MITSUBISHI ELECTRIC

Mitsubishi Programmable Controller

MELSEC iQ-R series

MELSEC iQ-R Inter-Module Synchronization Function Reference Manual

SAFETY PRECAUTIONS

(Read these precautions before using this product.)

Before using MELSEC iQ-R series programmable controllers, please read the manuals for the product and the relevant manuals introduced in those manuals carefully, and pay full attention to safety to handle the product correctly.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

CONDITIONS OF USE FOR THE PRODUCT

(1) Mitsubishi programmable controller ("the PRODUCT") shall be used in conditions;

i) where any problem, fault or failure occurring in the PRODUCT, if any, shall not lead to any major or serious accident; and

ii) where the backup and fail-safe function are systematically or automatically provided outside of the PRODUCT for the case of any problem, fault or failure occurring in the PRODUCT.

(2) The PRODUCT has been designed and manufactured for the purpose of being used in general industries.

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INTRODUCTION

Thank you for purchasing the Mitsubishi MELSEC iQ-R series programmable controllers.
This manual describes the inter-module synchronization function, which controls multiple modules synchronously.
Before using this product, please read this manual and the relevant manuals carefully and develop familiarity with the functions and performance of the MELSEC iQ-R series programmable controller to handle the product correctly.
When applying the program examples provided in this manual to an actual system, ensure the applicability and confirm that it will not cause system control problems.
Please make sure that the end users read this manual.

Point

Where a reference to the GX Works3 Operating Manual or the MELSEC iQ-R CPU Module User's Manual (Startup or Application) is given, the reference should be made to the following instead:
CW Configurator Operating Manual
MELSEC iQ-R C Controller Module User's Manual (Startup)
MELSEC iQ-R C Controller Module User's Manual (Application)

CONTENTS

RELEVANT MANUALS

Manual name [manual number]	Description	Available form
MELSEC iQ-R Inter-Module Synchronization Function Reference Manual [SH-081401ENG] (this manual)	Inter-module synchronization function, which controls multiple modules synchronously	e-Manual EPUB PDF
MELSEC iQ-R CPU Module User's Manual (Startup) [SH-081263ENG]	Performance specifications, procedures before operation, and troubleshooting of the CPU module	Print book
		e-Manual EPUB PDF
MELSEC iQ-R C Controller Module User's Manual (Application) [SH-081369ENG]	Functions, devices, and parameters of C Controller module	Print book
		e-Manual EPUB PDF

Point

e-Manual refers to the Mitsubishi FA electronic book manuals that can be browsed using a dedicated tool. e-Manual has the following features:

- Required information can be cross-searched in multiple manuals.
- Other manuals can be accessed from the links in the manual.
- The hardware specifications of each part can be found from the product figures.
- Pages that users often browse can be bookmarked.

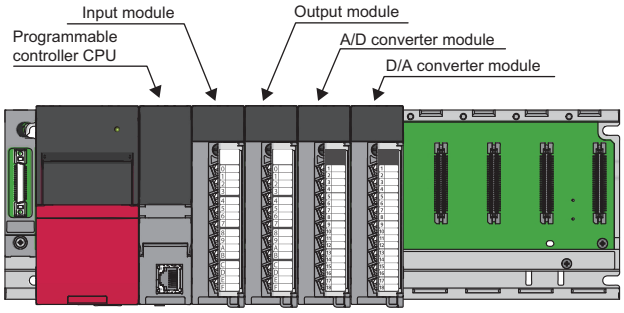
TERMS

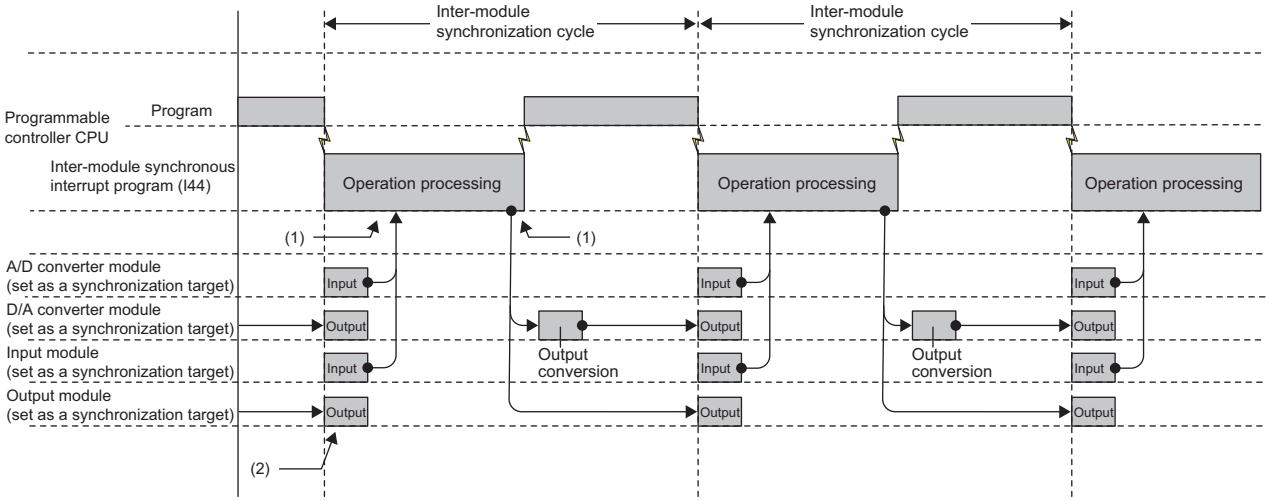
Unless otherwise specified, this manual uses the following terms.

Term	Description
A/D converter module	Another name for the analog-digital converter module
CPU module	A generic term for the MELSEC iQ-R series CPU module
C Controller module	A generic term for the MELSEC iQ-R series C Controller module
D/A converter module	Another name for the digital-analog converter module
RAS	The abbreviation for Reliability, Availability, and Serviceability. This term refers to usability of automated equipment.
Intelligent function module	A module that has functions other than input and output, such as an A/D converter module and D/A converter module
Engineering tool	The product name of the software package for the MELSEC programmable controllers
Control CPU	A CPU module that controls connected I/O modules and intelligent function modules. In a multiple CPU system, there are multiple CPU modules and each connected module can be controlled by a different CPU module.
Global label	A label that is valid for all the program data when multiple program data are created in the project. The global label has two types: a module specific label (module label), which is generated automatically by GX Works3, and an optional label, which can be created for any specified device.
Cyclic transmission	A function by which data are periodically exchanged among stations on the network using link devices
Slave station	A generic term for a local station, remote I/O station, remote device station, and intelligent device station
Device	A device (X, Y, M, D, or others) in a CPU module
Master/local module	A generic term for the RJ71GF11-T2 CC-Link IE Field Network master/local module and RJ71EN71 (when the CC-Link IE Field Network function is used)
Master station	A station that controls the entire network. This station can perform cyclic transmission and transient transmission with all stations. Only one master station can be used in a network.
Module label	A label that represents one of memory areas (I/O signals and buffer memory areas) specific to each module in a given character string. For the module used, GX Works3 automatically generates this label, which can be used as a global label.
Link scan time	Time required for all the stations on the network to transmit data.
Link device	A device (RX, RY, RWr, RWw, SB, SW) in a module on CC-Link IE Field Network
Local station	A station that performs cyclic transmission and transient transmission with the master station and other local stations.

1 OVERVIEW

The inter-module synchronization function adjusts the control timing for the signals between multiple modules. When this function is used, the synchronization target module can match the input or output timing to the inter-module synchronization cycle. The inter-module synchronization cycle is a fixed scan interval for the inter-module synchronization function. The multiple CPU system function's fixed communication interval and the CC-Link IE Field Network synchronous communication function can be coordinated with the inter-module synchronization cycle.





(1) Refreshing is executed before and after the inter-module synchronous interrupt program (I44).

(2) The input process and output process are performed at the timing of the inter-module synchronization cycle.

MEMO

2 SYSTEM CONFIGURATION

Shows the system configuration for the inter-module synchronization function.

2.1 Precautions for System Configuration

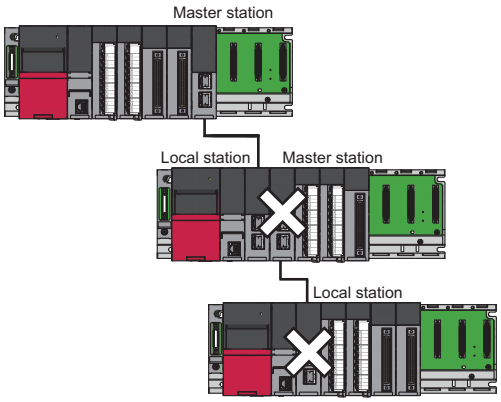
Lists precautions for configuring the inter-module synchronization function system.

Item		Description
Modules targeted for inter-module synchronization function*1		This function can be used only with the MELSEC iQ-R Series modules. (☞ Page 10 Configuration Devices)
For configuration that uses the network module as the synchronization target module.	Network compatible with inter-module synchronization function	Only CC-Link IE Field Network
	Number of network modules that can be specified as target module for inter-module synchronization function (Per station include those on extension base unit.)*2*3	• Master station modules: 8 modules • Local station modules: 1 module*6
	Network transmission path format compatible with inter-module synchronization function	Only the following network topology can be used. • Line topology • Star topology*4 • Line topology and star topology combination*4
	Mounting position of local station module in synchronization target network module	The local station can be mounted only on the main base unit. (Local stations on the extension base unit cannot be synchronized.)
	Types of stations supported with inter-module synchronization function*5	Only master station and local station
	Time required for inter-module synchronization function to start (rising edge)	Max. 20 seconds

*1 This is not restricted by the module mounting position, maximum number of mountable modules, or the number of CPU modules when using a multiple CPU system configuration. (Same as when not using the inter-module synchronization function.) (📖 MELSEC iQ-R Module Configuration Manual)

*2 In the multiple CPU system, the inter-module synchronization function can be used only by the network module controlled by the CPU No.1.

*3 If the local station is designated as the module targeted for the inter-module synchronization function, the master station on the same base unit as the local station cannot be set as a module targeted for the inter-module synchronization function.



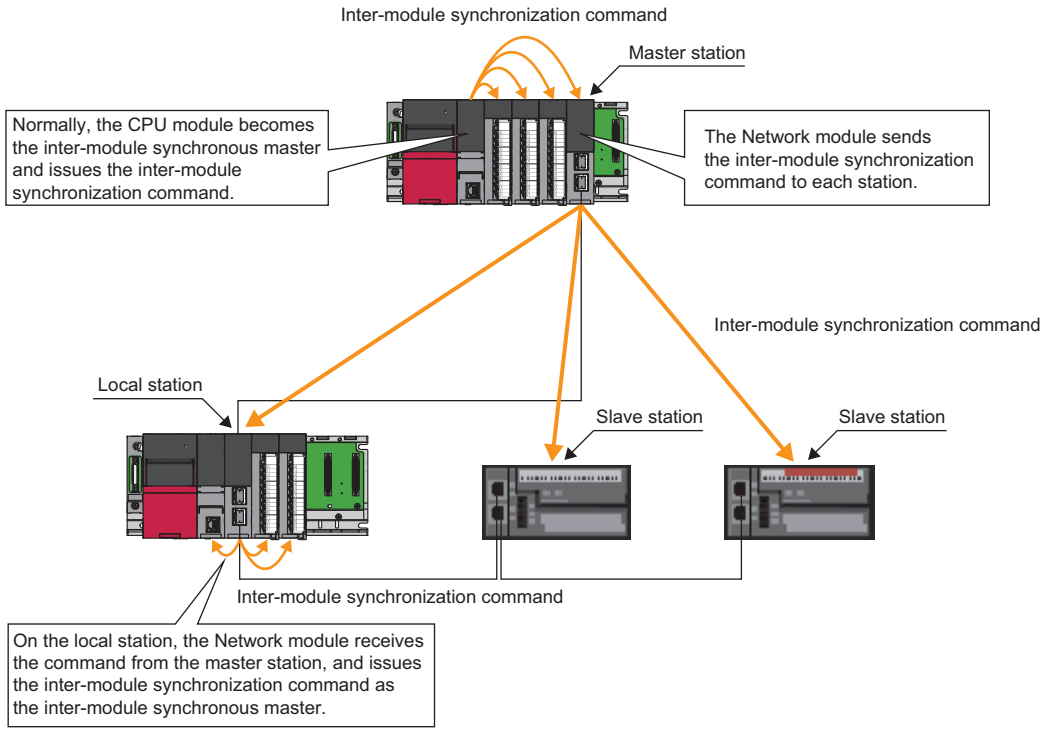
*4 A hub compatible with the inter-module synchronization function must be used. (📖 MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup))

*5 Shows the type of station that can be selected with the station type setting. (📖 MELSEC iQ-R CC-Link IE Field Network User's Manual (Application))

*6 To use the module on the local station as the synchronization target module, Synchronous Master Setting within the Modules is required. (☞ Page 9 Inter-module synchronous master, ☞ Page 30 Inter-Module Synchronization Setting)

Inter-module synchronous master

The inter-module synchronous master is a module that issues the inter-module synchronization command. Normally, the CPU module becomes the inter-module synchronous master. (For the multiple CPU system configuration, the CPU module on the extreme left, for which "Synchronize" is set in "Select the Synchronous Target Unit" of "Synchronization Setting within the Modules", becomes the inter-module synchronous master.) Note that if a module on the local station is used as the synchronization target, the master station becomes the inter-module synchronous master because the CC-Link IE Field Network module on the local station operates by receiving the command from the master station.



2.2 Configuration Devices

Shows the modules that can be synchronously controlled with the inter-module synchronization function.

Part name		Model name
CPU module	Programmable controller CPU	• R04CPU • R04ENCPU • R08CPU • R08ENCPU • R16CPU • R16ENCPU • R32CPU • R32ENCPU • R120CPU • R120ENCPU
	Process CPU	• R08PCPU • R16PCPU • R32PCPU • R120PCPU
	Motion CPU	• R16MTCPU • R32MTCPU
	C Controller module	R12CCPU-V
Network module	Master/local module	• RJ71GF11-T2 • RJ71EN71*1
I/O module	AC input module	RX10
	DC input module	• RX40C7 • RX41C4
	DC high-speed input module	• RX40PC6H • RX40NC6H
	Contact output module	RY10R2
	Transistor output module	• RY40NT5P • RY41NT2P • RY40PT5P • RY41PT1P
Intelligent function module	A/D converter module	• R60AD4 • R60ADI8 • R60ADV8
	D/A converter module	• R60DA4 • R60DAI8 • R60DAV8
	Simple motion module	• RD77MS2 • RD77MS4 • RD77MS8 • RD77MS16
	High-speed counter module	• RD62P2 • RD62D2 • RD62P2E
	Positioning module	• RD75P2 • RD75P4 • RD75D2 • RD75D4

*1 Usable only when operating as the CC-Link IE Field Network.

Point

A module other than those listed in the table can be mounted on the system as long as it is not a module that is synchronously controlled with the inter-module synchronization function.

3 SPECIFICATIONS

Shows the specifications for the inter-module synchronization function.

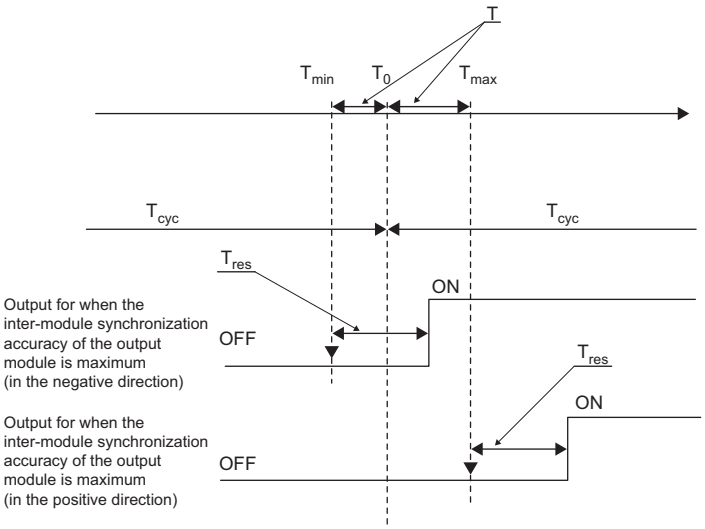
3.1 Performance Specifications

Shows the performance specifications for the inter-module synchronization function.

Item	Performance value
Inter-module synchronization cycle	100μs to 10ms
Inter-module synchronization accuracy	Calculate the accuracy with the inter-module synchronization accuracy formula. (☞ Page 12 Inter-module synchronization accuracy calculation formula)

Inter-module synchronization accuracy

The accuracy is the difference that each module recognizes the synchronization point and the time of the synchronization point. In the case of the following output module, the inter-module synchronization accuracy is T_{max}-T0 in the positive direction, and T0-T_{min} in the negative direction.



- T: Inter-module synchronization accuracy
- T_0: Synchronization point time
- T_{min}: Time that an output module recognizes synchronization point (Min.)
- T_{max}: Time that an output module recognizes synchronization point (Max.)
- T_{cyc}: Inter-module synchronization cycle
- T_{res}: Output module response time

The actual external output is output with the following time lag.
Inter-module synchronization accuracy + output module response time (T_{res})

Point

- Each module starts the process at the inter-module synchronization functions' start timing, so the input or output is made after the response time from that inter-module synchronization function's start timing.
- For details on each module's response time (T_{res}), refer to each module's manual.

Inter-module synchronization accuracy calculation formula

Shows the calculation formula for the inter-module synchronization accuracy. Use as a guide to set the inter-module synchronization cycle.

■When not going through a network module

$T=T_{cyc}\times 2.4\times 10^{-4}+N_r\times 80+150$

- T: Inter-module synchronization accuracy (ns)
- T_{cyc}: Inter-module synchronization cycle (ns)
- N_r: Number of stages in extension base unit in which the module for calculating the inter-module synchronization accuracy is mounted*1

*1 This is 0 for the main base unit.

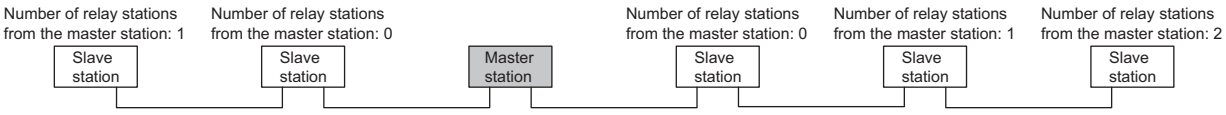
■When going through network module

$T=T_{cyc}\times 2.4\times 10^{-4}+N_r\times 80+N_s\times 12+700$

- T: Inter-module synchronization accuracy (ns)
- T_{cyc}: Inter-module synchronization cycle (ns)
- N_r: Number of stages in extension base unit in which the module for calculating the inter-module synchronization accuracy is mounted*1
- N_s: Number of transit stations from the master station in which the module for calculating the inter-module synchronization accuracy +1*2

*1 This is 0 for the main base unit.

*2 The number of relay stations from the master station refers to the number of stations physically related from the master station to the relevant station when using the following type of line topology or line topology/star topology combination.



Point

Obtain the inter-module synchronization accuracy for the module mounted in the master station with the "When not going through network module" method.

4 PROCEDURES BEFORE OPERATION

This section describes the procedures for using the inter-module synchronization function.

1. Starting up the engineering tool

Connect the personal computer in which the engineering tool is installed to the CPU module, and start up the engineering tool. (📖 GX Works3 Operating Manual)

Point

For details on the preparations for starting up the engineering tool (mounting the modules, wiring each device, turning the system power ON, etc.), refer to the following.
📖 MELSEC iQ-R CPU Module User's Manual (Startup)

2. Setting the applicable system

Set the system used in the unit configuration drawing. (📖 GX Works3 Operating Manual) When using the multiple CPU system configuration, set the system parameters for all CPU modules.) (📖 MELSEC iQ-R CPU Module User's Manual (Application))

3. Setting the inter-module synchronization function

Set the parameters required for using the inter-module synchronization function.

- Inter-module synchronization setting (☞ Page 30 Inter-Module Synchronization Setting)
- If necessary, set the CPU parameters and module parameters. (📖Manual for each module)
- To coordinate the multiple CPU system function's fixed scan communication cycle with the inter-module synchronization cycle, set the fixed scan communication setting. (☞ Page 32 Multiple CPU Settings)
- To coordinate the CC-Link IE Field Network synchronous communication function with the inter-module synchronization cycle, set the CC-Link IE Field Network master station. (☞ Page 33 Settings in CC-Link IE Field Network)

4. Programming

Create the inter-module synchronous interrupt program. To exchange the data used with the inter-module synchronization function between the multiple CPU systems, create a program for exchanging data.

5. RAS setting

If necessary, set to monitor the inter-module synchronous interrupt program's execution time. (☞ Page 42 Inter-module synchronous interrupt program execution time monitor)

6. Writing the parameters and programs

Write the parameters set with the engineering tool and the created program into the CPU module. (📖 GX Works3 Operating Manual)) When using the multiple CPU system configuration, the parameter settings and program must be written into each CPU module for CPU No. 2 to 4.

7. Restarting the system

Restart the system with one of the following methods.

- Power OFF→ON→RUN
- Reset the CPU module→RUN

8. Monitoring and diagnosis

If necessary, confirm the operation of the inter-module synchronization function with the system monitor or the interrupt program monitor list for each CPU module. (☞ Page 40 Error Processing and Recovery Methods)

MEMO

5 FUNCTION

Shows the details of the inter-module synchronization function.

5.1 Fixed Cycle Synchronization Function

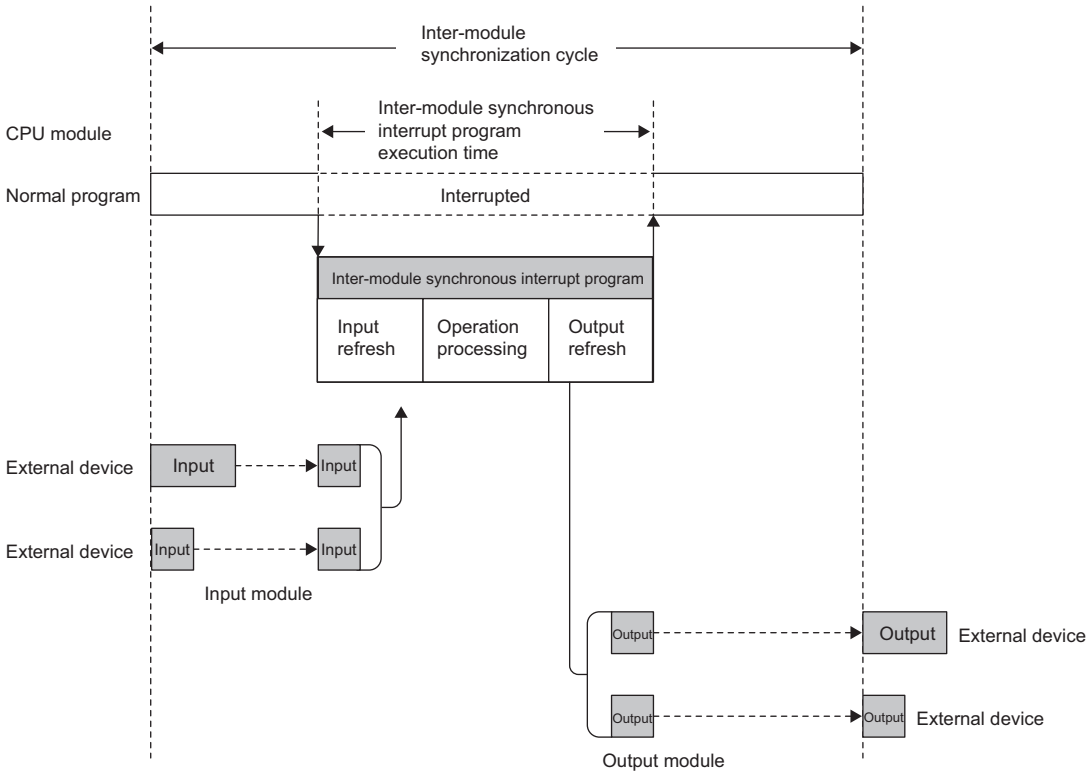
Multiple modules are synchronized at the inter-module synchronization cycle timing set with the parameters. The data is exchanged and the input/output is control at a fixed cycle. By using this function, the encoder input can be collected at a fixed-time so data is retrieved at an accurate speed. In addition, the input/output timing is accurately known so highly accurate model prediction control is possible.

Timing for synchronizing CPU modules

The CPU modules execute an inter-module synchronous interrupt program at each inter-module synchronization cycle. (☞ Page 16 Inter-module synchronous interrupt) The CPU module and each module are synchronized by refreshing. This is performed before or after the inter-module synchronous interrupt program. With this, the input data can be retrieved and the output data can be written at the inter-module synchronization cycle timing.

When using C Controller module, refer to the following manual.

MELSEC iQ-R C Controller Module User's Manual (Application)



Point

- The CC-Link IE Field Network module's input signal (X) and output signal (Y) are refreshed at the END process.
- For details on the refresh operation and settings, refer to each module's manual.

Inter-module synchronous interrupt

The interrupt program is executed at the inter-module synchronization cycle timing set in the parameters. The interrupt program executed at each inter-module synchronization cycle is called the inter-module synchronous interrupt program. For details on the inter-module synchronous interrupt program, refer to the manual for each CPU module.

Point

- Write the program for controlling the synchronization target in the inter-module synchronous interrupt program.
- The operation when an interrupt cause occurs and the methods of creating the program, etc., are the same as a normal interrupt program.

■Execution timing

The inter-module synchronous interrupt program is executed at the inter-module synchronization cycle timing. The inter-module synchronization cycle can be changed with the parameter settings. (☞ Page 30 Inter-Module Synchronization Setting)

■Multiple interrupt

For details on the inter-module synchronization (I44) multiple interrupt function, refer to the following.

📖 MELSEC iQ-R CPU Module User's Manual (Application)

Refresh timing according to CPU module's operation status

This section shows the refresh timing according to the CPU module operation status.

Point

For C Controller module, the refresh timing is before and after an inter-module synchronous interrupt program since an inter-module synchronous interrupt program is executed even when the operating status of C Controller module is STOP. For more details, refer to the following manual.

📖MELSEC iQ-R C Controller Module User's Manual (Application)

■(RUN→STOP) operation at STOP

At STOP[*1], the CPU module stops the execution of the inter-module synchronous interrupt program, and turns the output OFF. Refreshing is executed even during STOP. Note that refreshing will not be executed the specified inter-module synchronization cycle (fixed cycle), but will be executed at the END process.

*1 This includes CPU module stop errors.

■STOP→RUN operation[*1]

The CPU module issues the inter-module synchronization start instruction to each module at the inter-module synchronization cycle after STOP→RUN. The inter-module synchronous interrupt program execution starts at the next inter-module synchronization cycle. The refresh timing changes from the END process to before and after the inter-module synchronous interrupt program.

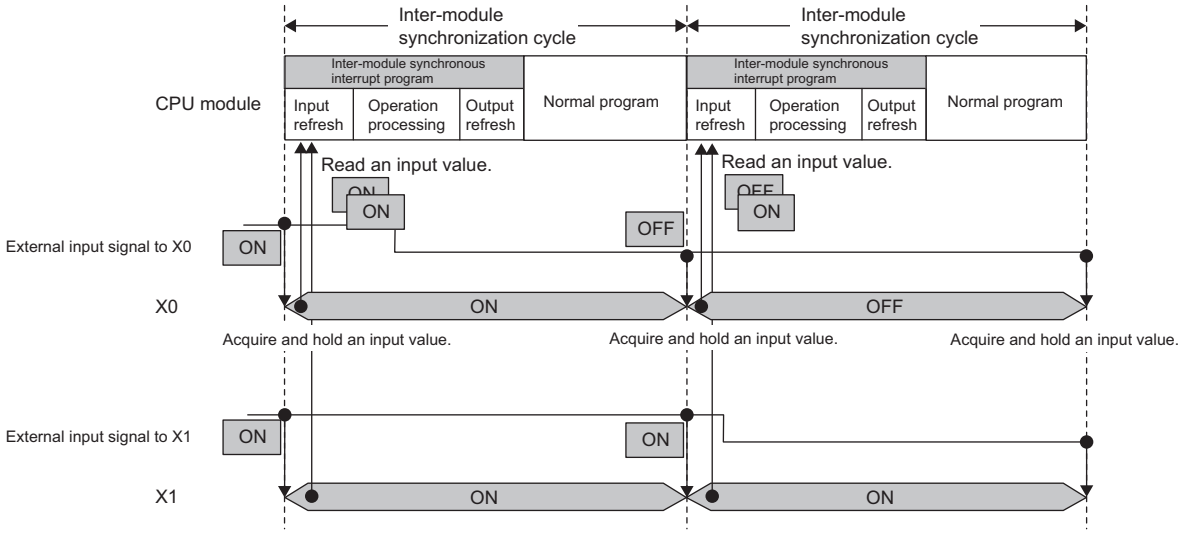
*1 The operation is the same at Power ON→RUN.

Timing to synchronize each module

Shows the timing to synchronize each module.

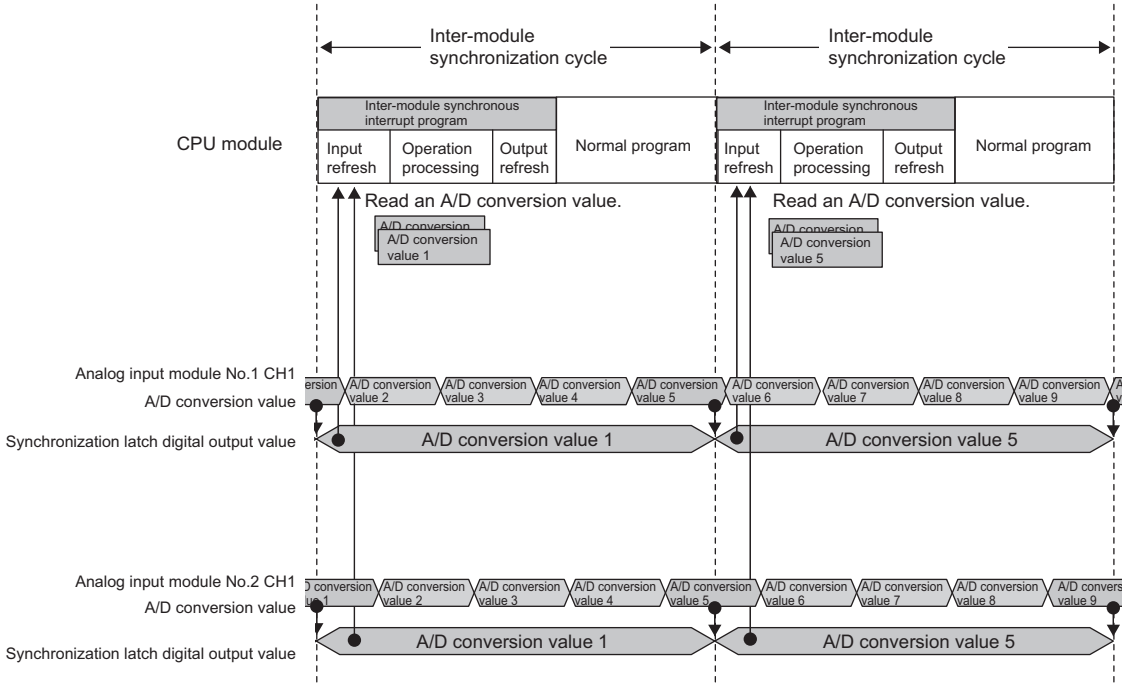
Input module

The input module retrieves the input module at the inter-module synchronization cycle start timing, and holds the input value during the inter-module synchronization cycle. (The input value is retrieved only once during the inter-module synchronization cycle.) By reading the input value (input signal) from the inter-module synchronous interrupt program, multiple modules can read the retrieved value at the same timing.



A/D converter module

During the interval from the inter-module synchronization cycle start timing to execution of the inter-module synchronous interrupt program, the latest A/D conversion value is retrieved and stored in the synchronization latch digital operation value. The synchronization latch digital operation value is held during the inter-module synchronization cycle. By reading the synchronization latch digital operation value from the inter-module synchronous interrupt program, multiple modules can read the A/D conversion value at the same timing.



Point

For details on the inter-module synchronization function in the A/D converter module, refer to the following.
Each A/D converter module manual

High-speed counter module

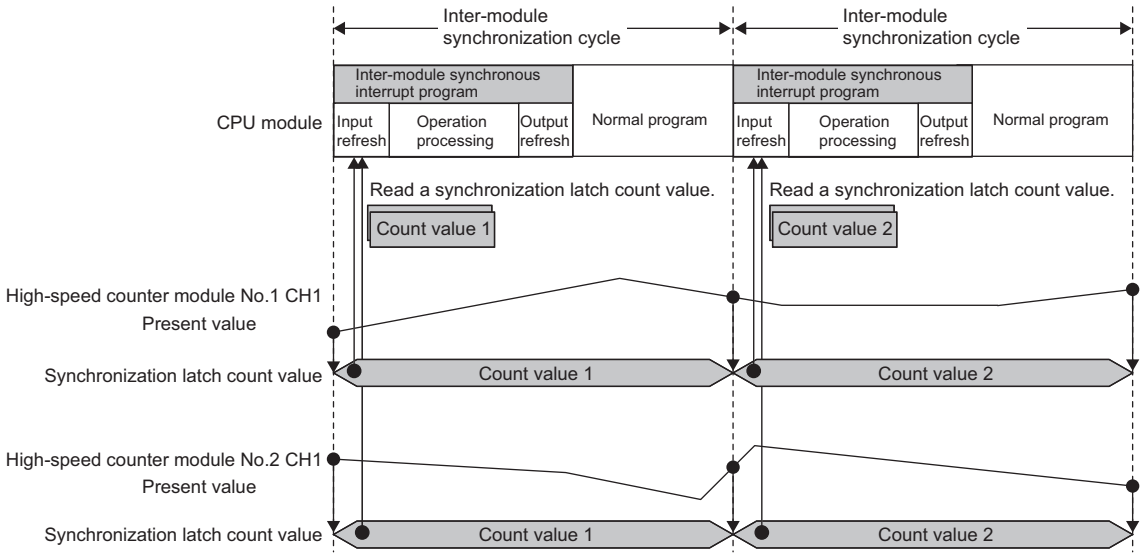
The value is latched in synchronization with the falling edge of the inter-module synchronization control signal. The latched value is stored in the buffer memory. The normal count operation is executed even when using the inter-module synchronization signal. The latch target and storage destination buffer memory differ according to the operation mode.

Operation mode	Latch timing	Latch target	Storage destination buffer memory name*1
Pulse count mode	Falling edge of inter-module synchronization control signal	Current counter value	Synchronization latch count value
Pulse measurement mode	Falling edge of inter-module synchronization control signal	Measured pulse value	Synchronization measured pulse value

*1 The value is updated only at the falling edge of the inter-module synchronization control signal regardless of the ON/OFF state of the count enable instruction pulse measurement instruction.

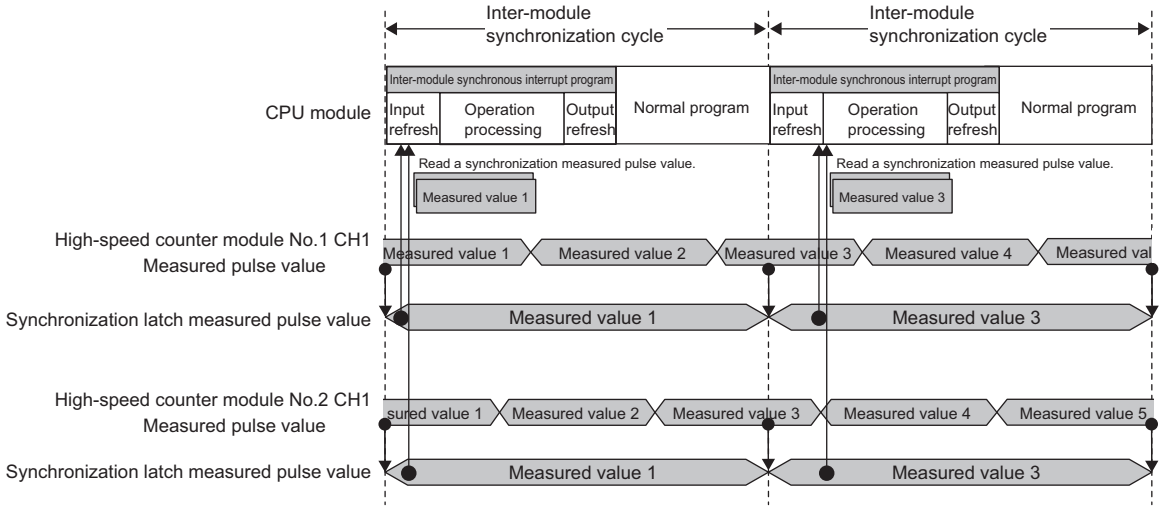
■Pulse count mode (Synchronization latch counter function)

The latest current counter value is retrieved at the inter-module synchronization cycle start timing, and is held during the inter-module synchronization cycle. By reading the synchronization latch counter value from the inter-module synchronous interrupt program, multiple modules can read the retrieved current count value at the same timing.



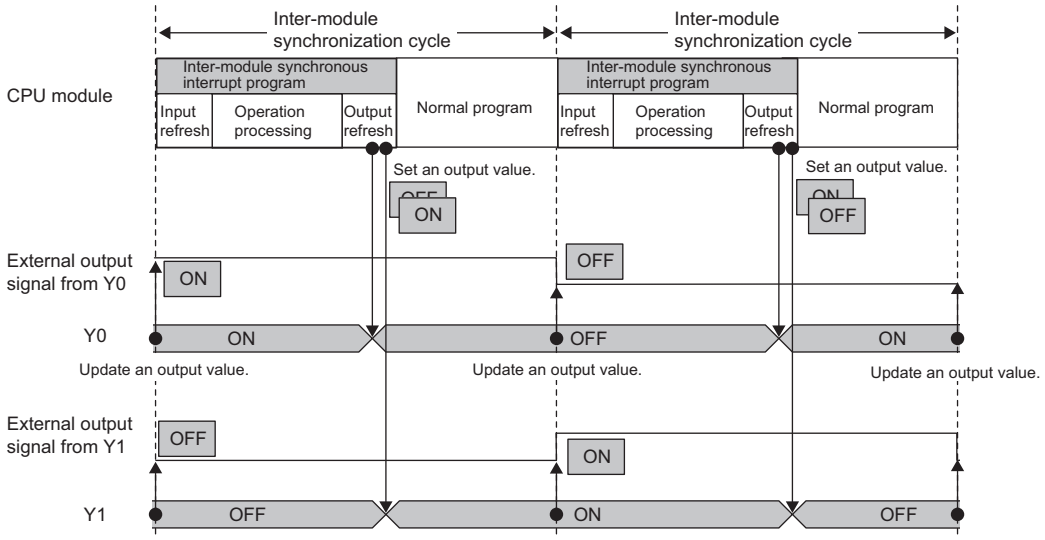
■Pulse measurement mode (Synchronous pulse measurement function)

The pulse measurement value of the function input terminal's input pulse is retrieved at the inter-module synchronization cycle start timing. The pulse measurement interval can be selected from four patterns: ON width, OFF width, rising edge to rising edge, or falling edge to falling edge. (The synchronization latch pulse measurement value is updated only once during the inter-module synchronization cycle.) By reading the synchronization latch pulse measurement value from the inter-module synchronous interrupt program, the pulse measurement value of the input pulse just before the inter-module synchronization cycle is started can be read out.



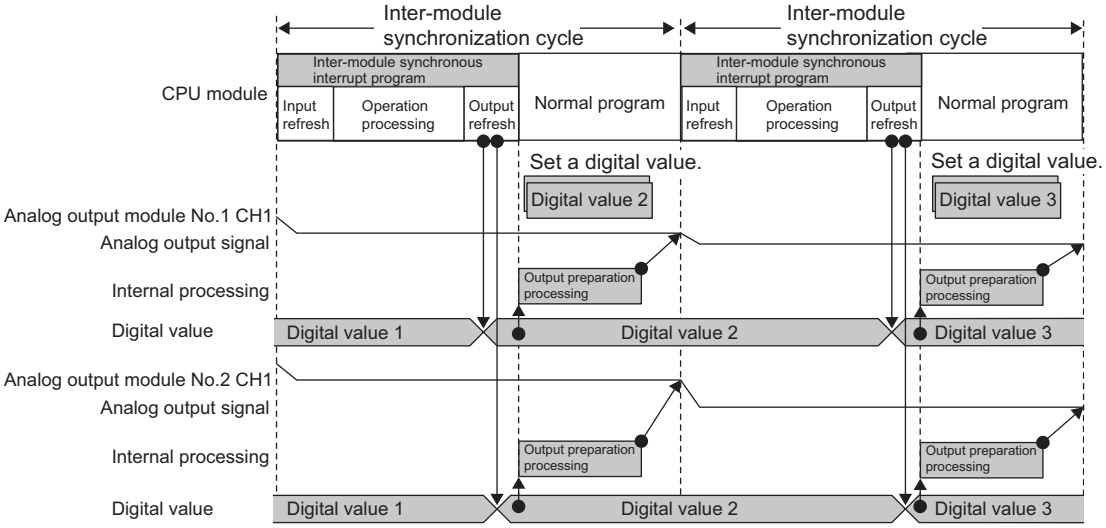
Output module

The output module's external output value (ON/OFF) is updated at the inter-module synchronization cycle start timing. (The output value is updated only once during the inter-module synchronization cycle.) By setting the output value from the inter-module synchronous interrupt program, several modules can output the setting value externally at the same value. The external output value is updated at the start timing of the inter-module synchronization cycle after the output that is set in the inter-module synchronous interrupt program.



D/A converter module

After execution of the inter-module synchronous interrupt program is completed, the output preparation process is executed suing the digital value set in the D/A converter module. The analog signal is output at the start timing of the next inter-module synchronization cycle after the inter-module synchronization cycle. (The output preparation process is executed only once during the inter-module synchronization cycle.) By writing the digital value from the inter-module synchronous interrupt program to multiple D/A converter modules, multiple modules can output the analog signal at the same timing.

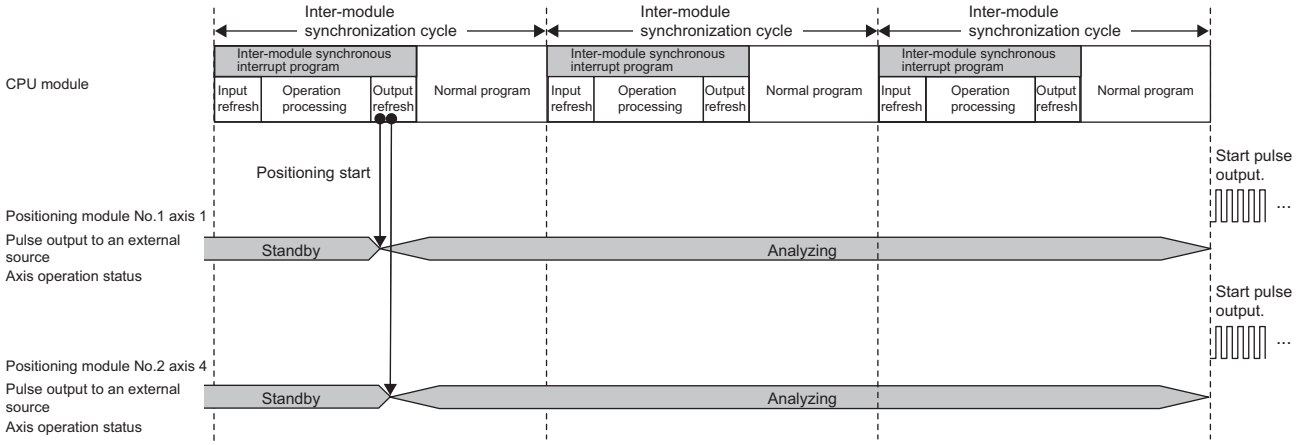


Point

For details on the inter-module synchronization function in the D/A converter module, refer to the following.
Manual for each D/A converter module

Positioning module

The pulse output is started at the inter-module synchronization cycle after the positioning start trigger is received. Note that the pulse output start timing is adjusted only to the inter-module synchronization cycle. After starting, each positioning module controls the positioning independently.



Point

For details on the positioning module's inter-module synchronization function, refer to the following.

Manual for each positioning module

Simple motion module

There is no need to match the inter-module synchronization cycle to the simple motion operation cycle. Note that the buffer memory value is updated and referred to at the simple motion operation cycle.

■When the inter-module synchronization cycle is faster than the simple motion operation cycle

The monitor data is updated at each simple motion operation cycle, and the control data, etc., is not processed if only the inter-module synchronization cycle is ON for only one scan, etc.

■When the inter-module synchronization cycle is slower than the simple motion operation cycle

Data may be skipped if the monitor data changes only during 1 simple motion operation cycle.

Point

For details on the inter-module synchronization function in the simple motion module, refer to the following.

Manual for simple motion module

Coordination with multiple CPU system function's fixed scan communication cycle

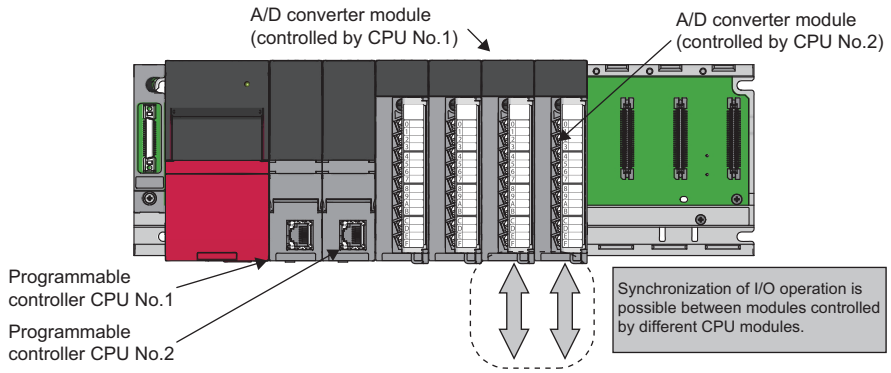
The fixed scan communication cycle for the multiple CPU system function can be set to the inter-module synchronization cycle.

When using C Controller module, refer to the following manual.

MELSEC iQ-R C Controller Module User's Manual (Application)

Programmable controller CPU

By setting the fixed scan communication cycle for the multiple CPU system function to the inter-module synchronization cycle, modules with different control CPUs can input and output in synchronization. Coordination with the fixed scan communication cycle for the multiple CPU system function is set with the parameters. (Page 32 Multiple CPU Settings)



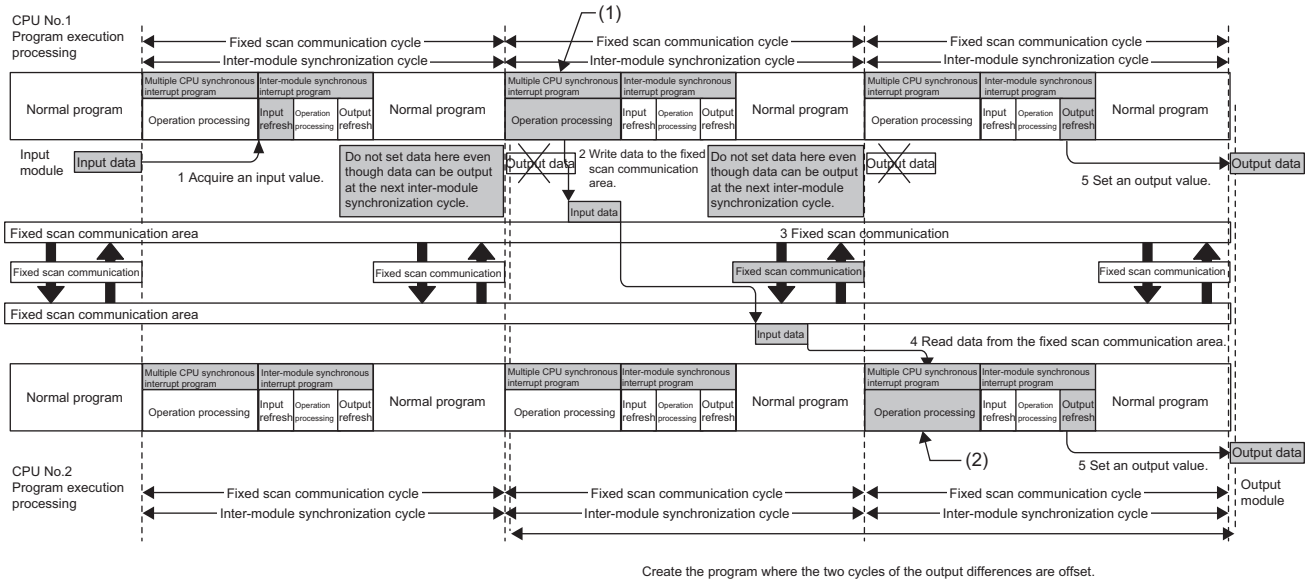
Point

For details on the multiple CPU system function, refer to the following.

MELSEC iQ-R CPU Module User's Manual (Application)

■Program operation

When the inter-module synchronization cycle is coordinated with the fixed scan communication cycle for the multiple CPU system function, the multiple CPU synchronous interrupt program (I45) and inter-module synchronous interrupt program (I44) are executed between the inter-module synchronization cycles. The programs are executed in the order of multiple CPU synchronous interrupt program (I45) and inter-module synchronous interrupt program (I44). It takes two inter-module synchronization cycles for the host CPU module's retrieval data to reach another CPU module. To synchronize the output between the CPU modules, the output timing from the host's control module must be delayed by two inter-module synchronization cycles.



Create the program where the two cycles of the output differences are offset.

(1) Write the input value into the CPU No.1's fixed scan communication area.
(2) Read the CPU No.1's fixed scan communication area, and set the output value.

Point

An inter-module synchronization function FB is provided to absorb the two-cycle output difference. To delay the output timing of the host's control module by two inter-module synchronization cycles, create a program using the inter-module synchronization function's FB. (MELSEC iQ-R CPU Module Function Block Reference)

■Precautions

This section describes the precautions for coordinating with the multiple CPU system function's fixed scan communication cycle.

- Even if the input/output settings for other than the group are enabled with another CPU module's program, the input or output cannot be retrieved from the synchronization target's module. Data can be read with direct specifications such as the DX, DY, Un\Gn or FROM instructions, but the data might be inconsistent.
- To synchronize the start timings of inter-module synchronization function for all CPU modules and all stations, set the CPU parameter to synchronize the rising of each module, and set the system parameter to synchronize the rising of all CPU modules.
- By setting "Fixed Scan Communication Function and Inter-module Synchronization Function" to "Cooperate" in multiple CPU settings of system parameter, the fixed scan communication cycle of multiple CPU system function operates according to the inter-module synchronization cycle of the inter-module synchronization function, and the both functions are controlled to operate at the same timing. (In this case, the fixed scan communication cycle of multiple CPU system function cannot be set.) Note that the number of program executions is different even though "Cooperate" is set in multiple CPU settings of system parameter, because the start timings of interrupt program executions are different between the inter-module synchronous interrupt (I44) and the multiple CPU synchronous interrupt (I45). For details on the start timings, refer to Page 16 Refresh timing according to CPU module's operation status. For details on the operations of interrupt programs (such as during interrupt disabled time), refer to the MELSEC iQ-R CPU Module User's Manual (Application).
- Control with synchronized timing is not possible without synchronizing with the inter-module synchronization function even if the same value is set for the multiple CPU system function's fixed scan communication cycle and the inter-module synchronization cycle.

Motion CPU

The execution timing for the motion operation or motion SFC event task (fixed cycle task) is as follows when the multiple CPU system function's fixed scan communication cycle or inter-module synchronization cycle is used.

<table>
<tr><th colspan="3" rowspan="3">Item</th><th colspan="3">Inter-module synchronization cycle</th></tr>
<tr><th>Disable</th><th colspan="2">Enable</th></tr>
<tr><th>Do not synchronize with the selected inter-module synchronization target module</th><th>Synchronize with the selected inter-module synchronization target module</th></tr>
<tr><td rowspan="3">Fixed scan communication cycle for multiple CPU system function</td><td colspan="2">Disable</td><td colspan="2">Cycle unique to Motion CPU</td><td>Synchronization with inter-module synchronization cycle*1</td></tr>
<tr><td rowspan="2">Enable</td><td>Do not synchronize with inter-module synchronization cycle</td><td colspan="2">Fixed scan communication cycle for multiple CPU system function*1 (☞ Page 26 Timing example 1)</td><td>Error occurs</td></tr>
<tr><td>Synchronize with inter-module synchronization cycle</td><td>Setting not possible</td><td colspan="2">Multiple CPU system function's fixed scan communication cycle = synchronization with inter-module synchronization cycle*1 (☞ Page 26 Timing example 2, ☞ Page 26 Timing example 3)</td></tr>
</table>

*1 When the motion operation cycle and the multiple CPU system function's fixed scan communication cycle or inter-module synchronization cycle differ, the start timing of the longer cycle is always synchronized with the start timing of the shorter cycle.

Ex.

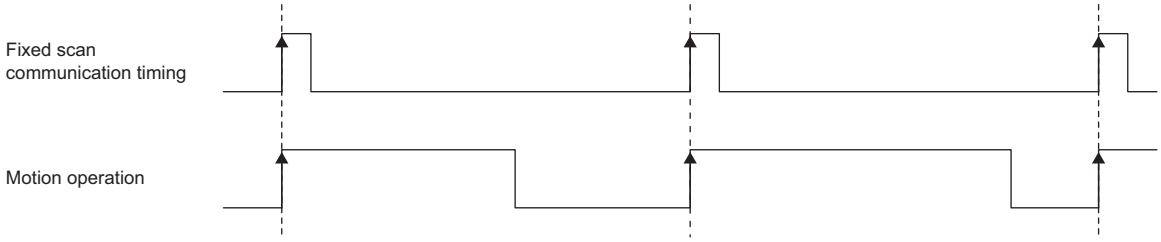
When using the following setting with programmable controller CPU (CPU No.1) and Motion CPU (CPU No.2)

- Inter-module synchronization cycle = 1.00ms, multiple CPU system function's fixed scan communication cycle = 0.888ms
- Set the Motion CPU (CPU No.2) to "Do not Synchronize" in the inter-module synchronization target module selection

The communication cycle of the programmable controller CPU (CPU No.1) and Motion CPU (CPU No.2) multiple CPU synchronous interrupt program (I45) and CPU buffer memory access device (U3En\HGn) is a 0.888ms cycle.
The programmable controller CPU (CPU No.1) inter-module synchronous interrupt program (I44) has a 1.00ms cycle.
The Motion CPU operation cycle is a cycle synchronized to 0.888ms.

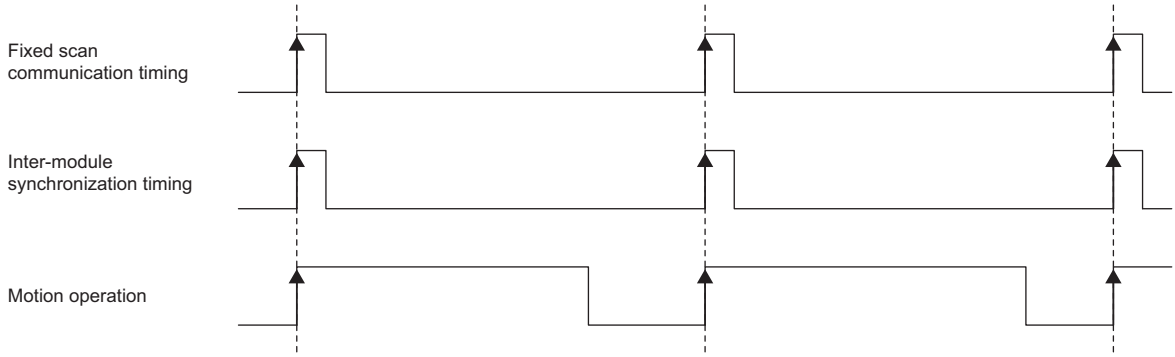
■Timing example 1

Synchronization with multiple CPU system function's fixed scan communication cycle



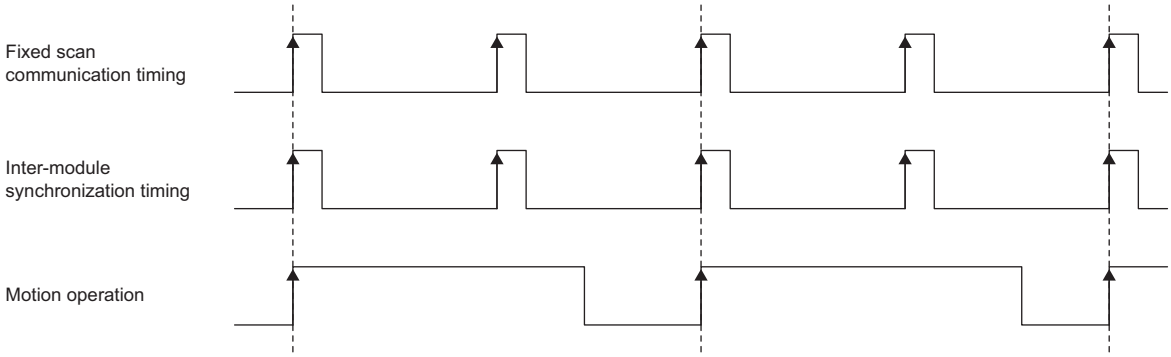
■Timing example 2

When motion operation cycle and inter-module synchronization cycle are equal



■Timing example 3

When motion operation cycle is double the inter-module synchronization cycle



Point

For details on the inter-module synchronization function in the Motion CPU, refer to the following.

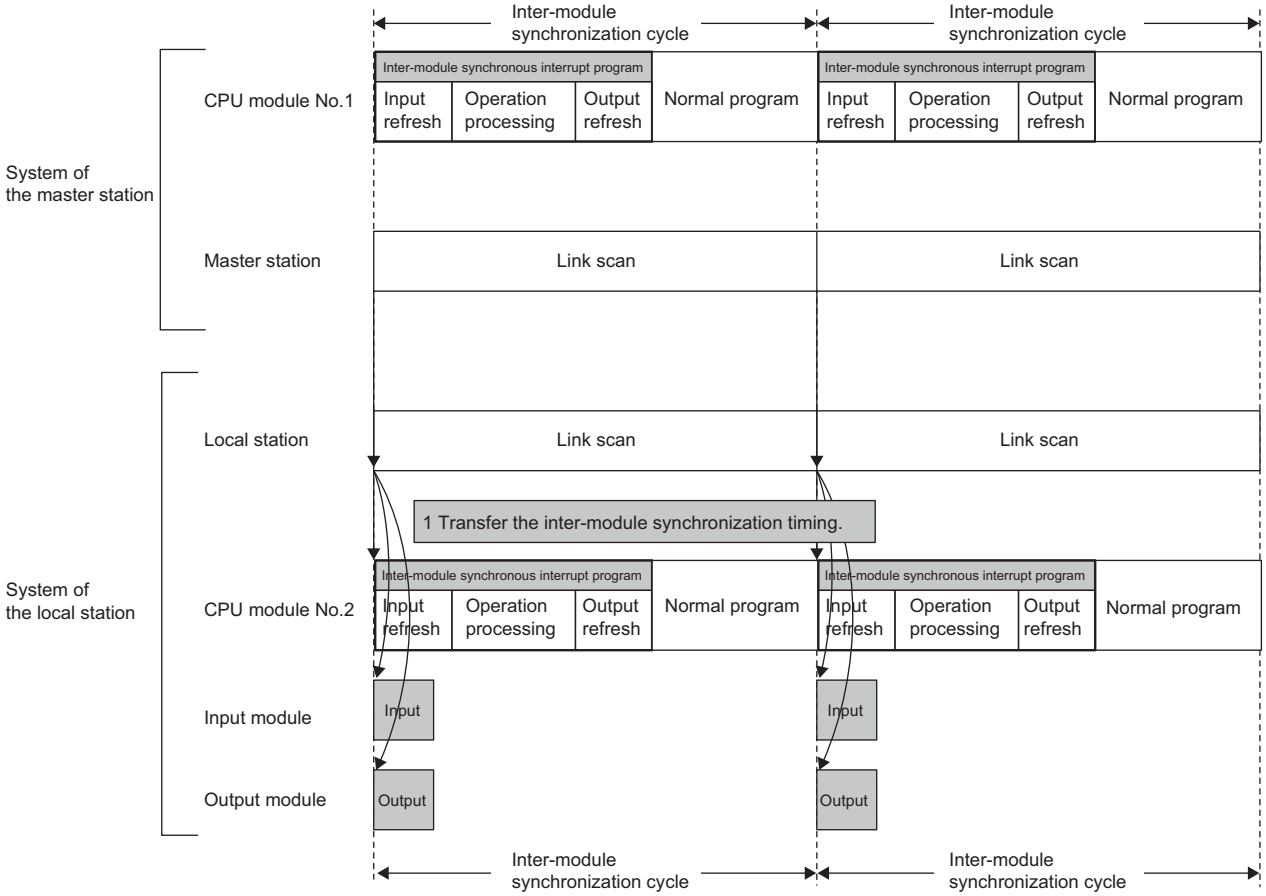
Motion CPU manual

CC-Link IE Field Network synchronous communication function

When the devices in the CC-Link IE Field Network are communicating, the send side and receive side timing are synchronized with the inter-module synchronization cycle. The master station parameters must be set to use this function. (☞ Page 33 Settings in CC-Link IE Field Network)

Master station and local station network synchronous communication

With the CC-Link IE Field Network synchronous communication function, the inter-module synchronization timing for the system in the master station is sent to the local station via the network. The local station sends the inter-module synchronization cycle timing to each module in its own station.

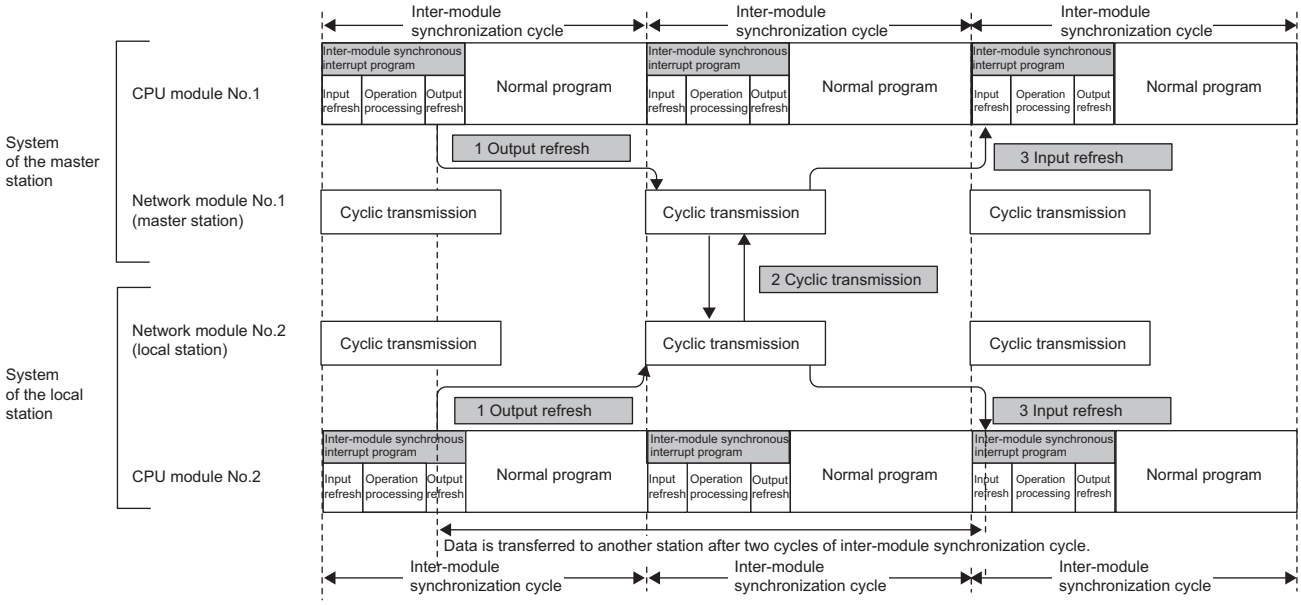


Point

When the local station is cut off from the master station because of a cable break, etc., synchronization cannot be maintained between the master station and local station. Thus, the inter-module synchronization target modules in the local station also cannot be synchronized.

■Cyclic transmission in master station and local station

It takes two inter-module synchronization cycles for the local station's input/output refreshing state to be sent. To synchronize the input/output refreshing between the master station and local station, the master station's input/output refreshing must be delayed by two inter-module synchronization cycles.

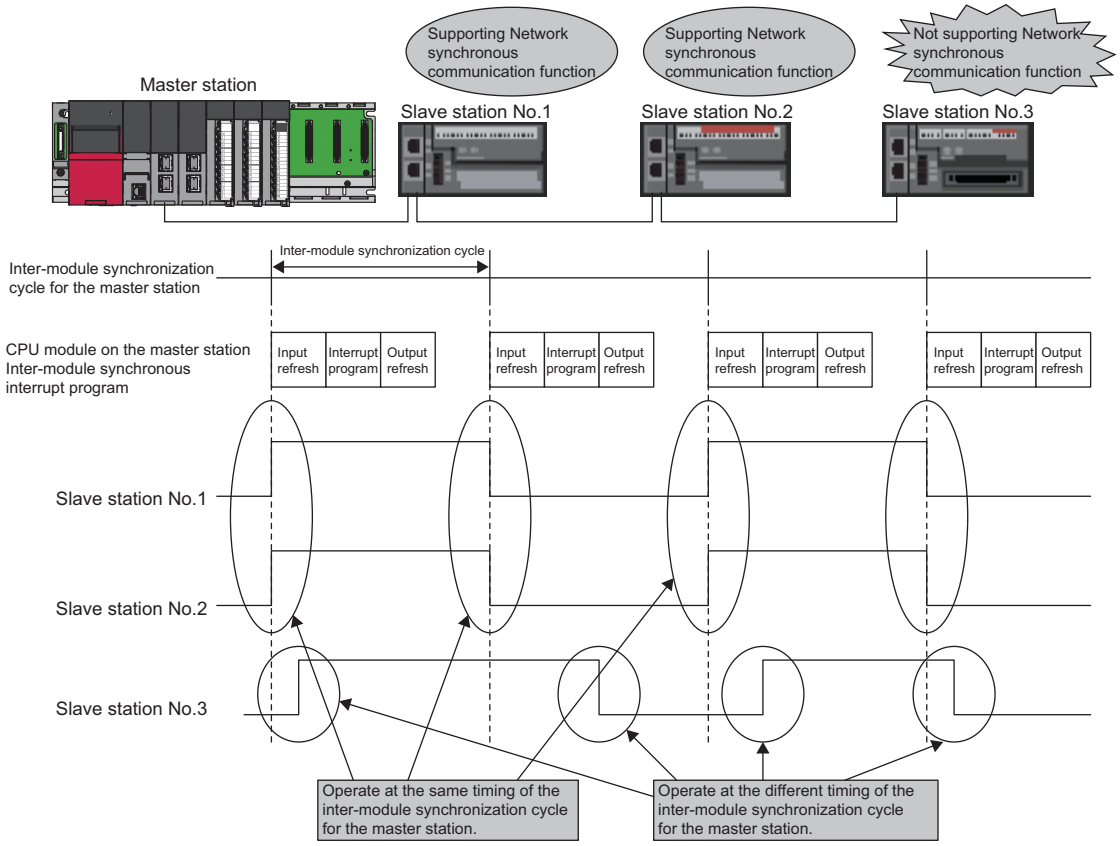


Point

An inter-module synchronization function FB is provided to absorb the two-cycle input/output difference. Use the inter-module synchronization function FBs to create a program to delay the master station's input/output refreshing by two inter-module synchronization cycles. (☞ Page 36 Program, 📖MELSEC iQ-R CPU Module Function Block Reference)

Network synchronous communication with slave station

Using the CC-Link IE Field Network synchronous communication function, another slave station connected in the same network can be operated in synchronization with the inter-module synchronization cycle.



Point

For details on the CC-Link IE Field Network synchronous communication function with the slave station, refer to the following.

📖Manual for each slave station

6 PARAMETER SETTINGS

This section describes the parameter settings required to use the inter-module synchronization function.

6.1 Inter-Module Synchronization Setting

Set the module configuration diagram with the engineering tool, and set the inter-module synchronization settings.

[System Parameter] ⇨ "Synchronization Setting within the Modules" ⇨ "Synchronization Setting within the Modules"

Operating procedure

"Synchronization Setting within the Modules" window

Item	Setting
Synchronization Setting within the Modules	
Use Inter-module Synchronization Function in System	Use
Select Synchronous Target Unit between Unit	<Detailed Setting>

"Select the Synchronous Target Unit" window

Slot	Module Name	Management	Master/Local	Setting
Main				
CPU	R04CPU(Host Station)	1PLC controlled		Synchronize
CPU	R08CPU	2PLC No.		Synchronize
1(0-1)	RX10	1PLC controlled		Synchronize
2(0-2)	RY10R2	1PLC controlled		Synchronize
3(0-3)	RD77MS2	1PLC controlled		Synchronize

"Synchronization Setting within the Modules" window

Item	Setting
Synchronous Fixed Scan Interval Setting within the Modules	
0.05ms Unit Setting	Set
Fixed Scan Interval Setting (Not Set by 0.05ms)	0.888ms
Fixed Scan Interval Setting (Set by 0.05ms)	0.50 ms

"Synchronization Setting within the Modules" window

Item	Setting
Synchronous Master Setting within the Modules	
Synchronous Master Setting of CC IE Field	Set
Mounted Slot No.	0

1. Select "Use" for "Use Inter-module Synchronization Function in System".
2. Click "Detailed Setting" at "Select Synchronous Target Unit between Unit".
3. The modules set in the module configuration diagram appear. Set "Synchronize" in the setting field for the synchronization target module.
4. Set the inter-module synchronization cycle at "Synchronous Fixed Scan Interval Setting within the Modules".
5. When writing the parameters, write in both the system parameters and module parameters.
6. To use the CC-Link IE Field Network module on the local station as the synchronization target module, set Synchronous Master Setting within the Modules. (For the module on the master station, the setting is not required.)

Displayed items

Item		Description	Setting range	Default
Use Inter-module Synchronization Function in System		Sets whether to use the inter-module synchronization function.	• Not Use • Use	Not Use
Select Synchronous Target Unit between Unit	Detailed Setting	Sets the module to be synchronized.	• Do Not Synchronize • Synchronize	Do Not Synchronize
Synchronous Fixed Scan Interval Setting within the Modules	0.05ms Unit Setting	Sets whether to set the inter-module synchronization cycle in 0.05ms units.	• Not Set • Set	Set
	Fixed Scan Interval Setting (Not Set by 0.05ms)	When not setting in 0.05ms units, select the inter-module synchronization cycle from the options.*1	• 0.222ms • 0.444ms • 0.888ms • 1.777ms • 3.555ms • 7.111ms	0.888ms
	Fixed Scan Interval Setting (Set by 0.05ms)	When setting in 0.05ms units, set the inter-module synchronization cycle.*1	0.10 to 10.00ms (0.05ms units)	0.50 ms
Synchronous Master Setting within the Modules	Synchronous Master Setting of CC IE Field	When "Set" is selected, the CC-Link IE Field Network module on the master station becomes the inter-module synchronous master." When "Not Set" is selected, the CPU module (CPU module on the extreme left for the multiple CPU system configuration) becomes the inter-module synchronous master. (☞ Page 9 Inter-module synchronous master)	• Not Set • Set	Not Set
	Mounted Slot No.	Set the mounted slot No. for the CC-Link IE Field Network moduleon the master station that becomes the inter-module synchronous master.	0 to 11	0

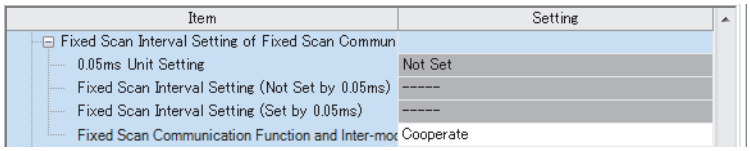
*1 The inter-module synchronization cycle setting range differs according to the module. (📖Manual for each module)

6.2 Multiple CPU Settings

Set when coordinating the inter-module synchronization cycle to the multiple CPU system function's fixed scan communication cycle.

[System Parameter] ⇨ [Multiple CPU Setting] ⇨ [Communication Setting between CPU] ⇨ [Fixed Scan Communication Setting]

Window



Displayed items

Item		Description	Setting range	Default
Fixed Scan Interval Setting of Fixed Scan Communication	Fixed Scan Communication Function and Inter-module Synchronization Function	Sets whether to coordinate with the inter-module synchronization cycle and multiple CPU system function's fixed scan communication cycle.	• Cooperate • Not Cooperated	Not Cooperated

Point

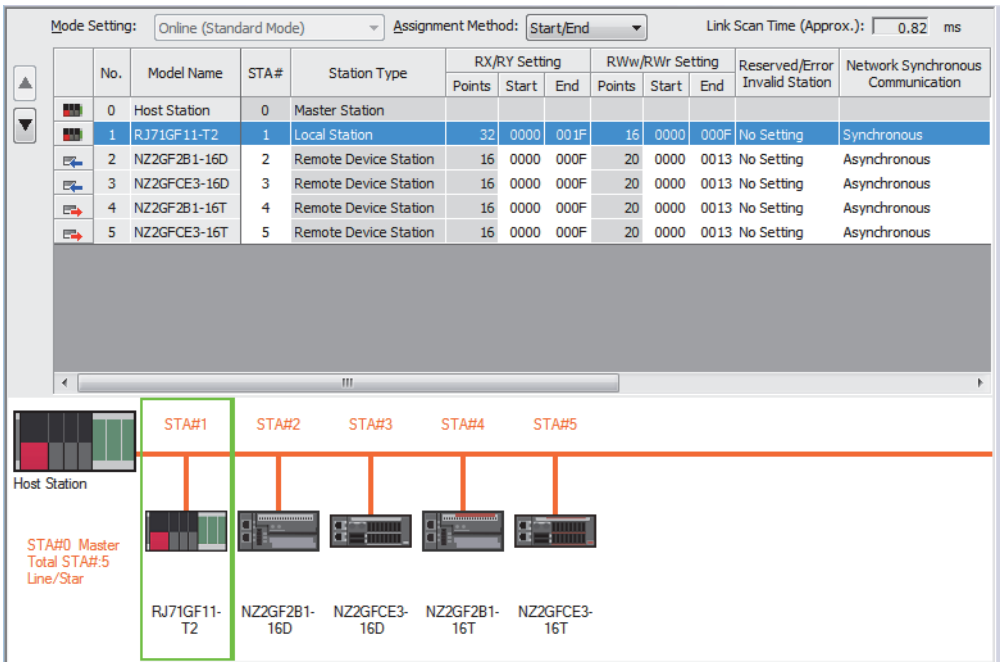
When set to "Cooperate", the fixed scan communication cycle of multiple CPU system function operates according to the inter-module synchronization cycle. ("Fixed Scan Interval Setting" in "Fixed Scan Communication Setting" cannot be set.)

6.3 Settings in CC-Link IE Field Network

Set this to synchronize with the inter-module synchronization cycle using the CC-Link IE Field network synchronous communication function. This setting is made in the master station.

[Module Parameter] ⇨ "Basic Setting" ⇨ "Network Configuration Settings" ⇨ "Detail Setting"

Window



Displayed items

Item	Description	Setting range	Default
Network Synchronous Communication Setting	Sets whether to coordinate the inter-module synchronization cycle with the CC-Link IE Field Network synchronous communication function.	• Asynchronous • Synchronous	Asynchronous

Point

- Set the ring device assignments so the network synchronous communication target station and non-target station are in succession. If these are not in succession, the time for the refreshing process at the inter-module synchronization interrupt will take longer.

No.	RX/RY Setting Start	RX/RY Setting End	RWw/RWr Setting Start	RWw/RWr Setting End	Network Synchronous Communication
0					
1	0000	00FF	0000	00FF	Synchronous
2	0100	01FF	0100	01FF	Asynchronous
3	0200	02FF	0200	02FF	Synchronous
4	0300	03FF	0300	03FF	Asynchronous
5	0400	04FF	0400	04FF	Synchronous

Refresh takes longer because a synchronous area and an asynchronous area comes alternately.

No.	RX/RY Setting Start	RX/RY Setting End	RWw/RWr Setting Start	RWw/RWr Setting End	Network Synchronous Communication
0					
1	0000	00FF	0000	00FF	Synchronous
2	0100	01FF	0100	01FF	Synchronous
3	0200	02FF	0200	02FF	Synchronous
4	0300	03FF	0300	03FF	Asynchronous
5	0400	04FF	0400	04FF	Asynchronous

Refresh takes shorter because the same areas (synchronous or asynchronous) come continuously.

- For details on setting the slave stations other than the local station, refer to the manual for each slave station.

7 PROGRAM EXAMPLES

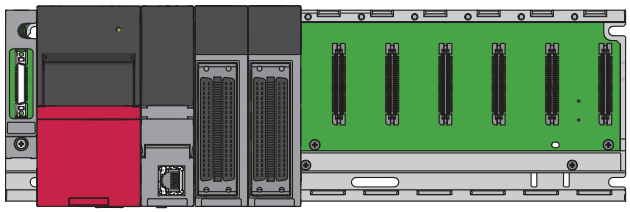
This section shows examples of the inter-module synchronization function.

7.1 For Single CPU System Configuration

An example of the program that starts at the inter-module synchronization cycle for multiple positioning modules is shown below. (This program starts axis 1 of each positioning module simultaneously.)

System configuration

The following system configuration is used.



- CPU module: R08CPU
- Positioning module: RD75D4, RD75P4

Programming condition

It is assumed that there are no errors in the positioning module settings.

Parameter setting

This table shows the details of the inter-module synchronization settings.

Item	Description
Use Inter-module Synchronization Function in System	Select "Use".
Select Synchronous Target Unit between Unit	Select "Synchronize" for all.
Fixed Scan Interval Setting	0.888ms (select "Not Set by 0.05ms".)

The default setting is used for each module's refresh setting.

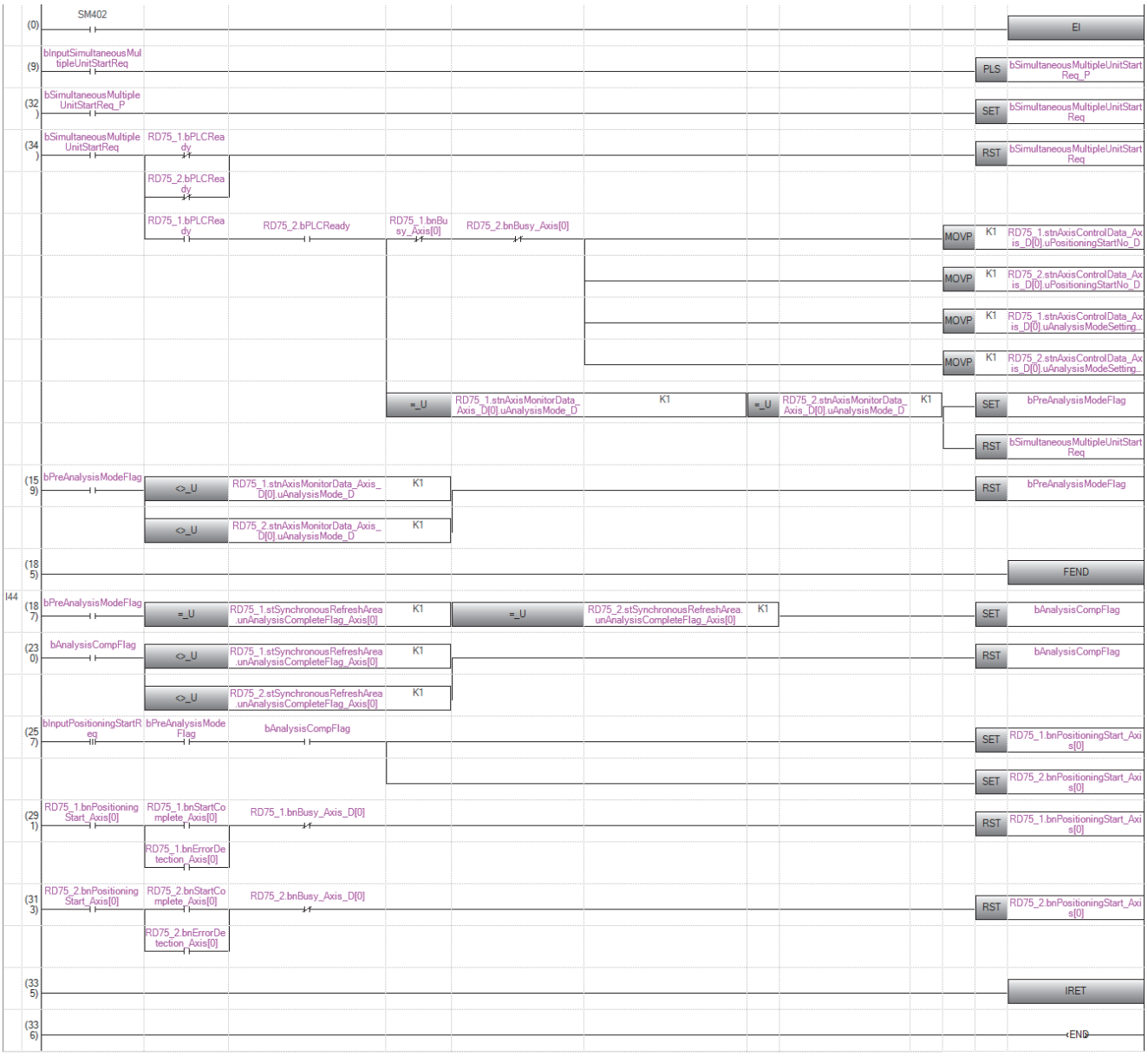
Applicable labels

This table shows the labels used in this program example.

Classification	Label name	Description	Device
Module label	RD75_1.bPLCReady	RW: Programmable controller ready	Y0
	RD75_2.bPLCReady	RW: Programmable controller ready	Y20
	RD75_1.bnBusy_Axis[0]	R: BUSY	X0C
	RD75_2.bnBusy_Axis[0]	R: BUSY	X2C
	RD75_1.stnAxisControlData_Axis_D[0].uPositioningStartNo_D	RW: Positioning start number (direct)	U0\G1500
	RD75_2.stnAxisControlData_Axis_D[0].uPositioningStartNo_D	RW: Positioning start number (direct)	U2\G1500
	RD75_1.stnAxisControlData_Axis_D[0].uAnalysisModeSetting_D	RW: Analysis mode setting (direct)	U0\G1590
	RD75_2.stnAxisControlData_Axis_D[0].uAnalysisModeSetting_D	RW: Analysis mode setting (direct)	U2\G1590
	RD75_1.stnAxisMonitorData_Axis_D[0].uAnalysisMode_D	R: Analysis mode (direct)	U0\G857
	RD75_2.stnAxisMonitorData_Axis_D[0].uAnalysisMode_D	R: Analysis mode (direct)	U2\G857
	RD75_1.stSynchronousRefreshArea.unAnalysisCompleteFlag_Axis[0]	R: Analysis complete flag	—
	RD75_2.stSynchronousRefreshArea.unAnalysisCompleteFlag_Axis[0]	R: Analysis complete flag	—
	RD75_1.bnPositioningStart_Axis[0]	RW: Positioning start	Y10
	RD75_2.bnPositioningStart_Axis[0]	RW: Positioning start	Y30
	RD75_1.bnStartComplete_Axis[0]	R: Start complete	X10
	RD75_1.bnErrorDetection_Axis[0]	R: Error detection	X8
	RD75_1.bnBusy_Axis_D[0]	R: BUSY (direct)	DX0C
	RD75_2.bnStartComplete_Axis[0]	R: Start complete	X30
	RD75_2.bnErrorDetection_Axis[0]	R: Error detection	X28
	RD75_2.bnBusy_Axis_D[0]	R: BUSY (direct)	DX2C
Defined labels	Define the global labels the following manner. Label Name: bInputSimultaneousMultipleUnitStartReq / Data Type: Bit / Class: VAR_GLOBAL Define the local labels in the following manner. Label Name: bSimultaneousMultipleUnitStartRe / Data Type: Bit / Class: VAR bPreAnalysisModeFlag / Bit / VAR bAnalysisCompFlag / Bit / VAR bInputPositioningStartReq / Bit / VAR bSimultaneousMultipleUnitStartRe / Bit / VAR		

Program

To shorten the inter-module synchronous interrupt program's processing time, perform the positioning start processing with the inter-module synchronous interrupt program, and perform the other processing with the normal program.

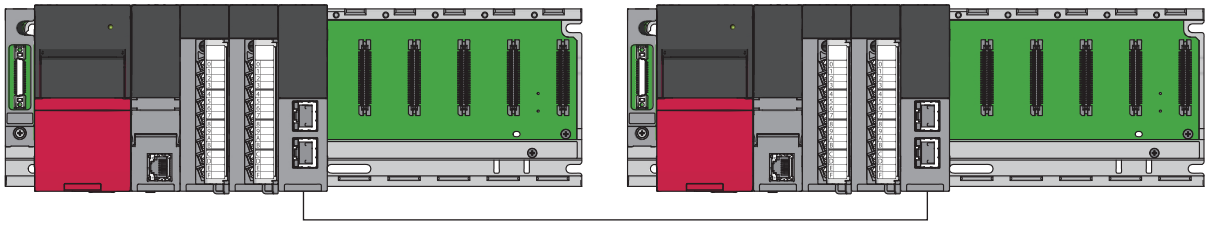


7.2 For Network Configuration

The following is an example of a program that outputs to the adjacent output module and multiple output modules via the network at the inter-module synchronization cycle timing.

System configuration

The following system configuration is used.



Master station side

- CPU module: R120CPU
- Each module: RX10, RY40NT5P, RJ71EN71 (when using CC-Link IE Field network function)

Local station side

- CPU module: R04CPU
- Each module: RY40NT5P, RY40NT5P, RJ71EN71 (when using CC-Link IE Field network function)

Parameter setting

This section shows the details of each parameter setting.

Master station side

This section shows the details of the master station side parameter settings.

■Inter-module synchronization setting

This table shows the details of the inter-module synchronization settings.

Item	Description
Use Inter-module Synchronization Function in System	Select "Use".
Select Synchronous Target Unit between Unit	Select "Synchronize" for all.
Fixed Scan Interval Setting	1.00ms (select "Set by 0.05ms")

■Network configuration setting

Add the local station with the network configuration settings.

■Refresh settings

Set the transmission range between the RJ71EN71 (when using CC-Link IE Field network function) and the CPU module devices).

[Module Parameter]" ⇨ "Basic Setting" ⇨ "Refresh Setting"

No.	Link Side					PLC Side				
	Device Name	Points	Start	End		Refresh Destination	Device Name	Points	Start	End
-	SB	512	00000	001FF	⇔	Module Label				
-	SW	512	00000	001FF	⇔	Module Label				
1	RX	32	00000	0001F	⇔	Specify Device	X	32	01000	0101F
2	RY	32	00000	0001F	⇔	Specify Device	Y	32	01000	0101F
3	RWr	16	00000	0000F	⇔	Specify Device	W	16	00000	0000F
4	RWw	16	00000	0000F	⇔	Specify Device	W	16	01000	0100F

Local station side

The table shows the details of the local station side parameters.

■Inter-module synchronization setting

This table shows the details of the inter-module synchronization settings. Set the same details as the master station side.

Item	Description
Use Inter-module Synchronization Function in System	Select "Use".
Select Synchronous Target Unit between Unit	Select "Synchronize" for all.
Fixed Scan Interval Setting	1.00ms (select "Set by 0.05ms")
Synchronous Master Setting within the Modules	Synchronous Master Setting of CC IE Field: "Set", Mounted Slot No.: 2

■Refresh settings

Set the transmission range between the RJ71EN71 (when using CC-Link IE Field network function) and the CPU module devices. Set the same details as the master station side.

[Module Parameter]" ⇨ "Basic Setting" ⇨ "Refresh Setting"

No.	Link Side					PLC Side				
	Device Name	Points	Start	End		Refresh Destination	Device Name	Points	Start	End
-	SB	512	00000	001FF	⇔	Module Label				
-	SW	512	00000	001FF	⇔	Module Label				
1	RX	32	00000	0001F	⇔	Specify Device	X	32	01000	0101F
2	RY	32	00000	0001F	⇔	Specify Device	Y	32	01000	0101F
3	RWr	16	00000	0000F	⇔	Specify Device	W	16	00000	0000F
4	RWw	16	00000	0000F	⇔	Specify Device	W	16	01000	0100F

Applicable labels

This table shows the labels used in this program example.

Master station side

This section shows the labels used by the master station.

Classification	Label name	Description	Device
Module label	EN71_F_1.bSts_BatonPassError	—	—
	EN71_F_1.bnOp_Synchronous_Station[1]	—	—
Defined labels	Define the global labels the following manner. Label Name / Data Type / Class / Assign (Device/Label) bnInput1 / Bit(0..15) / VAR_GLOBAL / X0 bnOutput1 / Bit(0..15) / VAR_GLOBAL / Y10 bnStation1_Output1 / Bit(0..15) / VAR_GLOBAL / Y1000 bnStation1_Output2 / Bit(0..15) / VAR_GLOBAL / Y1010 Define the local labels in the following manner. Label Name / Data Type / Class M_MSynchronization_Delay2OUT / M+MSynchronization_Delay2OUT / VAR		

Local station side

This section shows the labels used on the local station side.

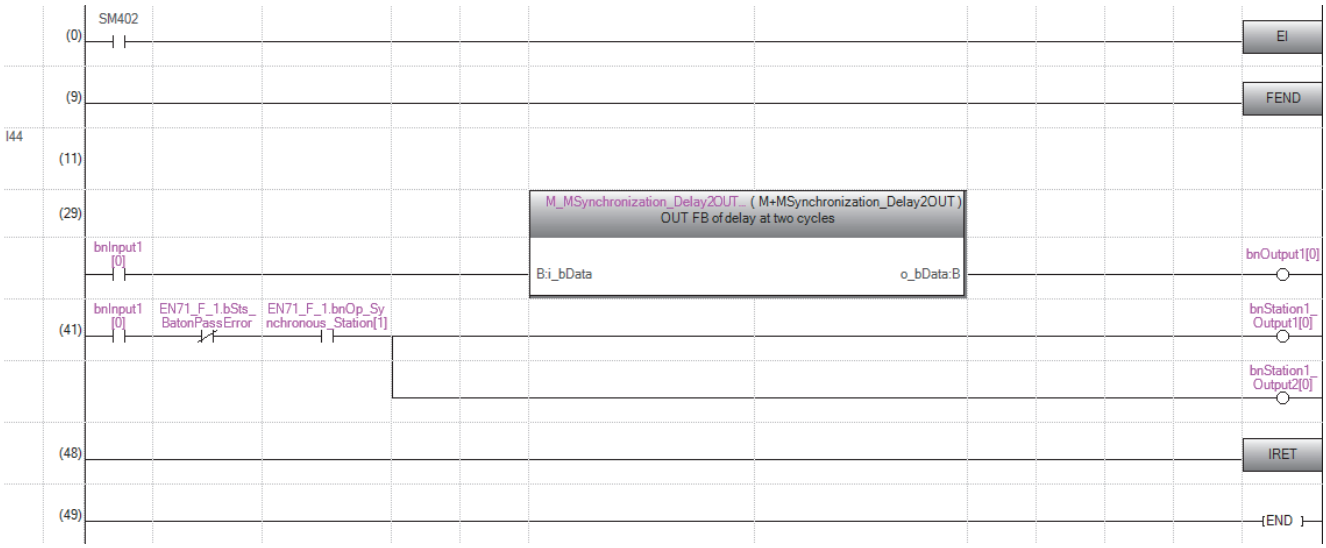
Classification	Label name	Description	Device
Defined labels	Define the global labels the following manner. Label Name / Data Type / Class / Assign (Device/Label) bnStation1_Output1 / Bit(0..15) / VAR_GLOBAL / X1000 bnStation1_Output2 / Bit(0..15) / VAR_GLOBAL / X1010 bnOutput1 / Bit(0..15) / VAR_GLOBAL / Y0 bnOutput2 / Bit(0..15) / VAR_GLOBAL / Y10		

Program

The local station system output from the master station CPU module is instructed, and the master station system output and local station system output are performed at the same inter-module synchronization cycle timing. Two inter-module synchronization cycles are required to instruct the local station system output from the master station CPU module and output from the local station system output. Thus, the output to the nearest master station is made using the inter-module synchronization function FB and is output after two inter-module synchronization cycles. (MELSEC iQ-R CPU Module Function Block Reference)

Master station side

This section shows the master station side program.



Local station side

This section shows the local station side program.

8 TROUBLESHOOTING

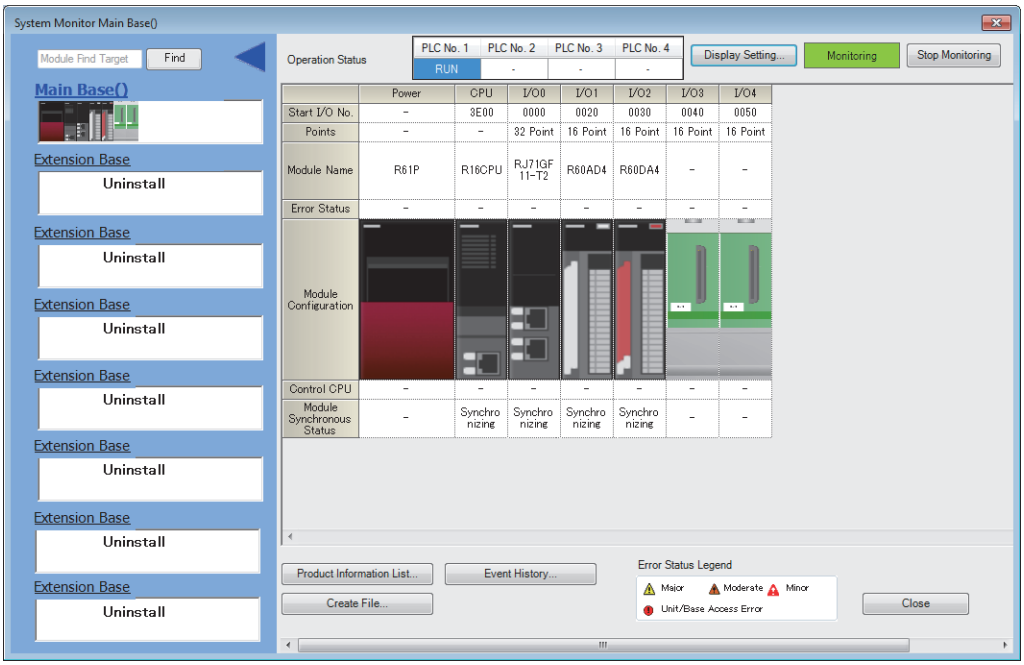
This section describes troubleshooting for the inter-module synchronization function.

8.1 Error Processing and Recovery Methods

This section shows the abnormal process detection and recovery methods used when an error occurs with the inter-module synchronization function. The inter-module synchronization function's synchronization state can be confirmed on the system monitor.

[Diagnostics] ⇨ [System Monitor]

Window



Displayed items

Item	Description	Setting range	Default
Inter-module synchronization state	Shows the synchronization state of the inter-module synchronization function. • Synchronizing: Shows that the inter-module synchronization function is operating. • Preparing: Shows that the inter-module synchronization function is in the pre-operation preparation stage. • Error: Appears when an error occurs with the inter-module synchronization function. • —: Appears when the inter-module synchronization function is disabled or when the module is not supported.	—	—

Inter-module synchronous interrupt program does not run

Check the following if the inter-module synchronous interrupt program does not run.

Confirmation items	Action
Is the inter-module synchronization setting enabled?	Enable the inter-module synchronization setting if it is not enabled. (☞ Page 30 Inter-Module Synchronization Setting)
Does an inter-module synchronous interrupt program present?	If the inter-module synchronous interrupt program is not present, add one.
Is the CPU module set to RUN?	Set the CPU module to RUN if it is not already set.
Is interrupt permitted?	Execute the EI instruction if it hasn't been executed yet.
Has the inter-module synchronous interrupt program been registered?	When C Controller module is used, register and enable the inter-module synchronous interrupt program using the C Controller module dedicated function.(📖MELSEC iQ-R C Controller Module User's Manual (Application))

Point

The inter-module synchronous interrupt program operating status can be checked with the interrupt program monitor list. (📖 GX Works3 Operating Manual)

A specific module is not synchronized

Check the following if a specific module does not run.

Confirmation items	Action
Is the inter-module synchronization function target module set?	Set the inter-module synchronization target module if it is not set yet. (☞ Page 30 Inter-Module Synchronization Setting)
Is refresh set?	• Check whether a module label is used in the inter-module synchronization function and whether the refresh destination device is used in the inter-module synchronous interrupt program. • Review the refresh settings.

Point

Synchronization of an arbitrary module can be confirmed with the system monitor. (☞ Page 40 Error Processing and Recovery Methods)

8.2 RAS Function

Shows the RAS functions related to the inter-module synchronization function.

Inter-module synchronous interrupt program execution time monitor

The error detection setting is used to monitor the inter-module synchronous interrupt program's execution time. Set whether to detect an error related to the inter-module synchronous interrupt program's execution time. When an error is detected, the number of cycle overs is stored in SD480. For details on the setting method of error detection setting and special register, refer to the following.

MELSEC iQ-R CPU Module User's Manual (Application)

Point

When synchronizing via a network module, even if an error is detected at the master station's CPU module is till not be detected at the local station. Therefore, to stop the local station when an error occurs, prepare a program to monitor the master station status using the network module's link special registers, etc.

Inter-module synchronization signal error monitoring

Each module monitors for errors in the inter-module signal cycle, and generates a moderate error if an error is detected. The CPU module can monitor for errors in the inter-module synchronization signal with SM488.

Monitor of output exceeding inter-module synchronization cycle

The D/A converter module monitors whether the output preparation process is completed before the next inter-module synchronization cycle. If the inter-module synchronous interrupt program does not complete before the next inter-module synchronization cycle starts, an error will occur even if the output preparation process has not started. If the output preparation process is constantly delayed, a cycle over will always occur. Set the inter-module synchronization cycle to a value at which the D/A converter module's output conversion can accurately finish.

Cyclic monitor

The CC-Link IE Field Network master/local module's master station monitors whether the cyclic transmission is completed before the next inter-module synchronization cycle. If the inter-module synchronous interrupt program does not complete before the next inter-module synchronization cycle starts, an error will occur even if the cyclic transmission process has not started. If the cyclic transmission process is constantly delayed, a cycle over will always occur. Set the inter-module synchronization cycle to a value higher than the link scan time.

MEMO

APPENDIX

Appendix 1 Processing Time

This section describes the processing time.

Overhead time for executing interrupt program

The overhead time for executing the inter-module synchronous interrupt program between modules differs according to each CPU module.

Each CPU module manual

Refresh processing time

For details on the refresh processing time, refer to the following.

Manual for each module

Instruction processing time in interrupt program

For details on the instruction processing time in the interrupt program, refer to the following.

MELSEC iQ-R Programming Manual (Instructions, Standard Functions/Function Blocks)

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MEMO

REVISIONS

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

Revision date	*Manual number	Description
June 2014	SH(NA)-081401ENG-A	First edition
July 2014	SH(NA)-081401ENG-B	■Added or modified parts Section 2.1, 6.1
February 2015	SH(NA)-081401ENG-C	■Added model R12CCPU-V
April 2015	SH(NA)-081401ENG-D	■Added models RX40PC6H, RX40NC6H
July 2015	SH(NA)-081401ENG-E	■Added models R04ENCPU, R08ENCPU, R16ENCPU, R32ENCPU, R120ENCPU, R08PCPU, R16PCPU, R32PCPU, R120PCPU ■Added or modified parts Section 2.2

Japanese manual number: SH-081400-E

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place. Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
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(2) Product supply (including repair parts) is not available after production is discontinued.

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Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

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