MITSUBISHI ELECTRIC

Programmable Controller

MELSEC iQ-R series

MELSEC iQ-R Array Handling Function Block Library Reference

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1 OVERVIEW

The FB library in this manual is for array handling.

1.1 FB Library List

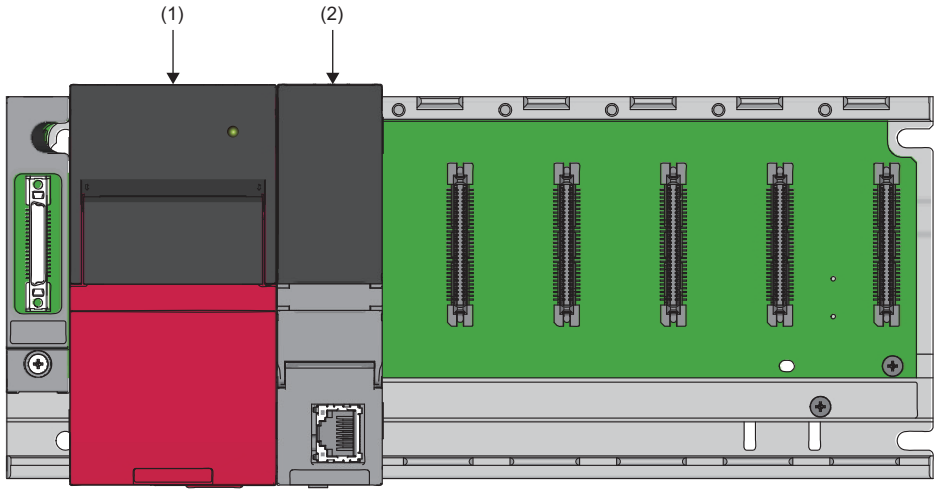
The following table lists the FB library in this manual.

Name	Description
M+ArrayHandling_PointAdd_R	Adds a specified value to values of each element in a specified array.
M+ArrayHandling_PointSub_R	Subtracts a specified value from values of each element in a specified array.
M+ArrayHandling_PointMul_R	Multiplies values of each element in a specified array by a specified value.
M+ArrayHandling_PointDiv_R	Divides values of each element in a specified array by a specified value.
M+ArrayHandling_Abs_R	Outputs absolute values of values of each element in a specified array.
M+ArrayHandling_Sort_R	Outputs the result of sorting a specified array in ascending order.
M+ArrayHandling_Reverse_R	Outputs the result of sorting a specified array in reverse order.
M+ArrayHandling_Compare_R	Compares two specified arrays.
M+ArrayHandling_Copy_R	Copies a specified array to specified storage locations.

For how to register the FB library, refer to the GX Works3 Operating Manual.

1.2 System Configuration Example

The following figure shows a system configuration example to use the FB library in this manual.



(1) Power supply module
(2) CPU module

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

MEMO

2 DETAILS OF THE FB LIBRARY

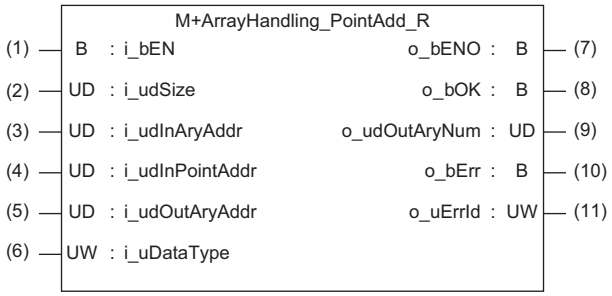
This chapter describes the details of the FB library.

2.1 M+ArrayHandling_PointAdd_R

Name

M+ArrayHandling_PointAdd_R

Overview

Item	Description
Functional overview	Adds a specified value to values of each element in a specified array.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the addition is performed.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data of the addition target values are stored.
(4)	i_udInPointAddr	Input value address	Double Word [unsigned]	Valid device range*1	Specifies the address of the file register (ZR) where the addition value is stored.
(5)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(6)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

No.	Variable name	Name	Data type	Default value	Description
(7)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(8)	o_bOK	Normal completion	Bit	Off	The on state indicates that the addition has been completed.
(9)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their addition completed is stored.
(10)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	853 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	
Functional description	(1) As i_bEN (execution command) turns on, this FB performs the addition between the input array data and the addition value. ■Example 1 When 1 is input as the addition value and this FB is executed for the array data in word [signed], the output result is as follows.	

	ZR0	ZR1	···	ZR998	ZR999
Stored value	0	1	···	32767	-32768

↓

Output result	ZR10000	ZR10001	···	ZR10998	ZR10999
Stored value	1	2	···	-32768	-32767

■Example 2

When 1 is input as the addition value and this FB is executed for the input array data in double word [signed], the output result is as follows.

	ZR0	ZR2	···	ZR1996	ZR1998
Stored value	0	1	···	2147483647	-2147483648

↓

Output result	ZR10000	ZR10002	···	ZR11996	ZR11998
Stored value	1	2	···	-2147483648	-2147483647

If an underflow or an overflow occurs during operation when word or double word is specified by i_uDataType (data type selection), the operation result is as follows.

Word [signed]	Effective data range: -32768 to 32767
Overflow	7FFFH(32767) + 0001H(1) = 8000H(-32768)
Underflow	8000H(-32768) + FFFFH(-1) = (1)7FFFH(32767) Underflow data (1) are discarded.
Double word [signed]	**Effective data range: -2147483648 to 2147483647**
Overflow	7FFFFFFFH(2147483647) + 00000001H(1) = 80000000H(-2147483648)
Underflow	80000000H(-2147483648) + FFFFFFFFH(-1) = (1)7FFFFFFFH(2147483647) Underflow data (1) are discarded.

(2) The input array data of the addition target values are read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads input array data for the number of points specified by i_udSize (number of data points).

(3) The addition value is read from the file register (ZR) of the address specified by i_udInPointAddr (input value address).

(4) The operation results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address).

(5) Set the following so that the input array data areas and the output array data areas are not overlapped.

· i_udInAryAddr (input array data start address)

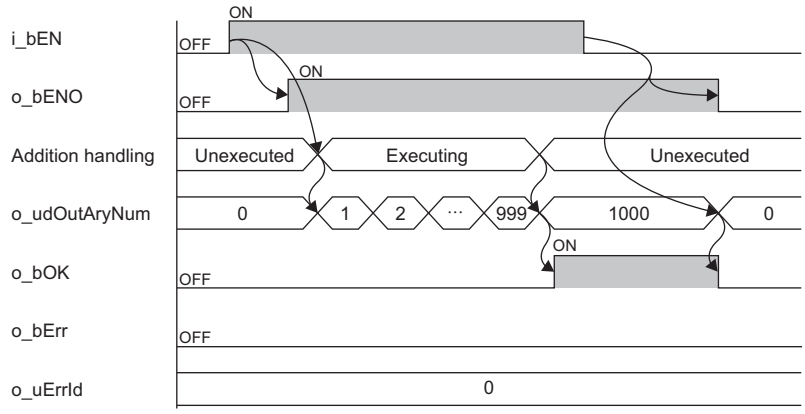
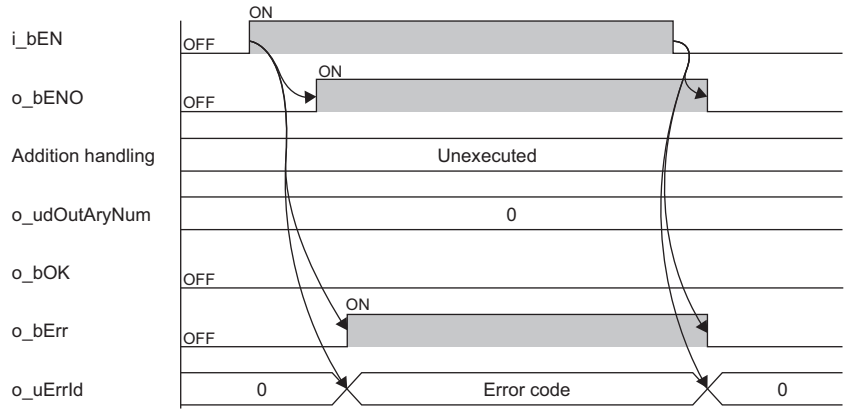
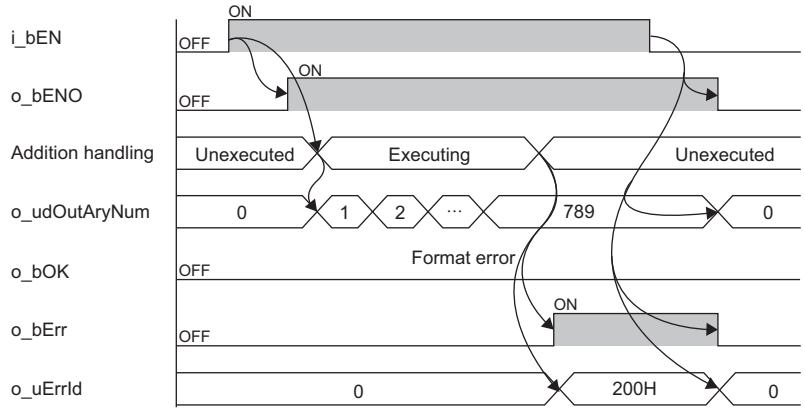
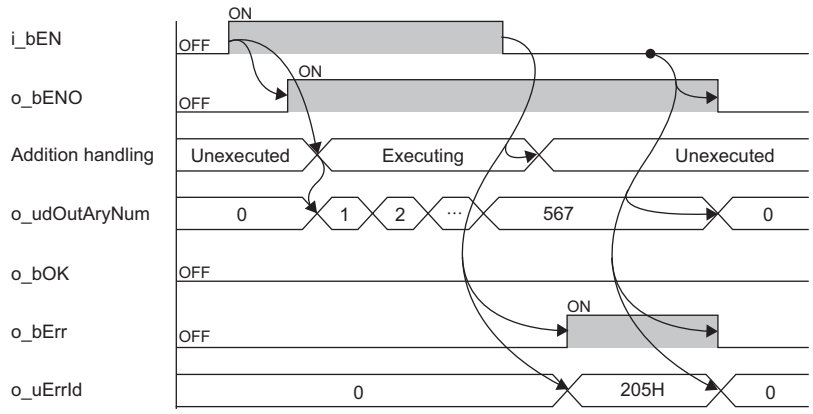
· i_udOutAryAddr (output array data start address)

· i_udSize (number of data points)

If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 9 List of error codes)

However, if the same value is set for i_udInAryAddr (input array data start address) and i_udOutAryAddr (output array data start address), the operation is processed normally. The operation results overwrite data in the file register (ZR), starting from the area specified by i_udInAryAddr (input array data start address).

Item	Description
Functional description	(6) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of input array data, addition value, and output array data in i_uDataType (data type selection). (7) Specify the number of data points for an array where addition is performed in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required. (8) It takes multiple scans until the addition is completed. When the input array data before the operation is changed during the operation processing, the operation processing is executed with the changed data. The number of points with the operation completed is output to o_udOutAryNum (number of output data points). When the addition is completed, o_bOK (normal completion) turns on. (9) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 9 List of error codes) (10)If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 9 List of error codes) (11)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 9 List of error codes) (12)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 9 List of error codes) The operation results of the addition that has been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR). (13)When a single-precision real number is set in i_uDataType (data type selection) and the operation result exceeds the scope of the single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 203H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 9 List of error codes)
FB compilation method	Subroutine type
FB operation	Pulse execution type (multiple scan execution type)

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during addition in array)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label. (6) This FB checks the input array data values before the operation execution to prevent an overflow or an underflow from occurring during the operation. If a possibility of an overflow or an underflow is detected at this check, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). For the operation with the single-precision real number, an error may occur depending on the combination of input array data values. Even after the input array data values are checked, the instruction execution fault (operation error) may occur at the operation execution. If "RAS Setting" of "CPU Parameter" is set to continue the processing even after an operation error occurs, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). (7) If 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module due to an error outside FB while i_bEN (execution command) of this FB is on, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 204H is stored in o_uErrId (error code). However, if "RAS Setting" of "CPU Parameter" is set to stop the processing after an operation error occurs, 204H is not stored in o_uErrId (error code).

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	14ms	3.62ms	4 scans
	1: Double Word [signed]	22.5ms	5.83ms	
	2: Single-precision real number	37.1ms	9.65ms	
500000 points	0: Word [signed]	754ms	3.9ms	200 scans
	1: Double Word [signed]	1210ms	6.16ms	
	2: Single-precision real number	1950ms	9.86ms	
1000000 points	0: Word [signed]	1510ms	3.92ms	400 scans
	1: Double Word [signed]	2400ms	6.17ms	
	2: Single-precision real number	3880ms	9.87ms	

*1 The time required from start to end of the processing

List of error codes

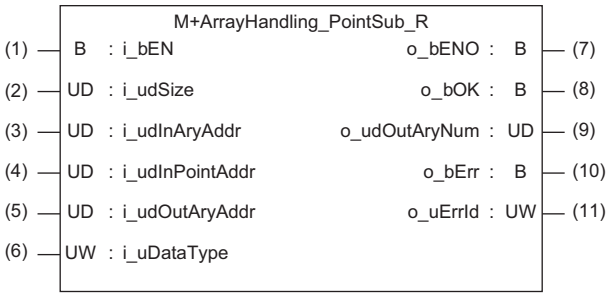
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data or the addition value is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and the addition value, and then execute the FB again.
203H	An overflow or an underflow has occurred in the FB during the operation.	Review and correct the input array data stored in the file register (ZR) and then execute the FB again. When 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module, refer to the MELSEC iQ-R CPU Module User's Manual (Application).
204H	The processing of the FB has been interrupted due to an overflow in an operation other than that of this FB.	An overflow has occurred in the operation other than that of this FB, and 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module. Refer to the MELSEC iQ-R CPU Module User's Manual (Application).
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.2 M+ArrayHandling_PointSub_R

Name

M+ArrayHandling_PointSub_R

Overview

Item	Description
Functional overview	Subtracts a specified value from values of each element in a specified array.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the subtraction is performed.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data of the subtraction target values are stored.
(4)	i_udInPointAddr	Input value address	Double Word [unsigned]	Valid device range*1	Specifies the address of the file register (ZR) where the subtraction value is stored.
(5)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(6)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

No.	Variable name	Name	Data type	Default value	Description
(7)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(8)	o_bOK	Normal completion	Bit	Off	The on state indicates that the subtraction has been completed.
(9)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their subtraction completed is stored.
(10)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	853 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	
Functional description	(1) As i_bEN (execution command) turns on, this FB performs the subtraction between the input array data and the subtraction value. ■Example 1 When 1 is input as the subtraction value and this FB is executed for the input array data in word [signed], the output result is as follows.	

	ZR0	ZR1	···	ZR998	ZR999
Stored value	0	1	···	32767	-32768

↓

Output result	ZR10000	ZR10001	···	ZR10998	ZR10999
Stored value	-1	0	···	32766	32767

■Example 2

When 1 is input as the subtraction value and this FB is executed for the input array data in double word [signed], the output result is as follows.

	ZR0	ZR2	···	ZR1996	ZR1998
Stored value	0	1	···	2147483647	-2147483648

↓

Output result	ZR10000	ZR10002	···	ZR11996	ZR11998
Stored value	-1	0	···	2147483646	2147483647

If an underflow or an overflow occurs during operation when word or double word is specified by i_uDataType (data type selection), the operation result is as follows.

Word [signed]	Effective data range: -32768 to 32767
Overflow	7FFFH(32767) - FFFFH(-1) = 8000H(-32768) (Subtract FFFFH from 17FFFH.)
Underflow	8000H(-32768) - 0001H(1) = 7FFFH(32767)
Double word [signed]	**Effective data range: -2147483648 to 2147483647**
Overflow	7FFFFFFFH(2147483647) - FFFFFFFFH(-1) = 80000000H(-2147483648) (Subtract FFFFFFFFH from 17FFFFFFFH.)
Underflow	80000000H(-2147483648) - 00000001H(1) = 7FFFFFFFH(2147483647)

(2) The array data of the subtraction target values are read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads array data for the number of points specified by i_udSize (number of data points).

(3) The subtraction value is read from the file register (ZR) of the address specified by i_udInPointAddr (input value address).

(4) The operation results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address).

(5) Set the following so that the input array data areas and the output array data areas are not overlapped.

· i_udInAryAddr (input array data start address)

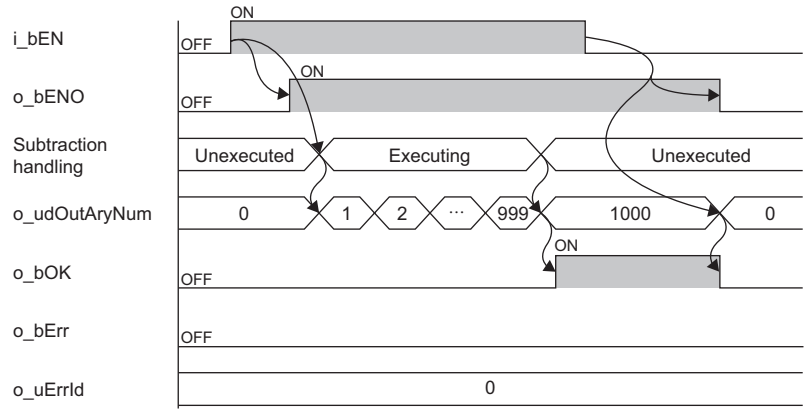
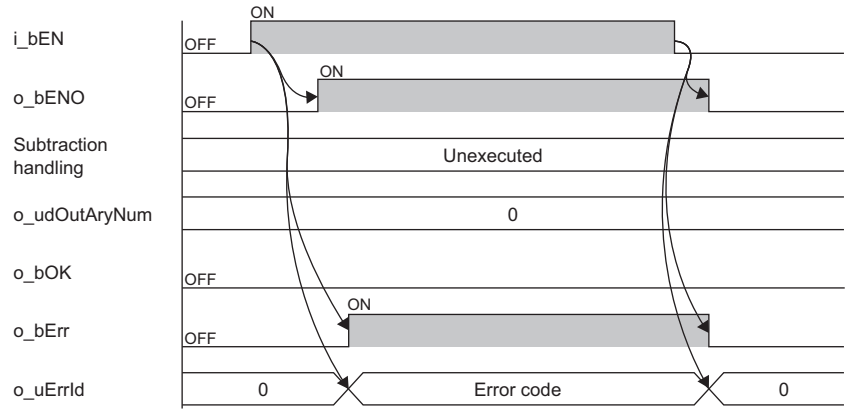
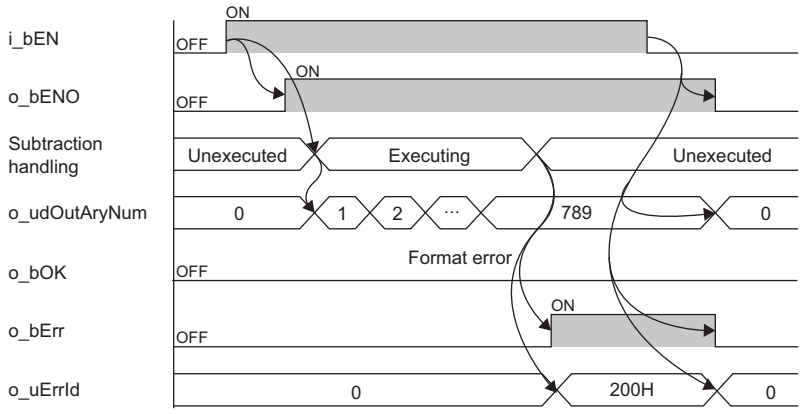
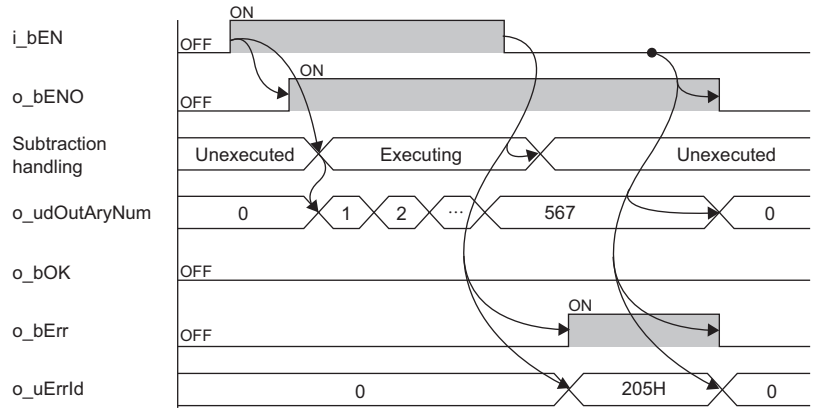
· i_udOutAryAddr (output array data start address)

· i_udSize (number of data points)

If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 15 List of error codes)

However, if the same value is set for i_udInAryAddr (input array data start address) and i_udOutAryAddr (output array data start address), the operation is processed normally. The operation results overwrite data in the file register (ZR), starting from the area specified by i_udInAryAddr (input array data start address).

Item	Description
Functional description	(6) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of input array data, the subtraction value, and output array data in i_uDataType (data type selection). (7) Specify the number of data points for an array where the subtraction is performed in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required. (8) It takes multiple scans until the subtraction is completed. When the input array data before the operation is changed during the operation processing, the operation processing is executed with the changed data. The number of points with the operation completed is output to o_udOutAryNum (number of output data points). When the subtraction is completed, o_bOK (normal completion) turns on. (9) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 15 List of error codes) (10)If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 15 List of error codes) (11)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 15 List of error codes) (12)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 15 List of error codes) The operation results of the subtraction that has been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR). (13)When a single-precision real number is set in i_uDataType (data type selection) and the operation result exceeds the scope of the single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 203H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 15 List of error codes)
FB compilation method	Subroutine type
FB operation	Pulse execution type (multiple scan execution type)

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during subtraction in array)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label. (6) This FB checks the input array data values before the operation execution to prevent an overflow or an underflow from occurring during the operation. If a possibility of an overflow or an underflow is detected at this check, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). For the operation with the single-precision real number, an error may occur depending on the combination of input array data values. Even after the input array data values are checked, the instruction execution fault (operation error) may occur at the operation execution. If "RAS Setting" of "CPU Parameter" is set to continue the processing even after an operation error occurs, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). (7) If 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module due to an error outside FB while i_bEN (execution command) of this FB is on, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 204H is stored in o_uErrId (error code). However, if "RAS Setting" of "CPU Parameter" is set to stop the processing after an operation error occurs, 204H is not stored in o_uErrId (error code).

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	14ms	3.6ms	4 scans
	1: Double Word [signed]	22.6ms	6.06ms	
	2: Single-precision real number	37ms	9.61ms	
500000 points	0: Word [signed]	754ms	3.91ms	200 scans
	1: Double Word [signed]	1210ms	6.17ms	
	2: Single-precision real number	1950ms	9.85ms	
1000000 points	0: Word [signed]	1510ms	3.92ms	400 scans
	1: Double Word [signed]	2400ms	6.17ms	
	2: Single-precision real number	3880ms	9.85ms	

*1 The time required from start to end of the processing

List of error codes

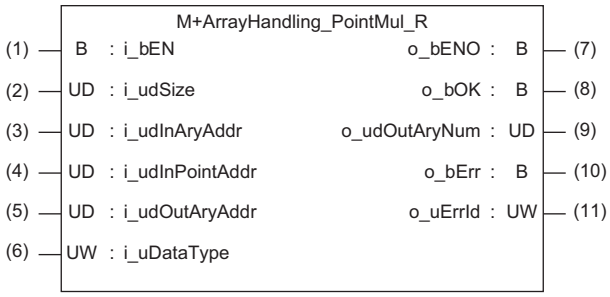
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data or the subtraction value is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and the subtraction value, and then execute the FB again.
203H	An overflow or an underflow has occurred in the FB during the operation.	Review and correct the input array data stored in the file register (ZR) and then execute the FB again. When 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module, refer to the MELSEC iQ-R CPU Module User's Manual (Application).
204H	The processing of the FB has been interrupted due to an overflow in an operation other than that of this FB.	An overflow has occurred in the operation other than that of this FB, and 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module. Refer to the MELSEC iQ-R CPU Module User's Manual (Application).
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.3 M+ArrayHandling_PointMul_R

Name

M+ArrayHandling_PointMul_R

Overview

Item	Description
Functional overview	Multiplies values of each element in a specified array by a specified value.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the multiplication is performed.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data of the multiplication target values are stored.
(4)	i_udInPointAddr	Input value address	Double Word [unsigned]	Valid device range*1	Specifies the address of the file register (ZR) where the multiplication value is stored.
(5)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(6)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

No.	Variable name	Name	Data type	Default value	Description
(7)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(8)	o_bOK	Normal completion	Bit	Off	The on state indicates that the multiplication has been completed.
(9)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their multiplication completed is stored.
(10)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	859 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	

Item	Description
Functional description	(1) As i_bEN (execution command) turns on, this FB performs the multiplication between the input array data and the multiplication value. ■Example 1 When 3 is input as the multiplication value and this FB is executed for the input array data in word [signed], the output result is as follows.

	ZR0	ZR1	···	ZR998	ZR999
Stored value	0	1	···	32767	-32768

↓

Output result	ZR10000	ZR10001	···	ZR10998	ZR10999
Stored value	0	3	···	32765	-32768

■Example 2

When 3 is input as the multiplication value and this FB is executed for the input array data in double word [signed], the output result is as follows.

	ZR0	ZR2	···	ZR1996	ZR1998
Stored value	0	1	···	2147483647	-2147483647

↓

Output result	ZR10000	ZR10002	···	ZR11996	ZR11998
Stored value	0	3	···	2147483645	-2147483645

If an underflow or an overflow occurs during operation when word or double word is specified by i_uDataType (data type selection), the operation result is as follows.

Word [signed]	Effective data range: -32768 to 32767
Overflow	7FFFH(32767) × 0003H(3) = (1)7FFDH(32765) Overflow data (1) are discarded.
Underflow	8000H(-32768) × 0003H(3) = (1)8000H(-32768) Underflow data (1) are discarded.
Double word [signed]	**Effective data range: -2147483648 to 2147483647**
Overflow	7FFFFFFFH(2147483647) × 00000003H(3) = (1)7FFFFFFDH(2147483645) Overflow data (1) are discarded.
Underflow	80000001H(-2147483647) × 00000003H(3) = (1)80000003H(-2147483645) Underflow data (1) are discarded.

(2) The input array data of the multiplication target values are read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads input array data for the number of points specified by i_udSize (number of data points).

(3) The multiplication value is read from the file register (ZR) of the address specified by i_udInPointAddr (input value address).

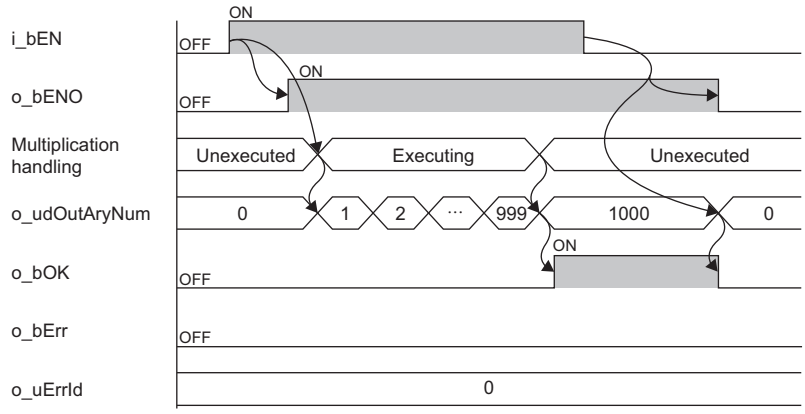
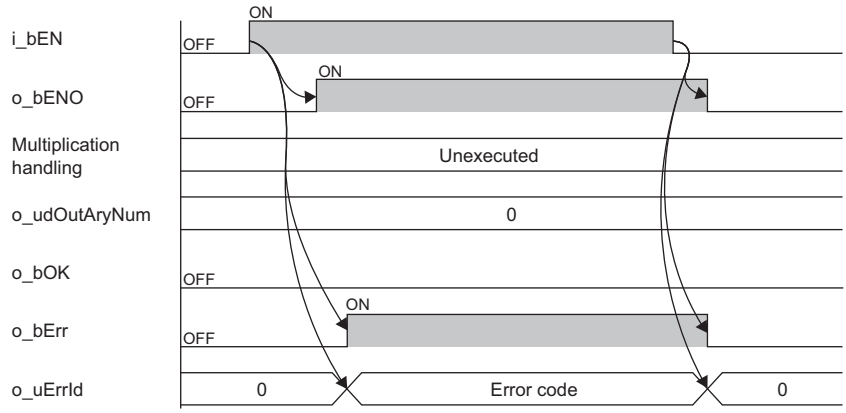
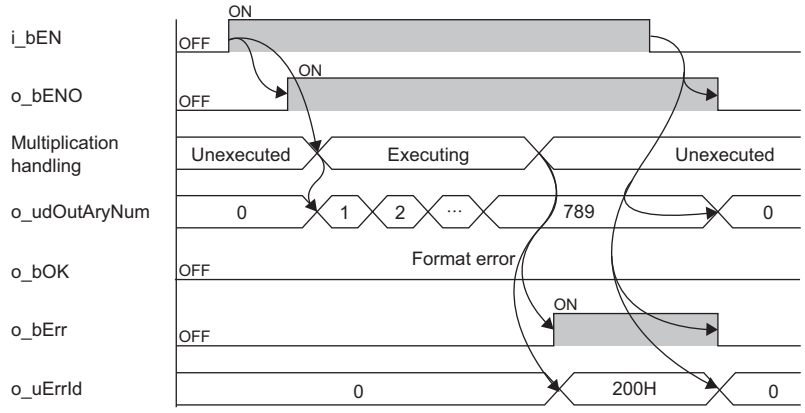
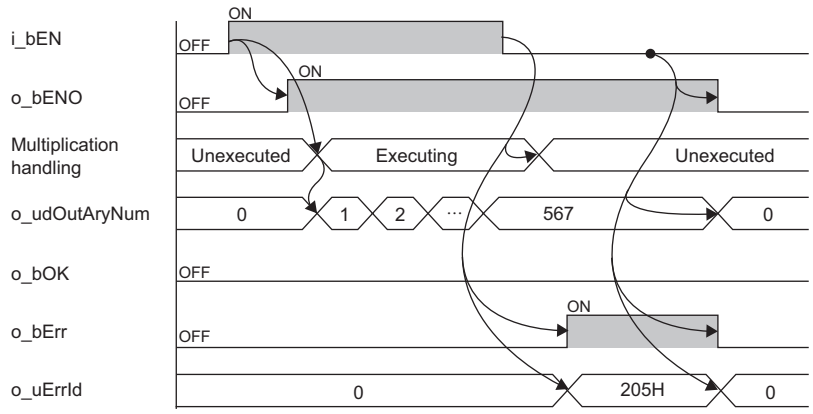
(4) The operation results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address).

(5) Set the following so that the input array data areas and the output array data areas are not overlapped.
- i_udInAryAddr (input array data start address)
- i_udOutAryAddr (output array data start address)
- i_udSize (number of data points)

If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 22 List of error codes)

However, if the same value is set for i_udInAryAddr (input array data start address) and i_udOutAryAddr (output array data start address), the operation is processed normally. The operation results overwrite data in the file register (ZR), starting from the area specified by i_udInAryAddr (input array data start address).

Item	Description
Functional description	(6) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of input array data, the multiplication value, and output array data in i_uDataType (data type selection). (7) Specify the number of data points for an array where the multiplication is performed in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required. (8) It takes multiple scans until the multiplication is completed. When the input array data before the operation is changed during the operation processing, the operation processing is executed with the changed data. The number of points with the operation completed is output to o_udOutAryNum (number of output data points). When the multiplication is completed, o_bOK (normal completion) turns on. (9) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 22 List of error codes) (10)If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 22 List of error codes) (11)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 22 List of error codes) (12)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 22 List of error codes) The operation results of the multiplication that has been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR). (13)When a single-precision real number is set in i_uDataType (data type selection) and the operation result exceeds the scope of the single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 203H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 22 List of error codes)
FB compilation method	Subroutine type
FB operation	Pulse execution type (multiple scan execution type)

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during multiplication in array)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label. (6) This FB checks the input array data values before the operation execution to prevent an overflow or an underflow from occurring during the operation. If a possibility of an overflow or an underflow is detected at this check, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). For the operation with the single-precision real number, an error may occur depending on the combination of input array data values. Even after the input array data values are checked, the instruction execution fault (operation error) may occur at the operation execution. If "RAS Setting" of "CPU Parameter" is set to continue the processing even after an operation error occurs, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). (7) If 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module due to an error outside FB while i_bEN (execution command) of this FB is on, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 204H is stored in o_uErrId (error code). However, if "RAS Setting" of "CPU Parameter" is set to stop the processing after an operation error occurs, 204H is not stored in o_uErrId (error code).

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	15.7ms	4.27ms	4 scans
	1: Double Word [signed]	25.1ms	6.57ms	
	2: Single-precision real number	37.8ms	9.82ms	
500000 points	0: Word [signed]	843ms	4.35ms	200 scans
	1: Double Word [signed]	1330ms	6.77ms	
	2: Single-precision real number	1970ms	9.97ms	
1000000 points	0: Word [signed]	1690ms	4.36ms	400 scans
	1: Double Word [signed]	2660ms	6.78ms	
	2: Single-precision real number	3930ms	9.94ms	

*1 The time required from start to end of the processing

List of error codes

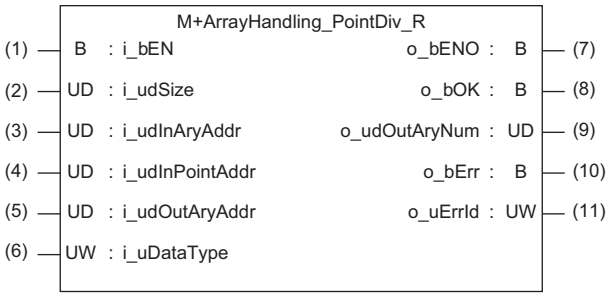
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data or the multiplication value is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and the multiplication value, and then execute the FB again.
203H	An overflow or an underflow has occurred in the FB during the operation.	Review and correct the input array data stored in the file register (ZR) and then execute the FB again. When 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module, refer to the MELSEC iQ-R CPU Module User's Manual (Application).
204H	The processing of the FB has been interrupted due to an overflow in an operation other than that of this FB.	An overflow has occurred in the operation other than that of this FB, and 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module. Refer to the MELSEC iQ-R CPU Module User's Manual (Application).
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.4 M+ArrayHandling_PointDiv_R

Name

M+ArrayHandling_PointDiv_R

Overview

Item	Description
Functional overview	Divides values of each element in a specified array by a specified value.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the division is performed.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data of the division target values are stored.
(4)	i_udInPointAddr	Input value address	Double Word [unsigned]	Valid device range*1	Specifies the address of the file register (ZR) where the division value is stored.
(5)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(6)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

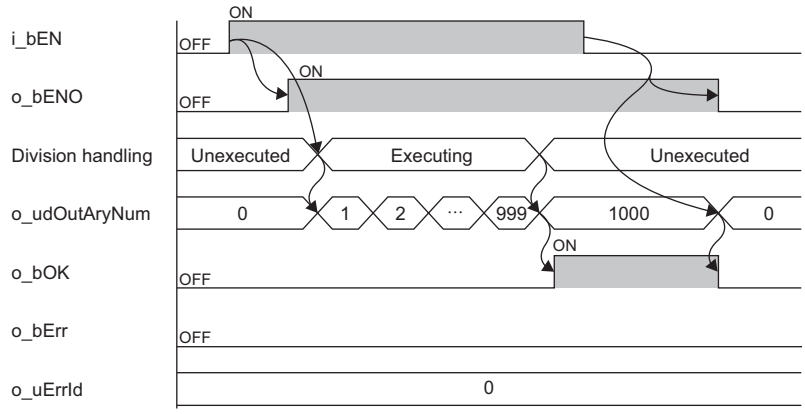
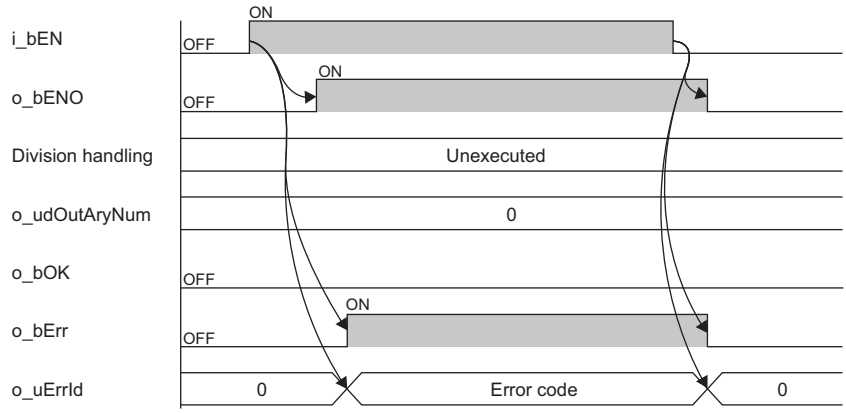
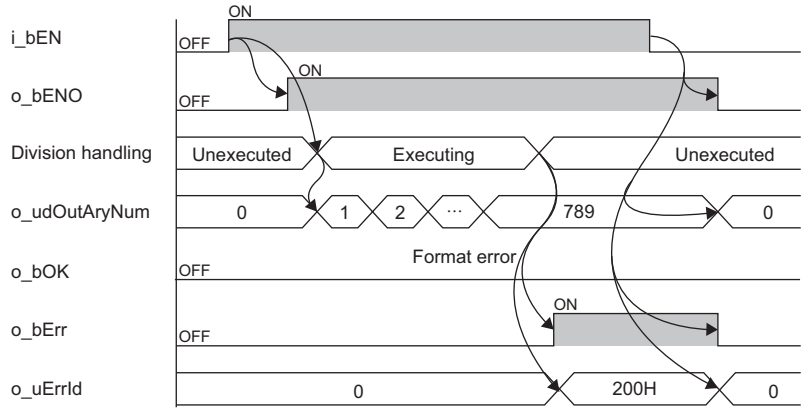
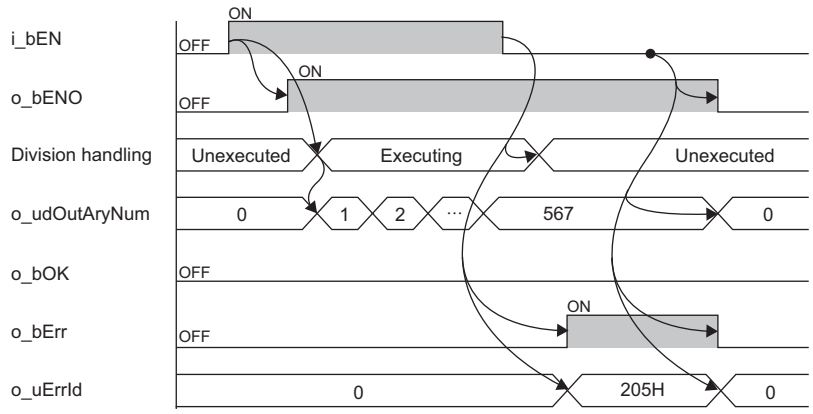
■Output labels

No.	Variable name	Name	Data type	Default value	Description
(7)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(8)	o_bOK	Normal completion	Bit	Off	The on state indicates that the division has been completed.
(9)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their division completed is stored.
(10)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

<table>
<tr><th>Item</th><th colspan="2">Description</th></tr>
<tr><td>Relevant devices</td><td>CPU module</td><td>MELSEC iQ-R series</td></tr>
<tr><td></td><td>Engineering tool</td><td>GX Works3 of version 1.015R or later</td></tr>
<tr><td>Language to use</td><td colspan="2">— (The internal program of this FB is not open to the public.)</td></tr>
<tr><td>Number of steps</td><td colspan="2">922 steps
The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.</td></tr>
<tr><td>FB dependence</td><td colspan="2">No dependence</td></tr>
<tr><td>Functional description</td><td colspan="2">(1) As i_bEN (execution command) turns on, this FB performs the division between the input array data and the division value.
■Example 1
When 3 is input as the division value and this FB is executed for the input array data in word [signed], the output result is as follows.
<table><tr><td></td><td>ZR0</td><td>ZR1</td><td>···</td><td>ZR998</td><td>ZR999</td></tr><tr><td>Stored value</td><td>0</td><td>1</td><td>···</td><td>32767</td><td>-32768</td></tr></table>↓
<table><tr><td>Output result</td><td>ZR10000</td><td>ZR10001</td><td>···</td><td>ZR10998</td><td>ZR10999</td></tr><tr><td>Stored value</td><td>0</td><td>0</td><td>···</td><td>10922</td><td>-10922</td></tr></table>■Example 2
When 3 is input as the division value and this FB is executed for the input array data in double word [signed], the output result is as follows.
<table><tr><td></td><td>ZR0</td><td>ZR2</td><td>···</td><td>ZR1996</td><td>ZR1998</td></tr><tr><td>Stored value</td><td>0</td><td>1</td><td>···</td><td>2147483647</td><td>-2147483648</td></tr></table>↓
<table><tr><td>Output result</td><td>ZR10000</td><td>ZR10002</td><td>···</td><td>ZR11996</td><td>ZR11998</td></tr><tr><td>Stored value</td><td>0</td><td>0</td><td>···</td><td>715827882</td><td>-715827882</td></tr></table>(2) The input array data of the division target values are read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads input array data for the number of points specified by i_udSize (number of data points).
(3) The division value is read from the file register (ZR) of the address specified by i_udInPointAddr (input value address).
(4) The operation results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address).
(5) Set the following so that the input array data areas and the output array data areas are not overlapped.
· i_udInAryAddr (input array data start address)
· i_udOutAryAryAddr (output array data start address)
· i_udSize (number of data points)
If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 28 List of error codes)
However, if the same value is set for i_udInAryAddr (input array data start address) and i_udOutAryAddr (output array data start address), the operation is processed normally. The operation results overwrite data in the file register (ZR), starting from the area specified by i_udInAryAddr (input array data start address).
(6) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of input array data, the division value, and output array data in i_uDataType (data type selection).
(7) Specify the number of data points for an array where the division is performed in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required.
(8) It takes multiple scans until the division is completed. When the input array data before the operation is changed during the operation processing, the operation processing is executed with the changed data. The number of points with the operation completed is output to o_udOutAryNum (number of output data points). When the division is completed, o_bOK (normal completion) turns on.</td></tr>
</table>

Item	Description
Functional description	(9) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 28 List of error codes) (10)If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 28 List of error codes) (11)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 28 List of error codes) (12)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 28 List of error codes) The operation results of the division that has been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR). (13)When the division value read from the file register (ZR) of the address specified by i_udInPointAddr (input value address) is 0, o_bErr (error completion) turns on and the processing of the FB is interrupted. When a single-precision real number is set, the value as close as possible to 0 (1.1920929E-007) is regarded as 0. In addition, 208H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 28 List of error codes) (14)When a single-precision real number is set in i_uDataType (data type selection) and the operation result exceeds the scope of the single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 203H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 28 List of error codes)
FB compilation method	Subroutine type
FB operation	Pulse execution type (multiple scan execution type)

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during division in array)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label. (6) This FB checks the input array data values before the operation execution to prevent an overflow or an underflow from occurring during the operation. If a possibility of an overflow or an underflow is detected at this check, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). For the operation with the single-precision real number, an error may occur depending on the combination of input array data values. Even after the input array data values are checked, the instruction execution fault (operation error) may occur at the operation execution. If "RAS Setting" of "CPU Parameter" is set to continue the processing even after an operation error occurs, o_bErr (error completion) turns on and 203H is stored in o_uErrId (error code). (7) If 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module due to an error outside FB while i_bEN (execution command) of this FB is on, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 204H is stored in o_uErrId (error code). However, if "RAS Setting" of "CPU Parameter" is set to stop the processing after an operation error occurs, 204H is not stored in o_uErrId (error code).

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	15.6ms	3.98ms	4 scans
	1: Double Word [signed]	25.2ms	6.6ms	
	2: Single-precision real number	39.8ms	10.3ms	
500000 points	0: Word [signed]	843ms	4.35ms	200 scans
	1: Double Word [signed]	1330ms	6.77ms	
	2: Single-precision real number	2060ms	10.5ms	
1000000 points	0: Word [signed]	1690ms	4.35ms	400 scans
	1: Double Word [signed]	2660ms	6.79ms	
	2: Single-precision real number	4120ms	10.5ms	

*1 The time required from start to end of the processing

List of error codes

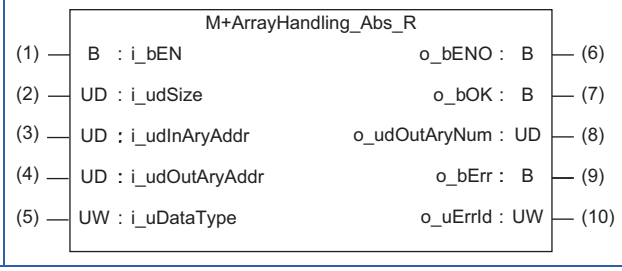
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data or the division value is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and the division value, and then execute the FB again.
203H	An overflow or an underflow has occurred in the FB during the operation.	Review and correct the input array data stored in the file register (ZR) and then execute the FB again. When 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module, refer to the MELSEC iQ-R CPU Module User's Manual (Application).
204H	The processing of the FB has been interrupted due to an overflow in an operation other than that of this FB.	An overflow has occurred in the operation other than that of this FB, and 3403H is stored in the special register SD0 (Latest self-diagnostic error code) of the CPU module. Refer to the MELSEC iQ-R CPU Module User's Manual (Application).
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
208H	The division by 0 occurs because 0 is stored as a division value in the file register (ZR) specified by i_udInPointAddr (input value address). Store the value other than 0.	Review and correct the division value and then execute the FB again.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.5 M+ArrayHandling_Abs_R

Name

M+ArrayHandling_Abs_R

Overview

Item	Description
Functional overview	Outputs absolute values of values of each element in a specified array.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the absolute values are calculated.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data to be operated is stored.
(4)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(5)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(7)	o_bOK	Normal completion	Bit	Off	The on state indicates that the absolute value calculations have been completed.
(8)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with absolute value calculation(s) completed is stored.
(9)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(10)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	651 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	

Item	Description
Functional description	(1) As i_bEN (execution command) turns on, this FB calculates the absolute values. ■Example 1 When the FB is executed for the input array data in word [signed], the output result is as follows.

	ZR0	ZR1	···	ZR997	ZR998	ZR999
Stored value	0	-1	···	-32766	32767	-32768

↓

Output result	ZR10000	ZR10001	···	ZR10997	ZR10998	ZR10999
Stored value	0	1	···	32766	32767	-32768

■Example 2

When the FB is executed for the input array data in double word [signed], the output result is as follows.

	ZR0	ZR2	···	ZR1994	ZR1996	ZR1998
Stored value	0	-1	···	-2147483646	2147483647	-2147483648

↓

Output result	ZR10000	ZR10002	···	ZR11994	ZR11996	ZR11998
Stored value	0	1	···	2147483646	2147483647	-2147483648

(2) The target input array data for operation is read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads input array data for the number of points specified by i_udSize (number of data points).

(3) The operation results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address).

(4) Set the following so that the input array data areas and the output array data areas are not overlapped.
- i_udInAryAddr (input array data start address)
- i_udOutAryAddr (output array data start address)
- i_udSize (number of data points)

If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 33 List of error codes)

(5) When the input array data is -32768 and Word is specified as the data type, the output result is -32768. When the input array data is -2147483648 and Double Word is specified as the data type, the output result is -2147483648.

(6) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of input array data and output array data in i_uDataType (data type selection).

(7) Specify the number of data points for an array where the absolute values are calculated in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required.

(8) It takes multiple scans until the absolute value calculations are completed. When the input array data before the operation is changed during the operation processing, the operation processing is executed with the changed data. The number of points with the operation completed is output to o_udOutAryNum (number of output data points). When the absolute value calculations are completed, o_bOK (normal completion) turns on.

(9) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 33 List of error codes)

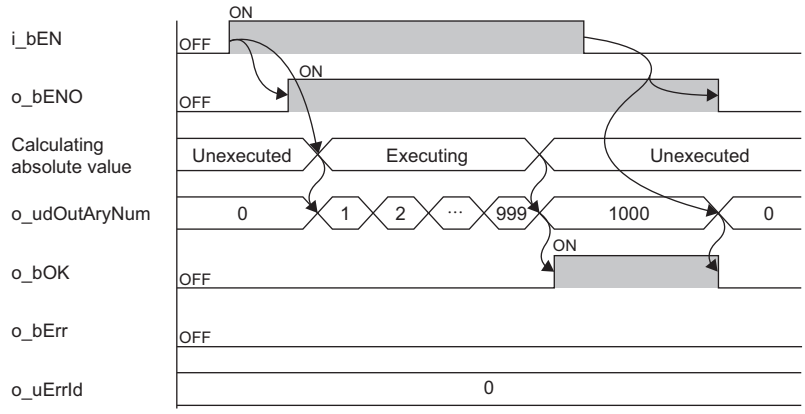
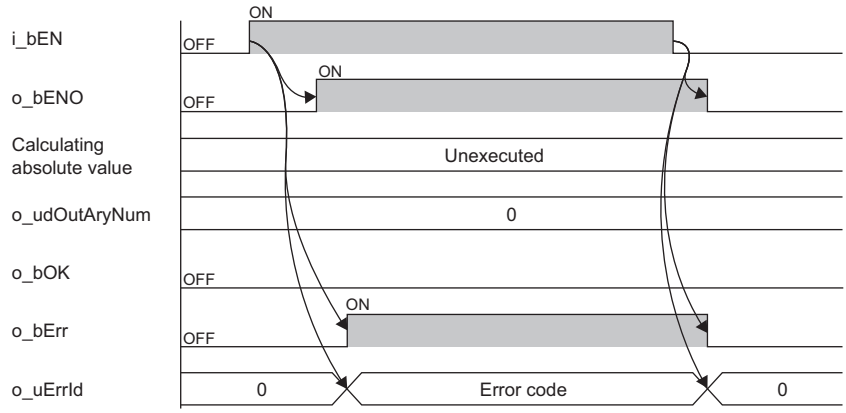
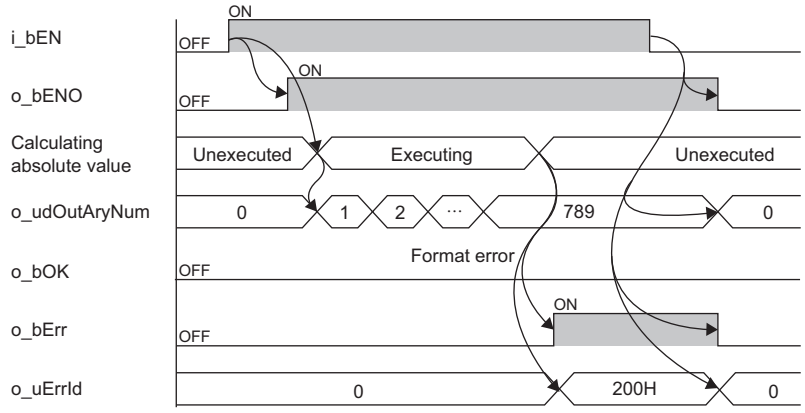
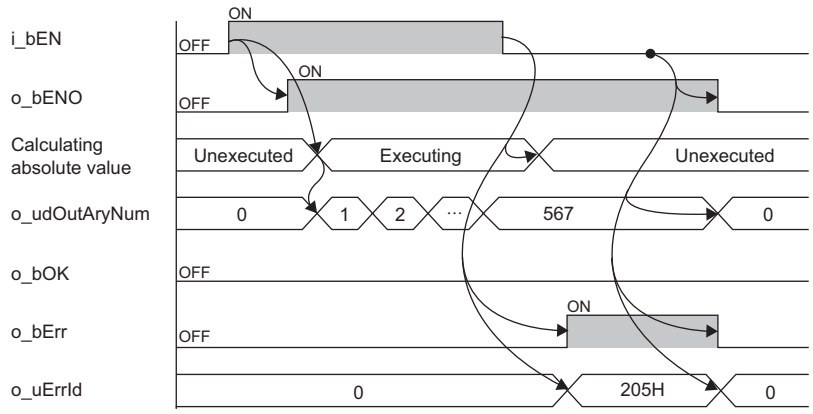
(10)If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 33 List of error codes)

(11)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 33 List of error codes)

(12)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 33 List of error codes)

The operation results of the absolute value calculations that have been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR).

FB compilation method	Subroutine type
FB operation	Pulse execution type (multiple scan execution type)

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during absolute value calculation)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label.

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: CPU built-in memory
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	14.1ms	4.31ms	4 scans
	1: Double Word [signed]	22.8ms	7.09ms	
	2: Single-precision real number	33.7ms	10.4ms	
500000 points	0: Word [signed]	758ms	4.7ms	167 scans
	1: Double Word [signed]	1220ms	7.45ms	
	2: Single-precision real number	1760ms	10.7ms	
1000000 points	0: Word [signed]	1520ms	4.68ms	334 scans
	1: Double Word [signed]	2440ms	7.43ms	
	2: Single-precision real number	3510ms	10.7ms	

*1 The time required from start to end of the processing

List of error codes

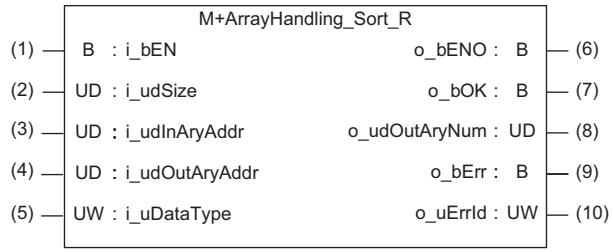
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and then execute the FB again.
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.6 M+ArrayHandling_Sort_R

Name

M+ArrayHandling_Sort_R

Overview

Item	Description
Functional overview	Outputs the result of sorting a specified array in ascending order.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the sort is performed.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data to be operated is stored.
(4)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(5)	i_uDataType	Data type selection	Word [unsigned]	0 to 4	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number 3: Word [unsigned] 4: Double Word [unsigned]

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(7)	o_bOK	Normal completion	Bit	Off	The on state indicates that the sort has been completed.
(8)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their sort completed is stored.
(9)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(10)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

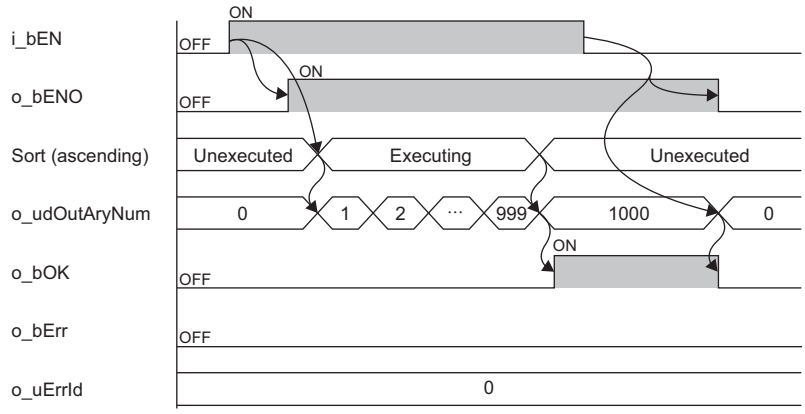
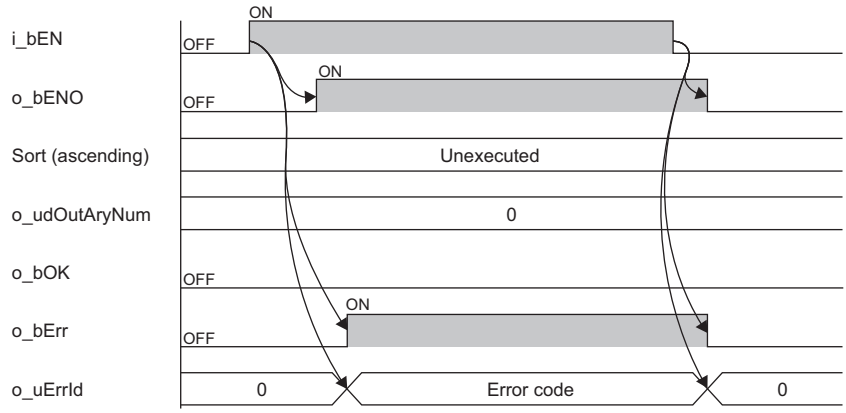
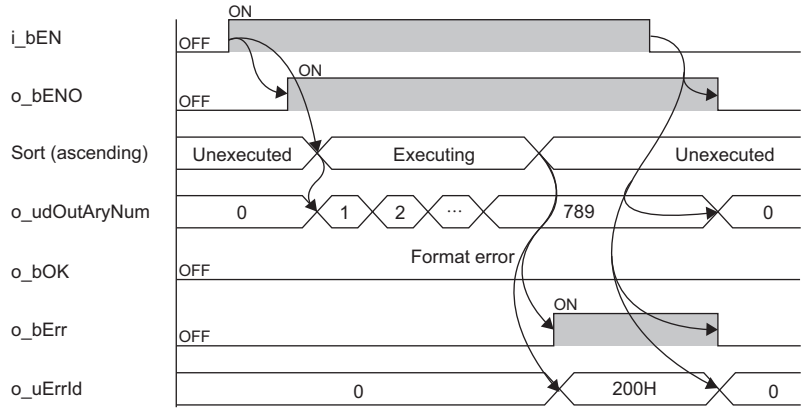
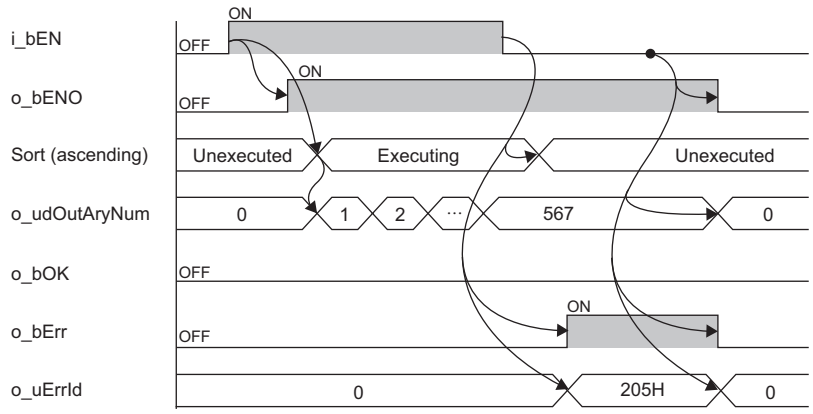
FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	3572 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	
Functional description	(1) As i_bEN (execution command) turns on, this FB performs the sort (ascending order). ■Example When the FB is executed for the input array data in word [signed] (number of data points: 1000), the output result is as follows. (2) The target input array data for operation is read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads input array data for the number of points specified by i_udSize (number of data points). (3) At the start of sorting, the target input array data for processing is stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address). The data stored in the output areas at the start of sorting is used for the sort processing. (4) Set the following so that the input array data areas and the output array data areas are not overlapped. · i_udInAryAddr (input array data start address) · i_udOutAryAddr (output array data start address) · i_udSize (number of data points) If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 38 List of error codes) (5) Specify Word [signed], Double Word [signed], Single-precision real number, Word [unsigned], or Double Word [unsigned] as the data type of input array data and output array data in i_uDataType (data type selection). (6) The sort results are determined in order from the maximum value. Thus, the data is stored in order from the end of the output array data areas. (7) Specify the number of data points for an array where the sort is performed in i_udSize (number of data points). When 1: Double Word [signed], 2: Single-precision real number, or 4: Double Word [unsigned] is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required. (8) It takes multiple scans until the sort processing is completed. Thus, do not change the target input array data until the processing is completed. The number of points with the sort completed is output to o_udOutAryNum (number of output data points). When the sort processing is completed, o_bOK (normal completion) turns on. (9) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 38 List of error codes) (10)If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 38 List of error codes) (11)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 38 List of error codes) The address of the file register (ZR) in which the value other than the single-precision real number is stored can be checked with the stored value in o_udOutAryNum (number of output data points). (12)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 38 List of error codes) If i_bEN (execution command) is turned off during the sort processing, unsorted data and sorted data are mixed in the file register (ZR). The number of data points with the sort completed is output to o_udOutAryNum (number of output data points) during the sort processing.	
FB compilation method	Subroutine type	
FB operation	Pulse execution type (multiple scan execution type)	

	ZR0	ZR1	···	ZR998	ZR999
Stored value	0	999	···	998	1

↓

Output result	ZR10000	ZR10001	···	ZR10998	ZR10999
Stored value	0	1	···	998	999

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during sort processing)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0 and LZ1. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label. (6) In this FB, the same address cannot be set for i_udInAryAddr (input array data start address) and i_udOutAryAddr (output array data start address).

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	557ms	7.29ms	93 scans
	1: Double Word [signed]	792ms	10.3ms	93 scans
	2: Single-precision real number	816ms	10.3ms	101 scans
	3: Word [unsigned]	557ms	7.34ms	93 scans
	4: Double Word [unsigned]	792ms	10.2ms	93 scans
500000 points	0: Word [signed]	40400ms	9.08ms	6623 scans
	1: Double Word [signed]	57500ms	10.4ms	6636 scans
	2: Single-precision real number	58700ms	10.7ms	7007 scans
	3: Word [unsigned]	40400ms	9.06ms	6623 scans
	4: Double Word [unsigned]	57500ms	10.4ms	6636 scans
1000000 points	0: Word [signed]	85300ms	9.07ms	13993 scans
	1: Double Word [signed]	122000ms	10.3ms	14025 scans
	2: Single-precision real number	124000ms	10.4ms	14766 scans
	3: Word [unsigned]	85300ms	9.07ms	13993 scans
	4: Double Word [unsigned]	122000ms	10.3ms	14025 scans

*1 The time required from start to end of the processing

List of error codes

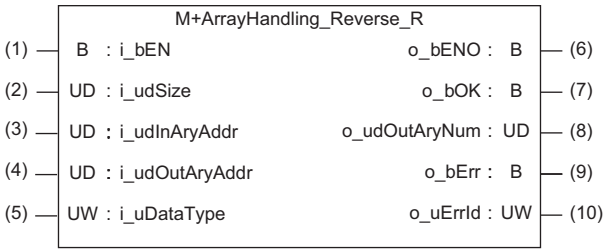
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 4 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and then execute the FB again.
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.7 M+ArrayHandling_Reverse_R

Name

M+ArrayHandling_Reverse_R

Overview

Item	Description
Functional overview	Outputs the result of sorting a specified array in reverse order.
Symbol	

Labels to use

■Input labels

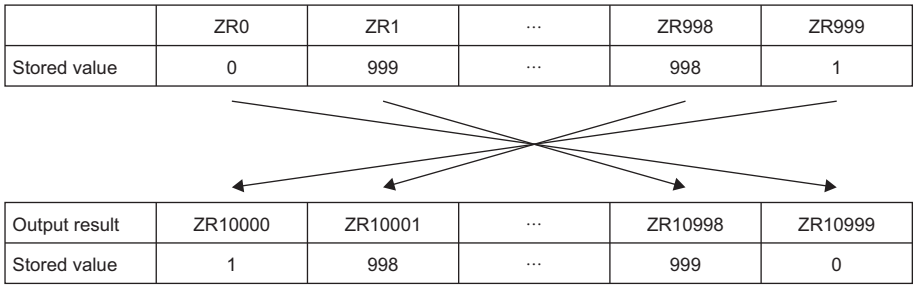
No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where sorting in reverse order is performed.
(3)	i_udInAryAddr	Input array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data to be operated is stored.
(4)	i_udOutAryAddr	Output array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the operation results are to be stored.
(5)	i_uDataType	Data type selection	Word [unsigned]	0 to 4	Specifies the data type of the data to be operated. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number 3: Word [unsigned] 4: Double Word [unsigned]

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

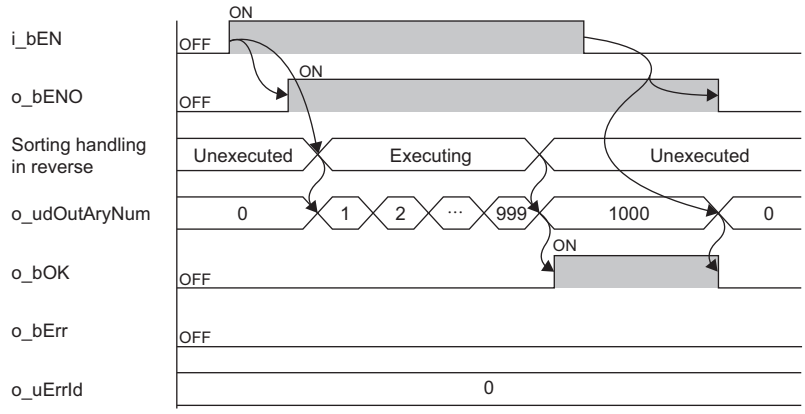
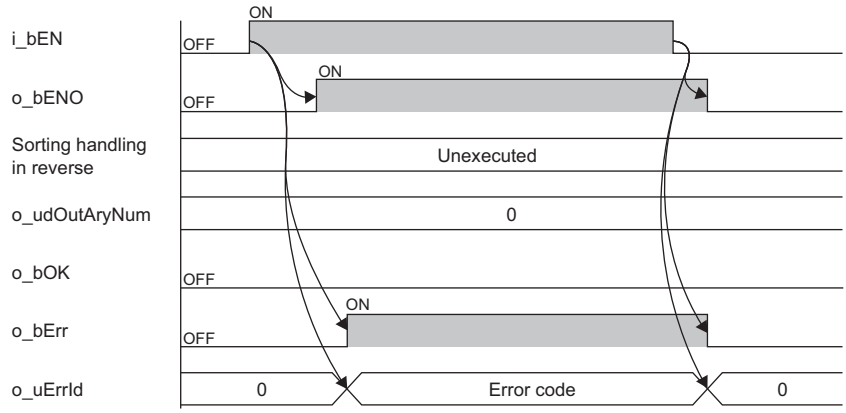
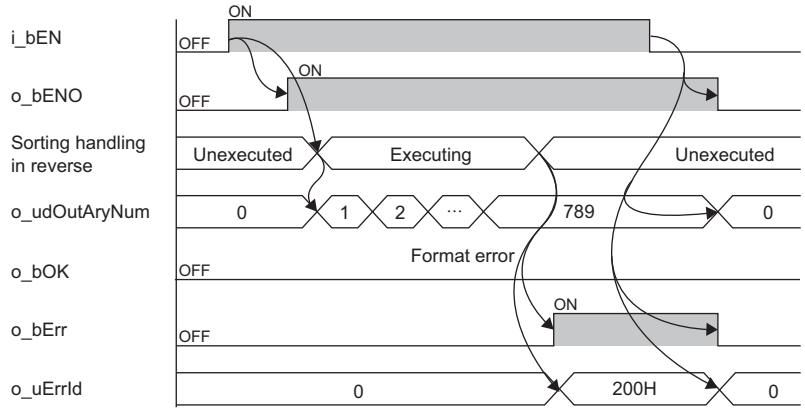
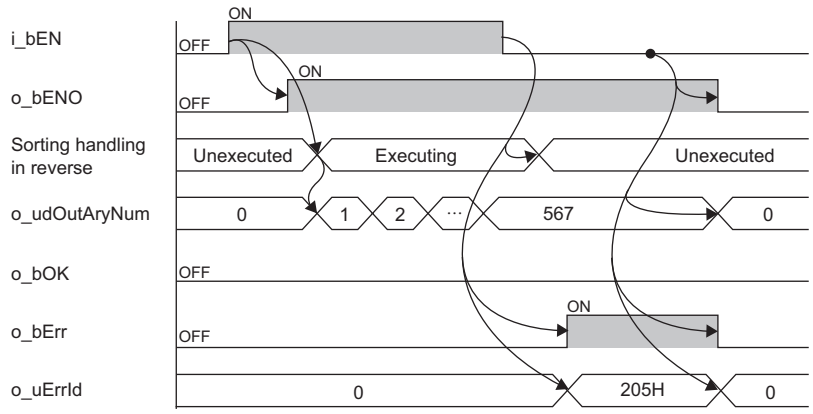
No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(7)	o_bOK	Normal completion	Bit	Off	The on state indicates that sorting has been completed.
(8)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their sorting completed is stored.
(9)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(10)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	638 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	
Functional description	(1) As i_bEN (execution command) turns on, this FB sorts an array in reverse order. ■Example When the FB is executed for the input array data in word [signed] (number of data points: 1000), the output result is as follows.  (2) The target input array data for processing is read from the file register (ZR), starting from the address specified by i_udInAryAddr (input array data start address). This FB reads input array data for the number of points specified by i_udSize (number of data points). (3) The processing results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udOutAryAddr (output array data start address). (4) Set the following so that the input array data areas and the output array data areas are not overlapped. · i_udInAryAddr (input array data start address) · i_udOutAryAddr (output array data start address) · i_udSize (number of data points) If some areas of input array data and output array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 43 List of error codes) (5) Specify Word [signed], Double Word [signed], Single-precision real number, Word [unsigned], or Double Word [unsigned] as the data type of input array data and output array data in i_uDataType (data type selection). (6) It takes multiple scans until the sorting processing is completed. Thus, do not change the target input array data until the processing is completed. The number of points with the sort completed is output to o_udOutAryNum (number of output data points). When the processing is completed, o_bOK (normal completion) turns on. (7) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 43 List of error codes) (8) If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 43 List of error codes) (9) When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 43 List of error codes) (10)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 43 List of error codes) The results of the operation that has been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR).	
FB compilation method	Subroutine type	
FB operation	Pulse execution type (multiple scan execution type)	

	ZR0	ZR1	···	ZR998	ZR999
Stored value	0	999	···	998	1

Output result	ZR10000	ZR10001	···	ZR10998	ZR10999
Stored value	1	998	···	999	0

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during sorting in reverse order)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label. (6) In this FB, the same address cannot be set for i_udInAryAddr (input array data start address) and i_udOutAryAddr (output array data start address).

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	16.9ms	5.04ms	4 scans
	1: Double Word [signed]	23.6ms	7.31ms	
	2: Single-precision real number	34.2ms	10.1ms	
	3: Word [unsigned]	16.9ms	5.14ms	
	4: Double Word [unsigned]	23.5ms	7.21ms	
500000 points	0: Word [signed]	903ms	5.55ms	167 scans
	1: Double Word [signed]	1260ms	7.67ms	
	2: Single-precision real number	1700ms	10.4ms	
	3: Word [unsigned]	903ms	5.56ms	
	4: Double Word [unsigned]	1260ms	7.67ms	
1000000 points	0: Word [signed]	1810ms	5.56ms	334 scans
	1: Double Word [signed]	2510ms	7.68ms	
	2: Single-precision real number	3390ms	10.3ms	
	3: Word [unsigned]	1810ms	5.56ms	
	4: Double Word [unsigned]	2510ms	7.67ms	

*1 The time required from start to end of the processing

List of error codes

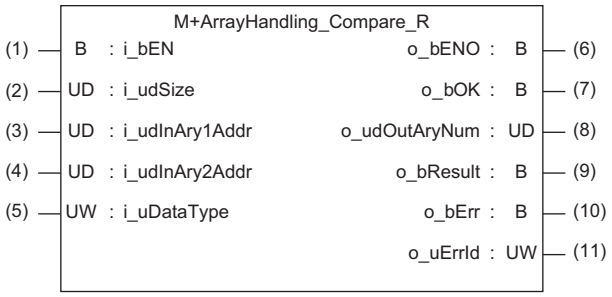
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 4 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and then execute the FB again.
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of input array data and output array data are overlapped. Review the following settings so that the input array data areas and the output array data areas are not overlapped. • i_udInAryAddr (input array data start address) • i_udOutAryAddr (output array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

2.8 M+ArrayHandling_Compare_R

Name

M+ArrayHandling_Compare_R

Overview

Item	Description
Functional overview	Compares two specified arrays.
Symbol	

Labels to use

■Input labels

No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for arrays where the comparison is performed.
(3)	i_udInAry1Addr	Input array data 1 start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data to be compared is stored.
(4)	i_udInAry2Addr	Input array data 2 start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the input array data to be compared is stored.
(5)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be compared. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(7)	o_bOK	Normal completion	Bit	Off	The on state indicates that the comparison has been completed.
(8)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their comparison completed is stored.
(9)	o_bResult	Check result	Bit	Off	On: Passed (data match) Off: Failed (data mismatch)
(10)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(11)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	646 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	
Functional description	(1) As i_bEN (execution command) turns on, this FB checks if two sets of input array data are matched. (2) The target input array data sets for comparison are read from the file register (ZR), starting from the address specified by i_udInAry1Addr (input array data 1 start address) and starting from the address specified by i_udInAry2Addr (input array data 2 start address). This FB reads each set of input array data for the number of points specified by i_udSize (number of data points). (3) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of input array data in i_uDataType (data type selection). (4) Specify the number of data points for arrays where the comparison is performed in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required. (5) The comparison result is stored in o_bResult (check result). The comparison processing is performed from the start data of the specified address. If the mismatched data is detected, o_bOK (normal completion) turns on while o_bResult (check result) is off (initial value) and the comparison processing ends. In such a case, the offset value of the file register (ZR) areas where a mismatch occurs is stored in o_udOutAryNum (number of output data points). When the data sets are perfectly matched, o_bResult (check result) and o_bOK (normal completion) turn on. In such a case, o_udOutAryNum (number of output data points) is the setting value of i_udSize (number of data points). ■Example 1 When the input array data 1 and 2 are perfectly matched, the output result is as follows. (Data type: Word [signed], number of data: 10)	

	ZR0	ZR1	ZR2	ZR3	ZR4	ZR5	ZR6	ZR7	ZR8	ZR9
Array data 1	13	48	21	-10	-38	1	35	40	3	-10

	ZR50	ZR51	ZR52	ZR53	ZR54	ZR55	ZR56	ZR57	ZR58	ZR59
Array data 2	13	48	21	-10	-38	1	35	40	3	-10

When the input array data 1 and input array data 2 of the above tables are used, the result of the comparison processing is as follows.
• o_bOK (normal completion) turns on.
• o_bResult (check result) turns on.
• As the number of data, 10 is stored in o_udOutAryNum (number of output data points).

■Example 2
When the input array data 1 and 2 are not matched, the output result is as follows. (Data type: Word [signed], number of data: 10)

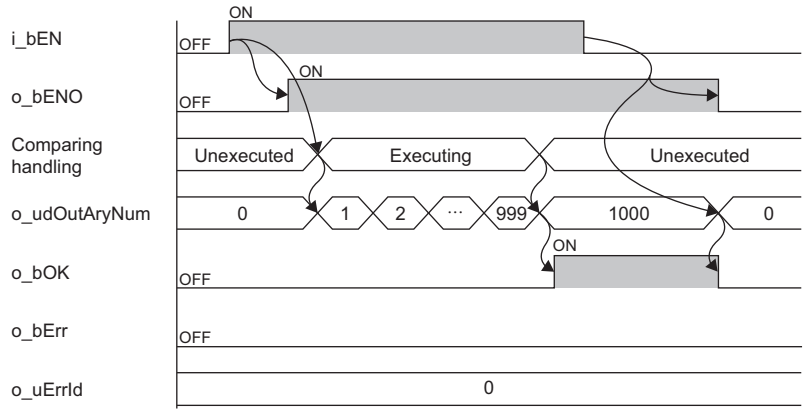
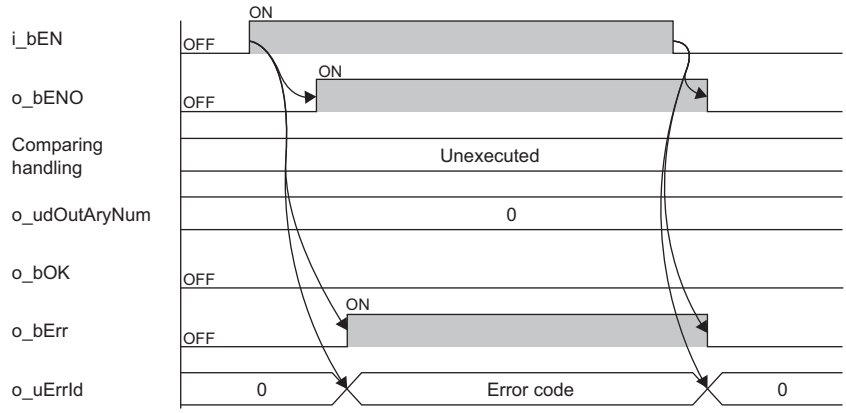
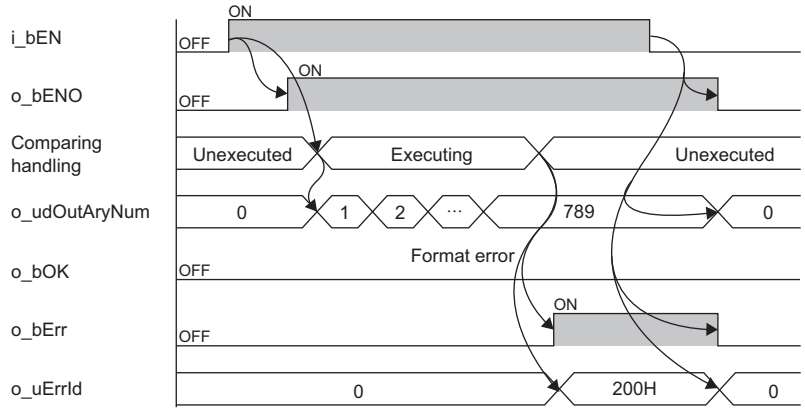
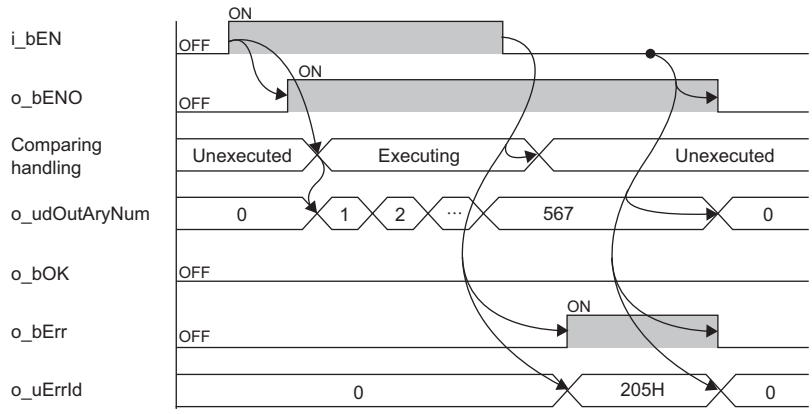
	ZR0	ZR1	ZR2	ZR3	ZR4	ZR5	ZR6	ZR7	ZR8	ZR9
Array data 1	13	48	21	-10	-38	1	35	40	3	-10

	ZR50	ZR51	ZR52	ZR53	ZR54	ZR55	ZR56	ZR57	ZR58	ZR59
Array data 2	13	48	21	-12	-38	2	35	40	-5	-10

When the input array data 1 and input array data 2 of the above tables are used, the result of the comparison processing is as follows.
• o_bOK (normal completion) turns on.
• o_bResult (check result) remains off.

As the offset of the mismatched data, 3 is stored in o_udOutAryNum (number of output data points). In the above example, data are not matched in the fourth, sixth, and ninth areas. The offset value of the mismatched data that are detected at first is stored in o_udOutAryNum (number of output data points). Thus, 3 is stored.

Item	Description
Functional description	(6) For the single-precision real number, data are compared by using the following formulas considering a rounding error. When S (difference) is smaller than E (tolerance) (S < E), the values of two data are regarded as matched. • S: Difference = |Input value 1 - Input value 2| • E: Tolerance = Rounding error (1.1920929E-007) (7) It takes multiple scans until the comparison processing is completed. Thus, do not change the target input array data sets until the processing is completed. The number of points with the comparison completed is output to o_udOutAryNum (number of output data points). When the processing is completed, o_bOK (normal completion) turns on. (8) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 48 List of error codes) (9) If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 48 List of error codes) (10)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 48 List of error codes) (11)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 48 List of error codes)
FB compilation method	Subroutine type
FB operation	Pulse execution type (multiple scan execution type)

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during comparison processing)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label.

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	15.5ms	3.14ms	5 scans
	1: Double Word [signed]	25.2ms	5.21ms	
	2: Single-precision real number	46.8ms	9.51ms	
500000 points	0: Word [signed]	783ms	3.29ms	250 scans
	1: Double Word [signed]	1260ms	5.18ms	
	2: Single-precision real number	2330ms	9.47ms	
1000000 points	0: Word [signed]	1570ms	3.29ms	500 scans
	1: Double Word [signed]	2510ms	5.16ms	
	2: Single-precision real number	4460ms	9.48ms	

*1 The time required from start to end of the processing

List of error codes

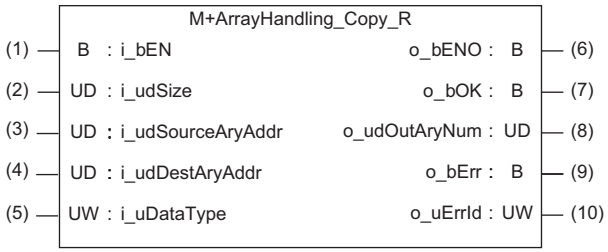
Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored input array data is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the input array data and then execute the FB again.
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.

2.9 M+ArrayHandling_Copy_R

Name

M+ArrayHandling_Copy_R

Overview

Item	Description
Functional overview	Copies a specified array to specified storage locations.
Symbol	

Labels to use

■Input labels

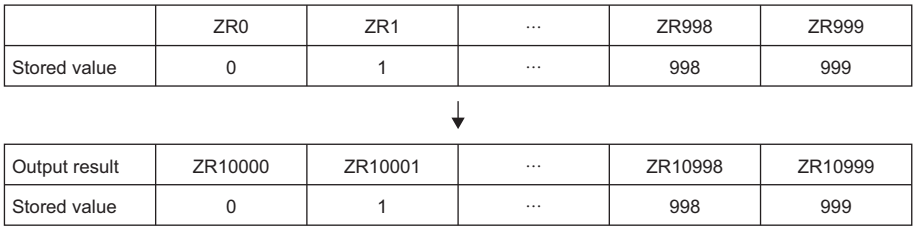
No.	Variable name	Name	Data type	Scope	Description
(1)	i_bEN	Execution command	Bit	On or off	On: The FB is activated. Off: The FB is not activated.
(2)	i_udSize	Number of data points	Double Word [unsigned]	1 to 1000000	Specifies the number of data points for an array where the copy is performed.
(3)	i_udSourceAryAddr	Copy source array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the array data of the copy source is stored.
(4)	i_udDestAryAddr	Copy destination array data start address	Double Word [unsigned]	Valid device range*1	Specifies the start address of the file register (ZR) where the array data of the copy destination is to be stored.
(5)	i_uDataType	Data type selection	Word [unsigned]	0 to 2	Specifies the data type of the data to be copied. 0: Word [signed] 1: Double Word [signed] 2: Single-precision real number

*1 The valid range varies depending on "Device/Label Memory Area Setting" of "CPU Parameter".

■Output labels

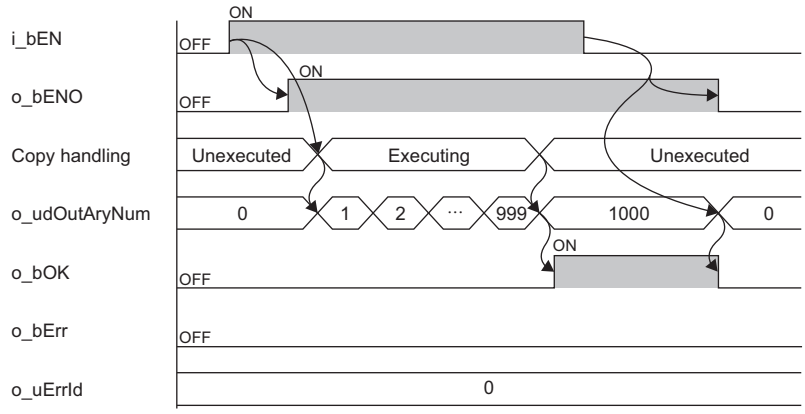
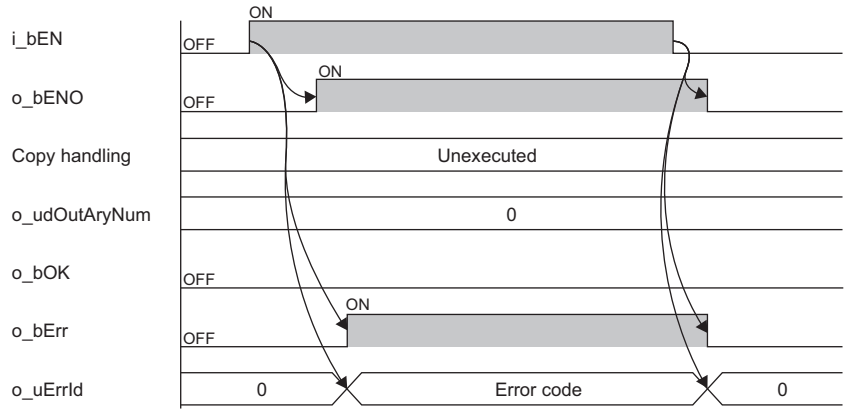
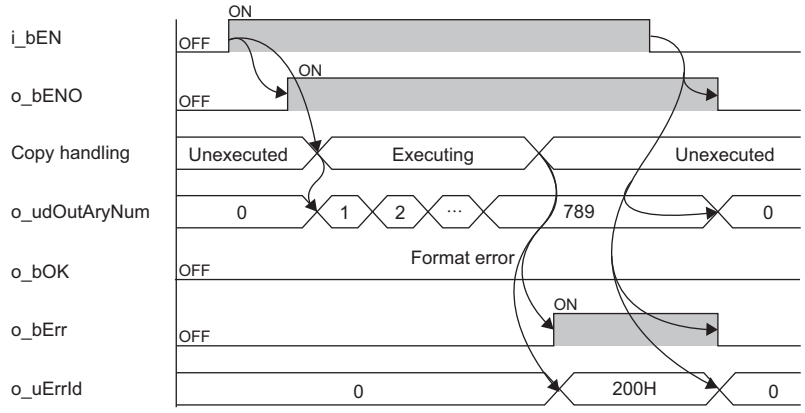
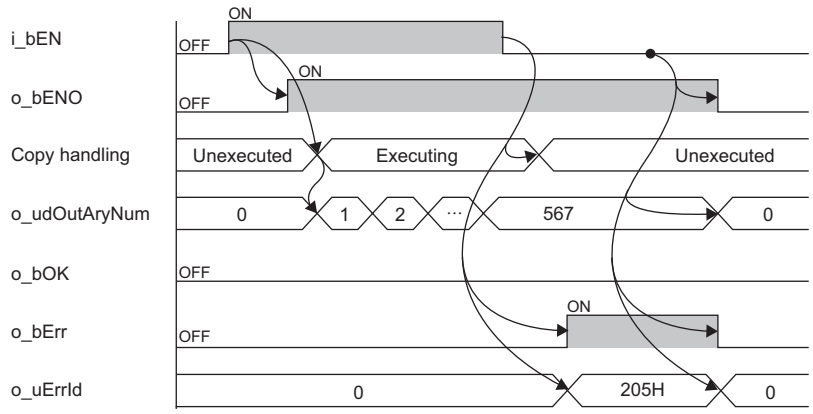
No.	Variable name	Name	Data type	Default value	Description
(6)	o_bENO	Execution status	Bit	Off	On: The execution command is on. Off: The execution command is off.
(7)	o_bOK	Normal completion	Bit	Off	The on state indicates that the copy has been completed.
(8)	o_udOutAryNum	Number of output data points	Double Word [unsigned]	0	The number of output data points with their copies completed is stored.
(9)	o_bErr	Error completion	Bit	Off	The on state indicates that an error has occurred in the FB.
(10)	o_uErrId	Error code	Word [unsigned]	0	The error code of an error occurred in the FB is returned.

FB details

Item	Description	
Relevant devices	CPU module	MELSEC iQ-R series
	Engineering tool	GX Works3 of version 1.015R or later
Language to use	— (The internal program of this FB is not open to the public.)	
Number of steps	648 steps The number of steps of the FB embedded in a program depends on the CPU module used, the input/output definitions, and the options setting of GX Works3. For the options setting of GX Works3, refer to the GX Works3 Operating Manual.	
FB dependence	No dependence	
Functional description	(1) As i_bEN (execution command) turns on, this FB copies data. ■Example When the FB is executed for the copy source array data in word [signed] (number of data points: 1000), the output result is as follows.  (2) The target copy source array data for processing is read from the file register (ZR), starting from the address specified by i_udSourceAryAddr (copy source array data start address). This FB reads the array data for the number of points specified by i_udSize (number of data points). (3) The processing results are stored in the file register (ZR) for the number of points specified by i_udSize (number of data points), starting from the address specified by i_udDestAryAddr (copy destination array data start address). (4) Set the following so that the copy source array data areas and the copy destination array data areas are not overlapped. · i_udSourceAryAddr (copy source array data start address) · i_udDestAryAddr (copy destination array data start address) · i_udSize (number of data points) If some areas of copy source array data and copy destination array data are overlapped, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 209H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 52 List of error codes) (5) Specify Word [signed], Double Word [signed], or Single-precision real number as the data type of copy source array data and the copy destination array data in i_uDataType (data type selection). (6) Specify the number of data points for an array where the copy is performed in i_udSize (number of data points). When 1: Double Word [signed] or 2: Single-precision real number is specified by i_uDataType (data type selection), file register (ZR) areas twice as many as the setting value of i_udSize (number of data points) are required. (7) It takes multiple scans until the copy processing is completed. Thus, do not change the target copy source array data until the processing is completed. The number of points with the copy completed is output to o_udOutAryNum (number of output data points). When the processing is completed, o_bOK (normal completion) turns on. (8) If a value out of the range is set in i_udSize (number of data points), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 105H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 52 List of error codes) (9) If a value out of the range is set in i_uDataType (data type selection), o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 103H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 52 List of error codes) (10)When a single-precision real number is set in i_uDataType (data type selection) and the value stored in the file register (ZR) is not a single-precision real number, o_bErr (error completion) turns on and the processing of the FB is interrupted. In addition, 200H is stored in o_uErrId (error code). For the error code, refer to the list of error codes. (☞ Page 52 List of error codes) (11)If i_bEN (execution command) is turned off before o_bOK (normal completion) or o_bErr (error completion) turns on, o_bErr (error completion) turns on in one scan. In addition, 205H is stored in o_uErrId (error code) in one scan. For the error code, refer to the list of error codes. (☞ Page 52 List of error codes) The results of the processing that has been completed before i_bEN (execution command) is turned off remain stored in the file register (ZR).	
FB compilation method	Subroutine type	
FB operation	Pulse execution type (multiple scan execution type)	

	ZR0	ZR1	···	ZR998	ZR999
Stored value	0	1	···	998	999

Output result	ZR10000	ZR10001	···	ZR10998	ZR10999
Stored value	0	1	···	998	999

Item		Description
Timing chart of I/O signals	Normal completion	When i_udSize (number of data points) is 1000 points 
	Error completion	• Parameter error (error before execution)  • Single-precision real number format error (error during copy processing)  • When i_bEN (execution command) is turned off during execution 

Item	Description
Restrictions and precautions	(1) This FB does not include the error recovery processing. Prepare the error recovery processing separately to suit the user's system and the expected operation. (2) This FB uses the long index register LZ0 and LZ1. When using an interrupt program, do not use the corresponding index register. (3) The FB cannot be used in an interrupt program. (4) Using the FB in a program that is to be executed only once, such as a subroutine program or a FOR-NEXT loop, has a problem that i_bEN (execution command) can no longer be turned off and normal operation is not possible; Always use the FB in a program that is capable of turning off the execution command. (5) The FB requires the configuration of the ladder for every input label.

Performance value

The following table lists the performance values of this FB under the following conditions.

- CPU module: R04CPU
- File register storage location: Extended SRAM cassette
- FB compilation method: Subroutine type

Input label		Time required for the processing*1	Maximum scan time	Number of the scans required for the processing
Number of data points	Data type selection			
10000 points	0: Word [signed]	2.33ms	2.33ms	1 scan
	1: Double Word [signed]	4.54ms	4.54ms	1 scan
	2: Single-precision real number	26.3ms	9.77ms	4 scans
500000 points	0: Word [signed]	112ms	9.06ms	13 scans
	1: Double Word [signed]	224ms	9.08ms	25 scans
	2: Single-precision real number	1390ms	10.7ms	137 scans
1000000 points	0: Word [signed]	224ms	9.06ms	25 scans
	1: Double Word [signed]	448ms	9.06ms	50 scans
	2: Single-precision real number	2780ms	10.7ms	273 scans

*1 The time required from start to end of the processing

List of error codes

Error code	Description	Action
103H	A value out of the range is set in i_uDataType (data type selection). Set a value of 0 to 2 in i_uDataType (data type selection).	Review and correct the setting and then execute the FB again.
105H	A value out of the range is set in i_udSize (number of data points). Set a value of 1 to 1000000 in i_udSize (number of data points).	Review and correct the setting and then execute the FB again.
200H	Although the value set in i_uDataType (data type selection) is Single-precision real number, the stored copy source array data is not a single-precision real number. Store the data as a single-precision real number in the file register (ZR).	Review and correct the copy source array data and then execute the FB again.
205H	i_bEN (execution command) has been turned off during the processing.	Do not turn off i_bEN (execution command) until o_bOK (normal completion) or o_bErr (error completion) turns on.
209H	Some areas of copy source array data and copy destination array data are overlapped. Review the following settings so that the copy source array data areas and the copy destination array data areas are not overlapped. • i_udSourceAryAddr (copy source array data start address) • i_udDestAryAddr (copy destination array data start address) • i_udSize (number of data points)	Review and correct the setting(s) and then execute the FB again.

MEMO

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REVISIONS

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

Revision date	*Manual number	Description
December 2017	BCN-P5999-0918-A	First edition

Japanese manual number: BCN-P5999-0917-A

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MODEL: ARRAYHANDL-FBR-E

MITSUBISHI ELECTRIC CORPORATION

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

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