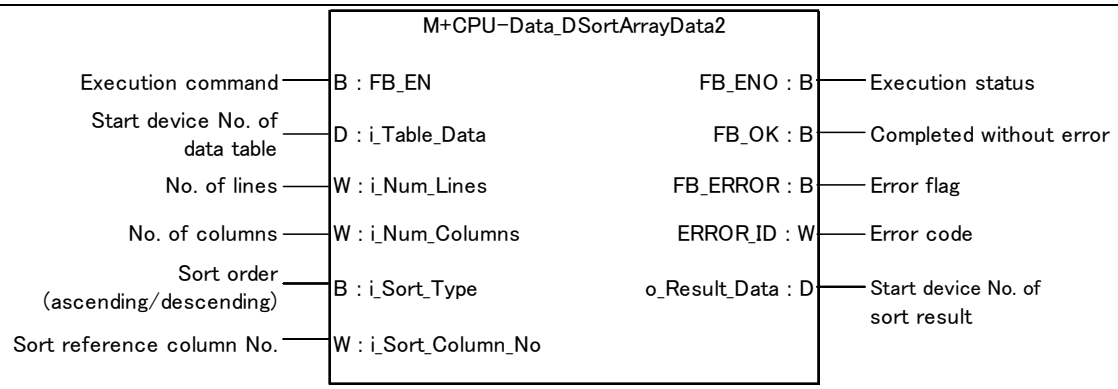
Before using any Mitsubishi products, please read all the relevant manuals.

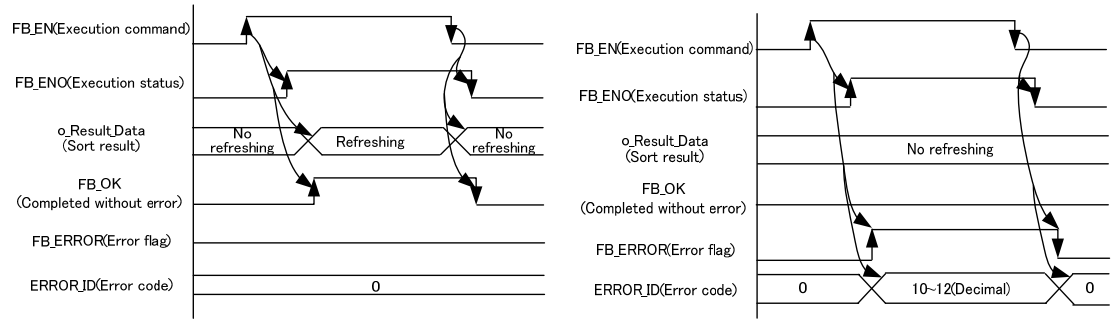
12. M+CPU-Data_DSortArrayData2 (32-bit data sort 2)

FB Name

M+CPU-Data_DSortArrayData2

Function Overview

Item	Description
Function overview	Sorts the data table, which consists of lines and columns, by lines in ascending or descending order based on a specified column. The data table stores consecutive values (32-bit data) in lines.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 447* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	By turning ON FB_EN (Execution command), the sort is performed as follows. 1) Checks if it is necessary to sort the data in the sort reference column in ascending/descending order. 2) If the data sort is performed, the data in the same lines are sorted as well. 3) If the data in the sort reference column are the same, the sort is performed based on the line numbers 4) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index registers Z9, Z8, Z7, Z6, Z5 and Z4. Please do not use these index registers in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Lines (No. of lines) is not valid. Set the data within the range of 1 to 32, and turn OFF FB_EN and then ON again.
11	i_Num_Columns (No. of columns) is not valid. Set the data within the range of 1 to 6, and turn OFF FB_EN and then ON again.
12	i_Sort_Column_No (Sort reference column No.) is not valid. Set the data within the range (1 to i_Num_Columns), and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of data table	i_Table_Data	D	Valid device range	Set the start device number of the data to be sorted. Use devices for (No. of lines × No. of columns × 2).
No. of lines	i_Num_Lines	W	1~32	Set the number of lines to construct the data table.
No. of columns	i_Num_Columns	W	1~6	Set the number of columns to construct the data table.
Sort order	i_Sort_Type	B	ON, OFF	ON: Descending order OFF: Ascending order
Sort reference column number	i_Sort_Column_No	W	1~i_Num_Columns	Set the reference column number for sort.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.

Name	Label name	Data type	Initial value	Description
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Start device No. of sort result	o_Result_Data	D	0	Return the sort result data. The same structure as the data table (No. of lines x No. of columns).

Processing description

1) The data table structure is as follows.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	S+1,S	S+3,S+2	S+5,S+4	S+7,S+6
Line 2	S+9,S+8	S+13,S+12	S+13,S+12	S+15,S+14
Line 3	S+17,S+16	S+19,S+18	S+21,S+20	S+23,S+22
Line 4	S+25,S+24	S+27,S+26	S+29,S+28	S+31,S+30
Line 5	S+33,S+32	S+35,S+34	S+37,S+36	S+39,S+38

i_Num_Columns=4

i_Num_Lins=5

2) Sorts the data in ascending or descending order based on the data in the sort reference column.

If the data sort is performed, the data in the same lines are sorted at the same time.

Data table structure

	Column 1	Column 2	Column 3	Column 4
Line 1	1	150	45	20
Line 2	2	180	50	40
Line 3	3	160	70	30
Line 4	4	100	20	8
Line 5	5	150	50	45

Sort reference column

Sort result (Ascending order)

	Column 1	Column 2	Column 3	Column 4
Line 1	4	100	20	8
Line 2	1	150	45	20
Line 3	5	150	50	45
Line 4	3	160	70	30
Line 5	2	180	50	40

3) The following table shows the devices for the above data table.

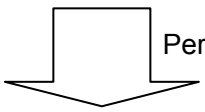
When i_Table_Data (Start device No. of data table) is D100

D100	1
D102	150
D104	45
D106	20
D108	2
D110	180
D112	50
D114	40
D116	3
D118	160
D120	70
D122	30
D124	4
D126	100
D128	20
D130	8
D132	5
D134	150
D136	50
D138	45

Sort reference column

Data in the lines corresponding to the reference column before sort

Value	1	150	45	20
Value	2	180	50	40
Value	3	160	70	30
Value	4	100	20	8
Value	5	150	50	45



Perform data sorting

D100	4
D102	100
D104	20
D106	8
D108	1
D110	150
D112	45
D114	20
D116	5
D118	150
D120	50
D122	45
D124	3
D126	160
D128	70
D130	30
D132	2
D134	180
D136	50
D138	40

Sort reference column

Data in the lines corresponding to the reference column after sort

Value	4	100	20	8
Value	1	150	45	20
Value	5	150	50	45
Value	3	160	70	30
Value	2	180	50	40

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_DSortArrayData2 function block.

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

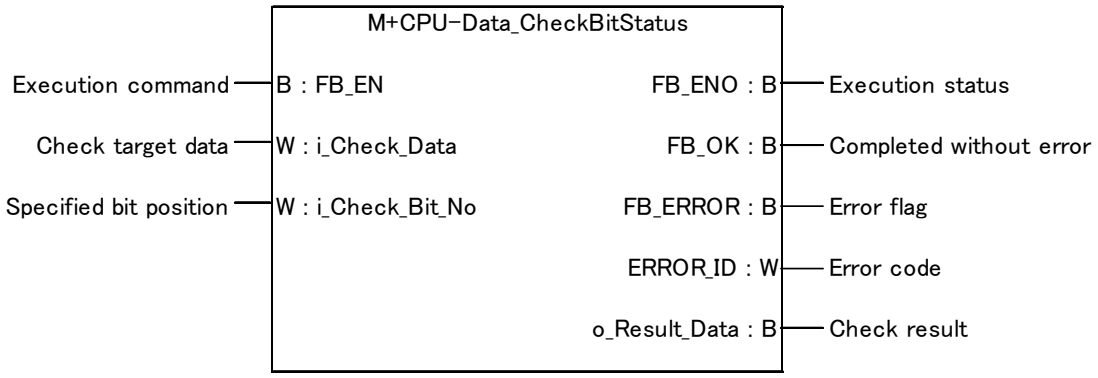
Before using any Mitsubishi products, please read all the relevant manuals.

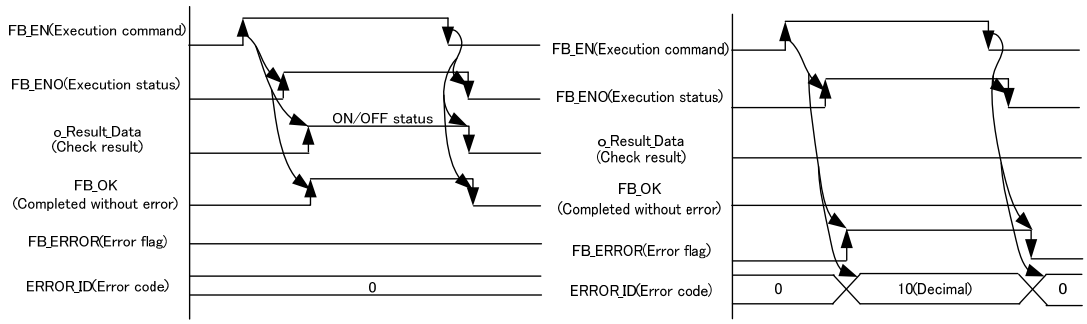
13. M+CPU-Data_CheckBitStatus (16-bit ON/OFF check)

FB Name

M+CPU-Data_CheckBitStatus

Function Overview

Item	Description
Function overview	Checks the ON/OFF status of the specified bit position of 16-bit data.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model / Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 110* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	1) By turning ON FB_EN (Execution command), the status of the specified bit position of the target data is output to the check result. 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Check_Bit_No (Specified bit position) is not valid. Set the data within the range of 0 to 15, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Check target data	i_Check_Data	W	-32768~32767	Set the device number of the data to be checked.
Specified bit position	i_Check_Bit_No	W	0~15	Set the bit position.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Check result	o_Result_Data	B	0	Return the status of the specified bit position.

Processing description

Same as “TEST instruction”.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_CheckBitStatus function block.

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

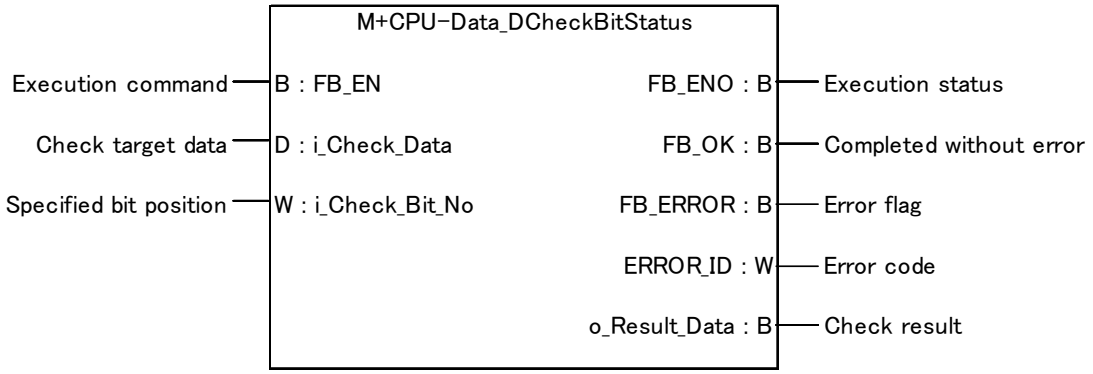
Before using any Mitsubishi products, please read all the relevant manuals.

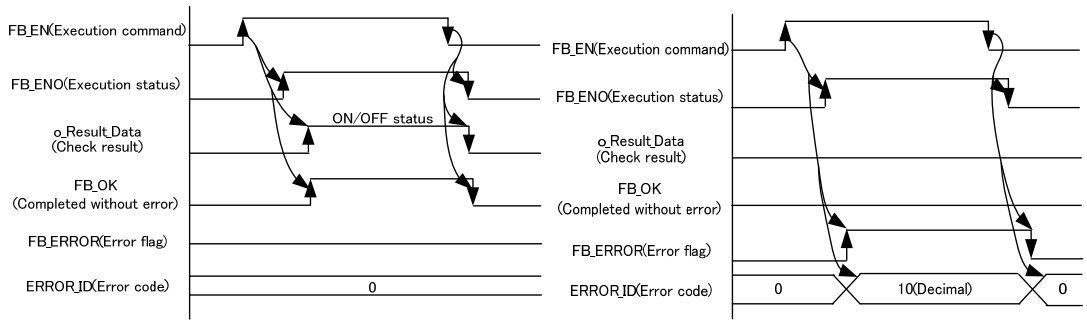
14. M+CPU-Data_DCheckBitStatus (32-bit ON/OFF check)

FB Name

M+CPU-Data_DCheckBitStatus

Function Overview

Item	Description
Function overview	Checks the ON/OFF status of the specified bit position of 32-bit data.
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 110* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	1) By turning ON FB_EN (Execution command), the status of the specified bit position of the target data is output to the check result. 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Check_Bit_No (Specified bit position) is not valid. Set the data within the range of 0 to 31, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Check target data	i_Check_Data	D	-2147483648~2147483647	Set the device number of the data to be checked.
Specified bit position	i_Check_Bit_No	W	0~31	Set the bit position.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Check result	o_Result_Data	B	0	Return the status of the specified bit position.

Processing description

Same as “DTEST instruction”.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_DCheckBitStatus function block.

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

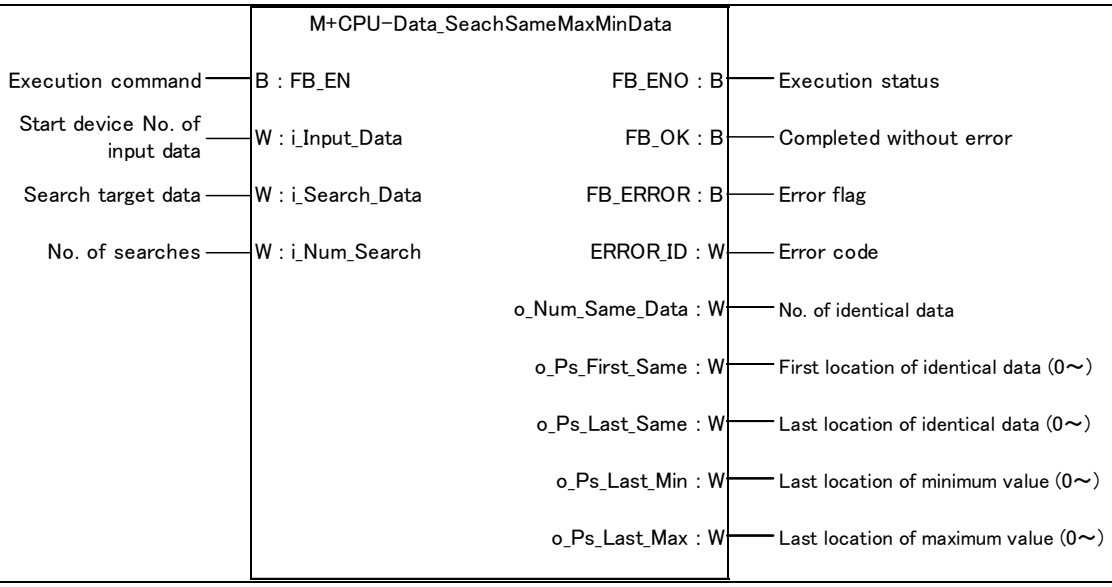
Before using any Mitsubishi products, please read all the relevant manuals.

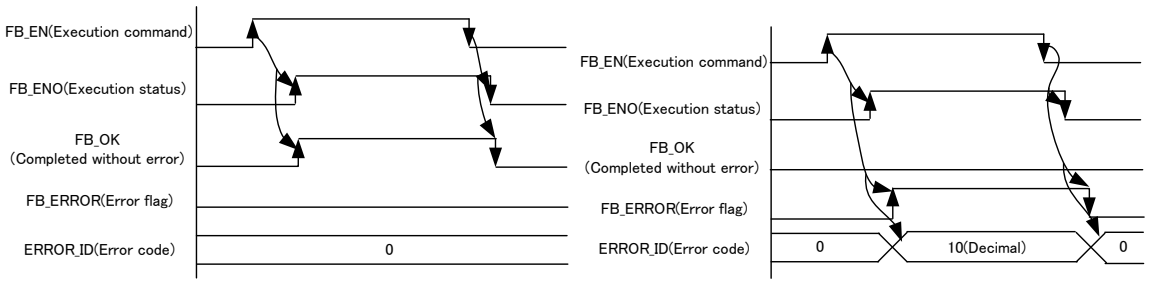
15. M+CPU-Data_SeachSameMaxMinData (Data search)

FB Name

M+CPU-Data_SeachSameMaxMinData

Function Overview

Item	Description
Function overview	Searches for the identical data and maximum and minimum values in consecutive data area (16-bit data).
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 232* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	1) By turning ON FB_EN (Execution command), the following items are searched from the input data: -No. of the data identical to the target data -The location that was found first -The location that was found last -The location of the minimum value that was found last -The location of the maximum value that was found last Then, the results are output. 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Search (No. of searches) is not valid. Set the data within the range of 1 to 256, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of input data	i_Input_Data	W	Valid device range	Set the start device number of the data for which to perform a search for the identical data, minimum and maximum values. Use devices for i_Num_Search.
Search target data	i_Search_Data	W	-32768~32767	Set the data to search for the identical data in the input data.
No. of searches	i_Num_Search	W	1~256	Set the number of data points of the input data for which to perform a search.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.

Name	Label name	Data type	Initial value	Description
No. of identical data	o_Num_Same_Data	W	0	Return the number of the identical data.
Identical data first location	o_Ps_First_Same	W	0	Return the first location of the identical data. (0~)
Identical data last location	o_Ps_Last_Same	W	0	Return the last location of the identical data. (0~)
Minimum value last location	o_Ps_Last_Min	W	0	Return the last location of the minimum value. (0~)
Maximum value last location	o_Ps_Last_Max	W	0	Return the last location of the maximum value. (0~)

Processing description

This FB checks the input data for the number of searches. After which, it searches for the number of the identical data, the location of the identical data, and the location of the minimum and maximum values.

The following example shows the output from the function block when the data is set to 10 words from D10.

The setting is made so that the output result is stored in D20 onwards.

The target data is 100 (D8).

Input data (i_Input_Data)

	Location	Contents (example)	Target data
D10	0	100	100
D11	1	111	(D8)
D12	2	100	
D13	3	98	
D14	4	123	
D15	5	66	
D16	6	100	
D17	7	95	
D18	8	210	
D19	9	88	

Output label	Device	Result data
No. of identical data	D20	3
Identical data first location	D21	0
Identical data last location	D22	6
Minimum value last location	D23	5
Maximum value last location	D24	8

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_SeachSameMaxMinData function block.

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

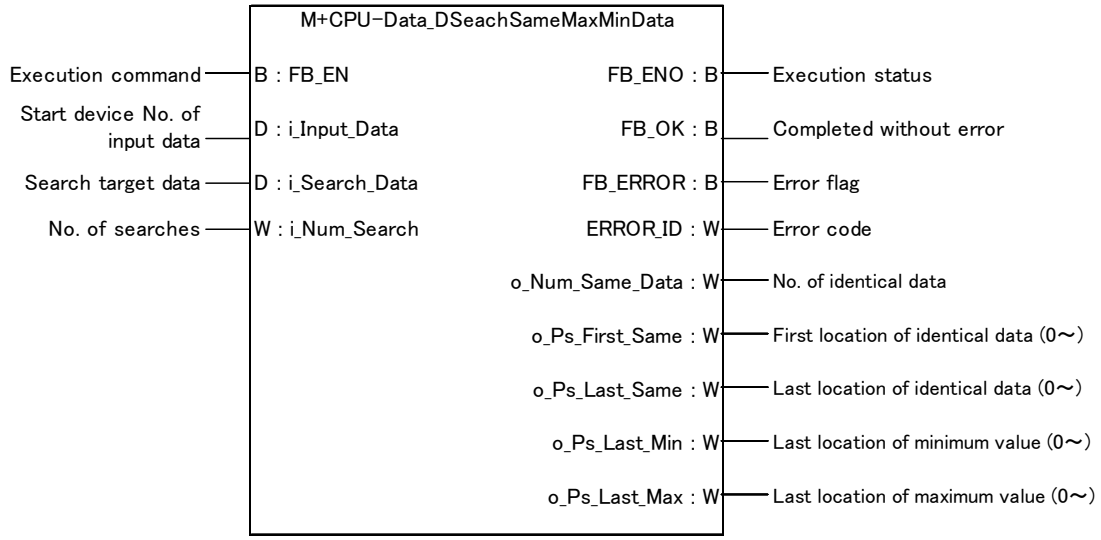
Before using any Mitsubishi products, please read all the relevant manuals.

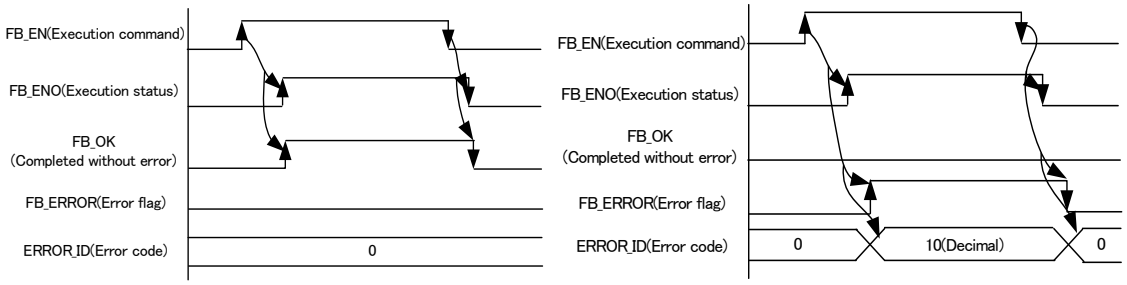
16. M+CPU-Data_DSeachSameMaxMinData (32-bit data search)

FB Name

M+CPU-Data_DSeachSameMaxMinData

Function Overview

Item	Description
Function overview	Searches for the identical data and maximum and minimum values from the consecutive data area (32-bit data).
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 247* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).

Item	Description
Function description	1) By turning ON FB_EN (Execution command), the following items are searched from the input data: -No. of data identical to the target data -The location that was found first -The location that was found last -The location of the minimum value that was found last -The location of the maximum value that was found last Then, the results are output. 2) When the input value is invalid, the FB_ERROR output turns ON, processing is interrupted, and the error code is stored in ERROR_ID (Error code). 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) If a message stating “Insufficient word device points in device/label (VAR) automatic-assign setting” appears when a program is compiled, adjust the automatically assigned device setting. 4) This FB uses index register Z9. Please do not use this index register in an interrupt program.
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Num_Search (No. of searches) is not valid. Set the data within the range of 1 to 128, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Start device No. of input data	i_Input_Data	D	Valid device range	Set the start device number of the data for which to perform a search for the identical data, minimum and maximum values. Use devices for (i_Num_Search × 2).
Search target data	i_Search_Data	D	-2147483648~2147483647	Set the data to search for the identical data in the input data.
No. of searches	i_Num_Search	W	1~128	Set the number of data points of the input data for which to perform a search.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.

Name	Label name	Data type	Initial value	Description
No. of identical data	o_Num_Same_Data	W	0	Return the number of the identical data.
Identical data first location	o_Ps_First_Same	W	0	Return the first location of the identical data. (0~)
Identical data last location	o_Ps_Last_Same	W	0	Return the last location of the identical data. (0~)
Minimum value last location	o_Ps_Last_Min	W	0	Return the last location of the minimum value. (0~)
Maximum value last location	o_Ps_Last_Max	W	0	Return the last location of the maximum value. (0~)

Processing description

This FB checks the input data for the number of searches. After which, it searches for the number of the identical data, the location of the identical data, and the location of the minimum and maximum values.

The following example shows the output from the function block when the data is set to 20 words in double word from D10.

The setting is made so that the output result is stored in D30 onwards.

The target data is 100 (double word, D8 and D9).

Input data (i_Input_Data)

	Location	Contents (example)	Target data
D10	0	100	100 (D8,D9)
D12	1	111	
D14	2	100	
D16	3	98	
D18	4	123	
D20	5	66	
D22	6	100	
D24	7	95	
D26	8	210	
D28	9	88	

Output label	Device	Result data
No. of identical data	D30	3
Identical data first location	D31	0
Identical data last location	D32	6
Minimum value last location	D33	5
Maximum value last location	D34	8

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_DSeachSameMaxMinData function block.

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

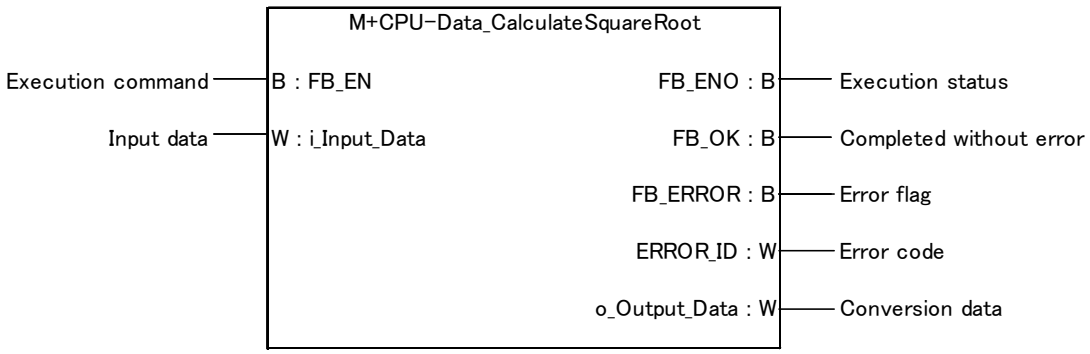
Before using any Mitsubishi products, please read all the relevant manuals.

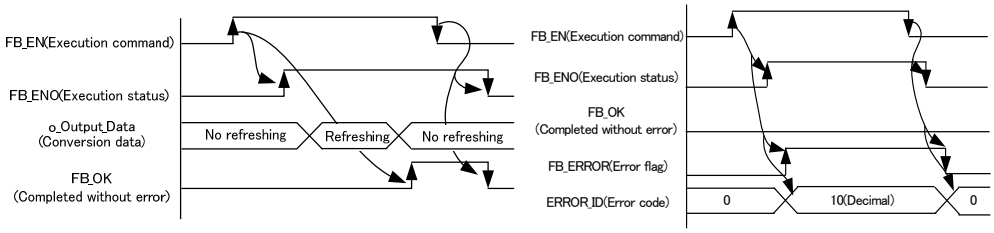
17. M+CPU-Data_CalculateSquareRoot (Binary data square root calculation)

FB Name

M+CPU-Data_CalculateSquareRoot

Function Overview

Item	Description
Function overview	Calculates the square root of the input binary data (16-bit data).
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 113* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	By turning ON FB_EN (Execution command), the square root of input data is calculated and the result is stored in the conversion data.
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.

Item	Description
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Input_Data (Input data) is not valid. Set the data within the range of 1 to 32767, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Input data	i_Input_Data	W	1~32767	Set the device number of the data to be calculated.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Conversion data	o_Output_Data	W	0	Store the square root of the input data. Return the integer value after dropping the number of decimal places. Return 0 if the input data is less than 1.

Processing description

1) Converts the input data (binary data) into floating decimal point data.
2) Executes “SQR instruction”.
3) Converts the operation result from the floating decimal point data into binary data, and stores it in the conversion data.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

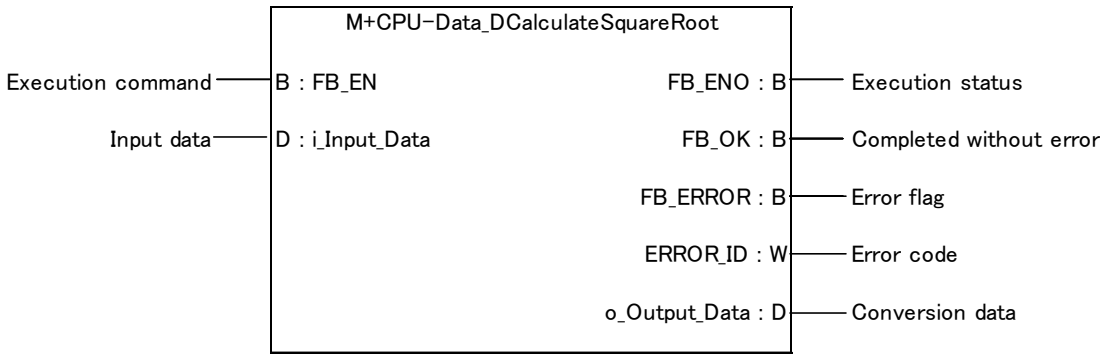
This chapter includes information related to the M+CPU-Data_CalculateSquareRoot function block.
It does not include information on restrictions of use such as combination with modules or programmable controller CPUs.
Before using any Mitsubishi products, please read all the relevant manuals.

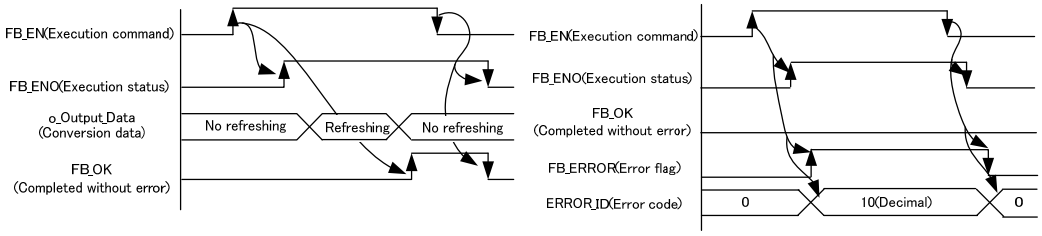
18. M+CPU-Data_DCalculateSquareRoot (32-bit binary data square root calculation)

FB Name

M+CPU-Data_DCalculateSquareRoot

Function Overview

Item	Description
Function overview	Calculates the square root of the input binary data (32-bit data).
Symbol	
Applicable hardware and software	Hardware details Q series: High performance model; Universal model L series: LCPU *Not applicable for QCPU (A mode) Compatible software: GX Works 2 Version 1.31H or later
Programming language	Ladder
Number of steps (maximum value)	For high performance model CPU: 118* *The value is the number of steps in the label program, and is therefore stated as a reference value. For details, refer to the GX Works2 Version1 Operation Manual (Simple Project).
Function description	By turning ON FB_EN (Execution command), the square root of the input data is calculated and the result is stored in the conversion data.
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.

Item	Description
FB operation type	Pulsed execution (1 scan execution type)
Application example	Refer to Appendix - Application examples.
Timing chart	•Operation of I/O signals [When operation completes without error] [When an error occurs] 
Relevant manual	MELSEC-Q/L Programming Manual (Common Instructions)

Error codes

■Error code list

Error code	Description
10	i_Input_Data (Input data) is not valid. Set the data within the range of 1 to 2147483647, and turn OFF FB_EN and then ON again.

Labels

■Input labels

Name	Label name	Data type	Setting range	Description
Execution command	FB_EN	B	ON, OFF	ON: The FB is activated. OFF: The FB is not activated.
Input data	i_Input_Data	D	1~2147483647	Set the device number of the data to be calculated.

■Output labels

Name	Label name	Data type	Initial value	Description
Execution status	FB_ENO	B	OFF	ON: Execution command is ON. OFF: Execution command is OFF.
Completed without error	FB_OK	B	OFF	When ON, it indicates that the processing is completed.
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.
Conversion data	o_Output_Data	D	0	Store the square root of the input data. Return the integer value after dropping the number of decimal places. Return 0 if the input data is less than 1.

Processing description

1) Converts the input data (binary data) into floating decimal point data.
2) Executes “SQR instruction”.
3) Converts the operation result from the floating decimal point data into binary data, and stores it in the conversion data.

Version Upgrade History

Version	Date	Description
1.00A	2011/03/22	First edition

Note

This chapter includes information related to the M+CPU-Data_DCalculateSquareRoot function block.
It does not include information on restrictions of use such as combination with modules or programmable controller CPUs.
Before using any Mitsubishi products, please read all the relevant manuals.

Appendix 1 – Application Examples

Application examples of data operation FB

System configuration

Power supply module	**CPU Module**	**QX40** (X10~X1F)	**QY41** (Y20~Y3F)

List of devices

External input (commands)

Device	FB function name	Application (ON details)
X10	Check code calculation	Conversion mode
X11	CRC-16 calculation	Conversion mode
X12	Digit copy	With/without BIN→BCD conversion
X13	Data sort	Sort order
X14	32-bit data sort	Sort order
X15	Data sort 2	Sort order
X16	32-bit data sort 2	Sort order

External output (checks)

Device	FB function name	Application (ON details)
Y20	Check code calculation	Check code calculation FB error
Y21	CRC-16 calculation	CRC-16 calculation FB error
Y22	Digit copy	Digit copy FB error
Y23	Bit right shift	Bit right shift FB error
Y24	Bit left shift	Bit left shift FB error
Y25	Word right shift	Word right shift FB error
Y26	Word left shift	Word left shift FB error
Y27	Data sort	Data sort FB error
Y28	32-bit data sort	32-bit data sort FB error
Y29	Data sort 2	Data sort 2 FB error
Y2A	32-bit data sort 2	32-bit data sort 2 FB error
Y2B	16-bit ON/OFF check	16-bit ON/OFF check FB error
Y2C		Check result
Y2D	32-bit ON/OFF check	32-bit ON/OFF check FB error
Y2E		Check result
Y2F	Data search	Data search FB error
Y30	32-bit data search	32-bit data search FB error
Y31	Binary data square root calculation	Binary data square root calculation error
Y32	32-bit binary data square root calculation	Binary data square root error

Data register

Device	FB function name	Application (ON details)
D0	Check code calculation	Operation data start device
D2		Check code calculation FB error code
D3		Addition (Sum) data
D4		Horizontal parity data
D10	CRC-16 calculation	CRC-16 calculation FB error code
D11		CRC data
D4000		Start device No.
D4500		No. of data
D20	Digit copy	Transfer source data
D21		Start digit position to transfer
D22		No. of digits to transfer
D23		Transfer destination data
D24		Start digit position of transfer destination
D25		Digit copy FB error code
D26		Transfer result data
D30	32-bit upper/lower byte conversion	32-bit upper/lower byte conversion input data
D32		Conversion data (uses 2 words)

Relay

Device	FB function name	Application (ON details)
M0	Check code calculation	Check code calculation request
M1		Check code calculation FB ready
M2		Check code calculation processing
M3	CRC-16 calculation	CRC-16 calculation request
M4		CRC-16 calculation FB ready
M5		CRC-16 calculation processing completed
M6	Digit copy	Digit copy request
M7		Digit copy FB ready
M8		Digit copy processing completed
M9	32-bit upper/lower byte conversion	32-bit upper/lower byte conversion request
M10		32-bit upper/lower byte conversion FB ready
M11		32-bit upper/lower byte conversion processing completed
M12	Bit right shift	Bit right shift request
M13		Bit right shift FB ready
M14		Bit right shift processing completed
M15	Bit left shift	Bit left shift request
M16		Bit left shift FB ready
M17		Bit left shift processing completed
M18	Word right shift	Word right shift request
M19		Word right shift FB ready
M20		Word right shift processing completed
M21	Word left shift	Word left shift request
M22		Word left shift FB ready
M23		Word left shift processing completed
M24	Data sort	Data sort request
M25		Data sort FB ready
M26		Data sort processing completed
M27	32-bit data sort	32-bit data sort request
M28		32-bit data sort FB ready
M29		32-bit data sort processing completed
M30	Data sort 2	Data sort 2 request
M31		Data sort 2 FB ready
M32		Data sort 2 processing completed
M33	32-bit data sort 2	32-bit data sort 2 request
M34		32-bit data sort 2 FB request
M35		32-bit data sort 2 processing completed
M36	16-bit ON/OFF check	16-bit ON/OFF check request
M37		16-bit ON/OFF check FB request
M38		16-bit ON/OFF check processing completed
M39	32-bit ON/OFF check	32-bit ON/OFF check request
M40		32-bit ON/OFF check FB request
M41		32-bit ON/OFF check processing completed

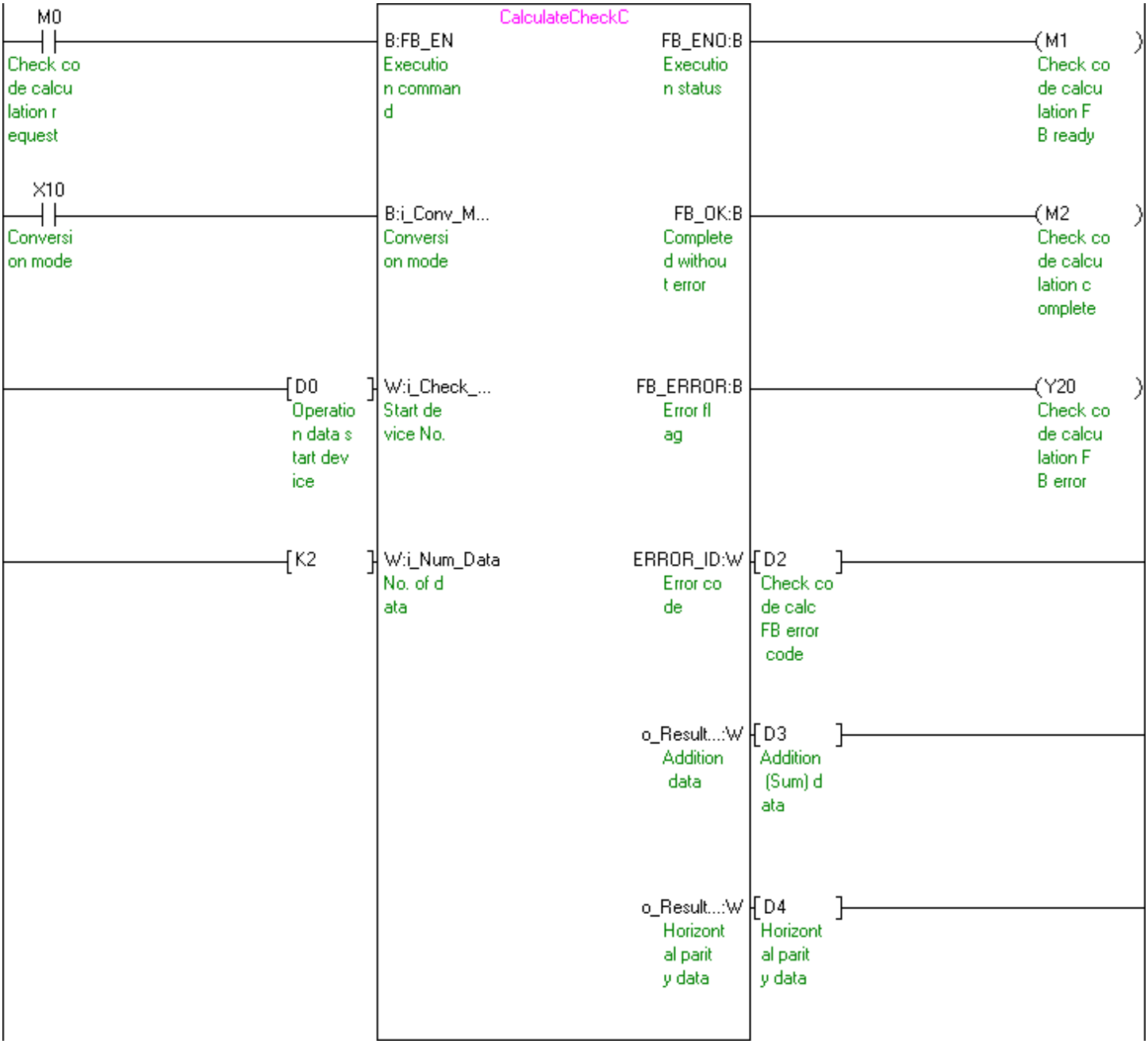
Data register

Device	FB function name	Application (ON details)
D40	Bit right shift	Data stored in shift result
D104		Start shift target data
D105		Bit data length of shift target data
D106		No. of bits to right shift
D107		Bit right shift FB error code
D108		Start device No. of shift result data
D110	Bit left shift	Data stored in shift result
D174		Start shift target data
D175		Bit data length of shift target data
D176		No. of bits to left shift
D177		Bit left shift FB error code
D178		Start device No. of shift result data
D180	Word right shift	Data stored in shift result
D181		Start shift target data
D693		Word data length of shift result data
D694		No. of words to right shift
D695		Word right shift FB error code
D696		Start device No. of shift result data
D700	Word left shift	Data stored in shift result
D701		Start shift target data
D1213		Word data length of shift result data
D1214		No. of words to left shift
D1215		Word left shift FB error code
D1216		Start device No. of shift result data
D1220	Data sort	Start device of data table
D1412		No. of lines
D1413		No. of columns
D1414		Sort reference column No.
D1415		Data sort FB error code
D1416		Start device No. of sort result
D1420	32-bit data sort	Start device No. of data table
D1804		No. of lines
D1805		No. of columns
D1806		Sort reference column No.
D1807		Data sort FB error code
D1808		Start device No. of sort result
D1810	Data sort 2	Start device No. of data table
D2194		No. of lines
D2195		No. of columns
D2196		Sort reference column No.
D2197		Data sort FB error code
D2198		Start device No. of sort result
D2200	32-bit data sort 2	Start device No. of data table
D2584		No. of lines
D2585		No. of columns
D2586		Sort reference column No.
D2587		Data sort FB error code
D2588		Start device No. of sort result
D2600	16-bit ON/OFF check	Check target data
D2601		Specified bit position
D2602		16-bit ON/OFF check FB error code
D2610	32-bit ON/OFF check	Check target data
D2612		Specified bit position
D2613		32-bit ON/OFF check FB error
D2715	Data search	Start device No. of input data
D2971		Search target data
D2972		Data search FB error code
D2973		No. of identical data
D2974		First position of identical data
D2975		Last position of identical data
D2976		Last position of minimum value
D2977		Last position of maximum value
D2978	32-bit data search	Start device No. of input data
D3234		Search target data (uses 2 words)
D3236		32-bit data search FB error code
D3237		No. of identical data
D3238		First position of identical data
D3239		Last position of identical data
D3240		Last position of minimum value
D3241		Last position of maximum value
D3242	Binary data square root calculation	Input data
D3243		Error code
D3244		Conversion data
D3245	32-bit binary data square root calculation	Input data (uses 2 words)
D3247		Error code
D3248		Conversion data (uses 2 words)

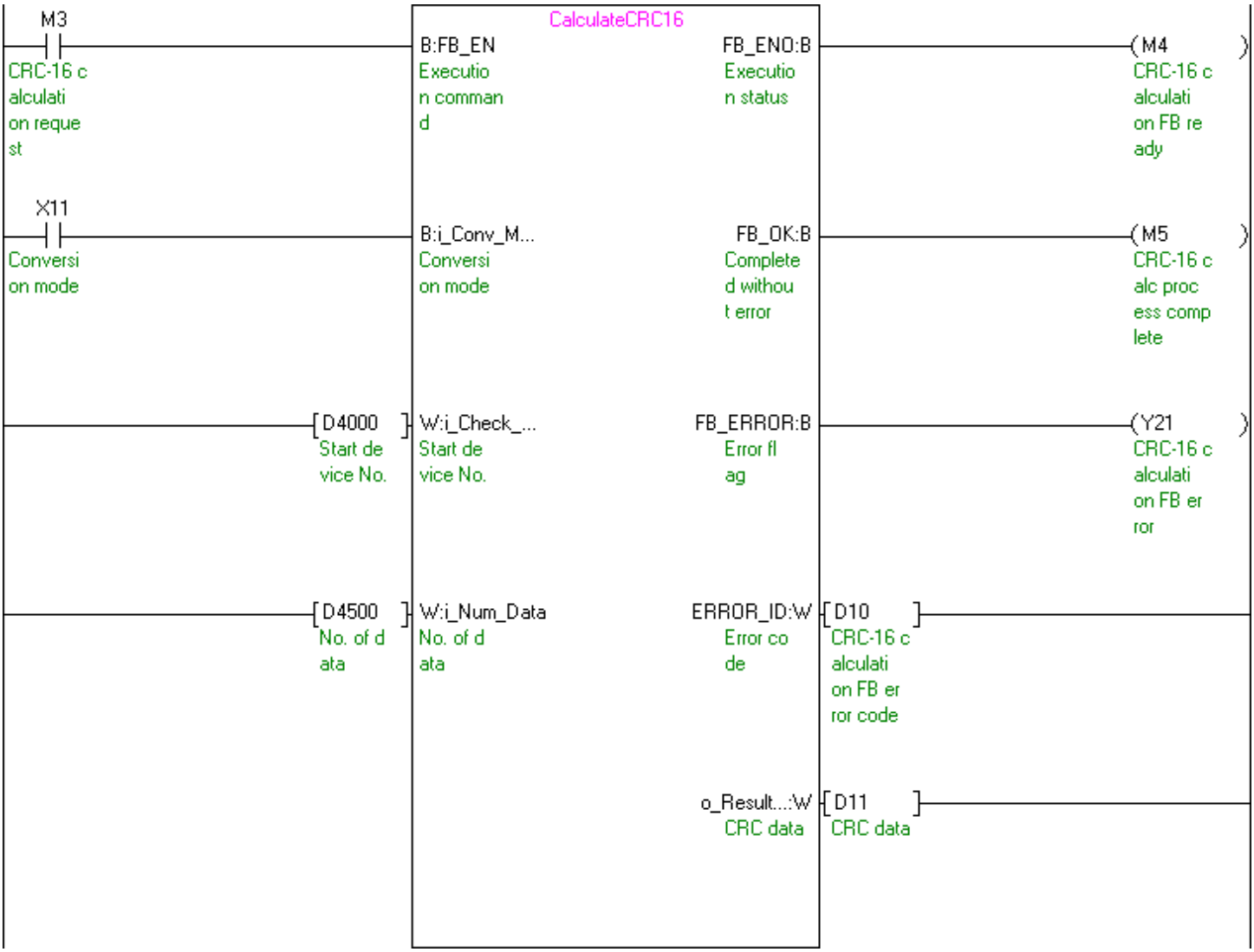
Relay

Device	FB function name	Application (ON details)
M42	Data search	Data search request
M43		Data search FB ready
M44		Data search processing completed
M45	32-bit data search	32-bit data search request
M46		32-bit data search FB ready
M47		32-bit data search processing completed
M48	Binary data square root calculation	Binary data square root calculation request
M49		Binary data square root calculation FB ready
M50		Binary data square root calculation
M52	32-bit binary data square root calculation	32 binary data square root calculation
M53		32 binary data square root calculation FB ready
M54		32 binary data square root calculation completed

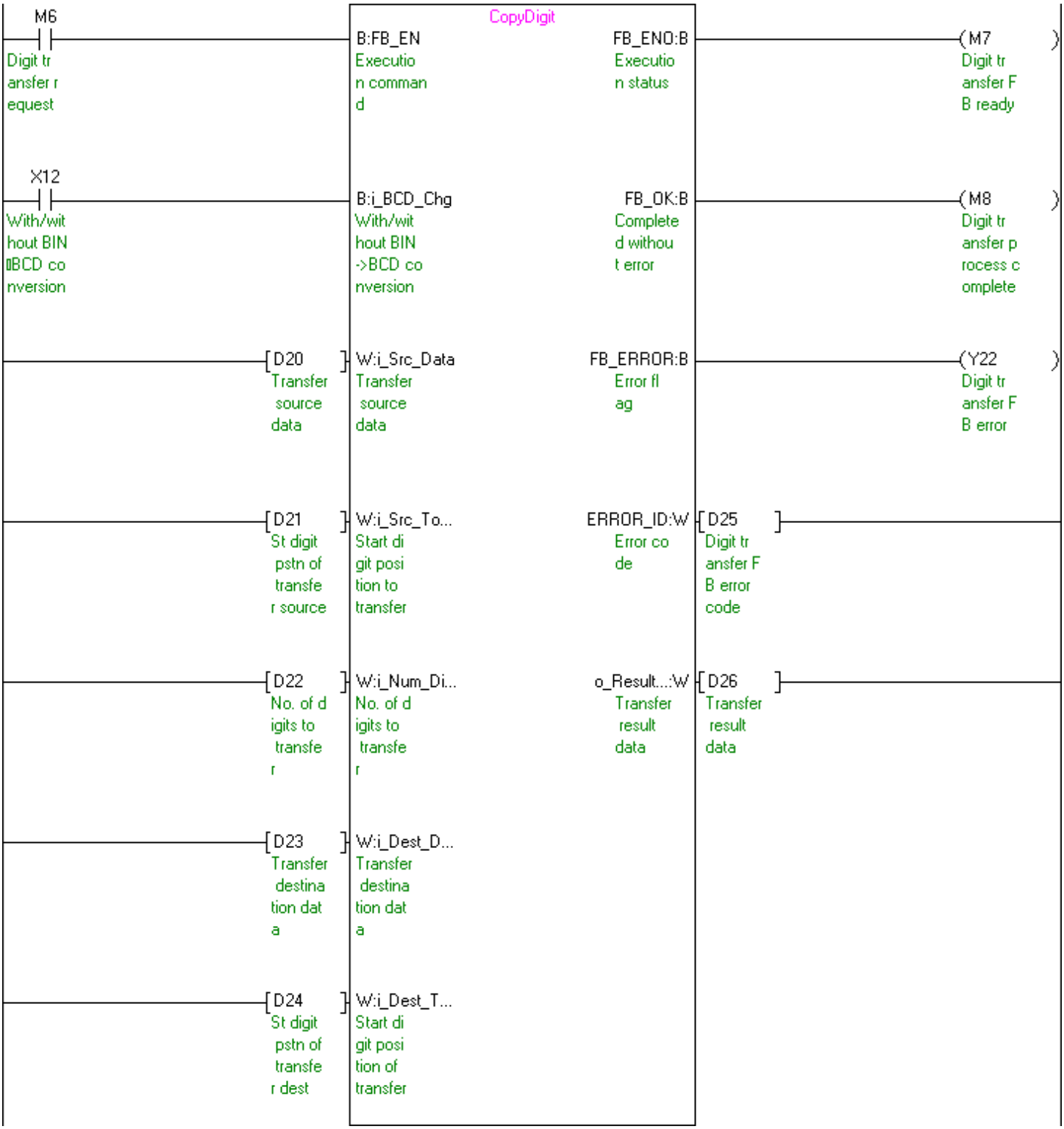
M+CPU-Data_CalculateCheckCode (Check code calculation)



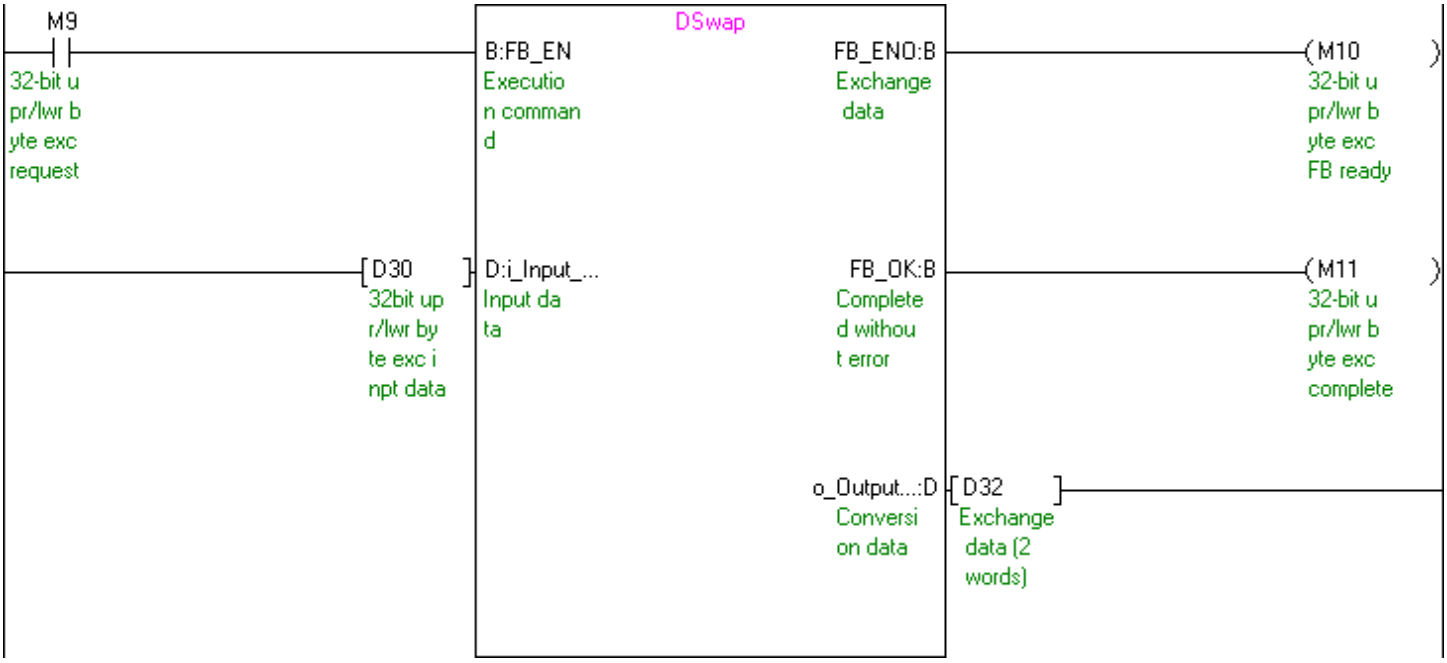
M+CPU-Data_CalculateCRC16 (CRC-16 calculation)



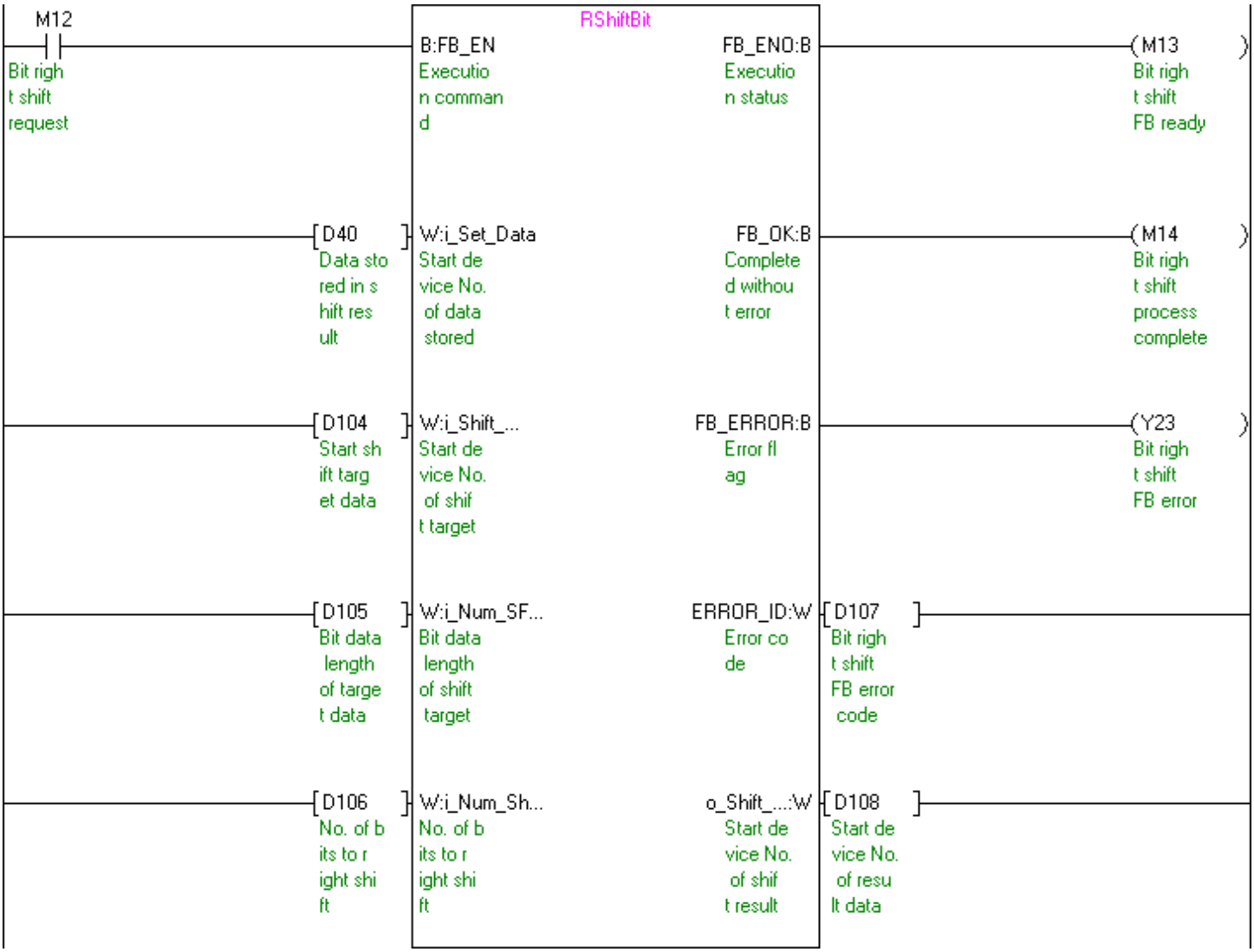
M+CPU-Data_CopyDigit (Digit copy)



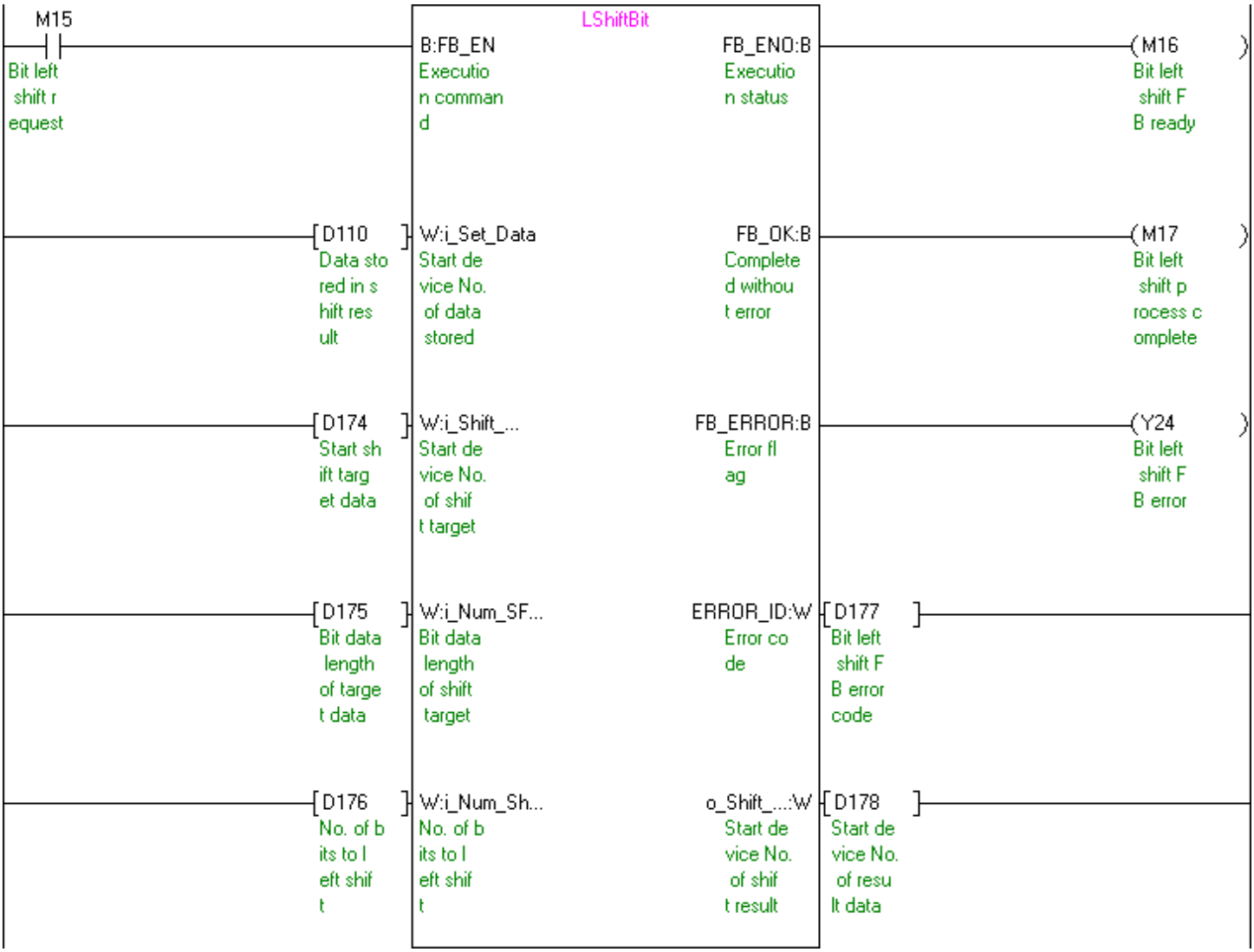
M+CPU-Data_DSwap (32-bit upper/lower byte exchange)



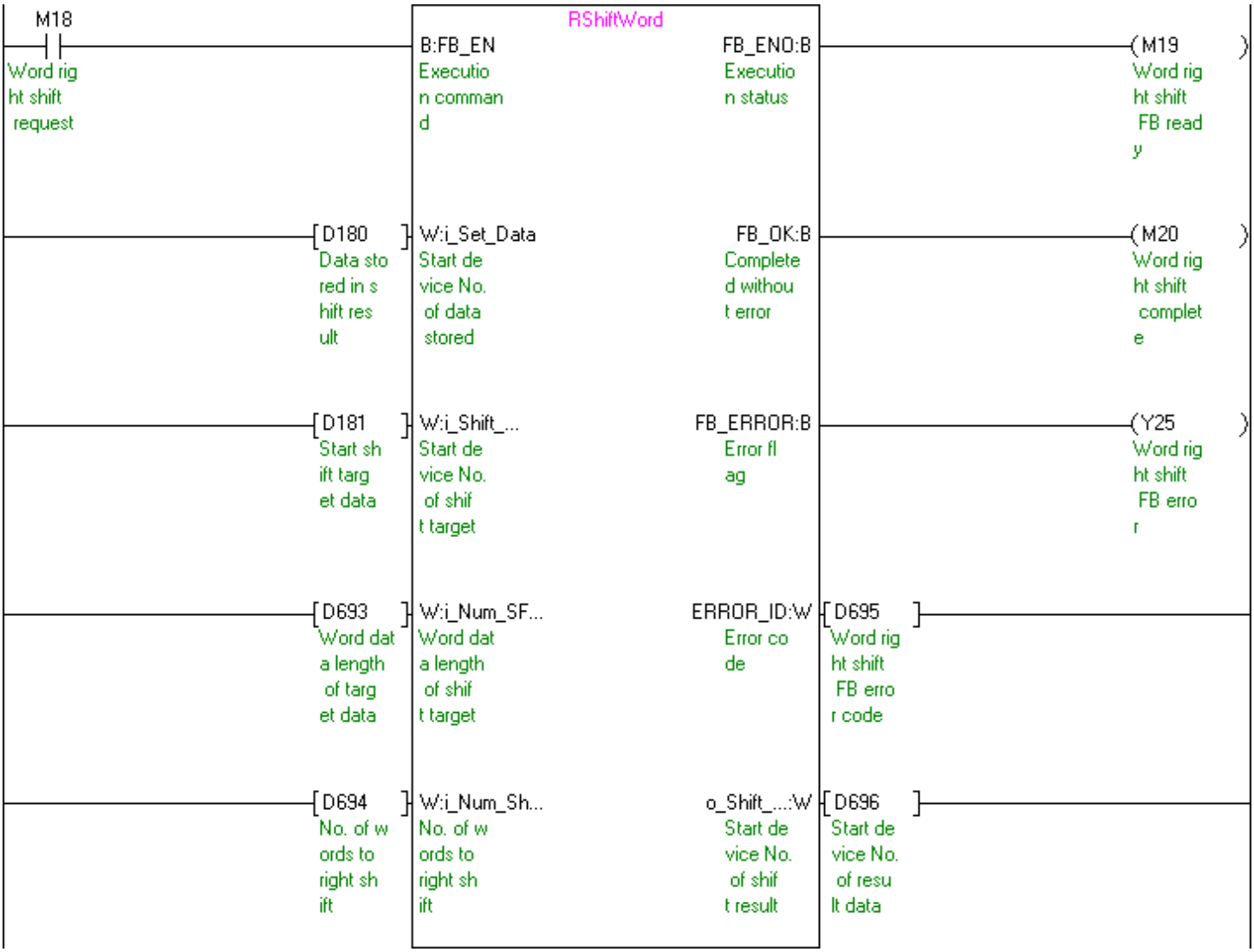
M+CPU-Data_RShiftBit (Bit right shift)



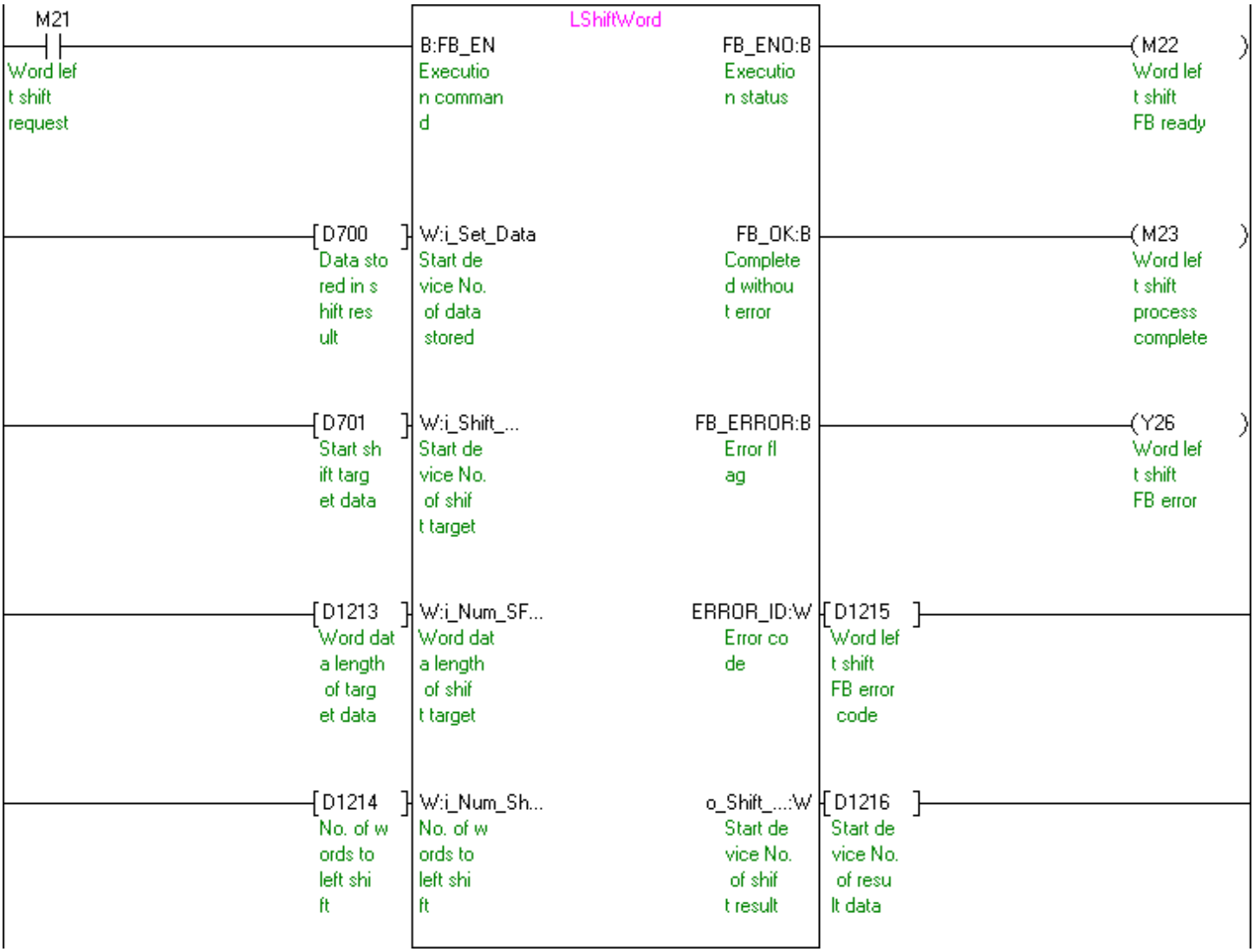
M+CPU-Data_LShiftBit (Bit left shift)



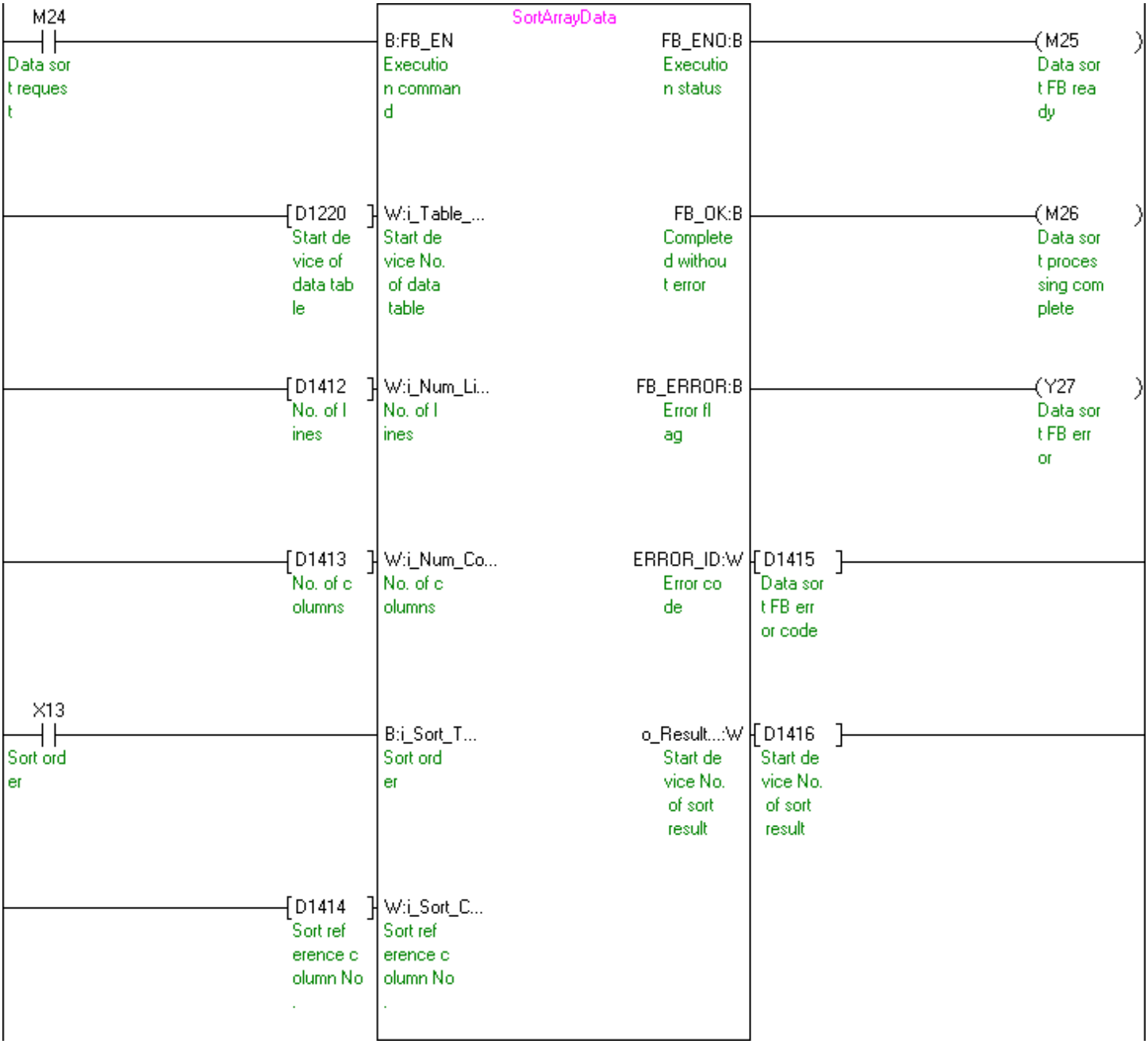
M+CPU-Data_RShiftWord (Word right shift)



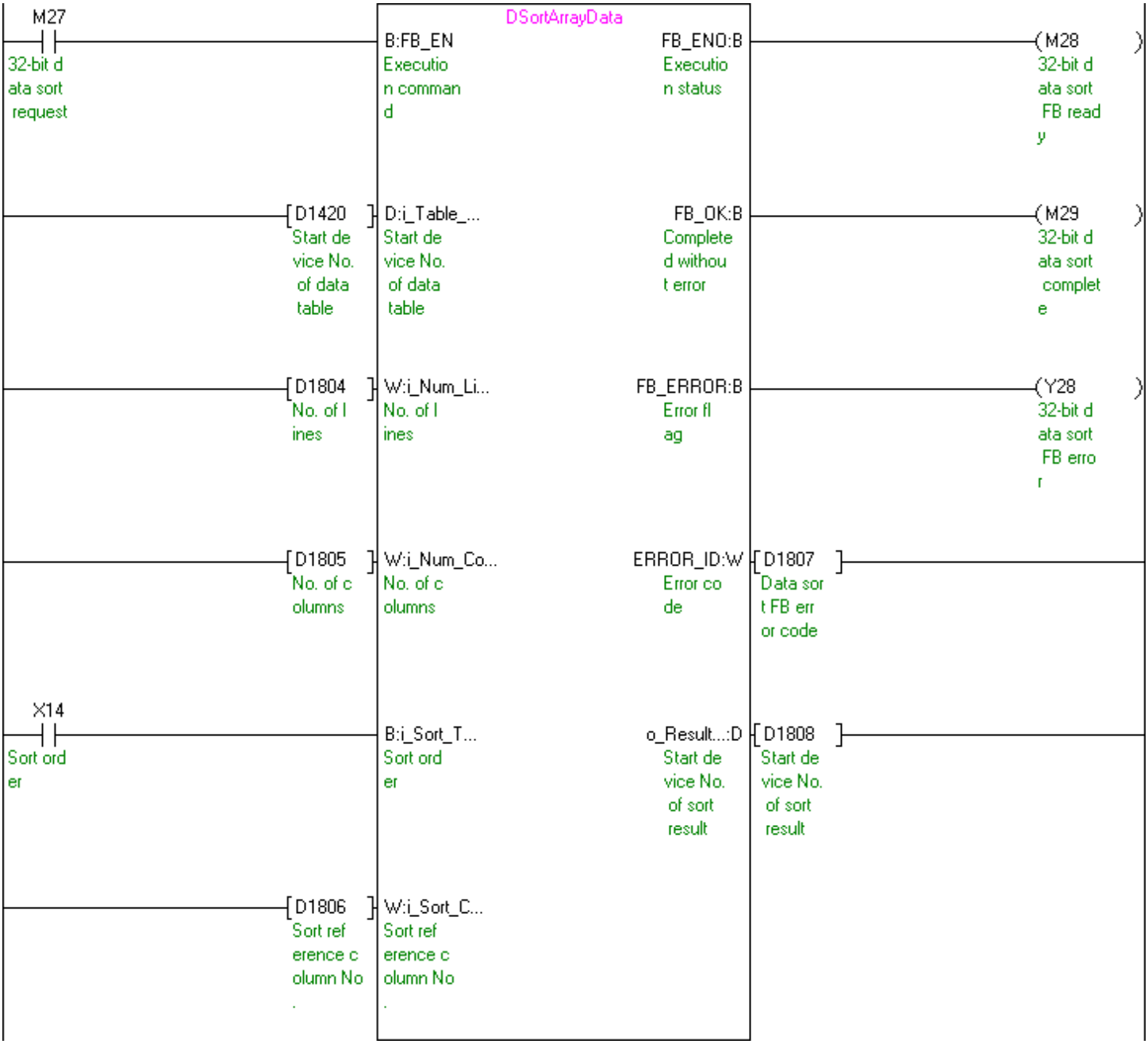
M+CPU-Data_LShiftWord (Word left shift)



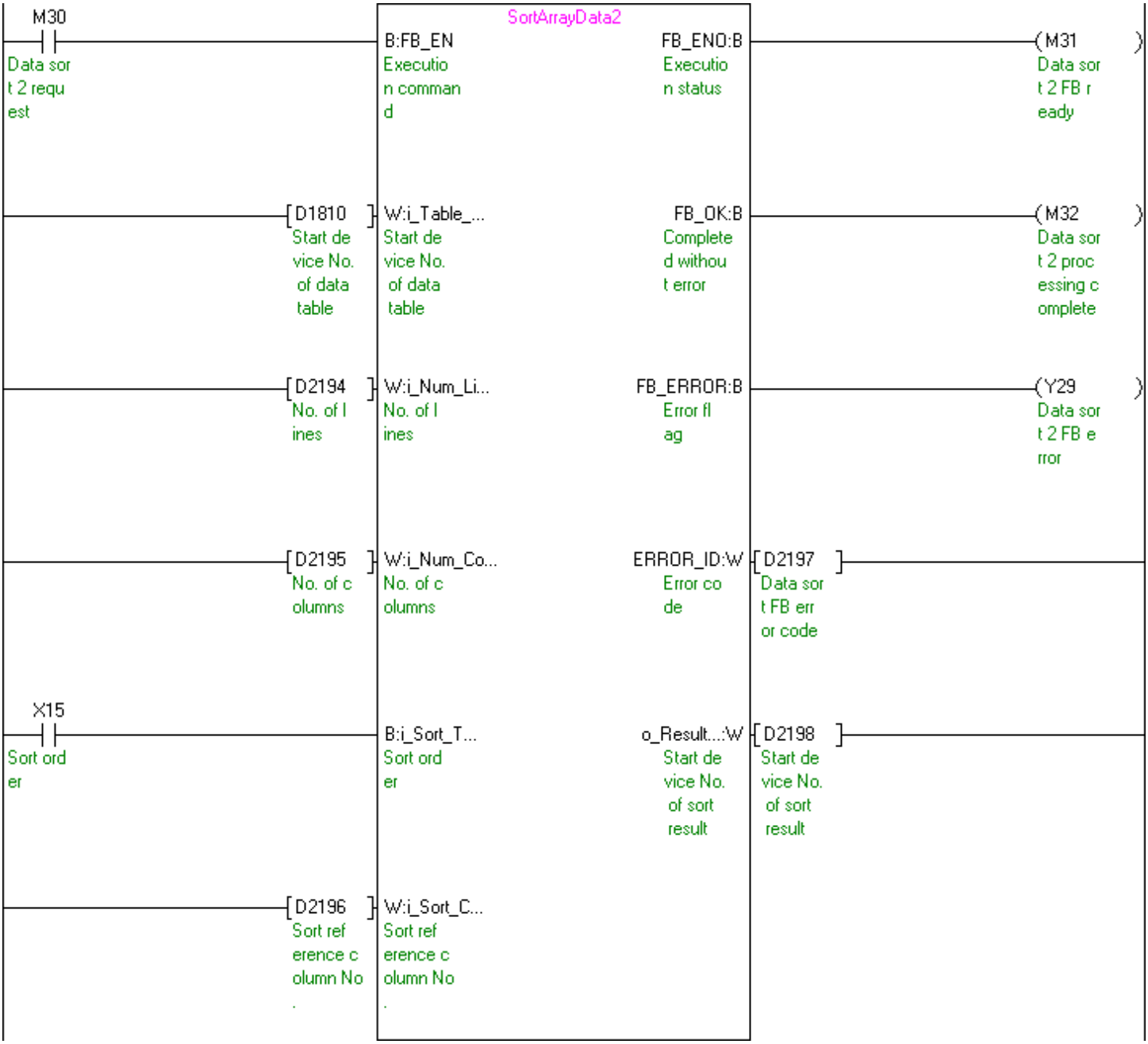
M+CPU-Data_SortArrayData (Data sort)



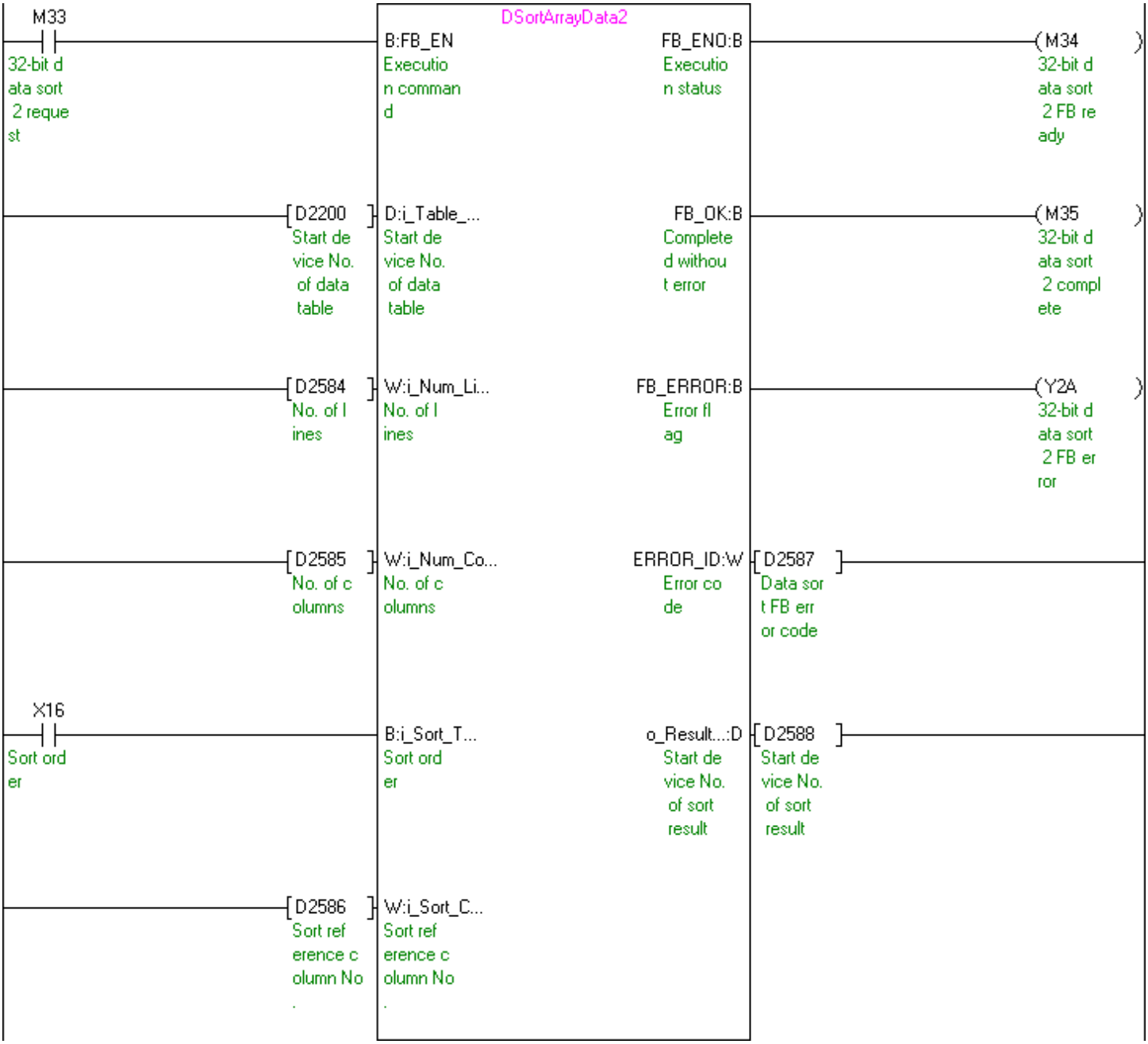
M+CPU-Data_DSortArrayData (32-bit data sort)



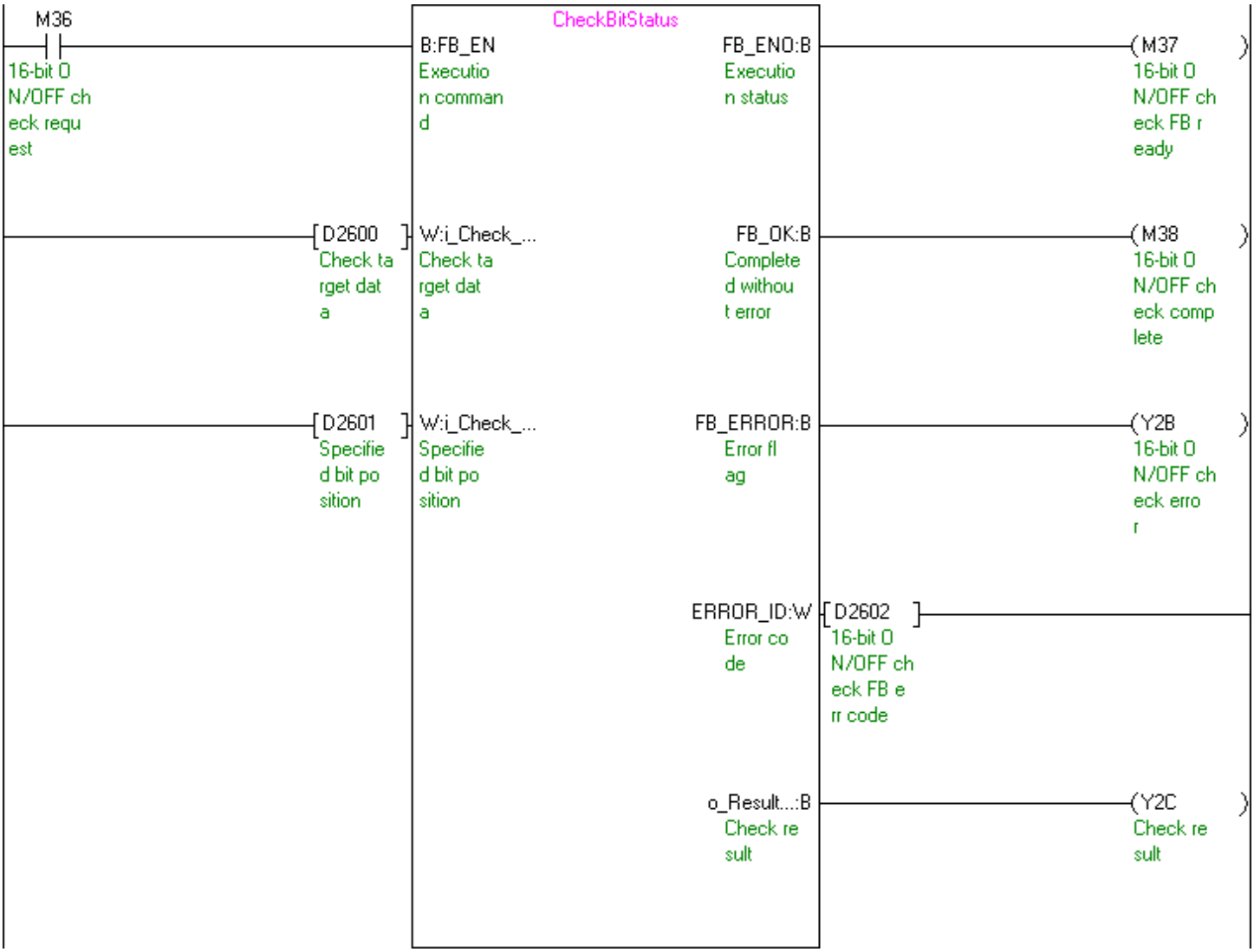
M+CPU-Data_SortArrayData2 (Data sort 2)



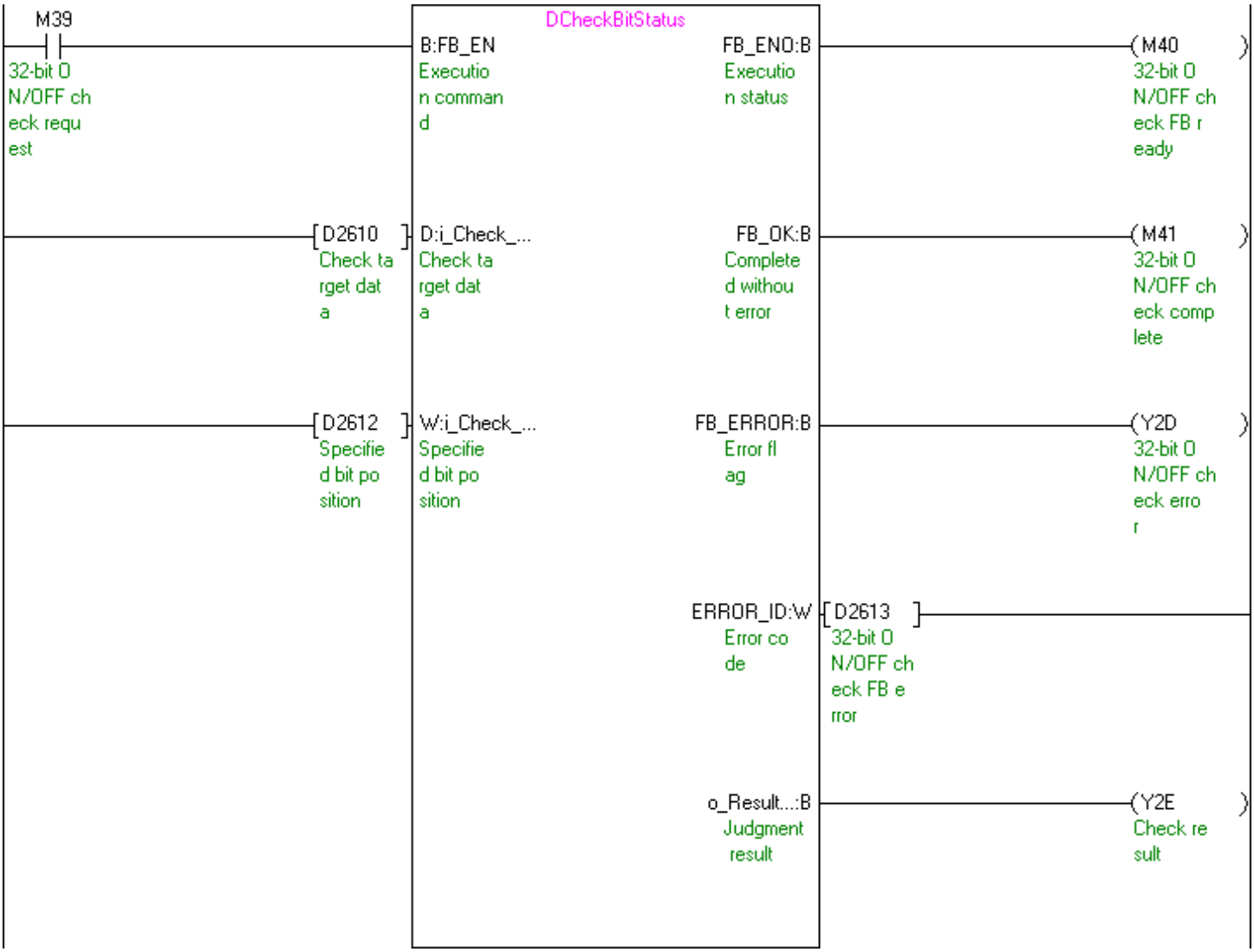
M+CPU-Data_DSortArrayData2 (32-bit data sort 2)



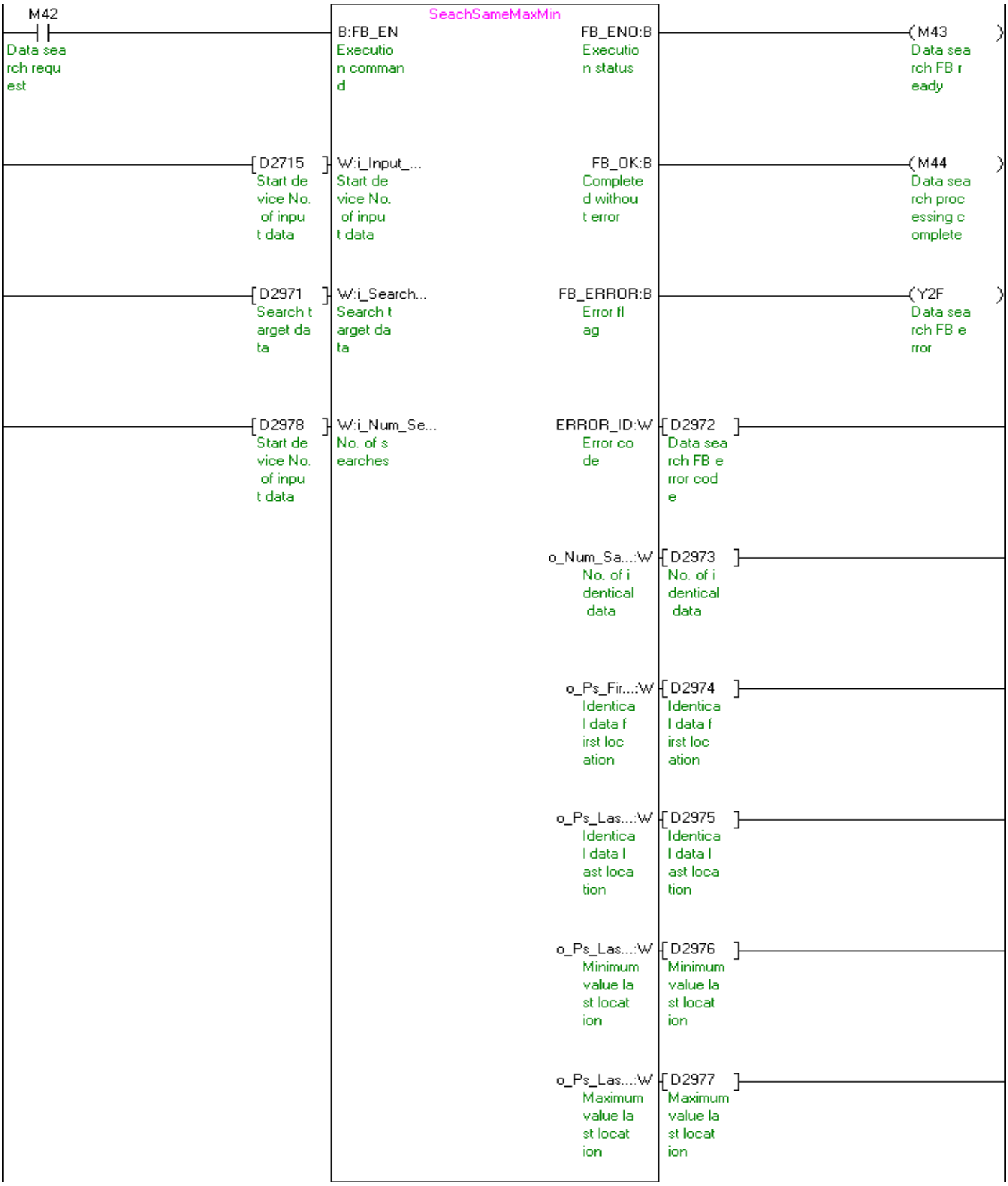
M+CPU-Data_CheckBitStatus (16-bit ON/OFF check)



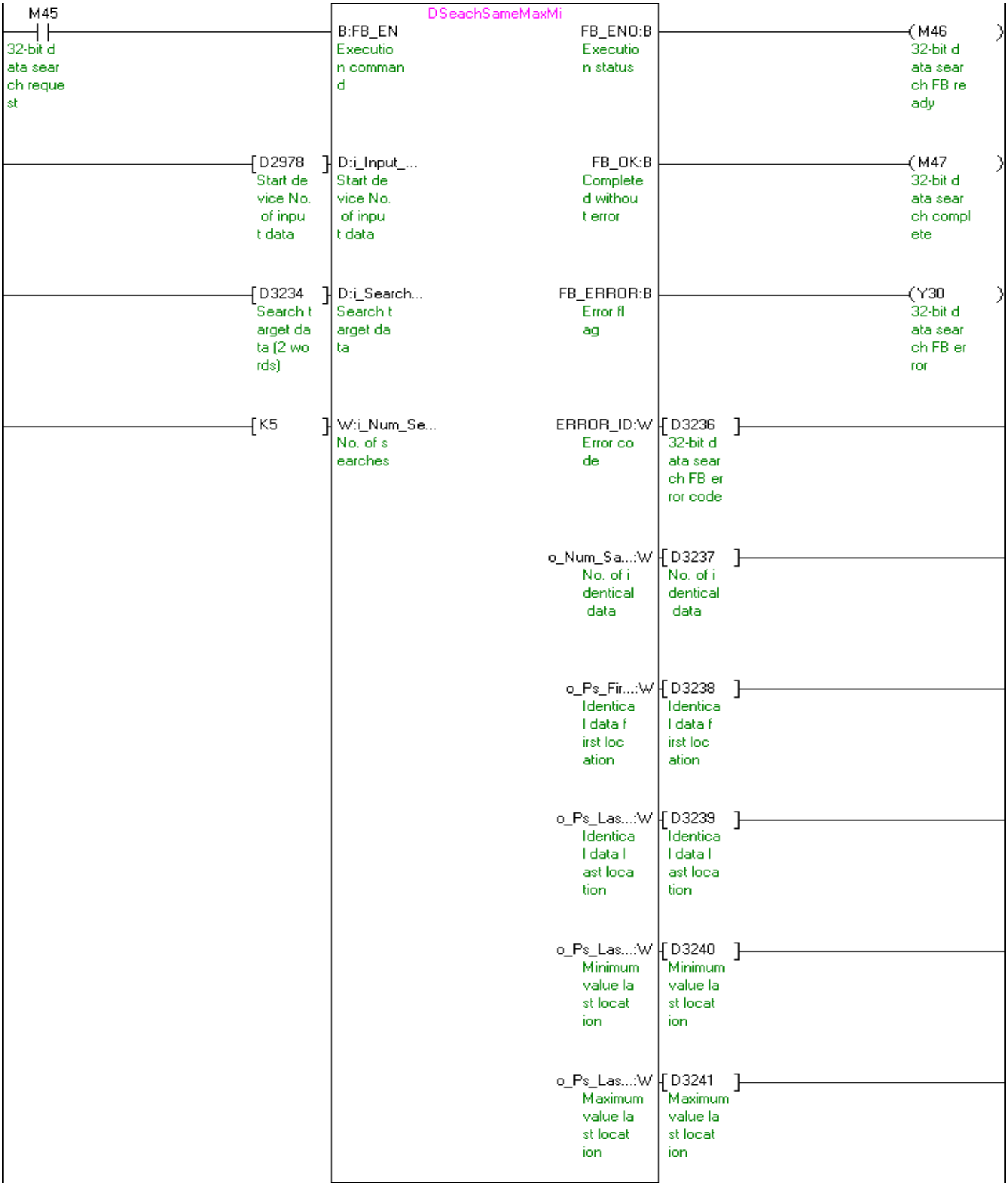
M+CPU-Data_DCheckBitStatus (32-bit ON/OFF check)



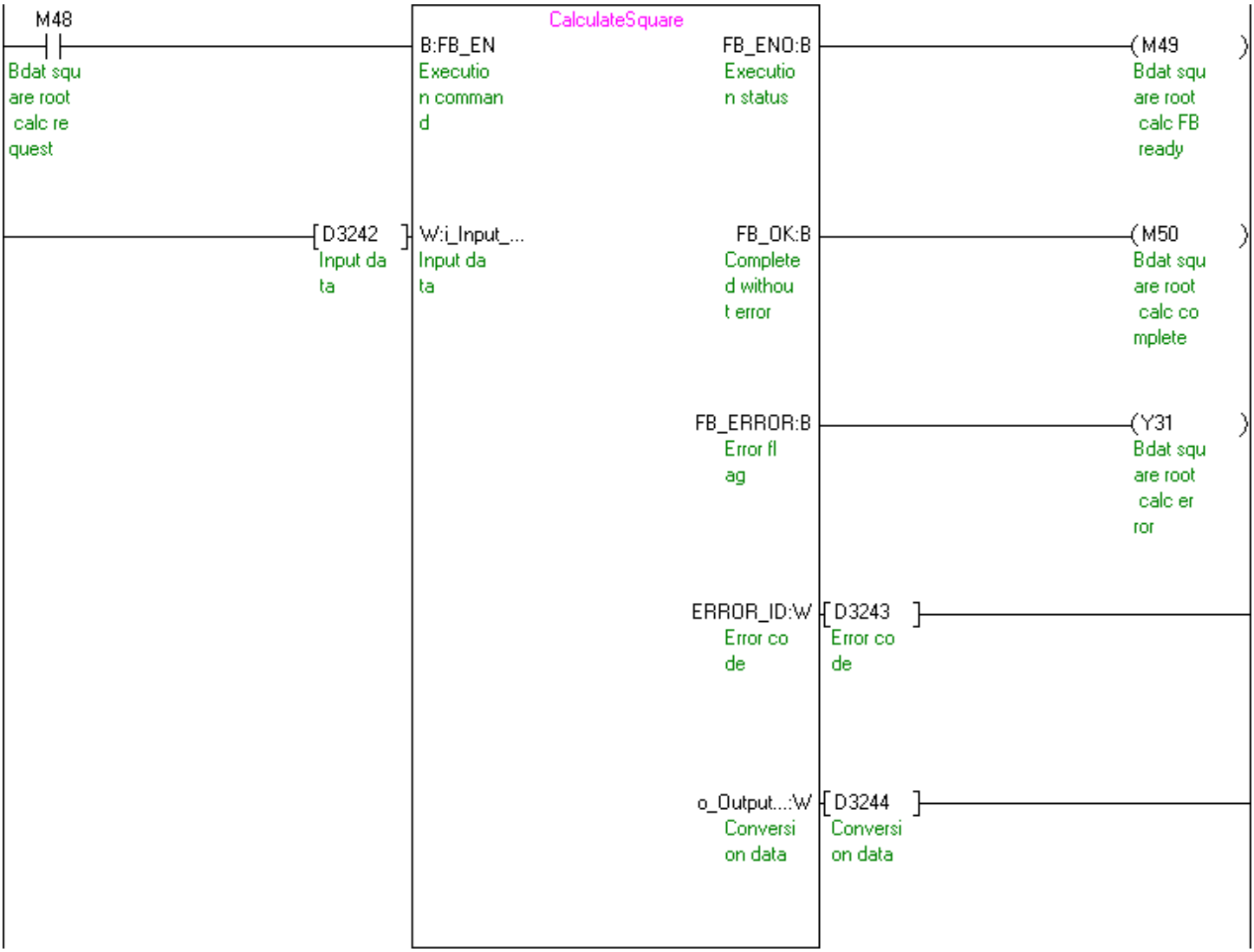
M+CPU-Data_SeachSameMaxMinData (Data search)



M+CPU-Data_DSeachSameMaxMinData (32-bit data search)



M+CPU-Data_CalculateSquareRoot (Binary data square root calculation)



M+CPU-Data_DCalculateSquareRoot (32-bit binary data square root calculation)