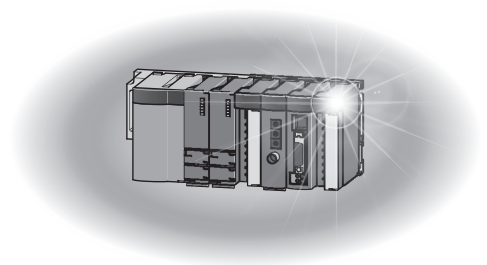# MITSUBISHI ELECTRIC

Programmable Controller

MELSEC Q series

QnPRHCPU User's Manual
(Redundant System)

-Q12PRHCPU
-Q25PRHCPU

●SAFETY PRECAUTIONS●

(Read these precautions before using this product.)

Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.

In this manual, the safety precautions are classified into two levels: " ⚠ WARNING" and " ⚠ CAUTION".

⚠ WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under " ⚠ CAUTION" may lead to serious consequences.
Observe the precautions of both levels because they are important for personal and system safety.
Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

[Design Precautions]

⚠ WARNING

● Configure safety circuits external to the programmable controller to ensure that the entire system operates safely even when a fault occurs in the external power supply or the programmable controller. Failure to do so may result in an accident due to an incorrect output or malfunction.

(1) Configure external safety circuits, such as an emergency stop circuit, protection circuit, and protective interlock circuit for forward/reverse operation or upper/lower limit positioning.

(2) The programmable controller stops its operation upon detection of the following status, and the output status of the system will be as shown below.

Status	Output
Overcurrent or overvoltage protection of the power supply module is activated.	All outputs are turned off.
The CPU module detects an error such as a watchdog timer error by the self-diagnostic function.	All outputs are held or turned off according to the parameter setting.

All outputs may turn on when an error occurs in the part, such as I/O control part, where the CPU module cannot detect any error. To ensure safety operation in such a case, provide a safety mechanism or a fail-safe circuit external to the programmable controller. For a fail-safe circuit example, refer to General Safety Requirements in the QCPU User's Manual (Hardware Design, Maintenance and Inspection).

(3) Outputs may remain on or off due to a failure of an output module relay or transistor. Configure an external circuit for monitoring output signals that could cause a serious accident.

[Design Precautions]

⚠ **WARNING**
● In an output module, when a load current exceeding the rated current or an overcurrent caused by a load short-circuit flows for a long time, it may cause smoke and fire. To prevent this, configure an external safety circuit, such as a fuse. ● Configure a circuit so that the programmable controller is turned on first and then the external power supply. If the external power supply is turned on first, an accident may occur due to an incorrect output or malfunction. ● For the operating status of each station after a communication failure, refer to relevant manuals for the network. Incorrect output or malfunction due to a communication failure may result in an accident. ● When changing data of the running programmable controller from a peripheral connected to the CPU module or from a personal computer connected to an intelligent function module, configure an interlock circuit in the sequence program to ensure that the entire system will always operate safely. For program modification and operating status change, read relevant manuals carefully and ensure the safety before operation. Especially, in the case of a control from an external device to a remote programmable controller, immediate action cannot be taken for a problem on the programmable controller due to a communication failure. To prevent this, configure an interlock circuit in the sequence program, and determine corrective actions to be taken between the external device and CPU module in case of a communication failure.

⚠ **CAUTION**
● Do not install the control lines or communication cables together with the main circuit lines or power cables. Keep a distance of 100mm or more between them. Failure to do so may result in malfunction due to noise. ● When a device such as a lamp, heater, or solenoid valve is controlled through an output module, a large current (approximately ten times greater than normal) may flow when the output is turned from off to on. Take measures such as replacing the module with one having a sufficient current rating. ● After the CPU module is powered on or is reset, the time taken to enter the RUN status varies depending on the system configuration, parameter settings, and/or program size. Design circuits so that the entire system will always operate safely, regardless of the time.

[Security Precautions]

⚠ WARNING

● To maintain the security (confidentiality, integrity, and availability) of the programmable controller and the system against unauthorized access, denial-of-service (DoS) attacks, computer viruses, and other cyberattacks from external devices via the network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.

[Installation Precautions]

⚠ CAUTION
● Use the programmable controller in an environment that meets the general specifications in the QCPU User's Manual (Hardware Design, Maintenance and Inspection). Failure to do so may result in electric shock, fire, malfunction, or damage to or deterioration of the product. ● To mount the module, while pressing the module mounting lever located in the lower part of the module, fully insert the module fixing projection(s) into the hole(s) in the base unit and press the module until it snaps into place. Incorrect mounting may cause malfunction, failure or drop of the module. When using the programmable controller in an environment of frequent vibrations, fix the module with a screw. Tighten the screw within the specified torque range. Undertightening can cause drop of the screw, short circuit or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction. ● When using an extension cable, connect it to the extension cable connector of the base unit securely. Check the connection for looseness. Poor contact may cause incorrect input or output. ● When using a memory card, fully insert it into the memory card slot. Check that it is inserted completely. Poor contact may cause malfunction. ● Shut off the external power supply (all phases) used in the system before mounting or removing the module. Failure to do so may result in damage to the product. A module can be replaced online (while power is on) on any MELSECNET/H remote I/O station or in the system where Redundant CPUs are used. Note that there are restrictions on the modules that can be replaced online, and each module has its predetermined replacement procedure. For details, refer to Section 2.4. ● Do not directly touch any conductive part of the module. Doing so can cause malfunction or failure of the module. ● When using a Motion CPU module and modules designed for motion control, check that the combinations of these modules are correct before applying power. The modules may be damaged if the combination is incorrect. For details, refer to the user's manual for the Motion CPU module.

[Wiring Precautions]

⚠ WARNING

● Shut off the external power supply for the system in all phases before wiring.
  Failure to do so may result in electric shock or damage to the product.

● After wiring, attach the included terminal cover to the module before turning it on for operation.
  Failure to do so may result in electric shock.

⚠ CAUTION

● Individually ground the FG and LG terminals of the programmable controller with a ground resistance of 100Ω or less.
  Failure to do so may result in electric shock or malfunction.

● Use applicable solderless terminals and tighten them within the specified torque range. If any spade solderless terminal is used, it may be disconnected when the terminal screw comes loose, resulting in failure.

● Check the rated voltage and terminal layout before wiring to the module, and connect the cables correctly.
  Connecting a power supply with a different voltage rating or incorrect wiring may cause a fire or failure.

● Connectors for external connection must be crimped or pressed with the tool specified by the manufacturer, or must be correctly soldered.
  Incomplete connections could result in short circuit, fire, or malfunction.

● Tighten the terminal screw within the specified torque range.
  Undertightening can cause short circuit, fire, or malfunction.
  Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.

● Prevent foreign matter such as dust or wire chips from entering the module.
  Such foreign matter can cause a fire, failure, or malfunction.

[Wiring Precautions]

⚠ WARNING
● When a protective film is attached to the top of the module, remove it before system operation. If not, inadequate heat dissipation of the module may cause a fire, failure, or malfunction.   ● Mitsubishi Electric programmable controllers must be installed in control panels.   Connect the main power supply to the power supply module in the control panel through a relay terminal block.   Wiring and replacement of a power supply module must be performed by maintenance personnel who is familiar with protection against electric shock. (For wiring methods, refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection)).

[Startup and Maintenance Precautions]

⚠ WARNING
● Do not touch any terminal while power is on.   Doing so will cause electric shock.   ● Correctly connect the battery connector.   Do not charge, disassemble, heat, short-circuit, solder, or throw the battery into the fire.   Doing so will cause the battery to produce heat, explode, or ignite, resulting in injury and fire.   ● Shut off the external power supply (all phases) used in the system before cleaning the module or retightening the terminal screws or module fixing screws.   Failure to do so may result in electric shock.   Undertightening the terminal screws can cause short circuit or malfunction.   Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.

[Startup and Maintenance Precautions]

⚠ CAUTION
● Before performing online operations (especially, program modification, forced output, and operation status change) for the running CPU module from the peripheral connected, read relevant manuals carefully and ensure the safety. Improper operation may damage machines or cause accidents. ● Do not disassemble or modify the modules. Doing so may cause failure, malfunction, injury, or a fire. ● Use any radio communication device such as a cellular phone or PHS (Personal Handy-phone System) more than 25cm away in all directions from the programmable controller. Failure to do so may cause malfunction. ● Shut off the external power supply (all phases) used in the system before mounting or removing the module. Failure to do so may cause the module to fail or malfunction. A module can be replaced online (while power is on) on any MELSECNET/H remote I/O station or in the system where Redundant CPUs are used. Note that there are restrictions on the modules that can be replaced online, and each module has its predetermined replacement procedure. For details, refer to Section 2.4. ● After the first use of the product, do not perform each of the following operations more than 50 times (IEC 61131-2/JIS B 3502 compliant). Exceeding the limit may cause malfunction. • Mounting/removing the module to/from the base unit • Mounting/removing the terminal block to/from the module ● Do not drop or apply shock to the battery to be installed in the module. Doing so may damage the battery, causing the battery fluid to leak inside the battery. If the battery is dropped or any shock is applied to it, dispose of it without using. ● Before handling the module, touch a grounded metal object to discharge the static electricity from the human body. Failure to do so may cause the module to fail or malfunction.

[Disposal Precautions]

⚠ **CAUTION**
● When disposing of this product, treat it as industrial waste. When disposing of batteries, separate them from other wastes according to the local regulations. (For details of the Battery Directive in EU member states, refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection).)

[Transportation Precautions]

⚠ **CAUTION**
● When transporting lithium batteries, follow the transportation regulations. (For details of the regulated models, refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection).)

●CONDITIONS OF USE FOR THE PRODUCT●

(1) MELSEC 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.

MITSUBISHI ELECTRIC SHALL HAVE NO RESPONSIBILITY OR LIABILITY (INCLUDING, BUT NOT LIMITED TO ANY AND ALL RESPONSIBILITY OR LIABILITY BASED ON CONTRACT, WARRANTY, TORT, PRODUCT LIABILITY) FOR ANY INJURY OR DEATH TO PERSONS OR LOSS OR DAMAGE TO PROPERTY CAUSED BY the PRODUCT THAT ARE OPERATED OR USED IN APPLICATION NOT INTENDED OR EXCLUDED BY INSTRUCTIONS, PRECAUTIONS, OR WARNING CONTAINED IN MITSUBISHI ELECTRIC USER'S, INSTRUCTION AND/OR SAFETY MANUALS, TECHNICAL BULLETINS AND GUIDELINES FOR the PRODUCT.

("Prohibited Application")

Prohibited Applications include, but not limited to, the use of the PRODUCT in;

• Nuclear Power Plants and any other power plants operated by Power companies, and/or any other cases in which the public could be affected if any problem or fault occurs in the PRODUCT.

• Railway companies or Public service purposes, and/or any other cases in which establishment of a special quality assurance system is required by the Purchaser or End User.

• Aircraft or Aerospace, Medical applications, Train equipment, transport equipment such as Elevator and Escalator, Incineration and Fuel devices, Vehicles, Manned transportation, Equipment for Recreation and Amusement, and Safety devices, handling of Nuclear or Hazardous Materials or Chemicals, Mining and Drilling, and/or other applications where there is a significant risk of injury to the public or property.

Notwithstanding the above restrictions, Mitsubishi Electric may in its sole discretion, authorize use of the PRODUCT in one or more of the Prohibited Applications, provided that the usage of the PRODUCT is limited only for the specific applications agreed to by Mitsubishi Electric and provided further that no special quality assurance or fail-safe, redundant or other safety features which exceed the general specifications of the PRODUCTs are required. For details, please contact the Mitsubishi Electric representative in your region.

(3) Mitsubishi Electric shall have no responsibility or liability for any problems involving programmable controller trouble and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

REVISIONS

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

Print Date	Manual Number	Revision
Jun., 2004	SH(NA)-080486ENG-A	First edition
Jun., 2005	SH(NA)-080486ENG-B	Partial correction GENERIC TERMS AND ABBREVIATIONS, Chapter 1, Section 2.3, 6.2.2, 8.1.1, 8.3.3, 9.1, 9.2
Aug., 2005	SH(NA)-080486ENG-C	Partial correction GENERIC TERMS AND ABBREVIATIONS, Section 2.1, 2.3, Chapter 4, Section 5.1.3, 5.1.4, 5.3.1, 5.4, 5.5.1, 5.5.3, 5.5.6, 5.5.7, 5.6.2, 5.7, 5.9, 6.2.1, 7.1, 8.3.3, 9.2, Appendix 1, 4
Mar., 2006	SH(NA)-080486ENG-D	Partial correction GENERIC TERMS AND ABBREVIATIONS, Section 2.1, 2.3, 4.2, 5.3.5, 6.2.2, Appendix 4.3, 4.5
Jun., 2006	SH(NA)-080486ENG-E	Model addition QJ71PB92V Addition Section 6.2.6 Partial correction ABOUT MANUALS, Section 1.2, 2.1, 2.3, 5.3.1, 5.3.4, 6.2, 7.1, 9.2
Jun., 2006	SH(NA)-080486ENG-F	Partial correction SAFETY PRECAUTIONS, Section 2.3, 2.4, Appendix 4.3, 4.5
Dec., 2006	SH(NA)-080486ENG-G	Partial correction SAFETY PRECAUTIONS, Section 4.2, 5.5.3, 7.1, 7.3, 8.2, Appendix 4.5, 5
Apr., 2007	SH(NA)-080486ENG-H	Revision involving Redundant CPU serial No.09012 Model addition Q65WRB Partial correction SAFETY PRECAUTIONS, Section 1.1, 1.2, 2.1, 2.3, 2.4, Chapter 4, Section 4.1, 4.2, 4.4, 5.1.3, 5.1.4, 5.1.5, 5.3.1, 5.2, 5.4, 5.5.1, 5.6.1, 5.8, 5.10.1, 5.10.2, 6.1.3, 6.2, 6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.3, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 7.1, 7.2, Chapter 8, Section 8.1.2, 8.1.4, 8.1.5, 8.3.4, 8.3.6, 9.2, Appendix 1, 2, 3 Addition Section 8.1.9, 8.1.10, 8.1.11, 8.3.8, 8.3.10, Chapter 6, Section 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, Chapter 7 Chapter number correction Section 8.3.8 → 8.3.9
Sep., 2007	SH(NA)-080486ENG-I	Partial correction GENERIC TERMS AND ABBREVIATIONS, Section 1.1, 1.2, 2.1, 2.3, 2.4, 3.3, 5.1.4, 5.1.5, 5.2, 5.4, 5.3.4, 5.3.6, 5.5.1, 5.5.4, 5.5.5, 5.6.2, 5.9, 5.10.1, 5.10.2, 6.1.3, 6.2, 6.2.2, 6.2.4, 6.2.5, 6.3, 6.3.2, 6.3.3, 6.3.4, 6.4, 7.1, 7.2, 8.1, 8.2, 9.2, Appendix 1, 2, 3, 4, 5, 7
Nov., 2007	SH(NA)-080486ENG-J	Revision due to a support of Redundant CPU having serial number 09102 and overall review

Print Date	Manual Number	Revision
May, 2008	SH(NA)-080486ENG-K	Revision due to a support of Redundant CPU having serial number 10042, This manual has been revised wholly because of integration of existing MELSECNET/G network modules into CC-Link IE Controller Network module. Partial correction GENERIC TERMS AND ABBREVIATIONS, Section 1.1, 1.2, 2.1, 2.3, 2.4, 4.2, 5.1, 5.1.1, 5.3.3, 5.3.4, 5.4, 5.6.1, 5.6.2, 5.7, 5.9, 5.10.1, 5.10.2, 6.1.1, 6.1.3, 6.3.2, 6.2, 6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.3, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.4, 7.1, 7.3, 8.1.7, 8.1.16, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.3.6, 8.3.9, 9.2, Appendix 1, 2, 3, 4.1, 5 Addition Section 8.1.12, 8.1.13, 8.1.14, 8.1.15
Mar., 2009	SH(NA)-080486ENG-L	Partial correction Section 2.4, 7.1
Jul., 2009	SH(NA)-080486ENG-M	Partial correction SAFETY PRECAUTIONS, GENERIC TERMS AND ABBREVIATIONS
Apr., 2010	SH(NA)-080486ENG-N	Partial correction SAFETY PRECAUTIONS, Section 2.3, 5.5.1, 6.3, Appendix 4.4 Addition CONDITIONS OF USE FOR THE PRODUCT
Jun., 2011	SH(NA)-080486ENG-O	Partial correction INTRODUCTION, Section 2.3, Appendix 4.4, 4.5
Jul., 2012	SH(NA)-080486ENG-P	Partial correction HOW TO USE THIS MANUAL, GENERIC TERMS AND ABBREVIATIONS, Section 2.3, 2.4, 5.3.3, 6.1.3, 7.5, 8.2, Appendix 1, 2, 3, 4.3, 4.5
Jan., 2013	SH(NA)-080486ENG-Q	Partial correction GENERIC TERMS AND ABBREVIATIONS, Section 2.1, 2.3, 4.2, 5.3.3, 6.2 Addition Section 6.2.5, Appendix 5
Jan., 2014	SH(NA)-080486ENG-R	Revision due to a support of Redundant CPU having serial number 16021 Partial correction MANUALS, GENERIC TERMS AND ABBREVIATIONS, Chapter 1, Section 2.3, 4.2, 5.3.4, 5.5.3, 5.11, 9.1, 9.2

INTRODUCTION

Thank you for purchasing the Mitsubishi Electric MELSEC-Q series programmable controllers.
Before using this product, please read this manual carefully and develop familiarity with the functions and performance of the MELSEC-Q series programmable controller to handle the product correctly.
When applying the program examples introduced in this manual to the actual system, ensure the applicability and confirm that it will not cause system control problems.
Note that the menu names and operating procedures may differ depending on an operating system in use and its version. When reading this manual, replace the names and procedures with the applicable ones as necessary.
Please make sure that the end users read this manual.

CONTENTS

CHAPTER1 OVERVIEW

CHAPTER2 SYSTEM CONFIGURATION

CHAPTER3 TRACKING CABLE

CHAPTER4 PROCEDURE FOR STARTING UP A REDUNDANT SYSTEM

INDEX   **INDEX - 1 to INDEX -3**

MANUALS

The manuals related to this product are listed below.
Order each manual as needed, referring to the following list.

Related Manuals

Manual Name	Manual Number (Model Code)
QCPU User's Manual (Hardware Design, Maintenance and Inspection) 　Specifications of the hardware (CPU modules, power supply modules, base units, extension cables, and memory cards), system maintenance and inspection, troubleshooting, and error codes 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080483ENG (13JR73)
Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals) 　Functions, methods, and devices for programming 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080808ENG (13JZ28)
MELSEC-Q/L Programming Manual (Common Instruction) 　How to use sequence instructions, basic instructions, and application instructions 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080809ENG (13JW10)
MELSEC-Q/L/QnA Programming Manual (PID Control Instructions) 　Dedicated instructions for PID control 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080040 (13JF59)
MELSEC-Q/L/QnA Programming Manual (SFC) 　System configuration, performance specifications, functions, programming, debugging, and error codes for SFC (MELSAP3) programs 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080041 (13JF60)
MELSEC-Q/L Programming Manual (MELSAP-L) 　Programming methods, specifications, and functions for SFC (MELSAP-L) programs 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080076 (13JF61)
MELSEC-Q Programming/Structured Programming Manual (Process Control Instructions) 　Dedicated instructions for process control 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080316E (13JF67)
MELSEC-Q/L Programming Manual (Structured Text) 　Programming methods using structured text language 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080366 (13JF68)
MELSEC-Q CC-Link IE Controller Network Reference Manual 　Specifications, procedures and settings before system operation, parameter setting, programming, and troubleshooting of the CC-Link IE Controller Network module 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080668ENG (13JV16)
Q corresponding MELSECNET/H Network System Reference Manual (Remote I/O network) 　Specifications, procedures and settings before system operation, parameter setting, programming, and troubleshooting of a MELSECNET/H network system (remote I/O network) 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	SH-080124 (13JF96)
Type MELSECNET/10 Network system (PLC to PLC network) Reference Manual 　Specifications, procedures and settings before system operation, parameter setting, programming, and troubleshooting of a MELSECNET/H network system (PLC to PLC network) 　　　　　　　　　　　　　　　　　　　　　　　　　　　　(Sold separately)	IB-66440 (13JE33)

Manual Name	Manual Number (Model Code)
Q Corresponding Serial Communication Module User's Manual (Basic) Overview, system configuration, specifications, procedures before operation, basic data communication method with external devices, maintenance and inspection, and troubleshooting for using the serial communication module (Sold separately)	SH-080006 (13JL86)
MELSEC-Q/L Serial Communication Module User's Manual (Application) Special functions (specifications, usage, and settings) and data communication method with external devices of the serial communication module (Sold separately)	SH-080007 (13JL87)
Q Corresponding Ethernet Interface Module User's Manual (Basic) Specifications, procedures for data communication with external devices, line connection (open/close), fixed buffer communication, random access buffer communication, and troubleshooting of the Ethernet module (Sold separately)	SH-080009 (13JL88)
MELSEC-Q/L Ethernet Interface Module User's Manual (Application) E-mail function, programmable controller CPU status monitoring function, communication via CC-Link IE Controller Network, CC-Link IE Field Network, MELSECNET/H, or MELSECNET/10, communication using the data link instructions, and file transfer function (FTP server) of the Ethernet module (Sold separately)	SH-080010 (13JL89)
MELSEC Communication Protocol Reference Manual Communication methods and control procedures through the MC protocol for the external devices to read and write data from/to the CPU module using the serial communication module/Ethernet module (Sold separately)	SH-080008 (13JF89)
MELSEC-Q CC-Link System Master/Local Module User's Manual System configuration, performance specifications, functions, handling, wiring, and troubleshooting of the QJ61BT11N (Sold separately)	SH-080394 (13JR64)
MODBUS Interface Module User's Manual System configuration, specifications, functions, procedures and settings before system operation, programming, dedicated instructions, and troubleshooting of the QJ71MB91. (Sold separately)	SH-080578ENG (13JR86)
MODBUS/TCP Interface Module User's Manual System configuration, specifications, functions, procedures and settings before system operation, programming, dedicated instructions, and troubleshooting of the QJ71MT91. (Sold separately)	SH-080446ENG (13JR71)
PROFIBUS-DP Master Module User's Manual System configuration, performance specifications, functions, handling, wiring, and troubleshooting of the QJ71PB92V (Sold separately)	SH-080572ENG (13JR84)

HOW TO USE THIS MANUAL

This manual explains the redundant system configuration, functions, communication with external devices and troubleshooting.

The manual is classified roughly into three sections as shown below.

1) Chapter 1 and 2   Explains the redundant system overview and system configuration

2) Chapter 3   Explains the tracking cable specifications, part names and connection method.

3) Chapter 4   Explains starting up the redundant system.

4) Chapter 5   Explains the redundant system functions.

5) Chapter 6   Explains the communication between a redundant system and each network, GOT and GX Developer.

6) Chapter 7   Explains the precautions for programming in a redundant system.

7) Chapter 8   Explains the troubleshooting methods and module replacement in a redundant system.

8) Chapter 9   Explains the processing time of a redundant system.

Remark •

(1) This manual does not explain the functions of power supply modules, base units, extension cables, memory cards and batteries of CPU module.
For these details, refer to the manual shown below.
☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(2) This manual does not explain the functions of the CPU module.
For these functions, refer to the manual shown below.
☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

(3) Operating procedures are explained using GX Developer.
The procedures are the same as those for when using GX Works2.

• •

HOW THIS MANUAL IS ORGANIZED

Reference destination

A reference destination or reference manual is marked ☞.

Chapter heading

The index on the right side of the page shows the chapter of the open page at a glance.

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5 REDUNDANT SYSTEM FUNCTIONS

MELSEC **Q** series

(2) Confirming system A/System B *

Identify system A and system B by checking the "SYSTEMA" and "SYSTEM B" LEDs of CPU modules.

Table5.1 Identify system A and system B by checking the "SYSTEM A" and "SYSTEM B" LEDs

CPU Module LED	LED Statuses		
Q12PRHCPU MODE / BACKUP RUN / CONTROL ERR. / SYSTEM A USER / SYSTEM B BAT. BOOT	LED Name	System A	System B
	SYSTEM A	ON	OFF
	SYSTEM B	OFF	ON

Refer to the following manual, for details on the CPU module LED.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(3) Precautions

When using the redundant system in the backup mode, connect the tracking cable to the control system and the standby system CPU modules.

If both systems are powered on without the tracking cable connected to the CPU models, the "TRK.CABLE ERR. (error code: 6120)" stop error will occur and the system cannot run.

If "TRK. CABLE ERR." occurs at power-on, power off System A and System B, then connect the tracking cable to the CPU modules, and power the systems on again.

⊠POINT

When starting up a single basic system, use the debug mode.
Refer to Section 5.1.3, for the debug mode.

* : System A and System B can be identified by checking whether the special relays "System A discriminating flag (SM1511)" and "System B discriminating flag (SM1512)" are ON or OFF.

Table5.2 Confirming SM1511 and SM1512 to Identify System A and System B

	SM1511	SM1512
System A	ON	OFF
System B	OFF	ON

5.1 Basic Concept of Redundant System
5.1.1 Determination of System A/System B

5 - 4

Section title

The section of the open page is shown at a glance.

A - 21

In addition, this manual provides the following explanations.

☒POINT

Explains the matters to be especially noted, the functions and others related to the description on that page.

Remark •

Provides the reference destination related to the description on that page and the convenient information.

• •

GENERIC TERMS AND ABBREVIATIONS

Unless otherwise specified, this manual uses the following generic terms and abbreviations to explain the Redundant CPU.

Generic Term/Abbreviation	Description
Basic model QCPU	A generic term for the Q00JCPU, Q00CPU, and Q01CPU
High Performance model QCPU	A generic term for the Q02CPU, Q02HCPU, Q06HCPU, Q12HCPU, and Q25HCPU
Process CPU	A generic term for the Q02PHCPU, Q06PHCPU, Q12PHCPU, and Q25PHCPU
Redundant CPU	A generic term for the Q12PRHCPU and Q25PRHCPU
Universal model QCPU	A generic term for the Q00UJCPU, Q00UCPU, Q01UCPU, Q02UCPU, Q03UDCPU, Q03UDVCPU, Q03UDECPU, Q04UDHCPU, Q04UDVCPU, Q04UDPVCPU, Q04UDEHCPU, Q06UDHCPU, Q06UDVCPU, Q06UDPVCPU, Q06UDEHCPU, Q10UDHCPU, Q10UDEHCPU, Q13UDHCPU, Q13UDVCPU, Q13UDPVCPU, Q13UDEHCPU, Q20UDHCPU, Q20UDEHCPU, Q26UDHCPU, Q26UDVCPU, Q26UDPVCPU, Q26UDEHCPU, Q50UDEHCPU, and Q100UDEHCPU
QCPU	A generic term for the Basic model QCPU, High performance model QCPU, Process CPU Redundant CPU, and Universal model QCPU
QnCPU	Another term for the Q02CPU
QnHCPU	A generic term for the Q02HCPU, Q06HCPU, Q12HCPU, and Q25HCPU
QnPHCPU	A generic term for the Q02PHCPU, Q06PHCPU, Q12PHCPU, and Q25PHCPU
QnPRHCPU	A generic term for the Q12PRHCPU and Q25PRHCPU
QnUCPU	A generic term for the Q00UJCPU, Q00UCPU, Q01UCPU, Q02UCPU, Q03UDCPU, Q03UDVCPU, Q03UDECPU, Q04UDHCPU, Q04UDVCPU, Q04UDPVCPU, Q04UDEHCPU, Q06UDHCPU, Q06UDVCPU, Q06UDPVCPU, Q06UDEHCPU, Q10UDHCPU, Q10UDEHCPU, Q13UDHCPU, Q13UDVCPU, Q13UDPVCPU, Q13UDEHCPU, Q20UDHCPU, Q20UDEHCPU, Q26UDHCPU, Q26UDVCPU, Q26UDPVCPU, Q26UDEHCPU, Q50UDEHCPU, and Q100UDEHCPU
Q Series	An abbreviation for the Mitsubishi Electric MELSEC-Q series programmable controller
GX Works2	The product name of the software package for the MELSEC programmable controllers
GX Developer	
OPS	An abbreviation for the operation system that includes MELSOFT and EZSocket partner products
CC-Link IE Controller Network module	A generic term for the QJ71GP21-SX and QJ71GP21S-SX CC-Link IE Controller Network modules
MELSECNET/H	An abbreviation for the MELSECNET/H network system
MELSECNET/H module	A generic term for the QJ71LP21, QJ71LP21-25, QJ71LP21S-25, QJ71LP21G, QJ71LP21GE, and QJ71BR11 MELSECNET/H network modules
MELSECNET/10	An abbreviation for the MELSECNET/10 network system
Ethernet	An abbreviation for the Ethernet network system
Ethernet module	A generic term for the QJ71E71-100, QJ71E71-B5, and QJ71E71-B2 Ethernet interface modules
CC-Link master module	An abbreviation for the CC-Link system master/local module
MODBUS module	An abbreviation for the QJ71MB91 MODBUS interface module
MODBUS/TCP module	An abbreviation for the QJ71MT91 MODBUS/TCP interface module
Q3☐B	A generic term for the Q33B, Q35B, Q38B, and Q312B main base units
Q3☐SB	A generic term for the Q32SB, Q33SB, and Q35SB slim type main base units
Q3☐RB	Another term for the Q38RB main base unit for redundant power supply system
Q5☐B	A generic term for the Q52B and Q55B extension base units
Q6☐B	A generic term for the Q63B, Q65B, Q68B, and Q612B extension base units

Generic Term/Abbreviation	Description
Q6□RB	Another term for the Q68RB extension base unit for redundant power supply system
Q6□WRB	Another term for the Q65WRB extension base unit for redundant system
Main base unit	A generic term for the Q3□B, Q3□SB, and Q3□RB
Extension base unit	A generic term for the Q5□B, Q6□B, Q6□RB, and Q6□WRB
Slim type main base unit	Another term for the Q3□SB
Redundant power main base unit	Another term for the Q3□RB
Redundant power extension base unit	Another term for the Q6□RB
Redundant type extension base unit	Another term for the Q6□WRB
Base unit	A generic term for the main base unit, extension base unit, slim type main base unit, redundant power main base unit, redundant power extension base unit, and redundant type extension base unit
Extension cable	A generic term for the QC05B, QC06B, QC12B, QC30B, QC50B, and QC100B extension cables
Tracking cable	A generic term for the QC10TR and QC30TR tracking cables for the Redundant CPU
Q series power supply module	A generic term for the Q61P-A1, Q61P-A2, Q61P, Q61P-D, Q62P, Q63P, Q64P, and Q64PN power supply modules
Slim type power supply module	An abbreviation for the Q61SP slim type power supply module
Redundant power supply module	A generic term for the Q63RP, Q64RPN, and Q64RP redundant power supply modules
Power supply module	A generic term for the Q series power supply modules and redundant power supply modules
Battery	A generic term for the Q6BAT, Q7BATN, Q7BAT, and Q8BAT CPU module batteries, Q2MEM-BAT SRAM card battery
SRAM card	A generic term for the Q2MEM-1MBSN, Q2MEM-1MBS, Q2MEM-2MBSN, Q2MEM-2MBS, and Q3MEM-4MBS SRAM cards
Flash card	A generic term for the Q2MEM-2MBF and Q2MEM-4MBF Flash cards
ATA card	A generic term for the Q2MEM-8MBA, Q2MEM-16MBA, and Q2MEM-32MBA ATA cards
Memory card	A generic term for the SRAM card, Flash card, and ATA card

RELEVANT TERMS

Relevant Term	Description
System A	The system to which the system A connector of tracking cable is connected
System B	The system to which the system B connector of tracking cable is connected
Host system	The system where the currently mentioned Redundant CPU module is mounted
Other system	The system connected to the host system via the tracking cable If system A is the host system, system B is the other system; if system B is the host system, system A is the other system
Control system	The basic system that is controlling the redundant system and performing network communication
Standby system	The basic system for backup that consists of the redundant system
New control system	The system that has switched to control system from standby system after system switching
New standby system	The system that has switched to standby system from control system after system switching
CPU slot	The slot that is located on the right side of the power supply module mounted on the main base unit In the case of redundant power supply base unit, it indicates the slot that is located on the right side of a pair of power supply modules

CHAPTER1 OVERVIEW

This manual describes the configuration and functions of the redundant system using the Redundant CPUs.

For common specifications, performance, and functions of the QCPUs, refer to the following.

(1) Specifications and handling of Q series products, such as QCPUs, power supply modules, base units, memory cards

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(2) Common functions, programs, and devices of QCPUs

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

(3) List of Redundant CPU manuals

Redundant CPU manuals are listed below.

For details such as manual numbers, refer to "MANUALS" in this manual.

Table1.1 List of User's Manuals for Redundant CPU
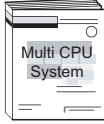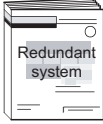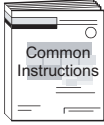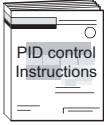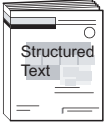
Purpose	Maintenance and Inspection QCPU User's Manual (Hardware Design, Maintenance and inspection)	Program Fundamentals Qn(H)/QnPH/ QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)	Multi CPU System QCPU User's Manual (Multiple CPU System)	Redundant system QnPRHCPU User's Manual (Redundant System)
Part names and specifications of the CPU module	Details	Outline		
Connecting methods of power supply modules, base units, and I/O modules	Details			
Construction of redundant system (including start-up procedure and I/O number assignment)				Details
Sequence programs and memory devices		Details		
Functions, parameters, and devices of the CPU module		Details		
Troubleshooting				Details
Error codes	Details			

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Table1.2 List of Programming Manuals for Redundant CPU

Purpose	MELSEC-Q/L Programming Manual (Common Instruction)	MELSEC-Q/L/ QnA Programming Manual (PID Control Instructions)	MELSEC-Q Programming/ Structured Programming Manual (Process Control Instructions)	MELSEC-Q/L/ QnA Programming Manual (SFC)	MELSEC-Q/L Programming Manual (MELSAP-L)	MELSEC-Q/L Programming Manual (Structured Text)
Usage of instructions, such as sequence instructions, basic instructions, and application instructions	Details					
Dedicated instructions for PID controls		Details				
Dedicated instructions for process control			Details			
System configuration, performance specifications, functions, programming, debugging, and error codes for SFC (MELSAP3) programs				Details		
Programming methods, specifications, and functions for SFC (MELSAP-L) programs					Details	
Programming methods using structured text language						Details

1.1 Redundant System Overview

A redundant system offers improved system reliability, as it consists of two basic systems, each of which includes the CPU module, power supply module, network module [3] and others, so that even if a module error occurs in one basic system, the other one continues the system control.

To configure a redundant system, prepare two sets of systems, i.e., two redundant main base units on which the abovementioned modules are mounted. Then, connect the CPU modules of both systems with a tracking cable.

I/O module(s) and intelligent function module(s) are installed to MELSECNET/H remote I/O station(s) or extension base unit(s) in redundant systems.

Power supply redundancy is also available by using redundant power main base units or redundant power extension base units.
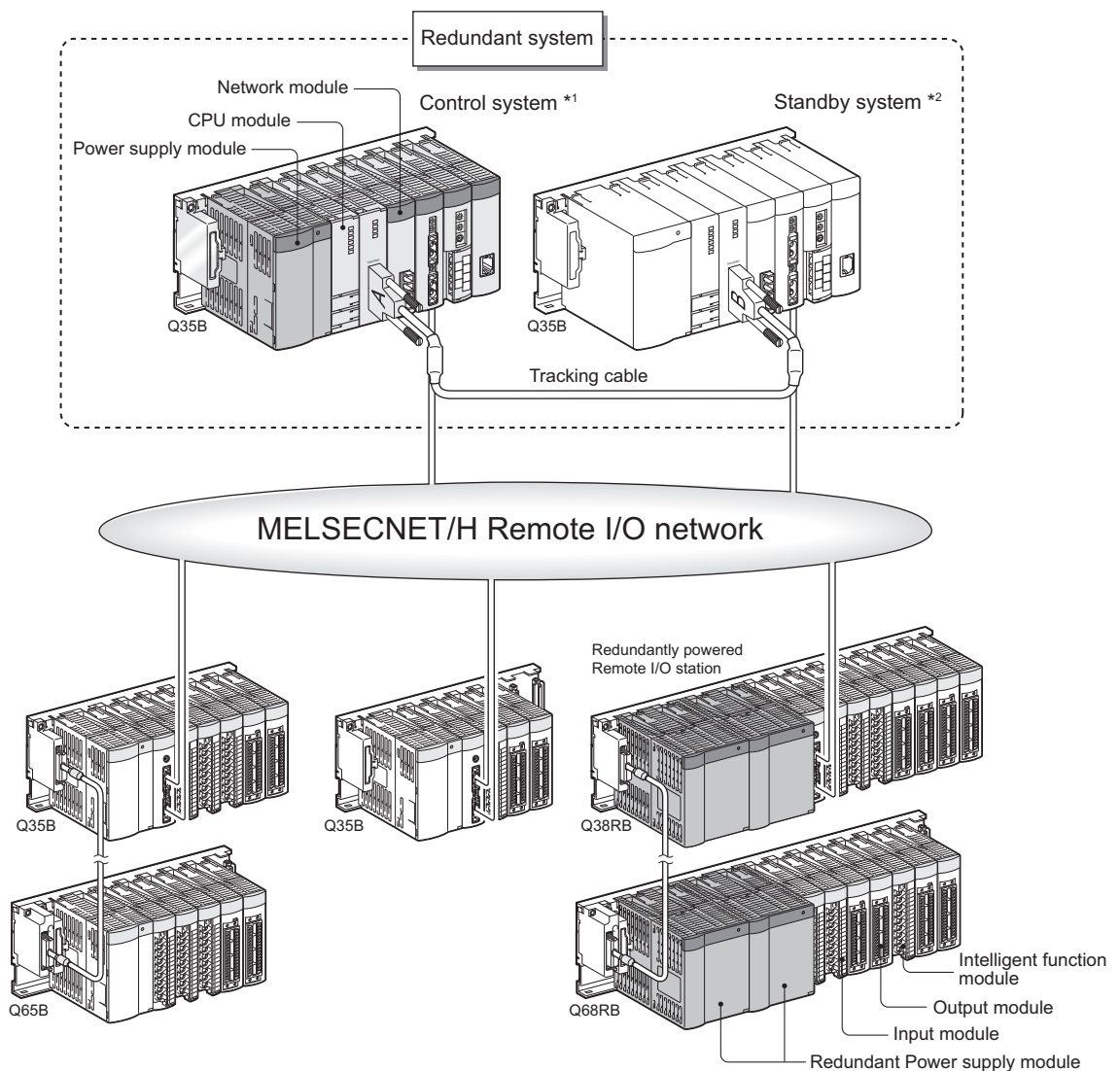
Diagram 1.1 Configuration Example of Redundant System

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* 1: The control system indicates the system that actually controls the redundant system.
       (☞ Section 5.1.2)
* 2: The standby system indicates the backup system within a redundant system.
       (☞ Section 5.1.2)
       If an error occurs in the control system, the standby system takes over the control of the redundant system.
* 3: Refer to Section 2.3, for details of network modules compatible for redundant system.

Remark •

The redundant system described in this manual does not guarantee continuous operation of the system depending on the failure status. Also, when system switching occurs due to an extension base unit error or a module error on the extension base unit, the standby system also detects the error and the CPUs on both systems will stop. Therefore, create a safety circuit externally so that the overall system safety can be ensured even in these cases.

• •

1.2 Features

Features of redundant system are indicated below.

(1) Redundant Configuration of Basic System

As a redundant system consists two basic systems, i.e., two sets of CPU modules, power supply modules, main base units, network module[*3], etc., one of the basic systems controls the whole system, while the other one performs backup.

Data of the CPU module performing control is transmitted to the backup CPU module in order to make the data consistent. This enables the backup system to take over the redundant system control after the control system goes down and system switching occurs.
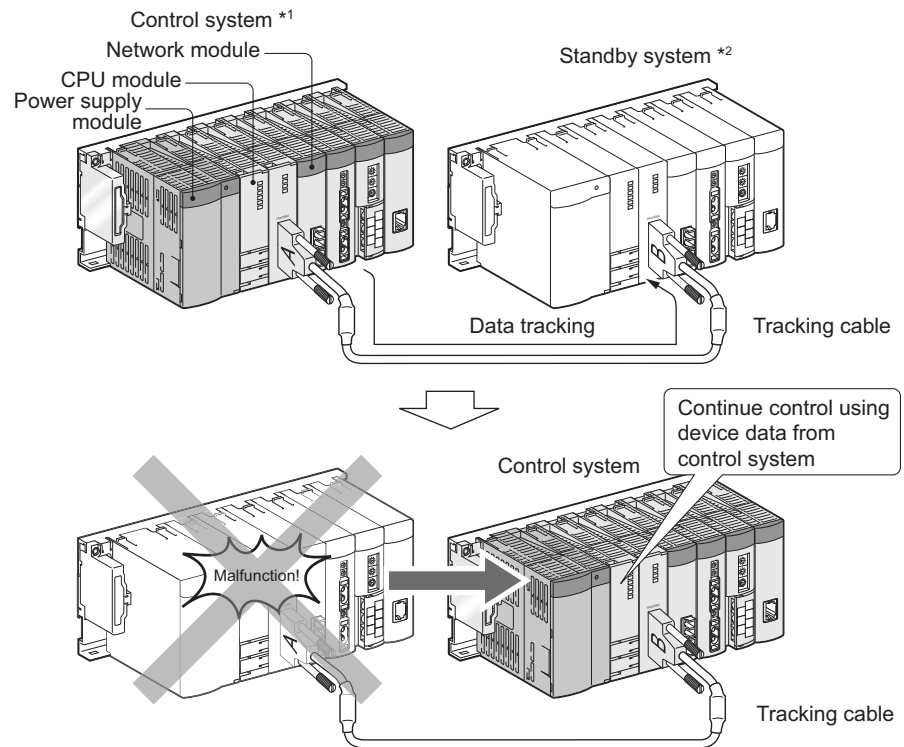
Diagram 1.2 Redundant Configuration of Basic System

* 1: The control system indicates the system that actually controls the a redundant system.
    (☞ Section 5.1.2)
* 2: The standby system indicates the backup system within a redundant system.
    (☞ Section 5.1.2)
    If an error occurs in the control system, the standby system takes over the control of the redundant system.
* 3: Refer to Section 2.3, for details of network modules compatible for redundant system.

(2) Connection of Extension Base Unit

In the redundant system where the Redundant CPU whose first 5 digits of serial No. is "09012" or later is used in both systems, the extension base unit can be connected.[1] Since communication can be made not by network but via bus, communication with the I/O module and the intelligent function module can be made in high speed.

Control system   Standby system

Tracking cable

Extension cable

Q65WRB

Q68RB

Q68RB
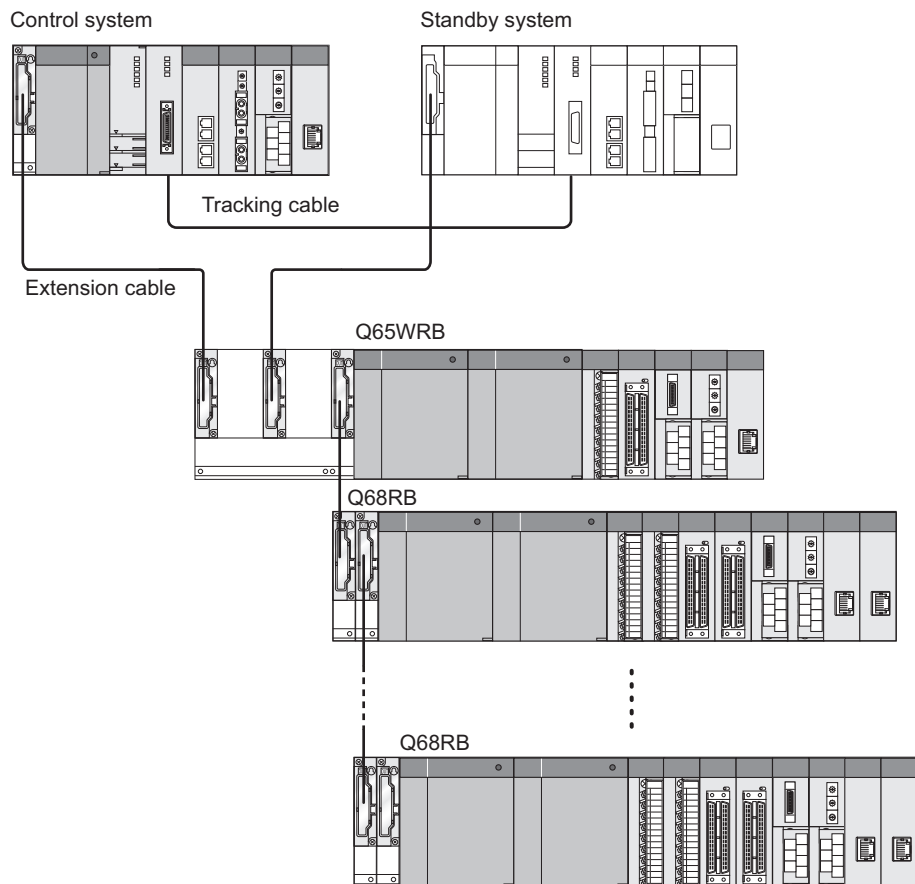
Diagram 1.3 System Configuration when Connecting Extension Base Unit

* 1: For the precautions of the system configuration when connecting the extension base unit, refer to Section 2.4.

(3) Network Configuration Including Redundant System.

(a) CC-Link IE Controller Network, MELSECNET/H PLC to PLC Network, Ethernet, and MODBUS/TCP

In the case of CC-Link IE Controller Network, MELSECNET/H PLC to PLC network, Ethernet, and MODBUS/TCP, control/standby system switching occurs and system control and network communication is continued even when a network module fails or when network cable disconnection is detected.

(Control station)　　　　(Normal station)　　　　OPS (Normal station)

CC-Link IE Controller Network interface board [1]

CC-Link IE Controller Network

Control system (Normal station)　　　　Standby system (Normal station)

Tracking cable

(Control station)　　　　(Normal station)　　　　OPS (Normal station)

CC-Link IE Controller Network interface board [1]

CC-Link IE Controller Network

Standby system

Communication not possible (malfunction, severed network cable)

Control system (Normal station)

Tracking cable

Control and network automatic system switching

Diagram 1.4 System Configuration for CC-Link IE Controller Network

* 1: For restrictions of the CC-Link IE Controller Network interface board, refer to the following manual.

☞ CC-Link IE Controller Network Interface Board User's Manual (For SW1DNC-MNETG-B)

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(b) MELSECNET/H Remote I/O Network

MELSECNET/H remote I/O stations can continue the operation even when control/standby system switching occurs. (☞ Section 6.2.2)
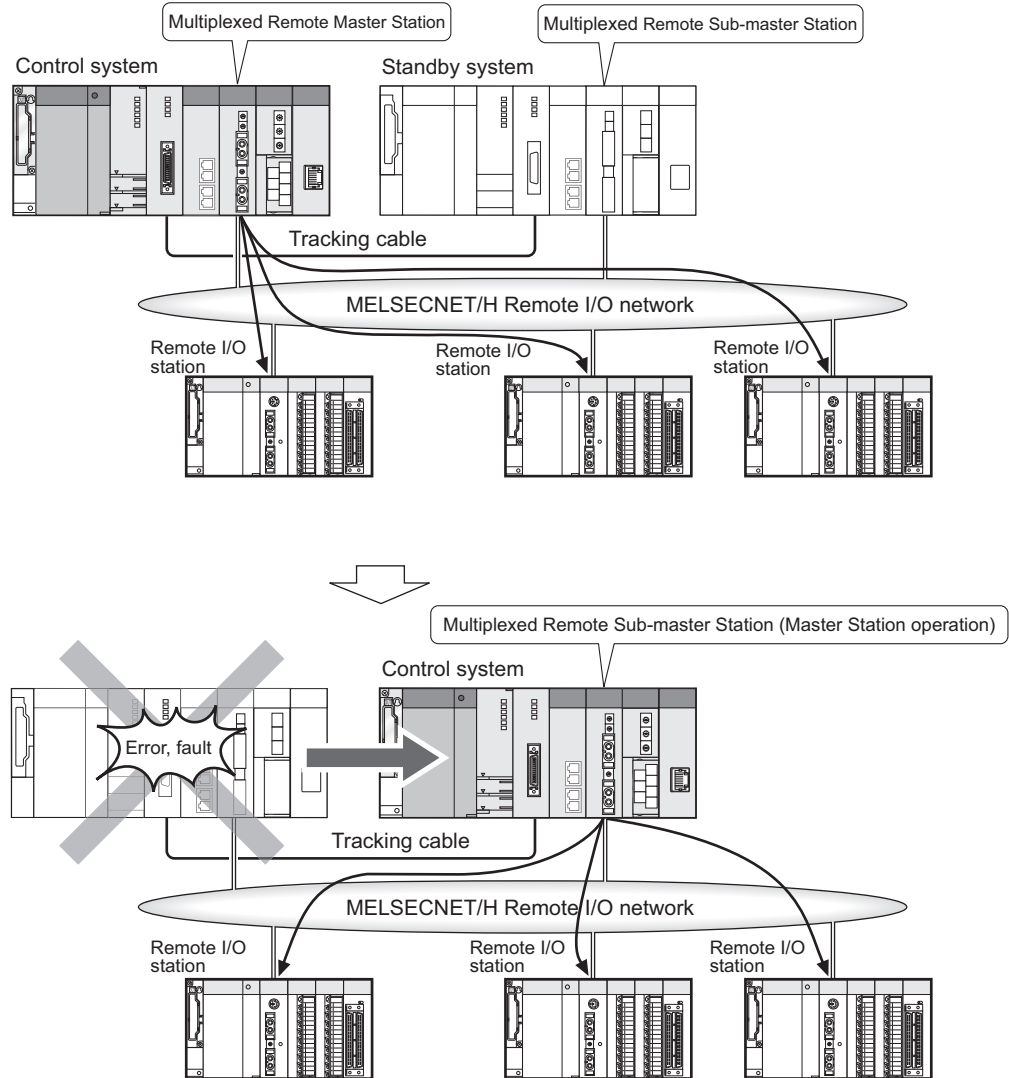
Diagram 1.5 System Configuration for MELSECNET/H Remote I/O Network

(c) PROFIBUS-DP

When the PROFIBUS-DP master module detects a fault or communication failure with slave stations, the both systems are switched so that the communications can be continued.
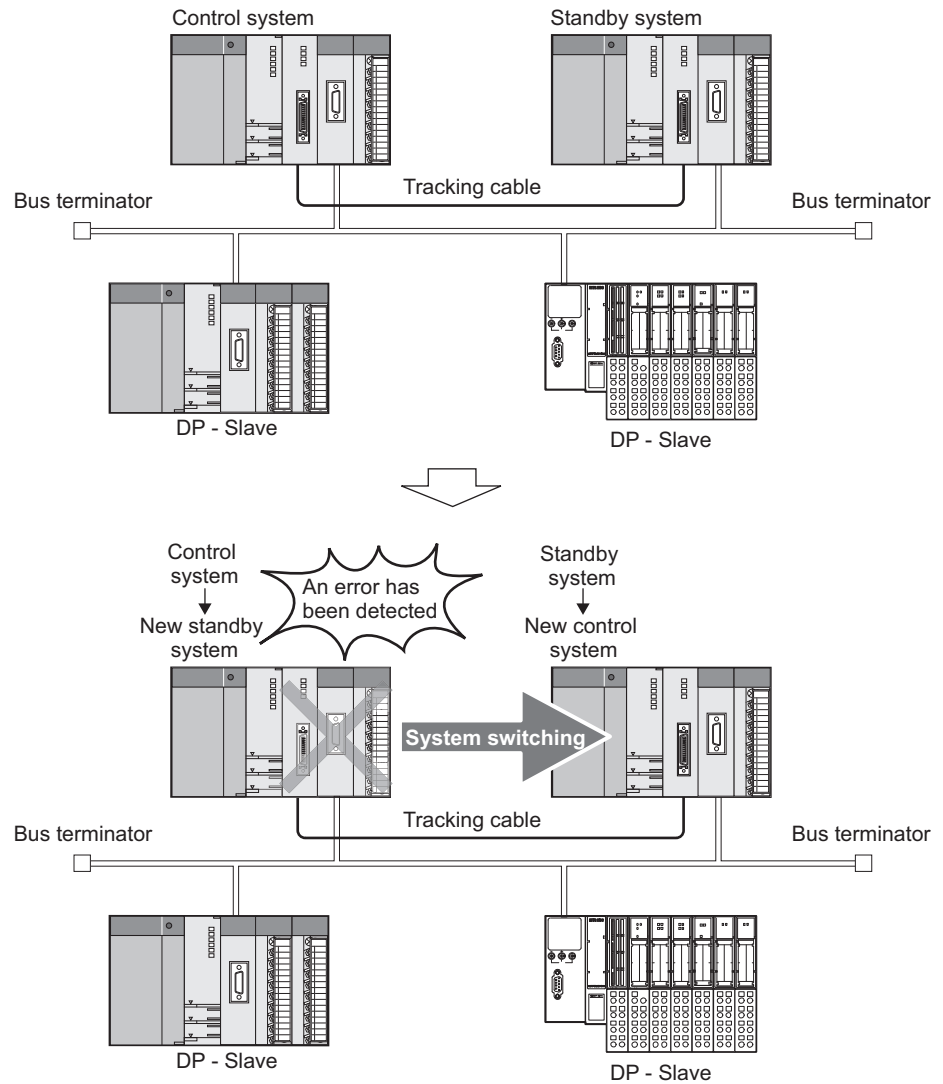
Diagram 1.6 System Configuration for PROFIBUS-DP

(4) Redundant system settings using parameters.

Redundant system settings such as tracking settings, network pairing settings, etc. can be made easily in the parameter settings of GX Developer.

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(5) Writing parameters and programs to control system and standby system without the need to identify each system

Parameters and programs can be written into both of control system and standby system using GX Developer. There is no need to identify each system.
(☞ Section 5.6.1)

Control system   Standby system

Tracking cable

2)   3)

1)

1) to 3) denotes the process up to writing.

1) Execute PLC Write
2) Write to Control system
3) Write to Standby system

· GX Developer
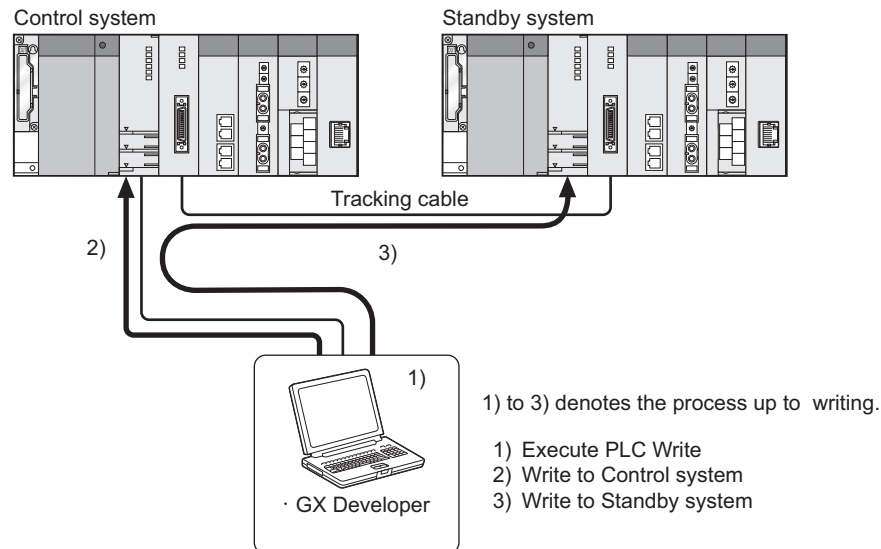
Diagram 1.7 Writing Data to the CPU Modules in the Control System and Standby System

(6) Copy of parameters and programs from control system to standby system

After the CPU module is replaced in standby system, parameters and programs can be copied from the CPU module of control system to the new CPU module by executing the transfer command from GX Developer. This operation can also be done via special relays and special registers.

(☞ Section 5.7)
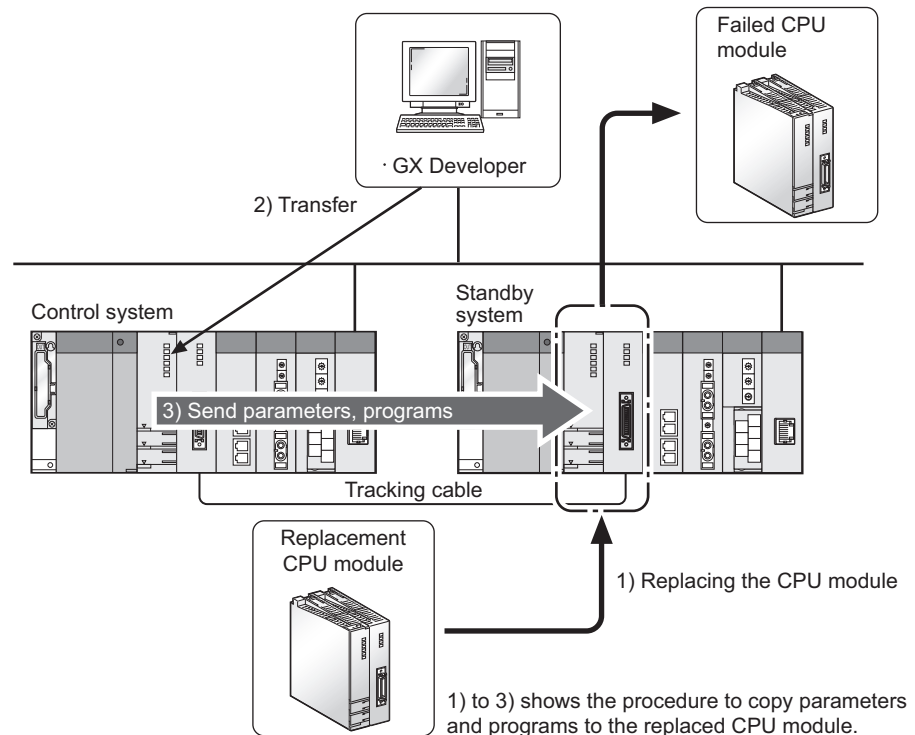
Diagram 1.8 Copy of Parameters and Programs when CPU Module is Replaced

(7) Access to redundant system from host network

When accessing to a redundant system, the host OPS can automatically identify and directly access to the control system, if it has been specified as destination in advance.
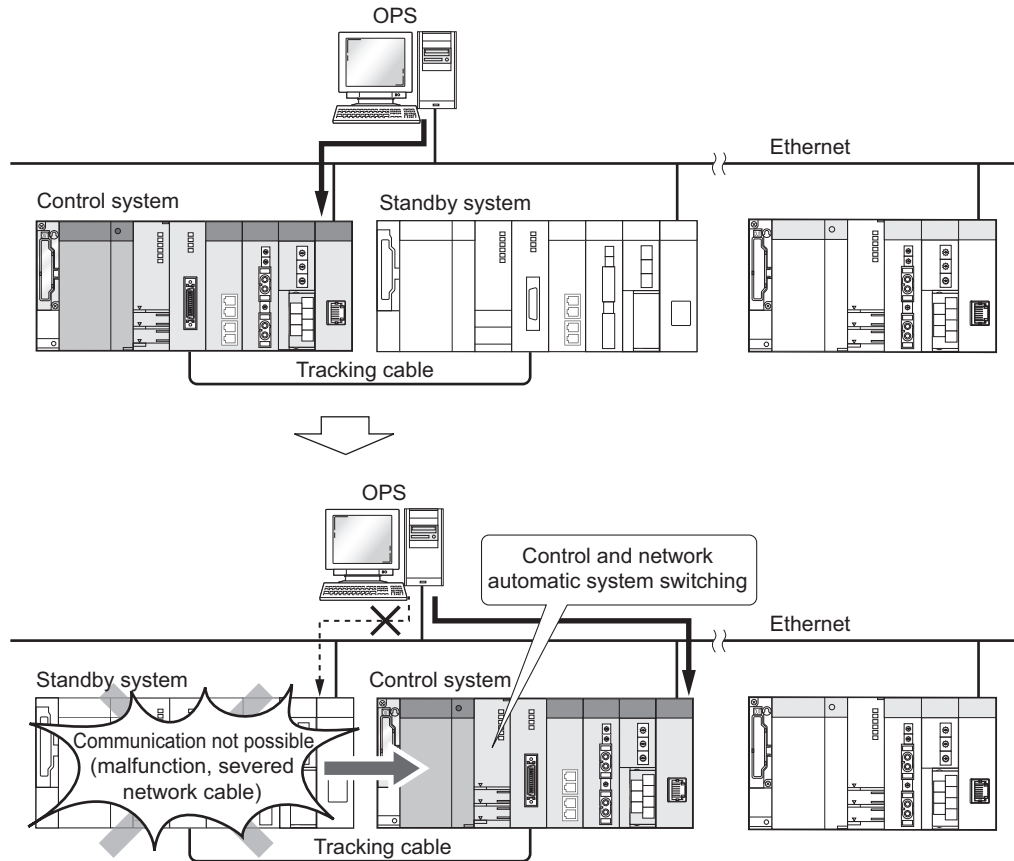
Diagram 1.9 System Configuration for Ethernet

(8) Compatible with Q series modules

Q series modules such as the I/O module, intelligent function module, and network module can be applied to a redundant system without making any modifications. (Some models are irrelevant) (☞ Section 2.3)

Therefore, equipments within factories can be utilized, maintenance costs can be reduced, and the system can be expanded.

(9) Online module change (hot swapping)

The I/O module mounted on a main base unit with a redundant CPU module and the module mounted on a remote I/O station can be replaced online (hot swapping) using GX Developer. (☞ Section 2.4 (6))

The module can be replaced without stopping the system, when it fails.

Note that a module mounted to the main base unit cannot be replaced online when the extension base unit is connected.

Control system   Standby system

Tracking cable

MELSECNET/H Remote I/O network

Remote I/O station   Remote I/O station

Failed module

2) Online module change (hot swapping)

1) Set online module change (hot swapping)
3) Cancel online module change (hot swapping)

Replacement module

1) to 3) shows the online module change (hot swapping) procedure.

· GX Developer
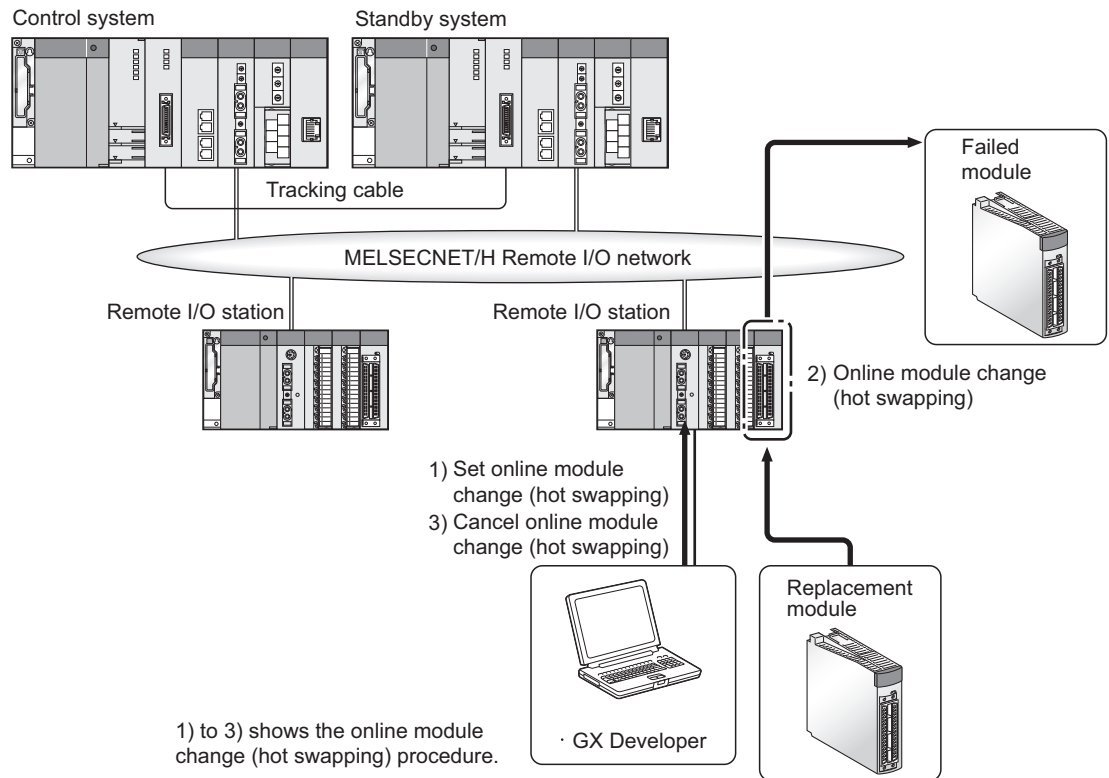
Diagram 1.10 Online Module Change (Hot Swapping) of Remote I/O Stations
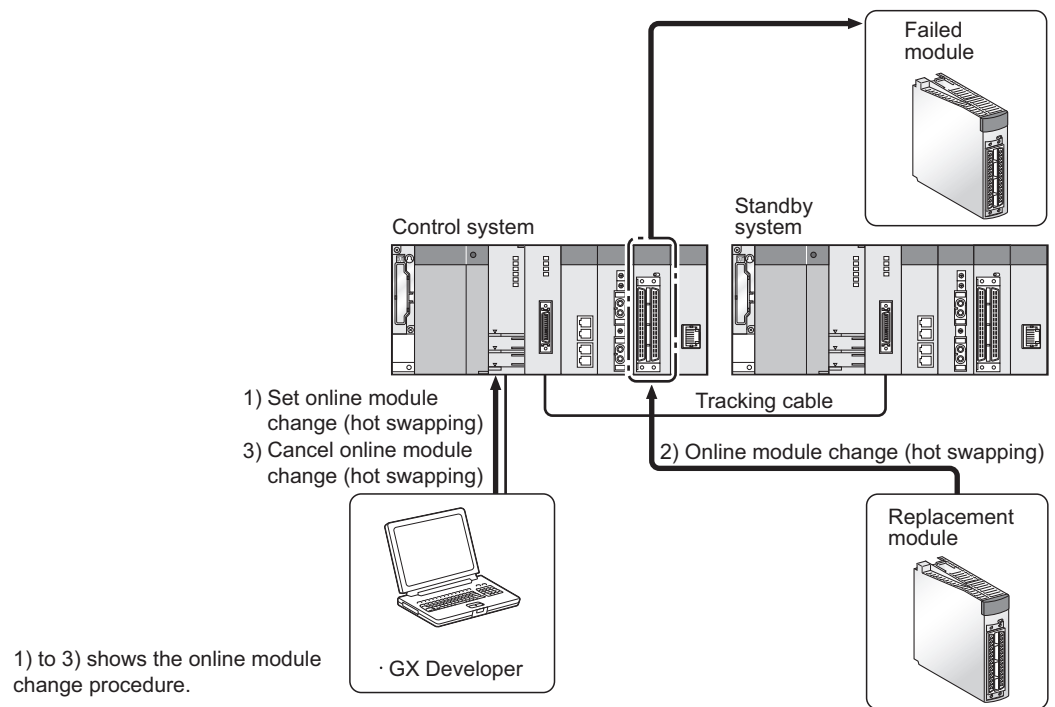
Diagram 1.11 Online Module Change (Hot Swapping) of I/O Modules mounted on a Main Base Unit

(10)System status can be monitored.

The operation status of the whole redundant system can be monitored using the System Monitor of GX Developer.
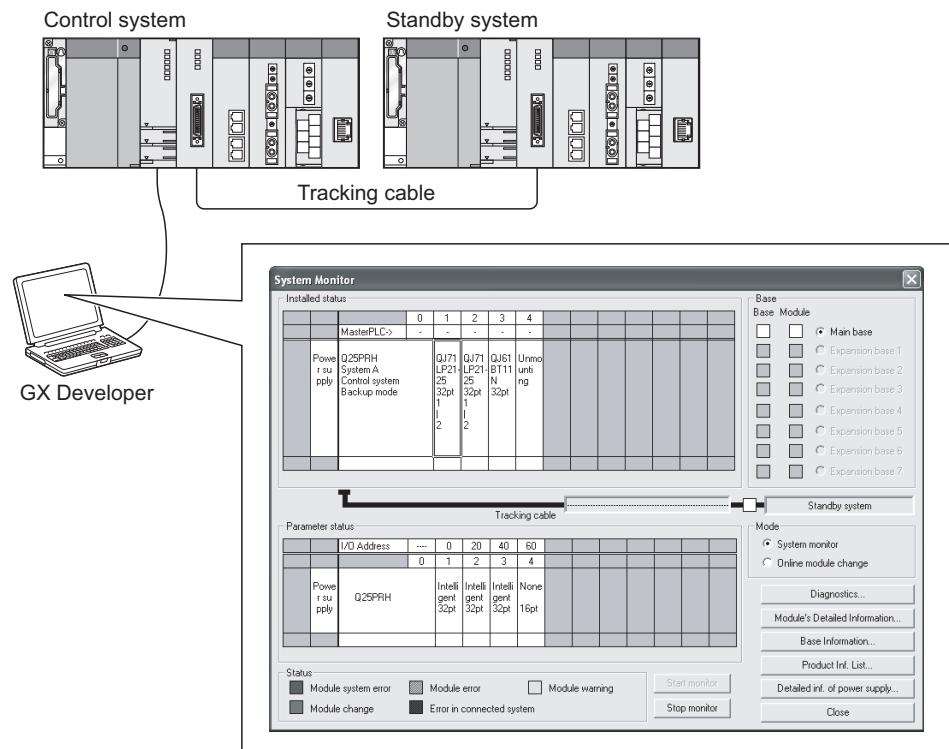
Diagram 1.12 System Monitor of GX Developer

(11) Compact Redundant System

The space of control panel can be saved, as Q series modules (other than the CPU module, redundant power supply module, and tracking cable) are applicable.

(12) Flexible layout

The layout can be changed flexibly because the main base unit is divided into two units for the control system and standby system.

Control system   Standby system

Tracking cable
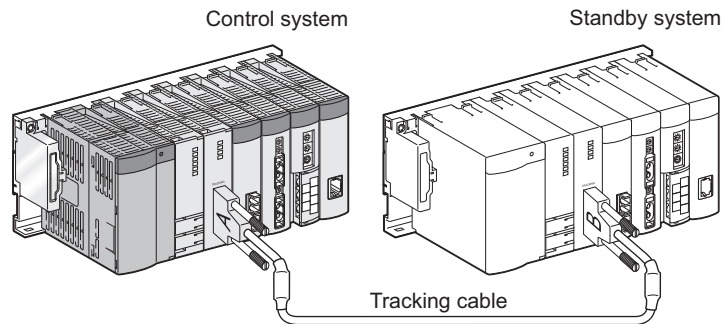
Diagram 1.13 Horizontal Arrangement of Control System and Standby System

Control system

Standby system

Tracking cable
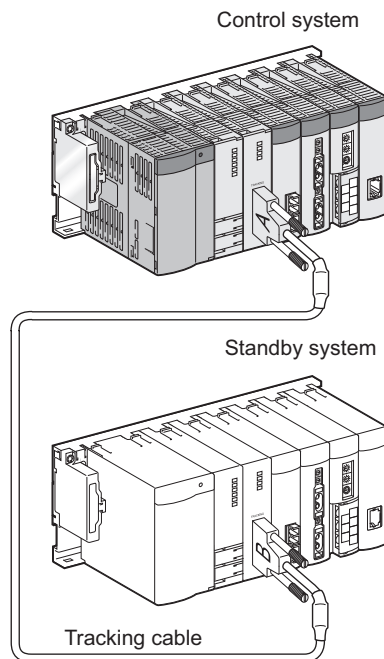
Diagram 1.14 Vertical Arrangement of Control System and Standby System

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Section 2.4 (6) (b)
CHAPTER2 SYSTEM CONFIGURATION

This chapter describes the redundant system configuration.

2.1 System Configuration

An example of redundant system configuration is illustrated in Diagram 2.1.
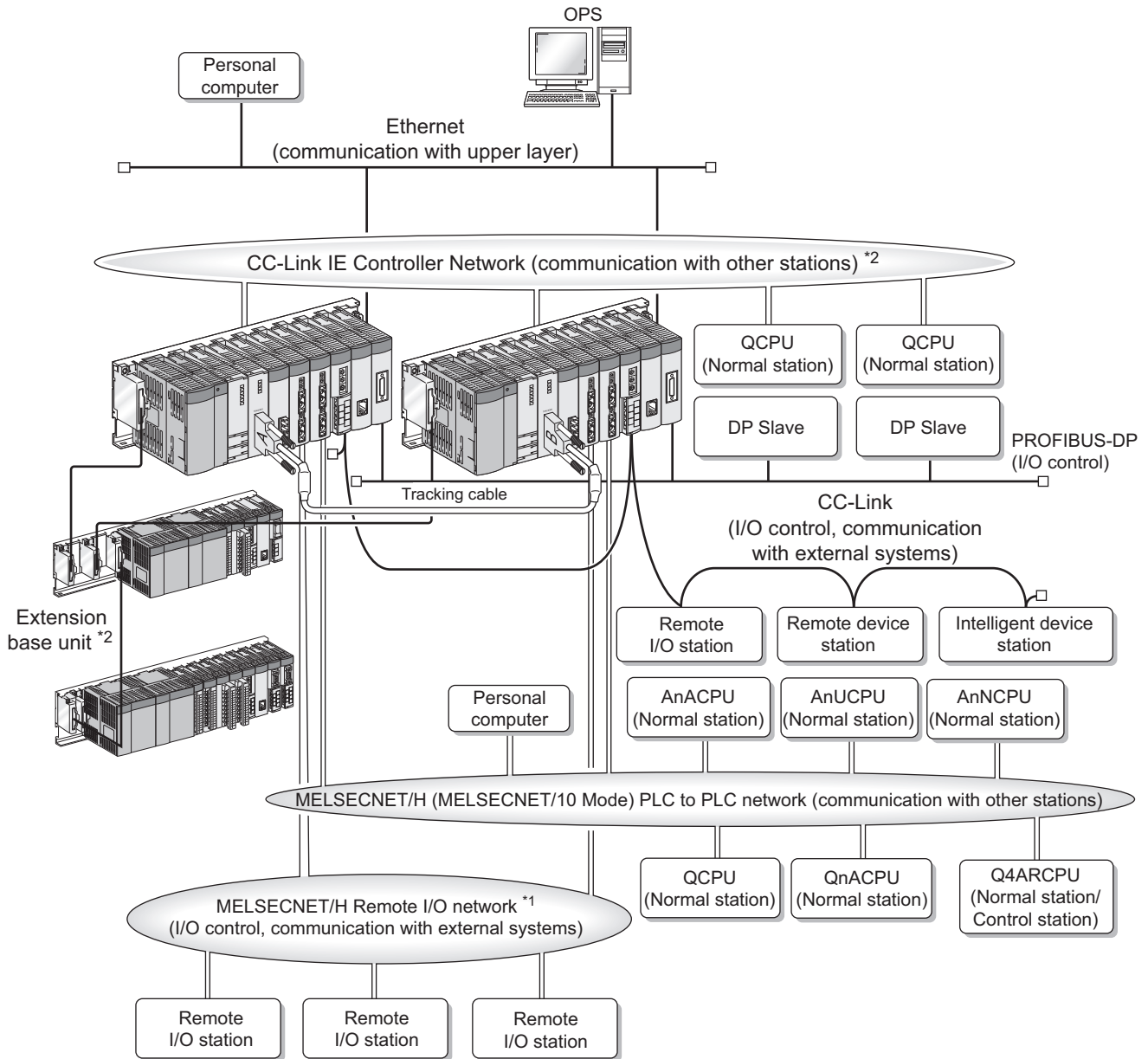
Diagram 2.1 Example of Redundant System Configuration

* 1: In a coaxial bus system, use double shielded coaxial cables.
  Refer to the following manual for the double shielded coaxial cables.

  ☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O Network)

* 2: For the extension base units and network modules compatible with the redundant system, refer to Section 2.3 and Section 2.4.

(1) Redundant System

(a) System Configuration

A redundant system consists of two sets of power supply modules, CPU modules, main base units, and network modules.

To configure a redundant system, prepare two sets of systems, i.e., mount the same model of power supply module, CPU module, and network module on each main base unit, then connect the CPU modules of both systems with a tracking cable.

The connection direction (connectors) of the tracking cable determines which one is system A or B.

(⟳ Section 5.1.1)

If system A and system B are started up simultaneously, system A becomes the control system.

If one of the systems is started up before the other, the system started up first becomes the control system.[1] (⟳ Section 5.1.2)

Install a module with the same module name into the same slot.

System A - Control System

System B - Standby System

Q38B

Q38B

Tracking cable

QJ71PB92V
QJ71E71
QJ61BT11N
QJ71LP21
QJ71GP21-SX
Q12PRHCPU
Q61P
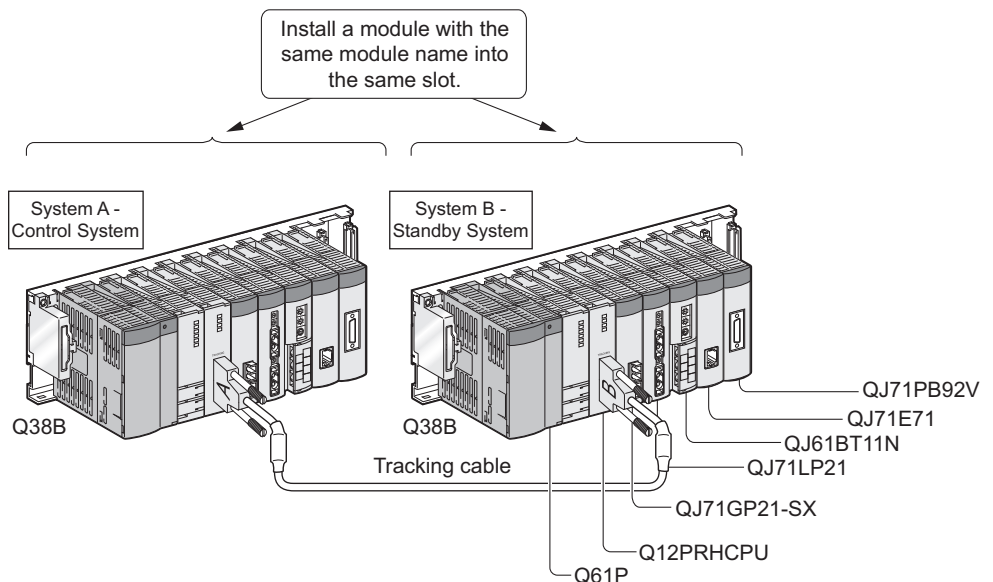
Diagram 2.2 Redundant System Configuration

⌧**POINT**

The extension base unit cannot be connected to the main base unit where the Redundant CPU whose first 5 digits of serial No. is "09011" or earlier is mounted. If connected, a stop error "BASE LAY ERROR (error code: 2010)" occurs. When connecting the extension base unit, use the Redundant CPU whose first 5 digits of serial No. is "09012" or later.

* 1 : If system A and system B are started up within three seconds of one another, system A becomes the control system.

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(b) Backup of Power Supply Module

The power supply module of each system can be backed up.

By adding backup power supply modules to system A and system B, even if an error occurs in the power supply system connected to one power supply module, or if the power supply module fails, the other power supply module can continue the operation.

This enables the faulty power supply system to be restored, and the faulty power supply module can be replaced while the system is running.

The power supply module can also be replaced for preventive maintenance while the system is running.
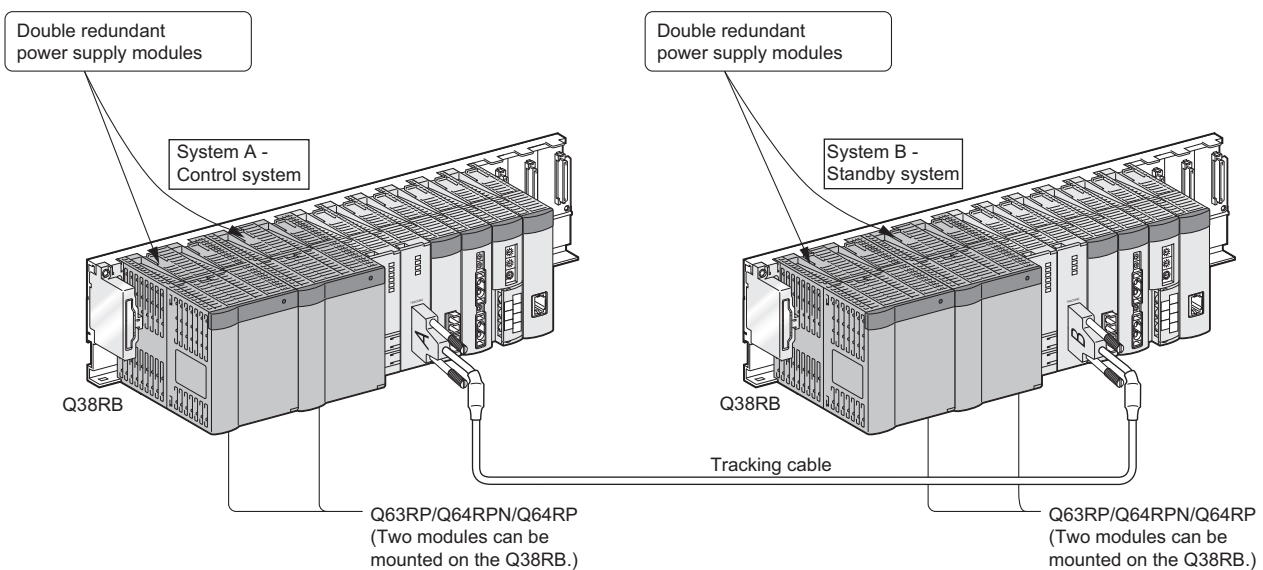
Diagram 2.3 Power Supply Modules and Redundant System

(c) Module which can be mounted to main base unit or extension base unit

For the module which can be mounted to the main base unit or extension base unit, refer to Section 2.3.

(d) Redundant System Operations

Refer to Section 5.1, for redundant system operations.

☒POINT

The extension base unit cannot be connected to the main base unit where the Redundant CPU whose first 5 digits of serial No. is "09011" or earlier is mounted. If connected, a stop error "BASE LAY ERROR (error code: 2010)" occurs. When connecting the extension base unit, use the Redundant CPU whose first 5 digits of serial No. is "09012" or later.

(2) Communication with a Host OPS or personal computer

(a) Communications over Ethernet

Communications between a host OPS or personal computer and Redundant CPUs are performed over Ethernet.
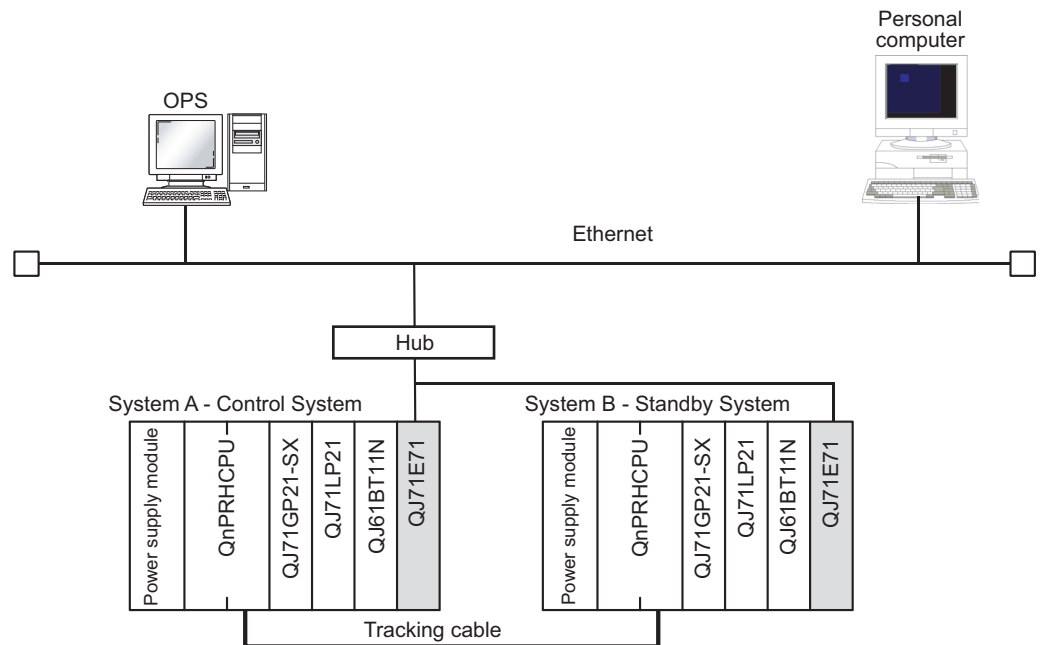
Diagram 2.4 Connection of Redundant System to Ethernet

(b) Ethernet Modules applicable to Redundant System

Refer to Section 2.3, for Ethernet modules applicable to a redundant system.

(c) Ethernet Communication Methods and Operations during System Switching

For an overview of communication methods between the OPS or personal computer connected to the Ethernet network and CPU modules in a redundant system, and operations during system switching, refer to Section 6.2.3.
For details, refer to the Q Corresponding Ethernet Interface Module User's Manual (Basic).

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(3) Communication via CC-Link IE Controller Network or MELSECNET/H PLC to PLC Network

(a) Connecting Redundant System to CC-Link IE Controller Network, MELSECNET/H, and MELSECNET/10 PLC to PLC Network

A redundant system can communicate with Q series CPU modules connected to CC-Link IE Controller Network or MELSECNET/H PLC to PLC network.

The system can also connect to MELSECNET/10 PLC to PLC network and communicate with Q series, QnA series, and A series CPU modules.

(b) Pairing Settings and Relevant CPU Modules

Pairing settings must be made using the control station network parameters when connecting a redundant system to CC-Link IE Controller Network, MELSECNET/H, or MELSECNET/10.

The following CPU modules include the network parameters for pairing settings.

- Redundant CPU [1]
- High Performance model QCPU [1]
- Process CPU [1]
- Basic model QCPU [1]
- Universal model QCPU [1]
- Q4ARCPUs [1] [2] [3]

When connecting a redundant system to a network, set any of the above CPU modules as the control station.

CPU modules other than above can be set as the normal station only.

Refer to the following manuals, for details on pairing settings for CC-Link IE Controller Network, MELSECNET/H, and MELSECNET/10 PLC to PLC networks.

☞ MELSEC-Q CC-Link IE Controller Network Reference Manual

☞ Q Corresponding MELSECNET/H Network System Reference Manual (PLC to PLC network)

☞ QnA/Q4AR Corresponding MELSECNET/10 Network System Reference Manual

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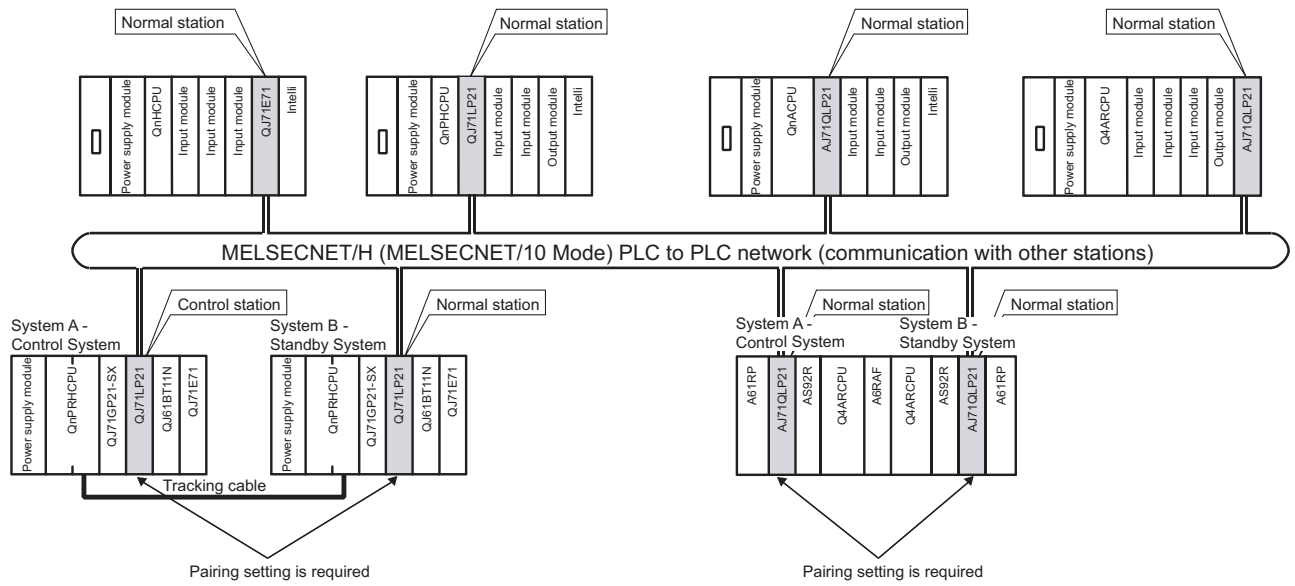
Diagram 2.5 Connection of Redundant System to MELSECNET/H PLC to PLC Network

* 1: Before making the pairing settings, check the GX Developer version. (☞ Section 2.3)
* 2: The Q4ARCPU makes pairing settings using the "J.PAIRSET" instruction.
* 3: The pairing settings cannot be made with the Q4ARCPU in the CC-Link IE Controller Network.

(4) Communication via MELSECNET/H Remote I/O Network

(a) Controlling External Devices

A redundant system controls external devices using I/O modules and intelligent function modules that are installed to remote I/O stations on the MELSECNET/H remote I/O network.

Communications with external devices are also available by installing a communication module to a remote I/O station, when it cannot be mounted on the main base unit of the redundant system.

(b) Backup of Power Supply Module

The power supply module for each remote I/O station can be backed up.

By adding a backup power supply module to a remote I/O station, the remote I/O station can continue to operate, even if an error occurs in either power supply system, or if the power supply module fails.

This enables the faulty power supply system to be restored and power supply modules that have failed can be replaced, even when the remote I/O station power supply is on.

The power supply module can also be replaced for preventive maintenance, etc. when the remote I/O station power supply is on.

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MELSEC **Q** series

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(c) Online Module Change (Hot Swapping) Using GX Developer
The I/O module mounted on a remote I/O station (including analog module of function version C) can be replaced online (hot swapping) using GX Developer. Refer to Section 2.4 (6), for modules on a remote I/O station that can be replaced online (hot swapping) using GX Developer.
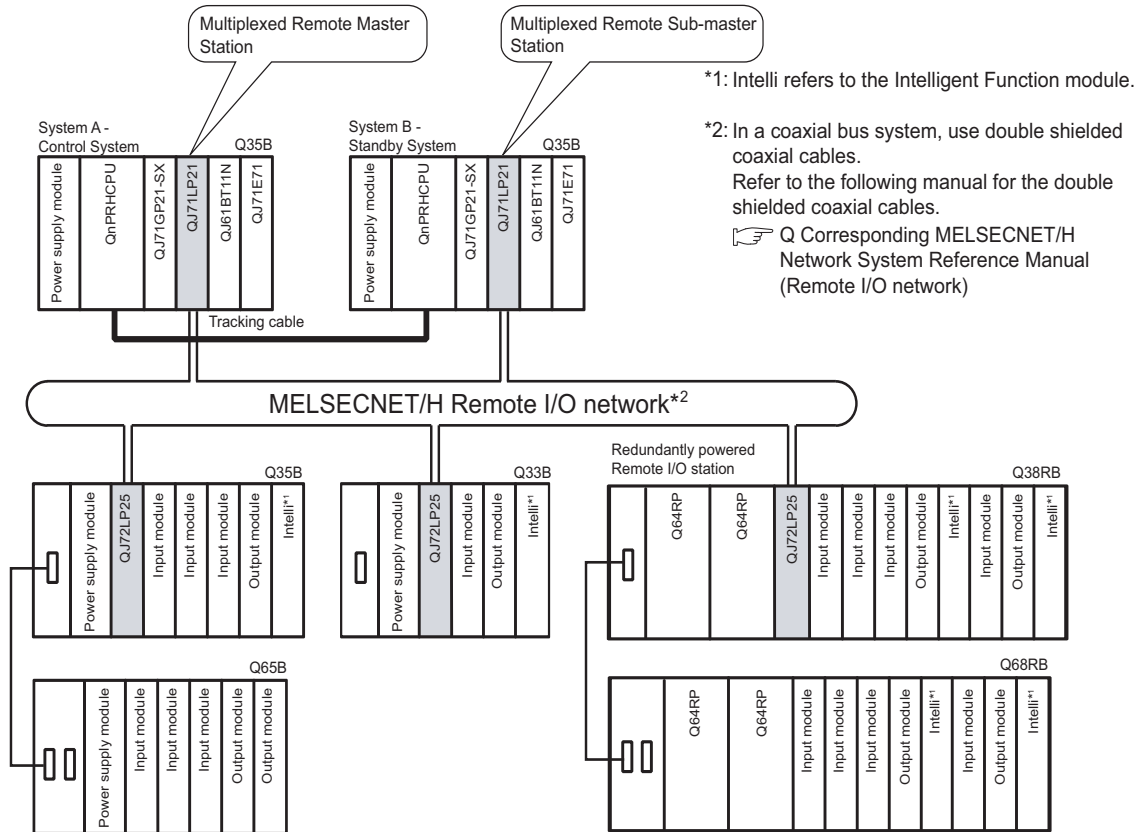
Diagram 2.6 MELSECNET/H Remote I/O Network Configuration

(d) Reference Manual
Refer to the following manual, for modules that can be mounted on a remote I/O station and parameter settings.

☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

(5) Communications through MODBUS/TCP

Mounting MODBUS/TCP modules in a redundant system enables data communications with MODBUS/TCP devices.

(a) When MODBUS/TCP modules are mounted on main base units
- Transmission lines can be redundant.
- The slave function can be used. (The modules work as slave stations.)

(b) When MODBUS/TCP modules are mounted on extension base units
Both the master and slave functions can be used. (The modules work as master or slave stations.)

1) Redundant transmission lines
Transmission lines cannot be redundant when the MODBUS/TCP modules are mounted on an extension base unit.

2) Dedicated instructions
Dedicated instructions cannot be used.
Use the automatic communication function instead of the MBRW instruction. For details of the automatic communication function, refer to the following manual.
☞MODBUS/TCP Interface Module User's Manual

3) GX Configurator-MB
When accessing the Redundant CPUs from GX Developer via an intelligent function module on an extension base unit, GX Configurator-MB cannot be used.
Connect GX Configurator-MB to the Redundant CPUs in either of the following ways.

Main base unit

Extension base unit

(GX Configurator-MB cannot be used.)
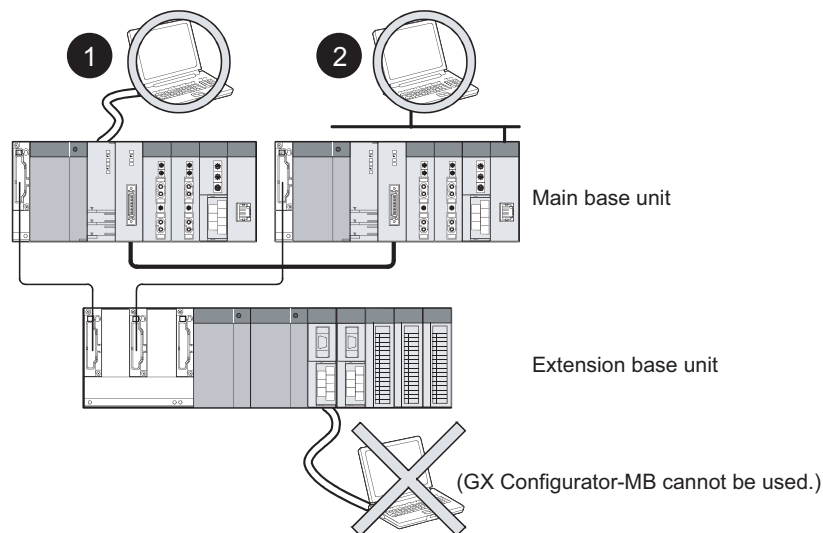
1 Direct connection to the CPU

2 Connection through an intelligent function module on the main base unit
(Through Ethernet module, MELSECNET/H module, or CC-Link module)

Diagram 2.7 Communication Route for GX Configurator-MB

(6) Communication via CC-Link

(a) Controlling External Devices
A redundant system controls external devices using remote I/O stations, remote device stations, and intelligent device stations connected to CC-Link.

(b) CC-Link master module setting
Set the CC-Link master modules as follows.

1) When mounting to the main base unit

- System A: master station
- System B: standby master station

If A system is standby master station and B system is master station, data link cannot be made.
Also, start the system so that A system can be the control system.
(☞ Section 5.1.2)
If B system starts as the control system, CC-Link communication cannot be made since CC-Link master station does not exist.
For the standby master station function, refer to the following manual.
☞ MELSEC-Q CC-Link System Master/Local Module User's Manual

2) When mounting to the extension base unit
Set [Master station (Extension base)].

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(c) System start-up

1) When using the QJ61BT11N whose first 5 digits of serial No. is 07112 or later

When using the CC-Link, control using the CC-Link can be made starting up from either system A or system B.

2) When using the QJ61BT11N whose first 5 digits of serial No. is 07111 or earlier

When using the CC-Link, start up the system so that system A will be the control system.

If starting up the system B as the control system, CC-Link cannot make communication since the master station of the CC-Link does not exist.
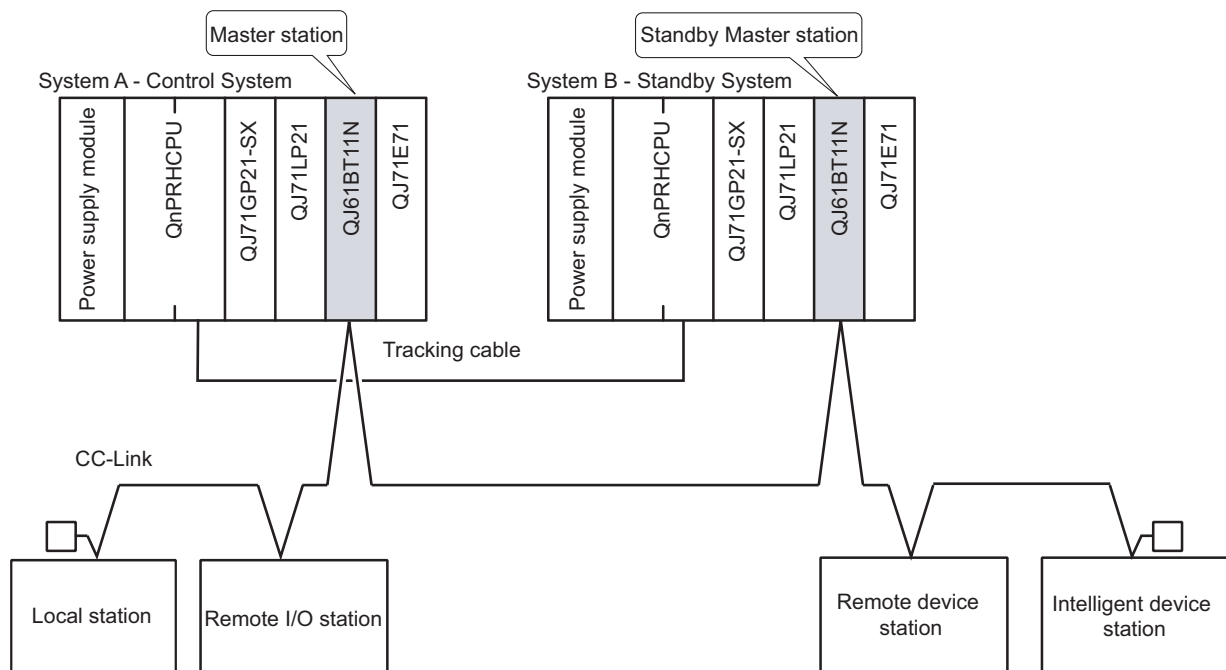
Diagram 2.8 Connection of Redundant System to CC-Link

(7) Communications through MODBUS

Mounting MODBUS modules in a redundant system enables data communications with MODBUS devices.

(a) When MODBUS modules are mounted on main base units
- Transmission lines can be redundant.
- The slave function can be used. (The modules work as slave stations.)

(b) When MODBUS modules are mounted on extension base units

Both the master and slave functions can be used. (The modules work as master or slave stations.)

1) Redundant transmission lines

Transmission lines cannot be redundant when the MODBUS modules are mounted on an extension base unit.

2) Dedicated instructions

Dedicated instructions cannot be used.

Use the automatic communication function instead of the MBRW instruction. For details of the automatic communication function, refer to the following manual.

☞ MODBUS Interface Module User's Manual

3) GX Configurator-MB

When accessing the Redundant CPUs from GX Developer via an intelligent function module on an extension base unit, GX Configurator-MB cannot be used.

Connect GX Configurator-MB to the Redundant CPUs in either of the following ways.

Main base unit

Extension base unit

(GX Configurator-MB cannot be used.)

1 Direct connection to the CPU

2 Connection through an intelligent function module on the main base unit
(Through Ethernet module, MELSECNET/H module, or CC-Link module)

Diagram 2.9 Communication Route for GX Configurator-MB

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(8) Communications through the PROFIBUS-DP

(a) I/O data exchange
The PROFIBUS-DP master module exchanges I/O data with slave stations connected to the PROFIBUS-DP.

(b) Communication method and operation at system switching of the PROFIBUS-DP
For the method of communications with slave stations connected to the PROFIBUS-DP and operation overview at system switching, refer to Section 6.2.8.
For the method of communications with slave stations connected to the PROFIBUS-DP and operation details at system switching, refer to the following manual.
☞ PROFIBUS-DP Master Module User's Manual
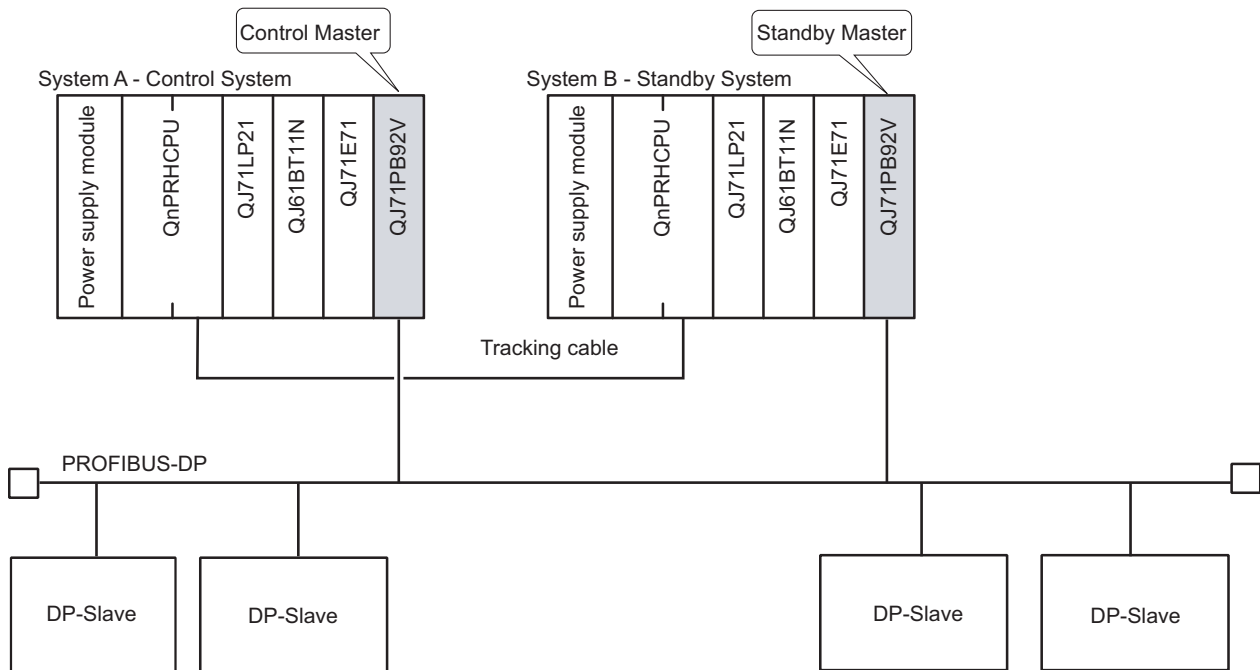
Diagram 2.10 Connection of Redundant System to PROFIBUS-DP

2.2 Peripheral Device Configuration

■ Redundant CPU

●Memory Card[*1]

■ Personal Computer
(GX Developer, PX Developer,
GX Simulator)[*2*3]

●Memory Card[*1] ● PC Card
Adapter

●RS-232 Cable

●USB Cable[*2]
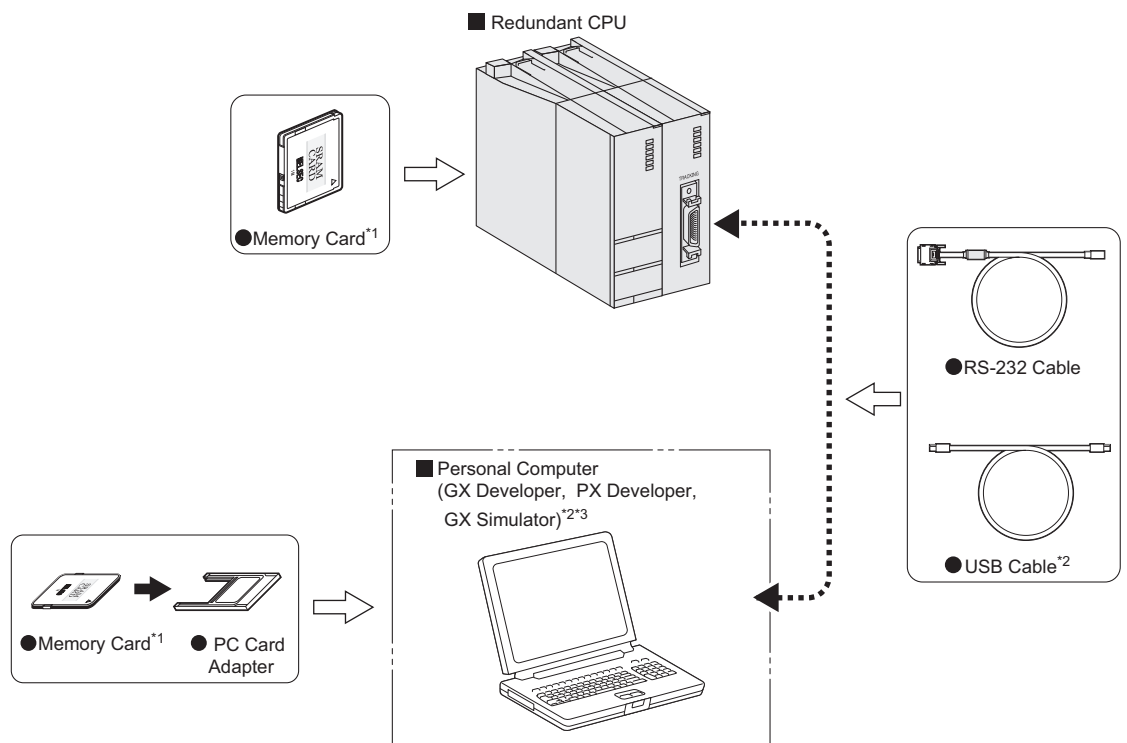
Diagram 2.11 Peripheral Device Configuration

* 1: Do not format ATA cards for using other than GX Developer.

　☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

* 2: Refer to the following manual, for details on writing to memory card and USB cable.

　☞ GX Developer Version 8 Operating Manual

* 3: Refer to Section 2.3, for versions of GX Developer, PX Developer and GX Simulator applicable to redundant CPU.

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2.3 Applicable Devices and Software

This section describes modules and software packages that can be used to configure a redundant system.

(1) List of system configuration devices

Table2.1 List of System Configuration Devices

Item	Description	
Applicable main base unit	Main base unit	Q33B, Q35B, Q38B, Q312B
	Redundant power main base unit	Q38RB
Applicable extension base unit	Redundant type extension base unit (first level)	Q65WRB
	Redundant power extension base unit (second level and later)	Q68RB
Number of connectable extension base units	7 extension base units maximum	
Number of mountable modules	Main base unit	11 modules (11 slots) maximum
	Extension base unit	53 modules (53 slots) maximum
Extension cable	QC05B, QC06B, QC12B, QC30B, QC50B, QC100B	
Total length of extension cables	13.2m	
Applicable memory card	SRAM card	Q2MEM-1MBSN, Q2MEM-1MBS, Q2MEM-2MBSN, Q2MEM-2MBS, Q3MEM-4MBS[*1]
	Flash card	Q2MEM-2MBF, Q2MEM-4MBF
	ATA card	Q2MEM-8MBA, Q2MEM-16MBA, Q2MEM-32MBA
Applicable battery	Q6BAT, Q7BATN, Q7BAT, Q8BAT	

* 1: The CPU module whose serial number (first five digits) is "16021" or later supports this SRAM card.

(2) Modules that can be used in the redundant system

Modules listed in Table2.2 are mountable to a main base unit where a redundant CPU is mounted. For any other module, mount it to a MELSECNET/H remote I/O station or an extension base unit. Note that, however, some modules cannot be mounted to MELSECNET/H remote I/O stations and extension base units.

($\Rightarrow$ (2) in this section, (b), (c))

(a) Modules mountable to main base unit where redundant CPU is mounted

Table2.2 lists the modules mountable to a main base unit where a redundant CPU is mounted.

Table2.2 Modules Mountable to Main Base Unit Where Redundant CPU is Mounted

Module Name	Model	Checking Method
Power supply module [1]	• Q61P-A1 • Q61P-A2 • Q61P • Q61P-D • Q62P • Q63P • Q64P • Q64PN	-
Redundant power supply module [2] [7]	• Q63RP • Q64RPN • Q64RP	-
CC-Link IE Controller Network module [6] [8]	• QJ71GP21-SX • QJ71GP21S-SX	
MELSECNET/H module [6]	• QJ71LP21-25 • QJ71LP21S-25 • QJ71LP21G • QJ71LP21GE • QJ71BR11	Function version: D[5]
Ethernet module [6] [7]	• QJ71E71-B2 • QJ71E71-B5 • QJ71E71-100	
CC-Link master module [4] [6] [7]	• QJ61BT11N	Serial No. (first 5 digits): "06052" or later[5]
MODBUS module [7] [9]	• QJ71MB91	-
MODBUS/TCP module [7] [9]	• QJ71MT91	Function version: D[5]
PROFIBUS-DP master module	• QJ71PB92V	Function version: D[5]
Input module [7]	• QX☐☐ [3]	-
Output module [7]	• QY☐☐ [3]	-
I/O combined module [7]	• QH42 • QX48Y57	-

* 1: Mountable only when the Q33B, Q35B, Q38B. or Q312B is used.
* 2: Mountable only when the Q38RB is used.
* 3: ☐☐ indicates the type of the input module or output module.
* 4: The QJ61BT11 cannot be mounted on a main base unit where a redundant CPU is mounted.
* 5: For checking of the serial No. and function version, refer to (3) in this section.
* 6: For restrictions on the number of modules that can be mounted to a main base unit in a redundant system, refer to Section 2.4.
* 7: Mountable to extension base units.
* 8: Use the Redundant CPUs whose first five digits of serial number is "10042" or later in both systems.
* 9: Only the slave function can be set.

(b) Modules that cannot be mounted to MELSECNET/H remote I/O stations

Refer to the following manual for the modules that cannot be mounted to MELSECNET/H remote I/O stations.

☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O Network)

(c) Modules that cannot be mounted to extension base units

The following modules cannot be mounted to extension base units.

- CC-Link IE Controller Network module
- MELSECNET/H module
- Ethernet module (function version: B or earlier)
- Web server module (first 5 digits of serial No.: "09011" or earlier.)
- MES interface module (first 5 digits of serial No.: "09011" or earlier.)
- Interrupt module
- DeviceNet master module
- DeviceNet slave module

(3) Confirming the serial No. and function version of the CPU module

(a) On the rated plate

The serial No. and function version of the CPU module can be confirmed on the rated plate.
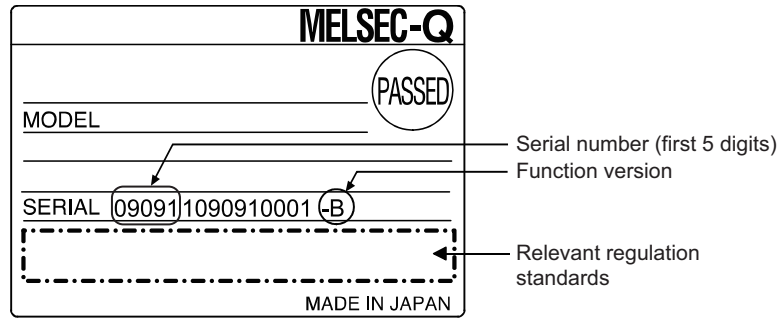
Diagram 2.12 Rated plate

(b) Checking on the front of the module

The serial number written on the rating plate is displayed on the front (at the bottom) of the module.
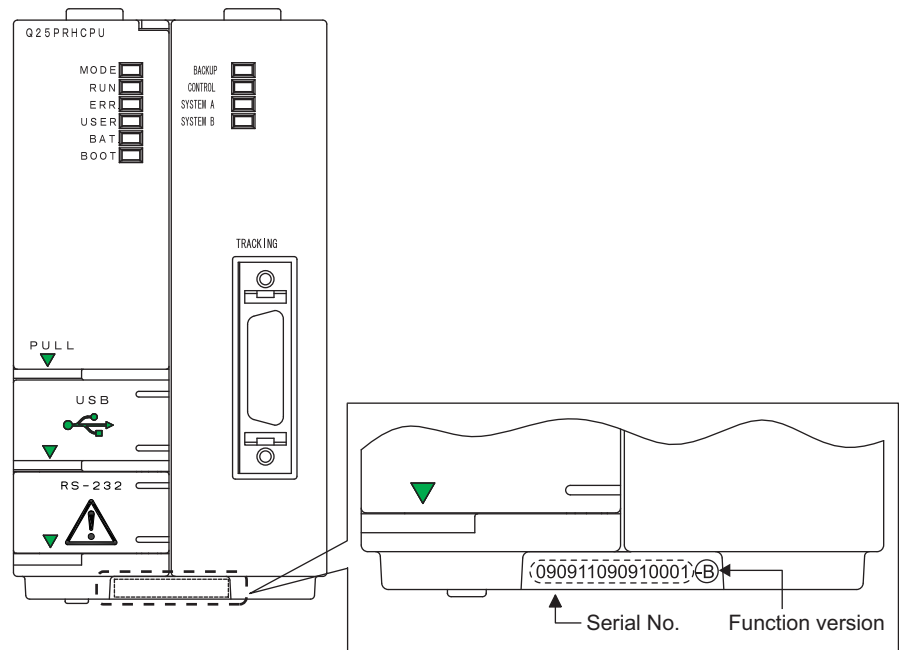
Diagram 2.13 CPU module front display

(c) Confirming the serial No. on the system monitor (Product Information List)
To display the System monitor window, select [Diagnostics] → [System monitor] and click the Product Information List button in GX Developer.
On the system monitor, the serial No. and function version of the intelligent function module can also be confirmed.

Serial number   Function version

Slot	Type	Series	Model name	Points	I/O No.	Master PLC	Serial No	Ver.
PLC	PLC	Q	Q25PRH	–	–	–	060510000000000	D
0-0	–	–	(PLC)	–	–	–	–	–
0-1	Intelli.	Q	QJ71LP21-25	32pt	0000	–	060510000000000	D
0-2	–	–	None	–	–	–	–	–

Diagram 2.14 System Monitor (Product Information List)

⊠**POINT**

The serial No. displayed on the "Product Information List" window of GX Developer may differ from that on the rating plate and on the front of the module.
- The serial No. on the rated plate and on the front of the module describes the management information of the product.
- The serial No. displayed on the "Product Information List" window of GX Developer describes the function information of the product.
  The function information of the product is updated when a function is added.

(4) Available software packages

(a) Available GX Works2, GX Developer, and PX Developer versions

Table2.3 lists the versions of software packages supporting a redundant system.

Table2.3 Versions of available software packages

Product Name	Model	Version
GX Works2	SW1DND-GXW2-E, SW1DNC-GXW2-E	Ver.1.87R or later
GX Developer	SW8D5C-GPPW-E	Ver.8.18U or later [1] [3]
PX Developer	SW1D5C-FBDQ-E	Ver.1.05F or later [2] [4]
GX Simulator	SW6D5C-LLT-E	Ver.6.20W or later

* 1: Use version 8.45X or later when using extension base unit.
* 2: Use version 1.14Q or later when using extension base unit.
* 3: Use version 8.68W or later when using CC-Link IE Controller Network module.
* 4: Use version 1.18U or later when using CC-Link IE Controller Network module.

(b) Available GX Configurator versions

Table2.4 lists GX Configurator versions supporting redundant system.

Table2.4 Available GX Configurator versions

Product Name	Model	Version
GX Configurator-CC	SW□D5C-J61P-E	Ver.1.10L or later [1]
GX Configurator-AD	SW□D5C-QADU-E	Ver.1.15R or later
GX Configurator-DA	SW□D5C-QDAU-E	Ver.1.15R or later
GX Configurator-SC	SW□D5C-QSCU-E	Ver.1.14Q or later
GX Configurator-CT	SW□D5C-QCTU-E	Ver.1.16S or later
GX Configurator-TC	SW□D5C-QTCU-E	Ver.1.14Q or later
GX Configurator-TI	SW□D5C-QTIU-E	Ver.1.14Q or later
GX Configurator-FL	SW□D5C-QFLU-E	Ver.1.14Q or later
GX Configurator-PT	SW□D5C-QPTU-E	Ver.1.14Q or later
GX Configurator-AS	SW□D5C-QASU-E	Ver.1.16S or later
GX Configurator-QP	SW□D5C-QD75P-E	Ver.2.14Q or later
GX Configurator-MB	SW□D5C-QMBU	Ver.1.00A or later

* 1: Use version 1.16S or later when mounting CC-Link master module on extension base unit.

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2.4 System Configuration Cautions

(1) Extension base unit

The extension base unit cannot be connected to the main base unit where the Redundant CPU whose first 5 digits of serial No. is "09011" or earlier is mounted. If connected, a stop error "BASE LAY ERROR (error code: 2010)" occurs.

When connecting the extension base unit, there are following restrictions.
- Use Redundant CPUs whose first 5 digits of serial No. are "09012" or later for both systems.
- Connect a redundant type extension base unit as the first extension stage. As the second and later stages, redundant power extension base units only can be used.
- Only one redundant type extension base unit can be used per system.
- Connect IN connector (IN1 and IN2) of the redundant type extension base unit to OUT connector of the main base unit.
- Connect OUT connector of the redundant type extension base unit to IN connector of the redundant power extension base unit.
- Use the same main base unit models in systems A and B.
- Configuration of multiple CPU system is not allowed.
- Do not power OFF or reset the control system in Separate mode.
- Do not perform boot operation of a Redundant CPU whose first 5 digits of serial No. is "09011" or earlier, using a memory card storing network parameters for Ethernet and CC-Link configurations on an extension base unit.
- Do not disconnect the extension cable while the power supply module mounted on the main base unit is ON.
- Any dedicated instructions cannot be used to intelligent function modules on extension base units. (Section 7.1 (8))
- Any interrupt pointer caused by an interrupt from an intelligent function module on an extension base unit cannot be used. (Section 7.5 (4))
- Connect extension cables so that an overall cable distance[1] does not exceed 13.2 m.

* 1: To calculate an overall cable distance, use the longer length for the two extension cables connecting between the system A or B main base unit and the redundant type extension base unit

Example) System A extension cable...1.5m
System B extension cable...3m

System A   System B

System A extension cable: 1.5m   System B extension cable: 3m

Extension cable: 2m

Extension cable: 5m

3+2+5=10m≤13.2m
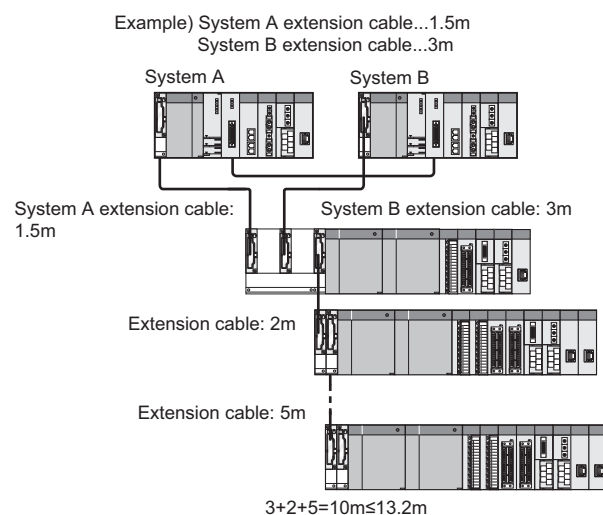
- To communicate via a module mounted on the extension base unit by using MC protocol, use QnA-compatible 2C/3C/4C frame, QnA-compatible 3E frame, or 4E frame for the access.
- MELSOFT products connectable to a module mounted on the extension base unit are GX Works2, GX Developer, and PX Developer. However, there are restrictions on applicable functions. For details, refer to the following manuals.

☞ GX Works2 Version 1 Operating Manual (Common)

☞ GX Developer Version 8 Operating Manual

☞ PX Developer Version 1 Operating Manual (Programming Tool)

⊠POINT

Only the control system can access modules on the extension base units.
If accessing the standby system while the system monitor function of GX Developer is in execution, the extension base units and modules on them are not displayed.
Using GX Developer with specifying "Control system" at [Target system] in the [Transfer Setup] window is preferable.

(2) Modules that can be mounted on a main base unit

The I/O modules used independently by the network module and System A or System B CPU module can be mounted on the same main base unit as a redundant CPU is mounted.
I/O modules and intelligent function modules used to control a redundant system must be mounted on MELSECNET/H remote I/O station or extension base unit.
Remote I/O station, remote device station, and intelligent device station can be used by mounting CC-Link master module on a main base unit or extension base unit.

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(3) Modules where the number of mountable modules is restricted

The module where the number of mountable modules is restricted when the redundant CPU is used is listed in Table2.5.

Table2.5 Number of modules loaded

Applicable Module	Type	Limitation on the number of mountable modules per system [1]	
CC-Link IE Controller Network module [2]	• QJ71GP21-SX • QJ71GP21S-SX	Up to 2	Up to 4 in total
MELSECNET/H module [2]	• QJ71LP21-25 • QJ71LP21S-25 • QJ71LP21G • QJ71LP21GE • QJ71BR11	Up to 4 in total of PLC to PLC network and remote I/O network modules	
Ethernet module	• QJ71E71-B2 • QJ71E71-B5 • QJ71E71-100	Up to 4	
CC-Link master module	• QJ61BT11N	Up to 8 [3]	

* 1: The number of mountable modules per system indicates the number of modules that can be mounted on main base unit or extension base unit. Or, it indicates the number of modules that can be mounted on either one of the systems when they are mounted on main base unit.
* 2: CC-Link IE Controller Network module or MELSECNET/H module cannot be mounted to the extension base unit.
* 3: This applies to the following combinations only.
  • Redundant CPU: The serial number (first five digits) of 09102 or later
  • GX Works2 with the version of 1.87R or later or GX Developer with the version of 8.58L or later
  Up to four modules can be mounted per system for a combination other than those listed above.

☒POINT

If setting 5 or more at "No. of boards in module" in CC-Link network parameter of GX Developer version 8.55H or earlier, the following error dialog box appears.
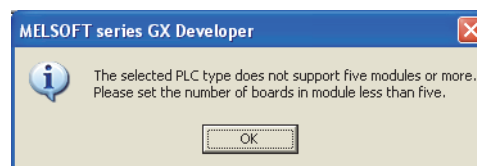
In this case, set 4 or less at "No. of boards in module".

(4) System A/System B configuration

Set up system A and system B so that they will be configured the same.

If they are configured differently, a stop error will occur, and they will not start up as a system.

(In some cases, they may start up as a system, even when configured differently. Refer to Section 5.1.4 for details.)

(5) Number of Slots Occupied by a Redundant CPU

A redundant CPU occupies two slots.

Main base unit slot 0 is set as follows, type: redundant, points: 0 points.

The I/O number for slot 1, in which modules are mounted, is X/Y0$_H$.
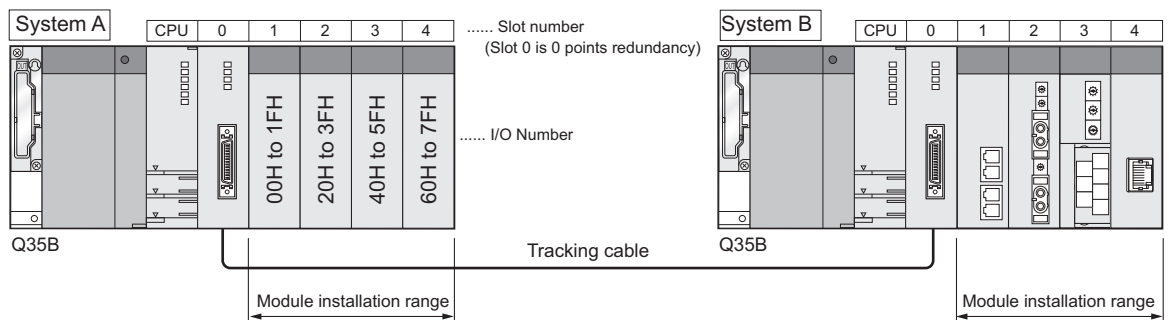
Diagram 2.15 Number of Slots Occupied by Redundant CPU and I/O Numbers of Main Base Units

(6) Restrictions on online module change (Hot Swapping)

The online module change (hot swapping) using GX Developer can be performed to the main base unit, extension base unit, and MELSECNET/H remote I/O station where the Redundant CPU is mounted.

The target modules of online module change are listed in Table2.6.

Table2.6 Target Modules of Online Module Change (Hot Swapping)

Module	Function version	Mounting position		
		Main base unit where Redundant CPU is mounted	Extension base unit	MELSECNET/H Remote I/O station
Input module	–	○ *1	○	○
Output module	–	○ *1	○	○
I/O combined module	–	○ *1	○	○
Analog input module	C	×	○	○
Analog output module	C	×	○	○
Temperature input module	C	×	○	○
Temperature adjustment module	C	×	○	○
Pulse input module	C	×	○	○

* 1: When the extension base unit is connected, online module change (hot swapping) cannot be performed to modules mounted on the main base unit.

○ :Online Module Change (Hot Swapping) Possible

× :Online Module Change (Hot Swapping) not Possible (because cannot be mounted on a main base unit.)

Refer to the following manuals, for online module change (hot swapping) of input modules, output modules, and I/O combined modules.

(a) Main base unit where Redundant CPU is mounted

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(b) Extension base unit

☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

Refer to the manual of each module, for online module change (hot swapping) of analog input module, analog output module, temperature adjustment module, and pulse input module.

(7) Cables applicable to coaxial bus system of MELSECNET/H Remote I/O Network

In a coaxial bus system, use double shielded coaxial cables.

Refer to the following manual for the double shielded coaxial cables.

☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

CHAPTER3 TRACKING CABLE

This chapter provides the tracking cable specifications and part names, and explains connecting/disconnecting the cable to/from the CPU module.

3.1 Specifications

The tracking cable specifications are listed in Table3.1.

Table3.1 Tracking Cable Specifications

Item	Name	
	QC10TR	**QC30TR**
Cable Length	1.0 m	3.0 m
Purpose	Connecting the CPU modules of a redundant system	
Mass	0.15 kg	0.28 kg
Tightening Torque	29.4N•cm	

3.2 Part Names

Tracking cable part names are indicated here.

No.	Name
1)	System A Connector
2)	System A Confirmation Mark
3)	Cable
4)	System B Connector
5)	System B Confirmation Mark
6)	Connector Fixing Screw

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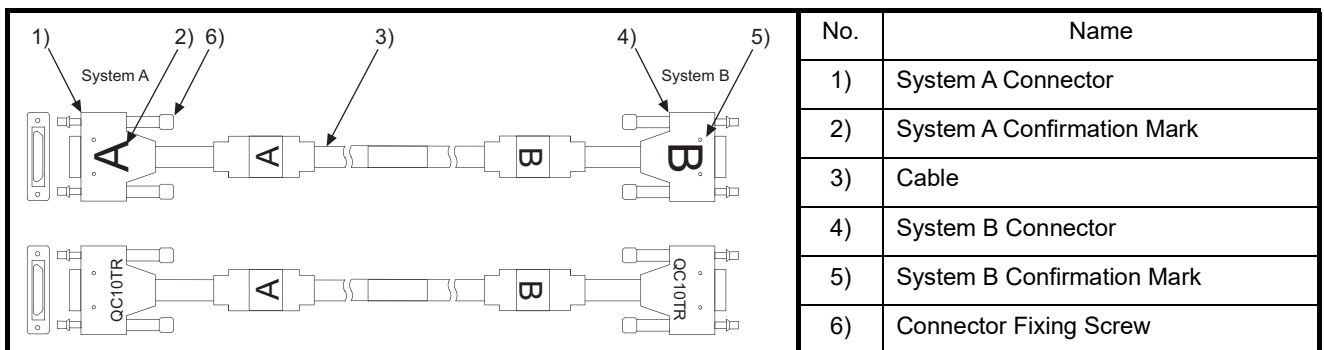
3.3 Connecting and Disconnecting a Tracking Cable

(1) Cautions when Connecting a Tracking Cable

- Be careful not to step on the tracking cable.
- When laying tracking cables, secure a minimum bending radius of 27.6 mm or more.
- If the bending radius is less than 27.6 mm, a malfunction may occur due to characteristic deterioration, wire breakage, etc.
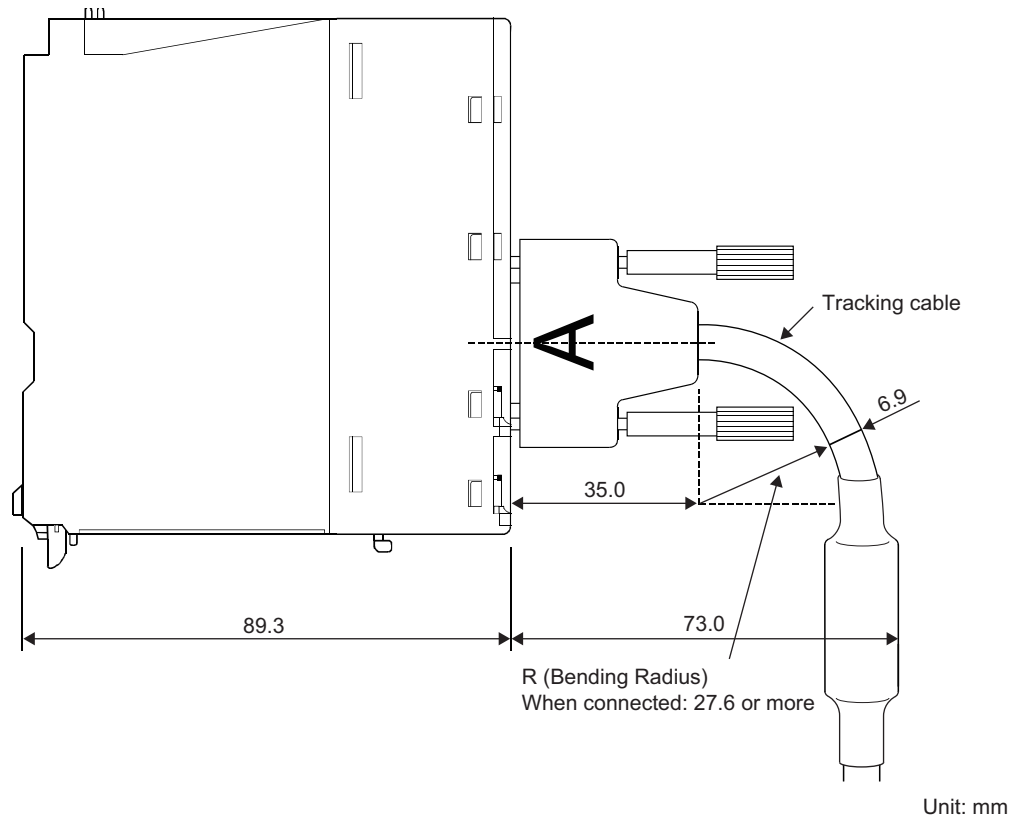
Diagram 3.1 Minimum Bending Radius of a Tracking Cable

☒POINT

1. Always power OFF the standby system or set the RESET/L.CLR switch of the standby system CPU module to RESET before connecting or disconnecting the tracking cable.
2. To connect or disconnect the tracking cable, hold it by the cable connector.

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(2) Connecting a Tracking Cable

(a) Make sure that you are using the correct tracking cable connector for System A or System B.
Refer to Section 3.2 and Section 5.1.1, for confirming System A and System B.

(b) Hold the tracking cable connector, and align it with the CPU module TRACKING connector.
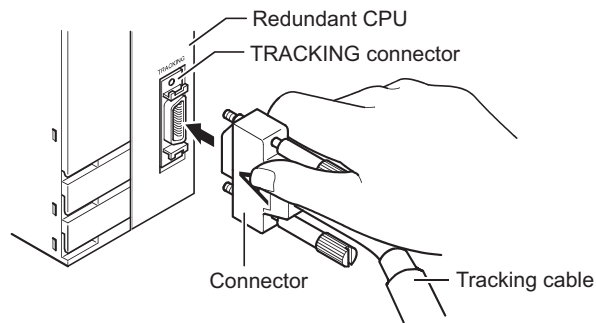
Diagram 3.2 Checking the Connection Orientation of the Tracking Connector

(c) Connect the tracking cable connector to the CPU module TRACKING connector.
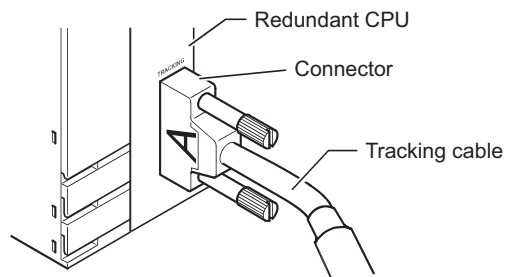
Diagram 3.3 Connecting the Tracking cable Connector

(d) Tighten the connector fixing screws and fix the connector to the CPU module.
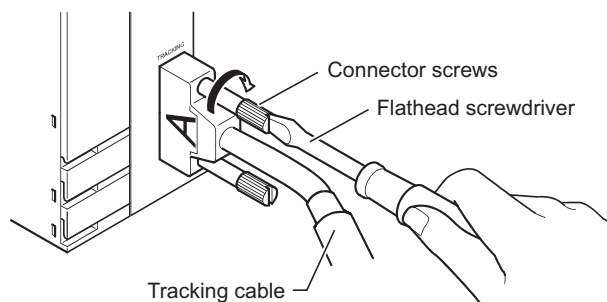
Diagram 3.4 Fixing the Tracking cable Connector

(3) Disconnecting a Tracking Cable

(a) Loosen the connector fixing screws.

Connector screws

Flathead screwdriver
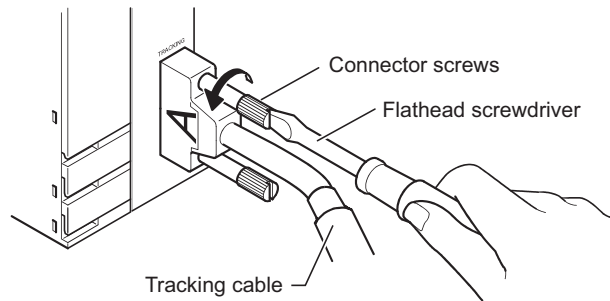
Tracking cable

Diagram 3.5 How to Loosen the Connector Fixing Screws

(b) When disconnecting the tracking cable, hold the tracking cable connector, and then remove it.

Redundant CPU

TRACKING connector

Connector
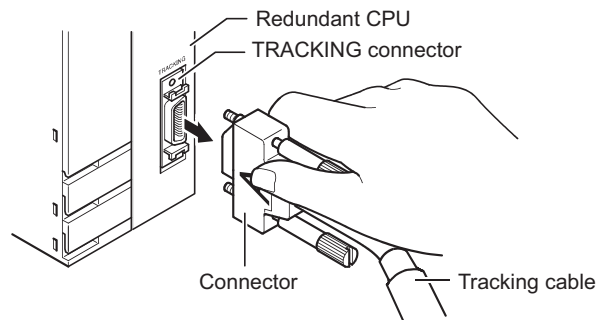
Tracking cable

Diagram 3.6 Disconnecting the Tracking Cable

CHAPTER4 PROCEDURE FOR STARTING UP A REDUNDANT SYSTEM

(1) Procedure for starting up in the backup mode

The standard procedure for starting up system A as the control system and system B as the standby system of a redundant system in the backup mode is described below. Explanation of program and parameter creation is not provided here.

Start

Mounting Modules	...Refer to Section 4.1
Mount the power supply module, CPU module, network module, and I/O module to the main base unit/extension base unit.	

Wiring	...Refer to Section 4.2
(1) Connect the power cable to the power supply module. (2) Connect the battery connector to the CPU module battery connector. (3) Connect the CPU modules with the tracking cable. (4) When connecting the extension base unit, connect the main base unit and the extension base unit by an extension cable. (5) Connect the network wiring to the network module.[1] (6) Connect the I/O module.	

Module Initial Settings	...Refer to Section 4.3
(1) Set the RUN/STOP switch of the CPU module to the STOP position. (2) Set the RESET/L.CLR switch of each CPU module to the reset switch neutral position. (3) Make switch settings for the MELSECNET/H module.	

Checking that power supply of main base unit and extension base unit is ON	...Refer to Section 4.4
(1) Check the following items and turn ON power supplies of the power supply modules of the main base units and extension base units simultaneously. •Wiring of power supply •Power supply voltage •RUN/STOP switch position of system A/system B CPU module: STOP •RESET/L.CLR switch position of system A/system B CPU module: Reset switch neutral (2) Check that "POWER" LEDs of the power supply modules of the main base unit and the extension base unit in the systems A and B are turned ON (green).	

Checking System A/System B	...Refer to Section 4.5
Check system A and system B by the "SYSTEM A" / "SYSTEM B" LED of each CPU module.[2]	

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↓

Connecting to a Personal Computer in which GX Developer is Installed	...Refer to
(1) Start up GX Developer in a personal computer. (2) Connect the personal computer to the system A CPU module.	Section 4.6

↓

Writing Parameters and Programs to the CPU Module	...Refer to
Write the parameters and programs created with GX Developer to the CPU modules of System A and System B.	Section 4.7

↓

Restarting System A and System B[*3]	...Refer to
(1) Power off system A and system B, or toggle RESET/L.CLR switch of CPU module. (2) Simultaneously power on system A and system B, or simultaneously set the RESET/L.CLR switches of both CPU modules to reset switch neutral position.	Section 4.8

↓

Error Check	...Refer to
Check if the "ERR." LEDs of system A and system B CPU modules are OFF. If the "ERR." LEDs are ON/flashing, check the error cause using the System Monitor or diagnostics[*4] of GX Developer, and eliminate it.	Section 4.9

↓

Checking the Control System/Standby System	...Refer to
Check the control system/standby system by the "CONTROL" LED status of each CPU module.	Section 4.10

↓

Running Standby System (System B) CPU Module	...Refer to
(1) Set the RUN/STOP switch of standby system CPU module (the "CONTROL" LED is OFF) to the RUN position, and confirm that the "RUN" LED of CPU module is OFF. (2) Confirm that the "ERR." LED of standby system CPU module is ON. Confirm that the error cause is "OPE.MODE DIFF. (error code: 6010)" [*5] using the System Monitor or diagnostics[*4] of GX Developer. If the error is caused by the parameter or programs related to other than "OPE.MODE DIFF.", correct the parameters or programs of system A and system B.	Section 4.11

↓

⊠POINT

When switching power on again, switch power on more than 5 seconds after switching power off. Failure to do so may disable a normal start of the redundant system because an inrush current of higher than the specified value may flow or the tracking communication circuit in the CPU module may not be initialized.

↓

Running Control System (System A) CPU module	...Refer to Section 4.11

(1) Set the RUN/STOP switch of control system CPU module (the "CONTROL" LED is OFF) to the RUN position, and confirm that the "RUN" LED of CPU module is ON.

(2) Confirm that the "ERR." LED of control system CPU module is OFF.

If the "ERR." LED is ON/flashing, check the error cause using the System Monitor or diagnostics[4] of GX Developer, and eliminate it.

If the error is caused by the parameter or programs, correct the parameters or programs of system A and system B.

↓

Restarting System A and System B[3]	...Refer to Section 4.8

(1) Power off system A and system B, or simultaneously set the RESET/L.CLR switches of CPU modules to the RESET position.

(2) Simultaneously power on system A and system B, or simultaneously set the RESET/L.CLR switches of CPU modules to the reset switch neutral position.

↓

(Complete)

Diagram 4.1 Procedure for starting Up in Backup Mode

* 1: Use "double-shielded coaxial cables" when configuring a coaxial bus system on a MELSECNET/H remote I/O network.

Refer to the following manual for the double shielded coaxial cables.

☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

* 2: When the "SYSTEM A"/"SYSTEM B" LED is off and the "ERR." LED is flashing, they indicate that the tracking cable is not connected or is faulty.

Connect or change the tracking cable.

* 3: When starting the redundant system, do not perform the following operations until the "BACKUP" LED is ON (green).

Failure to do so may disable a normal start of the CPU module due to a stop error, "TRK. INIT. ERROR (error code: 6140)" or "CONTROL SYS. DOWN (error code: 6310 to 6312)".

(☞ Section 8.1.7, Section 8.1.8)

Power either system off and then on.

Reset either system CPU module and then set its RESET switch to the neutral position.

* 4: Diagnostics includes PLC diagnostics, Ethernet diagnostics, CC IE Control diagnostics, MELSECNET diagnostics, and CC-Link/CC-Link/LT diagnostics.

For details, refer to each network manual.

* 5: If the RUN/STOP switch of standby CPU module is set to RUN and the operation status differs between the control system and standby system, the "consistency check" causes "OPE.MODE DIFF. (error code: 6010)" in the control system CPU module. (☞ Section 5.1.4)

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(2) Procedure for starting up in the debug mode

The standard procedure for starting up either system in the debug mode is described below.

Explanation of program and parameter creation is not provided here.

```
                    (        Start        )
                              ↓
```

Mounting Modules	...Refer to Section 4.1
Mount the power supply module, CPU module, network module, and I/O module to the main base unit/extension base unit.	

```
                              ↓
```

Wiring	...Refer to Section 4.2
(1) Connect the power cable to the power supply module. (2) Connect the battery connector to the CPU module battery connector. (3) When connecting the extension base unit, connect the main base unit and the extension base unit by an extension cable. (4) Connect the network wiring to the network module. [*1] (5) Connect the I/O module.	

```
                              ↓
```

Module Initial Settings	...Refer to Section 4.3
(1) Set the RUN/STOP switch of the CPU module to the STOP position. (2) Set the RESET/L.CLR switch of the CPU module to the reset switch neutral position. (3) Make switch settings for the MELSECNET/H module.	

```
                              ↓
```

Checking that Power Supply of Main Base Unit and Extension Base Unit is ON	...Refer to Section 4.4

(1) Check the following items and turn ON power supplies of the power supply modules of the main base units and extension base units .
  · Wiring of power supply
  · Power supply voltage
  · RUN/STOP switch position of the CPU module: STOP
  · RESET/L.CLR. switch position of the CPU module: Reset switch neutral
(2) Check that "POWER" LEDs of the power supply modules of the main base unit and the extension base unit are turned ON (green).	

```
                              ↓
```

Connecting to a Personal Computer in which GX Developer is Installed	...Refer to Section 4.6
(1) Start up GX Developer in a personal computer. (2) Connect the personal computer to the CPU module.	

```
                              ↓
```

Writing Parameters and Programs to the CPU Module	...Refer to Section 4.7
Write the parameters and programs created with GX Developer to the CPU module.	

```
                              ↓
```

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↓

Restarting System	...Refer to Section 4.8
Power off the system and then power on again, or set the RESET/L.CLR switch of the CPU module to the RESET position and then set it to the reset switch neutral position.	

↓

Error Check	...Refer to Section 4.9
Check if the "ERR." LED of the CPU module is OFF. If the "ERR" LED is ON/flashing, check the error cause using the System Monitor or diagnostics of GX Developer, and eliminate it.	

↓

⊠POINT

When switching power on again, switch power on more than five seconds after switching power off. Failure to do so may cause an inrush current of higher than the specified value to flow.

↓

Running CPU Module	...Refer to Section 4.11
(1) Set the RUN/STOP switch of the CPU module (the "CONTROL" LED is ON) to the RUN position, and confirm that the "RUN" LED is ON. (2) Confirm that the "ERR." LED of the CPU module is OFF. 　If the "ERR." LED is ON/flashing, check the error cause using the System Monitor or diagnostics[3] of GX Developer, and eliminate it. 　If the error is caused by the parameters or programs, correct the parameters or programs.	

↓

Restarting System	...Refer to Section 4.8
Power off the system and then power on again, or set the RESET/LCLR switch of the CPU module to the RESET position and then set it to the reset switch neutral position.	

↓

(Complete)

Diagram 4.2 Procedure for Starting Up in Debug Mode

* 1 : Use "double-shielded coaxial cables" when configuring a coaxial bus system on a MELSECNET/H remote I/O network.
　　Refer to the following manual for the double shielded coaxial cables.

　　☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

* 2 : Diagnostics includes PLC diagnostics, Ethernet diagnostics, CC IE Control diagnostics, MELSECNET diagnostics, and CC-Link/CC-Link/LT diagnostics.
　　For details, refer to each network manual.

4.1 Mounting Modules

(1) Procedure for Mounting Modules

Mount a module to the main base unit and the extension base unit in the following procedures.

(a) Insert the module fixing latch, into the module fixing cutout firmly so that the module fixing latch may not come off the module fixing cutout.

(b) Using the module fixing hole as a support, install the module onto the base unit by pushing it in the direction of arrow.
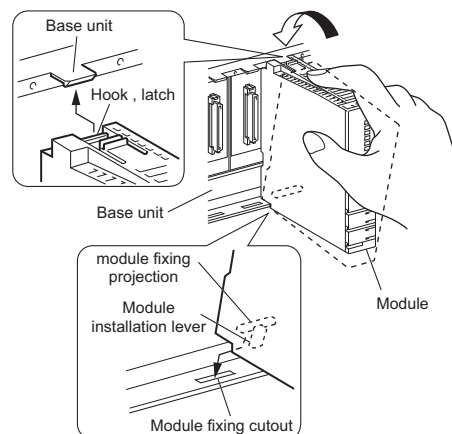
Diagram 4.3 Procedure for Mounting Modules

(2) Handling Cautions

(a) Do not drop the module case or subject it to strong impact, as it is made of resin.

(b) The module can be fixed to the base unit easily by the upper hook. However, it is recommended that the module be fixed using the module fixing screw, if installed in a location exposed to strong vibration or impact. In such cases, tighten the module fixing screw within the following range.
Module fixing screw (M3×12 screw): Tightening torque range: 36-48 N•cm

4.2 Wiring

This section explains wiring to the power supply module necessary for starting up a redundant system, connection of the Q6BAT battery connectors, tracking cable connection.

Install the wiring to a network module by referring to the corresponding manual, as the wiring method differs according to model.

Install the wiring to an I/O module by referring to the following manual, as the wiring method differs according to the model.

☞ I/O Module Type Building Block User's Manual

(1) Wiring to a Power Supply Module

Connect a power cable and ground cable to the power supply module on a main base unit by referring to the wiring example shown in Diagram 4.5.

• Q64RPN
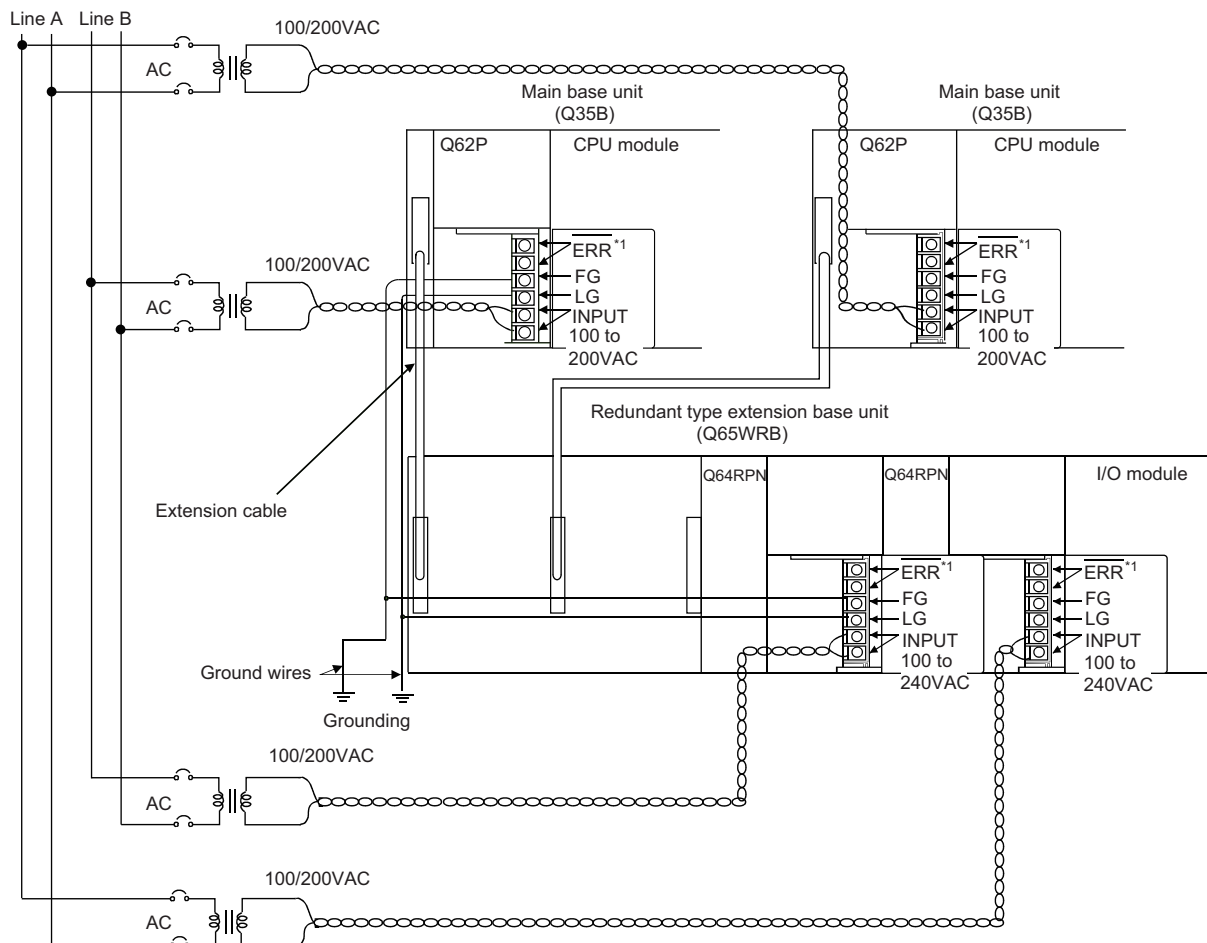
Diagram 4.4 Example of Wiring to a Power Supply Module

* 1: Operation of an ERR terminal is as follows:

<When mounting power supply module to main base unit>

The ERR terminal is OFF (open) when AC power is not turned ON, when the CPU module stop error (including an error at the time of reset) occurs, or when fuse of the power supply module is blown.

<When mounting redundant power supply module to redundant type extension base unit>

The ERR terminal is OFF (open) when AC power is not turned ON, when fuse of the redundant power supply module is blown, or when the redundant power supply module breaks down.

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• Q64RP
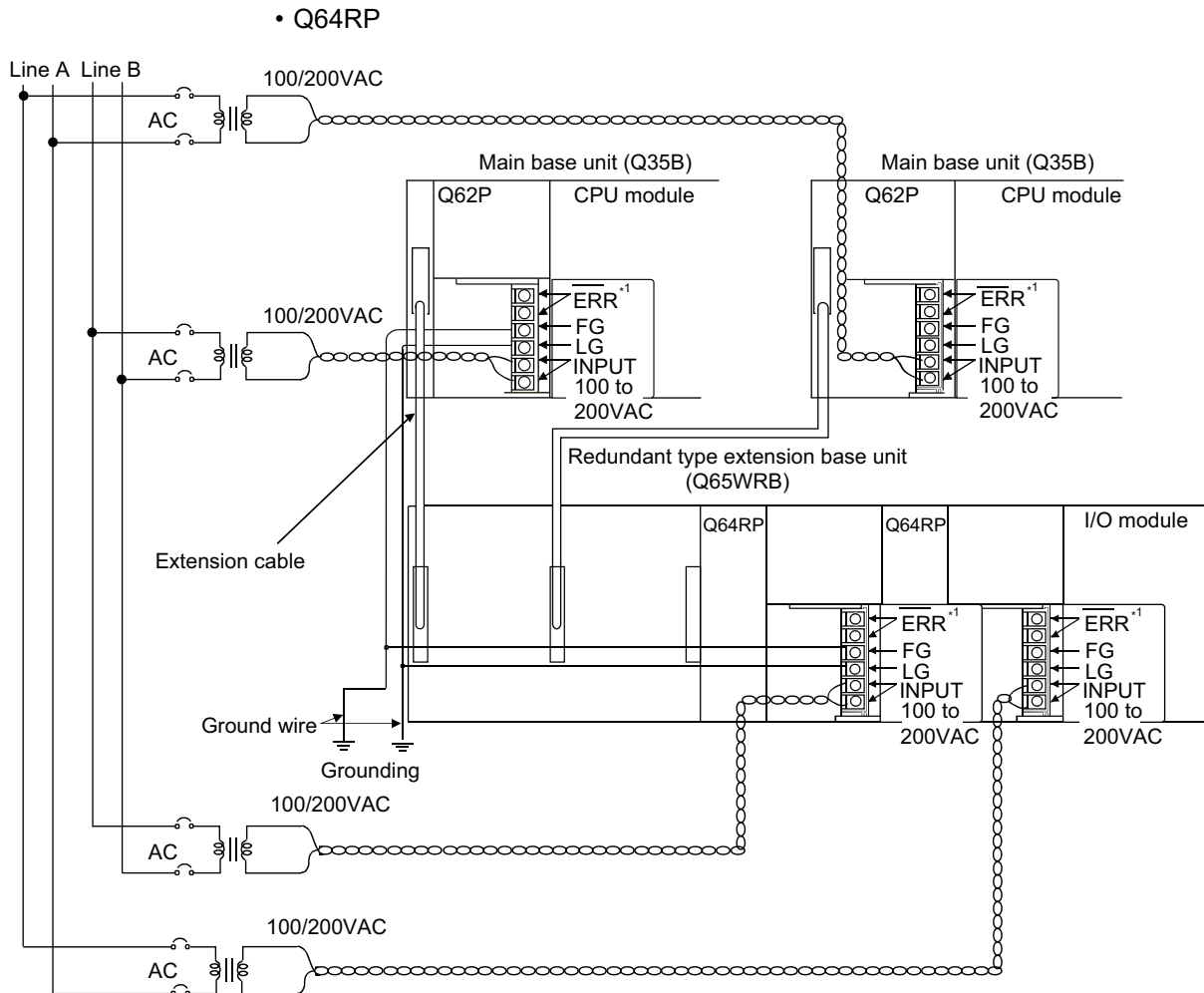
Diagram 4.5 Example of Wiring to a Power Supply Module

* 1: Operation of an ERR terminal is as follows:
  <When mounting power supply module to main base unit>
  The ERR terminal is OFF (open) when AC power is not turned ON, when the CPU module stop error (including an error at the time of reset) occurs, or when fuse of the power supply module is blown.
  <When mounting redundant power supply module to redundant type extension base unit>
  The ERR terminal is OFF (open) when AC power is not turned ON, when fuse of the redundant power supply module is blown, or when the redundant power supply module breaks down.

◇POINT

1. Use the thickest possible (max. 2 mm^2 (14 AWG) wires for the 100/200VAC and 24VDC power cables. Be sure to twist these wires starting at the connection terminals.
   For wiring a terminal block, be sure to use a solderless terminal.
   To prevent short-circuit due to loosening screws, use the solderless terminals with insulation sleeves of 0.8 mm or less.
   Also, only two solderless terminals can be connected per terminal block.

Solderless terminals with insulation sleeves   Terminal block
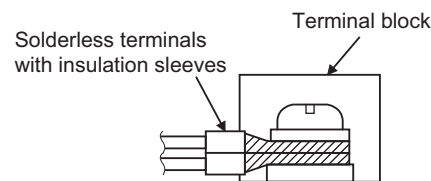
2. Supply power to two redundant power supply modules individually (redundant power supply module).

3. When two redundant power supply modules (Q64RPN, Q64RP) are placed together and operated as a redundant power supply system, it is recommended to use one of them as an AC power input and connect the other to an uninterruptible power supply.

4. When LG and FG terminals are connected, ground the wires.
   If not, the programmable controller may become susceptible to noise.
   The potential of the LG terminal is a half of the input voltage.

5. When the redundant power main base unit is used in the system, and the redundant power modules mounted on the redundant power main base unit and redundant power extension base unit are powered on simultaneously, on-timing (short circuit) of the ERR terminals differs between the modules. (The ERR terminal on-timing of the CPU module on the redundant power main base unit delays by the time required for the initial processing.)

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(2) Connecting the Q6BAT Battery Connectors

The CPU module Q6BAT batteries are shipped with the battery connectors disconnected.
Connect the battery connectors according to the following procedure prior to use.

(a) Confirming Battery Installation Status

Open the CPU module bottom cover, and confirm that the battery is installed properly.

(b) Connecting the Battery Connectors

Align the connector mounted in the case with battery connector pin and insert it.
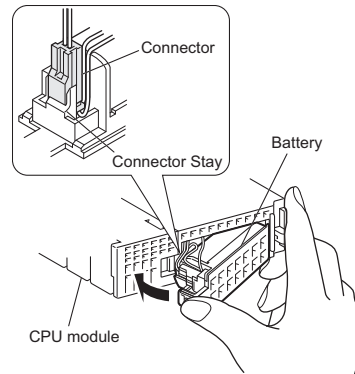
Diagram 4.6 Connecting the Case Connector and Battery Connector Pin

Remark •

Refer to the following manual, for installation of Q7BATN, Q7BAT, and SRAM card batteries applicable to CPU modules.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

• •

(3) Connecting a Tracking Cable

Connect a tracking cable to CPU module tracking connectors according to the following procedure.

(a) Confirming System A/System B Connectors

Confirm each connector of system A/system B.

(b) Connecting a Tracking Cable Connector

Align the tracking cable connector with the CPU module TRACKING connector, and then connect them.

For details, refer to Section 3.3.

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(4) Connecting extension cables

When using the redundant type extension base unit, connect extension cables by the following procedures.
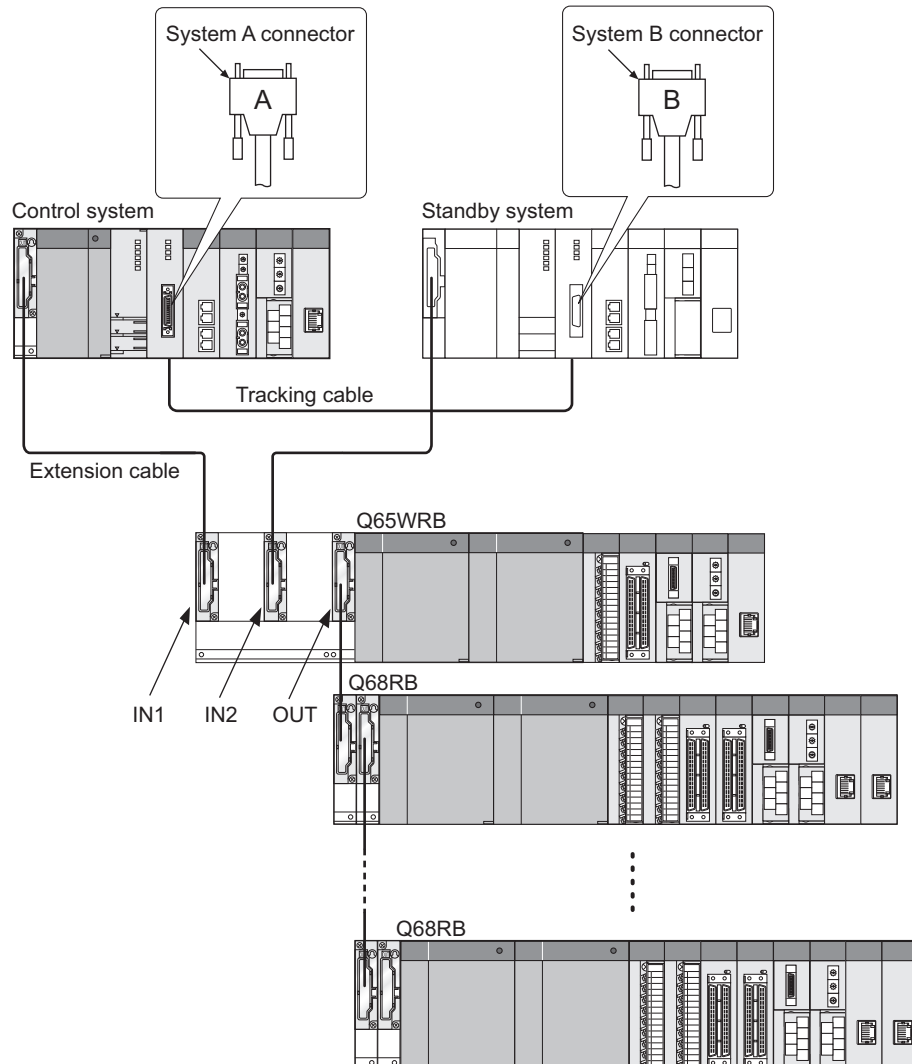
Diagram 4.7 Connection method for extension cables when using the redundant type extension base unit

(a) Connecting the main base unit to the redundant type extension base unit

- System A extension cable → Connect to IN connector (IN1) on the redundant type extension base unit.
- System B extension cable → Connect to IN connector (IN2) on the redundant type extension base unit.

(b) Connecting the redundant type extension base unit to the redundant power extension base unit

Connect extension cable from OUT connector on the redundant type extension base unit to IN connector on the redundant power extension base unit.

4.3 Module Initial Settings

Make the switch settings for the CPU module and network module.
Refer to the manual for the network module used, as the settings vary according to the model.

(1) CPU Module RUN/STOP Switch Settings
Set the RUN/STOP switch of CPU module to the STOP position.

(2) CPU Module RESET/L.CLR Switch Settings
Set the RESET/L.CLR switch of CPU module to the reset switch neutral position.

CPU module

Power Switch [1]

STOP   RUN

RESET/L.CLR Switch [1]
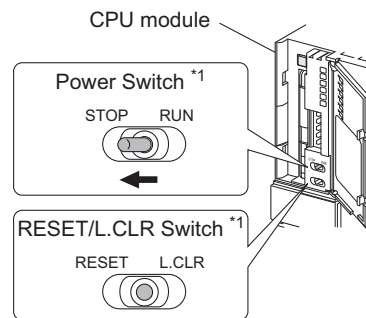
RESET   L.CLR

Diagram 4.8 CPU Module Switch Positions and Settings

* 1: Make sure to operate the RUN/STOP switch and the RESET/L.CLR switch by hand to make the settings.
If these switches are operated by the screw driver or other tool, this can result in damage.

4.4 Confirming that the Power Supply is ON

(1) Powering on the system
Check the power line and power supply voltage of the power supplies of the power supply modules of the main base units and extension base units in systems A and B, and turn ON power supplies simultaneously.

(2) Confirming the Power Supply Module "POWER" LED
After turning ON power supplies of the power supply modules of the main base units and extension base units in systems A and B, check that "POWER" LED is turned ON (green).[1]

POWER LED ON (green)

POWER

Power supply module
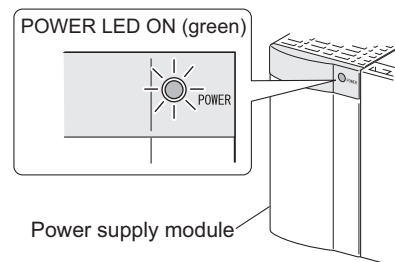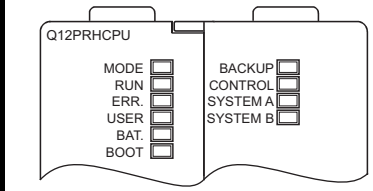
Diagram 4.9 Confirm that the "POWER" LED of power supply module is ON

* 1: The LED turns on on either system in the debug mode.

4.5 Confirming System A/System B

Identify system A and system B by checking the "System A" and "System B" LEDs of CPU modules.

Table4.1 Identify system A and system B by checking the "SYSTEM A" and "SYSTEM B" LEDs

CPU Module LEDs	System A and System B LEDs		
Q12PRHCPU MODE RUN ERR. USER BAT. BOOT BACKUP CONTROL SYSTEM A SYSTEM B	LED Name	System A	System B
	SYSTEM A	ON	OFF
	SYSTEM B	OFF	ON

Refer to the following manual, for details on the CPU module LED.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

4.6 Starting up/Connecting GX Developer

(1) Starting up GX Developer

Power on the personal computer and start up GX Developer.

(2) Connecting GX Developer

Connect the computer in which GX Developer has been installed and the System A CPU module with a cable.

Refer to the following manual for applicable cables.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

Tracking cable

USB Cable

Personal Computer
(GX Developer)
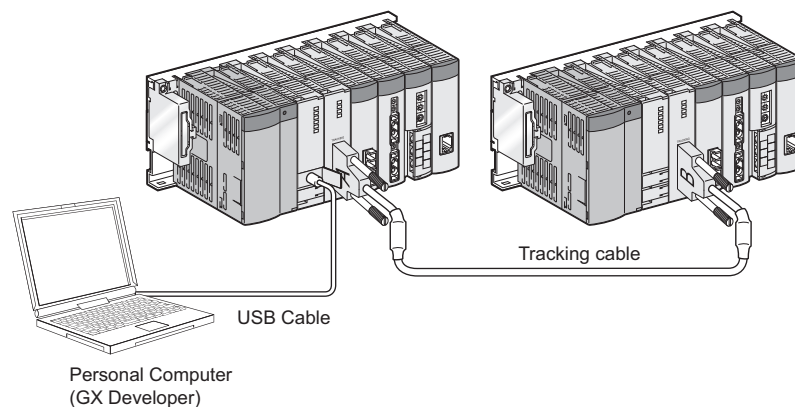
Diagram 4.10 Connecting GX Developer and System A CPU Module

4.7 Writing Parameters and Programs to CPU

Write parameters and programs to the CPU modules (one CPU module in the debug mode) of System A and System B according to the following procedures.

(1) Display of Write to PLC Window

Select [Online] to [Write to PLC] from the menu bar to display the "Write to PLC" window.
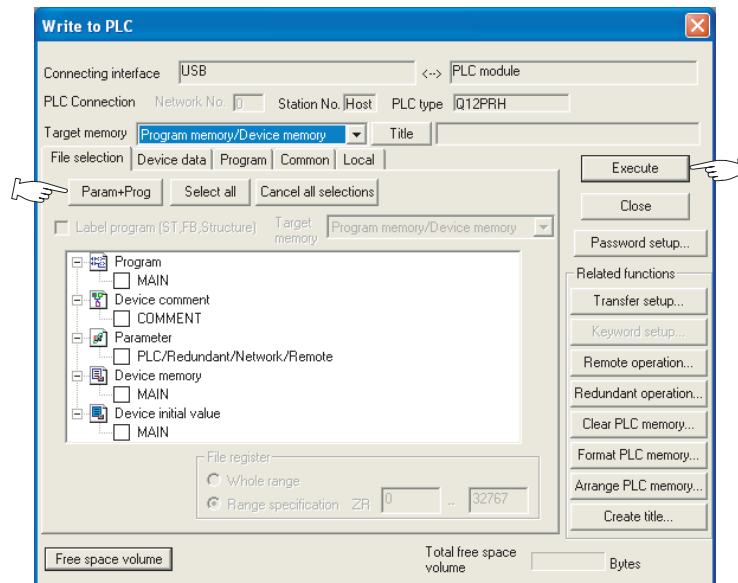
Diagram 4.11 Write to PLC Window

(2) Selection of Write Data

Click the "Parameters and Programs" button, and select parameters and programs as Write Data.

(3) Execution of Write to PLC

Click the "Execute" button.
As the following confirmation dialog box appears, click "Yes".
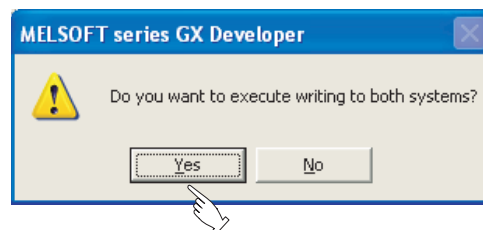
Diagram 4.12 Execution of Write to PLC Confirmation Window

4.8 Restarting System A and System B

Power on system A and system B again, or set the reset switches of system A/system B CPU modules to neutral position, in order to restart the redundant system.

(1) Powering supply ON again

Power off system A and system B, and then simultaneously power on the both systems. [1]

(2) Setting the Reset Switches of CPU modules to Neutral Position

Set the RESET/L.CLR switches of system A and system B CPU modules to the RESET position, and then simultaneously set the switches to neutral position. [2] [3]
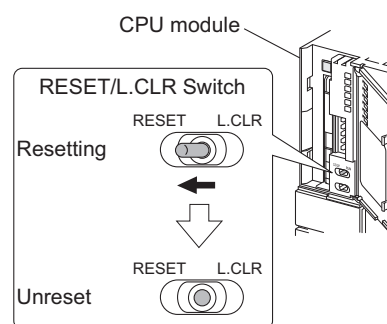
Diagram 4.13 Setting the CPU Module RESET Switch to Neutral Position

* 1: Power on one system within three seconds after powering on the other system.
* 2: Set the reset switch of one CPU module to neutral position within three seconds after making the same settings for the other CPU module.
* 3: The LED turns on on either system in the debug mode.
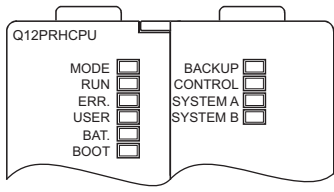
⊠**POINT**

When switching power on again, switch power on more than 5 seconds after switching power off. Failure to do so may disable a normal start of the redundant system because an inrush current of higher than the specified value may flow or the tracking communication circuit in the CPU module may not be initialized.

4.9 Error Check

Confirm that no error has occurred in the CPU module by checking the "ERR." LED.

Table4.2 Checking the "ERR." LED to Check for Errors

CPU Module LED	LED (common to System A and System B)		
Q12PRHCPU MODE ☐ BACKUP ☐ RUN ☐ CONTROL ☐ ERR. ☐ SYSTEM A ☐ USER ☐ SYSTEM B ☐ BAT. ☐ BOOT ☐	LED Name	Normal	Error[1]
	ERR.	OFF	ON/Flashing

* 1: If any error has occurred in the CPU module, check the details by using the PLC diagnostics of
GX Developer.

Refer to the following manual, for details on CPU module LEDs.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

4.10 Confirming the Control System/Standby System

Identify the control system/standby system by checking the "CONTROL" LEDs.

Table4.3 Checking the "CONTROL" LED to Identify Control System and Standby System

CPU Module LED	LED (common to System A/System B, i.e., Control System/Standby System)		
Q12PRHCPU MODE ☐ BACKUP ☐ RUN ☐ CONTROL ☐ ERR. ☐ SYSTEM A ☐ USER ☐ SYSTEM B ☐ BAT. ☐ BOOT ☐	LED Name	Control System (System A)	Standby System (System B)
	CONTROL	ON	OFF

4.11 Running CPU Modules

Set the RUN/STOP switch to the RUN position in this order: standby system (System B)
CPU module→control system (System A) CPU module.

CPU module

Power Switch

STOP   RUN
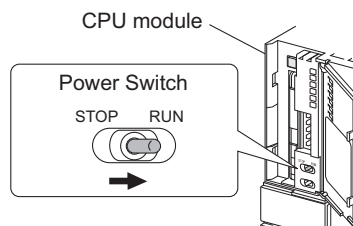
Diagram 4.14 CPU Module RUN/STOP Switch Position and Setting

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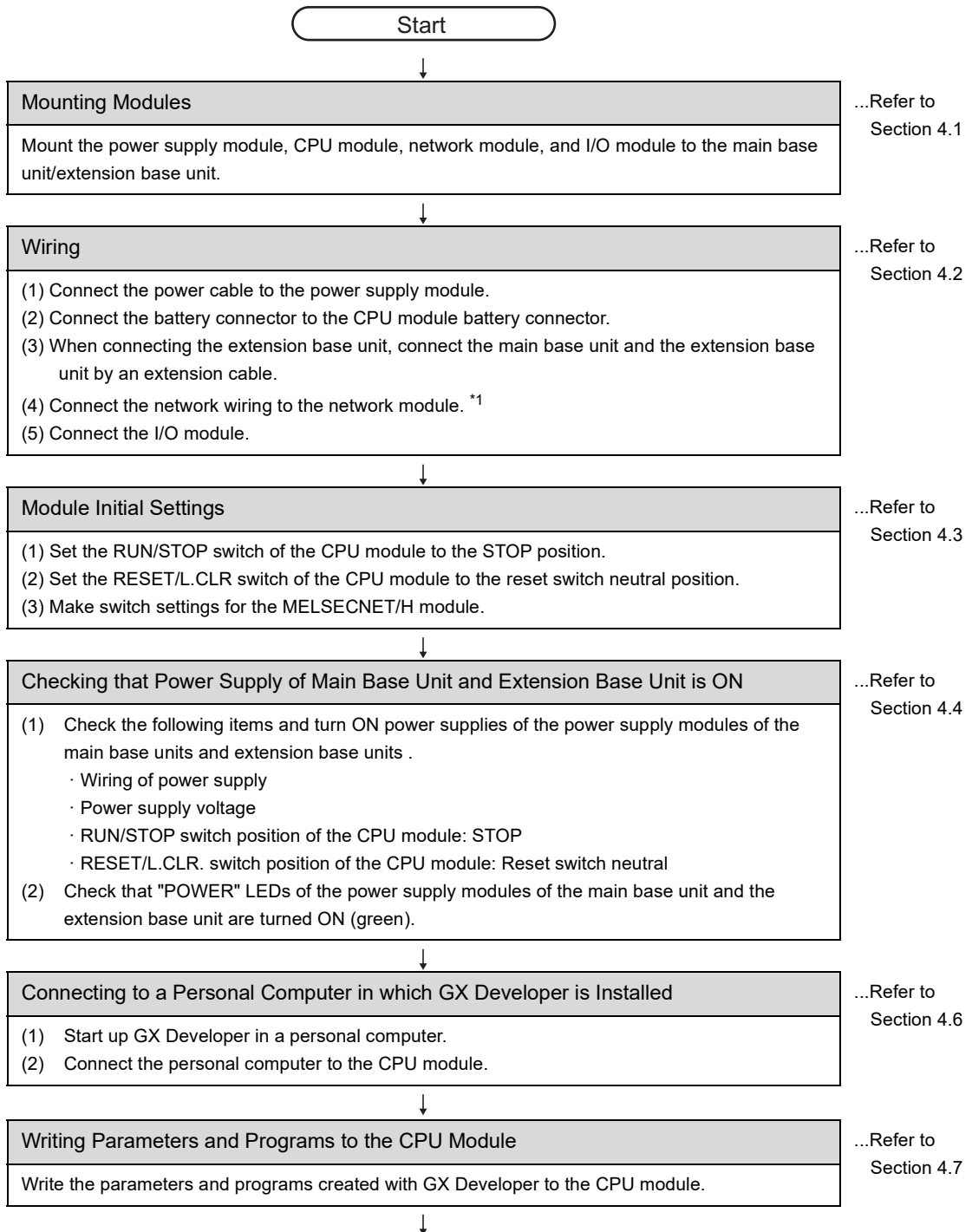6 REDUNDANT SYSTEM NETWORKS

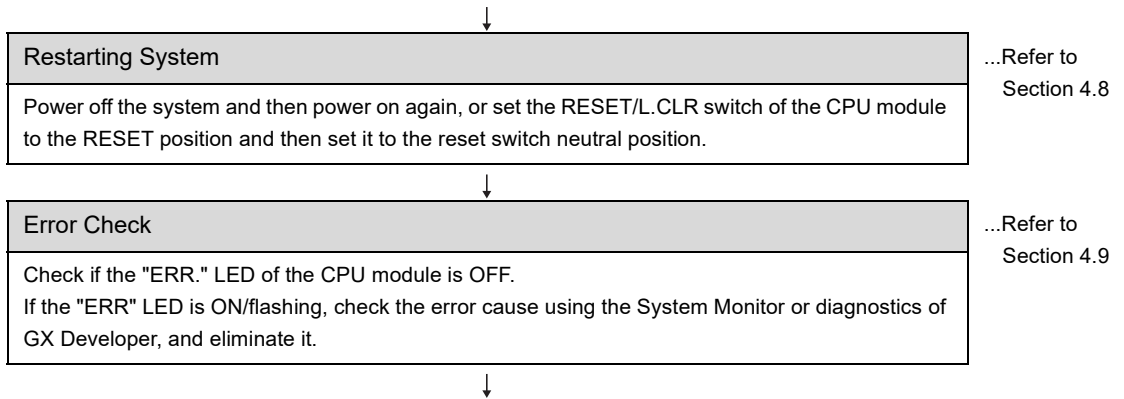7 PROGRAMMING CAUTIONS

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CHAPTER5 REDUNDANT SYSTEM FUNCTIONS

This chapter explains the redundant system functions.

5.1 Basic Concept of Redundant System

A redundant system consists of two basic systems, each of which includes a power supply module, CPU module, main base unit and network module.
To configure a redundant system, connect the basic systems on which above modules are mounted with a tracking cable.
 (Please refer to Section 2.1 for system configuration.)

System A - Control System   System B - Standby System
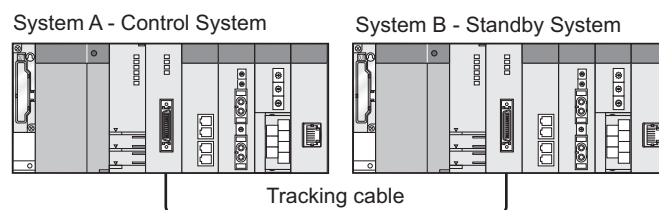
Tracking cable

Diagram 5.1 Redundant System Configuration

(1) Determination of System A and System B
In a redundant system, one basic system is called "System A", and the other, "System B", to identify each of the two systems connected with a tracking cable.
Please refer to Section 5.1.1 for determination of system A and system B.

(2) Control System and Standby System
In a redundant system, the CPU module of either system performs operations and controls the redundant system.
The other system, which is for backup, does not perform operations.
The controlling system is referred to as "Control system", and the backup system, "Standby system".
Please refer to Section 5.1.2 for details on the control system and standby system.

(3) Switching Between the Control System and Standby System
If a fault occurs in the control system, the backup system takes over the system control and continues the operation.
Please refer to Section 5.3 for switching between the control system and standby system.

(4) Consistency Check between Control System and Standby System
A redundant system conducts "Consistency check between Systems A and B" to check if the control system and standby system are consistent so that control continues without the system going down when system switching occurs.
Refer to Section 5.1.4, for consistency check between systems A and B.

(5) Operation Mode

The redundant system operates in the following three modes.

(a) Backup mode

The backup mode is for normal operation of redundant system. If a fault or failure occurs in the control system, the standby system takes over the control and continues the system control.

(b) Separate mode

The separate mode is for maintenance without stopping control. In the separate mode, different programs can be run in the control system and standby system CPU modules. While continuing the system control in the control system, program of standby system can be corrected and operation of program can be checked by using the data tracked from the control system. However, in the separate mode, system switching is not executed even if a fault or failure occurs in the control system. (System switching can be manually carried out.)

(c) Debug mode

The debug mode is for debugging with a system configuration of only either system prior to the system operation. In a redundant system, two Redundant CPUs are normally required; however, debugging can be executed with only one CPU.

In the debug mode, the CPU module uses the parameters for system A to operate. Therefore, the station set as system B in the network parameters becomes absent station (disconnected station).

Check the system switching operation in the backup mode prior to the system operation because the system switching cannot be checked in the debug mode. On the programming at system switching, refer to CHAPTER 7 "PROGRAMMING CAUTIONS".

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5.1.1 Determination of System A/System B

In a redundant system, one of the systems connected with a tracking cable is referred to as "System A", and the other, "System B".
System A and System B are determined by the direction of the tracking cable, i.e., connectors.

(1) Determination of System A/System B
The system that includes the CPU module connected with the tracking cable system A connector will be "System A" and the other one with the system B connector will be "System B".

(a) When the System A connector is connected to the left system
When the system A connector is connected to the CPU module of the left system, system A/B will be determined as shown in Diagram 5.2.
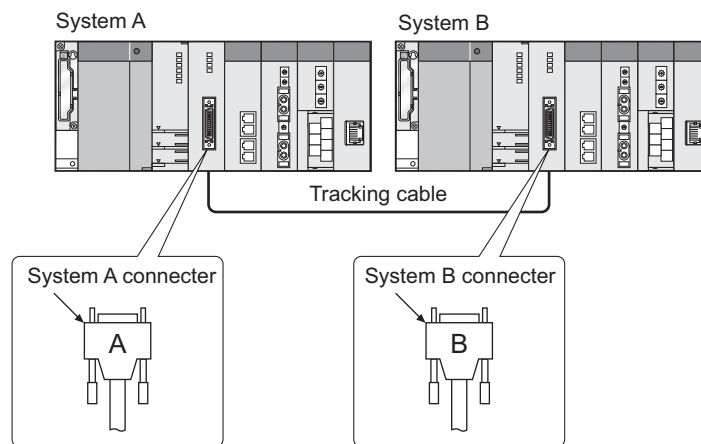
Diagram 5.2 System A and System B when System A Connector Is Connected to Left System

(b) When the System A connector is connected to the right system
When the system A connector is connected to the CPU module of the right system, system A/B will be determined as shown in Diagram 5.3.
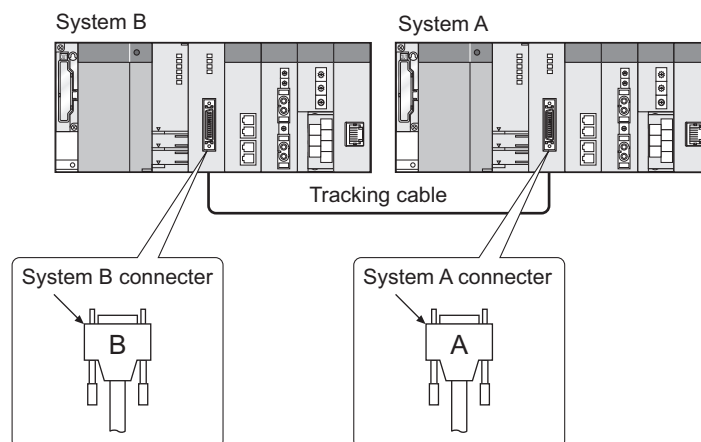
Diagram 5.3 System A and System B when System A Connector Is Connected to Right System

Refer to CHAPTER 3, for tracking cable specifications and connection.

(2) Confirming system A/System B [*1]

Identify system A and system B by checking the "SYSTEM A" and "SYSTEM B" LEDs of CPU modules.

Table5.1 Identify system A and system B by checking the "SYSTEM A" and "SYSTEM B" LEDs

CPU Module LED	LED Statuses		
Q12PRHCPU MODE RUN ERR. USER BAT. BOOT BACKUP CONTROL SYSTEM A SYSTEM B	LED Name	System A	System B
	SYSTEM A	ON	OFF
	SYSTEM B	OFF	ON

Refer to the following manual, for details on the CPU module LED.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

* 1: System A and System B can be identified by checking whether the special relays "System A discriminating flag (SM1511)" and "System B discriminating flag (SM1512)" are ON or OFF.

Table5.2 Confirming SM1511 and SM1512 to Identify System A and System B

	SM1511	SM1512
System A	ON	OFF
System B	OFF	ON

(3) Precautions

When using the redundant system in the backup mode, connect the tracking cable to the control system and the standby system CPU modules.
If both systems are powered on without the tracking cable connected to the CPU models, the "TRK.CABLE ERR. (error code: 6120)" stop error will occur and the system cannot run.
If "TRK. CABLE ERR." occurs at power-on, power off System A and System B, then connect the tracking cable to the CPU modules, and power the systems on again.

⊠**POINT**

When starting up a single basic system, use the debug mode.
Refer to Section 5.1.3, for the debug mode.

5.1.2 Determination of Control System and Standby System

In a redundant system, either system CPU module runs the programs, controls the system and communicates with the network.
The system that includes the CPU module running the programs is referred to as the "Control system".

The other system serves as a backup for continuing the system operation in the case the module on the control system fails or develops an error.
This backup system is referred to as the "standby system".
The standby system CPU module does not run the programs. (The same status as the STOP status.)

The control system and standby system are determined by which system starts up first, or which RESET/L.CLR switch of the CPU module is set to the neutral position first.

(1) When One of the Systems Starts Up Before the Other One [1] [2]

If either system A or system B starts up before the other one, the system that starts up first will be the "Control system", and the other one will be the "Standby system". [3]
When both CPU modules of the system A and system B are reset, the system with the CPU module of which RESET/L.CLR switch is set to the neutral position first will be the "Control system", and the other one will be the "Standby system". [3]

(a) When system A starts up first
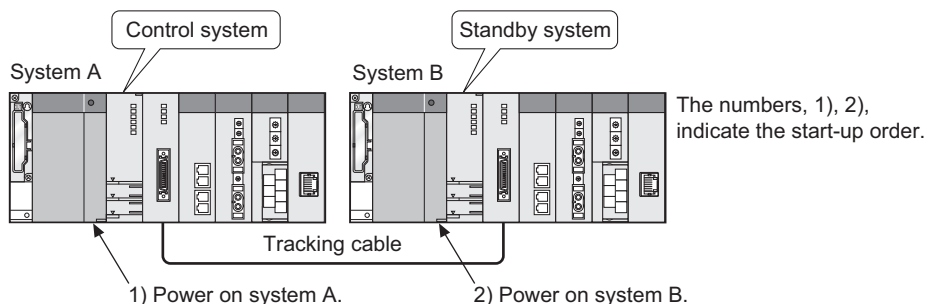
Diagram 5.4 Control System and Standby System when System A Starts Up First

* 1: Refer to Section 5.1.1 for determination of system A and system B.
* 2: Indicates the case where one system starts up within 3 seconds after the other system.
* 3: If the second system does not start up within 3 seconds of the first one, the "STANDBY SYS.DOWN(error code: 6300)" continuation error will occur in the control system CPU module. By disabling "Check standby system malfunction," at the standby System Monitor settings in the redundant parameter operation mode settings with GX Developer, the control system will not detect the "STANDBY SYS. DOWN" continuation error.

(b) When system B starts up first
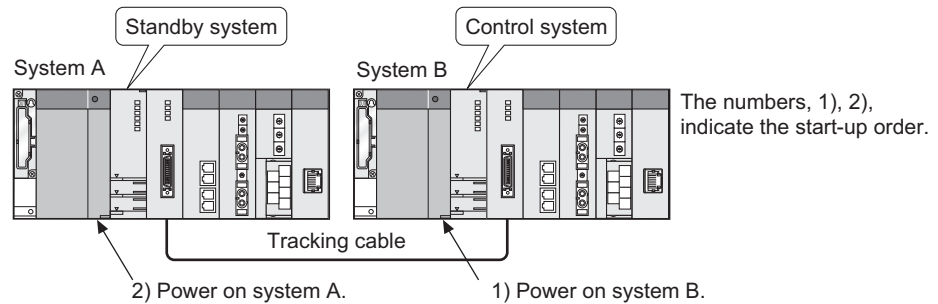
Diagram 5.5 Control System and Standby System when System B Starts Up First

(2) When System A and System B Start Up Simultaneously *4 *5

If system A and system B start up simultaneously, system A will be the "Control system", and system B will be the "Standby system".

If the system A and system B CPU modules are reset (RESET/L.CLR switch is set to the RESET position) and unreset (RESET/L.CLR switch is set to the neutral position) simultaneously, system A will be the "Control system", and system B will be the "Standby system".
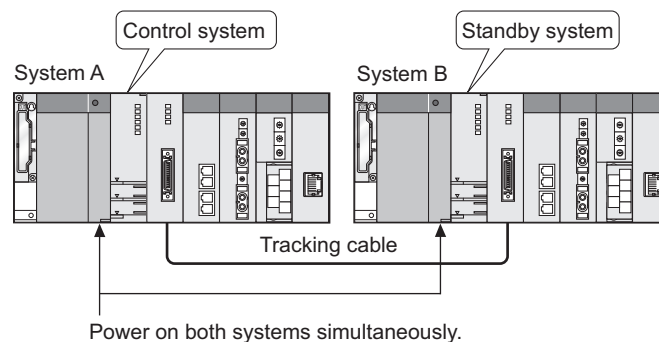
**Diagram 5.6 Control System and Standby System
when System A and System B Start Up Simultaneously**

* 4: Refer to Section 5.1.1 for determination of system A and system B.
* 5: This indicates the following cases:
    •One system starts up and the other starts up within 3 seconds.
    •When one CPU module is unreset (RESET/L.CLR switch is set to the neutral position) within 3 seconds of the other.

(3) When Only One System Starts Up

Whichever system that starts up first will be the "Control system".[6]

Also, if the control system is already on, the other system will be the "Standby" system when it starts up.

Control system

Tracking cable

Turn on the power.   Leave the power in OFF position.
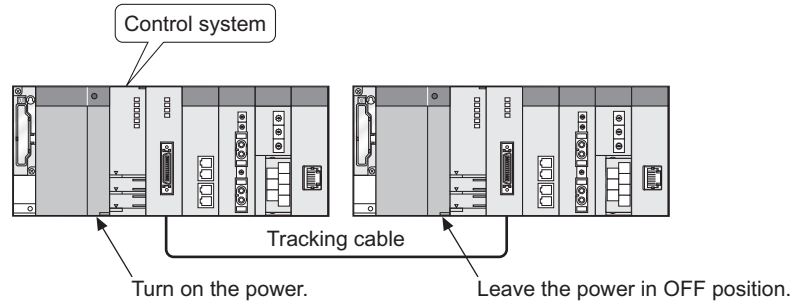
Diagram 5.7 Control System when Only One System Starts Up

* 6: The "STANDBY SYS. DOWN (error code: 6300) continuation error will occur in the control system CPU module.

By disabling "Check standby system malfunction," at the standby System Monitor settings in the redundant parameter operation mode settings with GX Developer, the control system will not detect the "STANDBY SYS. DOWN" continuation error.

(4) Confirming the Control System/Standby System[7]

Identify the control system and standby system by checking the "CONTROL" LEDs. of CPU modules.

Table5.3 Confirming the control system and standby system by checking the "CONTROL" LEDs

CPU module LED	LED status
Q12PRHCPU MODE BACKUP RUN. CONTROL ERR. SYSTEM A USER SYSTEM B BAT. BOOT	

LED Name	Control System	Standby System
CONTROL	ON	OFF

Refer to the following manual, for details on the CPU module LED :

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

* 7: The control system and standby system can be identified by checking the status in the special relay "Control system judgement flag" (SM1515) and "Standby system judgement flag" (SM1516).

Table5.4 Confirming SM1515 and SM1516 to Identify Control system and Standby system

	SM1515	SM1516
Control system	ON	OFF
Standby system	OFF	ON

(5) Precautions

When using the redundant system in the backup mode, connect the tracking cable to the control system and the standby system CPU modules.

If both systems are powered on without the tracking cable connected to the CPU models, the "TRK.CABLE ERR. (error code: 6120)" stop error will occur and the system cannot run.

If "TRK. CABLE ERR." occurs at power-on, power off System A and System B, then connect the tracking cable to the CPU modules, and power the systems on again.

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5.1.3 Operation Mode

The operation mode determines the redundant system operation methods. Following three operation modes are available.

- Backup Mode
- Separate Mode
- Debug mode

Use GX Developer to switch between the backup mode and separate mode.
Refer to Section 5.3 for switching between the backup mode and separate mode.
Switch the operation mode to the debug mode in the redundant parameter settings.

(1) **Backup Mode**

The backup mode is for normal operation of redundant system.
If a fault or failure occurs in the control system, the standby system takes over the control and continues the system operation.
To enable the standby system to continue the system operation when the control system goes down, the data of the control system must be continuously transferred to the standby system through the tracking cable.
Refer to Section 5.5, for details on the tracking function.
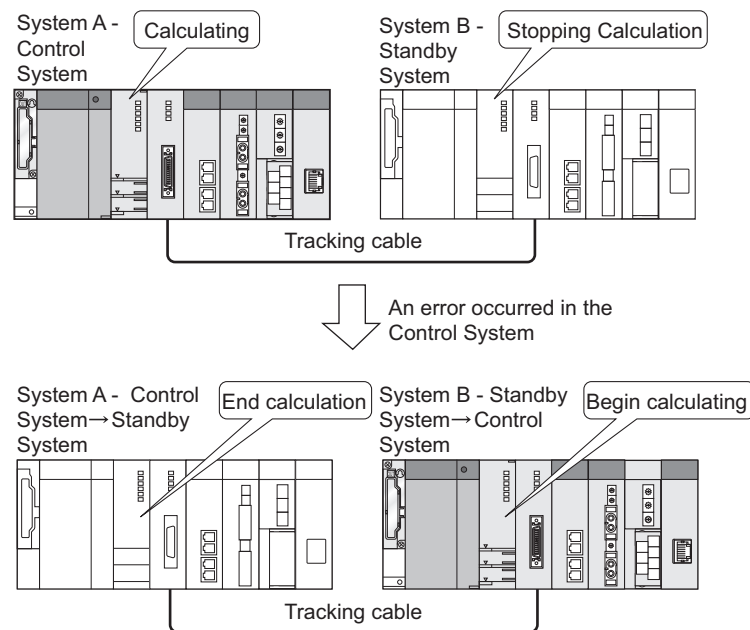
Diagram 5.8 System Switching Operation in Backup Mode

(a) Confirming Backup Mode

Confirm that the redundant system is running in the backup mode by checking the "BACKUP" LEDs of CPU modules.

Table5.5 Checking the "BACKUP" LED to Confirm the Backup Mode

CPU Module LED	LED status		
Q12PRHCPU MODE □ BACKUP □ RUN □ CONTROL □ ERR. □ SYSTEM A □ USER □ SYSTEM B □ BAT. □ BOOT □	**LED Name**	**Control System**	**Standby System**
	BACKUP	ON (green)	ON (green)

Refer to the following manual, for details on the CPU module LED:

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(b) Precautions

1) When the system A and system B CPU modules are reset simultaneously (RESET/L.CLR switch is set to the RESET position), or unreset (RESET/L.CLR switch is set to the neutral position) simultaneously, the operation mode will automatically change to the backup mode. (This applies to only when the debug mode has not been specified in the redundant parameter settings.)
If the above operation is performed when the operation mode has been set to the separate mode with GX Developer while the system is running, this also will change the operation mode to the backup mode.

2) In the backup mode, make system A and system B parameters and programs consistent.
If inconsistent, the "FILE DIFF. (error code: 6000)" stop error will be detected by the consistency check between systems A and B.
Refer to Section 5.1.4, for consistency check between systems A and B.

(2) Separate Mode

The separate mode is for maintenance without stopping control.
In the separate mode, different programs can be run in the control system and standby system CPU modules. While continuing the system control in the control system, program of standby system can be corrected and operation of program can be checked by using the data tracked from the control system.

(a) Enabling/Disabling the Tracking Function
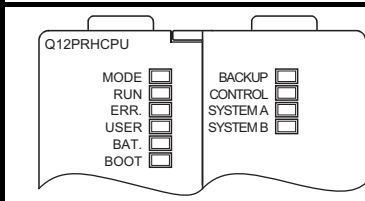
In the separate mode, it is possible to select whether the tracking function is enabled or not, in order to perform the tracking.
Refer to Section 5.5 for the tracking function.

(b) Confirming the Separate Mode

Confirm that the redundant system is running in the backup mode by checking the "BACKUP" LEDs of CPU modules.

Table5.6 Checking the "BACKUP" LED to Confirm the Separate Mode

CPU Module LED	LED Status	
Q12PRHCPU MODE RUN ERR. USER BAT. BOOT BACKUP CONTROL SYSTEM A SYSTEM B		

LED Name	Control System	Standby System
BACKUP	ON (amber)	ON (amber)

Refer to the following manual, for details on the CPU module LED:
☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(c) Precautions

1) When the operation mode is changed with GX Developer while the redundant system is running, the operation mode will automatically change to the separate mode. (Refer to Section 5.4, for details on changing Operating Mode.)

2) If either system is powered on again or either CPU module is unreset (RESET/ L.CLR switch is set to the neutral position) in the separate mode, system switching will not occur.
   - If the control system is powered on again or unreset (RESET/L.CLR switch is set to the neutral position), it will start up as the control system, again.
   - If the standby system is powered on again or unreset (RESET/L.CLR switch is set to the neutral position), it will start up as the standby system, again.

   System switching will not occur even when the control system is powered on again or unreset (RESET/L.CLR switch is set to the neutral position).
   However, system switching can be manually carried out.
   Refer to Section 5.3, for details on system switching.

3) Do not turn OFF the power supply of the control system or perform reset operation in the separate mode when the extension base unit is connected.
   (If doing so, turn ON both systems simultaneously or cancel the reset.)

4) Internal device tracking can be done in the separate mode.
   Internal devices are tracked even when the operation mode is changed from the backup mode to separate mode.
   To interrupt internal device tracking, turn the tracking trigger off.
   (☞ Section 5.5.5)

⊠ POINT

1. When the system A and system B are powered on simultaneously or unreset (RESET/L.CLR switch is set to the neutral position) simultaneously, the operation mode will change to the backup mode.

2. Make sure the tracking cable is connected to the system A and system B CPU modules before powering on the either system again in the separate mode. Failure to do so may cause the "TRK. CABLE ERR (error code: 6120)" stop error in the CPU module of that system.

(3) Debug Mode[*1]
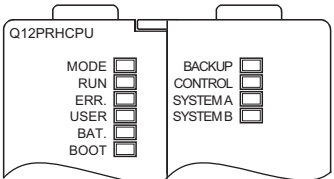
The debug mode is for debugging with a system configuration of only either system prior to the system operation. In a redundant system, two Redundant CPUs are normally required; however, debugging can be executed with only one CPU. (An error will not occur even if the tracking cable is not connected.)

In the debug mode, the CPU module is fixed to "system A" and "control system", and uses the parameters for system A to operate.

Therefore, the station set as system B in the network parameters becomes absent station (disconnected station).

Confirm that the redundant system is running in the debug mode by checking the relevant LEDs of the CPU module.

Table5.7 Checking the "BACKUP" LED to Confirm the Debug Mode

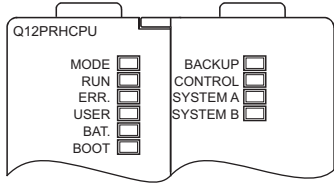| CPU module LED	LED Status	
	LED Name	LED Status
	BACKUP	OFF
	CONTROL	ON
	SYSTEM A	ON
	SYSTEM B	OFF

Refer to the following manual, for details on the CPU module LED:

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

* 1 : When CC-Link IE Controller Network modules are mounted, do not connect the CC-Link IE Controller Network module on both systems to the network at the same time.
In the debug mode, the system B CPU module uses the same parameters for the system A CPU module for operation. Therefore, control station overlap and station number overlap occur when connecting to the network at the same time.

(a) Setting and Canceling the Debug Mode

The debug mode must be specified in the redundant parameter settings with GX Developer to operate the system in the debug mode.

1) Write the redundant parameter in which "Start with Debug mode" is set into the CPU module, and power on the system again or set the RESET/L.CLR switch of the CPU module to reset switch neutral position. Then, the system will start up in the debug mode.
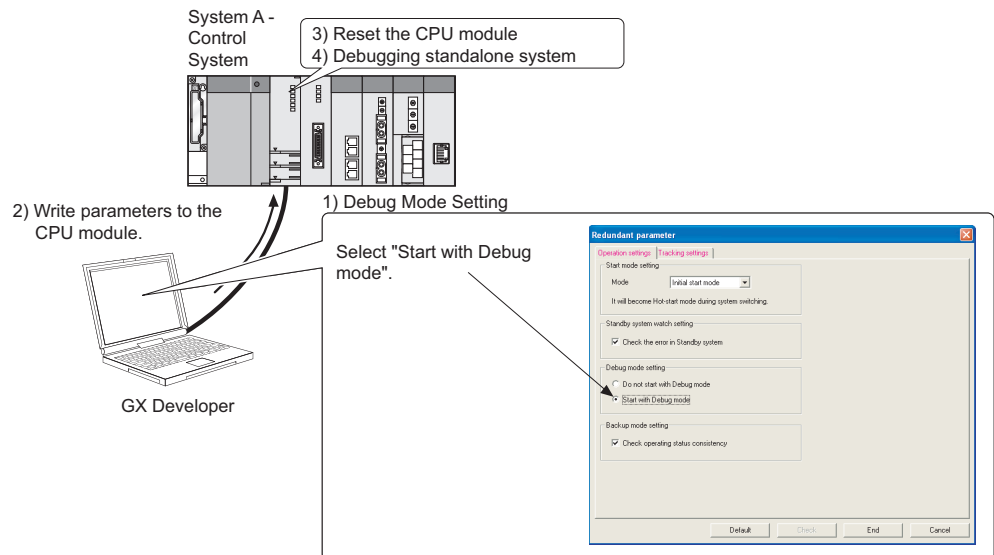
Diagram 5.9 Setting of Debug Mode on Redundant Parameter Window

2) Write the redundant parameter in which "Do not start with Debug mode" is set into the CPU module, and power on the system again or set the RESET/L.CLR switch of the CPU module to reset switch neutral position. Then, the system will start up in the operation mode other than debug mode.

(b) Precautions

1) The following redundant system functions cannot be executed in the debug mode, as the systems do not operate as a redundant system even when they are connected with the tracking cable.

   • System switching (including manual system switching)
   • Memory copy from control system to standby system.
   • Tracking

2) The debug mode cannot be changed to the backup mode or separate mode with GX Developer, as it is set by the redundant parameter.
   Cancel the debug mode if the dialog box (Diagram 5.10) appears on GX Developer:
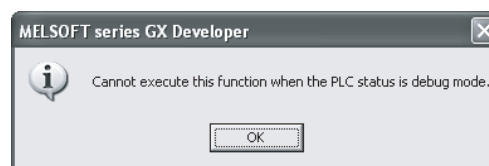
Diagram 5.10 Error Dialog Box Displayed on GX Developer

   Change the redundant parameter to cancel the debug mode.

3) When mounting the MELSECNET/H remote master station on the main base unit, set the station No. to 0 (master station).
   If the station No. is set to a value other than 0, the "LINK PARA. ERROR (error code: 3101)" stop error will occur.

4) When the CPU modules connected with the tracking cable are running in the different modes (backup mode/separate mode and debug mode), each of them operate as listed in Table5.8.

Table5.8 Operation of CPU Module Connected to CPU Module Running in Debug Mode by Tracking Cable

OPERATION MODE		CPU MODULE OPERATIONS
BACKUP MODE	CONTROL SYSTEM	The CPU module develops the "STANDBY SYS. DOWN (error code: 6300)" stop error.
	STANDBY SYSTEM	The CPU module develops the "CONTROL SYS. DOWN (error code: 6310)" stop error.
SEPARATE MODE	CONTROL SYSTEM	The CPU module ignores the CPU module in the debug mode. (Does not detect any error.)
	STANDBY SYSTEM	

   Cancel the debug mode in the redundant parameter when using the redundancy system in the backup mode.

5) In the debug mode, the CPU module uses the parameters for system A to operate. Therefore, the station set as system B in the network parameters becomes absent station (disconnected station). Check the system switching operation in the backup mode prior to the system operation because the system switching cannot be checked in the debug mode. On the programming at system switching, refer to CHAPTER 7 "PROGRAMMING CAUTIONS".

5.1.4 System Consistency Check

In order to continue the redundant system control after system switching, the system configurations, parameters and programs of the control system and standby system must be consistent.

In the backup mode, the standby system CPU module checks if the system configurations, parameters and programs of both systems are consistent. The redundant system operates as listed below according to the check results.[1]
If the control system and standby system are consistent in the system configuration, parameters and programs, the redundant system operates normally.

- If the control system and standby system are inconsistent in the system configuration, parameters and programs, an error will occur in the standby system CPU module.

    * 1: This check is referred to as "Consistency Check Between Systems A and B".

The consistency check is executed in the following cases:
- When both systems are powered on simultaneously
- When both system CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) simultaneously.
- During END processing by the control system CPU module
- When the tracking cable is reconnected

Table5.9 lists consistency check points, and Table5.10 lists execution conditions.
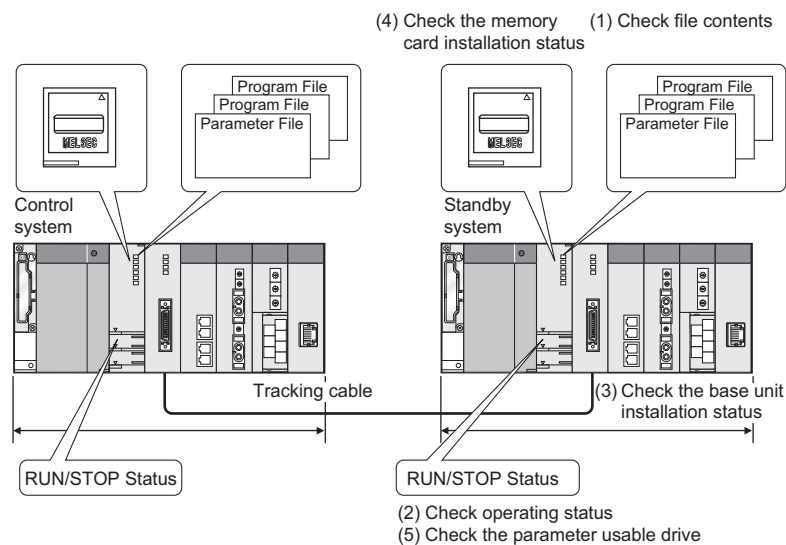
Diagram 5.11 Consistency Check Points Between Systems A and B

Table5.9 Consistency Check Points Between Systems A and B

Check Points		Description
(1)	File Contents	Parameters, programs, and initial device values are checked. The memory capacity of the area for online change of multiple blocks is also checked.
(2)	Operating Status	The operating status (RUN/STOP/PAUSE) of each CPU module is checked.
(3)	Basic System Configuration	The mounting status of each CPU module, I/O module, and network module mounted on the main base units is checked.
(4)	Memory Card Setting	The status of each memory card inserted (SRAM, Flash, or ATA cards) is checked.
(5)	Parameter Valid Drive Settings	The parameter-valid drive settings (dip switches SW2 and SW3) are checked.

Table5.10 Consistency Check Execution Conditions between System A and System B

Conditions *1				Description				
Execution Timing	Operation Mode	Standby System Operating Status	Control System Operating Status	File	Operating Status	Basic System Configuration	Memory Card Settings	Parameter Valid Drive Settings
Execution Timing	Operation Mode	Standby System Operating Status	Control System Operating Status	File	Operating Status	Basic System Configuration	Memory Card Settings	Parameter Valid Drive Settings
Both systems powered on simultaneously	Backup Mode	–	–	○	○	○	○	○
Both systems Unreset *3 simultaneously	Backup Mode	–	–	○	○	○	○	○
END processing	Backup Mode	RUN	RUN	○ *1	○	–	–	–
		RUN	STOP PAUSE	–	○	–	–	–
		RUN	STOP→RUN	○	○	–	–	–
		STOP PAUSE	RUN STOP PAUSE	–	○	–	–	–
		STOP PAUSE	STOP→RUN	–	○	–	–	–
		STOP→RUN	RUN	○	○	–	–	–
		STOP→RUN	STOP PAUSE	–	○	–	–	–
		Power ON Unreset *3	RUN	○	○	○	–	○
		Power ON Unreset *3	STOP PAUSE	–	○	○	–	○
	Changing from Separate Mode to Backup Mode	RUN STOP→RUN Power ON Unreset *3	RUN	○	○	○	–	○
			STOP PAUSE	–	○	○	–	○
Tracking cable reconnected	Backup Mode	RUN	RUN	○	○	○	–	○
		STOP PAUSE	RUN STOP PAUSE	–	○	○	–	○

○ Consistency Check Target, – Out of Consistency Check Target

* 1 The consistency check is executed only in the following cases:
 •After online program change is completed (the consistency check is executed only for the program files.)
 •At system switching
 (The consistency check is executed under the above conditions only.)
* 2 The consistency check is not executed under any other conditions not listed in the table.
* 3 "Unreset" indicates that the RESET/L.CLR switch is set to the neutral position.

Remark •

The consistency check will not be executed during the following:
• Memory copy from control system to standby system

• •

(1) File Consistency Check

(a) Check points

The file consistency check means checking the following files at system switching as listed in Table5.11.

Table5.11 Target Files and Check Contents

Target Files	Details
Parameters	• Checks the parameters stored in the drive set as parameter valid drive (PLC parameters, redundant parameters, network parameters) and the intelligent function module parameters set with GX Configurator. • Checks the remote password stored in the program memory.
Programs	• Checks the program file set in the PLC parameters program settings. • The password set in the password registration is irrelevant.
Initial Device Values	• Checks the initial device value file set in the PLC parameter PLC file settings. • The password set in the password registration is irrelevant.
Area for Online Change of Multiple-Block Write	• Checks the memory capacity of the area for online change of multiple blocks set during formatting. [*1]

* 1   If the memory capacities of the area for online change of multiple blocks are different in both systems, carry out the following operations:
   • Using memory copy from control system to standby system function, copy the program memory contents of the control system to the standby system.
   • Format program memories of both system CPU modules. (The memory capacities of the area for online change of multiple blocks will be the same.)

(b) Inconsistency Errors

Table5.12 lists the file inconsistency errors occurred when the target files are inconsistent.

Table5.12 File Inconsistency Errors

Execution Conditions	Error Description
• When both systems are powered ON simultaneously. • When both system CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) simultaneously. • When one system starts up after the other. • When the separate mode is changed to the backup mode.	The following stop error will occur in the standby system CPU module only: "FILE DIFF. (error code: 6000)". [*2]

If the "FILE DIFF." occurs in the standby system, execute the PLC verify by either of the methods described below to confirm the differences between the files of both system, correct the problem file, and perform write to PLC again.

   • After reading the system A programs and parameters using GX Developer or PX Developer, compare them with the System B programs and parameters.
   • Verify the GX Developer and PX Developer programs and parameters saved in the offline environment with the those written to both system CPU modules.

* 2   If a stop error occurs in the standby CPU module, the "STANDBY SYS. DOWN (error code: 6300)" continuation error will occur in the control system CPU module.

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(2) Operating Status Consistency Check

(a) Check points

The operating status consistency check means checking the CPU module operating status (RUN / STOP / PAUSE).
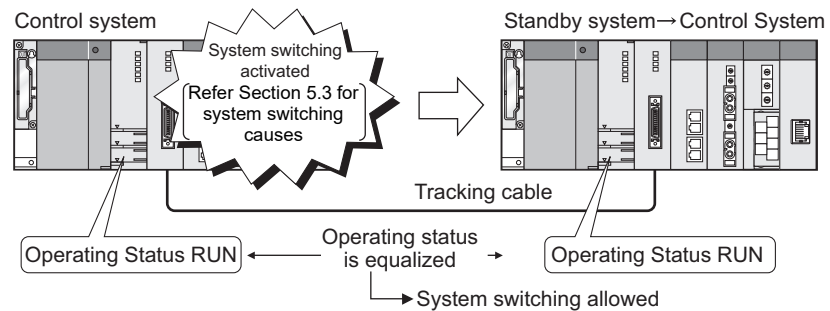
Diagram 5.12 Operating Status Consistency Check

(b) Inconsistency Errors

Table5.13 lists inconsistency errors that occur when the operating statuses are inconsistent.

Table5.13 Inconsistency Errors

Execution Conditions	Error Description
• When both systems are powered ON simultaneously. • When both system CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) simultaneously.	The following stop error will occur in the control system and standby system CPU modules: "OPE.MODE DIFF. (error code: 6020)".
• When one system starts up after the other. • During normal operation. • When the separate mode is changed to the backup mode. • When reconnecting the tracking cable.	The following continuation error will occur in the standby system CPU module only: "OPE.MODE DIFF. (error code: 6010)".

If the "OPE.MODE DIFF." error occurs in the control and standby systems, or in the standby system only, check and correct the following so that they will be consistent in both systems.

- CPU module RUN/STOP switch position
- GX Developer remote operation
- Remote contact ON/OFF status

(c) Operating Status Consistency Check Settings

1) In order that no error will be detected when the operating status is changed during normal operation, uncheck "Check operating status consistency" at backup mode settings in the redundant parameter settings.
   Then, write the parameter to the CPU module, reset it, and the parameter setting will take effect.

2) When "Check operating status consistency" is unchecked, the CPU module will not detect an error even when writing the parameters with GX Developer to change the CPU operating status.

3) When powering on both systems simultaneously, even if the backup mode redundant parameters are set not to check the "Check operating status consistency" has been unchecked at the backup mode settings of operation mode settings in the redundant parameter settings, it will execute a consistency check.
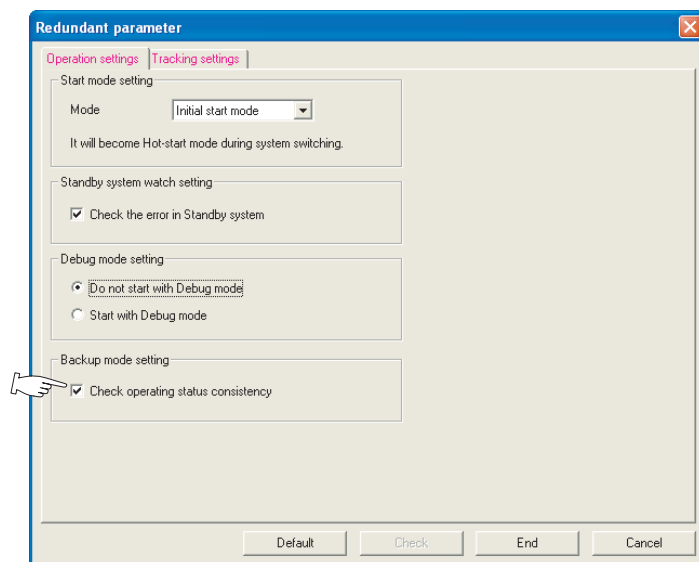
Diagram 5.13 Operation setting Window

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(3) Basic System Configuration Consistency Check

(a) Check points
The following items are checked in the basic system configuration consistency check.
(If the number of slots of the main base unit has been set in the PLC parameter I/O assignment, only the specified number of slots will be checked.)

- CPU module model
- Model and type of modules mounted on each slot in the main base unit
- Network module mode settings
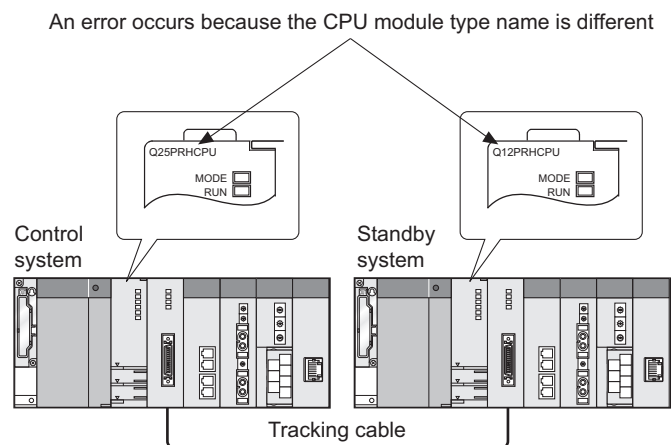
Diagram 5.14 Basic system Configuration Consistency Check

On the other hand, the following items are not checked.

- Model of battery set in the CPU module
- Main base unit model and number of available slots
- Serial Nos. of modules mounted in the main base unit
- Number of power supply modules mounted in the main base unit
- Model of power supply modules mounted in the main base unit
- Slots set to "Open" in the PLC parameter I/O assignment
- Modules being replaced online
- Modules mounted on slots after the number of those in the PLC parameter I/O assignment

(b) Inconsistency Errors

Table5.14 lists inconsistency errors that occur when the basic system configurations are inconsistent.

Table5.14 Basic System Configuration Inconsistency Errors

Execution Conditions	Error Description
• When both systems are powered ON simultaneously • When both system CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) simultaneously	The following stop error will occur in the control system and standby system CPU modules: "UNIT LAY. DIFF. (error code: 6030 or 6035)".
• When one system starts up after the other. • When the separate mode is changed to the backup mode • When reconnecting the tracking cable	The following stop error will occur in the standby system CPU module only: "UNIT LAY. DIFF. (error code: 6030 or 6035)". [1]

If the "UNIT LAY. DIFF." error occurs in the standby system, check and correct the following so that they will be consistent in both systems.

- Model and type of modules mounted in the control system and standby system main base units
- Network module mode settings

* 1: If a stop error occurs in the standby system CPU module, the following continuation error will occur in the control system CPU module: "STANDBY SYS. DOWN (ERROR CODE: 6300)".

(4) System configuration check when using extension base unit

When the extension base unit is used, there are following restrictions. The error description for the case where the system configuration does not meet the following conditions is listed in Table5.15.

- Connect the redundant type extension base unit to the first extension stage.
- Only one redundant type extension base unit is applicable per system.
- Connect IN connector (IN1 and IN2) of the redundant type extension base unit to OUT connector of the main base unit.
- Connect OUT connector of the redundant type extension base unit to IN connector of the redundant power extension base unit.
- The main base units used in systems A and B should be the same model.

Table5.15 Error description when extension base unit does not meet use condition

Use condition	Error description
• Connect the redundant type extension base unit to the first extension stage • Properly connect the redundant type extension base unit and the main base unit	"BASE LAY ERROR (error code: 2012 or 2013)" occurs.
Only one redundant type extension base unit is applicable per system	"EXT.CABLE ERR. (error code: 2020)" occurs.
The main base units used in systems A and B should be the same model	"BASE LAY ERROR (error code: 2012)" occurs.

(5) Memory Card Setting Status Consistency Check

(a) Check points

The memory card setting consistency check means checking if a memory card is set and the type.

Table5.16 Memory Card Setting Status Check Points

Check Points	Description
Memory Card Setting	Checks if a memory card is set or not.
Memory Card Type	Checks if type of memory cards set in the control system and standby system (SRAM card, Flash card, ATA card) are the same.
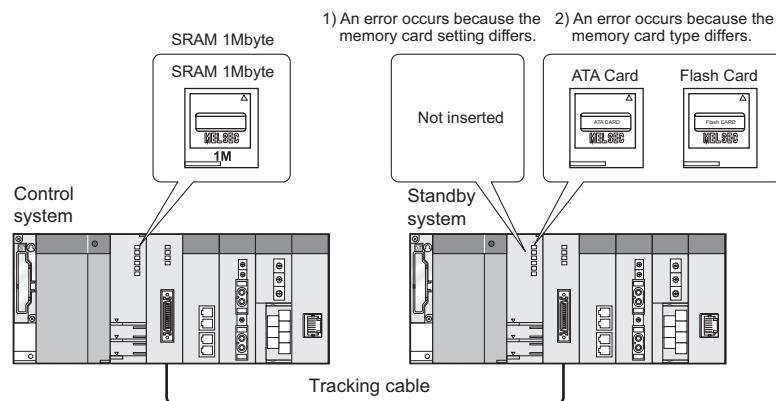
Diagram 5.15 Memory Card Setting Status Consistency Check

(b) Inconsistency Errors

Table5.17 lists the inconsistency errors that occur when the card setting statuses are inconsistent.

Table5.17 Memory Card Setting status Inconsistency Errors

Execution Conditions	Error Description
• When both systems are powered ON simultaneously. • When both system CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) simultaneously.	The following stop error occurs in the control system and standby system CPU modules: "CARD TYPE DIFF. (error code: 6040 or 6041)".

If the "CARD TYPE DIFF." error occurs in the control system and standby system CPU modules, set the same memory card in each system.

⊠**POINT**

1. The memory card setting status consistency check does not include the memory card capacity check.
   When using memory cards of different capacities, check the capacity required for the actual control.

2. If the special relay "Card removal/setting enable flag (SM609) is turned on and the memory card is changed during redundant system operation, an error does not occur since a memory card setting status consistency check is not performed.
   However, a memory card setting status consistency check is executed if both systems are powered on simultaneously or unreset (RESET/L.CLR switch is set to the neutral position) simultaneously.
   When changing the memory card during redundant system operation, set the memory card of the same type in each system.

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(6) Parameter Valid Drive Settings Consistency Check

(a) Check points

The parameter-valid drive settings (dip switches SW2 and SW3) in the control system and standby system are checked.

An error occurs because the dip switch (SW3) setting is incorrect

Control system   Standby system

Tracking cable
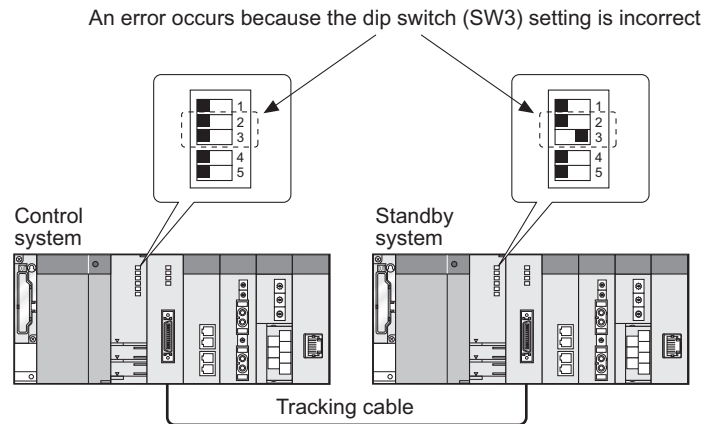
Diagram 5.16 Parameter Valid Drive Settings Consistency Check

(b) Inconsistency Errors

Table5.18 displays the consistency errors that occurred when the parameter valid drive settings are inconsistent.

Table5.18 Parameter Valid Drive Settings Inconsistency Errors

Execution Conditions	Error Description
• When both systems are powered ON simultaneously • When both system CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) simultaneously	The following stop error occurs in the control system and standby system CPU modules: "FILE DIFF. (error code: 6001)".
• When one system starts up after the other • When the separate mode is changed to the backup mode • When reconnecting the tracking cable	The following stop error occurs in the standby system CPU module only: "FILE DIFF. (error code: 6001)".[*1]

If the "FILE DIFF." occurs in the standby CPU module, Use the dip switches SW2, SW3 of the control system and standby system CPU modules so that the settings will be consistent.

* 1: If a stop error occurs in the standby CPU module, the following continuation error will occur in the control system CPU module: "STANDBY SYS. DOWN (error code: 6300)".

5.1.5 Self Diagnostics Function

(1) Self Diagnostics Function

The self diagnostics function means that the redundant CPU checks for its own error, in order to prevent malfunction as well as to perform preventive maintenance.

If an error occurs when the redundant system is powered on or while the redundant CPU is running, the redundant CPU detects the error and displays it and performs system switching, etc.

(2) Error Detection Processing

(a) Error detection processing

When detecting an error, the redundant CPU will perform the following process:

1) **Turning the ERR.LED etc. on**

2) **Turning the special relays (SM0, SM1) on**

3) **Storing the error information (error code) into the special resistor (SD0)**

   When detecting multiple errors, the redundant CPU will store only the latest error code into the SD0.

   Use the special relay and special register in a program to make a programmable controller or machine system interlock.

(b) Error history confirmation

The redundant CPU records the 16 latest error codes as error history.

The error history can be checked in the PLC diagnostics of GX Developer.

The error history is backed up by the battery even if the programmable controller is powered off.

(3) Redundant CPU Operation upon an error detection

(a) Operation Mode when detecting an error

When detecting an error through the self diagnostics, the redundant CPU operates in the following two ways:

1) **Stop of redundant CPU operation**

   Upon an error detection, the redundant CPU stops the operation and performs system switching.

   The redundant CPU holds all outputs (Y) that have not been assigned to the main base unit, while it processes the outputs (Y) that have been assigned to the main base unit according to "Output Mode on Error Detection" of the PLC parameters I/O assignment settings as listed below:

   - Turns off all output of modules set to "Clear Output" (default).
     (Device memory output (Y) is held.)
   - Output of modules set to "Maintain output" is held. (Device memory output (Y) is maintained.)

2) **Continuation of redundant CPU operation**

   Upon an error detection, the redundant CPU executes all programs other than the program (instruction) where the error occurred.

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(b) Errors that allow selection of operation

For the following errors, the operation can be selected to "continue" or "stop" in the PLC parameter's PLC RAS settings.
(In the parameter default settings, all errors are set to "stop".)

1) Operation error (including SFC program)

2) Extension instruction error (setting for extension in future)

3) Blown fuse

4) Module verify error

5) Intelligent program execution error

6) File access error

7) Memory card operation error

8) External power supply OFF (setting for extension in future)

As the module verify error is preset to "stop", when the error occurs, a stop error is detected in the control system, resulting in system switching.
However, since the new control system also detects the module verify error and stops its operation, the redundant system stops the control.
When the module verify error is set to "continue", even if the error occurs, the system switching does not occur and the operation continues with I/O numbers used before the error occurrence.

(4) Self Diagnostic at Startup of Redundant CPU

The redundant CPU diagnoses the system based on the points described in Table5.19 when the redundant system is powered on or the CPU modules are unreset (RESET/ L.CLR switch is set to the neutral position) . When detecting an error, the redundant CPU develops a stop error.

Table5.19 Self Diagnostic at CPU Module Startup

Priority [1]	Diagnostics Description		Detected Error	
			Error Message	Error Code
1	Redundant CPU Hardware Check	CPU module hardware check	MAIN CPU DOWN [2]	1000 to 1009
2		RAM check	RAM ERROR	1101 to 1109
3		Operation circuit check	OPE.CIRCUIT ERR.	1200 to 1202
4		Tracking cable connection check	TRK.CABLE ERR.	6120
5		Tracking communication (system status) check	TRK.INIT.ERROR	6140
6	Redundant System Startup Ability Check	Extension base unit mounting check	BASE LAY-ERROR	2010 to 2013
7		For unsupported module being mounted check	SP.UNIT VER.ERR.	2151
8		Main base unit bus check	CONTROL-BUS ERR. [2]	1411
9		Extension base unit bus check		1418
10		Extension base unit mounting status	EXT.CABLE ERR.	2020
11		Base assignment check	SP.UNIT LAY ERR.	2122, 2125
12		Booting check	BOOT ERROR	2210, 2211
13		For parameters check	MISSING PARA.	2200
14		Parameters and system configuration check	SP.UNIT LAY ERR.	2100, 2103, 2106, 2107, 2124, 2125, 2128
15		Intelligent Function Module check	SP.UNIT DOWN [3]	1401, 1403
16		RUN/STOP switch status check	OPE.MODE DIFF.	6020
17		Control system and standby system configuration check	UNIT LAY.DIFF.	6030
18		Control system and standby system CPU module models check	UNIT LAY.DIFF.	6035
19		For control system and standby system memory card settings check	CARD TYPE DIFF.	6040, 6041
20		Parameter settings check	PARAMETER ERROR	3000 to 3004, 3007, 3040, 3041, 3042
21		File storage to program memory check	FILE SET ERROR	2400, 2401
22		Program files check	CAN'T EXE.PRG.	2500 to 2504
23		Instruction codes check	INSTRCT. CODE ERR.	4000 to 4004
24		Pointer (P) check	CAN'T SET(P)	4020, 4021
25		Pointer (I) check	CAN'T SET(I)	4030
26		END instruction check	MISSING END INS.	4010
27		Link parameter error	LINK PARA.ERROR	3100 to 3107
28		Remote password check	REMOTE PASS.ERR.	3400, 3401
29		Intelligent parameters check	SP.PARA.ERROR	3300 to 3302
30		File consistency check	FILE DIFF.	6000
31		Parameter valid drive settings consistency check	FILE DIFF.	6001
32		Tracking setting parameter check	TRK.PARA.ERROR	6500, 6501

* 1   Indicates the priority of the order in which errors are detected when the both systems are powered on or the CPU modules are unreset (RESET/L.CLR switch is set to the neutral position).
* 2   The errors may be detected regardless the priority.
* 3   Can be changed to "continue" in the PLC parameters settings of GX Developer.

5.1.6 Start Mode

The start mode is the mode that determines device status at system startup or unreset (RESET/L.CLR switch is set to the neutral position).

Two types of start modes are available: Initial start mode and Hot-start mode. (Initial start mode is set by default.)
Select the start mode at backup mode settings in the redundant parameter settings of GX Developer.

Select Initial start mode / Hot-start mode

Redundant parameter

Operation settings | Tracking settings

Start mode setting

Mode   Initial start mode ▼

It will become Hot-start mode during system switching.

Standby system watch setting

☑ Check the error in Standby system

Debug mode setting

⦿ Do not start with Debug mode
◯ Start with Debug mode

Backup mode setting

☑ Check operating status consistency

Default   Check   End   Cancel
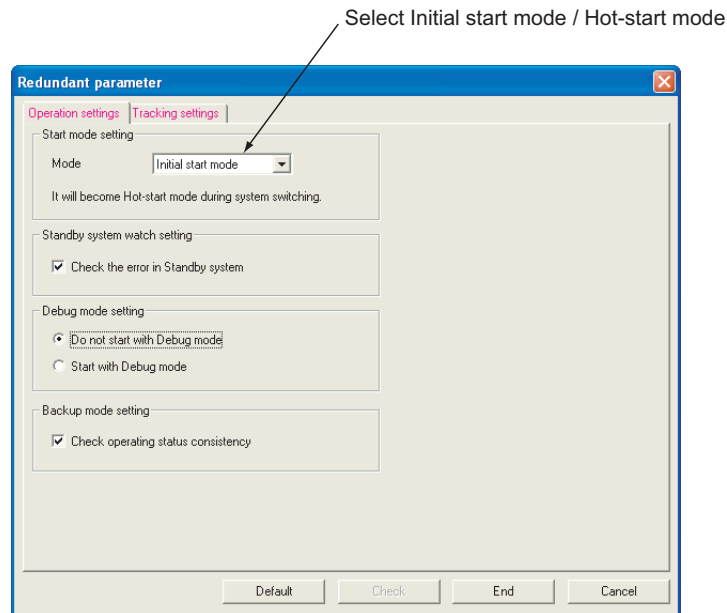
Diagram 5.17 Operation setting Window

(1) Initial start mode (Default)

This mode is for clearing all devices except the file register and the latch range settings device (word device: 0; bit device: OFF) before performing the operation.

System A - Control System   System B - Standby System

[Control using Initial start mode]

Tracking cable

| D100 | 1234 |
| D101 | 2345 |

Power the system off and back on

System A - Control System   System B - Standby System

[Control using Initial start mode]

Tracking cable

| D100 | 0 |
| D101 | 0 |
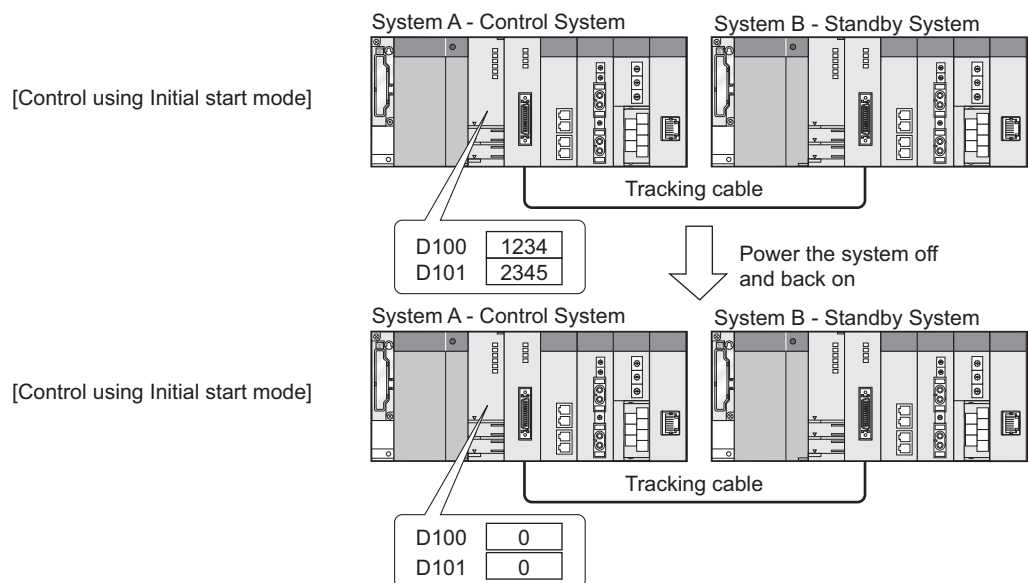
Diagram 5.18 Initial Start Mode Operation

⊠POINT

> After system switching, the new control system will start up in the Hot-start mode regardless of the start mode settings.

(2) Hot-start mode

This mode is for performing the operation from when holding the device.
(Some devices such as the step relay and the index register will be cleared.)
As holding the devices even when the redundant system goes down due to power OFF or CPU module reset, the system can continue the operation when it is powered on or the CPU modules are unreset (RESET/L.CLR switch is set to the neutral position) .

System A - Control System   System B - Standby System

[Control using Hot-start mode]

Tracking cable

| D100 | 1234 |
| D101 | 2345 |

Power the system off and back on

System A - Control System   System B - Standby System

[Start in Hot-start mode]

Tracking cable

| D100 | 1234 |
| D101 | 2345 |
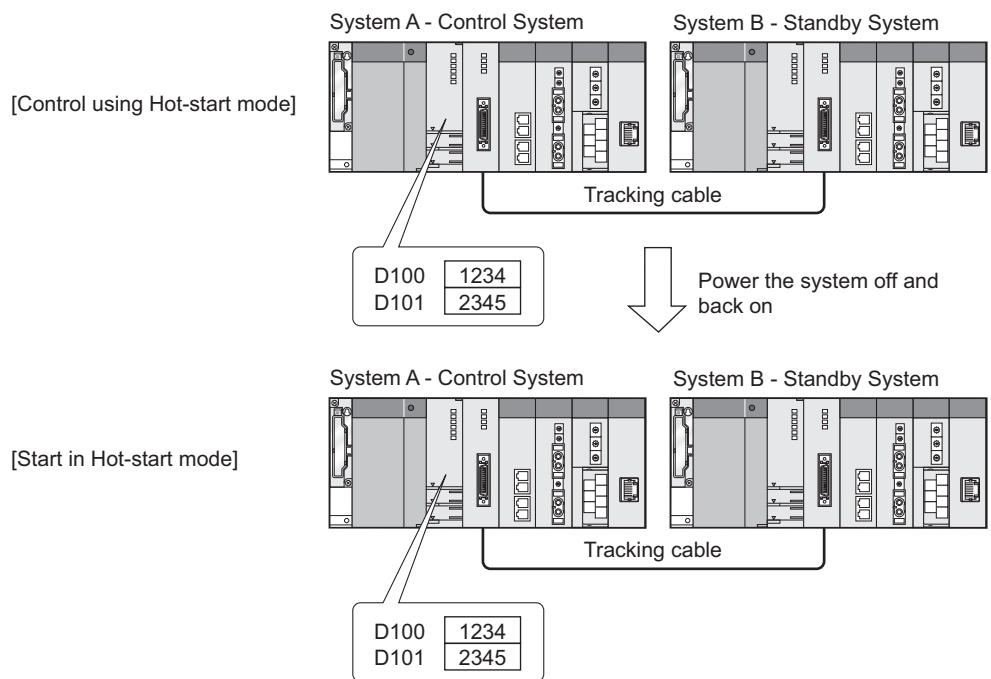
Diagram 5.19 Hot-Start Mode Operation

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(3) Differences Between Initial Start Mode and Hot-start Mode

Table5.20 lists the differences between Initial start mode and Hot-start Mode.

Table5.20 Differences Between Initial Start Mode and Hot-start Mode

			Initial Start Mode	Hot Start Mode
Device Memory	All Other Than Index Register and Step Relay	Not held in power OFF	Cleared	Held [*1]
		Held in power OFF	Held	
	Index Register and Step Relay		Cleared	
	Special Relay and Special Register		Initial value is set	
	Initial Device Value Setting Range		Initial value is set	
	Local Device		Cleared	
	File Register		Held	
Program Execution	Initial Execution Type Program		Executed only one time during STOP→RUN	
	Interrupt Permitted / Not Permitted		Set to not permit interrupt	
	SM402 (After RUN, ON for 1 scan)		Turned ON 1 scan during STOP→RUN	
	SM403 (After RUN, OFF for 1 scan)		Turned OFF 1 scan during STOP→RUN	
Program Execution Type (Initial / Scan / Standby)			Based on the PLC parameter settings	
File Register Settings			Based on the PLC parameter settings	
Comment File Settings			Based on the PLC parameter settings	
SFC Program Startup Mode			Based on the PLC parameter settings	
Boot from Memory Card / Standard ROM			Based on the PLC parameter settings	
Intelligent Module Parameter Initial Settings			The intelligent module parameters are reflected	

* 1: Clear device data by latch clear.

5.2 Function List

The redundant system functions are listed in Table5.21
 Please refer to the following manual, for functions other than the redundant system functions.

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

Table5.21 Function List

Item	Description	Reference
System Switching Function (Switching between the Control System and Standby System)	This function switches the control system and the standby system. (It changes the control system to the standby system, and the standby system to the control system.) There are 2 types: automatic system switching and manual system switching.	Section 5.3
Operation Mode Change	This function switches the operation mode between the separate mode and backup mode	Section 5.4
Tracking Function	This function transfers the operation control data to the standby system to ensure continuous system operation when a control system failure or fault occurs. Control can be continued with the same data even if a control system failure or fault occurs and the systems switching occurs.	Section 5.5
Online Program Change for Redundancy	This function transfers the data, such as programs (including those written online) and parameters written to the control system CPU from the standby system.	Section 5.6
Memory Copy from Control System to Standby System	This function copies program memory contents from the control system to the standby system. (When exchanging the standby system CPU module, use of this function can make the control system and standby system program memories consistent.) This function can be executed by using GX Developer, or by using the special relay and special register.	Section 5.7
Online Module Change (Hot swapping)	• Allows replacement of an I/O module mounted on the main base unit where the Redundant CPU is mounted while power supply is ON. (Not applicable when any extension base unit is connected.) • Allows replacement of an I/O module or intelligent function module [1] mounted on an extension base unit while power supply is ON. • Allows replacement of an I/O module or intelligent function module [1] mounted on a MELSECNET/H remote I/O station while power supply is ON. • Allows replacement of a power supply module while the system is operating when the system uses the redundant power main base unit.	Section 5.8

* 1: Intelligent function module that supports online module change. (☞ Section 2.4 (6))

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6 REDUNDANT SYSTEM NETWORKS

7 PROGRAMMING CAUTIONS

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5.3 System Switching (Between Control System and Standby System) Function

This section describes how to switch the system during RUN, execution timings, execution possibilities, operations of the CPU modules in both (control and standby) systems after system switching, and relevant precautions.

5.3.1 System Switching Method

2 methods of system switching are available: automatic system switching and manual system switching that is performed by the user.
Whether the system switching can be executed automatically or manually depends on the operation mode. (Refer to Section 5.1.3 for details on operation mode.)
Table5.22 indicates the system switching methods and applicable operation modes.

Table5.22 System Switching Method and the Applicable Operation Modes

System Switching Method	Description	Operation Modes
Automatic system switching	• System switching when a fault occurs in the control system • System switching by the system switching request issued from the network module	Backup Mode
Manual System Switching	• System switching using GX Developer [1] • System switching by system switching instruction	Backup Mode Separate Mode

* 1: System switching can be done from the OPS (application using EZ Socket), too.

If system switching is performed in the backup mode, the following error codes will be stored into the error history of the new control system and new standby system CPU modules.
In this case, the ERR. LED will remain off. (The ERR. LED does not turn on or flash.)
• New control system: "CONTROL EXE. (error code: 6200)"
• New standby system: "STANDBY (error code: 6210)"
It is possible to confirm if the system switching has been executed or not in the PLC diagnostics (Error log) of GX Developer. [*2]
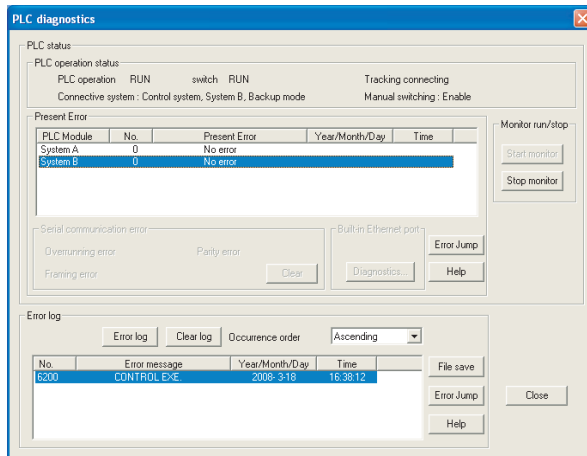
Diagram 5.20 PLC Diagnostics Window of the New Control System
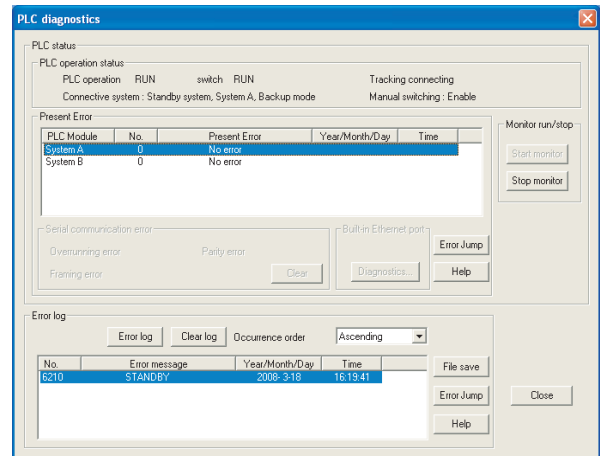
Diagram 5.21 PLC Diagnostics Window of the New Standby System

* 2: If the "WTD error" occurs in the new standby system, PLC diagnostics cannot be done via the tracking cable.
Connect an RS-232 cable or USB cable to the system to be diagnosed (new control system/new standby system) and execute the PLC diagnostics.

The reason for system switching can be confirmed on the Error details window.
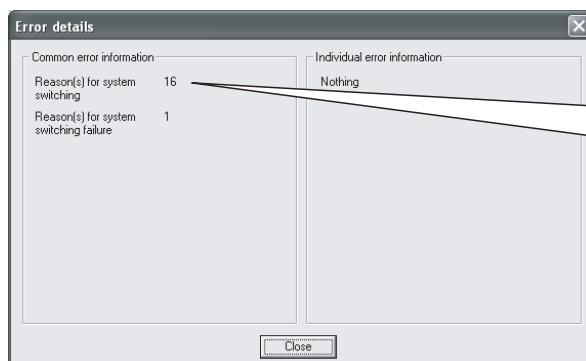
【Reason(s) for system switching】
0 : No system switching condition (default)
1 : Power OFF, reset, hardware failure, watchdog timer error
2 : Stop error (except watchdog timer error)
3 : System switching request by network module
16 : Control system switching instruction
17 : Control system switching request from GX Developer

Diagram 5.22 Error details window

(1) Automatic System Switching

In automatic system switching, the redundant CPU determines if a system switching is necessary and automatically switches the control system and standby system.

2 types of automatic system switching are available: automatic system switching when a fault occurs in the control system, and system switching requested by the network module.

(a) System switching when a fault occurs in the control system

In the redundant system, the standby system CPU module monitors the control system operating status.

When the control system is in any of the following status and is not able to continue the redundant system control, the standby system CPU module switches to the control system and continues the redundant system control.

- A stop error occurs in the control system CPU module
- The control system is powered OFF
- The control system CPU module is reset

If a continuation error occurs in the control system CPU module, system switching will not occur.

Diagram 5.23 shows the processes that take place if a stop error occurs in the control system CPU module:
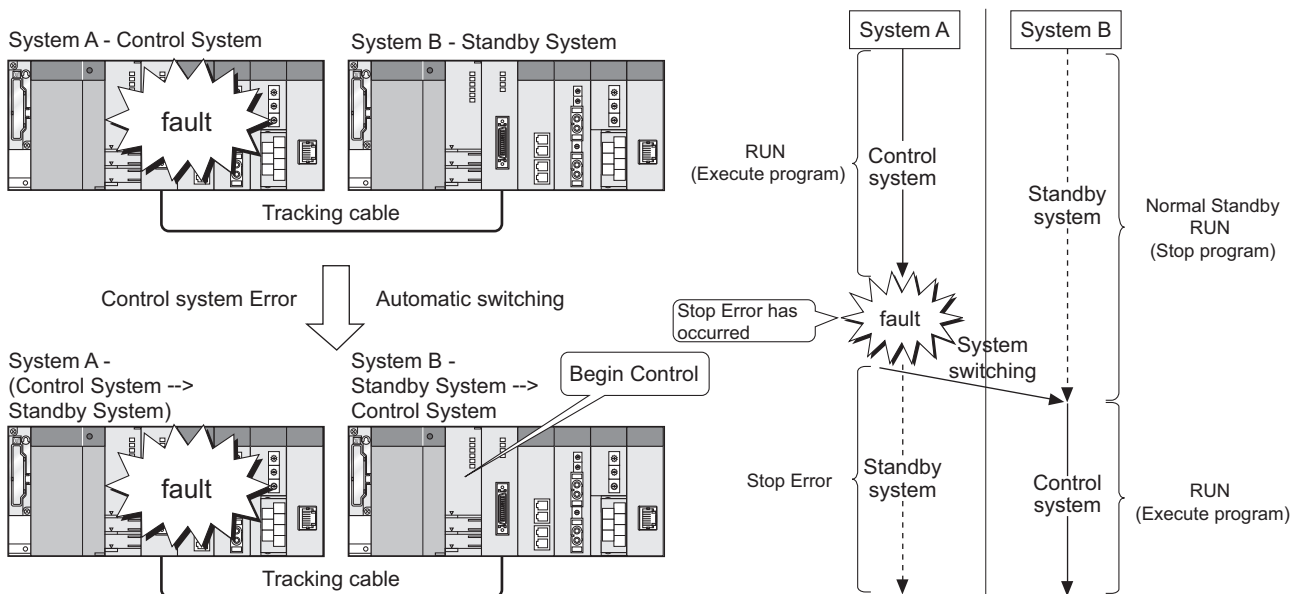
Diagram 5.23 System switching operations when a control system error occurs

(b) System switching requested by the network module

- When the control system CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module, or the MODBUS/TCP module detects a communication error or wire break[1], the module requests system switching to the CPU module. (The standby system CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module, or the MODBUS/TCP module does not request system switching, even if the module detects a communication error or wire break[1].)

- When the PROFIBUS-DP master module detects a module fault or communication failure with DP-Slaves, the module requests system switching to the CPU module. (The standby system PROFIBUS-DP master module does not request system switching, even if the module detects a module fault or communication failure with DP-Slaves.)

When receiving the system switching request from the network module, the control system CPU module will perform a system switching at END processing.

Diagram 5.24 shows the processes that take place when the system switching request is received from the network module.
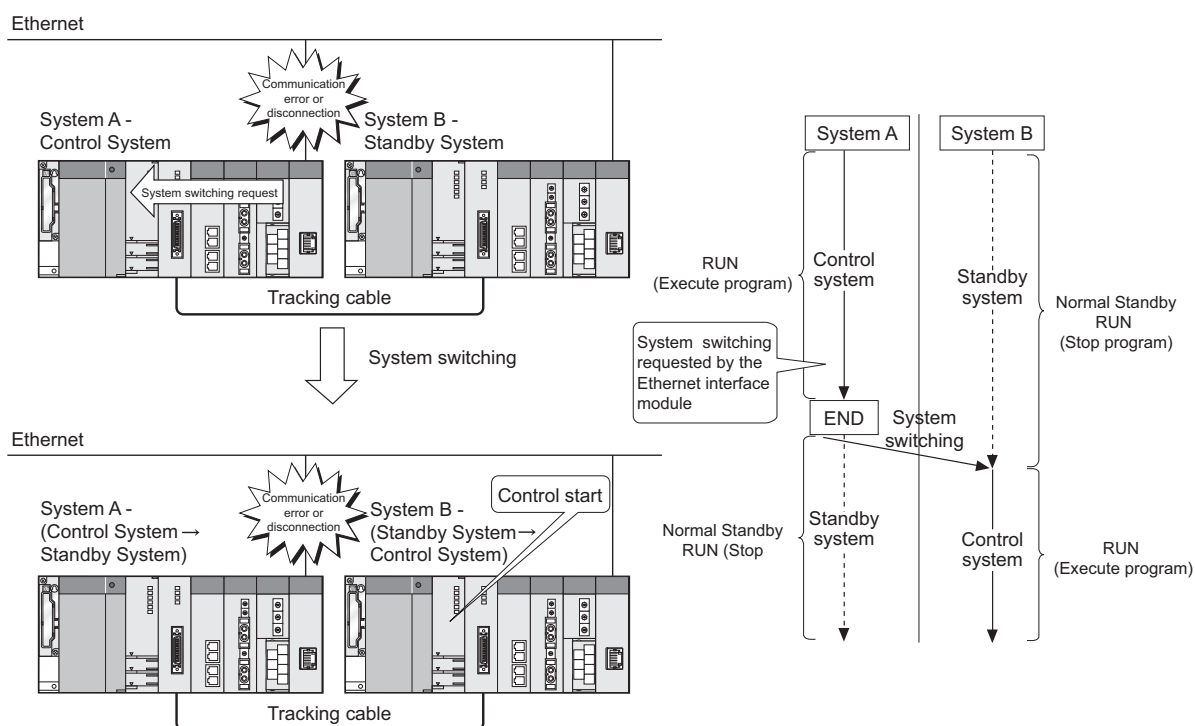
Diagram 5.24 System switching operations requested by the network module

* 1: For the Ethernet interface modules, only the QJ71E71-100 can detect wire break.

⊠**POINT**

1. The network module system switching can only be requested from a redundant system-compatible CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module, MODBUS/TCP module, and PROFIBUS-DP master module.
   Refer to Section 2.3 for details on serial Nos. of these redundant system-compatible modules.
2. When the Ethernet module is mounted on the extension base unit, the system switching request cannot be issued.
   (The CC-Link IE Controller Network module and MELSECNET/H module cannot be mounted on the extension base unit.)

If the network module cable is disconnected, the system switching may not be performed depending on the timing when the control system and standby system detects the fault.

Example: The following diagram shows the processes that take place when the redundant system is connected to the MELSECNET/H.

- If the control system detects the cable disconnection first, the system switching will be performed.
- If the standby system detects the cable disconnection first, the system switching will not be performed.
- In this case, the "CAN'T SWITCH (error code: 6220)" continuation error will occur in the control system CPU module.
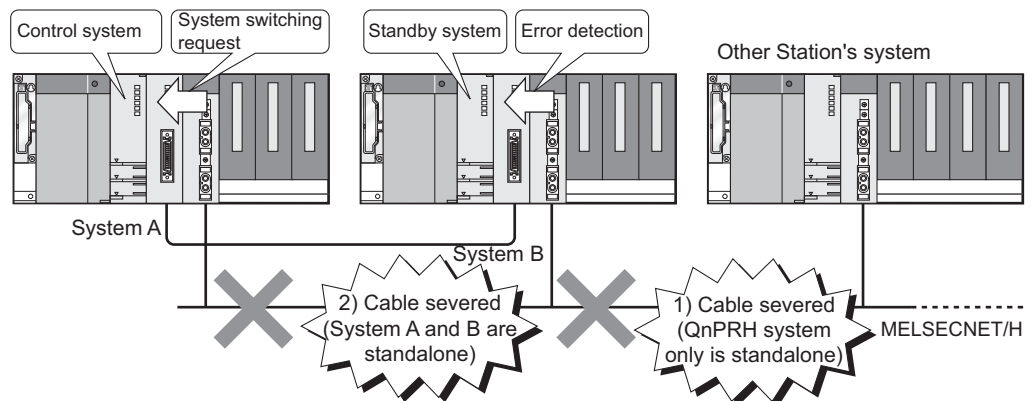
Diagram 5.25 System Switching Operation at Cable Disconnection

⊠POINT

1. If SM1592 is not turned ON at the time of system switching executed from GX Developer, the error dialog box as Diagram 5.27 appears.
   If the error dialog box as Diagram 5.27 has appeared, turn ON SM1592 and then execute system switching again from GX Developer.
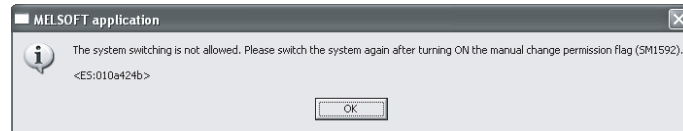
Diagram 5.27 Error Dialog Box Displayed on GX Developer

(b) System switching by the system switching instruction (SP. CONTSW instruction) [1]

When the system switching instruction is executed in the control system CPU module, the system switching is performed at END processing after instruction execution.

1) The system switching by system switching instruction is done in the following procedure:
   - Turn on the "Enable/disable user system switching" flag (SM1592) in the control system CPU module.
     ↓
   - Turn on the system switching instruction condition in the control system CPU module and execute the instruction.
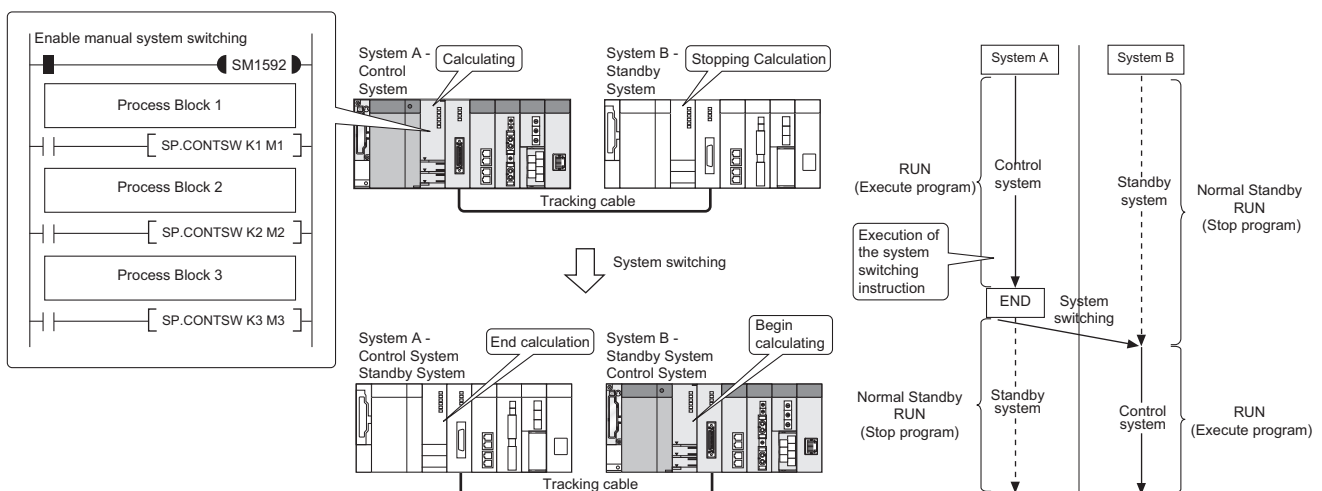
Diagram 5.28 System Switching Operation by System Switching Instruction

* 1: Refer to the following manual for details on the system switching instruction.

　　☞ MELSEC-Q/L Programming Manual (Common Instruction)

⊠**POINT**

1. Precautions When Executing the System Switching Instruction (SP.CONTSW instruction)

   As the control system and standby system CPU module programs and device data are consistent, when the system switching instruction is executed in the control system CPU module, the system switching may be executed in the new control system CPU module, too.

   When executing the system switching instruction, it is required to use the special relay "Standby system to control system switching status flag (SM1518)" as illustrated in Diagram 5.29, and modify the program so that the instruction will not be executed in the new control system CPU module again.

```
Standby system to control system
switching status flag
SM1518
 | |                                [SET M0]

system switching command
M1000      M0
 | |       |/|          [SP.CONTSW K1 M10 *1]

Cancel Signal
M1001
 | |                                [RST M0]
```

*1 : When the SP.CONTSW instruction cannot perform a system switch, the error completion device (M10) is set to ON.
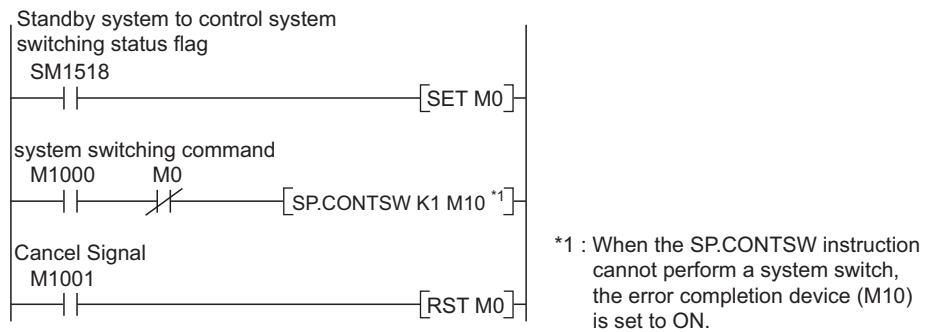
Diagram 5.29 Program That Does Not Execute System Switching Instruction Again in New Control System CPU Module

2. The error completion device for the system switching instruction can be used to check whether system switching is executed by the system switching instruction or not.

   • When the error completion device is OFF . .System switching is executed
   • When the error completion device is ON . . .System switching is not executed

2) Reasons for system switching can be set as system switching instruction parameter.
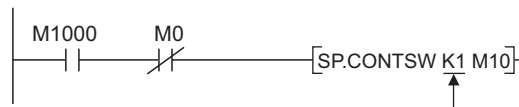
Argument (Reason for system switching, etc.)

Diagram 5.30 Example of System Switching Instruction programming

The system switching instruction parameter value can be confirmed in the system switching instruction error details window, which can be displayed from the PLC Diagnostics window.

The system switching instruction parameter value can be used in troubleshooting.
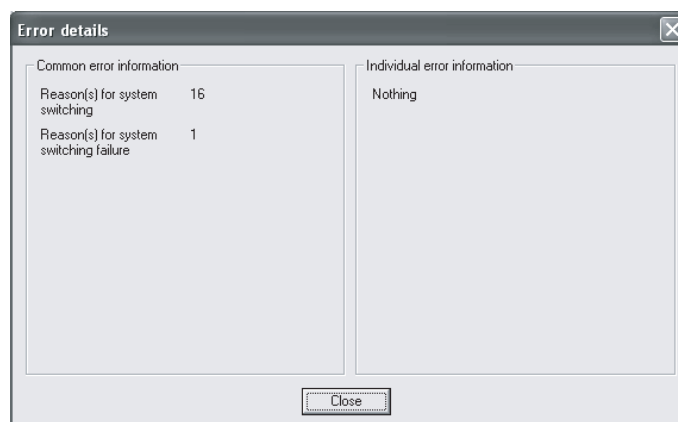
Diagram 5.31 Error details window

In addition, this parameter value is also stored in the special register SD6 (error common information) and SD1602 (system switching dedicated instruction parameter).

(3) System Switching Priority

The system switching priorities are listed in Table5.23.

Table5.23 Priority of Reasons for System Switching

Priority		Reasons for System Switching
High	1	• Control system powered off
		• Control system CPU module reset
↓	2	• Stop error in control system CPU module
	3	• Execution of system switching instruction
	4	• System switching operation using GX Developer
Low	5	• System switching request by network module

(a) System switching processing when multiple system switching requests are issued simultaneously

When multiple system switching requests are issued simultaneously, system switching is performed according to the priority (from high to low) of reasons for system switching.

(b) Error message displayed on GX Developer

If the system switching is actually executed due to another reason for system switching when an attempt of system switching has been made using GX Developer, the error message (Diagram 5.32) will appear on GX Developer.

MELSOFT application

System switching was previously executed by one factor. Please confirm the system.

<E5:010a424f>

OK
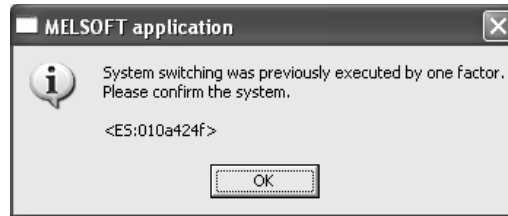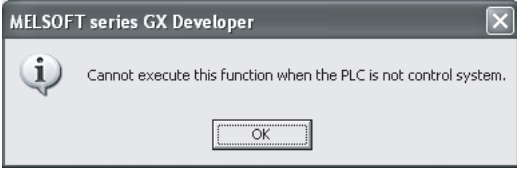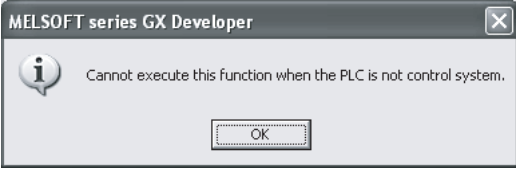
Diagram 5.32 Error Dialog Box Displayed on GX Developer

(4) Operations When System Switching is Executed in the Standby System CPU Module

If the manual system switching request is issued to the standby system CPU module, the system switching will not be executed.
Table5.24 indicates the operations performed when a system switching request is issued to the standby system CPU module.

Table5.24 Operations When a System Switching Request is issued to the standby system CPU Module

System Switching Request	Operation Mode	
	Backup Mode	**Separate Mode**
System Switching by System Switching Instruction	Not performed	The following stop error will occur upon instruction execution: "OPERATION ERROR (error code: 4121)".
System Switching Using GX Developer	The following error message will be displayed on the GX Developer that was used to perform the system switching **MELSOFT series GX Developer** Cannot execute this function when the PLC is not control system. OK	The following error message will be displayed on the GX Developer that was used to perform the system switching **MELSOFT series GX Developer** Cannot execute this function when the PLC is not control system. OK

5.3.2 System Switching Execution Timing

Table5.25 indicates the system switching execution timing when a system switching condition occurs.

Table5.25 System Switching Execution Timing

System Switching Method	Reasons for System Switching in Control System	Execution Timing
Automatic System Switching	Stop error	System switching is executed when the reason for system switching occurs.
	Power off	
	Reset	
	System switching request by network module	System switching is executed at END processing of the scan where the reason for system switching occurred. [1]
Manual Switching	System switching using GX Developer	
	System switching by system switching instruction	

* 1: Even if the COM instruction is executed after a reason for system switching occurs, system switching will not be executed by END processing.
Refer to the following manual for details on the COM instruction.

☞ MELSEC-Q/L Programming Manual (Common Instruction)

5.3.3 System Switching Execution Possibility

(1) In Backup Mode

System switching execution possibility in Backup Mode is listed in Table5.26.

Table5.26 System Switching Execution Capability

Standby System Operating Status *1		Control System Switching Condition						
		Automatic System Switching					Manual System Switching	
		Power Off Reset	Hardware Failure	Watchdog Timer Error *3	Stop Error Other Than Watchdog Timer Error	System Switching requested by the Network Module	System Switching by System Switching Instruction	System Switching using GX Developer
Normal		○	○	○	○	○	○	○
Continuation ERROR		○	○	○	○	○	○	○
Tracking Cable Disconnection		×	○ *4	○ *4	×	×	×	×
Power OFF *2 Resetting *2 Hardware Failure *2		×	○ *4	○ *4	×	×	×	×
CPU stop error	Watchdog Timer Error *2 *3	○	○	○	×	×	×	×
	Stop Error Other Than Watchdog Timer Error *2	○	○	○	○	×	×	×
At network fault detection		○	○	○	○	×	×	×
Memory Copy from Control System to Standby System		○	○	○	○	×	×	×
During Online Program Change		○	○	○	○	×	×	×
Operating Status Inconsistency		○	○	○	○	×	×	×
Preparing for Tracking		×	○	○	×	×	×	×
System Switching Request Timeout		×	○	○	×	×	×	×
Executing System Switching		○	○	○	○	○	×	×

○ System switching enabled, × System switching disabled

* 1: Standby System Operating Status is displayed in Table5.27.
* 2: When the reasons for system switching failure such as standby system power off/being reset, standby system stop error, tracking cable disconnection, are removed, the system switching may occur. (☞ Table5.28 to Table5.32)
* 3: Watchdog timer error corresponds to the "WDT ERROR (error code: 5000 or 5001)".
* 4: The control system switches to the standby system, but the standby system status does not change.

5.3 System Switching (Between Control System and Standby System) Function
5.3.3 System Switching Execution Possibility

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Table5.27 Operating Status and Details

Operating Status	Description
Normal	The CPU module is in the RUN, STOP or PAUSE status, where no error such as a continuation error or stop error has occurred.
Continuation Error	The CPU module is in the RUN, STOP and PAUSE status, where a continuation error has occurred.
Stop Error	The CPU module has stopped, as a stop error has occurred.
Power Off	The system power is OFF.
Resetting	The CPU module is being reset.
At network fault detection	A fault has been detected by at least one module of standby system network modules (CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module, MODBUS/TCP module, PROFIBUS-DP master module).
Preparing for Tracking	The communication is not made between the control system and standby system via tracking cable.
System Switching Request Timeout	The system switching has not been completed, as a data error occurred due to noise, etc., in the communication between the control system and standby system during system switching processing.
Executing System Switching	System switching cannot be executed since the control system or standby system is executing system switching due to the previous system switching condition.

⊠POINT

1. Make sure to set "CPU Operation Mode" to "STOP (default)" on the details settings of the PLC parameters I/O Assignment settings.
   If set to "Continue", system switching cannot be executed when the "SP. UNIT DOWN" error occurs due to a network module hardware failure.

Table5.28 Operations When System Switching Cannot Be Executed Due to Standby System Power Off, Resetting or Hardware Failure

System Switching Method	Control System Switching Condition	System Status Before System Switching		System Status After System Switching Condition		Operation After B System Power ON → OFF or unresetting the CPU module (RESET/L.CLR switch is set to the neutral position)
		System A	System B	System A	System B	
Automatic System Switching	Stop Error Other Than Watchdog Timer Error	Control System	Standby System	Control System	Standby System	Startup as standby system
	Watchdog Timer Error	Control System	Standby System	Standby System	Standby System	Startup as control system
	Hardware Failure	Control System	Standby System	Control System	Standby System	Startup as control system
	Power OFF	Control System	Standby System	Control System	Standby System	Startup as control system
	Resetting	Control System	Standby System	Control System	Standby System	Startup as control system
	System Switching Request by Network Module	Control System	Standby System	Control System	Standby System	System switching will causes system B to become control system
Manual System Switching	System Switching Using GX Developer	Control System	Standby System	Control System	Standby System	Startup as standby system
	System Switching by System Switching Instruction	Control System	Standby System	Control System	Standby System	Startup as standby system

Table5.29 Operations When System Switching Cannot Be Executed Due to Error Other Than Stop Error in the Standby System

System Switching Method	Control System Switching Condition	Status Before System Switching		System Status After System Switching Condition		Operation After System B Power OFF → ON
		System A	System B	System A	System B	
Automatic System Switching	Stop Error Other Than Watchdog Timer Errors	Control System	Standby System	Standby System	Control System	Startup as control system
	Watchdog Timer	Control System	Standby System	Standby System	Standby System	Startup as control system
	Hardware Failure	Control System	Standby System	Standby System	Control System	Startup as control system
	Power OFF	Control System	Standby System	Standby System	Control System	Startup as control system
	Resetting	Control System	Standby System	Standby System	Control System	Startup as control system
	System Switching Request by Network Module	Control System	Standby System	Control System	Standby System	System switching will cause system B to become control system
Manual System Switching	System Switching Using GX Developer	Control System	Standby System	Control System	Standby System	Startup as standby system
	System Switching by System Switching Instruction	Control System	Standby System	Control System	Standby System	Startup as standby system

5.3 System Switching (Between Control System and Standby System) Function
5.3.3 System Switching Execution Possibility

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Table5.30 Operations When System Switching Cannot Be Executed Due to Tracking Cable Disconnection

System Switching Method	Control System Switching Condition	Before System Switching		System Status After System Switching Condition		Operation After Tracking Cable Disconnection
		System A	System B	System A	System B	
Automatic System Switching	Stop Error Other Than Watchdog Timer Errors	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	Watchdog Timer Error	Control System	Standby System	Standby System	Standby System	System switching will not be executed.
	Hardware Failure	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	Power OFF	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	Resetting	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	System Switching Request by Network Module	Control System	Standby System	Control System	Standby System	System switching will not be executed.
Manual System Switching	System Switching Using GX Developer	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	System Switching by System Switching Instruction	Control System	Standby System	Control System	Standby System	System switching will not be executed.

Table5.31 When System Switching Cannot Be Executed Due to Network Error of Standby System

System Switching Method	Control System Switching Condition	System Status Before System Switching		System Status After System Switching Condition		Operation After B System Power OFF → ON
		System A	System B	System A	System B	
Automatic System Switching	Stop Error Other Than Watchdog Timer Error	Control System	Standby System	Standby System	Control System	Startup as control system
	Watchdog Timer Error	Control System	Standby System	Standby System	Standby System	Startup as control system
	Hardware Failure	Control System	Standby System	Standby System	Control System	Startup as control system
	Power OFF	Control System	Standby System	Standby System	Control System	Startup as control system
	Resetting	Control System	Standby System	Standby System	Control System	Startup as control system
	System Switching Request by Network Module	Control System	Standby System	Control System	Standby System	Startup as standby system
Manual System Switching	System Switching Using GX Developer	Control System	Standby System	Control System	Standby System	Startup as standby system
	System Switching by System Switching Instruction	Control System	Standby System	Control System	Standby System	Startup as standby system

Table5.32 When System Switching Cannot Be Executed Due to Watchdog Timer Error of Standby System

System Switching Method	Control System Switching Condition	Status Before System Switching		System Status After System Switching Condition		Operation After System B Power OFF → ON
		System A	System B	System A	System B	
Automatic System Switching	Stop Error Other Than Watchdog Timer Errors	Control System	Standby System	Standby System	Control System	Startup as standby system
	Watchdog Timer	Control System	Standby System	Standby System	Standby System	Startup as control system
	Hardware Failure	Control System	Standby System	Standby System	Control System	Startup as control system
	Power OFF	Control System	Standby System	Standby System	Control System	Startup as control system
	Resetting	Control System	Standby System	Standby System	Control System	Startup as control system
	System Switching Request by Network Module	Control System	Standby System	Control System	Standby System	System switching will cause system B to become control system
Manual System Switching	System Switching Using GX Developer	Control System	Standby System	Control System	Standby System	Startup as standby system
	System Switching by System Switching Instruction	Control System	Standby System	Control System	Standby System	Startup as standby system

5.3 System Switching (Between Control System and Standby System) Function
5.3.3 System Switching Execution Possibility

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(2) In Separate Mode

System switching execution possibility in Separate Mode is listed in Table5.33.

Table5.33 System Switching Execution Capability

Standby System Operating Status [1]	Control System Switching Condition						
	Automatic System Switching					Manual System Switching [2]	
	Stop Error Other Than Watchdog Timer Errors	Watchdog Timer Error [3]	Hardware Failure	Power OFF Reset	System Switching requested by the Network Module	System Switching Using GX Developer	System Switching with System Switching Instruction
Normal	×	×	×	×	×	○	○
Continuation Error	×	×	×	×	×	○	○
Power OFF Resetting Hardware Failure	×	×	×	×	×	×	×
Watchdog Timer Error [3]	×	×	×	×	×	×	×
Stop Error Other Than Watchdog Timer Errors	×	×	×	×	×	×	×
At network fault detection	×	×	×	×	×	○	○
Copying memory from Control System to Standby System	×	×	×	×	×	×	×
During Online Program Change	×	×	×	×	×	○	○
Operating Status Inconsistency	×	×	×	×	×	○	○
Tracking Cable Disconnection	×	×	×	×	×	×	×
Preparing for Tracking	×	×	×	×	×	×	×
System Switching Request Timeout	×	×	×	×	×	×	×
Executing System Switching	×	×	×	×	×	×	×

○ Indicates system switching possible, × Indicates system switching not possible

* 1: For details of the standby system operating status, refer to Table5.34.
* 2: On the condition that an extension base unit is used, if the system switching timing matches the interrupt timing of the internal timer (I28 to I31), the interrupt interval of the internal timer may become longer in the standby system CPU module.
* 3: Watchdog timer error corresponds to "WDT ERROR (error code: 5000 or 5001)".

Table5.34 Operating Status and Details

Operating Status	Description
Normal	The CPU module is in the RUN, STOP or PAUSE status, where no error such as a continuation error or stop error has occurred.
Continuation Error	The CPU module is in the RUN, STOP and PAUSE status, where a continuation error has occurred.
Stop Error	The CPU module has stopped, as a stop error has occurred.
Power Off	The system power is OFF.
Resetting	The CPU module is being reset.
At network fault detection	A fault has been detected by at least one module of standby system network modules (CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module, MODBUS/TCP module, PROFIBUS-DP master module).
Preparing for Tracking	The communication is not made between the control system and standby system via tracking cable.
System Switching Request Timeout	The system switching has not been completed, as a data error occurred due to noise, etc., in the communication between the control system and standby system during system switching processing.
Executing System Switching	System switching cannot be executed since the control system or standby system is executing system switching due to the previous system switching condition.

Table5.35 Operations When System Switching Cannot Be Executed Due to Operation mode, i.e., Separate Mode

System Switching Method	Control System Switching Condition	Before System Switching		System Status After System Switching Condition		Operation After Changing From Separate Mode to Backup Mode
		System A	System B	System A	System B	
Automatic System Switching	Stop Error Other Than Watchdog Timer Errors	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	Watchdog Timer Error	Control System	Standby System	Control System	Standby System	System switching will not be executed.
	Hardware Failure	Control System	Standby System	Control System	Standby System	Cannot change from Separate Mode to Backup Mode due to a control system hardware failure.
	Power OFF	Control System	Standby System	Control System	Standby System	Cannot change from Separate Mode to Backup Mode due to control system power OFF.
	Resetting	Control System	Standby System	Control System	Standby System	Cannot change from Separate Mode to Backup Mode due to control system reset status.
	System Switching Request by Network Module	Control System	Standby System	Control System	Standby System	System switching will not be executed.
Manual System Switching	System Switching Using GX Developer	Control System	Standby System	Standby System	Control System	System switching will not be executed.
	System Switching by System Switching Instruction	Control System	Standby System	Standby System	Control System	System switching will not be executed.

5.3 System Switching (Between Control System and Standby System) Function
5.3.3 System Switching Execution Possibility

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5.3.4 Operation in Both Systems After Switched

Table5.36 and Table5.37 list the operation of the CPU modules and network modules in the control and standby systems after they are switched.

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5.3 System Switching (Between Control System and Standby System) Function
5.3.4 Operation in Both Systems After Switched

(1) Operation of CPU modules

Table5.36 Operation of CPU Modules After the Systems are Switched

Item		New Control System CPU Module	New Standby System CPU Module
Program Execution[1]	Initial Execution Type Program	Does not execute the program. However, executes the initial execution type program from the 0 step again, if it was not completed in the previous control system at the time of system switching.	Stops program execution.
	Scan Execution Type Program	Executes scan execution type program based on the tracked device data from step 0.	
	Fixed Scan Execution Type Program	Starts counting the interrupt interval time from 0. (Refer to Section 7.2)	
	Standby Type Program	Not executed.	
	Interrupt Program	Executes when the interrupt factor is established. (Refer to Section 7.2)	
Tracking		Starts tracking to the new standby system.	Starts reception of tracking data. However, stops the reception of tracking data if a stop error has occurred.
Online Program Change		Continues the write operation after system switching.	Continues the write operation after system switching.
Writing files in RUN		Continues the write operation after system switching.	Continues the write operation after system switching.
General Data Processing		Executes the request received after system switching.	Executes the request received at time of system switching. However, a communication error may occur if a system switching is executed during general data processing.
Device Memory		Holds the data.	Holds the data. Sets the received tracking data to specified device.
Signal Flow Memory		Holds the tracked data. Turns ON signal flow memory in all steps if has not been tracked. Stores the execution results in the signal flow memory, after program execution.	Holds the data Sets the received tracking data in the signal flow memory.
Initial Device Value Setting		Does not set the value.	Does not process it.
Special Relays and Special Registers		Holds the data. However, stores the statuses of control system and standby system after system switching in SM1515 and SM1516.	Holds the data. However, stores the statuses of control system and standby system after system switching in SM1515 and SM1516. Sets the received tracking data in the corresponding special relay and special register.
Output (Y)		Holds the output. Outputs program execution results.[2]	Turns OFF the output (Y) from modules mounted on the main base unit. Holds the output (Y) from modules other than above.
Local Device Settings		Sets devices according to parameter settings.	Does not process it.
File Register Settings		Holds the file register settings prior to system switching.	Not processed.
Direct Input (DX)		Inputs data when an instruction using the direct input is executed after the systems are switched.[2]	Not processed.
Direct Output (DY) [3]		Inputs data when an instruction using the direct input is executed after the systems are switched.	Not processed.
Intelligent Function Module Dedicated Instruction		Executes the instruction in a program after system switching if the corresponding execution condition has been satisfied, and does not execute it if it has not been satisfied.	Not processed.
FROM/TO Instruction		Executes the instruction in a program after system switching if the corresponding execution condition has been satisfied, and does not execute if it has not been satisfied.	Not processed.
Access Request from Intelligent Function Module		Ignores the access request.	Not processed.

* 1: The Redundant CPU cannot execute low-speed execution type programs.
* 2: In the redundant system where the modules are mounted on the execusion base unit, if the systems are switched because of an extension cable failure, data are not input to the modules on the extension base unit in the new control system.
* 3: The direct output cannot be used to mounted modules on the extension base unit. (☞ Section 7.5 (5))

5.3 System Switching (Between Control System and Standby System) Function
5.3.4 Operation in Both Systems After Switched

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(2) Operation of network modules

Table5.37 Operation of Network Modules After the Systems are Switched

Item	New Control System Network Module	New Standby System Network Module
CC-Link IE Controller Network	Starts cyclic transmission.	Continues cyclic transmission. However does not perform output.
MELSECNET/H PLC to PLC network	Starts cyclic transmission.	Continues cyclic transmission. However does not perform output.
MELSECNET/H Remote I/O network	Starts cyclic transmission. Operates as master station.	Continues cyclic transmission as sub-master station. However, does not perform output.
Ethernet	Communicates with the control system when it is specified by external device. Transfers a message to the standby system when it is specified by external device.	Communicates with the standby system when it is specified by external device. Transfers message to the control system when it is specified by external device.
PROFIBUS-DP	Continues PROFIBUS-DP communications.	Stands by and prepares for system switching.

For more details, refer to the manual for the network module used.

5.3.5 Special Relays/Registers For System Switching

(1) Special Relays For System Switching

Special relays for system switching are listed in Table5.38.

Table5.38 Special Relays For System Switching

Device No.	Name	Description	Setting at Time of System Switching	
			New Control System CPU Module	New Standby System CPU Module
SM1590	System switching enable/disable flag from network module	This flag turns on when a system switching request is issued from a network module. The number of a module that issued a system switching request can be checked in SD1590. This flag turns off when all the bits of SD1590 are off.	○	○
SM1591	Standby system error detection disable flag at system switching	This flag is used to determine whether to detect "STANDBY" (error code: 6210) in the new standby system after the system is switched due to the causes listed later in this column. • ON: An error is not detected in the new standby system upon system switching. • OFF: An error is detected in the new standby system upon system switching. [Reason(s) for system switching] • System switching with GX Developer • System switching using the dedicated instruction • System switching request from a network module	–	○

○Set, – Not set

(2) Special Registers For System Switching

Special registers for system switching are listed in Table5.39.

Table5.39 Special Registers For System Switching

Device No.	Name	Description	Setting at Time of System Switching	
			New Control System CPU Module	New Standby System CPU Module
SD5	Error common information	This register stores the system switching condition that occurred in the control system prior to system switching only when "5 (System switching condition)" is saved to the error common information category code for SD4. 0: No system switching condition (default) 1: Power-off, reset, H/W failure, watchdog timer error 2: CPU stop error (except a watchdog timer error) 3: System switching request from a network module 16: Control system switching instruction 17: Control system switching request from GX Developer	○	○

5.3 System Switching (Between Control System and Standby System) Function
5.3.5 Special Relays/Registers For System Switching

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Device No.	Name	Description	Setting at Time of System Switching	
			New Control System CPU Module	New Standby System CPU Module
SD16	Individual error information	This register stores the system switching disabling condition only when "8 (System switching condition)" is saved to the individual error information category code for SD4. 0: Switch successfully completed (default) 1: Tracking cable malfunction (cable disconnection, cable malfunction, internal circuit malfunction, or hardware malfunction) 2: H/W failure, power-off, reset, or watchdog timer error occurring in the standby system 3: H/W failure, power-off, reset, or watchdog timer error occurring in the control system 4: Preparing for tracking communications 5: Timeout 6: Stop error (except a watchdog timer error) 7: Different operations between the two systems (detected only in the backup mode) 8: Copying memory from the control system to the standby system 9: Writing during RUN 10: Error detection by a standby system network module 11: Executing system switching 12: Online module change	○	–

○Set, – Not set

Table5.39 Special Registers For System Switching (Continued)

Device No.	Name	Description	Setting at Time of System Switching	
			New Control System CPU Module	New Standby System CPU Module
SD1588	Reason(s) for system switching	This register stores the reason(s) for system switching in the own system. A system switching condition is stored even when the system cannot be switched due to causes system switching is disabled. This register is initialized with zero (0) stored when the system is powered on from off or is reset. 0: Initial value (The control system has never been switched.) 1: H/W failure, watchdog timer error 2: CPU stop error (except a watchdog timer error) 3: System switching request from a network module 16: System switching dedicated instruction 17: System switching request from GX Developer	–	○
SD1589	Reason(s) for system switching failure conditions	If a system switching fails, one of the following values is stored in this register. 0: System switching complete (default) 1: Tracking cable malfunction (cable disconnection, cable malfunction, or internal circuit malfunction) 2: H/W failure, power-off, reset, watchdog timer error in the standby system 3: H/W failure, power-off, reset, watchdog timer error in the control system 4: Preparing for tracking communications 5: Communication timeout 6: Stop error in the standby system (except a watchdog timer error) 7: Different operations between the two systems (detected only in the back up mode) 8: During memory copy from the control system to the standby system 9: Performing online program change 10: Detecting an error of the network module in the standby system 11: The system is being switched. • This register is initialized with zero (0) stored when the own system is powered on. • Zero is stored in this register upon normal completion of system switching.	–	–
SD1590	Network module head address, which requested system switching	• When system switching is requested from the network module in the own system, the bit corresponding to the module that received the request turns on. • The system turns off the bit after the error is removed by a user. • For the number of a module that issued a system switching request from the network module in another system, refer to SD1690.	○	○

○Set, – Not set

5.3 System Switching (Between Control System and Standby System) Function
5.3.5 Special Relays/Registers For System Switching

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Table5.39 Special Registers For System Switching (Continued)

Device No.	Name	Description	Setting at Time of System Switching	
			New Control System CPU Module	New Standby System CPU Module
SD1600	System error information	• If an error is detected by the error check for a redundant system, the corresponding bit shown below turns on. That bit turns off when the error is cleared after that. • If any of b0, b1, b2, and b15 is on, the other bits are off. • In the debug mode, b0, b1, b2, and b15 are all off.	○	○
SD1601	System switching results	This register stores the reason(s) for system switching. • When a system is switched, the reason for system switching is stored in SD1601 of both systems. • This register is initialized with zero (0) stored when the system is powered on from off or is reset. • The following lists the values stored in this register. 0: Initial value (The control system has never been switched.) 1: Power-off, reset, H/W failure, or watchdog timer error[*1] 2: Stop error (except a watchdog timer error) 3: A system switching request from a network module 16: Control system switching instruction 17: System switching request from GX Developer	○	○
SD1602	System switching dedicated instruction parameter	• This register stores the argument to the instruction when a system is switched by the SP.CONTSW instruction. (The argument for the SP.CONTSW instruction is stored in SD1602 of both systems upon system switching.) • SD1602 is only valid when "16 (Control system switching instruction)" is stored in SD1601. • SD1602 is updated only when a system is switched by Control system switching instruction.	○	○
SD1610	Other system diagnostic error	• This register stores an error code for the error occurred in another system. • The value in SD0 of the CPU module in another system is reflected.	○	–

○Set, – Not set

* 1 : When the system is switched upon the power-off or reset of the control system, "1" is not stored in SD1601 of the new standby system.

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5.3 System Switching (Between Control System and Standby System) Function
5.3.5 Special Relays/Registers For System Switching

5.3.6 System Switching Precautions

(1) System Switching Failure
The control system may disappear and the redundant system may not function in any of the following cases:

(a) A tracking cable error (including tracking cable disconnection) has occurred during system switching (due to hardware failure, power off, or CPU module reset).

(b) A communication error has occurred between the CPU modules during system switching due to a user instruction or a stop error.

(c) During system switching due to a user instruction or a stop error, a tracking cable error (including tracking cable disconnection) has occurred concurrently with any of the following standby system conditions:
- The standby system is powered off or its CPU module is reset.
- A stop error occurs in the standby CPU module.
- Control system and standby system CPU module operating statuses are different.
- A standby system network module failure

Operations when the system switching fails due to one of (a) to (c) are listed in the Table5.40 below.

Table5.40 System A and B CPU Module Operations When the System Switching Fails

Function		System A and System B CPU Module Operation
CPU Module Operating Status		Standby System Operation
LED Indication	BACKUP	Red light ON (in Backup Mode) Amber light ON (in Separate Mode)
	CONTROL	Light OFF
Special Relay	SM1516 (Operation System Status)	ON (Standby system)
System Switching Request	System Switching Request from Network Module	Cannot execute system switching (ignores system switching request)
	System Switching Instruction	Cannot execute system switching (instruction cannot be executed due to standby system operation)
	System Switching Request from GX Developer, etc.	Cannot execute system switching Returns error code 4240H on startup (Can't execute on standby system).
Communication from GX Developer, etc.	Communication specified by control system CPU module	Communication error Returns error code 4248H on startup (inconsistency).

If the system switching has failed, power OFF the system A and B, connect a perfect cable to the CPU module, and then power ON the both systems simultaneously. With this operation, the system A will operates as the control system.

(2) Monitoring the Watchdog Timer During System Switching
The redundant system suspends the watchdog timer from being monitored during system switching.
Therefore, the "WDT ERROR (error code: 5001)" will not occur in the system switching scan even if the scan time exceeds the monitoring time set in the scan time watchdog timer.

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(3) Enabling System Switching During Online Program Change

System switching is disabled during online program change.

In order to prevent system switching during online program change, the redundant system disables the redundant CPU module from performing system switching prior to online program change, and enables it to perform system switching upon completion of online program change.

If the communication is interrupted between the redundant CPU module and GX Developer due to cable disconnection or other reason during online program change, the redundant system CPU module cannot complete the online program change and may remain to be disabled from performing system switching.

As long as the redundant CPU module is in this status, either of manual system switching or system switching by network module system switching request cannot be performed.

In this case, enable the system switching by performing the following operation, in order to enable the manual system switching or system switching by network module system switching request.

- Turn on the control system CPU module special relay "Disable prohibition of system switching during Online program change" (SM1709).
- Perform online program change again to complete it.

5.4 Operation Mode Change Function

2 types of redundant system operation mode change are available.
- Change from the backup mode to separate mode
- Change from the separate mode to backup mode

Refer to Section 5.1.3 for details on the backup mode and separate mode.

(1) Operation Mode Change Procedure
The operation mode change is performed in the control system CPU module by the redundant operation of GX Developer.

(a) Changing from the Backup Mode to Separate Mode

1) Connect GX Developer to the control system CPU module.

2) Select "Online" - "Redundant operation" from the menu bar of GX Developer to open the "Redundant operation" window.

3) Open the GX Developer online Redundancy Procedure window.
Check the "Change operation mode" at the redundant operation area, and then select "Separate mode" from the list.

4) Click the Execute button.

5) Set the RUN/STOP switch of the standby system CPU module to RUN→STOP→RUN, or use GX Developer to change from remote STOP to remote RUN. With this setting, the CPU module starts running and executes.[1]
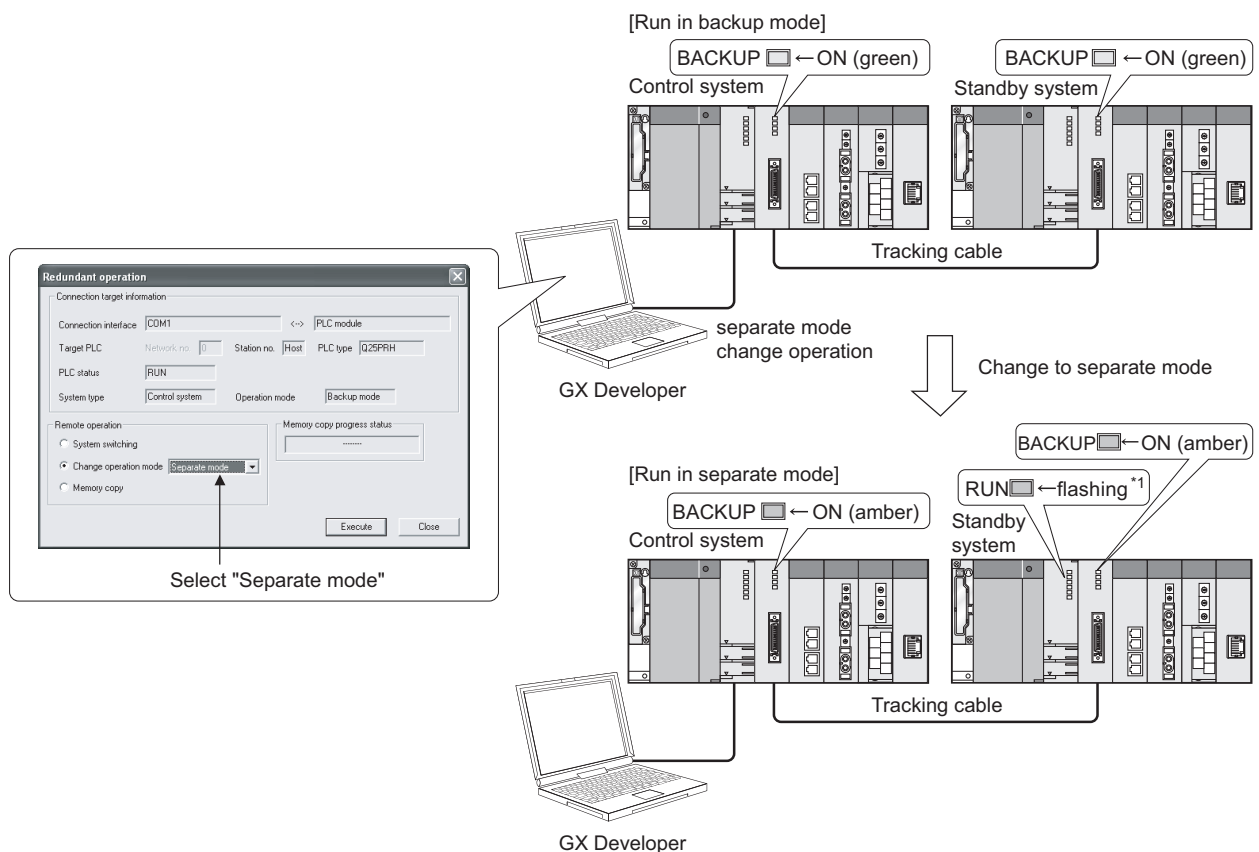
Diagram 5.33 Operation when Changing from Backup Mode to Separate Mode

* 1: When changing from the backup mode to the separate mode, the RUN LED of the standby system CPU module will flash and will be in a stop status.

(b) Changing From Separate Mode to Backup Mode [*1]

1) Connect GX Developer to the control system CPU module.

2) Select "Online" - "Redundant operation" from the menu bar of GX Developer to open the "Redundant operation" window.

3) Open the GX Developer online Redundancy Procedure window.
Check the "Change operation mode" at the redundant operation area, than select "Backup mode" from the list.

4) Click on the Execute button.

[Run in separate mode]

BACKUP ☐ ←ON (amber)   BACKUP ☐ ←ON (amber)
Control system   Standby system
Tracking cable

backup mode change operation

GX Developer

Change to backup mode mode

[Run in backup mode]

BACKUP ☐ ←ON (green)   BACKUP ☐ ←ON (green)
Control system   Standby system
Tracking cable

GX Developer

Select "Backup mode"
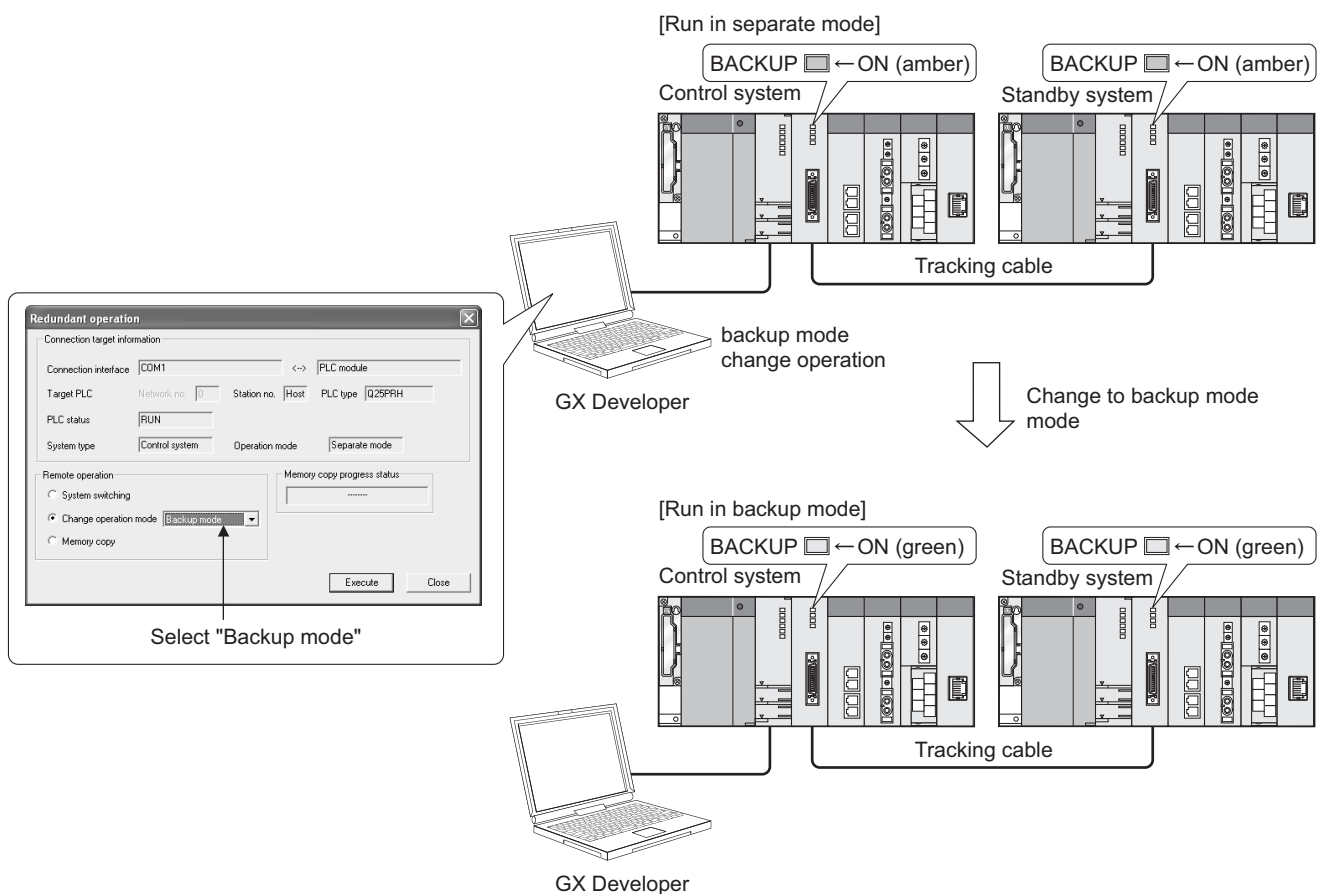
Diagram 5.34 Operation when Changing from Separate Mode to Backup Mode

* 1: The operation mode can be changed from the separate mode to backup mode by either of the following methods:
•Powering on system A and system B simultaneously
•Setting the RESET/L.CLR switches of both CPU modules to reset switch neutral position simultaneously.

(c) Precautions

1) After the operation mode is changed from the separate mode to backup mode, the standby system CPU module resumes the Consistency Check Between Systems A and B.
When returning to the backup mode, make sure to make the settings so that the control system and standby system will be consistent in advance.
Refer to Section 5.1.4 for details on the Consistency Check Between Systems A and B.

2) To change the operation mode back to backup mode, use the same GX Developer that changed the mode from backup mode to separate mode.
If the control system CPU module, however, is powered off or is reset in separate mode, the operation mode can be changed back to backup mode using any GX Developer.
When different GX Developer is used to change the operation mode back to backup mode, the error dialog box (Diagram 5.35) appears.
If the error dialog box appears, change GX Developer to the one used to change the mode to separate mode or reset the control system CPU module.
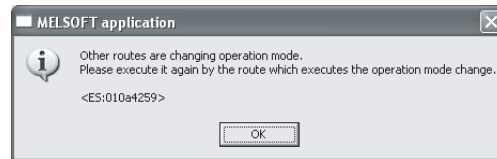
Diagram 5.35 Error Dialog Box Displayed on GX Developer

3) The operation mode cannot be changed from separate mode to backup mode using GX Developer when the control system CPU module operation is stopped (the "RUN" LED of the CPU module is flashing).

4) Operation mode cannot be changed in the following situations:
   • When standby system is powered off or the standby system CPU module is being reset.
     If the error dialog box (Diagram 5.36) appears on GX Developer, turn the standby system on again or clear reset on the CPU module and then change the operation mode.
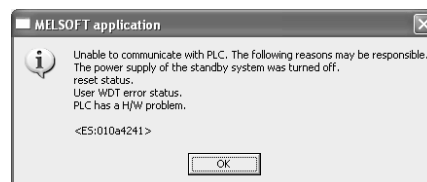
Diagram 5.36 Error Dialog Box Displayed on GX Developer

   • When the communication with the standby system is disabled due to tracking cable disconnection.
     If the error dialog box (Diagram 5.37) appears on GX Developer, check the tracking cable connection and change the operation mode.

Diagram 5.37 Error Dialog Box Displayed on GX Developer

- When the operation mode change request is issued to the standby system CPU module
  (If the system switching is executed in the separate mode, the operation mode change request is issued to the new control system CPU module.)
  If the error dialog box (Diagram 5.38) appears on GX Developer, specify the control system CPU module and make the operation mode change request.
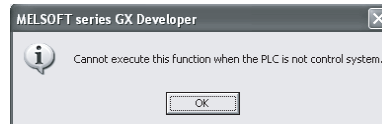
Diagram 5.38 Error Dialog Box Displayed on GX Developer

- When the operation mode change request and the system switching request are issued simultaneously
  The operation mode will not be changed even after the system switching is completed.
  If the error dialog box (Diagram 5.39) appears on GX Developer, after the system switching, repeat the operation mode change.

Diagram 5.39 Error Dialog Box Displayed on GX Developer

- When the operation mode change request is issued to the CPU module in the debug mode
  If the error dialog box (Diagram 5.40) appears, cancel Debug Mode in the redundancy parameters.(Section 5.1.3)

Diagram 5.40 Error Dialog Box Displayed on GX Developer

- When a hardware failure or watchdog timer error has occurred in the control system CPU module
  If the error dialog box (Diagram 5.41) appears on GX Developer, cancel the specified control system CPU error and change the operating mode.
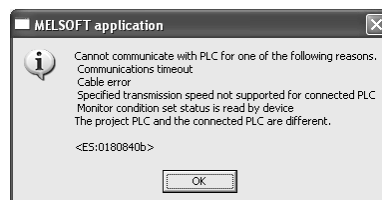
Diagram 5.41 Error Dialog Box Displayed on GX Developer

• During online program change
  If the error dialog box (Diagram 5.42) appears on GX Developer, wait for
  RUN write to complete and then change the operation mode.

MELSOFT application

This peripheral device or another peripheral device are operating online change function.
Please execute it again after it completed online change function.

<ES:010a424c>

OK
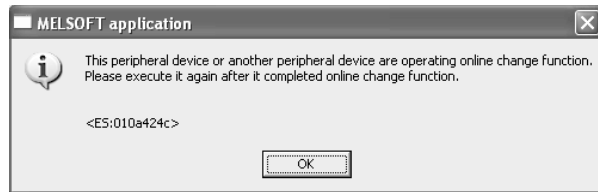
Diagram 5.42 Error Dialog Box Displayed on GX Developer

• During memory copy from control system to standby system
  If the error dialog box (Diagram 5.43) appears on GX Developer, wait for
  memory copy from the control system to the standby system to complete
  and then change the operation mode.

MELSOFT application

The memory copy function is being executed.
Please execute it again for a while after time.

<ES:010a4247>

OK

Diagram 5.43 Error Dialog Box Displayed on GX Developer

• When a stop error occurs in the control system CPU module (the "RUN"
  LED: flashing)
  If the error dialog box (Diagram 5.44) appears on GX Developer, cancel
  the control system CPU error and change the operation mode.

MELSOFT application

Operation mode is being changed (from backup to separates).
Please change RUN-LED blink PLC from STOP status to RUN status.
After it, Please execute the change of Operation mode again.

<ES:010a4258>

OK
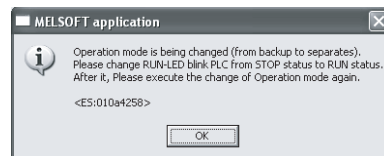
Diagram 5.44 Error Dialog Box Displayed on GX Developer

(2) Operations When Changing Operation Mode

The CPU module operations after operation mode change and the input/output processing to the remote station are listed in Table5.41.

Refer to Table5.41 for operations during operation in the corresponding operation mode.

Table5.41 Operations When Changing Operation Mode

Function			From Backup Mode to Separate Mode		
			Control system	Standby system	
Program execution	Operation	Operation status: RUN	Continues execution.	Stops. (Starts operation when the RUN/STOP switch is operated from RUN to STOP to RUN.)	
		Operation status: STOP, PAUSE, stop error	Stops (continues).	Stops (continues).	
	Program execution type		Takes over the current setting.	Takes over the current setting.	
	EI/DI setting		Takes over the current setting.	Takes over the current setting.	
	IMASK setting		Takes over the current setting.	Takes over the current setting.	
	DUTY setting		Takes over the current setting.	Takes over the current setting.	
	File register setting		Takes over the current setting.	Takes over the current setting.	
	Instruction executed over several scans (dedicated instruction)		Continues the instruction execution.	- (since operation was not executed before operation mode change.)	
Device memory (including special relays and special registers)			Takes over the current status.	Takes over the current status.	
Signal flow		With tracking setting	Takes over the current status.	Takes over the current status.	
		Without tracking setting	Takes over the current status.	Clears.	
LED	"RUN"	Operation status: RUN	Turns on (continues).	Turns off and then flashing. (Turns on when the RUN/STOP switch is operated from RUN to STOP to RUN.)	
		Operation status: STOP, PAUSE, stop error	Turns off (continues).	Turns off (continues).	
	"BACKUP"		ON (green) and then ON (orange).	ON (green) and then ON (orange).	
	Other than "RUN" and "BACKUP"		Takes over the current status.	Takes over the current status.	
I/O	I/O from/to main base unit	Input	Continues execution.	Continues execution.	
		Output	Continues execution.	Starts output.	
	I/O from/to extension base unit	Input	Continues execution.	Does not execute input.	
		Output	Continues execution.	Does not execute output.	
	CC-Link IE Controller Network	Link to CPU	Continues execution.	Continues execution.	
		CPU to link	Continues execution.	Does not execute refresh. (No change from before operation mode change)	
	MELSECNET/H PLC to PLC network	Link to CPU	Continues execution.	Continues execution.	
		CPU to link	Continues execution.	Does not execute refresh. (No change from before operation mode change)	
	MELSECNET/H remote I/O network	Link to CPU	Continues execution.	Continues execution.	
		CPU to link	Continues execution.	Does not execute refresh. (No change from before operation mode change)	
	Auto refresh to network module on main base unit	Intelligent module to CPU	Continues execution.	Continues execution.	
		CPU to intelligent module	Continues execution.	Continues execution.	
	Auto refresh of network module on extension base unit	Intelligent module to CPU	Continues execution.	Does not execute auto refresh.	
		CPU to intelligent module	Continues execution.	Does not execute auto refresh.	
	SB/SW refresh (CC-Link IE Controller Network, MELSECNET/H, CC-Link)	Link to CPU	Continues execution.	Continues execution.	
		CPU to link	Continues execution.	Does not execute refresh. (No change from before operation mode change)	

	From Separate Mode to Backup Mode	
	Control system	**Standby system**
	Continues execution.	Stops.
	Stops (continues).	Stops (continues).
	Takes over the current setting.	Takes over the current setting.
	Takes over the current setting.	Changes to the DI status (interrupt disable).
	Takes over the current setting.	Takes over the current setting.
	Takes over the current setting.	Takes over the current setting.
	Takes over the current setting.	Takes over the current setting.
	Continues the instruction execution.	Continues the instruction execution.
	Takes over the current setting.	Takes over the current setting.
	Takes over the current setting.	Takes over the current setting.
	Takes over the current setting.	Takes over the current setting.
	Turns on (continues).	Turns on, flickers and then turns off.
	Turns off (continues).	Turns off (continues).
	Lit orange and then lit green.	Lit orange and then lit green.
	Takes over the current setting.	Takes over the current setting.
	Continues execution.	Continues execution.
	Continues execution.	Stops output.
	Continues execution.	Does not execute input.
	Continues execution.	Does not execute output.
	Continues execution.	Continues execution.
	Continues execution.	Does not execute refresh. (No change from before operation mode change)
	Continues execution.	Continues execution.
	Continues execution.	Does not execute refresh. (No change from before operation mode change)
	Continues execution.	Continues execution.
	Continues execution.	Does not execute refresh. (No change from before operation mode change)
	Continues execution.	Continues execution.
	Continues execution.	Continues execution.
	Continues execution.	Does not execute auto refresh.
	Continues execution.	Does not execute auto refresh.
	Continues execution.	Continues execution.
	Continues execution.	Does not execute refresh. (No change from before operation mode change)

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Table5.41 Operations When Changing Operation Mode (Continue)

Function			From Backup Mode to Separate Mode		
			Control system	**Standby system**	
Redundant function	Data tracking (☞ Section 5.5.3)	Device memory	Continues execution.		
		SM/SD (system dependent)	Stops tracking.		
		SFC information	Stops tracking.		
		PID control instruction information	Stops tracking.		
		Signal flow (with tracking setting)	Stops tracking.		
	Consistency check between System A & B (☞ Section 5.1.4)		• There are no items to be checked when operation mode change is made. • Stops operation status consistency check between System A & B.		

	From Separate Mode to Backup Mode	
	Control system	**Standby system**
	Continues execution.	
	Starts tracking.	
	Starts tracking.	
	Starts tracking.	
	Starts tracking.	
	Makes consistency check between System A & B for the following items. When an error is detected, a self-diagnostic error occurs in the standby system. • File • Operation status • Main base mounting status • Parameter valid drive	

(a) Operations When Changing from Backup Mode to Separate Mode
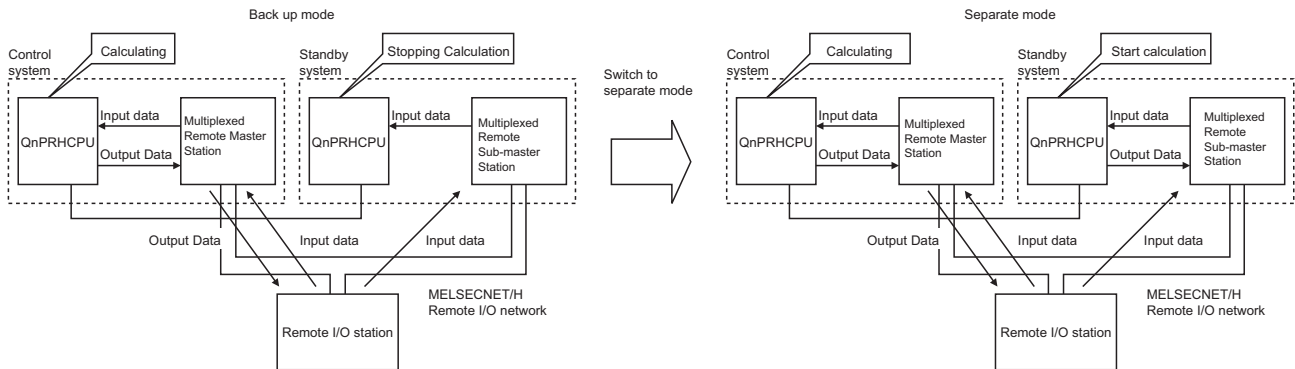
Diagram 5.45 Operations When Changing from Backup Mode to Separate Mode

(b) Operations When Changing from Separate Mode to Backup Mode
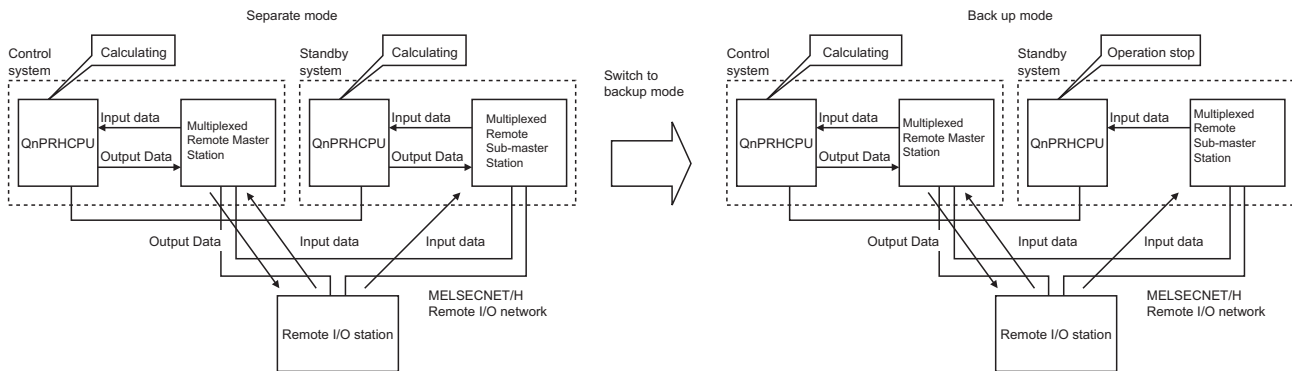
Diagram 5.46 Operations When Changing from Separate Mode to Backup Mode

Memo

(3) Processing After Operation Mode Change

Table5.42 indicates the redundant system operations after operation mode change.

Table5.42 Operations After Operation Mode Change

Item	In Backup Mode						
	Control System			Standby System			
	During Normal RUN and During Continuation Error	During Stop	During Stop Error	During Normal RUN and During Continuation Error	During Stop	During Stop Error	
Program Execution	Executes the program	Does not execute the program		Does not execute the program			
Signal Flow Memory	Reflects the operation result of the control system.	Holds.		When the setting is "Enable tracking of signal flow memory": Renews the old data into the signal memory flow data tracked from the control system CPU module. When the setting is "No tracking": Holds the current status.			
RUN LED	ON	OFF		OFF			
END Processing	Executes it.			Executes it.			
Consistency Check Between Systems A and B	Does not execute the check			Executes the check while the control system is running. Does not execute it when the control system is in STOP status or has developed a stop.		Does not execute the check	
Tracking	Executes the function			Executes the function		Does not execute the function.	
Program Change in Ladder Mode During RUN	Executable			Executes the online program change in the control system. Does not execute it in the standby system only.			
Writing files in RUN	Executable			Executes the function when control system has been rewritten. Standby system rewrite only is not possible			
Input from Input Module on Main Base Unit	Inputs it		Executes system switching	Inputs it			
Output to Output Module on Main Base Unit	Outputs it.			Turns OFF output (Y) during system switching Does not execute output (Y) in the standby system.		Does not output it	
Output from input module on extension base unit	Inputs it			Does not execute input			
Output from input module on extension base unit	Outputs it.			Does not execute output			
Automatic Refresh to Network Module on Main Base Unit (CPU module→network module)	Executes the function			Executes the function		Does not execute output it	
Automatic Refresh from network Module on Main Base Unit (Network Module→CPU Module)	Executes the function			Executes the function			
Auto refresh to network module on extension base unit (CPU module→network module)	Executes auto refresh			Does not execute auto refresh			
Auto refresh from network module on extension base unit (Network Module→CPU Module)	Executes auto refresh			Does not execute auto refresh			

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	In Separate Mode					
	Control System			Standby System		
	During Normal RUN and During Resume Error	**During Stop**	**During Stop Error**	**During Normal RUN and During Resume Error**	**During Stop**	**During Stop Error**
	Executes the program	Does not execute the program		Executes the program *3	Does not execute the program	
	Reflects the operation result of the control system.	Holds.		Reflects the operation result of the standby system.	Holds.	
	ON	OFF		ON	OFF	
	Executes it			Executes it		
	Does not execute the check			Does not execute the check		
	Executes the function			Executes the function		Does not execute function
	Executes the check on the specified CPU module only.			Executes only on specified CPU module		
	Executes only on specified CPU module			Executes only on specified CPU module		
	Input it			Input it		
	Output it		Does not output it	Output it		Does not output it
	Executes input			Does not execute input		
	Executes output			Does not execute output		
	Executes the function		Does not perform output it	Executes the function		Does not perform output it
	Executes the function			Executes the function		
	Executes auto refresh			Does not execute auto refresh		
	Executes auto refresh			Does not execute auto refresh		

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Table5.42 Operations After Operation Mode Change (Continue)

Item	In Backup Mode						
	Control System			Standby System			
	During Normal RUN and During Continuation Error	During Stop	During Stop Error	During Normal RUN and During Continuation Error	During Stop	During Stop Error	
Refresh between CC-Link IE Controller Network CPU Module←→Network Module	Executes the function		Executes system switching	Executes a refresh from the network module to the CPU module. Does not execute a refresh from the CPU module to the network module	Executes the function		
Transient Requested from Other Station in CC-Link IE Controller Network	Executes the function			Executes the function			
Refresh between MELSECNET/H PLC to PLC Network CPU Module←→Network Module	Executes the function			Executes a refresh from the network module to the CPU module. Does not execute a refresh from the CPU module to the network module	Executes the function		
Transient Requested from Other Station in MELSECNET/H PLC to PLC Network	Executes the function			Executes the function			
Input from MELSECNET/H Remote I/O network (Input Refresh from Network Module to CPU Module)	Inputs it			Inputs it	Does not input it		
Output to MELSECNET/H Remote I/O net (Output Refresh From CPU Module to Network Module) *1	Outputs it	Turns OFF output (Y)		Does not output it			
SB/SW Refresh from Network Module to CPU Module *2	Executes the function			Executes the function			
SB/SW Refresh from CPU Module to Network Module *2	Executes the function			Executes the function		Does not execute the function	

* 1: When a stop error occurs in both system CPU modules, all output (Y) to the remote I/O station is turned off.
Remote I/O station output can be held when a stop error occurs in both system CPU modules.
Please refer to the following manuals for information on how to hold remote I/O station output.
☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)
☞ MELSEC-Q CC-Link System Master/Local Module User's Manual
* 2: Indicates refresh of SB (Link special relay)/SW (Link special register used for) CC-Link IE Controller Network, MELSECNET/H PLC to PLC network, MELSECNET/H Remote I/O network, and CC-Link.

	In Separate Mode					
	Control System			Standby System		
	During Normal RUN and During Resume Error	During Stop	During Stop Error	During Normal RUN and During Resume Error	During Stop	During Stop Error
	Executes the function		Does not execute the function	Executes refresh from network module to CPU module Does not execute refresh from CPU module to network module		Does not execute the function
	Executes the function			Executes the function		
	Executes the function		Does not execute the function	Executes refresh from network module to CPU module Does not execute refresh from CPU module to network module		Does not execute the function
	Executes the function			Executes the function		
	Inputs it		Inputs it	Inputs it		Inputs it
	Outputs it	Turns OFF output (Y)	Does not output it	Does not output it		
	Executes the function			Executes the function		
	Executes the function		Does not execute the function	Executes the function		Does not execute the function

* 3: When changing from the backup mode to separate mode, the RUN LED will flash and programs will not be executed.

Set the RUN/STOP switch of the standby system CPU module to RUN→STOP→RUN, or use GX Developer to change from remote STOP to remote RUN. With this setting, the CPU module starts running and executes programs

5.5 Tracking Function

5.5.1 Tracking Function Overview

(1) Tracking Function

The tracking function maintains the data of the control system and standby systems consistent so that the redundant system can continue to operate with the standby system in case the control system goes down.

As the tracking data settings have been made by the default in the redundant CPU, tracking can be done without changing the tracking settings. [1]

Tracking can be done in either backup mode or separate mode. [2]

Control system   Standby system

Tracking cable

During END processing, default set data is tracking forwarded.[3]
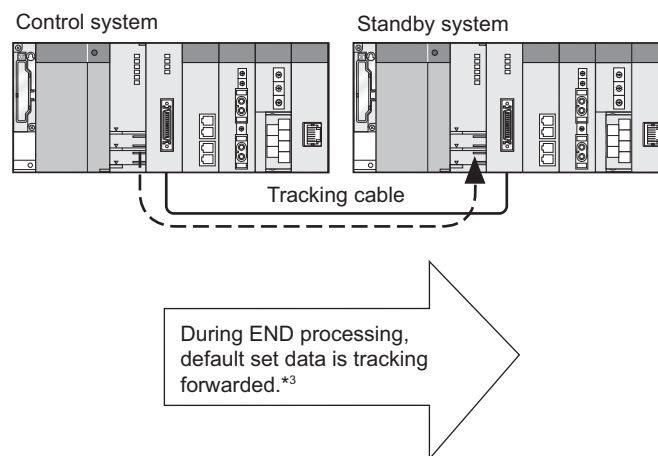
Diagram 5.47 Data Transfer by Tracking Function

* 1: Following tracking data are set by default:
    •Internal devices
    •SFC data
    •PID control instruction data
     Refer to Section 5.3 for the tracking data setting.
* 2: Please refer to Section 5.5.3, for data tracking in the backup mode and separate mode.
* 3: If the data for tracking is changed, data after the change will be tracked.(Section 5.5.3)

(2) Tracking Data

There are 2 types of tracking data: tracking data based on the range set by the user and tracking data regardless of the settings, i.e., automatic tracking data.

(a) Tracking Data Range Setting by User

The tracking data range and tracking timing can be set by the user.
As the tracking data range has been set by default in the redundant CPU, tracking will be executed even without the user making the tracking settings.

(b) Automatic Tracking Data

The data will be automatically tracked regardless of the tracking settings.
The automatic tracking data range cannot be changed by the user.

Refer to Section 5.5.3 for details on the tracking data settings.

(3) Changing Tracking Data Settings

The tracking data range settings can be changed in the following cases:

- To shorten the tracking time
- To add to the tracking data (file register, etc.)
- To change the tracking timing in a program
- To track signal flow memory

Change the tracking data setting at the tracking settings in the redundant parameter settings of GX Developer.
Refer to Section 5.5.4 for details on changing the tracking data settings.

Remark •

When changing the tracking data settings at the tracking settings in the redundant parameter settings, the data can be divided into blocks (tracking block).
Each block can be set to be tracked or not for each scan with the special relay for data tracking execution (Data tracking block specification trigger: SM1520 to SM1583).
Refer to Section 5.5.5, for details on tracking blocks and tracking triggers.

• •

(4) Precautions

Tracking transfer cannot be performed in the following cases.
Scan time will shorten by the tracking transfer time.

(a) The tracking cable is disconnected or is a failure. (TRK. DISCONNECT (error code: 6130))
Make sure the tracking cable is connected or change the cable.

(b) If the following malfunctions occur on the standby system:
- Standby system power is off
- A stop error occurs on the standby system CPU module
- The standby system CPU module is resetting
  (Tracking can be performed if reset is cleared.)

When tracking device setting is not made, the program is executed with the values before refresh at first scan after system switching.
Set the following devices as tracking devices.
- Device that makes auto refresh setting to the intelligent function module on the extension base unit with GX Configurator
- Device that makes auto refresh setting to the CC-Link master module on the extension base unit

5.5.2 Tracking Execution Procedure

The procedure for executing tracking in Diagram 5.48.

```
                        ┌─────────────────┐
                        │      Start      │
                        └─────────────────┘
                                 │
                                 ▼
                           ╱───────────╲
                          ╱ Perform      ╲        NO
                         ╱  tracking       ╲─────────────────┐
                         ╲  transfer       ╱                  │
                          ╲ according to  ╱                   │
                           ╲ defaults?   ╱                    │
                            ╲───────────╱                     │
                                 │ YES                        ▼
                                 │            ┌─────────────────────────────────┐
                                 │            │ Use GX Developer to change      │
                                 │            │ tracking setting redundancy     │
                                 │            │ parameters.                     │
                                 │            │ ☞ Section 5.5.3                 │
                                 │            └─────────────────────────────────┘
                                 │                          │
                                 │                          ▼
                                 │            ┌─────────────────────────────────┐
                                 │            │ Use GX Developer to add tracking│
                                 │            │ forwarding triggers to the      │
                                 │            │ controlling program. ☞ Section 5.5.4 │
                                 │            └─────────────────────────────────┘
                                 │                          │
                                 ▼                          ▼
              ┌─────────────────────────────┐  ┌─────────────────────────────┐
              │ Write to the CPU module     │  │ Write to the CPU module     │
              │ parameters set with GX      │  │ parameters set with GX      │
              │ Developer and programs.     │  │ Developer and programs.     │
              └─────────────────────────────┘  └─────────────────────────────┘
                                 │                          │
                                 ▼                          ▼
              ┌─────────────────────────────┐  ┌─────────────────────────────┐
              │ Perform a system restart.   │  │ Perform a system restart.   │
              └─────────────────────────────┘  └─────────────────────────────┘
                                 │                          │
                                 │                          ▼
                                 │            ┌─────────────────────────────┐
                                 │            │ Turn ON tracking forward    │
                                 │            │ trigger using the program.  │
                                 │            └─────────────────────────────┘
                                 │                          │
                                 ◄──────────────────────────┘
                                 ▼
              ┌─────────────────────────────┐
              │  Begin tracking transfer    │
              └─────────────────────────────┘
                                 │
                                 ▼
                        ┌─────────────────┐
                        │    Completed    │
                        └─────────────────┘
```

Diagram 5.48 Tracking Execution Procedure

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5.5.3 Tracking Data

Tracking data are listed in Table5.43.

Table5.43 Tracking Data

Type		Description	Auto Tracking [1]	Setting Change by User [2]	Operating Mode [3]	
					Backup Mode	Separate Mode
Device Data	Internal Device	Data of input (X), output (Y), internal relay (M) and others used in programs	○ [4]	○	○	○
	Special Relay	Data turned ON or OFF by user or system (☞ Table5.46)	○	× [5]	○	○
	Special Register	Data stored by user or system (☞ Table5.47)	○	× [5]	○	○
Signal Flow Memory		Data that determines whether the rise and fall instructions will be executed or not in sequence programs	×	○	○	×
SFC data		Data used to execute SFC	○	×	○	×
PID Control Instruction data		PID control data specified by PIDINIT and S.PIDINIT instructions	○	×	○	×

* 1: ○ Auto tracking enabled, × Auto tracking disabled
* 2: ○ Setting change enabled, × Setting change disabled
* 3: ○ Tracking enabled, × Tracking disabled
* 4: The device range set by default will be transferred.
* 5: The control system and standby system use different special relay and special register areas (SM/SD) for storing some information, such as system information. If data in these areas are transferred from the control system to the standby system, the system does not operate properly. Do not transfer data in these areas.

(1) Tracking Data Range Setting by User

The tracking data range and tracking timing can be set by the user.
This applies to the internal devices and signal flow memory. (Set whether the signal flow memory will be tracked or not.)
Up to 100K words of internal devices and signal flow memory can be transferred for each tracking.

(a) Internal devices

Internal devices are data of input (X), output (Y), internal relay (M) and others used in programs.
Table5.44 lists the internal devices that can be tracked.

1) Internal Device Default Setting Range

The default tracking range is set to the internal devices as listed in Table5.44. When changing the number of the device points to be used in the PLC parameter device setting using GX Developer, the number after change will be the tracking range.
By default, all device points in the tracking range are to be tracked.

Table5.44 Internal Devices That Can Be Tracked

Device	Default Tracking Range	Tracking Range Set by User
Input	X0 to X1FFF	X0 to X1FFF
Output	Y0 to Y1FFF	Y0 to Y1FFF
Internal relay [1]	M0 to M8191	M0 to M8191
Latch Relay [1]	L0 to L8191	L0 to L8191
Step Relay	S0 to S8191	S0 to S8191
Annunciator [1]	−	F0 to F2047 [7]
Edge Relay [1]	V0 to V2047	V0 to V2047
Link Relay [1]	B0 to B1FFF	B0 to B1FFF
Link Special Relay	−	SB0 to SB7FF [6]
Timer (Contact Points and Current Value) [1]	T0 to T2047	T0 to T2047
Retentive Timer (Contact Points and Current Value)	[2]	[2]
Counter (Contact Points and Current Value) [1]	C0 to C1023	C0 to C1023
Data Register [1]	D0 to D12287	D0 to D12287
Link Register [1]	W0 to W1FFF	W0 to W1FFF
Link Special Register	−	SW0 to SW7FF [6]
Index Register	Z0 to Z15	Z0 to Z15
Special Relay	[3]	[5]
Special Register	[4]	[5]
File Register	−	ZR0 to ZR1042431

− :Indicates data that is set to be not tracked by default.

* 1: The number of device points to be used can be changed in the PLC parameter device settings using GX Developer.
   If the number of points to be used is changed, the number after change will be the "default tracking range" or the "tracking range set by user."
* 2: The number of retentive timer points is 0 by default.
   When setting the number of retentive timer points to be used in the PLC parameter device settings of GX Developer, the set number will be the "default tracking range" or the "tracking range set by user."
* 3: For the special relays, the data in the range listed in Table5.46 will be automatically tracked:
* 4: For the special registers, the data in the range listed in Table5.47 will be automatically tracked:
* 5: Special relays and special registers used in the redundant system are transferred automatically. The tracking transfer range cannot be set by the user.
* 6: Do not perform the tracking transfer to the link special relay (SB) and link special register (SW) used in the network module system since they are the data inherent to stations.
* 7: Refer to Section 7.3 for the processing to be performed when the annunciator is tracked.

Remark •

Please use the following settings when changing the internal device settings:

- Bit devices (including timer, retentive timer, counter)
  Multiples of 16 of the beginning device number
  Transfer range is set in 16 point units
- Word device
  Set in 1 point units

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2) Changing the Internal Device Settings

Internal device settings are changed in the following cases:

Table5.45 Internal Device Settings Change

Objective	Tracking Setting
To shorten tracking time	• Change the settings so that only the devices actually used will be tracked. • Divide the tracking data range into multiple blocks and change the tracking timing for each block.
To add file register or annunciator	Set the file register or annunciator to tracking blocks No. 1 to 64.
Program tracking timing to any time.	• Change the settings so that the tracking trigger of tracking block No. 1 will be turned on and off manually. • Divide the tracking data range into multiple blocks and turn the tracking trigger of each block on and off in the program.

(b) Signal Flow Memory

Signal flow memory records the operation execution result of each sequence program step, i.e., whether each sequence program step was executed or not. The signal flow memory information determines whether the rise, fall and SCJ instructions will be executed or not.

1) Default Tracking Settings

By default, signal flow memory is set to be not tracked.

2) Changing the Tracking Setting

When signal flow memory has not been tracked, the rise, fall and SCJ instructions may not function normally in the new control system after system switching.

In order to ensure these instructions function even if system switching occurs, change the settings so that signal flow memory will be tracked.

This setting reduces the number of internal device points that can be tracked at a time by 16K words.

☒ **POINT**

1. Precautions when disabling signal flow memory from being tracked
   - Rise instruction (PLS, □ P, SP.□)
     Even if the execution condition is changed from off to on during system switching, the rise instruction will not be executed after system switching.
   - Fall instruction (LDF, ANDF, ORF, MEF, PLF)
     If the execution condition is off during system switching, the fall instruction will be executed after system switching.
   - SCJ instruction
     If the execution condition is on during system switching, the SCJ instruction will jump to the specified pointer without waiting 1 scan.
2. Signal flow memory tracking capacity
   Signal flow memory as much as program capacity will be tracked.

(2) Automatic Tracking Data

Automatic tracking data is the data that the redundant CPU tracks regardless of the redundant parameter tracking settings.

The data settings cannot be changed by changing the redundant parameter tracking settings.

This applies to the SFC data, PID control instruction data, and some special relays and special registers.

(a) SFC data

SFC data is necessary for continuing the SFC program.
SFC data is tracked when using the SFC program in the backup Mode.

(b) PID control instruction data

PID control instruction data to be automatically tracked is the data that is specified for PID control by the PIDINIT and S.PIDINIT instructions.
The PID control data is tracked when executing the PIDINIT and S.PIDINIT instructions in the backup mode.

(c) Special Relay

Table5.46 lists the automatically transferred special relay areas.

Data in the special relay are transferred only in Backup Mode.

Do not transfer data in the special relay areas other than those listed in Table5.46.

Table5.46 Automatically Transferred Special Relay Areas

Number	Name	Number	Name
SM90 to SM99	Startup watchdog timer for step transition (Enabled only when SFC program exists)	SM701	Number of output characters selection
SM202	LED OFF command	SM702	Search method
SM206	PAUSE enable coil	SM703	Sort order
SM210	Clock data set request	SM710	CHK instruction priority ranking flag
SM213	Clock data read request	SM715	EI flag
SM250	Max. loaded I/O read	SM722	BIN/DBIN instruction error disabling flag
SM254	All stations refresh command	SM774	PID bumpless processing (for complete derivative)
SM255 to SM257	MELSECNET/H module 1 information	SM775	Selection of link refresh processing during COM instruction execution
SM260 to SM262	MELSECNET/H module 2 information	SM776	Enable/disable local device at CALL
SM265 to SM267	MELSECNET/H module 3 information	SM777	Enable/disable local device in interrupt program
SM270 to SM272	MELSECNET/H module 4 information	SM794	PID bumpless processing (for incomplete derivative)
SM321	Startup/stop SFC program	SM1500 SM1501	Hold mode (S.IN, S.OUT instruction)
SM322	SFC program start status	SM1520 to SM1583	Data tracking block specification trigger
SM323	Presence/absence of continuous transition for entire blocks	SM1591	Standby system error detection disable flag at system switching
SM325	Output mode at block stop	SM1592	Enable/disable user system switching
SM326	SFC device clear mode	SM1598	Copy contents of standard ROM during memory copy
SM327	Output during end step execution	SM1649	Standby system cancel error flag
SM402	After RUN, ON for 1 scan only	SM1709	Disable prohibition of system switching during online program change
SM403	After RUN, OFF for 1 scan only	SM1710	Transfer tracking data during online program change enable flag
SM551	Reads module service interval		

(d) Special register

Table5.47 lists the automatically transferred special register areas.

Data in the special register are transferred only in Backup Mode.

Do not transfer data in the special register areas other than those listed in Table5.47.

Table5.47 Automatically Transferred Special Register Areas

Number	Name
SD90 to SD99	Step transition monitoring timer setting value (Enabled only when SFC program exists)
SD207 to SD209	LED display priority ranking
SD210 to SD213	Clock data
SD250	Loaded maximum I/O
SD315	Time reserved for communication processing
SD414	2n second clock setting
SD415	2nms clock setting
SD550	Service interval measurement module
SD774 to SD775	PID limit setting (for complete derivative)
SD778	Refresh processing selection when the COM/CCOM instruction is executed
SD794 to SD795	PID limit setting (for incomplete derivative)
SD1500 to SD1501	Basic period
SD1649	Standby system error cancel command
SD1710	Waiting time for online program change (standby system)

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5.5.4 Tracking Data Settings

Make the tracking data settings at Tracking settings in Redundant parameter in GX Developer.

If no tracking settings are made by the user, Tracking device settings will be set to "Internal device block setting" (default) and tracking will be executed based on "Default Tracking Range" in Table5.44 in Section 5.5.3 (1).
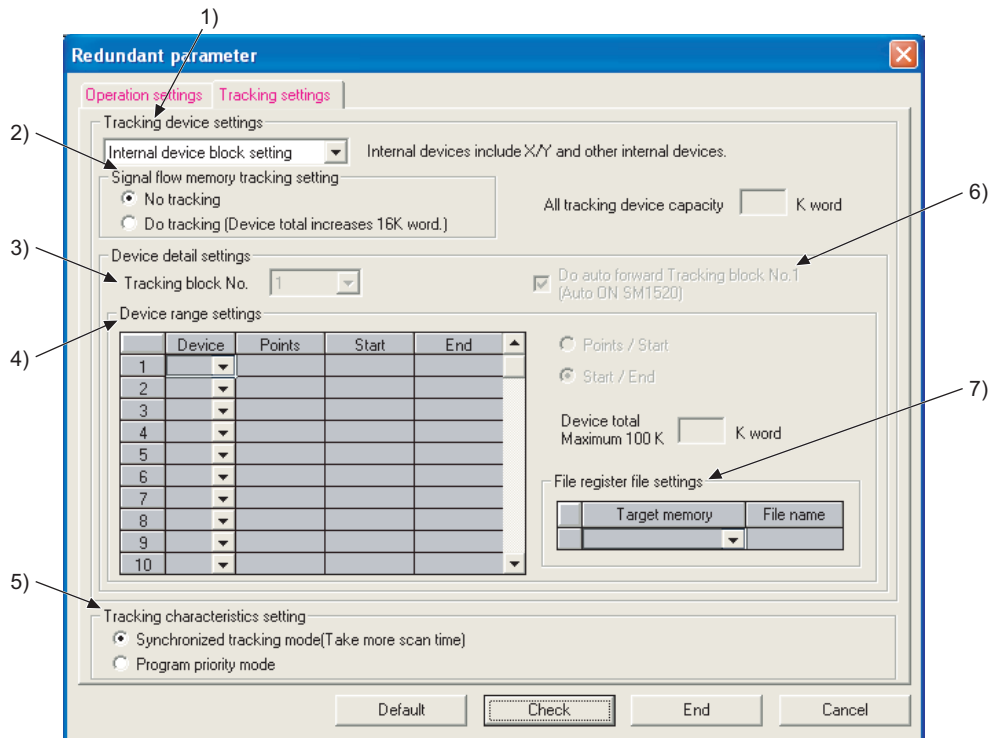
Diagram 5.49 Tracking setting Window

Table5.48 Tracking Setting Items and Ranges

	Item		Range	Default	Reference
1	Tracking device setting		• Internal device block setting • Device detail settings	Internal device block setting	Section 5.5.3
2	Signal flow memory tracking setting		• No tracking • Enable tracking of signal flow memory	No tracking	Section 5.5.3
3	Tracking block No.		• 1 to 64	1	Section 5.5.5
4	Device range Settings [*1]	Device	• Table5.44 Tracking Range Set by User	Table5.44 Default Tracking Range	Section 5.5.3
		Points / Start			
		Start / End			
5	Tracking characteristics setting		• Synchronized tracking mode • Program priority mode	Synchronized tracking mode	Section 5.5.7
6	Do auto forward Tracking block No. 1		• Do auto forward Tracking block No. 1 • Do not auto forward Tracking block No. 1	Do auto forward Tracking block No. 1	Section 5.5.5
7	File register file settings [*2]	Target memory	• Memory card (SRAM) • Standard RAM	–	–
		File name	Sets tracking file register file name • Up to 8 half-width characters • Cannot include the following characters: \ / : ; * ? < > | += [ ] . ,	–	–

* 1: The following is the setting range in the detailed device settings:
    • 1 to 2048 devices can be set for one block
      The total of the number of devices for all blocks is 2048 (maximum).
    • The device range settings for the timer, retentive timer and counter device will be doubled.
    • Tracking device capacity per block is up to 100K words, including single flow memory tracking
      capacity (16K words).
    • Tracking device points per range are:
      Bit device: 0 to 32767 (set in 16 point units)
      Timer, retentive timer and counter: 0 to 32767 (set in 16 point units)
      Word device: 0 to 32767 (set in 1 point units)
* 2: The file register file can be set in each tracking block.
* 3: 16 device points of timer, retentive timer and counter is equivalent to 18 words.

☒POINT

1. The same device No. cannot be set in 2 ranges for 1 tracking block.
   If the same device No. is set in 2 ranges in the tracking settings of GX
   Developer, an error will occur in GX Developer.
2. As 100K words can be set in one block and up to 64 blocks can be set, up to
   6,400K words can be set as a total at the tracking settings in the redundant
   parameter settings of GX Developer.
   However, up to 100K words can be tracked for each scan.
   When setting tracking data to multiple tracking blocks, make sure that
   tracking capacity is within 100K words for each scan.

5.5.5 Tracking Block And Tracking Trigger

(1) Tracking Blocks

(a) Tracking Block Overview

The internal device tracking range can be divided into multiple blocks, i.e., tracking blocks (tracking block No. 1 to 64) at the tracking settings in the redundant parameter settings of GX Developer.

(b) Tracking the Tracking Blocks

Set whether the tracking block will be tracked or not with the data tracking block specification trigger (SM1520 to SM1583) that corresponds to the target tracking block.

When the data tracking block specification trigger is turned ON, the device data set to the corresponding tracking block No. will be tracked.

[Program Example]
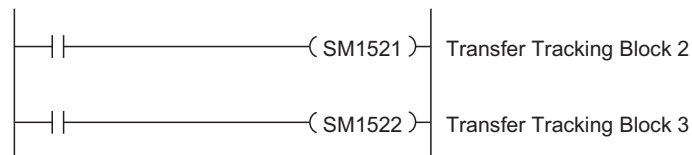
[Operation]
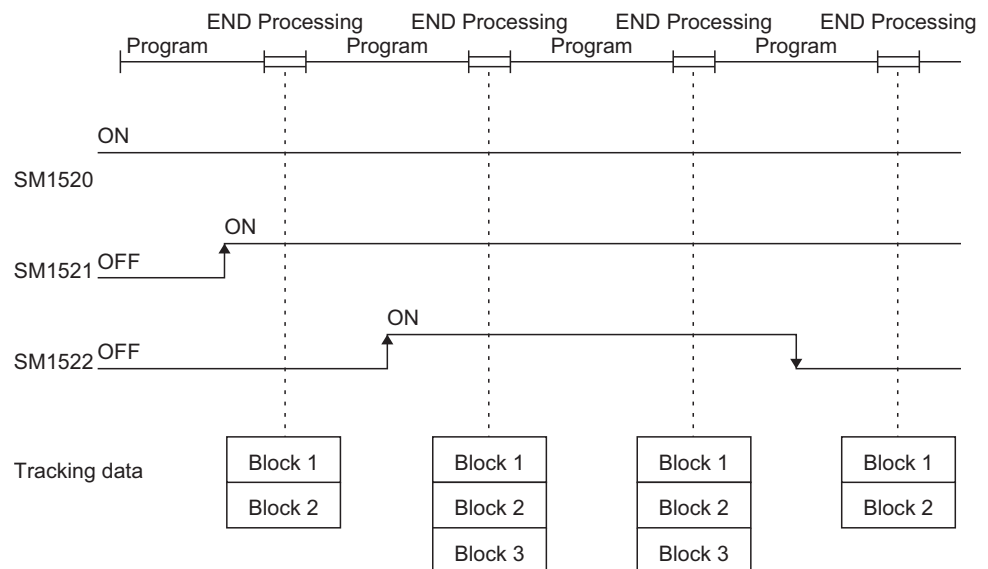
Diagram 5.50 Tracking Operation Timing by Tracking Trigger

(c) Default Tracking Block Setting

When the tracking settings are not made (default settings), devices will be set to tracking block No.1, based on the Default Tracking Range in Table5.44.

X0 to X1FFF
Y0 to Y1FFF
M0 to M8191
$\wr$
W0 to W1FFF
Z0 to Z15

Table 5.42 "Default Transfer Range" is set.
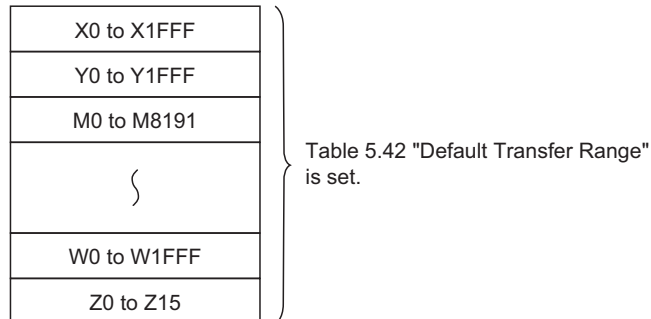
Diagram 5.51 Tracking device default settings (internal device block setting)

(d) Caution When Dividing Into Multiple Blocks

1) When tracking multiple blocks at a time, make sure that the tracking capacity is within 100K words.
   If the tracking capacity exceeds 100K words, the continuation error "TRK. SIZE ERROR (error code: 6110) will occur and tracking cannot be performed.

2) When multiple blocks are set for tracking, they will be tracked in the setting order starting from the one of lowest No.

(2) Tracking Trigger

(a) Tracking Trigger Overview

A tracking block trigger is a special relay that determines whether to track the multiple blocks of internal device data.

Tracking block triggers are assigned to each tracking block. (☞ Table5.49.) When executing tracking, turn on the tracking trigger that corresponds to each tracking No. to execute tracking in the program.

(b) Setting Tracking Trigger for Tracking Block No. 1

It is possible to make the settings at the tracking settings in the redundant parameter settings, so that the data tracking trigger (SM1520) for tracking block No. 1 will turn on automatically when power is turned on.
(By default, the tracking trigger for tracking block No. 1 turns on automatically and automatically tracks the device data in tracking block No. 1.)

Table5.49 Tracking Triggers

Number	Name	Description	Default	Set By User or System
SM1520	Tracking Block No. 1 Tracking Trigger	OFF: No trigger ON: Trigger	When setting batch of internal devices at the tracking: Turns on at the time of power ON/ reset/STOP to RUN. When the detailed device settings are made at the tracking settings: • The trigger turns on at the time of power ON/ reset/ STOP to RUN, if tracking block No. 1 is set to be tracked in the automatic tracking parameter. • Turn off if tracking block No. 1 is set to not to be tracked in the automatic tracking parameter.	System / User
SM1521	Tracking Block No. 2 Tracking Trigger	OFF: No trigger ON: Trigger	OFF	User
SM1522	Tracking Block No. 3 Tracking Trigger			
SM1523	Tracking Block No. 4 Tracking Trigger			
SM1524	Tracking Block No. 5 Tracking Trigger			
SM1525	Tracking Block No. 6 Tracking Trigger			
SM1526	Tracking Block No. 7 Tracking Trigger			
SM1527	Tracking Block No. 8 Tracking Trigger			
SM1528	Tracking Block No. 9 Tracking Trigger			
SM1529	Tracking Block No. 10 Tracking Trigger			
SM1530	Tracking Block No. 11 Tracking Trigger			
SM1531	Tracking Block No. 12 Tracking Trigger			
SM1532	Tracking Block No. 13 Tracking Trigger			
SM1533	Tracking Block No. 14 Tracking Trigger			
SM1534	Tracking Block No. 15 Tracking Trigger			
SM1535	Tracking Block No. 16 Tracking Trigger			
SM1536	Tracking Block No. 17 Tracking Trigger			
SM1537	Tracking Block No. 18 Tracking Trigger			
SM1538	Tracking Block No. 19 Tracking Trigger			
SM1539	Tracking Block No. 20 Tracking Trigger			
SM1540	Tracking Block No. 21 Tracking Trigger			

Table5.49 Tracking Triggers (Continued)

Number	Name	Description	Default	Set By User or System
SM1541	Tracking Block No. 22 Tracking Trigger			
SM1542	Tracking Block No. 23 Tracking Trigger			
SM1543	Tracking Block No. 24 Tracking Trigger			
SM1544	Tracking Block No. 25 Tracking Trigger			
SM1545	Tracking Block No. 26 Tracking Trigger			
SM1546	Tracking Block No. 27 Tracking Trigger			
SM1547	Tracking Block No. 28 Tracking Trigger			
SM1548	Tracking Block No. 29 Tracking Trigger			
SM1549	Tracking Block No. 30 Tracking Trigger			
SM1550	Tracking Block No. 31 Tracking Trigger			
SM1551	Tracking Block No. 32 Tracking Trigger			
SM1552	Tracking Block No. 33 Tracking Trigger			
SM1553	Tracking Block No. 34 Tracking Trigger			
SM1554	Tracking Block No. 35 Tracking Trigger			
SM1555	Tracking Block No. 36 Tracking Trigger			
SM1556	Tracking Block No. 37 Tracking Trigger			
SM1557	Tracking Block No. 38 Tracking Trigger			
SM1558	Tracking Block No. 39 Tracking Trigger			
SM1559	Tracking Block No. 40 Tracking Trigger			
SM1560	Tracking Block No. 41 Tracking Trigger			
SM1561	Tracking Block No. 42 Tracking Trigger	OFF: No trigger	OFF	User
SM1562	Tracking Block No. 43 Tracking Trigger	ON: Trigger		
SM1563	Tracking Block No. 44 Tracking Trigger			
SM1564	Tracking Block No. 45 Tracking Trigger			
SM1565	Tracking Block No. 46 Tracking Trigger			
SM1566	Tracking Block No. 47 Tracking Trigger			
SM1567	Tracking Block No. 48 Tracking Trigger			
SM1568	Tracking Block No. 49 Tracking Trigger			
SM1569	Tracking Block No. 50 Tracking Trigger			
SM1570	Tracking Block No. 51 Tracking Trigger			
SM1571	Tracking Block No. 52 Tracking Trigger			
SM1572	Tracking Block No. 53 Tracking Trigger			
SM1573	Tracking Block No. 54 Tracking Trigger			
SM1574	Tracking Block No. 55 Tracking Trigger			
SM1575	Tracking Block No. 56 Tracking Trigger			
SM1576	Tracking Block No. 57 Tracking Trigger			
SM1577	Tracking Block No. 58 Tracking Trigger			
SM1578	Tracking Block No. 59 Tracking Trigger			
SM1579	Tracking Block No. 60 Tracking Trigger			
SM1580	Tracking Block No. 61 Tracking Trigger			
SM1581	Tracking Block No. 62 Tracking Trigger			
SM1582	Tracking Block No. 63 Tracking Trigger			
SM1583	Tracking Block No. 64 Tracking Trigger			

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5.5.6 Tracking Execution

When a tracking trigger is turned on, device data of the tracking block No. that corresponds to the tracking trigger will be tracked.

Tracking target data is different depending on the operation mode and the operating statuses of both systems.

(1) In Backup Mode

The tracking target data in backup mode are listed in Table5.50 according to the operating status in both systems.

Table5.50 Tracking Target Data According to Operating Statuses of Both Systems

Operating Status		Tracking Data				
Control System	Standby System	Device Data [*1]		Signal Flow	SFC Data	PID Control Instruction Data
		Internal Device	Special Relay and Special Register			
RUN	RUN	○	○	○	○	○
	STOP PAUSE	○	○	○	○	○
	Stop Error	×	×	×	×	×
STOP PAUSE	RUN	○	○	○	○	○
	STOP PAUSE	○	○	○	○	○
	Stop Error	×	×	×	×	×

○:Tracked , ×:Not tracked

* 1: Device data
 •Indicates the internal devices set at the tracking settings in the redundant parameter settings.
 (☞ Section 5.5.3)
 •Indicates the special relays and special registers that will be automatically tracked.
 (☞ Section 5.5.3)

(2) In Separate Mode

The tracking target data in separate mode are listed in Table5.51 according to the operating status in both systems.

Table5.51 Tracking Data By System Operating Status

Operating Status		Tracking Data				
		Device Data [1]		Signal Flow	SFC Data	PID Control Instruction Data
Control System	Standby System	Internal Device	Special Relay and Special Register			
RUN	RUN	○	×	×	×	×
	STOP PAUSE	○	×	×	×	×
	Stop Error	×	×	×	×	×
STOP PAUSE	RUN	○	×	×	×	×
	STOP PAUSE	○	×	×	×	×
	Stop Error	×	×	×	×	×
Stop Error	RUN	×	×	×	×	×
	STOP PAUSE	×	×	×	×	×
	Stop Error	×	×	×	×	×

○:Performs tracking , ×:Does not perform tracking

* 1: Device data:

•Internal device refers to device set in the redundancy parameters tracking setting.

(☞ Section 5.5.3)

•Special relays and special registers refers to the automatically tracked special relay and special register.

(☞ Section 5.5.3)

5.5.7 Tracking Mode

Tracking mode determines processing when a new tracking request occurs before the previous tracking processing is completed.
(If the previous tracking has been completed while the control system CPU module is executing the END processing, the next tracking will be initiated.)

There are 2 types of tracking modes:
- Synchronous tracking mode
- Asynchronous tracking mode

(1) Tracking Mode For Each Operation Mode and System Operating Status

Tracking mode is determined by the operation mode and system operating status as listed in Table5.52.

Table5.52 Tracking Mode by Operation Mode and System Operating Status

Operating Status		Operation Mode			
Control System	Standby System	Backup Mode	Separate Mode	Backup Mode to Separate Mode	Separate Mode to Backup Mode
RUN	RUN	Synchronous tracking mode[3]	Asynchronous tracking mode	Synchronous to asynchronous tracking mode[1]	Asynchronous to synchronous tracking mode[2]
RUN	STOP PAUSE	Asynchronous tracking mode		Asynchronous to synchronous tracking mode	Asynchronous to synchronous tracking mode
RUN	Stop Error				
STOP PAUSE	RUN				
STOP PAUSE	STOP PAUSE				
STOP PAUSE	Stop Error				
Stop Error	RUN	–		–	–
Stop Error	STOP PAUSE				
Stop Error	Stop Error				

* 1: Tracking mode will change to asynchronous mode when the backup mode is changed to separate mode.
* 2: Tracking mode will change to synchronous mode within maximum 150ms after the separate mode is changed to backup mode.
* 3: When the special relay "Device memory tracking during RUN write (SM1710)" is turned on to execute tracking during online program change, tracking during online program change is executed in the asynchronous tracking mode. (☞ Section 5.6.2)

(2) Synchronized Tracking Mode

This method performs tracking to the standby system for each scan while the control system CPU module is executing the END processing.

If the previous tracking is not complete during END processing, the system will wait and perform the next tracking after it has been completed.

2 types of synchronized tracking modes are available: synchronized tracking mode and program priority mode.

The default tracking mode is synchronized tracking mode.

Change the tracking mode settings at the tracking settings in the redundant parameter settings.

(a) Synchronized Tracking Mode

In synchronized tracking mode, the control system CPU stands from tracking start to finish, and executes the scan execution type program upon tracking completion.

For this reason, when system switching occurs, the new control system CPU starts operation based on the scan tracking data of up to 1 scan before

However, scan time increases by the amount of tracking time.
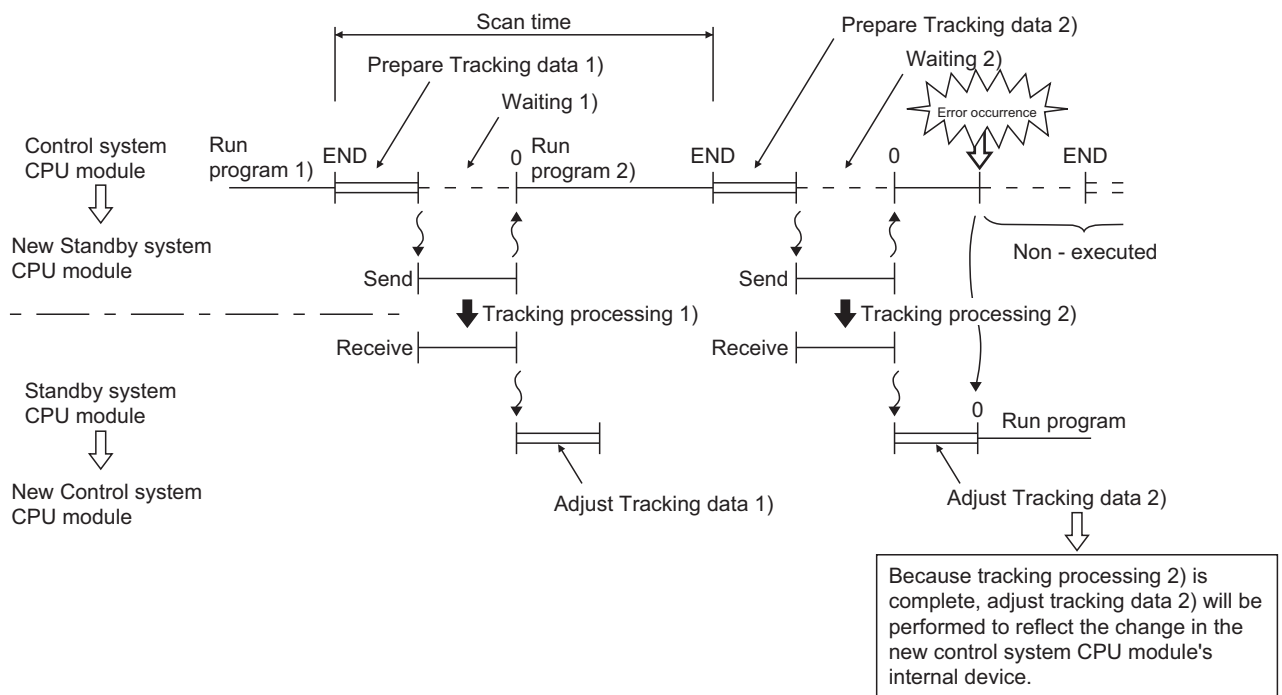
Diagram 5.52 Synchronized Tracking Mode Operation Timing

(b) Program Priority Mode

In program priority mode, the control system CPU module executes the scan execution type program as soon as tracking starts.

If tracking time is longer than program execution time, the next tracking cannot start until the current tracking is completed.

In this mode, the scan time can be made shorter than in synchronized tracking mode.

However, if system switching occurs, the new control system CPU starts operation based on the tracking data of up to 2 scans before.

1) tracking when program run time $\geq$ tracking time
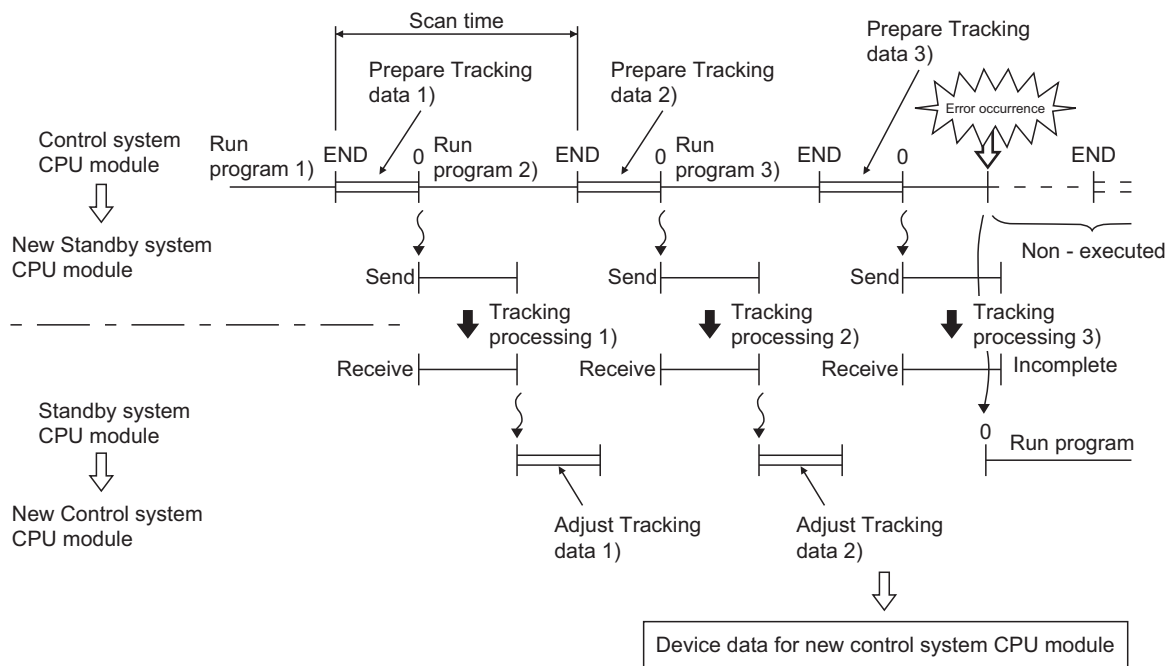
Diagram 5.53 Tracking Operation Timing When Program Execution Time $\geq$ Tracking Processing Time

2) Tracking when program run time $<$ tracking time
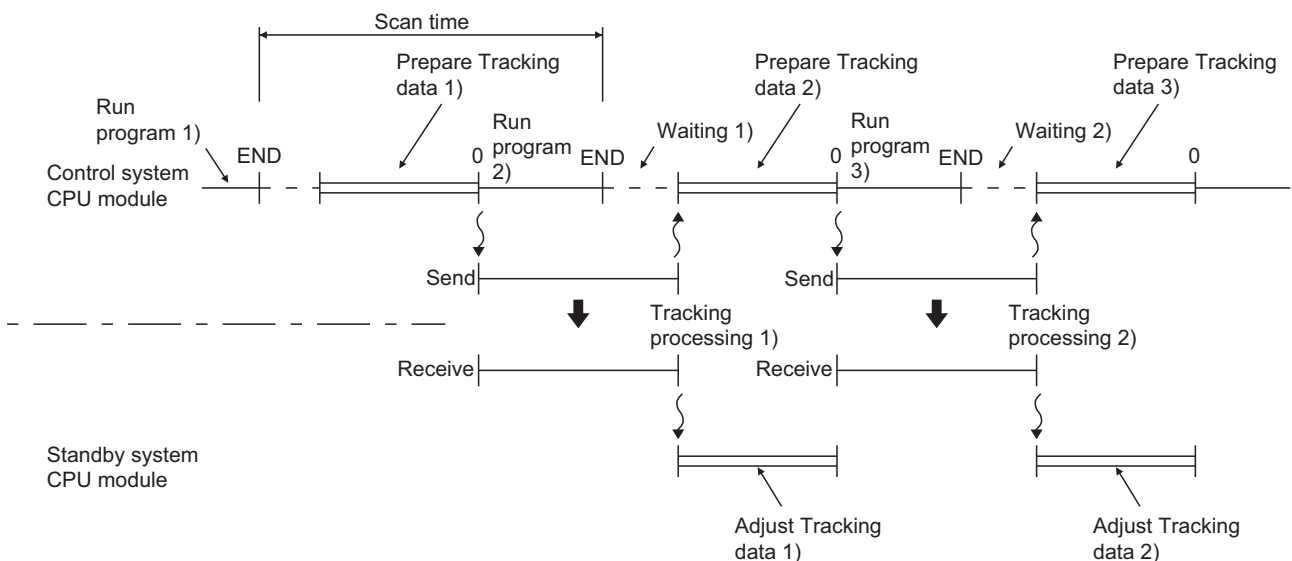
Diagram 5.54 Tracking Operation Timing When Program Execution Time $<$ Tracking Processing Time

(3) Asynchronous Tracking Mode

In this mode, the control system CPU prioritizes program operation over tracking processing.
If the previous tracking has not been completed before the END processing, the control system CPU module suspends the next tracking and performs the program operation.

(a) Tracking when Control System is in RUN, Standby System is in STOP and System is in Backup Mode

1) tracking when program run time ≧ tracking time
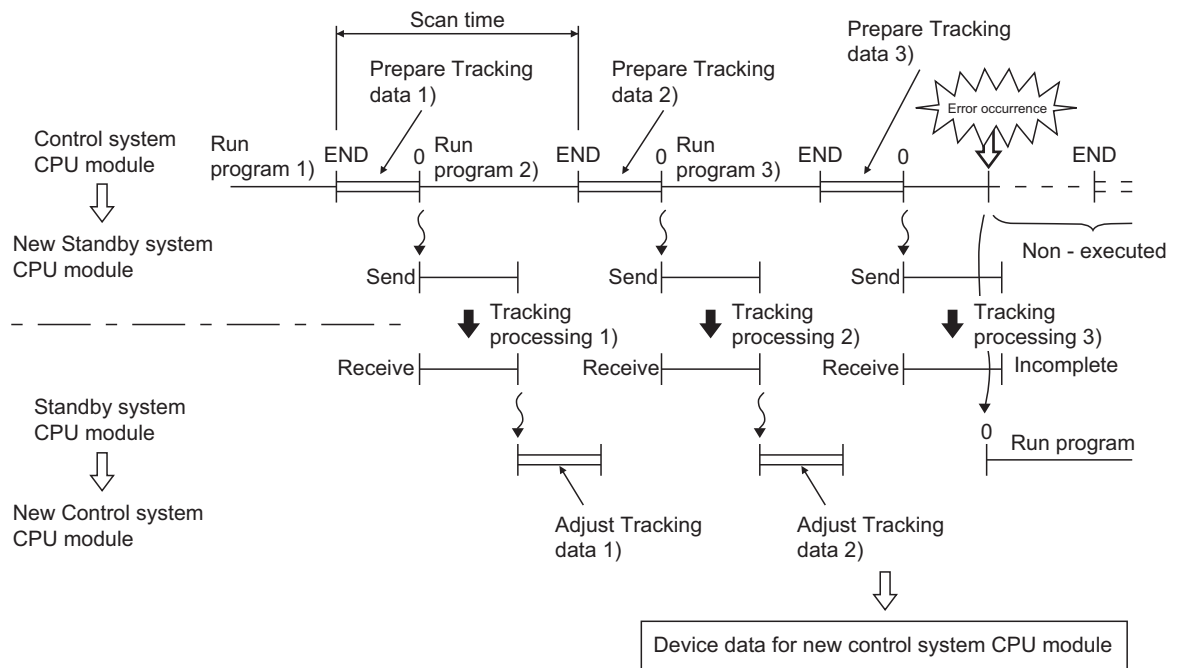
Diagram 5.55 Tracking Operation Timing When Program Execution Time ≧ Tracking Processing Time

2) Tracking when program run time < tracking time
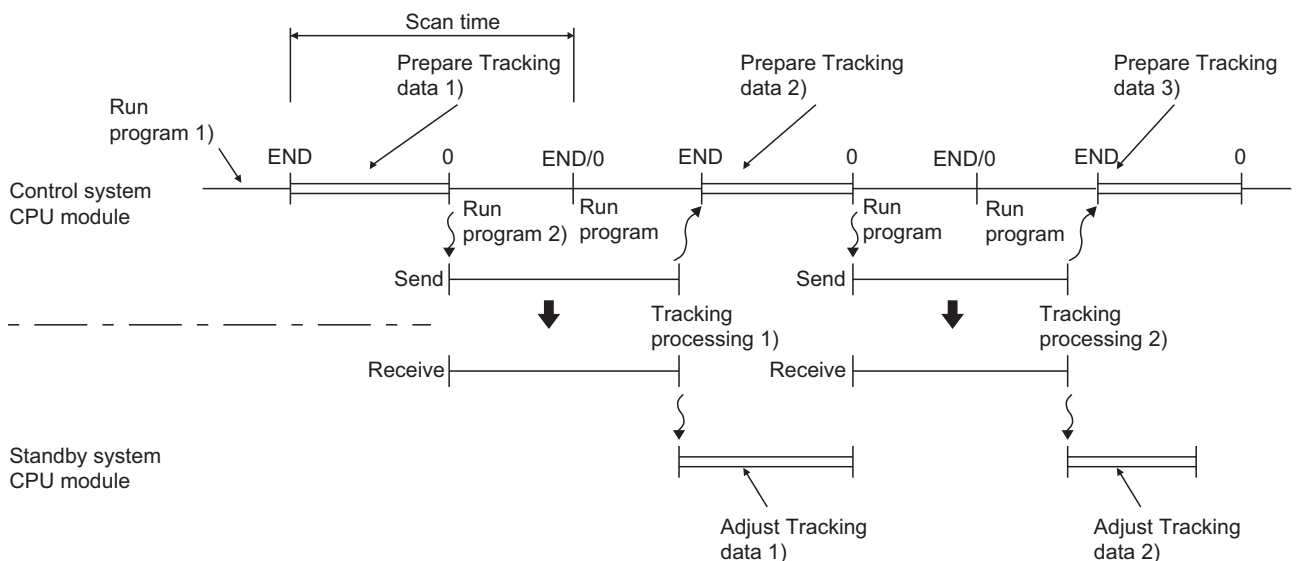
Diagram 5.56 Tracking Operation Timing When Program Execution Time < Tracking Processing Time

(b) Tracking in Separate Mode
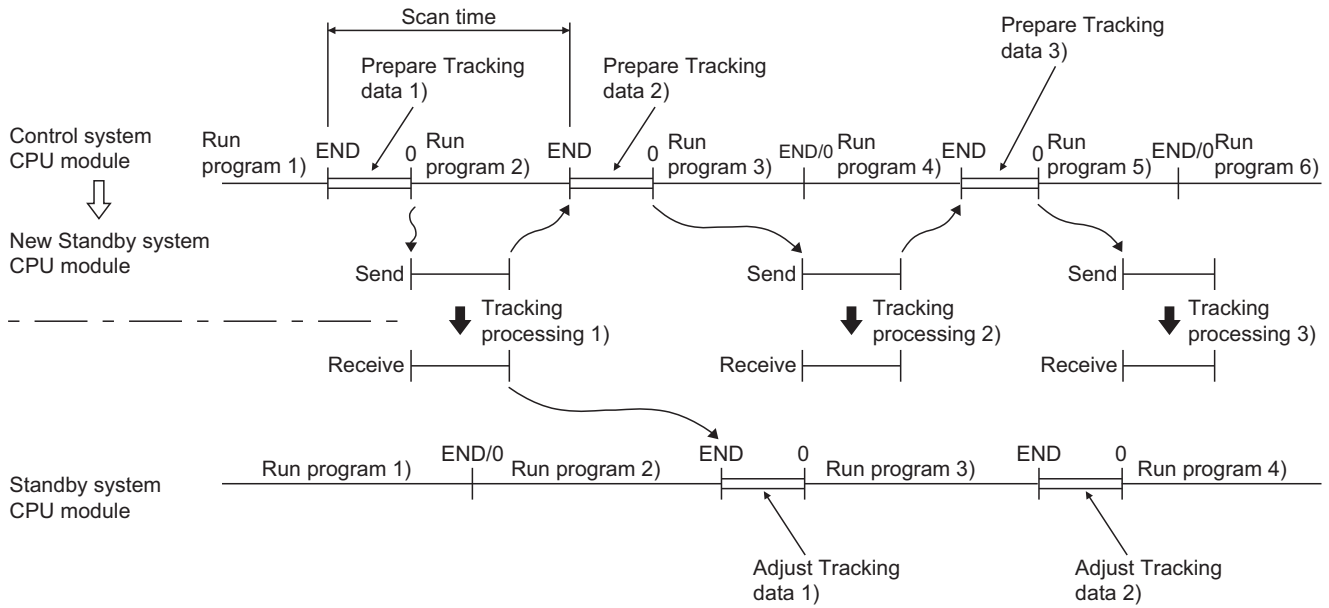
Diagram 5.57 Tracking Operation Timing in Separate Mode

5.5.8 Device Data Used By The New Control System

When the tracking from the control system CPU module is complete, the standby system CPU stores the received tracking data into the specified devices sequentially.

When system switching occurs, the new control system CPU begins operation based on the received tracking data, which varies depending on the reception condition at the time of system switching.

Table5.53 lists the device data used by the new control system CPU module depending on the tracking data reception condition.

Table5.53 Device Data Used by New Control System CPU Module

System Switching Timing	Tracking Data Not Received	Tracking Data Received	
		Receiving Tracking Data	Reception of Tracking Data Completed [1]
Device in which Initial Value is not set	CPU Module Device Data	CPU Module Device Data	Received Tracking Data
Device in which Initial Device Value is set	Preset Initial Device Data	CPU Module Device Data	Received Tracking Data

* 1: If received tracking data is not stored in the specified device, the CPU module will begin operation after storing tracking data in the specified device.

[Tracking in Program Synchronized Mode]
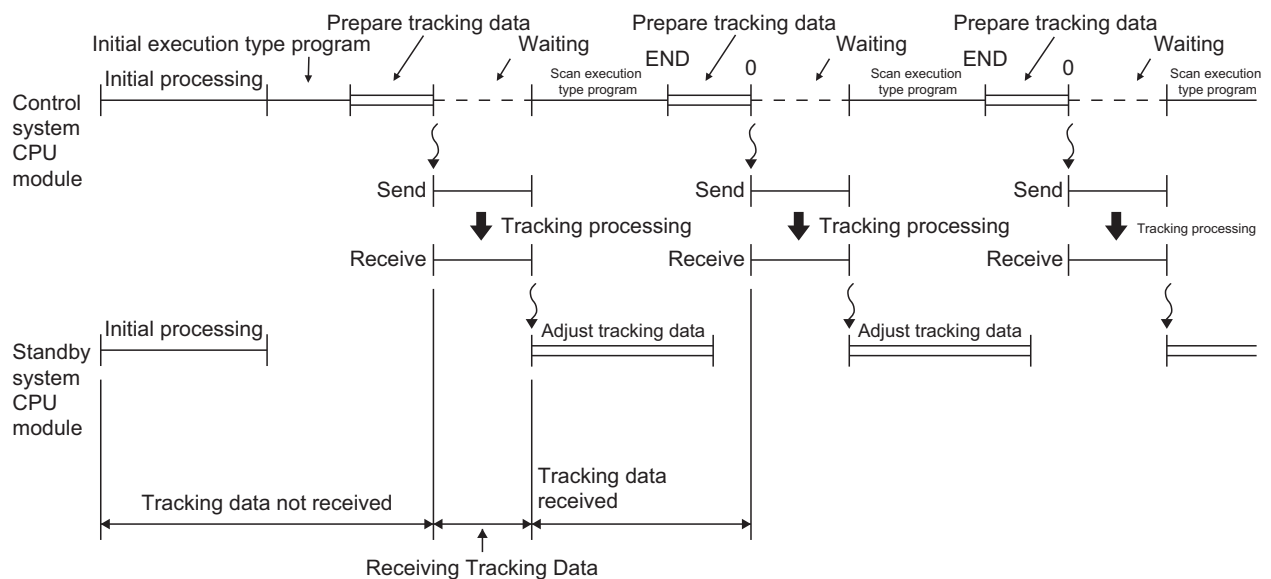
Diagram 5.58 Tracking Operation Timing in Program Synchronized Mode

5.6 Online Program Change for Redundancy

In the backup mode, GX Developer writes the same program to the control system and standby system CPU modules to keep them consistent.

Write to the control system and standby system is executed in the following conditions:
- Writing to the CPU module that is in STOP status (☞ Section 5.6.1)
- Writing to the CPU module that is running (☞ Section 5.6.2)

5.6.1 Writing to the CPU Module in STOP Status

(1) Operation Outline

When writing the parameters and programs either system CPU module, GX Developer will write the same parameters and programs to the other system as well.

(2) Write Order

GX Developer writes to the control system first and then the standby system, regardless of connection route, i.e., the system to which GX Developer is connected. The following diagram shows the writing operation on the assumption that GX Developer is connected to the standby system. (Write of program B to the control system and standby system is executed in the order (1) and (2).)
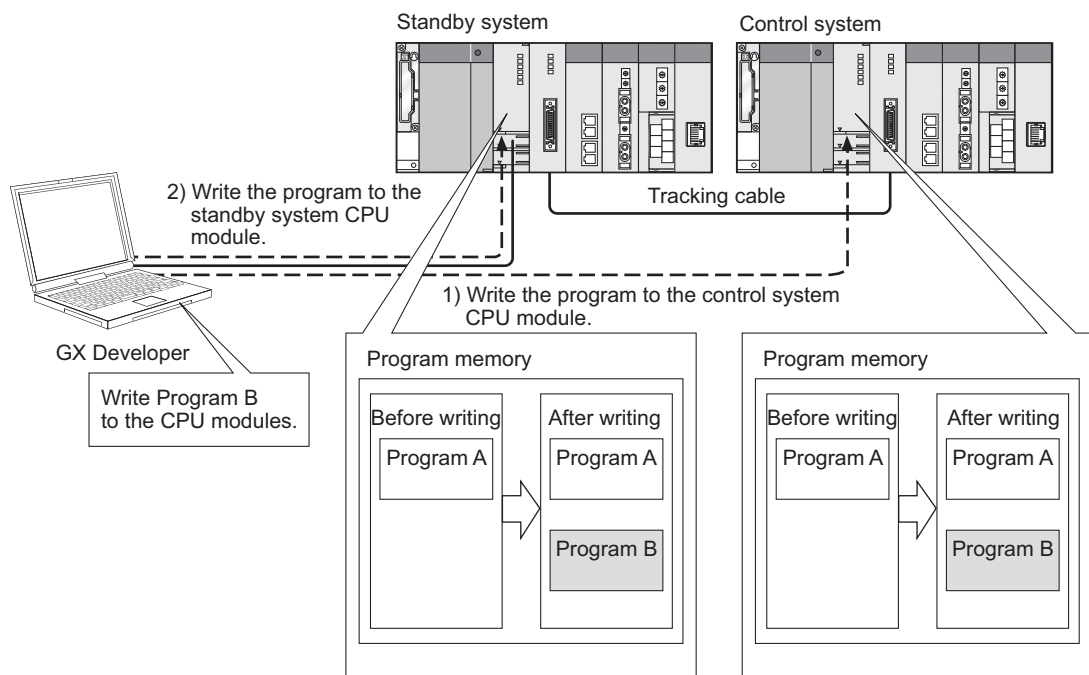
Diagram 5.59 Write Order

(3) Precautions

(a) If programs cannot be written to the standby system CPU module

In the following cases, the data will be written into only the CPU module to which GX Developer is connected:

- Either or both powers on control system/standby system are OFF
- Either or both CPU modules on control system/standby system are in RESET
- Either or both systems have a hardware failure
- Either or both CPU modules on control system/standby system have "Watchdog timer error (error code: 5000 or 5001)"
- Tracking cable disconnection or malfunction

In these cases, the error dialog box in Diagram 5.60 will appear on GX Developer.

Diagram 5.60 Error Dialog Box Displayed on GX Developer

(b) Operations prohibited during online program change

Do not perform the following operations in either control system or standby system during online program change:

- System power OFF
- CPU module reset
- Tracking cable connection or disconnection

If any of the above operations is performed, "Consistency check between system A and B" may cause the "FILE DIFF. (error code: 6000) stop error in the standby system CPU module.

In addition, the error dialog box in Diagram 5.61 will appear on GX Developer that wrote the program.
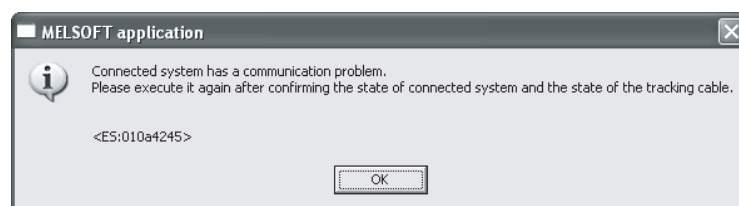
Diagram 5.61 Error Dialog Box Displayed on GX Developer

If the dialog box appears, eliminate the error cause displayed in the dialog box, and write the program to the CPU modules again.

(c) Writing a program via module mounted to extension base unit

Writing a program via a module mounted to the extension base unit is disabled.

(d) Access to files being written

The files being written by GX Developer cannot be accessed by other GX Developer.

If you access the files being written, the error dialog box in Diagram 5.62 will appear:
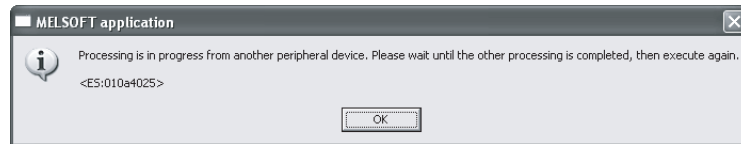
Diagram 5.62 Error Dialog Box Displayed on GX Developer

Access the files again after the writing operation has been completed.

(e) Write to files being accessed by another GX Developer

If data is tried to be written to the files being accessed by another GX Developer, the error dialog box in Diagram 5.63 will appear.

Diagram 5.63 Error Dialog Box Displayed on GX Developer

After the current processing ends, write the data to the CPU module again.

(f) Write Processing in Separate Mode

In the separate mode, GX Developer writes to the CPU module of the system that is specified in the connection target settings.

GX Developer will not write to the CPU module of the system that is not specified in the connection target settings

(g) Writing of CC-Link parameter setting

If writing to the programmable controller with setting 5 or more at "No. of boards in module" in CC-Link network parameter while the following conditions are met, the error dialog box in Diagram 5.63 appears.

- The first five digits of serial number for the Redundant CPUs is "09101" or lower.
- GX Developer version is 8.58L or later.
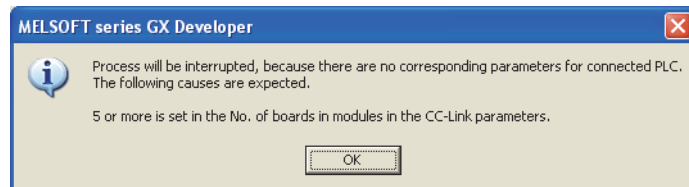
Diagram 5.64 Error dialog box appearing on GX Developer

Clicking the OK button displays the following error dialog box. Replace the Redundant CPU by the one whose first five digits of serial number is "09102" or higher.
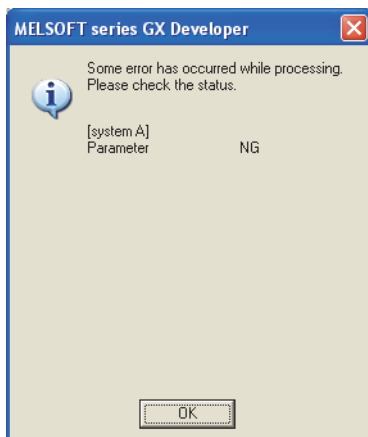
Diagram 5.65 First five digits of serial number for the Redundant CPU on system A is "09101" or lower.
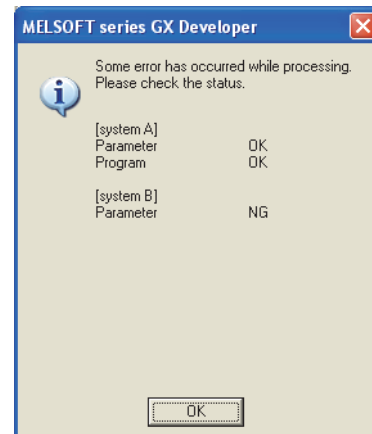
Diagram 5.66 First five digits of serial number for the Redundant CPU on system A is "09102" or higher and that for the Redundant CPU on system B is "09101" or lower.

5.6.2 Program Change While CPU is Running

Data are written to both systems while CPU is running, in the following cases:

- Online program change
- Writing files in RUN
- T/C set value change

Refer to the following manual for details on the above operations.

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

(1) Operations When Changing Programs While CPU is running

When changing the program of the control system CPU module during RUN in the backup mode, the same program will be written to the standby system CPU module. Even if a stop error occurs in the control system during the online program change and system switching occurs, the online program change to both systems will continue.

(2) Procedure for Writing to the Control System and Standby System

When performing the online program change to the control system CPU module by GX Developer, regardless of the connection route.

When the online program change is performed to the control system CPU module, data will be written to the control system and standby system CPU modules.

Diagram 5.65 shows the operation in the case of program change in ladder mode during RUN.

(The program change in ladder mode during RUN is executed in the order (1) and (2).)
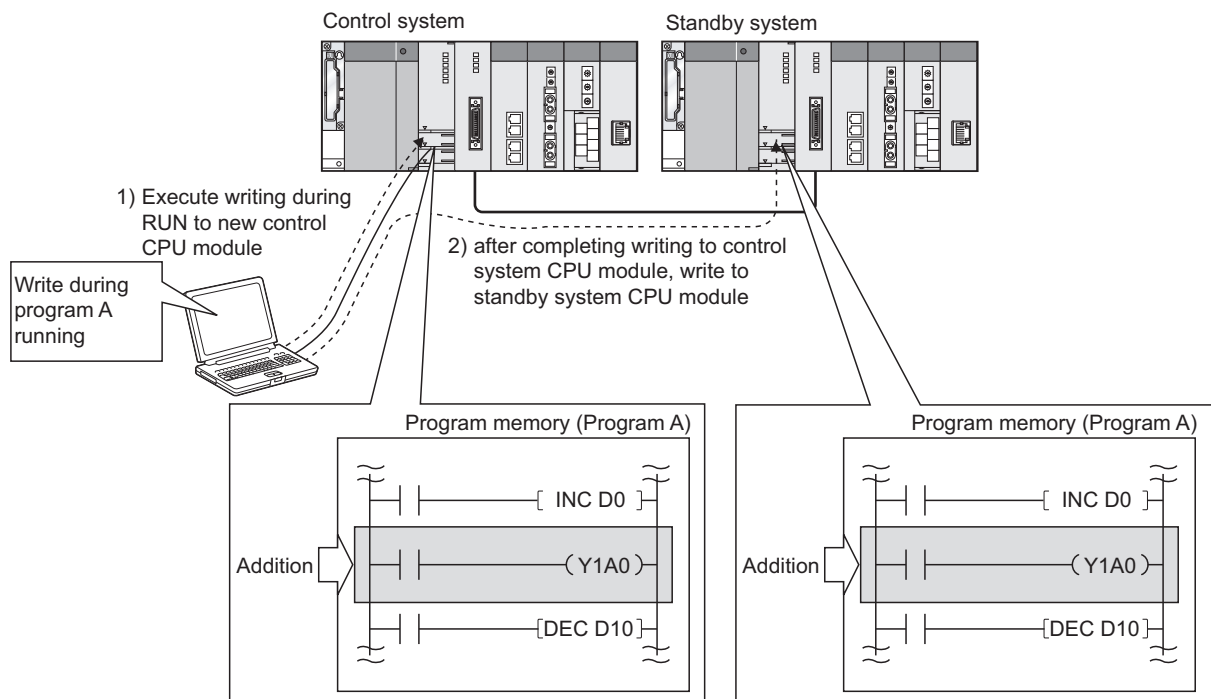
Diagram 5.65 Procedure for Writing to Control System and Standby System When Program Is Changed during CPU RUN

(3) Tracking Execution During Online Program Change

Use the special relay "SM1710" (Transfer tracking data during online program change enable flag) to enable or disable the tracking execution of the following control data during online program change.

- Internal device (Table5.44)
- Special relay (Table5.46)
- Special register (Table5.47)
- SFC data (Section 5.5.3 (2))
- PID control instruction data (Section 5.5.3 (2))

Make sure to set SM1710 to on or off (whether or not to execute tracking) before executing online program change.

If the special relay is turned on during online program change, tracking will not be executed.

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(a) When SM1710 is OFF (Default)

When SM1710 is off, tracking will be suspended until online program change is complete.

If a system switching occurs during online program change, the new control system CPU module may output old data.

For example, if output (Y) is turned on in the control system during online program change, the output (Y) on information will not be tracked to the standby system CPU module since tracking has not been performed.

If system switching occurs under these conditions, output will turn on and off at the time of the system switching.
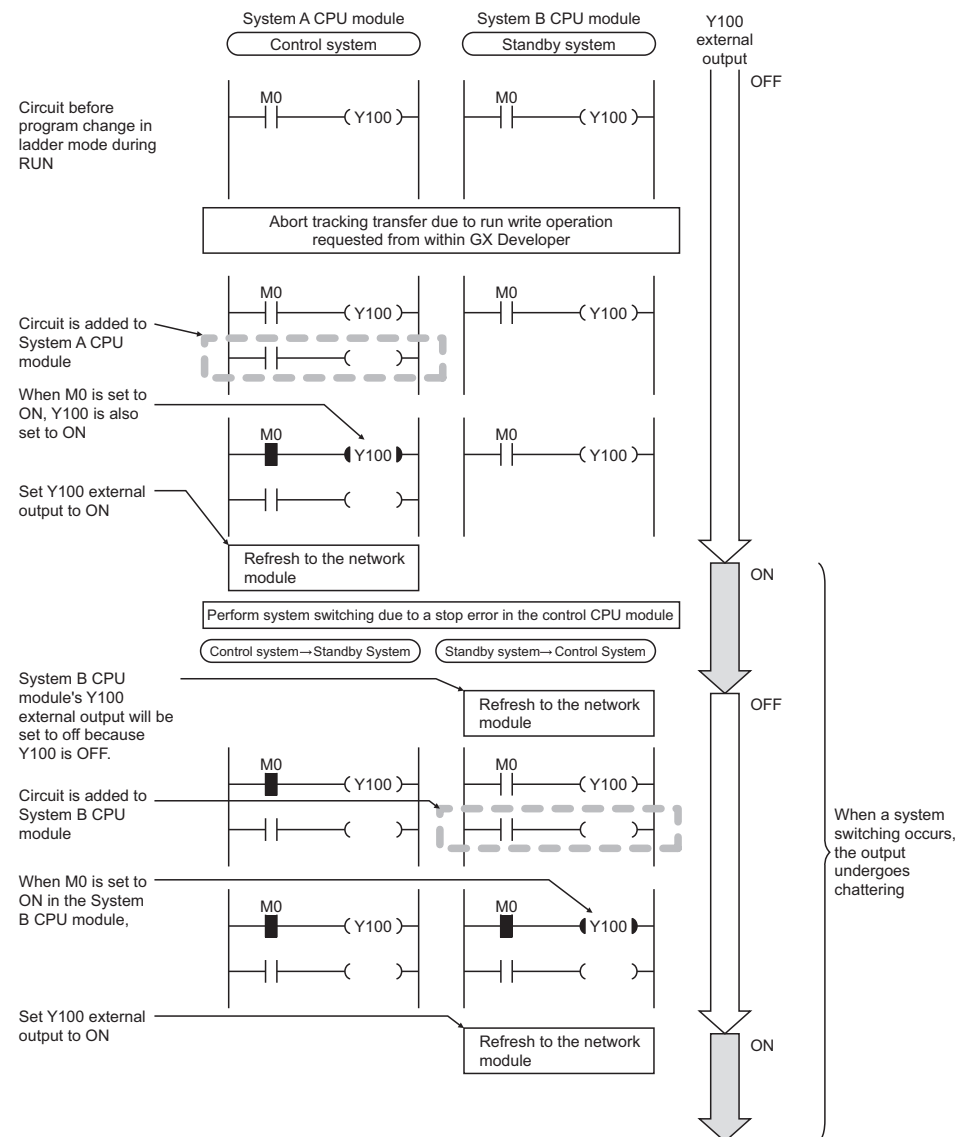
Diagram 5.66 Operation When System Switching Occurs during Online Program Change

(b) When SM1710 is ON

When SM1710 is on, if a system switching occurs, old data will not be output because tracking is performed also during online program change.
(Refer to Section 5.5.4 for tracking data settings.)
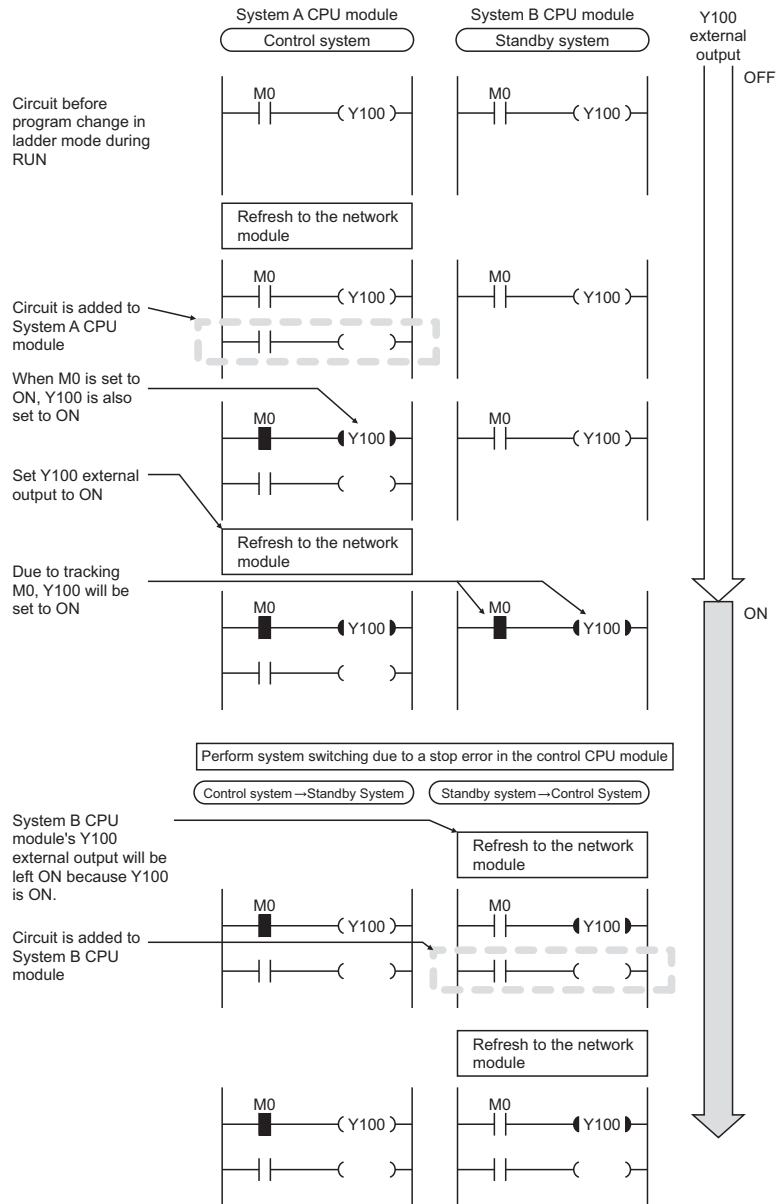
Diagram 5.67 Operation When System Switching Occurs during Online Program Change

However, even if the program of the new control system CPU module has not been changed due to the system switching timing, the data calculated in the previous control system after system switching may be tracked.
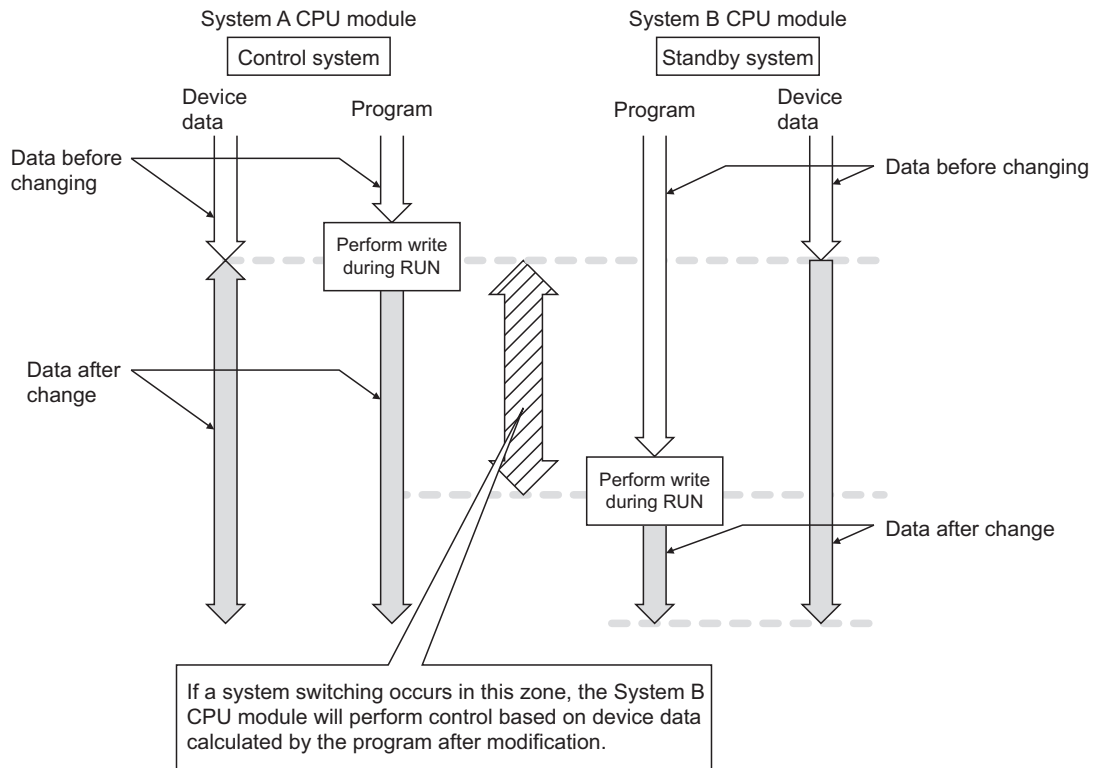
Diagram 5.68 Program and Device Data due to System Switching Timing

(4) System Switching During Online Program Change

Table5.54 lists the operation when the reason for system switching occurs during online program change.

Table5.54 System Switching During RUN Write Redundancy Compliance Execution

Type	System Switching Condition	System Switching Execution During RUN Write
Automatic System Switching	Stop error	○
	System switching request by network module	✕ [*1]
	System power OFF	○
	CPU module reset	○
	CPU module hardware malfunction	○
Manual System Switching	System switching instruction	✕ [*1]
	System switching request from GX Developer	✕ [*2]

○ Yes, ✕ No

* 1: The "CAN'T SWITCH (error code: 6220)" continuation error occurs in control system CPU module that executed the system switching instruction.
"System switching has failed due to online program change" is set in the detailed information special relay.
* 2: The error dialog box in Diagram 5.69 will appear on the GX Developer which requested the system switching:

MELSOFT application

This peripheral device or another peripheral device are operating online change function.
Please execute it again after it completed online change function.

<E5:010a424c>

OK
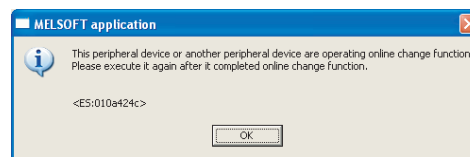
Diagram 5.69 Error Dialog Box Displayed on GX Developer

(5) Waiting Time Check for Online Program Change to Standby System

The waiting time check for online program change to the standby system abnormally completes the online program change and enables the online program change again when a communication error occurs between GX Developer and the control system/ standby system CPU module.

When the time from when the online program change to the control system is completed until the online program change to the standby system starts falls outside the SD1710 setting range, this function judges it as a communication error and abnormally completes the online program change.

SD1710 defaults to 90 seconds and can be set within the range 90 to 3600 seconds.

(6) Special Relays And Special Registers For Online Program Change

(a) Special Relays For Online Program change
Special relays for online program change are listed in Table5.55.

Table5.55 Special Relays For Online Program change

Number	Name	Explanation

SM1709	Manual system switching disable/enable setting during online program change redundant tracking	• This relay is turned from off to on to enable the user to switch a system during online program change for redundancy.
		After the manual system switching disable status is canceled, the system automatically turns off SM1709.
		• A system can be switched even an online program change for redundancy is being performed and regardless of the status of this relay, if the reason for the switching is any of the following:
		  • Power-off
		  • Reset
		  • Hardware failure
		  • CPU stop error
		• The system switching disable status can also be canceled by this relay during the following states.
		• Multiple-block online program change redundant tracking execution status
		• File batch online program change redundant tracking execution status

SM1710	Transfer tracking data during online program change enable flag	• This relay specifies whether to execute a tracking transfer for the following control data during online program change for redundancy.
		  • Device memory (including the SM and SD areas transferred automatically)
		  • PIDINIT information, S.PIDINIT information, SFC information
		• SM1710 can be also used to specify whether to enable a tracking transfer during multiple-block online program change redundant tracking execution and file batch online program change redundant tracking execution.
		• Data in SM1710 are transferred from the control system to the standby system by tracking transfer.

(b) Special Registers For Online Program Change
Special registers for online program change are listed in Table5.56.

Table5.56 Special Registers For Online Program Change

Number	Name	Explanation
SD1710	Waiting time for online program change (standby system)	• This register stores the waiting time required for starting the online program change in the standby system after completion of that in the control system. The value is specified in units of seconds. • If online program change is not requested within the set time even after it is completed in the control system, the CPU modules in both systems determine that it is a failure of an online program change for redundancy. In this case, the CPU modules in both systems resume the consistency check for the systems that have been on hold during the online program change. Also, the control system is set to accept another request of online program change for redundancy. • When both systems are powered on, 90 seconds are set to SD1710 as the default value. • Set the value within the range 90 to 3600 seconds. When the setting is 0 to 89 seconds, it is regarded as 90 seconds for operation. If the setting is outside the allowed range, it is regarded other than 0 to 3600 seconds for operation. • The waiting time for a start of online program change to the standby system CPU module is checked according to the SD1710 setting during online change of multiple blocks and online change of batch of files for redundancy.

(7) Precautions

(a) When program memory space is insufficient for writing files in RUN

To write files to the program memory in RUN, a working memory area (free area) as large as the size of the files is required.

If a sufficient working memory area is not reserved in the program memory, writing files in RUN is not executable.

However, if the necessary space is available in a memory card (SRAM card or ATA card), a batch of files can be written into the card during RUN.

(b) Memory used for writing files in RUN

When writing files in RUN, the same kind of memory is used for the control and standby system CPU modules.

If different memories are reserved for them, writing files in RUN is not executed.

Table5.57 Memories for Control System and Standby System CPU Modules and Executability of Writing Files in RUN

Memory available for control system	Memory available for standby system	
	Program memory	**Memory card**
Program memory	○	×
Memory card	×	○

When writing files in RUN fails the error dialog box in Diagram 5.70 appears.
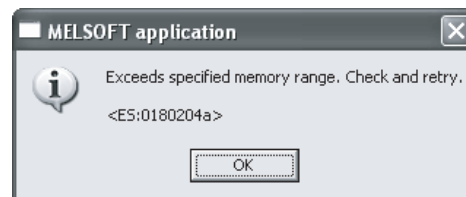
Diagram 5.70 Error Dialog Box Displayed on GX Developer

(c) Operations disabled during online program change

Do not perform the following operation during online program change:

- System power OFF
- CPU module reset
- Tracking cable connection or disconnection

Executing any of the above operations may corrupt the contents of program memory.

(d) Processing when the target programs are different between the control system and standby system CPU modules

If the target programs are different between the control system and standby system CPU modules, it will be written to the control system CPU module only.

If this happens, the error dialog box in Diagram 5.71 will appear on GX Developer:
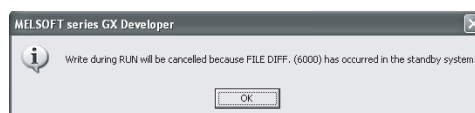
Diagram 5.71 Error Dialog Box Displayed on GX Developer

(e) Access to programs being changed online

The programs being changed online cannot be accessed by GX Developer.

If programs in RUN write by GX Developer are accessed, the error dialog box in Diagram 5.72 will appear on GX Developer:

Diagram 5.72 Error Dialog Box Displayed on GX Developer

Access the programs again after the online program change is complete.

(f) When online program change cannot be executed to either control system or standby system

In the following cases, online program change cannot be executed to either control system or standby system:

1) Online program change when a fault has occurred in the standby system

The error dialog box illustrated below will appear if online program change is executed during the following:

- Standby system power is OFF
- Standby system CPU is resetting
- WDT error occurring on the standby system CPU
- Tracking cable not connected or malfunctioning
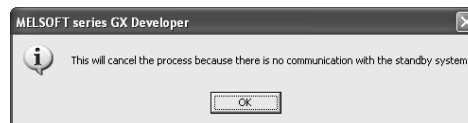
Diagram 5.73 Error Dialog Box Displayed on GX Developer

2) Changing programs being accessed by the other GX Developer online

The error dialog box Diagram 5.74 will appear if online program change is executed to programs being accessed by the other GX Developer:

Diagram 5.74 Error Dialog Box Displayed on GX Developer

3) Changing programs being accessed by the other GX Developer online

The error dialog box in Diagram 5.75 will appear if online program change is executed to the CPU module during system switching or operation mode change:
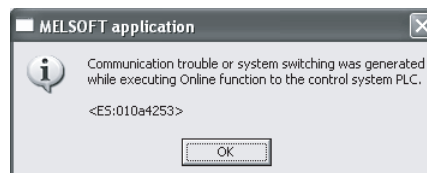
Diagram 5.75 Error Dialog Box Displayed on GX Developer

4) Online program change to CPU module during system switching or operation mode change

The error dialog box in Diagram 5.76 will appear if online program change is executed during memory copy from the control system to the standby system:
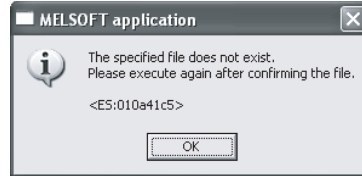
Diagram 5.76 Error Dialog Box Displayed on GX Developer

(g) Online program change in Separate Mode

In the separate mode, online program change is executed only to the system that specified in the target connection settings.

Online program change is not executed to the CPU module of the system that is not specified in the target connection settings.

(h) Extension of scan time due to online program change

If online program change is executed, the control system CPU module scan time will extended.

Refer to the following manual for information on control system CPU module scan time extension:

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

(i) Signal Flow Processing

The signal flow in the changed steps or program turns on.

Therefore, if a running program is changed online, the rise, fall and SCJ instructions will do the following:

1) Rise instruction (PLS instruction, □P instruction, SP.□ instruction)

Even if the execution condition changes from off to on when online program change is complete, the rise instruction will not be executed.

It will be executed when the execution condition is turned off and on again.

2) Fall instruction (LDF, ANDF, ORF, MEF, PLF)

If the execution condition is off when online program change is complete, the fall instruction will be executed again.

3) SCJ instruction

If the execution condition is on when online program change is complete, a jump to the specified pointer will be executed without waiting 1 scan.

(j) Consistency check between both systems during online program change

1) File Consistency Check

The file consistency check cannot be performed during online program change.

Therefore, during online program change, an error will not occur even if the programs of the control system and standby system CPU modules are temporarily different.

However, if any of the following operations is performed, an error may occur during the file consistency check even though the online program change is completed successfully.

- Either control system or standby system CPU module is changed from STOP (PAUSE) to RUN
- Either control system or standby system CPU module is reset, then unreset (RESET/L.CLR switch is set to the neutral position)
- Either control system or standby system is powered OFF and then ON
- The tracking cable is disconnected and then connected

2) Operating Status Consistency Check

The operation status consistency check cannot be performed during online program change.

3) Main base unit configuration

The main base unit configuration check cannot be performed during online program change.

However, if one of the following conditions occurs during online program change, it will be performed.

- Standby system CPU module is reset and then unreset (RESET/L.CLR switch is set to the neutral position)
- Standby system is powered OFF and ON
- Tracking cable is disconnected and connected

4) Parameter valid drive settings consistency check

The parameter valid drive settings consistency check cannot be performed during online program change.

However, if one of the following conditions occurs during online program change, it will be performed.

- Standby system CPU module resets and clears reset
- Standby system power is turned OFF and ON
- Tracking cable is disconnected and connected

5) Memory Card Setting Status Consistency Check

The memory card setting status consistency check cannot be performed during online program change.

5.7 Memory Copy From Control System To Standby System

(1) Overview of Memory Copy From Control System To Standby System Function

Memory copy form control system to standby system function transfers the parameters, programs, file register and other data from the control system CPU module to the standby system CPU module to make the standby system and control system consistent.

The applicable memory is standard RAM, standard ROM and program memory. (Memory cards are irrelevant.)

This function is used to make the memory contents of the control system and standby system CPU modules consistent when replacing the standby system CPU module, etc.
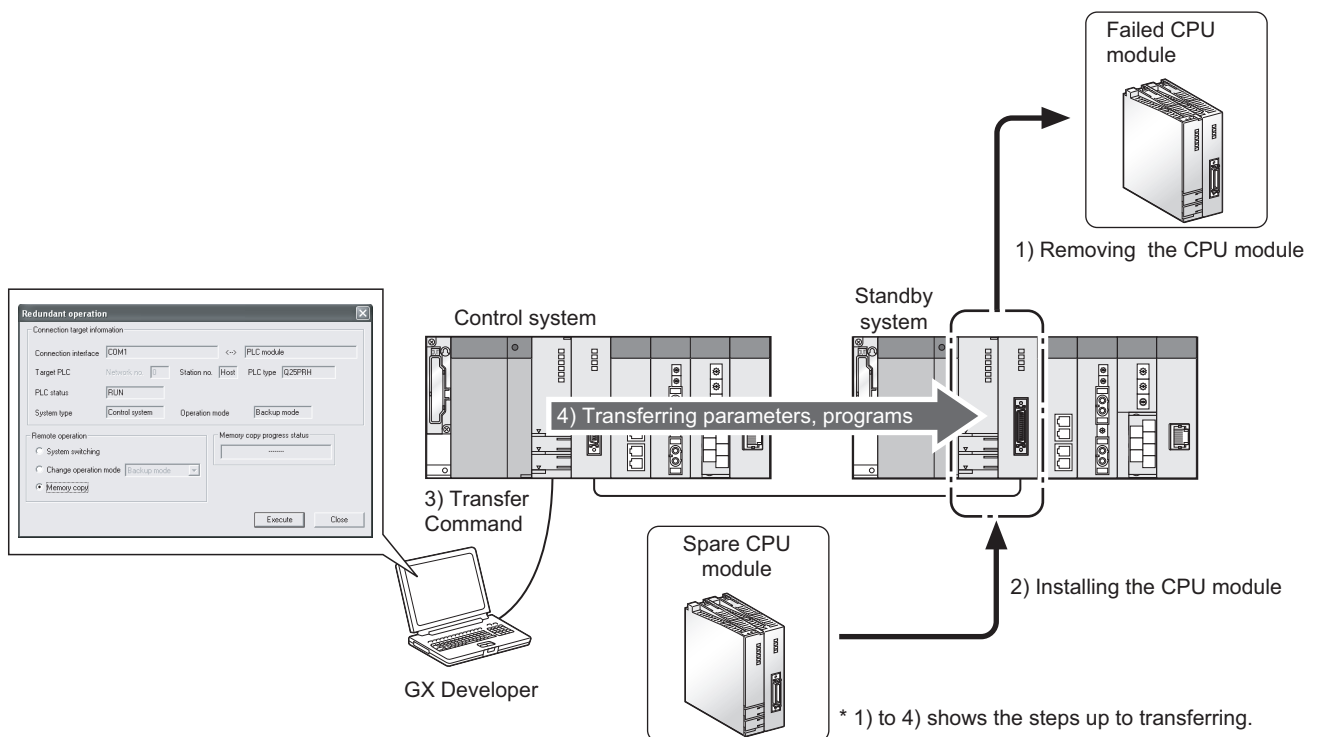
(a) Executing memory copy

Memory copy can be executed by using either of the following.
- GX Developer
- Special relays and special registers

(b) Special Relays and Special Registers for Memory Copy

Table5.58 lists the special relays and special registers for the memory copy function.

Table5.58 Special Relays and Special Registers for Memory Copy

Type	Number	Description	Set by User or System	Remarks
Special Relays	SM1595	Turn on this relay to start memory copy after storing $3D1_H$ into SD1595.	User	Specific to control system CPU module
	SM1596	This relay is on during memory copy from the control system to the standby system. This relay turns off when memory copy is complete.[1]	System	Applicable to both control system and standby system CPU modules
	SM1597	This relay turns on after memory copy. [1] Turn off this relay when starting memory copy. In the case of memory copy by GX Developer, GX Developer will turn off this relay before starting memory copy.	System / User	Applicable to both control system and standby system CPU modules
	SM1598	If set to on by user, the standard ROM data is not copied to the other system while memory copy is executing. Default: Off (Execution of standard ROM memory copy)	User	Specific to control system CPU module
Special Registers	SD952	This register stores a value indicating the completion status of the latest memory data copy from the control system to the standby system. • The value same as the SD1596 value is stored at completion or abend of the memory data copy from the control system to the standby system. • Since data have been backed up in case of power failure, this register holds the value indicating the latest memory data copy status from the control system to the standby system. • This register is cleared to 0 by latch clear.	System	Applicable to both control system and standby system CPU modules
	SD1595	Before SM1595 is turned from off to on, the I/O No. of the memory copy destination (Standby system CPU module: $3D1_H$) is stored in this register.	User	Specific to control system CPU module
	SD1596	Stores the execution result of Memory copy function. (0: Memory copy is complete)	System.	Applicable to control system and standby system CPU modules

* 1: If any of the following occurs during memory copy from control system to standby system, the memory copy will be stopped.
   In this case, SM1596 (Memory copy to other system status flag) turns off and SM1597 (Memory copy to other system completion flag) turns on.
   •Standby system power OFF
   •Standby system CPU module reset
   •Tracking cable disconnection or malfunction

(c) Memory Copy Precautions

1) Before memory copy, the standby system CPU memory will be automatically formatted.

Then, the "PRG. MEM. CLEAR (error code: 6400)" stop error will occur in the standby system CPU module.

However, if a stop error has occurred before memory copy, the "PRG. MEM CLEAR" is not detected.

2) Memory copy is stopped when any of the following operations is performed during memory copy.

At this time, the memory contents of the standby system CPU module will be illegal.

Perform any of the following operations after confirming that memory copy is completed.

- Power off the control system or standby system.
- Reset the control system or standby system CPU module.
- Disconnect the tracking cable.

If the following error occurs during memory copy, the memory copy is also stopped with the memory contents of the standby system CPU module being illegal.

- Tracking cable fault

(d) How to confirm memory copy completion

Completion of memory copy can be confirmed by the special relays and GX Developer.

1) Confirmation by special relays

When memory copy is completed, the special relay "Memory copy to other system status flag (SM1596)" turns off and "Memory copy to other system completion flag (SM1597)" turns on.

Check whether SM1596 and SM1597 are ON or OFF to confirm memory copy completion.

Also, whether memory copy is normally completed or abnormally completed can be checked by the special register "Memory copy completion status (SD1596)".

- When memory copy is normally completed: SD1596: 0
- When memory copy is abnormally completed: SD1596: other than 0 (error code)

2) Confirmation by GX Developer

Whether memory copy is normally completed or abnormally completed can be checked on the "Redundant operation" window of GX Developer.
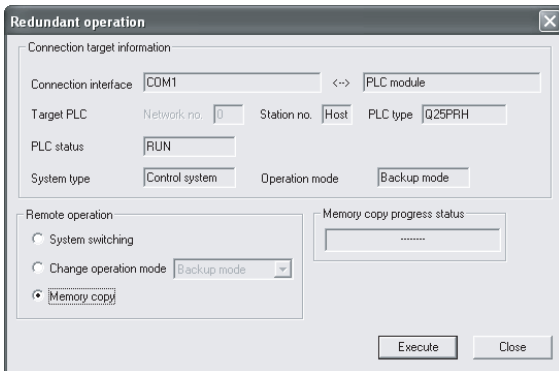
Diagram 5.77 Redundant Operation Window Showing Normal Completion
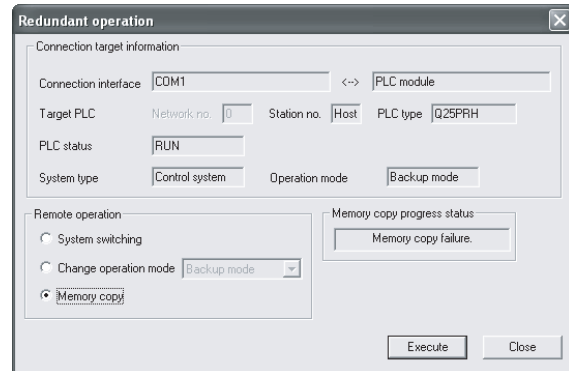
Diagram 5.78 Redundant Operation Window Showing Abnormal Completion

(2) Memory Copy from Control System to Standby System Using GX Developer

The following provides the procedure for executing memory copy function using GX Developer and the relevant operations.

(a) Procedure

1) Connect the control system and standby system CPU modules with a tracking cable and power on the standby system.
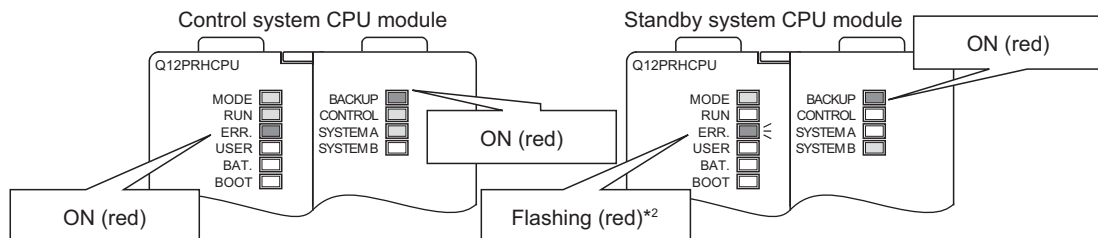
Diagram 5.79 LED Indications When Tracking Cable Is Connected

* 2: If the standby system CPU module is replaced and the parameters are not stored in the new CPU module, the "MISSING PARA. (error code: 2200)" stop error will occur.

2) Connect GX Developer to the control system CPU module.
Identify the control system CPU module with the "CONTROL" LED or in the special relay (SM1515 (Control system judgement flag): ON, SM1516 (Standby system judgement flag): OFF).

3) Select "Memory copy" on the Redundant operation window of the Online dialog box on GX Developer, and click the Execute button.
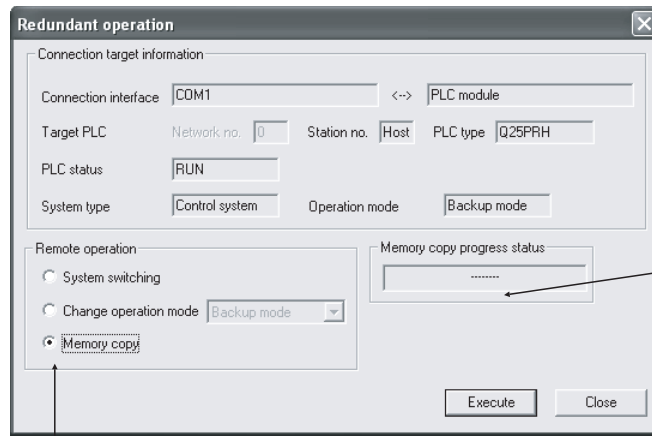
Select "Memory copy".

Diagram 5.80 Redundant Operation Window

4) When the memory copy confirmation dialog box appears, click the "Yes" button.
   This transfers the control system data to the standby system.

Diagram 5.81 Confirmation Dialog Box Displayed on GX Developer

Then, the "BACKUP" LED of the standby system CPU module will flash (red).
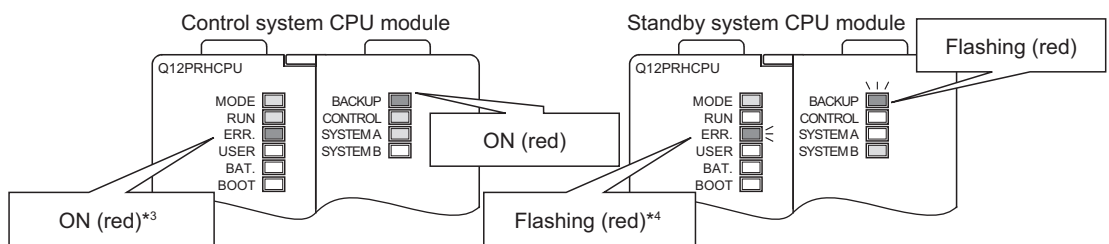
Diagram 5.82 LED Indications during Memory Copy

* 3: When memory copy begins, the "MEM. COPY EXE. (error code: 6410)" continuation error will occur in the control system CPU module, and then the "STANDBY SYS. DOWN (error code: 6300)" continuation error will occur.

* 4: When memory copy begins, the "PRG. MEM. CLEAR (error code: 6400)" stop error will occur in the standby system CPU module.

5) When memory copy is complete, the "BACKUP" LED of the standby system CPU module will turn on (red).

Control system CPU module   Standby system CPU module

Q12PRHCPU

MODE   BACKUP
RUN   CONTROL
ERR.   SYSTEM A
USER   SYSTEM B
BAT.
BOOT

ON (red)

ON (red)

Q12PRHCPU

MODE   BACKUP
RUN   CONTROL
ERR.   SYSTEM A
USER   SYSTEM B
BAT.
BOOT

ON (red)

Flashing (red)
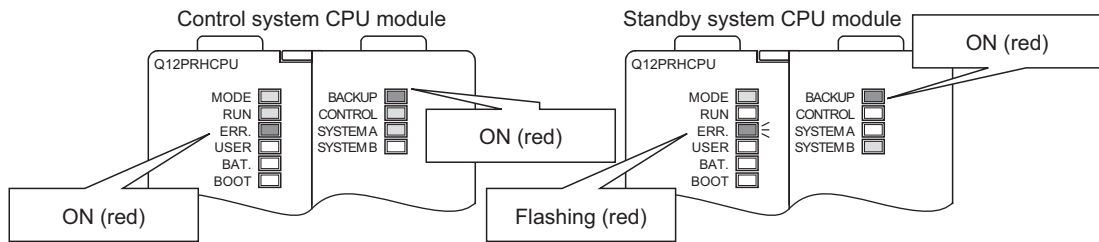
Diagram 5.83 LED Indications at Memory Copy Completion

6) When memory copy is complete, restart the standby system or reset the standby system CPU module. It will operate as the standby system CPU module.
Then, the "BACKUP" LED of the standby system CPU module will turn on (green).

Control system CPU module   Standby system CPU module

Q12PRHCPU

MODE   BACKUP
RUN   CONTROL
ERR.   SYSTEM A
USER   SYSTEM B
BAT.
BOOT

ON (green)

ON (red)

Q12PRHCPU

MODE   BACKUP
RUN   CONTROL
ERR.   SYSTEM A
USER   SYSTEM B
BAT.
BOOT

ON (green)

OFF
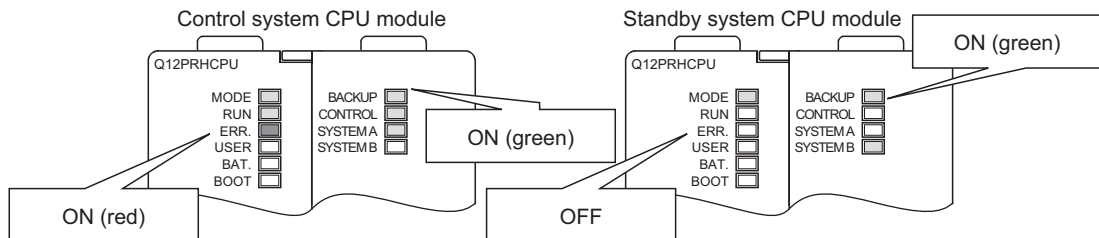
Diagram 5.84 LED Indications during Standby System CPU Module Operation

(b) Operations when executing Memory Copy

The operation at memory copy execution is shown in Diagram 5.85.

[Specify memory copy]

Control system   Standby system

Tracking cable

GX Developer

1) Memory copy from GX Developer

[Perform memory copy]

Control system   Standby system

Tracking cable

GX Developer

2) Begin copying to the standby system CPU

[Memory copy completed]

Control system   Standby system

Tracking cable

GX Developer

3) Copying to the standby system CPU complete
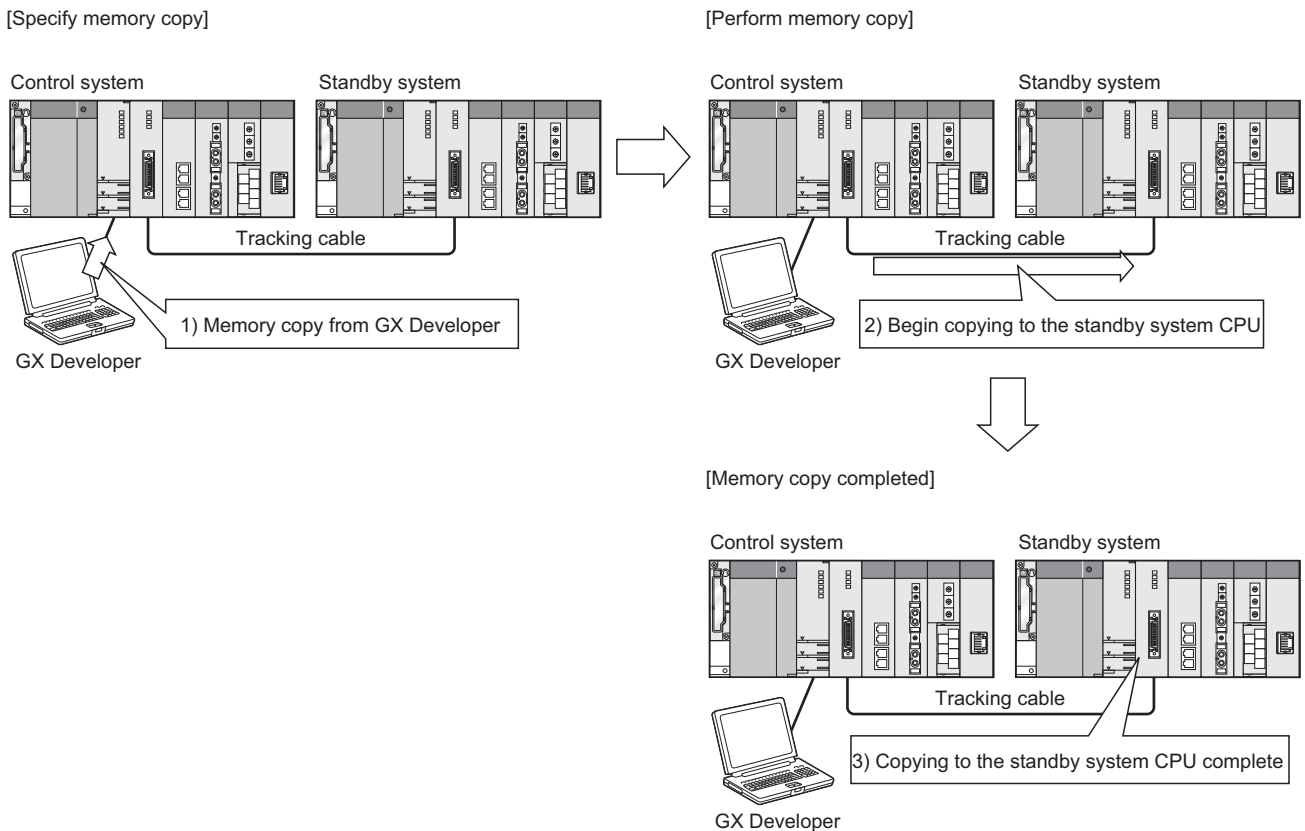
Diagram 5.85 shows the operation performed when memory copy is executed.

(3) Memory Copy From Control System to Standby System Using Special Relays and Special Registers

The following provides the procedure for executing memory copy function using the special relays and special registers and the relevant operations

(a) Steps

1) Connect the control system and the standby system with the tracking cable, and turn the standby system power ON.

Control system CPU module   Standby system CPU module

ON (red)

ON (red)

ON (red)

Flashing (red)*1
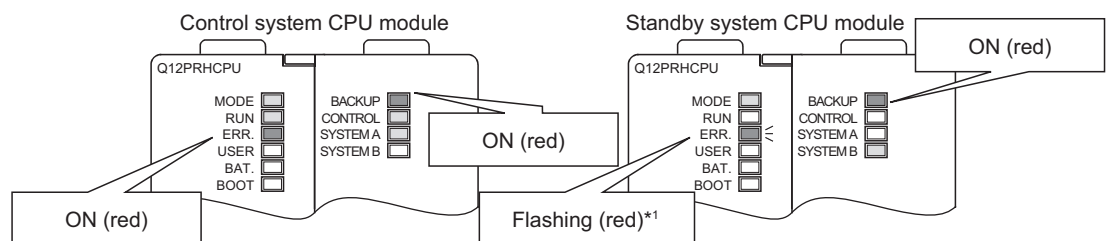
Diagram 5.86 LED Indications when Tracking Cable Is Connect

* 1: If the standby system CPU module is replaced and the parameters are not stored in the new CPU module, the "MISSING PARA. (error code: 2200)" stop error will occur.

2) Make sure SM1596 and SM1597 are turned OFF.
   If SM1596 or SM1597 is ON, turn it OFF.

1 OVERVIEW

2 SYSTEM CONFIGURATION

3 TRACKING CABLE

4 PROCEDURE FOR STARTING UP A REDUNDANT SYSTEM

5 REDUNDANT SYSTEM FUNCTIONS

6 REDUNDANT SYSTEM NETWORKS

7 PROGRAMMING CAUTIONS

8 TROUBLESHOOTING

3) When 3D1H is stored in the special register (SD1595) and the special relay (SM1595) is turned ON, the contents of control system memory will be copied to the standby system.
Then, the "BACKUP" LED of the standby system CPU module will turn ON (red).

Control system CPU module　　　　　　　　Standby system CPU module
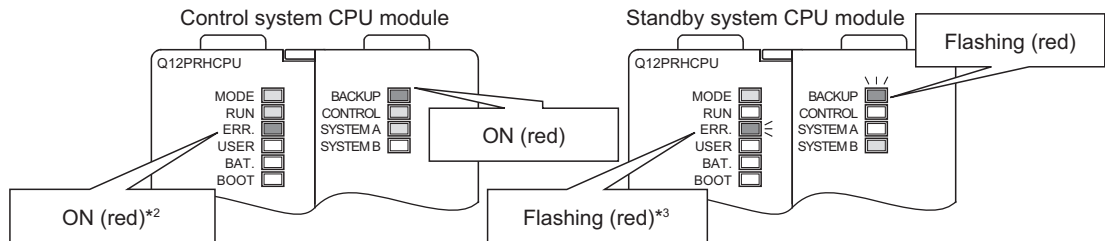
Diagram 5.87 LED Indications during Memory Copy

* 2: When memory copy begins, the "MEM. COPY EXE. (error code: 6410)" continuation error will occur in the control system CPU module, and then a "STANDBY SYS. DOWN (error code: 6300)" resume error will occur.

* 3: When memory copy begins, the "PRG. MEM. CLEAR (error code: 6400)" stop error will occur in the standby system CPU module.

4) When memory copy is complete, SM1597 will turn ON.
Then, the "BACKUP" LED of the standby system CPU module will turn ON (red).

Control system CPU module　　　　　　　　Standby system CPU module
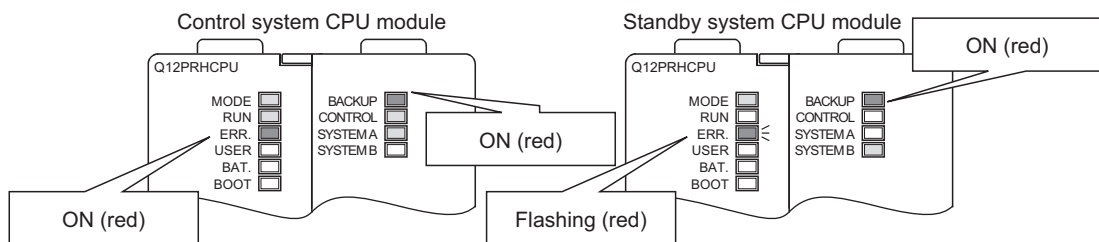
Diagram 5.88 LED Indications at Memory Copy Completion

5) After completing memory copy to the other system, restart the standby system or reset the standby system CPU module. It will operate as the standby system CPU module.
Then, the "BACKUP" LED of the standby system CPU module will turn ON (green).

Control system CPU module　　　　　　　　Standby system CPU module
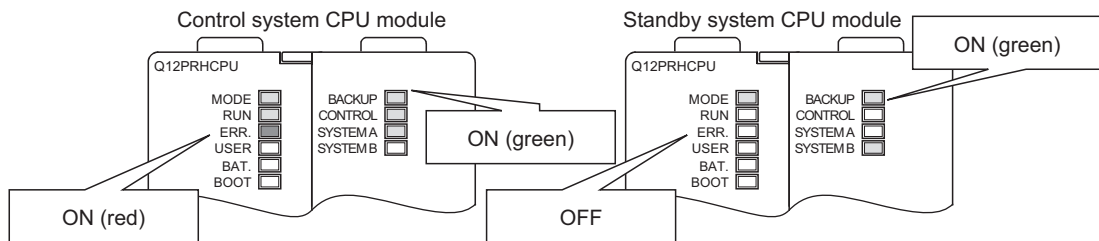
Diagram 5.89 LED Indications during Standby System CPU Module Operation

(b) Memory Copy Operations

Diagram 5.90 illustrates the processes that take place in memory copy.

[Memory copy preparation]

[Perform memory copy]

Control system   Standby system

Control system   Standby system

Tracking cable

Tracking cable

Display devices

1) Be sure that SM1596, SM1597 are OFF and store 3D1H in SD1595.

Display devices

2) Turn ON SM1595.
3) Begin memory copy (SM1596: ON)

[Memory copy complete]

Control system   Standby system

Tracking cable

Display devices

4) Memory copy completed. (SM1596:OFF, SM1597:ON, SD1596: Status information)

Diagram 5.90 Operation When Memory Copy Is Executed

(c) Memory Copy special relay and special register status

| | | Executing memory copy | Completed |

Memory copy to other system start flag (Set ON/OFF by the user) — SM1595 — OFF — ON

Memory copy to other system status flag (The system turns it ON/OFF) — SM1596[*1] — OFF — ON

Memory copy to other system completion flag (The system turns it ON.) — SM1597[*1] — OFF

Memory copy target I/O No. (Set by the user) — SD1595 — 0 — 3D1H

Memory copy status (The system sets it.) — SD1596 — 0 — 0 — 0
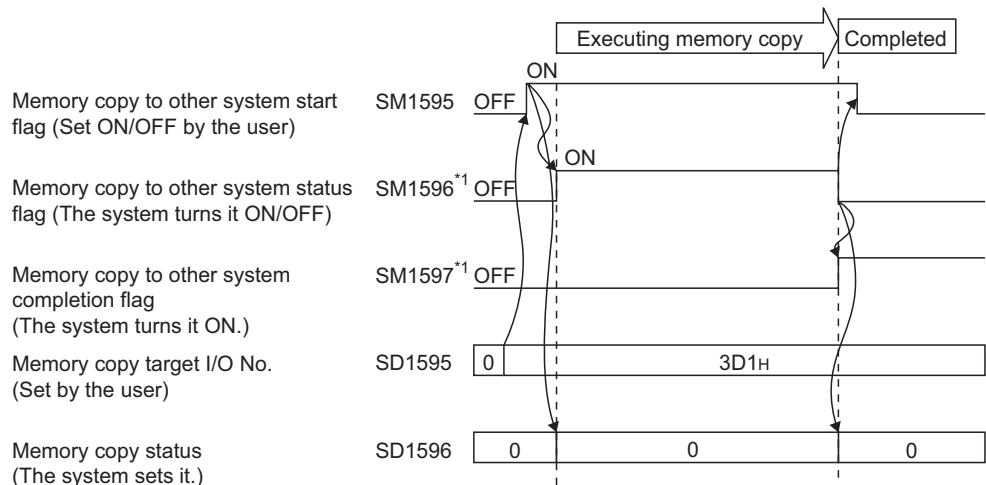
Diagram 5.91 Memory Copy Special Relay and Special Register Status

* 1: If any of the following malfunctions occur during memory copy from the control system to the standby system, memory copy will stop.
  If this happens, the "Memory copy to other system status" flag (SM1596) will turn OFF, and the "Memory copy to other system completion" flag (SM1597) will turn ON.
  - Standby system power OFF
  - Standby system CPU reset
  - Tracking cable disconnection or malfunction

5.7 Memory Copy From Control System To Standby System

⊠**POINT**

1. When the special relay "Memory copy to other system status executed" flag (SM1596) or the "Memory copy to other system completion" flag (SM1597) is ON, memory copy will not be to other system status executed even if the "Memory copy to other system start" flag (SM1595) is turned ON.
    In this case, no error code will not be stored in "Memory copy target I/O No." (SD1596) in the special register.
    Turn OFF SM1596 or SM1597 if either of them is ON, then execute memory copy again.

2. When a transfer target I/O No. other than the standby CPU module ($3D1_H$) is set to "Memory copy target I/O No." (SD1595) and memory copy is executed, the "Unsupported transfer target I/O No. (error code: 4248_H) will be stored in SD1596.
    In this case, memory copy will not be executed.

(4) Error Occurrence During Memory Copy

If any of errors listed in Table5.59 occurs during memory copy, the contents of standby system memory will be corrupted.

In this case, memory copy is not complete, but the special relay "Memory copy in process" flag (SM1596) will turn OFF and the "Memory copy complete" flag (SM1597) will turn ON.

Remove the cause of the error and execute memory copy again.

Table5.59 Error Occurrence During Memory Copy

Cause	Memory Copy Using GX Developer	Memory Copy Using Special Relays and Special Registers
• Control system power OFF • Control system CPU reset	The following error dialog box will appear: **MELSOFT application** Cannot communicate with the PLC. Execute again after checking the connections with the PLC. <ES:01808201> OK	-
• Standby system power OFF • Standby system CPU reset	The following error dialog box will appear: **MELSOFT application** Unable to communicate with PLC. The following reasons may be responsible. The power supply of the standby system was turned off. reset status. User WDT error status. PLC has a H/W problem. <ES:010a4241> OK	4241_H will be stored in SD1596 of the control system CPU module.
• Tracking cable disconnection • Tracking cable failure	The following error dialog box will appear: **MELSOFT application** The tracking cable has a communication problem. Please execute it again after confirming the state of the tracking cable. <ES:010a4242> OK	4242_H will be stored in SD1596 of the control system CPU module.
• USB cable disconnection • RS-232 cable disconnection	The following error dialog box will appear: **MELSOFT application** Cannot communicate with the PLC. Execute again after checking the connections with the PLC. <ES:01808201> OK	-

(5) Precautions

(a) GX Developer Functions Disabled During Memory Copy
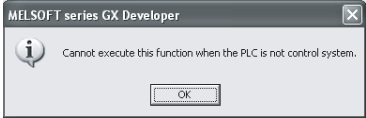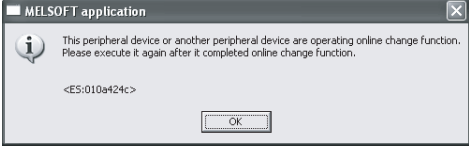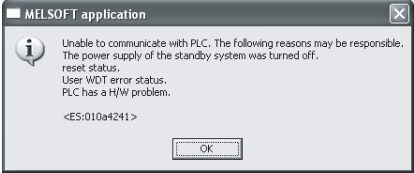
The GX Developer cannot perform the following operations on either the control system or the standby system during memory copy:

1) PLC memory format
2) Program memory to ROM
3) Write to PLC (Flash ROM)
4) Online change
5) System switching
6) Operation mode change

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(b) Restrictions on Memory Copy

Memory copy cannot be done using either GX Developer or the special relays and special registers under the conditions listed in Table5.60.

Table5.60 Restrictions on Memory Copy

Execution Conditions	Memory Copy Operation	
	Memory Copy Using GX Developer	Memory Copy Using Special Relays and Special Registers
Memory copy executed to the standby system CPU module	The following error dialog box will appear: MELSOFT series GX Developer Cannot execute this function when the PLC is not control system. OK	-
Memory copy executed in Debug Mode	The following error dialog box will appear: MELSOFT series GX Developer Cannot execute this function when the PLC status is debug mode. OK	$424D_H$ will be stored in SD1596 of the control system CPU.
Memory copy re-executed during memory copy	The following error dialog box will appear: MELSOFT application The memory copy function is being executed. Please execute it again for a while after time. <ES:010a4247> OK	4247_H will be stored in SD1596 of the control system CPU.
During online program change or similar operation to the control system CPU module	The following error dialog box will appear: MELSOFT application This peripheral device or another peripheral device are operating online change function. Please execute it again after it completed online change function. <ES:010a424c> OK	$424C_H$ will be stored in SD1596 of the control system CPU.
Memory copy target I/O No. (SD1595) is any value other than 3D1H	-	4248_H will be stored in SD1596 of the control system CPU.
Standby system power OFF Standby system CPU module reset	The following error dialog box will appear: MELSOFT application Unable to communicate with PLC. The following reasons may be responsible. The power supply of the standby system was turned off. reset status. User WDT error status. PLC has a H/W problem. <ES:010a4241> OK	4241_H will be stored in SD1596 of the control system CPU.
Tracking cable disconnection	The following error dialog box will appear: MELSOFT application The tracking cable has a communication problem. Please execute it again after confirming the state of the tracking cable. <ES:010a4242> OK	4242_H will be stored in SD1596 of the control system CPU.

5.8 Online Module Change (Hot Swapping)

In the redundant system, following modules can be replaced online.

- Module mounted to the extension base unit (I/O module, analog module etc.)
- Module mounted to the remote I/O station in the MELSECNET/H Remote I/O network (I/O module, analog module etc.)
- Power supply module when the power supply modules are duplicated
- I/O module mounted on the main base unit where the Redundant CPU is mounted (Only when the extension base unit is not connected)

The network module mounted on the control system main base unit cannot be replaced online (while the system power is ON).
When replacing the network module mounted on the control system main base unit, make sure to switch it to the standby system using GX Developer or the system switching instruction (SP. CONTSW instruction).
The standby system is not actually controlling. Therefore, there will be no effect on the redundant system control if the standby system is powered off.
When powering the standby system OFF, the "STANDBY SYS. DOWN (error code: 6300)" continuation error will occur in the control system CPU module.

(1) Module mounted to the extension base unit

The online module change (hot swapping) is applicable for a module mounted to the extension base unit.
However, there are restrictions on the module where the online module change is applicable.
(For modules that can be replaced online, refer to Section 2.4)
For replacing modules where the extension base unit is connected online, refer to the following manual.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(2) Module mounted on the MELSECNET/H remote I/O station

The MELSECNET/H remote I/O station supports online module change.
If a module mounted on the MELSECNET/H remote I/O station has a failure, the module can be replaced without stopping system control.
However, the target module of online module change is restricted.
(Refer to Section 2.4 (4) for details.)
Refer to the following manual for information on online change of the module mounted on the MELSECNET/H remote I/O station.

☞ Q Corresponding MELSECNET/H Network System Reference Manual

(Remote I/O network)

☞ User's Manual of the corresponding module

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(3) Redundant Power Supply Module

When a pair of redundant power supply modules is used in each system of the redundant system, one redundant power supply module can be replaced at a time after powering off the module.

As another redundant power supply module supplies power to the modules mounted on the same base unit, the redundant system control can be continued during the replacement.

Refer to Section 8.3.3, for details.

(4) I/O module mounted to main base unit where Redundant CPU is mounted

The I/O modules mounted on the control system and standby system main base units can be replaced online.

If an error occurs in an I/O module mounted on the control system or standby system main base unit, the module can be replaced without stopping system control.

Note that a module mounted to the main base unit cannot be replaced online when the extension base unit is connected.

Refer to the following manual, for details.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

5.9 Network Module Redundant Group Settings

(1) Network Module Redundant Group Settings

When a pair of Ethernet modules is used in each system of the redundant system, by making the network module redundant group settings of the Ethernet modules, system switching can be disabled even if an error occurs in one network.
However, if a communication error occurs in both Ethernet modules, system switching will occur.

[Example:]
Diagram 5.92 and Diagram 5.93 show the operations when an error occurs in the communication between the control system and standby system via the Ethernet.

- Diagram 5.92 shows the processes that take place when a malfunction occurs on one of the networks with network module redundant group settings.

One of the modules set in the redundant group setting has requested a system switching
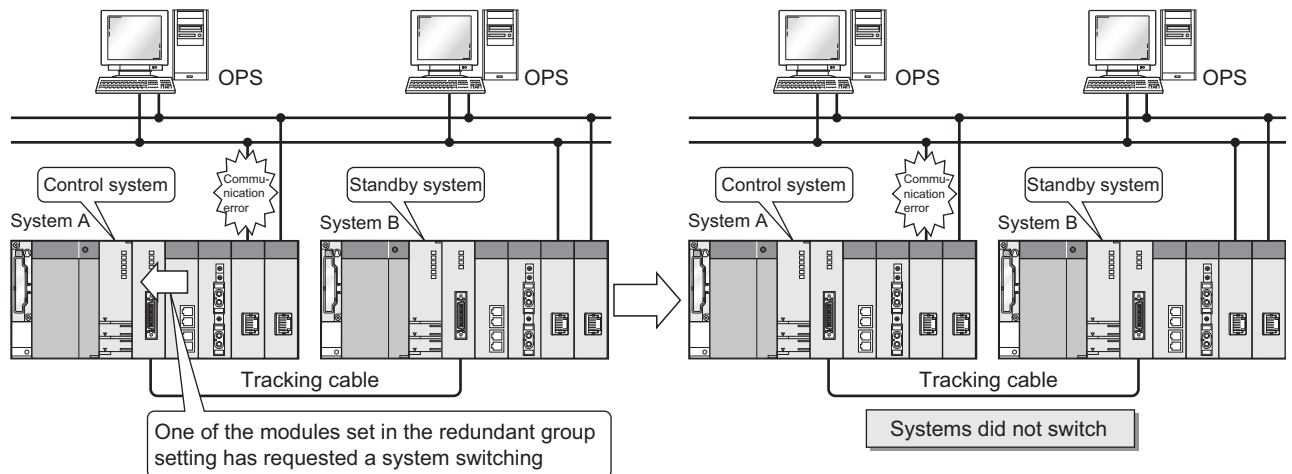
Diagram 5.92 Operation When Error Occurs on One of the Networks

- Diagram 5.93 shows the processes that take place when a malfunction occurs on both networks with network module redundant group settings.

Both modules set in the network module redundant group setting have requested a system switching
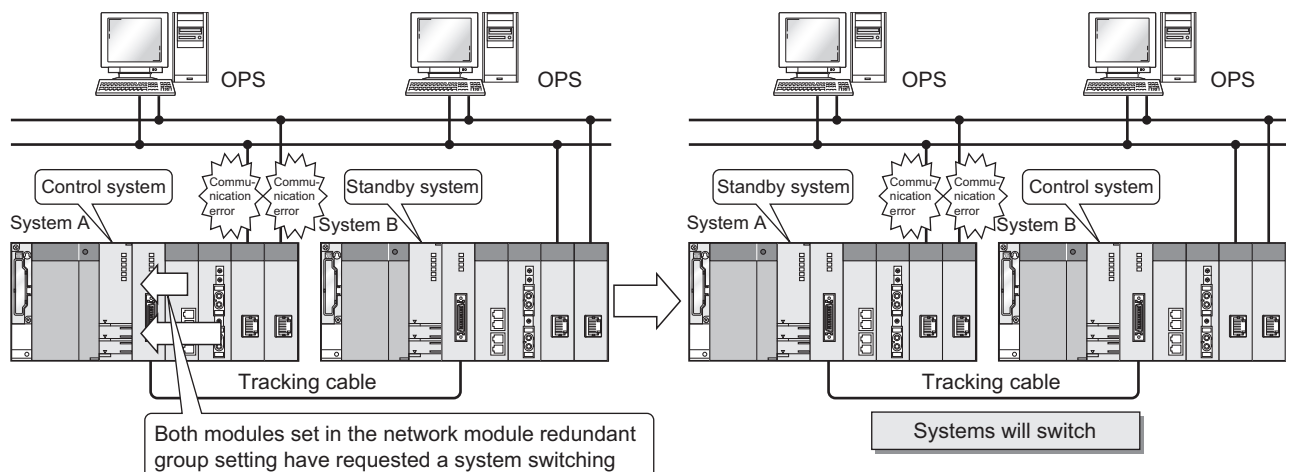
Diagram 5.93 Operation When Error Occurs on Both Networks

(2) Redundant Group Settings

Redundant group settings are made in the network parameter group settings using GX Developer.

Set "Group" or leave it block in the network module set to the lower I/O No.

Diagram 5.94 Network module redundant group setting Window
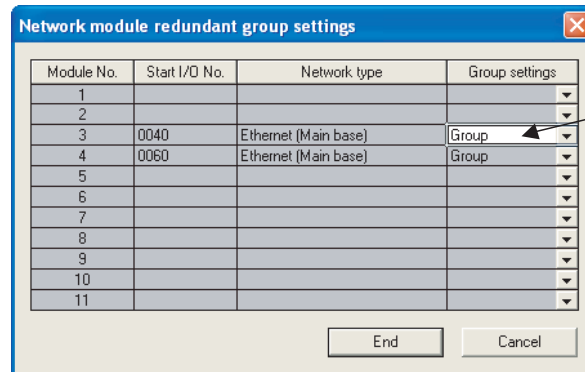
When module No. 3 is set in "Group", module No. 3 becomes grouped with module No.4.

(3) Confirming a System Switching Request by a Network Module

If a network module requests a system switching, the SD1590 bit for the module No. will change to "1". [1]
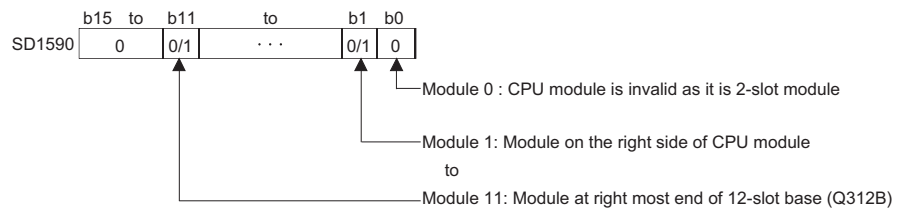
Diagram 5.95 Network Module That Issued System Switching Request

[1] : The module No. corresponds to the slot number on the main base unit.
  • Module No. 0...Slot 0
  • Module No. 1...Slot 1
  • Module No. 2...Slot 2
  •
  •
  •
  • Module No. 11...Slot 11

(4) When a non-redundant network module is set in the redundant group settings

If redundant group settings are made for a network module that does not support redundant systems, a stop error, "PARAMETER ERROR (error code: 3000)" will occur.

In this case, check the network parameter group settings.

5.10 Redundant CPU Functions Restricted in Redundant System

This section explains the following Redundant CPU functions that are restricted in a redundant system.

- Enforced ON/OFF of external I/O
- Remote operation

Refer to the following manual for details of each function.

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

5.10.1 Enforced ON/OFF of external I/O

The Redundant CPU can forcibly turn ON/OFF the enforced ON/OFF of external I/O operation from GX Developer.
The registered ON/OFF information can be cleared by GX Developer operation.

(1) CPU modules that can be forcibly turned ON/OFF

The enforced ON/OFF of the external I/O can be executed for only the control system CPU module. (It cannot be executed for the standby system CPU.)
If registration/change/clear of the forced I/O ON/OFF status is made to the standby system CPU, the error dialog box (in Diagram 5.96) will appear on GX Developer.
In this case, change the connection target of GX Developer to the "control system".
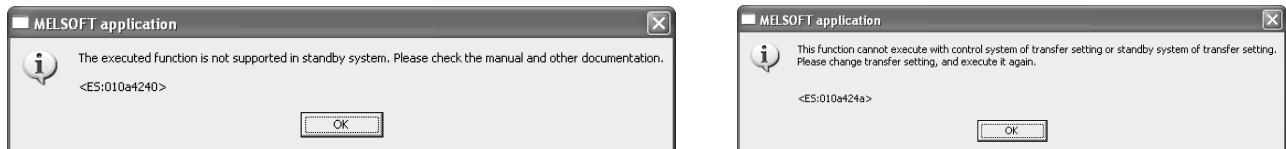
Diagram 5.96 Error Dialog Box That Appears When Forced ON/OFF/Cancel Is Executed in Standby System

(2) Tracking of Registered Forced ON/OFF Information from Control System to Standby System

The forced ON/OFF information registered in the control system CPU module is tracked to the standby system CPU module.

(Track the registered forced ON/OFF information from the control system CPU module to the standby system CPU module in the "backup mode" or "separate mode".)

Hence, if system switching occurs, the external I/O forced ON/OFF can be continued according to the forced ON/OFF information registered by GX Developer before system switching.
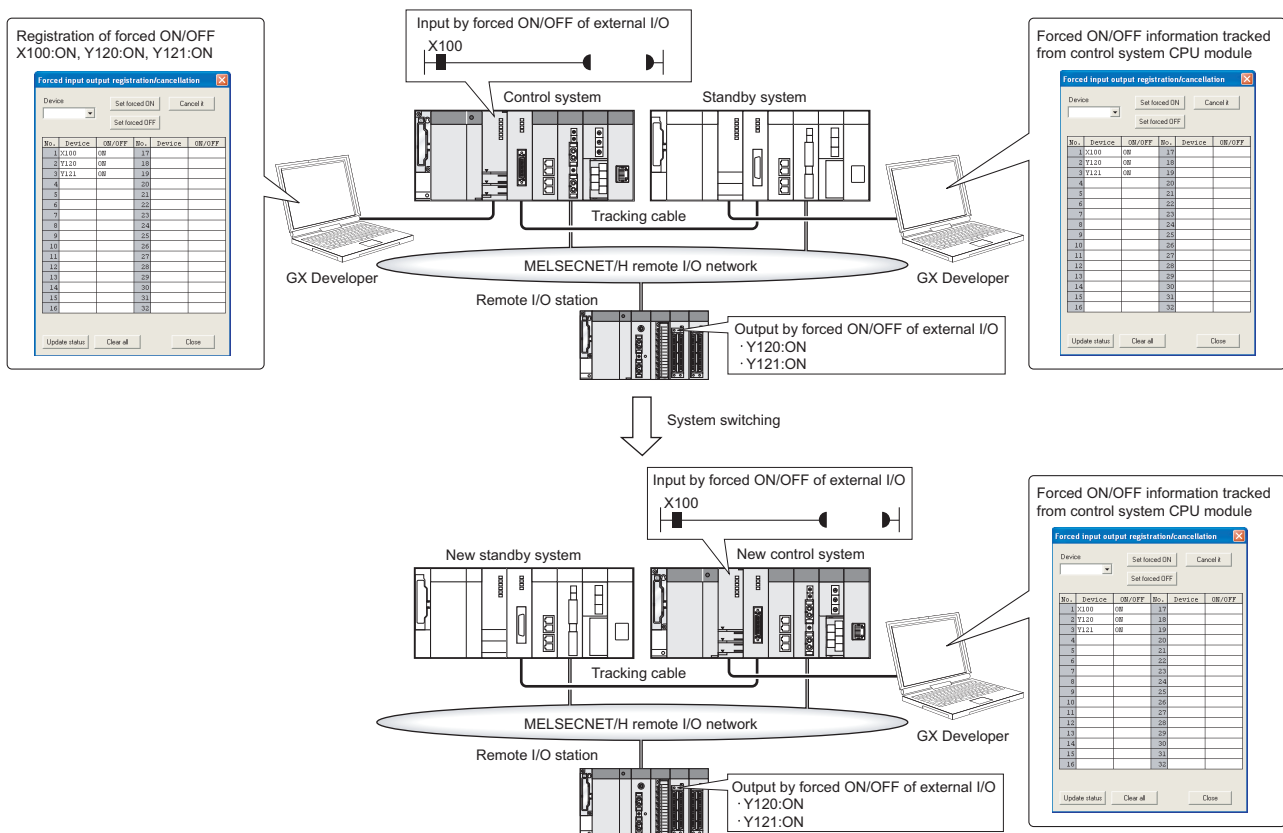
Diagram 5.97 Input/Output by Forced ON/OFF of External I/O at System Switching Occurrence

(3) Operation of Input/Output of which forced ON/OFF information has been registered at Operation Mode Change

If the operation mode is changed, the forced ON/OFF information before operation mode change remains.

Hence, if the operation mode is changed, the external I/O forced ON/OFF can be continued according to the forced ON/OFF information before operation mode change.

If the operation mode is in the separate mode, the external I/O forced ON/OFF by GX Developer can be executed for only the control system CPU module.

If in the separate mode, the external I/O forced ON/OFF registration cannot be executed individually for the control system and standby system CPU modules.

5.10 Redundant CPU Functions Restricted in Redundant System
5.10.1 Enforced ON/OFF of external I/O

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(4) Operation When Control System/Standby System Is Powered Off and Then On/CPU Module Is Reset and Then its RESET Switch Is Set to Neutral Position

(a) In the backup mode

1) Operation when control system is powered off and then on/control system CPU module is reset and then its RESET switch is set to neutral position

System switching occurs when the control system is powered off/the control system CPU module is reset.

The input/output of which forced ON/OFF has been registered remains the ON/OFF status according to the forced ON/OFF information of the new control system CPU module.

Table5.61 Operation When Control System Is Powered Off and Then On/Control System CPU Module Is Reset and Then its RESET Switch Is Set to Neutral Position

Item	Module mounted on main base unit including Redundant CPU	Module mounted on remote I/O station
Input	Device X remains ON/OFF according to the forced ON/OFF information.	
Output	External output ON/OFF is continued according to the forced ON/OFF information.	

2) Operation when standby system is powered off and then on/standby system CPU module is reset and then its RESET switch is set to neutral position

If the standby system is powered off/the standby system CPU module is reset, the forced ON/OFF information of the control system CPU module does not change.

The input/output of which forced ON/OFF has been registered continues the ON/OFF status according to the forced ON/OFF information of the control system CPU module.

Table5.62 Operation When Standby System Is Powered Off and Then On/Standby System CPU Module Is Reset and Then its RESET Switch Is Set to Neutral Position

Item	Module mounted on main base unit including Redundant CPU	Module mounted on remote I/O station
Input	Device X remains ON/OFF according to the forced ON/OFF information.	
Output	External output ON/OFF is continued according to the forced ON/OFF information.	

(b) In the separate mode

1) Operation when control system is powered off and then on/control system CPU module is reset and then its RESET switch is set to neutral position

When the control system is powered off/the control system CPU module is reset, the forced ON/OFF information is all cleared.
The input/output of which forced ON/OFF has been registered all return to the status before the forced ON/OFF registration.

However, when the control system is powered off/the control system CPU module is reset, the master station on the MELSECNET/H remote I/O network changes to the sub master station. Therefore, the output to the remote I/O station holds the status when the control system was powered off/the control system CPU module was reset.

Table5.63 Operation When Control System Is Powered Off and Then On/Control System CPU Module Is Reset and Then its RESET Switch Is Set to Neutral Position

Item	Module mounted on main base unit including Redundant CPU	Module mounted on remote I/O station
Input	Device X changes according to the external input.	[After power is switched on/RESET switch is set to neutral position] Device X changes according to the external input.
Output	The external output changes according to device Y.	[When power is switched off/CPU is reset] The output status when the control system is powered off/ the control system CPU module is reset is held. [After power is switched on/RESET switch is set to neutral position] The external output changes according to device Y.

2) Operation when standby system is powered off and then on/standby system CPU module is reset and then its RESET switch is set to neutral position

If the standby system is powered off/the standby system CPU module is reset, the forced ON/OFF information of the control system CPU module does not change.
The input/output of which forced ON/OFF has been registered remains the ON/OFF status according to the forced ON/OFF information of the control system CPU module.

Table5.64 Operation When Standby System Is Powered Off and Then On/Standby System CPU Module Is Reset and Then its RESET Switch Is Set to Neutral Position

Item	Module mounted on main base unit including Redundant CPU	Module mounted on remote I/O station
Input	Device X remains ON/OFF according to the forced ON/OFF information.	
Output	External output ON/OFF is continued according to the forced ON/OFF information.	

3) Turning power supply OFF or reset operation when the extension base unit is connected

Do not turn OFF the power supply of the control system or perform reset operation in the separate mode when the extension base unit is connected. (If doing so, turn ON both systems simultaneously or cancel the reset.)

5.10.2 Remote Operation for Redundant System

In the redundant system, the following remote operations can be performed by GX Developer or other means.
(The remote operation for the Redundant CPU can be executed regardless of the communication route.)
- Remote RUN
- Remote STOP
- Remote PAUSE
- Remote latch clear
- Remote reset

The remote operation for the Redundant CPU can be executed in any of the following methods.
- Remote operation from GX Developer
- CC-Link IE Controller Network module, MELSECNET/H module dedicated instruction
- Remote operation by MC protocol
- Remote operation function from OPS using EZSocket

(1) Target CPU modules of remote operation

(a) In the backup mode

1) Remote RUN, remote STOP, remote PAUSE or remote latch clear can change the operation status of the CPU module(s) in the system or both systems specified in the Connection Setup of GX Developer or other means.

2) Remote reset can be executed for only the control system CPU module. Performing remote reset for the control system CPU module resets both systems.

(b) In the separate mode

Remote operation can be performed for only the CPU module of the system specified in the Connection Setup of GX Developer or other means.

(2) Target Specification for Remote Operation

As the target CPU module of remote RUN, remote STOP, remote PAUSE or remote latch clear, select the CPU module of either system or the CPU modules of both systems in the Connection Setup of GX Developer.
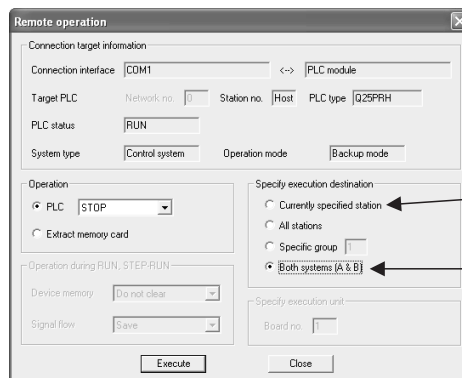
Select when performing remote operation for the CPU module of the system specified in Connection Setup.

Select when performing remote operation for the control system and standby system CPU modules.

Diagram 5.98 Remote Operation Window

(a) Remote operation for the system specified in the Connection Setup of GX Developer

When "Currently specified station" is selected at the execution destination area on the Remote operation window of GX Developer, remote operation is performed for only the system specified in the Connection Setup, which can be selected from [Online] from the menu bar of GX Developer.

(The current station can be selected in the "backup mode" and "separate mode".)

For example, when remote STOP is executed after the "control system" is specified on the Connection Setup window, remote STOP is executed for the current control system CPU module.
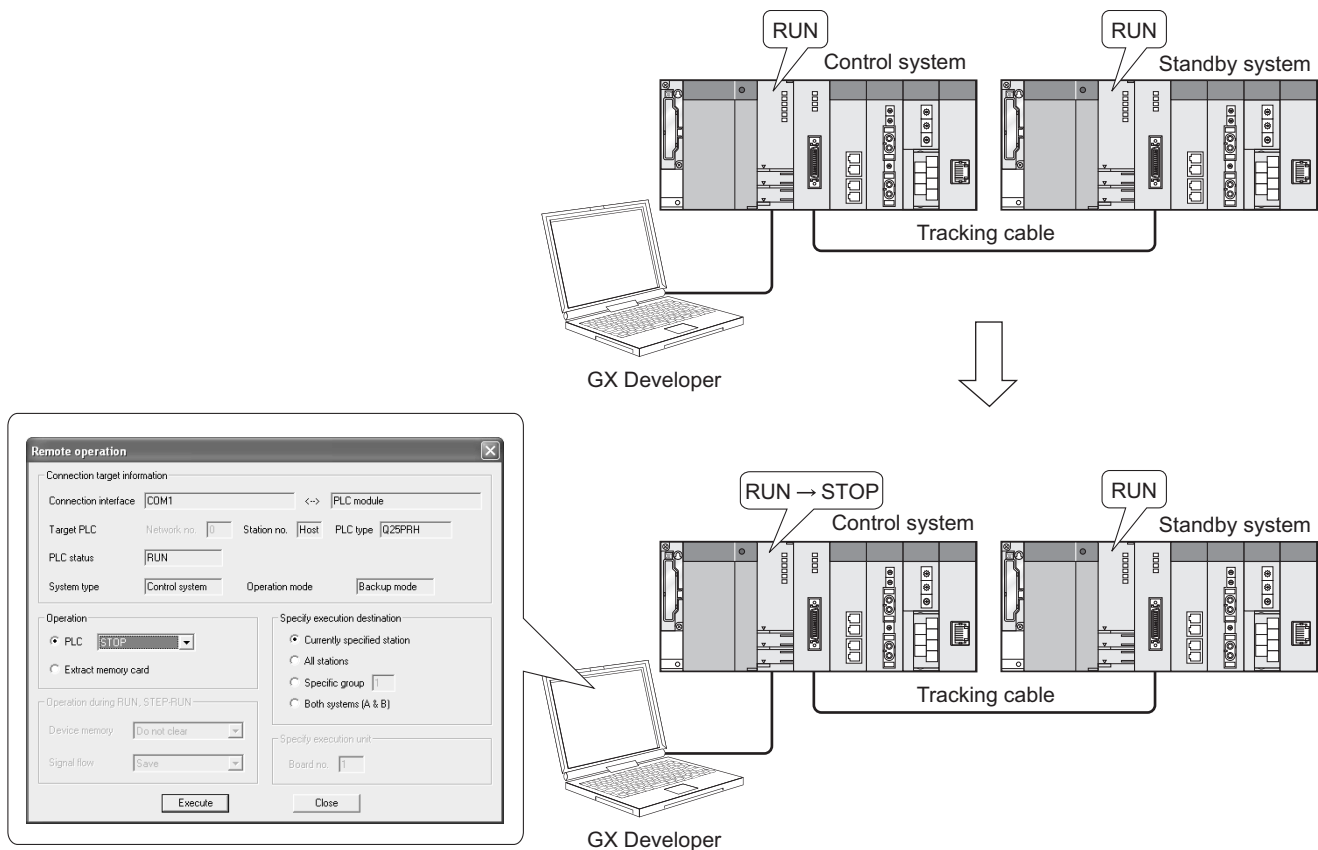
Diagram 5.99 Remote STOP Operation When Current Station Is Specified

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(b) Remote operation for both systems

When "Both systems (A & B)" is selected at the execution destination area on the Remote operation window of GX Developer, remote operation is performed for the control system and standby system.

Remote operation for "Both systems" can be selected in the backup mode only. (In the separate mode, "Both systems" cannot be selected at the execution destination area on the Remote operation window of GX Developer.)

When "Both systems (A & B)" is selected, GX Developer executes remote operation in order of the "standby system CPU module" and "control system CPU module".
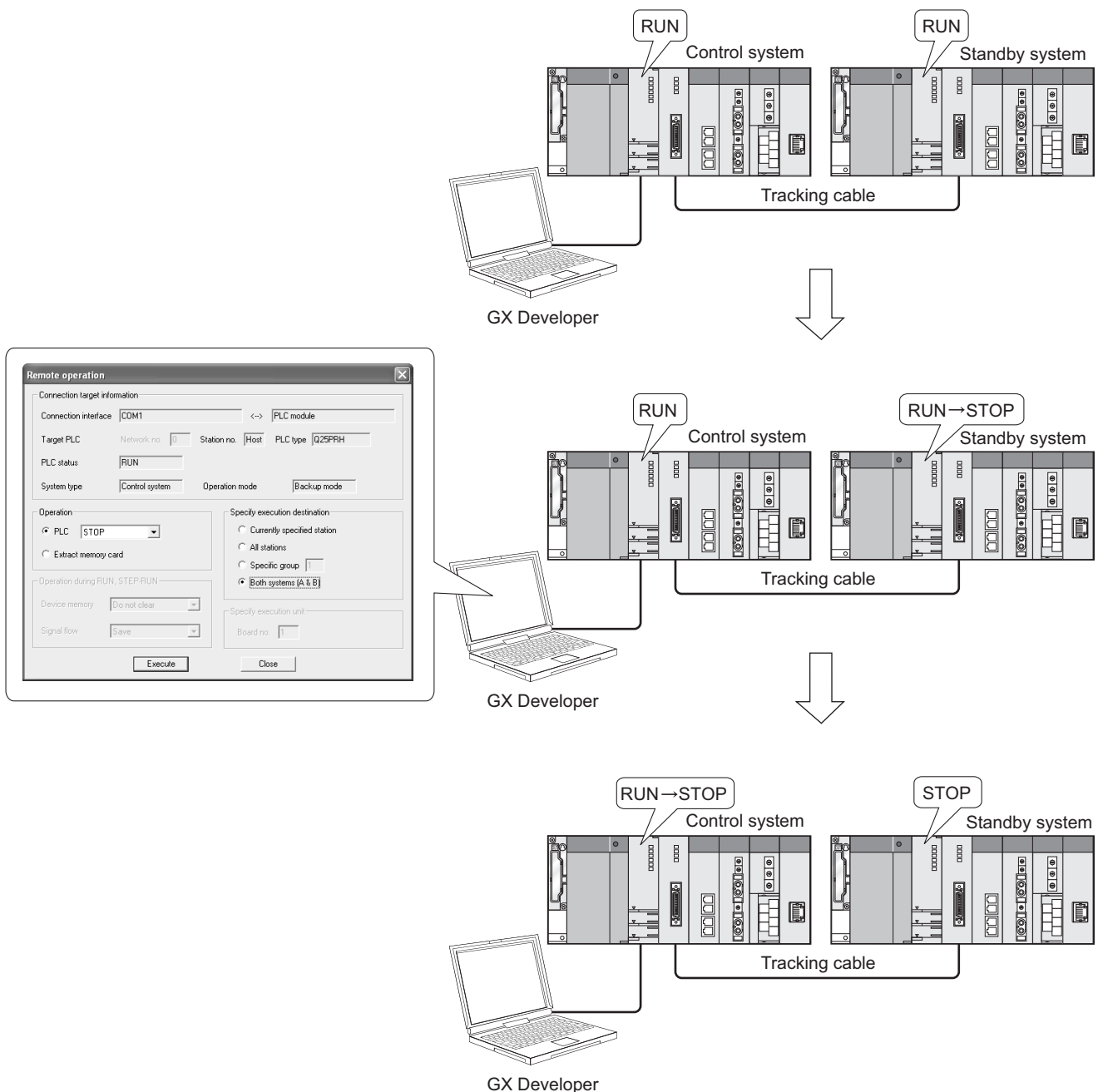
Diagram 5.100 Remote STOP Operation When Both Systems Are Specified

(3) Remote reset operation

(a) In the backup mode

In the backup mode, performing remote reset operation for the control system resets both systems.

(Both systems are reset also when "Currently specified station" is selected at the execution destination area on the Remote operation window of GX Developer.)
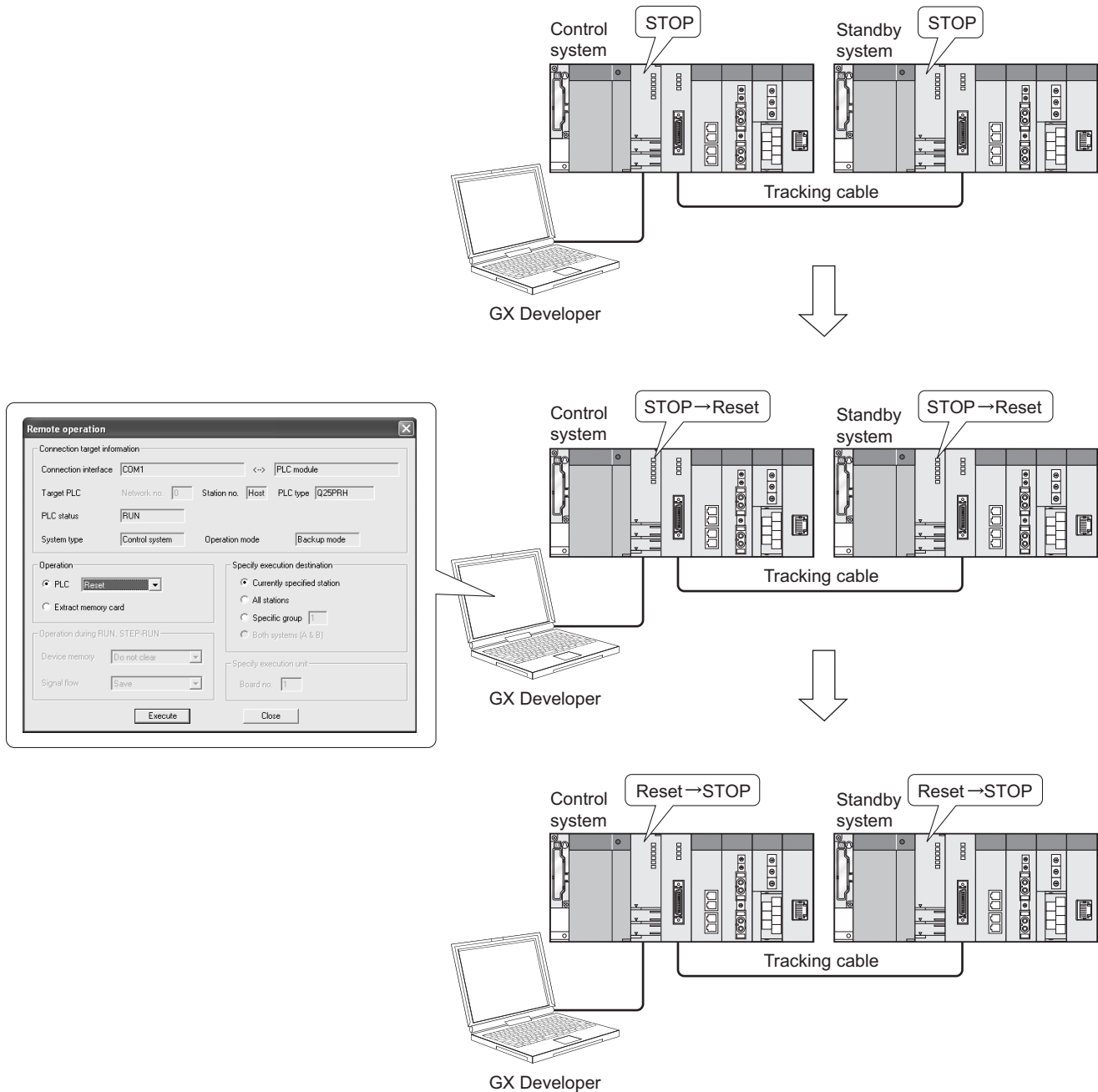
Diagram 5.101 Remote Reset Operation

Remote reset operation cannot be performed for the standby system.

If remote reset operation is performed for the standby system by GX Developer, the error dialog box in Diagram 5.102 will appear.

Diagram 5.102 Error Dialog Box Displayed on GX Developer

(b) In the separate mode or debug mode

In the separate mode or debug mode, remote reset can be executed for only the system specified in the Connection setup of GX Developer. The operation status of the unspecified system does not change.
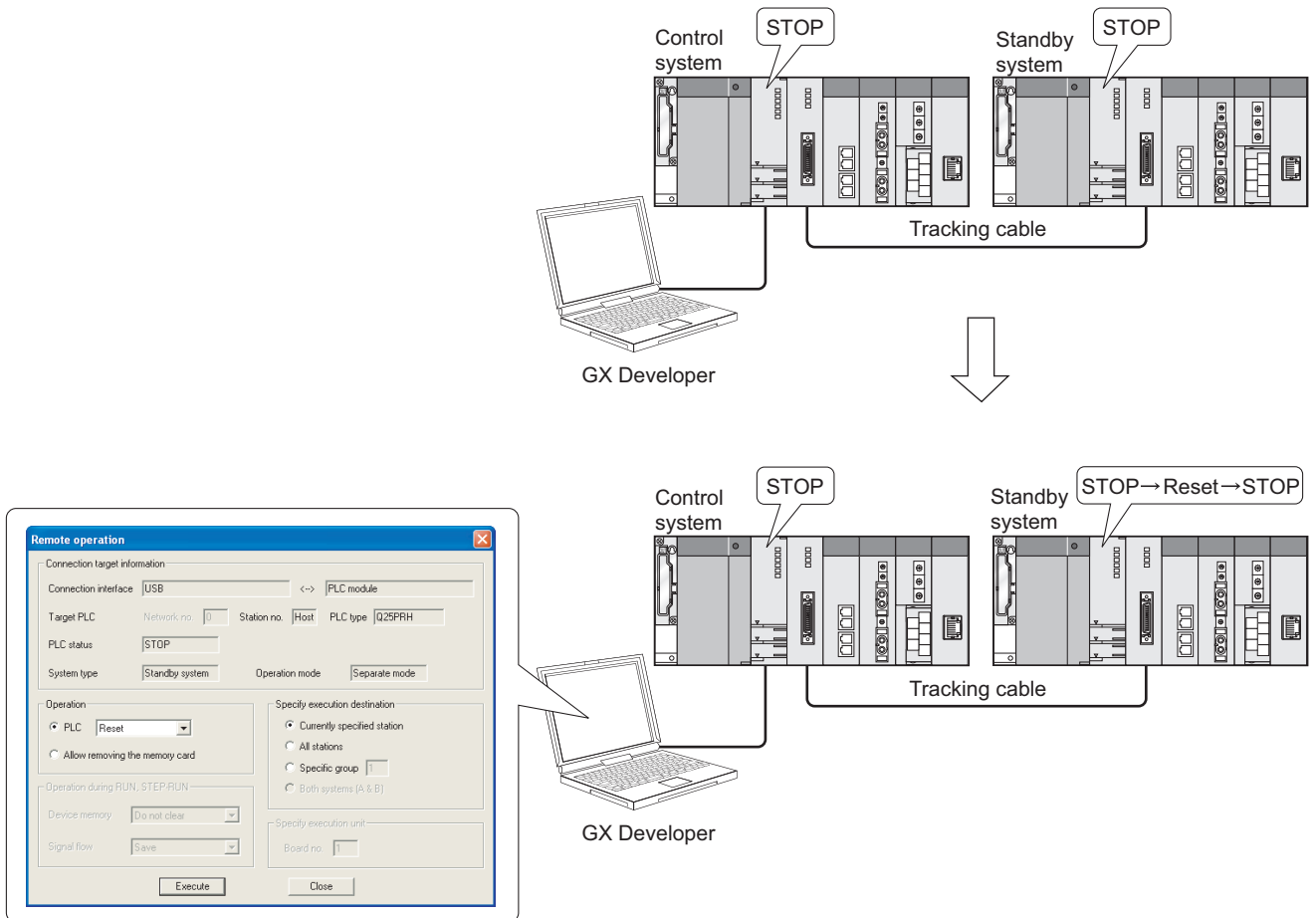
Diagram 5.103 Remote Reset Operation in Separate Mode

(c) Precautions when executing remote reset operation

The following describes the precautions to be taken when performing remote reset for both systems in the backup mode.

1) Remote reset when control system CPU module is in the STOP status and standby system CPU module is in the RUN status

System switching will occur when remote reset operation is performed for the control system CPU module when the control system CPU module is in the STOP status and the standby system CPU module is in the RUN status.

To disable system switching at the time of remote reset, change the operation statuses of the control system and standby system CPU modules to the STOP status, and then perform remote reset.
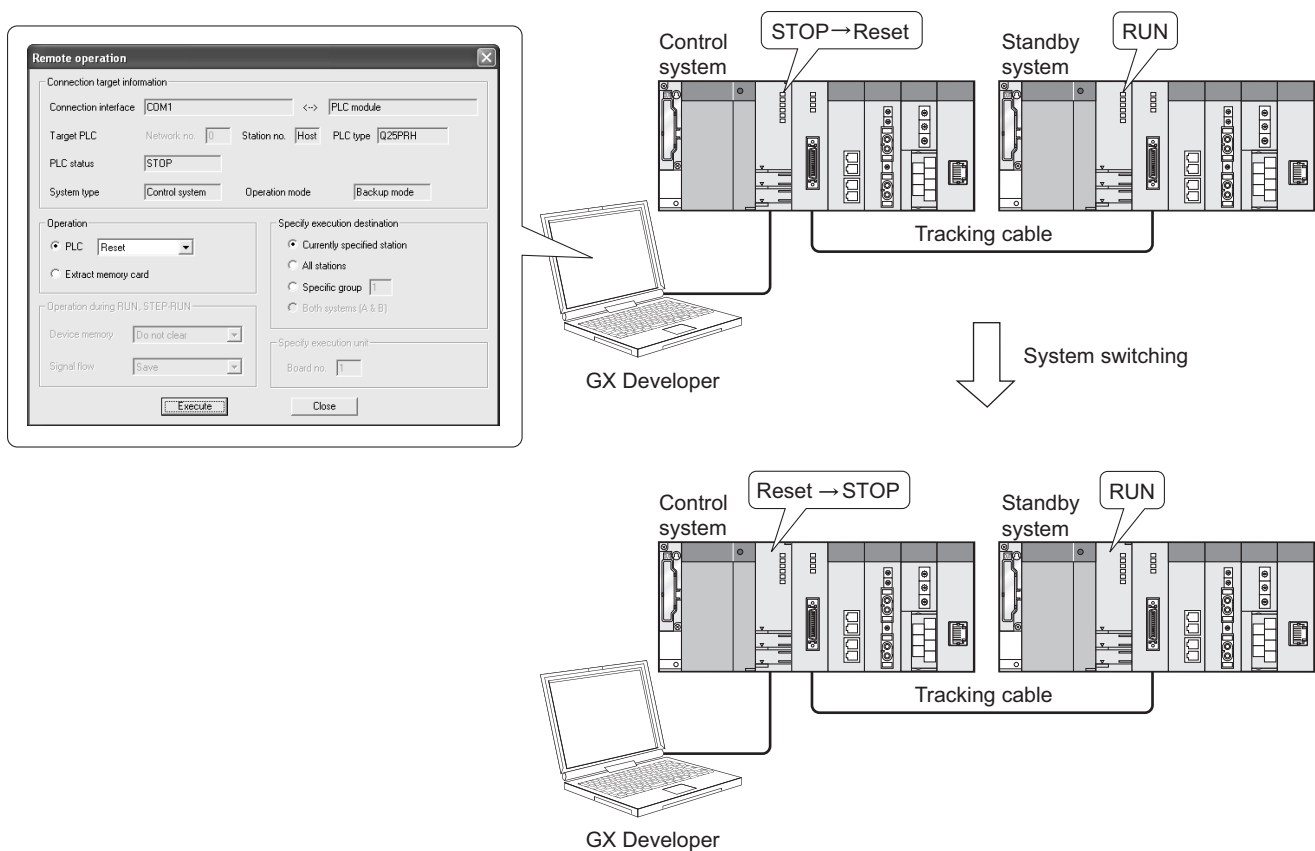
Diagram 5.104 Remote Reset Operation When Control System CPU Module Is in STOP Status and Standby System CPU Module Is in RUN Status

2) **When watchdog timer error has occurred in the standby system CPU module**

When a watchdog timer error has occurred in the standby system CPU module, only the control system CPU module is reset and the standby system CPU module is not reset.

When performing remote reset for the standby system CPU module in which a watchdog timer error has occurred, set the communication route where the tracking cable is not relayed.
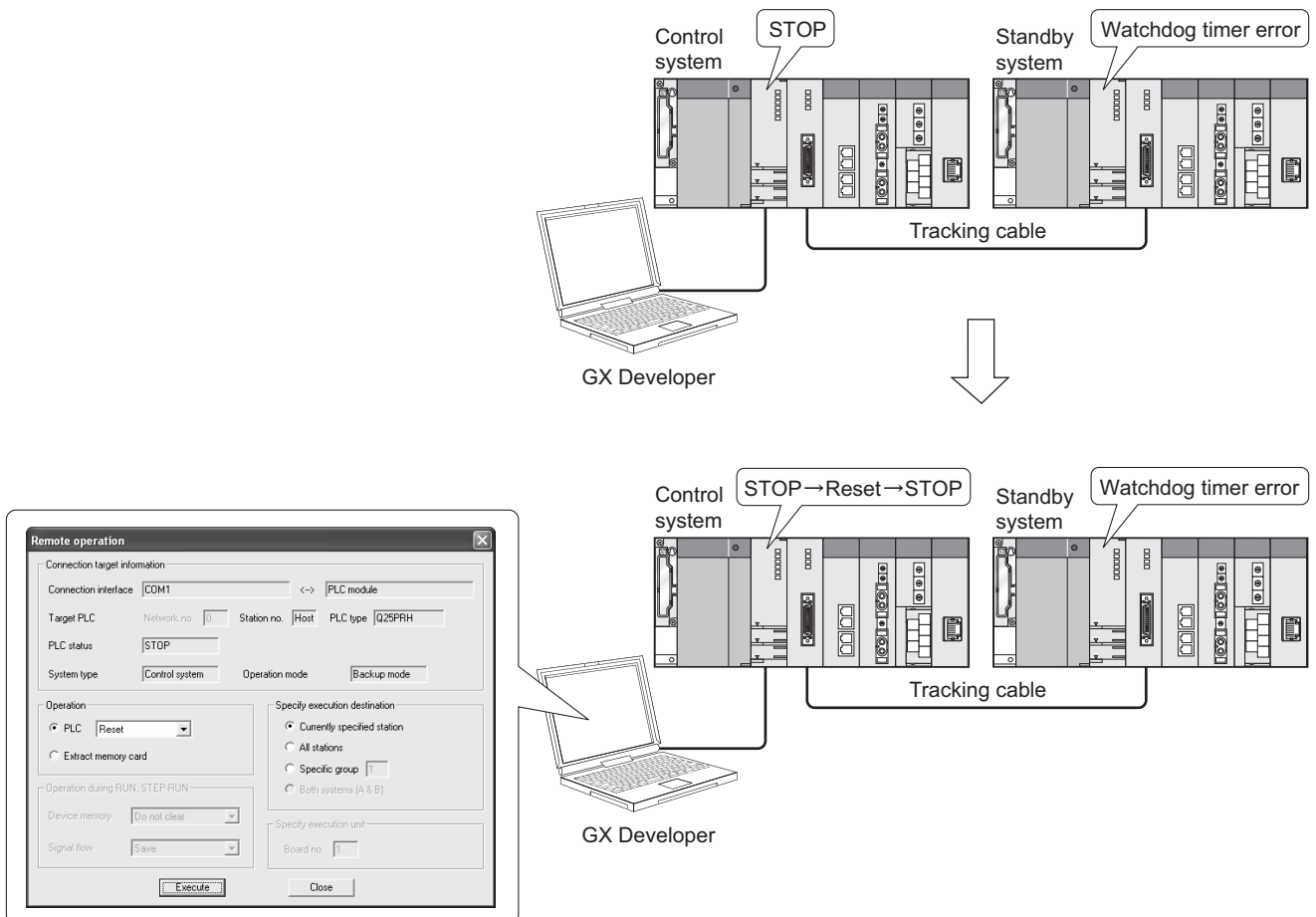
Diagram 5.105 Remote Reset Operation When Watchdog Timer Error Has Occurred in Standby System CPU Module

3) **Remote reset after execution of remote operation for control system or standby system CPU module from other route**

When remote operation is being performed for the control system or standby system CPU module from GX Developer in the other route, the standby system CPU module is not reset if remote operation is performed for the control system CPU module.[1]

When performing remote reset for the control system or standby system CPU module, cancel the remote operation for the standby system CPU module from GX Developer or other means that executed the remote operation for the standby system CPU module.
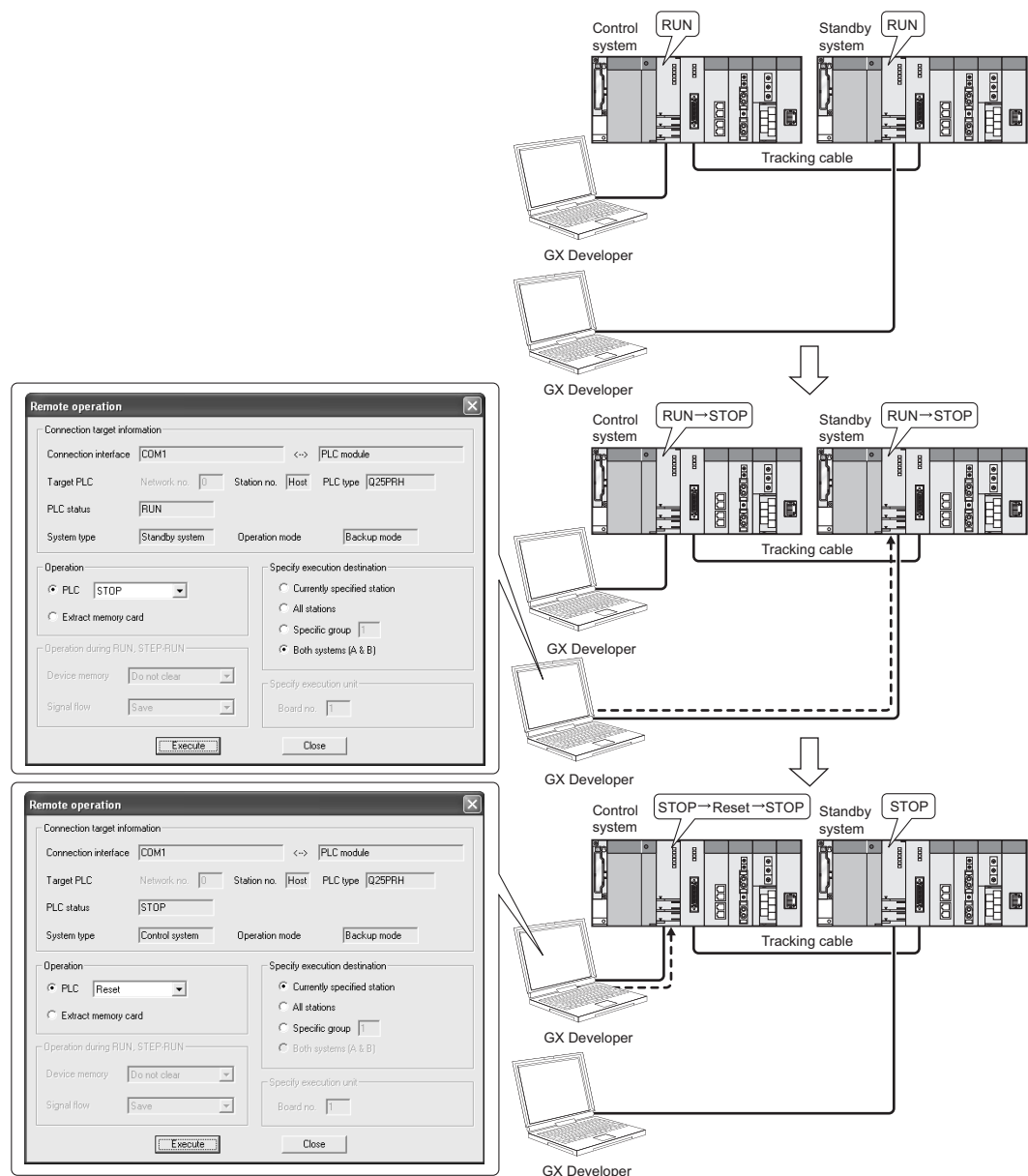
Diagram 5.106 Remote Reset Operation after Execution of Remote STOP for Control System or Standby System CPU Module from Other Route

* 1: How to confirm remote operation execution
Whether remote operation has been executed or not can be checked by the special register "CPU operation status (SD203)".
When the CPU operation status is changed by remote operation, "2 (remote operation from GX Developer/serial communication module)" is stored into b4 to b7 of SD203.

5.11 Access to Module Mounted on Extension Base Unit

Table5.65 lists the access to a module mounted on the extension base unit when accessing from the control system and when accessing from the standby system.

Table5.65 Access to Module Mounted on Extension Base Unit

Item		Execution timing	Name	Access from control system		Access from standby system	
				Backup mode	Separate mode	Backup mode	Separate mode
I/O access	Refresh	At END processing	Input from input module	Execute	Execute	- *5	- *5
			Output from output module	Execute	Execute	Not execute	Not execute
	Instruction	At instruction execution	Direct access of input device (DX)	Executable	Executable	Inexecutable	Inexecutable
			Direct access of output device (DY)	Inexecutable	Inexecutable	Inexecutable	Inexecutable
			I/O refresh instruction	Executable	Executable	Inexecutable	Inexecutable
Access to buffer memory	Refresh	At END processing	Refresh of intelligent function module	Executable	Executable	Inexecutable	Inexecutable
			Refresh of CC-Link IE Controller Network module	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]
			Refresh of MELSECNET/H module	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]
			Refresh of CC-Link master module	Executable	Executable	Inexecutable	Inexecutable
			Device initial value of link direct device (J□\□)	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]
			Device initial value of intelligent function module (U□\G□)	Executable	Executable	Inexecutable	Inexecutable
	Instruction	At instruction execution	Data link instruction	Executable	Executable	Inexecutable	Inexecutable
			Refresh instruction	Executable	Executable	Inexecutable	Inexecutable
			Read/write from/to intelligent function module/ special function module	Executable	Executable	Inexecutable	• SM1593=ON: Inexecutable (An error does not occur) • SM1593=OFF: Stop error
			Link direct device (J□\□)	Inexecutable[*1]	Inexecutable[*1]	Inexecutable[*1]	
			Intelligent function module (U□\G□)	Executable	Executable	Inexecutable	
	Monitor	At END processing	Buffer memory batch monitor/device batch monitor	Executable[*2]	Executable[*2]	Inexecutable[*4]	Inexecutable[*4]

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Table5.65 Access to Module Mounted on Extension Base Unit (Continued)

Item		Execution timing	Name	Access from control system		Access from standby system	
				Backup mode	Separate mode	Backup mode	Separate mode
Dedicated instruction	Dedicated instruction	At instruction execution	Intelligent function module (U□\G□)	Inexecutable[*3]	Inexecutable[*3]	Inexecutable[*3]	Inexecutable[*3]

* 1: CC-Link IE Controller Network, MELSECNET/H module cannot be mounted to the extension base unit.
* 2: An error code (4248_H) is returned to the request source when system switching occurs during monitoring.
* 3: An error (OPERATION ERROR: 4122) occurs.
* 4: Accessing to a module mounted on the extension base unit from the standby system is disabled. When buffer memory batch monitor or device batch monitor is executed from GX Developer, the following message box is displayed.

    1) When executing buffer memory batch monitor   2) When executing device batch monitor

* 5: Input (X) from the input module on the extension base unit will be an undefined value.

⊠POINT

In the redundant system where the modules are mounted on the extension base unit, if the systems are switched because of an extension cable failure, data are not output/input from/to the modules on the extension base unit in the new control system.

6 REDUNDANT SYSTEM NETWORKS

CHAPTER6 REDUNDANT SYSTEM NETWORKS

This chapter explains the redundant system networks on the assumption that the operation mode has been set to the backup mode.

6.1 Communication with GX Developer and PX Developer

6.1.1 Communication Methods with GX Developer

The communication between GX Developer and redundant CPU module can be made through the following three paths.
- CPU module direct connection
- Routing a network module
- Routing an intelligent function module

In the case of GX Developer, select [Online] - [Specify Connection] from the menu bar, and specify the connection path on the displayed dialog box.
And, specify the communication target system from the following: "Not specified" (default), "Control system", "Standby system", "System A" and "System B". (☞Table6.1)
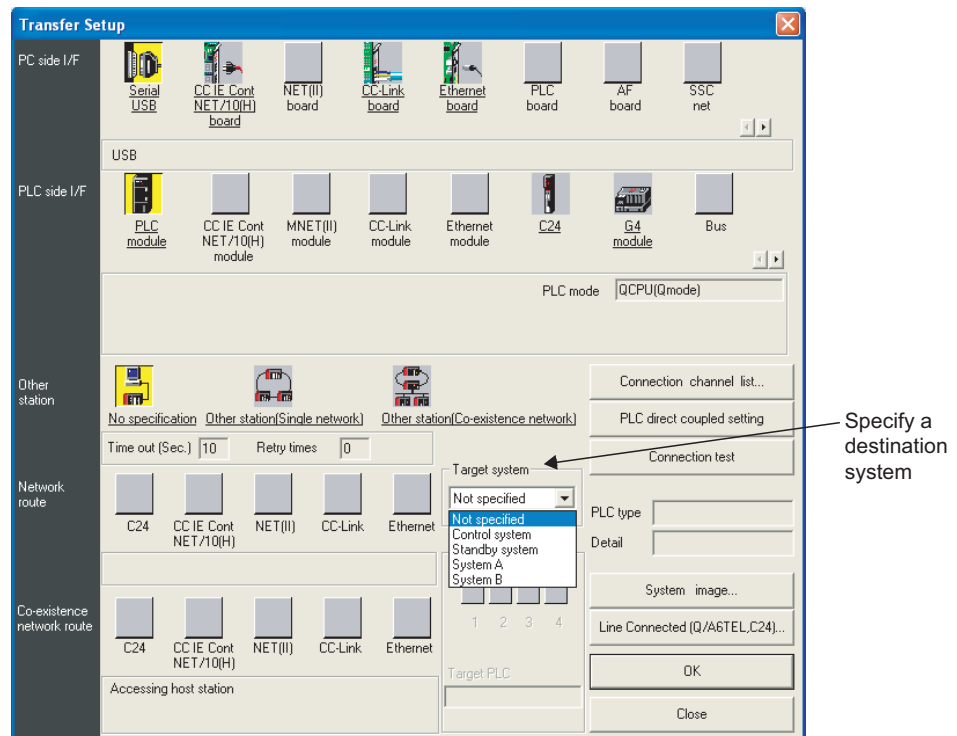
Diagram 6.1 Connection Setup Window

Table6.1 GX Developer System Specification and Communication Paths

System Specification		Communication Path
Not specified (Default)	• Select this option to communicate with only the CPU module connected to GX Developer.	
Control System	• Select this option to communicate with the control system CPU module using GX Developer. If system switching occurs, communication is done with the new control system CPU module. • If the CPU module connected to GX Developer is the control system, communication is done with that CPU module. If the CPU module connected to GX Developer is the standby system, communication is done with the other system (the control system) via the tracking cable.	
Standby System	• Select this option to communicate with the standby system CPU module using GX Developer. If system switching occurs, communication is done with the new standby system CPU module. • If the CPU module connected to GX Developer is the standby system, communication is done with that CPU module. If the CPU module connected to GX Developer is the control system, communication is done with the other system (the standby system) via the tracking cable.	
System A	• Select this option to communicate with system A CPU module using GX Developer. If system switching occurs, communication continues with the new system A CPU module. • If the CPU module connected to GX Developer is system A, communication is done with that CPU module. If the CPU module connected to GX Developer is system B, communication is done with the other system (system A) via the tracking cable.	
System B	• Select this option to communicate with system B CPU module using GX Developer. If system switching occurs, communication continues with the new system B CPU module. • If the CPU module connected to GX Developer is system B, communication is done with that CPU module. If the CPU module connected to GX Developer is system A, communication is done with the other system (system B) via the tracking cable.	

6.1 Communication with GX Developer and PX Developer
6.1.1 Communication Methods with GX Developer

6.1.2 Confirming the Connection Target on GX Developer

The current communication target CPU module and the connection path can be confirmed on the following GX Developer window.

Display information for the connected system in monitor status
(control system/standby system and System A/System B).
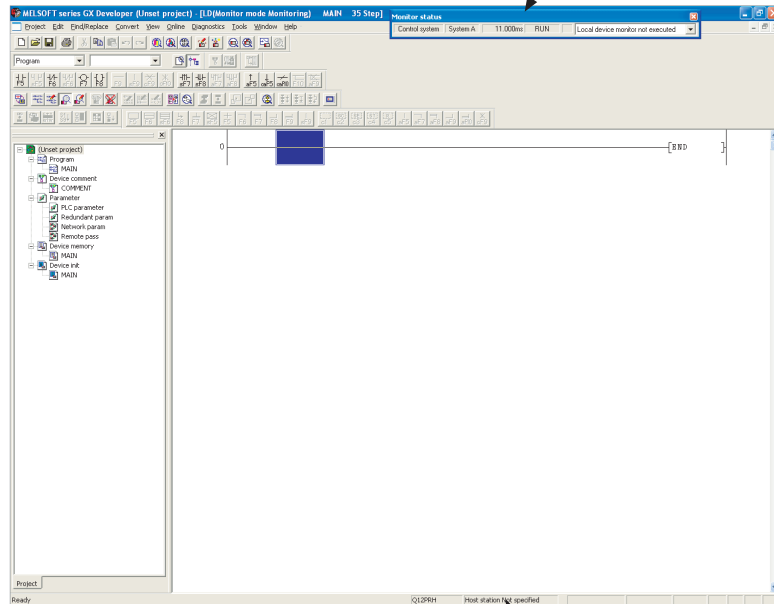
Display information for the system specified in connection settings
(control system/standby system and System A/System B).

Diagram 6.2 GX Developer Ladder Monitor Window

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6.1.3 Cautions on Access from GX Developer and PX Developer

This section describes cautions on access from GX Developer and PX Developer.

(1) Cautions when the System Connected to GX Developer/PX Developer and the Specified System are Different

(a) Communicating with a CPU Module via a Tracking Cable
When the system for the CPU module to which GX Developer/PX Developer is connected is different from the specified system, communication is done with the CPU module of the other system (specified system) via the tracking cable. (☞Table6.1)
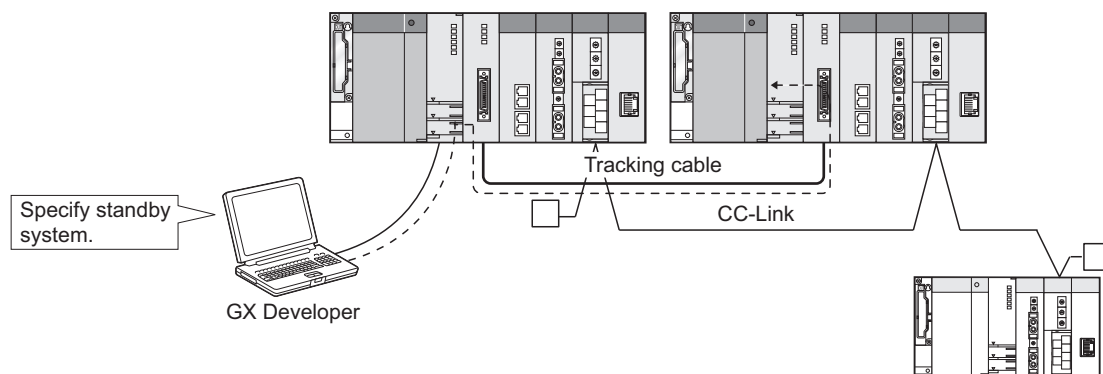
Diagram 6.3 Communication with CPU Module via Tracking Cable

(b) Accessing a Network Module via a Tracking Cable
Communication with a network module on the other system via a tracking cable is not available for GX Developer and PX Developer.
To communicate with a network module on the other system (e.g., network diagnosis of the other system), reconnect the GX Developer and PX Developer to the CPU module on the other system.
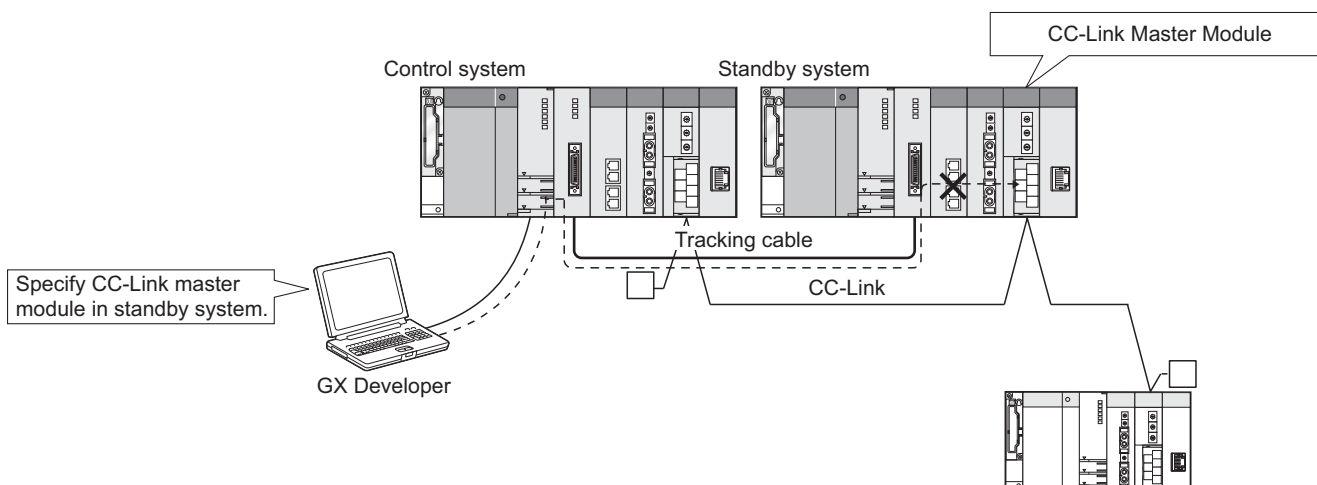
Diagram 6.4 Access to Network Module via Tracking Cable

(2) Corrective Action when a Line Down Occurs during Access via a Network

(a) In the case of other than monitoring

A communication error occurs when accessing to a module mounted on the extension base unit via the network using the function other than [Monitor] of GX Developer or PX Developer.

As for functions other than [Monitor] of GX Developer or PX Developer, change the connection destination at [Transfer setup] and retry the communication.

For MC protocol commands that can be used for communications made via a module on an extension base unit, refer to Appendix 8.

MELSOFT products connectable to a module mounted on the extension base unit are GX Works2, GX Developer, and PX Developer. However, there are restrictions on applicable functions. For details, refer to the following manuals.

☞ GX Works2 Version 1 Operating Manual (Common)

☞ GX Developer Version 8 Operating Manual

☞ PX Developer Version 1 Operating Manual (Programming Tool)

(b) In the case of monitoring

When a line down occurs during access via a network using PX Developer (monitoring tool), take the corrective action according to the system specified in the connection setup.

1) When "Not Specified" is Specified

A communication error occurs when "Not Specified" has been specified as the connection target using GX Developer or PX Developer (monitoring tool). Change the connection target in the connection set up of GX Developer or PX Developer (monitoring tool), and restart communication.

2) When "Control System", "Standby System", "System A", or "System B" is Specified

When "Control System", "Standby System", "System A", or "System B" has been specified as the connection target using GX Developer or PX Developer (monitoring tool), switch the connection path, and, communication will continue with the specified system.

[Example]

If a line down occurs in system A during access when PX Developer (monitoring tools) is connected to that system, and the connection target is specified as system A, communication is continued with system A via system B.
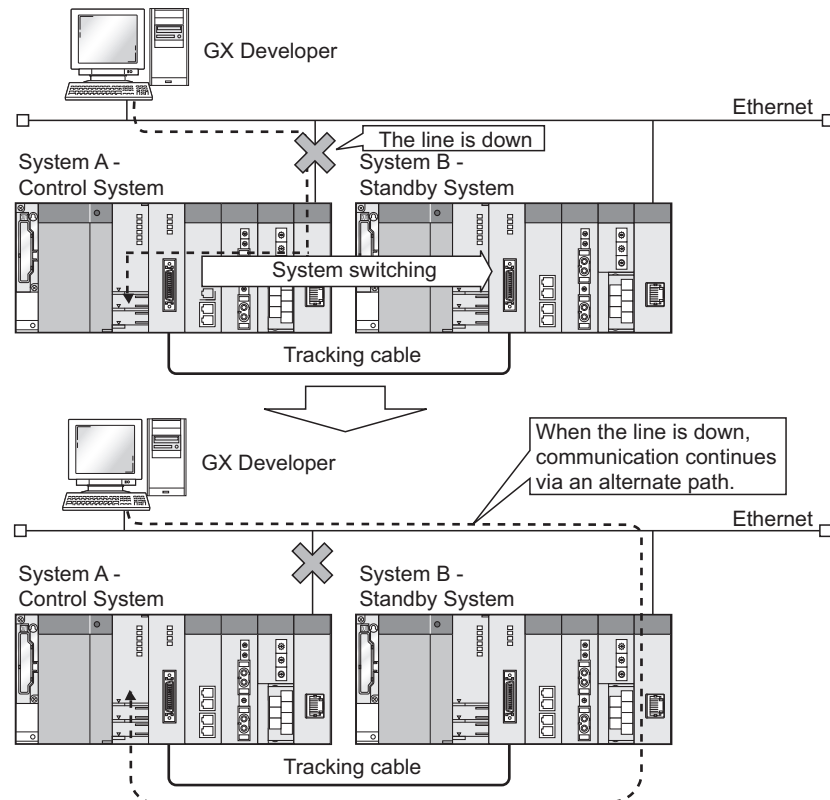
Diagram 6.5 Communication continuation through system switching

⊠POINT

Communication via a tracking cable is carried out when the route system's power supply is on, and the tracking cable is connected properly.
Communication via a tracking cable is not carried out in the following cases.

- When the route system's power supply is off
- When the route CPU module is reset
- When a watchdog timer error occurs in the route CPU module
- When the connected system's power supply is off
- When the connected CPU module is reset
- When a watchdog timer error occurs in the connected CPU module
- When the tracking cable is not connected or broken.

6.2 Redundant System Network Overview

The following networks can be redundant.
(Network modules must be mounted on the main base units.)

- CC-Link IE Controller Network
- MELSECNET/H PLC to PLC network
- MELSECNET/H Remote I/O network
- MELSECNET/10 PLC to PLC network [1]
- Ethernet
- MODBUS/TCP
- CC-Link
- MODBUS
- PROFIBUS-DP

  [1]: When connecting to MELSECNET/10 PLC to PLC network in redundant system, set
  MELSECNET/H to MELSECNET/10 mode. For details, refer to the following manual.

  ☞ Q Corresponding MELSECNET/H Network System Reference Manual
  (PLC to PLC network)

The above networks can continue the data link and communication with external devices, even when an error occurs in the control system.

However, the system is not switched when a communication error occurs in CC-Link and MODBUS. To switch the system, use the system switching instruction.

For details of each network, refer to the manual for the network used.

The network modules for networks other than the abovementioned and serial communication modules, etc., cannot be mounted on a main base unit for redundant system.

Mount them to the remote I/O station or extension base unit in the MELSECNET/H Remote I/O network.
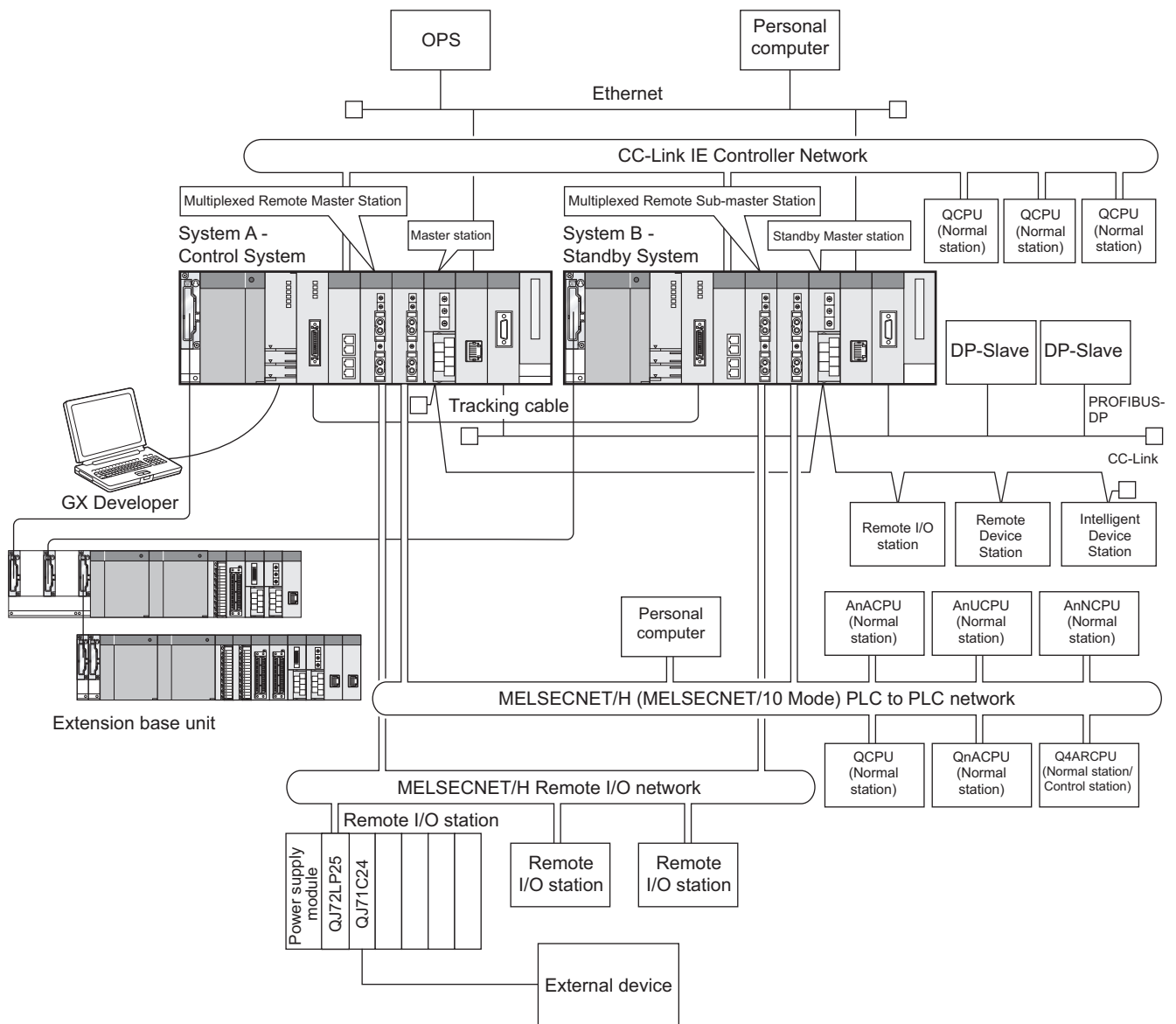
Diagram 6.6 Redundant System Network

6.2.1 CC-Link IE Controller Network or MELSECNET/H PLC to PLC network

In a redundant system, the data link is continued through system switching even when an error occurs in the control system or control system network.

(1) Overview of Communication between Control System and Standby System Network Modules

In a redundant system, the control system network module carries out cyclic data communication, as the control system and standby system form one system.
The standby system network module receives cyclic data from the other station in order to continue control even when system switching occurs.
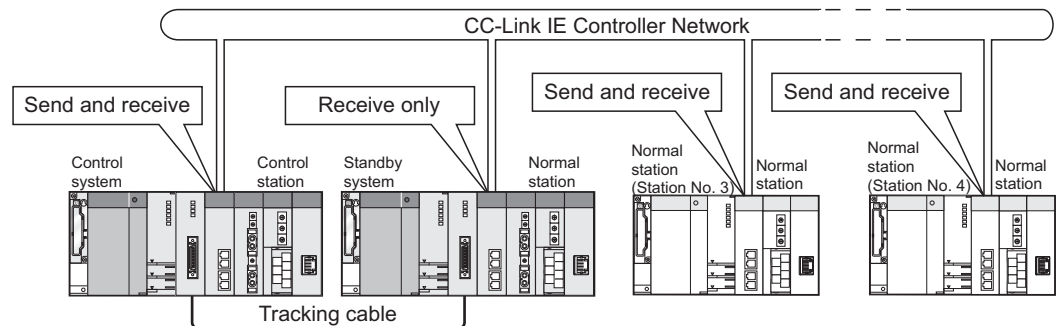
Diagram 6.7 Communication between Control System and Standby System Network Modules

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(2) Redundant System Operation at System Switching due to Control System Error

When system switching occurs due to a control system error, the data link is continued by the network module mounted on the new control system.

[Example]

Diagram 6.8 shows the redundant system operation when a stop error occurs in the control system CPU module, on the assumption that the control system network module is the control station of station No. 1, and the standby system network module is the normal station of station No. 2.
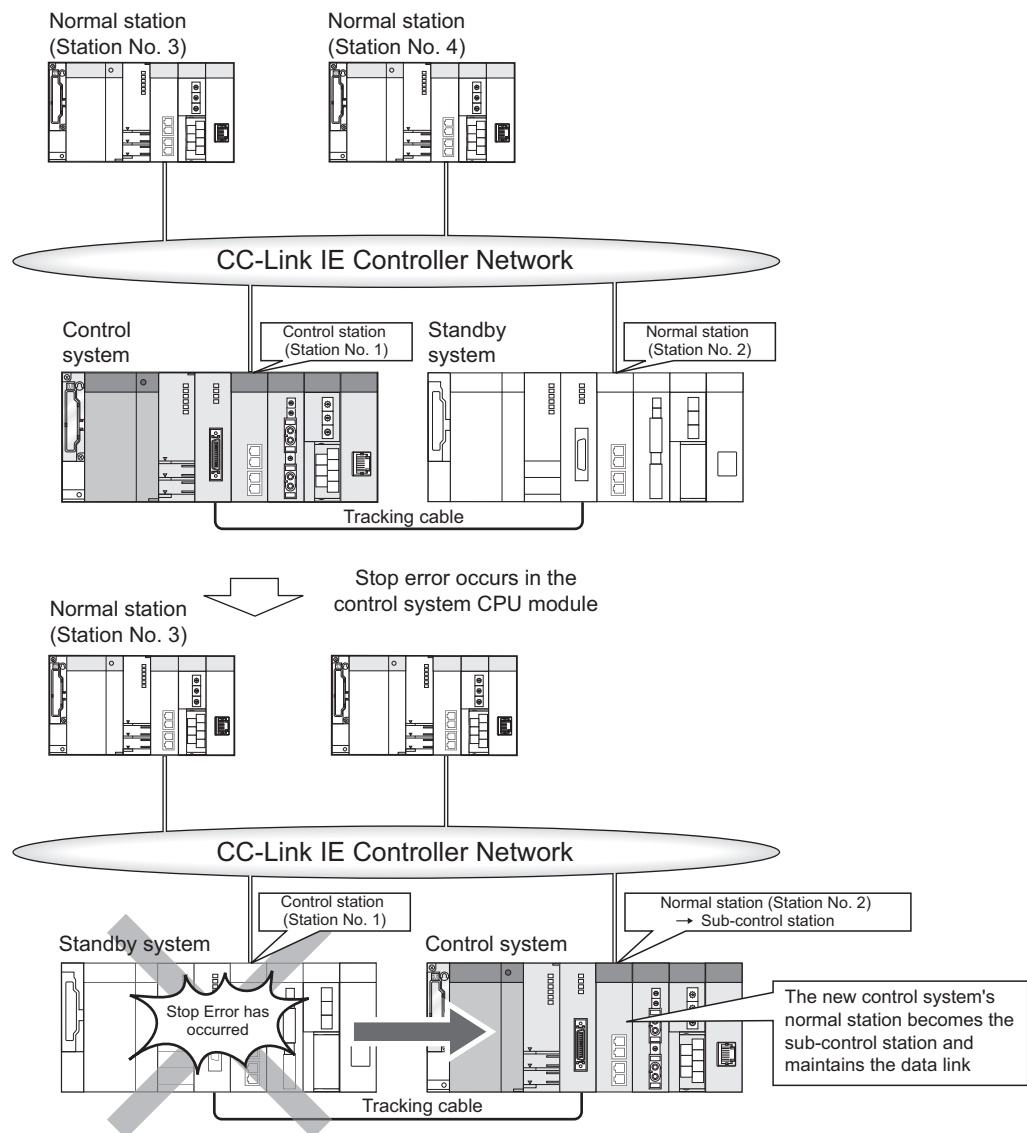
Diagram 6.8 Operation When System Switching Occurs Due to Control System Error

(3) Redundant System Operation when a Communication Error Occurs in CC-Link IE Controller Network or MELSECNET/H PLC to PLC Network

(a) Continuation of Data Link via System Switching

When a communication error occurs in CC-Link IE Controller Network or MELSECNET/H PLC to PLC network, system switching is performed according to the following procedure so that the data link will be continued.

1) When detecting a communication error, the control system network module issues a system switching request to the control system CPU module.

2) When receiving the system switching request from the network module, the control CPU module performs END processing.   Through the processing, system switching is performed.

3) After system switching is completed, the new control system network module continues the data link.
The standby system network module does not issue a system switching request even when a communication error occurs in CC-Link IE Controller Network or MELSECNET/H PLC to PLC network.

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[Example]

Diagram 6.9 shows the redundant system operation when the control system network module detects a communication error, on the assumption that the control system network module is the control station of station No.1, and the standby system network module is the normal station of station No. 2.
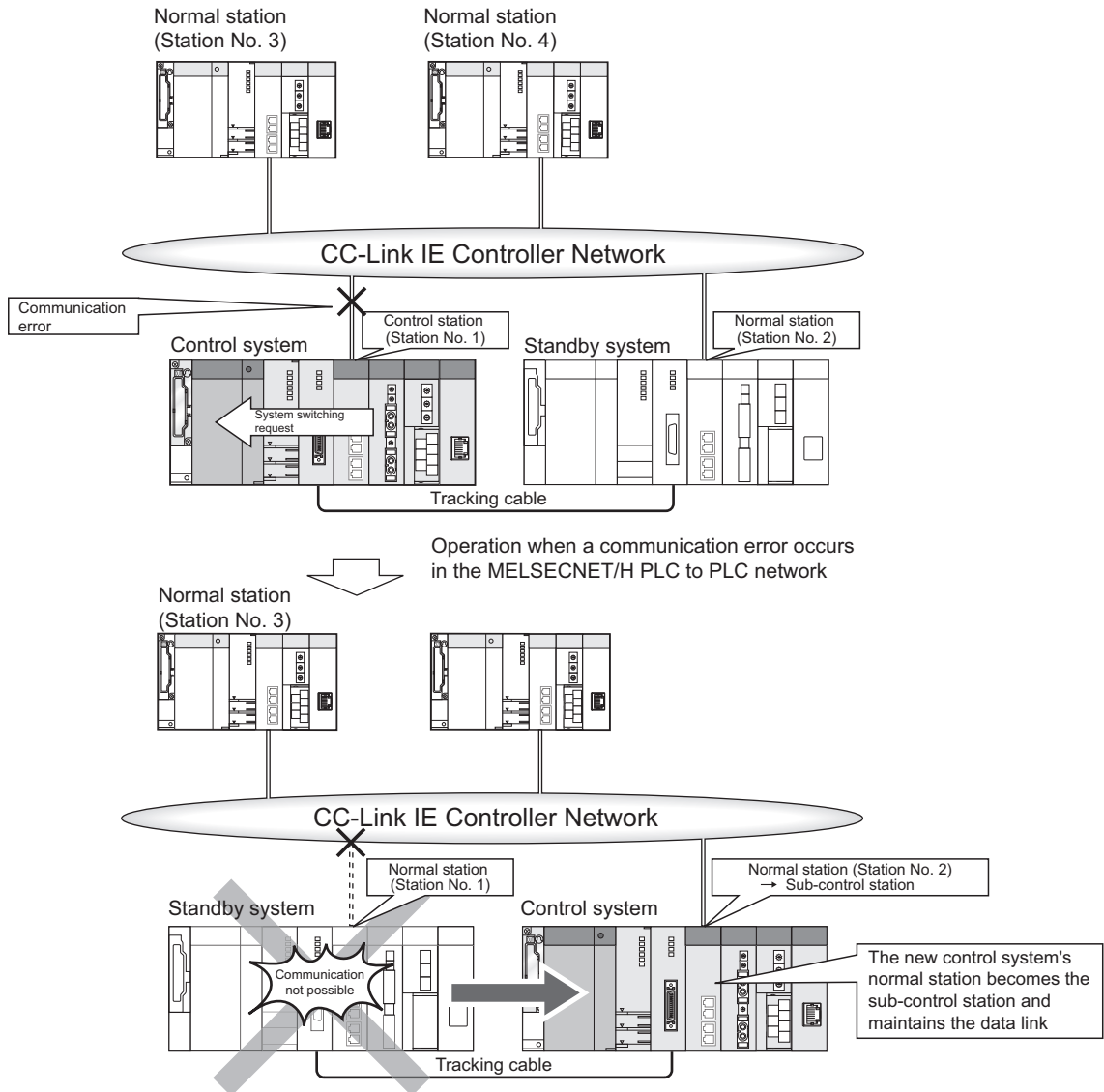
Diagram 6.9 Continuation of Data Link via System Switching

(b) Operation of New Standby System Network Module

The new standby system network module that has developed a communication error is cut off from the network.

When the network communication error is cleared, the new standby system network module is returned to the network as the normal station.

(4) Station No. Settings for the Network Module

Set the station Nos. for network modules mounted on system A and system B of a redundant system with consecutive numbers.

[Example]

If station No. 3 is set for system A network module, system B network module can be set as station No. 2 or station No. 4.
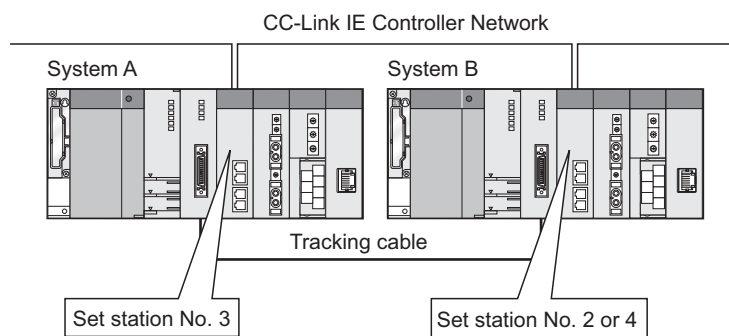
Diagram 6.10 Station No. settings for the network module

(5) Network Parameter Settings

The "host transmission ranges" of the network modules of system A and system B must be identical by making the pairing settings, as the systems form a redundant system.

For the control stations of network systems connected to a redundant system, make sure to make the pairing settings for the station Nos. of the network modules of system A and system B in the network parameter settings.[1]
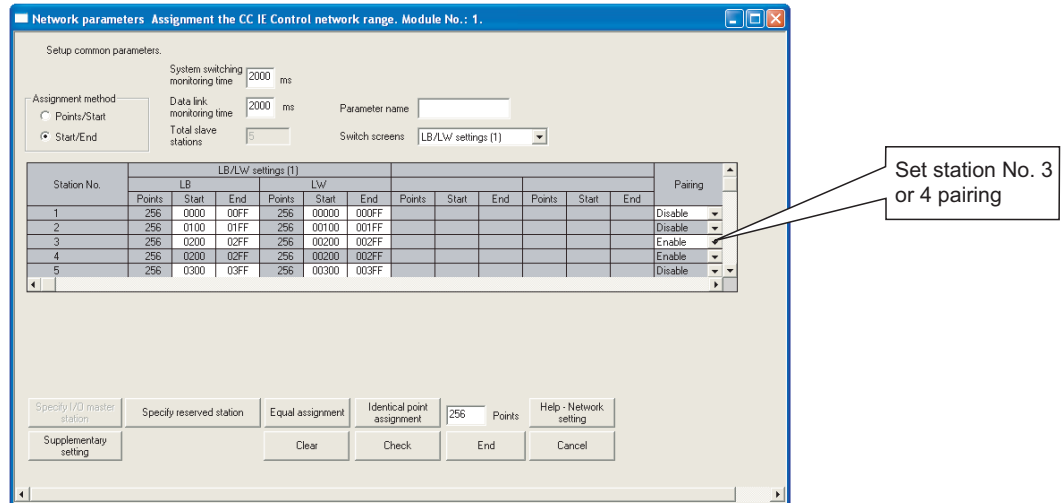
Diagram 6.11 Network Parameter Settings

* 1 : In the debug mode, the CPU module uses the parameters for system A to operate. Therefore, the station set as system B in the network parameters becomes absent station (disconnected station).

Refer to the following manual, for network parameters.

☞ MELSEC-Q CC-Link IE Controller Network Reference Manual

☞ Q Corresponding MELSECNET/H Network System Reference Manual

(PLC to PLC Network)

Pairing settings can be made for the following CPU modules that can work as the control station.

- Redundant CPU [1]
- High performance model QCPU [1]
- Process CPU [1]
- Basic model QCPU [1]
- Universal model QCPU [1]
- Q4ARCPU [1] [2]

When connecting a redundant system to the network that includes the CPU module other than above, for which control station network parameters have been set, change the system A or system B of the redundant system to the control station.
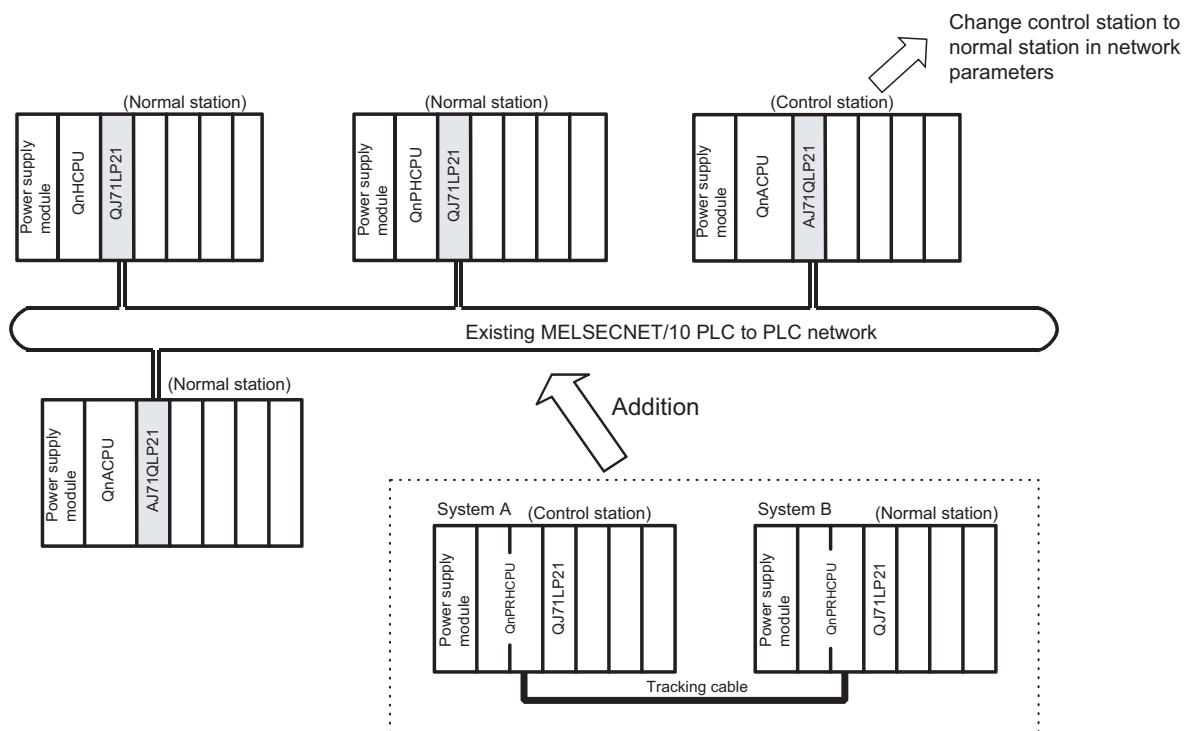
Diagram 6.12 Changing the Control Station When Adding Redundant System

* 1 : Refer to Section 2.3, for GX Developer that supports a redundant system (including pairing settings).
* 2 : The pairing settings cannot be made with the Q4ARCPU in the CC-Link IE Controller Network.

(6) Startup Order of System A and System B

No restrictions apply to the startup order of system A and system B when connected to the CC-Link IE Controller Network or MELSECNET/H PLC to PLC network.
After starting up system A and system B, the control system and standby system are determined, and then the data link is continued.

(7) Precautions for Using Redundant System in CC-Link IE Controller Network or MELSECNET/H PLC to PLC Network

(a) Programming of CC-Link IE Controller Network or MELSECNET/H
CC-Link IE Controller Network or MELSECNET/H network detects a temporary communication error depending on conditions such as power supply ON/OFF or cable and noise.
Create the program using CC-Link IE Controller Network or MELSECNET/H so that it will not stop controlling even when the temporary communication error is detected.

(b) Error detection by turning ON/OFF other station (including standby system)
When turning ON/OFF power supply of the other station (including standby system) CPU module or booting and shutting down the personal computer where CC-Link IE Controller Network interface board or MELSECNET/H board is mounted, CC-Link IE Controller Network module or MELSECNET/H module of the control system may issue a system switching request, detecting a temporary communication error.
When the above-mentioned system switching request is issued before the standby system is started up, a continuation error "CAN'T SWITCH" may be detected in the control system CPU module. In this case, control can be continued normally. Therefore, create the program so that control will not be stopped due to error detection.
For canceling the error "CAN'T SWITCH", refer to Section 8.1.16.
For details of CC-Link IE Controller Network or MELSECNET/H, refer to the following manual.
☞ MELSEC-Q CC-Link IE Controller Network Reference Manual
☞ Q Corresponding MELSECNET/H Network System Reference Manual
(PLC to PLC network)

(c) Usage in debug mode when CC-Link IE Controller Network modules are mounted
When CC-Link IE Controller Network modules are mounted, do not connect CC-Link IE Controller Network module on both systems to the network at the same time.
In the debug mode, the system B CPU module uses the same parameters for the system A CPU module for operation. Therefore, control station overlap and station number overlap occur when connecting to the network at the same time.

6.2.2 MELSECNET/H Remote I/O network

A redundant system uses a multiplexed remote I/O system of MELSECNET/H remote I/O network to continue the control of remote I/O stations even when system switching occurs. The multiplexed remote I/O network system consists of "multiplexed remote master station" that controls remote I/O stations, and "multiplexed remote sub-master stations" that is for backup of multiplexed remote master station.

In a redundant system, make sure to set system A as the multiplexed remote master station, and system B as the multiplexed remote sub-master station.

(1) Overview of Remote I/O Stations

The control system network module (multiplexed remote master station) performs data control with remote I/O station by data transmission, and data transmission with the multiplexed remote sub-master station.

The standby system network module (multiplexed remote sub-master station) receives data from remote I/O stations and sends/receives data to/from the multiplexed remote master station in order to take over the control of remote I/O stations even when system switching occurs.
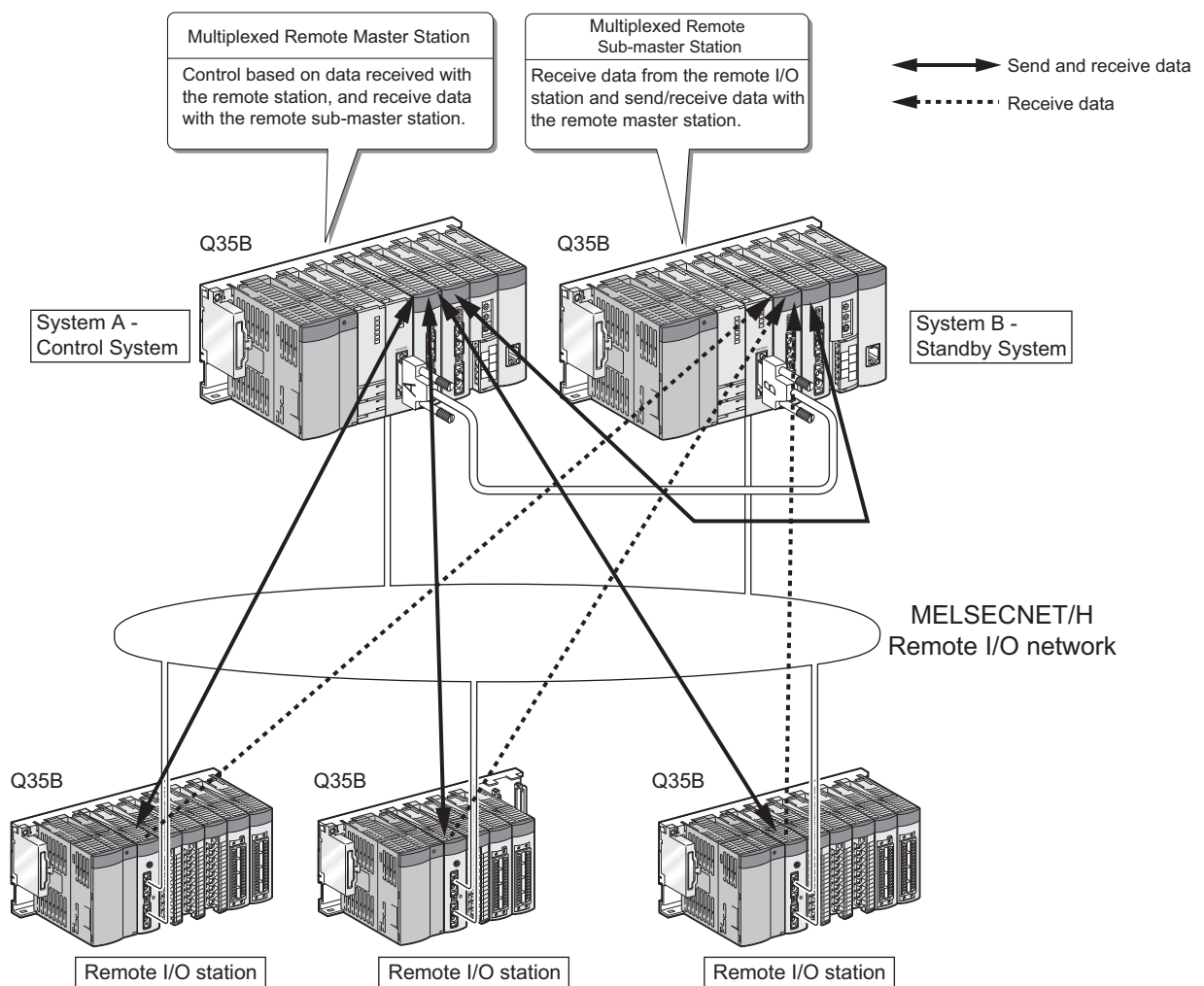
Diagram 6.13 Overview of Remote I/O Station

(2) Redundant System Operation at System Switching

When system switching occurs, the new control system network module operates as the master station, and takes over the control of remote I/O stations.

Diagram 6.14 shows a redundant system operation when a stop error occurs in the control system CPU module.

Multiplexed Remote Master Station (station No. 0)

Multiplexed Remote Sub-master Station (station No. 1)

Control system

Standby system

Tracking cable

MELSECNET/H Remote I/O network

Remote I/O station (station No. 2)

Remote I/O station (station No. 3)

Multiplexed Remote Master Station (station No. 0) → Stop

Multiplexed Remote Sub-master Station (station No. 1) → Master station

Control system → Standby System

Standby system → Control System

1) Stop Error has occurred

2) Perform system switching

Tracking cable

MELSECNET/H Remote I/O network

Remote I/O station (station No. 2)

Output is preserved during system switching

Remote I/O station (station No. 3)

Output is preserved during system switching

Diagram 6.14 Redundant System Operation at System Switching

(3) Redundant System Operation when a Communication Error Occurs in the MELSECNET/H Remote I/O Network

(a) System Switching Procedure

When a communication error occurs in the MELSECNET/H remote I/O network, system switching is performed according to the following procedure, so that the data link will be continued.

1) When a communication error occurs in the MELSECNET/H remote I/O network, the control system network module issues a system switching request to the control system CPU module.

2) When receiving the system switching request from the network module, the control system CPU module performs END processing. Through the processing, system switching is performed.

3) After system switching is completed, the new control system network module continues the data link.

(b) Output Status during System Switching

The remote I/O station's output is held during system switching.

[Example]

Diagram 6.15 shows the redundant system when the control system network module detects a communication error, on the assumption that the control system network module is the master station, and the standby system network module is the sub-master station.
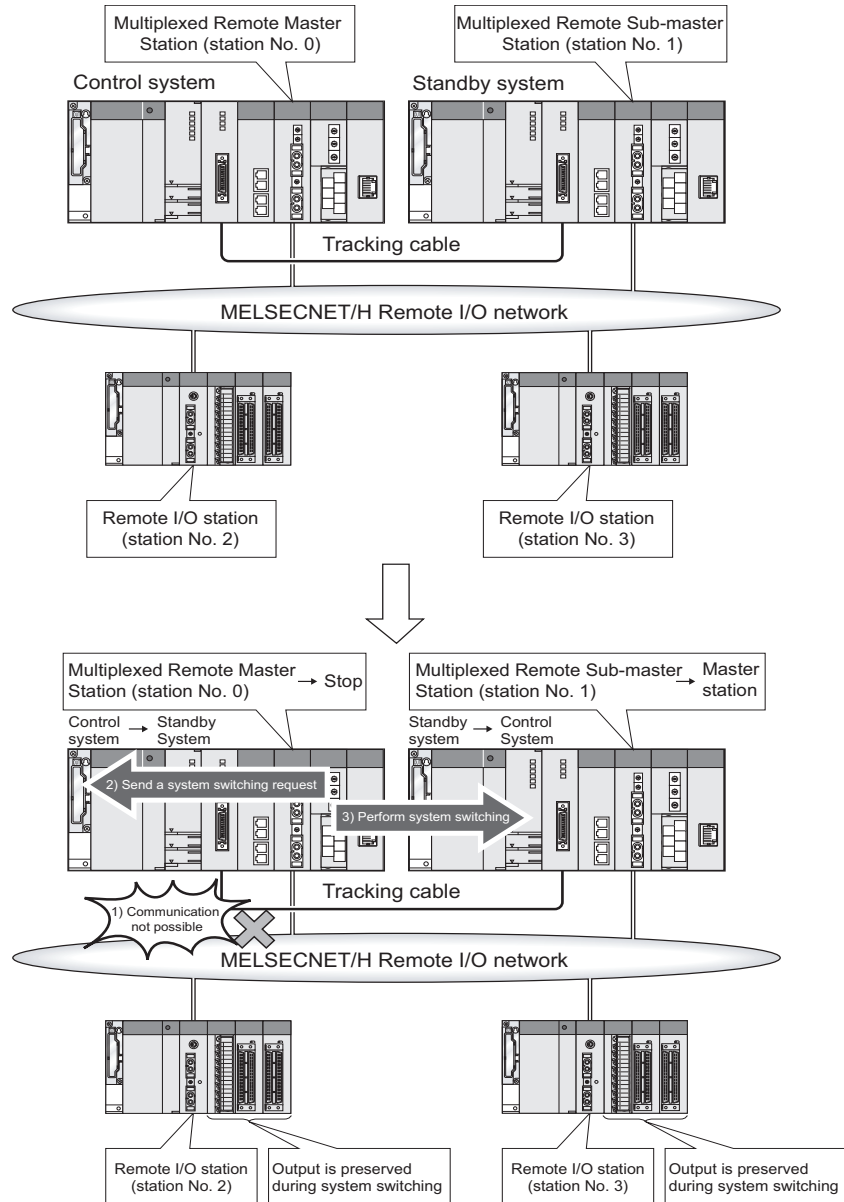
Diagram 6.15 Output Status during System Switching

6 **REDUNDANT SYSTEM NETWORKS**

MELSEC Q series

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(4) Network Module Station No. Settings

Set station No. 0 (multiplexed remote master station) for the network module which is mounted on system A.

Set any of station No. 1 to 64 for the network module that is mounted on system B.

If the network module mounted on system B is set to station No. 0, the "LINK PARA.ERROR (error code: 3101)" stop error will occur.
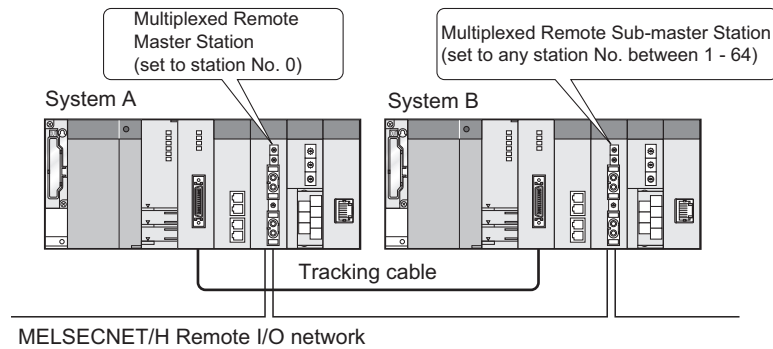
Diagram 6.16 Network Module Station No. Settings

(5) Network Parameter Settings

In the network parameters for system A and system B, set the network type identically as "MNET/H (multiplexed remote master)".[1]

Select MNET/H (Multiplexed remote master)
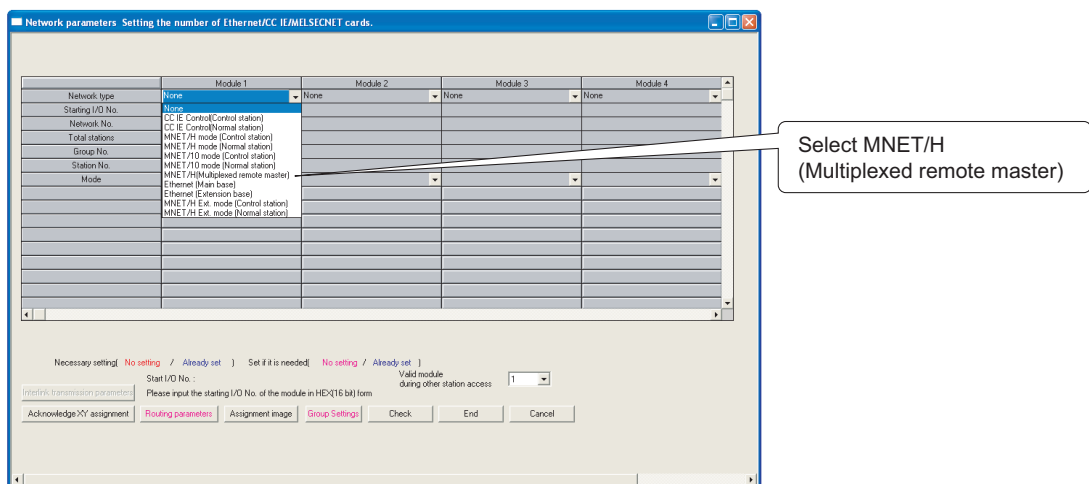
Diagram 6.17 Network parameter Setting the number of Ethernet/CC IE/MELSECNET cards

* 1 : In the debug mode, the CPU module uses the parameters for system A to operate. Therefore, the station set as system B in the network parameters becomes absent station (disconnected station).

Refer to the following manual for network parameters.

☞ Q Compatible MELSECNET/H Network System Reference Manual
(Remote I/O Network)

(6) Startup Order of System A and System B

No restrictions apply to the startup order of system A and system B when connected to the MELSECNET/H remote I/O network.

After starting up system A and system B, the control system and standby system are determined, and then the data link is started.

(7) Checking the Standby System Operating Status

After power-ON, the status of a MELSECNET/H module on the standby system can be checked with the following link special relays (SB) on the control system CPU module side.

- SB75: Remote master station cyclic transmission status
- SB76: Remote sub-master station cyclic transmission status

When both of the above link special relays (SB) are OFF, the MELSECNET/H module on the standby system is running normally.

(8) Detecting Configuration Mismatch for the Remote I/O Station in the Master Station and Sub-master Station

When a disconnection occurs in the system connected to the MELSECNET/H multiplexed remote I/O network, the accessible remote I/O stations might be different between the control system (master station) and standby system (sub-master station). In this case, as control cannot be continued after system switching, the "UNIT LAY. DIFF. (error code: 6036)" stop error (specific to the standby system in the backup mode) occurs in order to prevent system switching.

The abovementioned operation, i.e., checking whether the accessible remote I/O stations for the master station and sub-master station are identical, is called the "network separation check".

The "UNIT LAY. DIFF" occurs in the MELSECNET/H multiplexed remote I/O network that uses optical cables, when a disconnection occurs simultaneously at the following locations.

• Between the master station and sub-master station
• Other than above location

In the diagram below, the "UNIT LAY. DIFF" occurs when a disconnection occurs simultaneously at point A and any of point B to D.
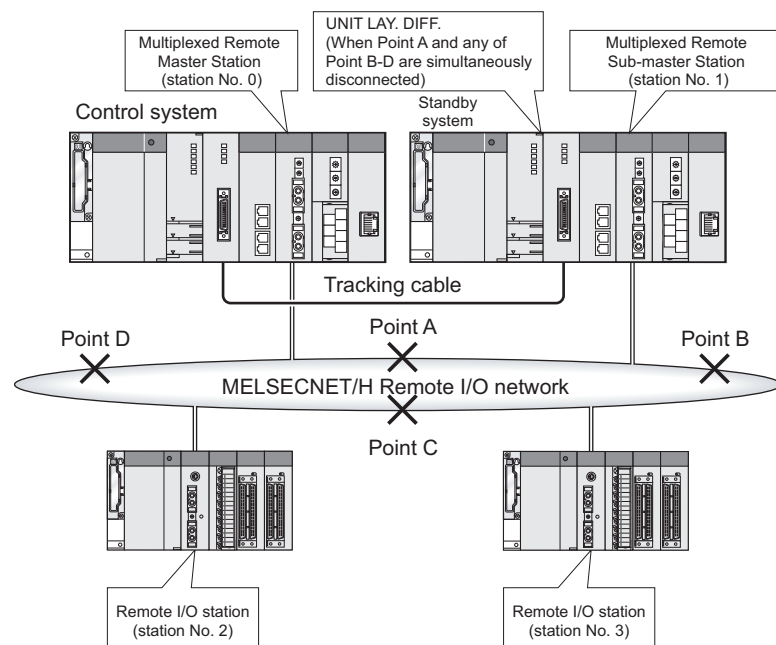
Diagram 6.18 Error Detection at Cable Disconnection

Table6.2 lists the transmission possibilities when a disconnection occurs at Point A only and when a disconnection occurs simultaneously at Point A and Point C.

Table6.2 Transmission Possibilities when Disconnection Occurs at Point A and Point C

	At Point A Only		At Points A and C	
	System A CPU Module	System B CPU Module	System A CPU Module	System B CPU Module
1 Station	○	○	×	○
2 Stations	○	○	○	×
3 Stations	○	○	×	○

○:Possible, ×:Not Possible

(9) Operation Mode Setting for Error Occurrence

For Redundant CPUs and MELSECNET/H remote I/O stations, the operation mode for occurrence of "fuse blown" and "module verify error" can be preset in PLC RAS settings in PLC parameter.[2]
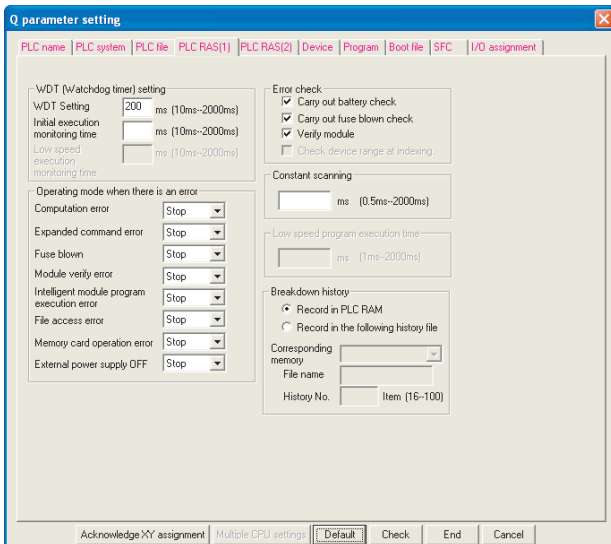
Diagram 6.19 In the case of Redundant CPU
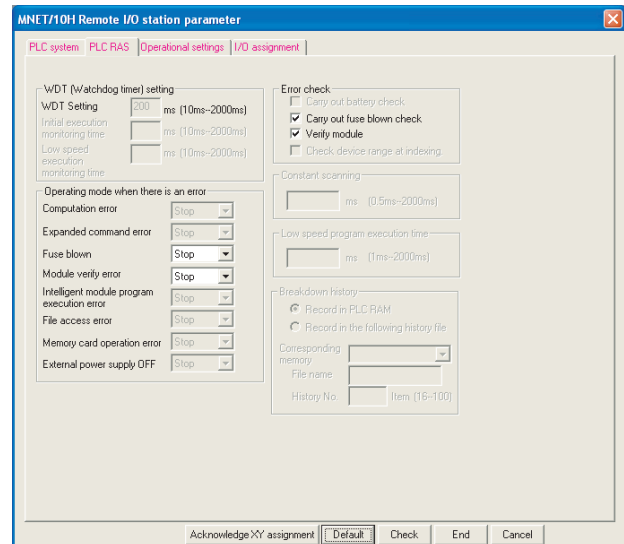
Diagram 6.20 In the case of Remote I/O Station

Different error-time operation modes can be set to the Redundant CPU (remote master station) and remote I/O station.

When an error (fuse blown or module verify error) occurs in a Redundant CPU (remote master station) and a remote I/O station, the data link and output of the remote I/O station is determined by the combination of the error-time operation mode settings of the Redundant CPU (remote master station) and remote I/O station. The following describes the data link and output status of the remote I/O station determined by the combination of the parameter settings.

(a) Operation when error occurs in Redundant CPU (remote master station)

Table6.3 Operation When Error Occurs in Redundant CPU (Remote Master Station)

Settings of operation mode for error occurrence		Redundant CPU control status	Data link operation of MELSECNET/H remote I/O network	Output operation from remote I/O station
Redundant CPU	Remote I/O station			
Stop	Stop	Stops control. (Stop error)	All stations stop data link.	Depends on the output mode hold/clear settings for error occurrence.[3]
	Continue			
Continue	Stop	Continues control. (Continue error)	All station continue data link.	All stations output normally.
	Continue			

* 2 : Refer to the following manual for details of the PLC RAS setting.

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

* 3 : Set the output mode for error occurrence in the I/O assignment detailed setting of the PLC parameter dialog box.
Refer to the following manual for details of the I/O assignment detailed setting.

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

(b) Operation when error occurs in remote I/O station

Table6.4 Operation When Error Occurs in remote I/O station

Settings of operation mode for error occurrence		Redundant CPU control status	Data link operation of MELSECNET/H remote I/O network	Output operation from remote I/O station
Redundant CPU	Remote I/O station			
Stop	Stop	Stops control. (Stop error)	All stations stop data link.	Depends on the output mode hold/clear settings for error occurrence.[4]
	Continue			
Continue	Stop	Continues control. (Continue error)	All stations continue data link.	The output of the faulty station follows the hold/clear setting in the error-time output mode.[4] All stations output normally.
	Continue			All stations output normally.

* 4 : Set the output mode for error occurrence in the I/O assignment detailed setting of the PLC parameter dialog box.
Refer to the following manual for details of the I/O assignment detailed setting.
☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

(10)Precautions for Using Redundant System in MELSECNET/H Remote I/O Network

(a) Programming of MELSECNET/H
The MELSECNET/H network detects a temporary communication error depending on conditions such as power supply ON/OFF or cable and noise. Create the program using the MELSECNET/H so that it will not stop controlling even when the temporary communication error is detected.

(b) Error detection by turning ON/OFF other station (including standby system)
When turning ON/OFF power supply of the other station (including standby system) CPU module or booting and shutting down the personal computer where the MELSECNET/H board is mounted, the MELSECNET/H module of the control system may issue a system switching request, detecting a temporary communication error.
When the above-mentioned system switching request is issued before the standby system is started up, a continuation error "CAN'T SWITCH" may be detected in the control system CPU module. In this case, control can be continued normally. Therefore, create the program so that control will not be stopped due to error detection.
For canceling the error "CAN'T SWITCH", refer to Section 8.1.16.
For details of the MELSECNET/H network system, refer to the following manual.
☞ Q Corresponding MELSECNET/H Network System Reference Manual
(PLC to PLC network)

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6.2.3 Ethernet

External devices use MC protocol, fixed buffers, random access buffers, data link instructions, etc. to communicate with the CPU modules of a redundant system.

Partner products including EZ Socket[1] can also communicate with them through OPS connection.

Refer to the following manual below for details.

☞ Q-Corresponding Ethernet Interface Module User's Manual (Basic)

* 1: Indicates the FA communication middleware for programmable controllers, servos, robots, NC, etc. made by Mitsubishi Electric, which consists of the Windows[®] API (Application Programming Interface). By using EZ Socket, each partner company can easily develop FA-related application software using FA devices made by Mitsubishi Electric, which operate on Windows[®] personal computers.

⊠ **POINT**

Ethernet module can be mounted to the main base unit or extension base unit. Note that dedicated instructions cannot be used when it is mounted to the extension base unit. When using dedicated instructions, mount it to the main base unit.

The control system Ethernet module can issue a system switching request to the control system CPU module when it detects a communication error or disconnection*[2].

System switching is carried out when the control system CPU module receives the system switching request from that Ethernet module.

The system switching request can be set to be issued or not in the network parameters, as indicated in (3).

OPS

Communications error occurred

System A - Control System   System B - Standby System

System switching request

OPS

System A - Control System   System B - Standby System

Communication not possible
(malfunction, severed cable)
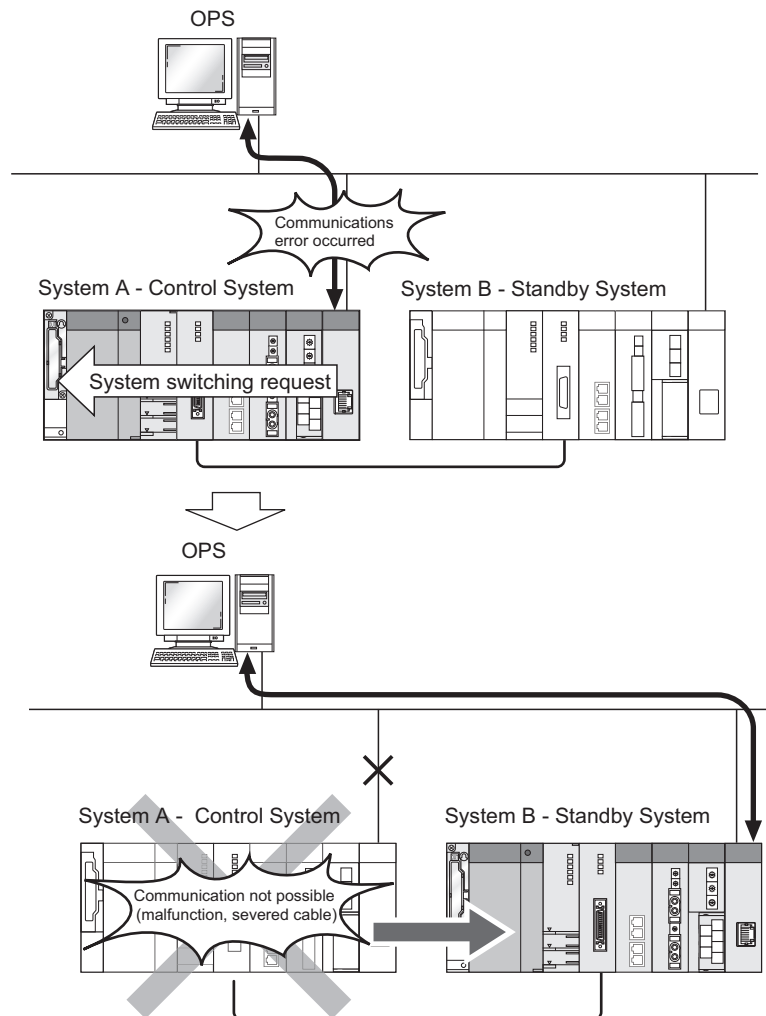
Diagram 6.21 Operation when a communication error or disconnection is detected

* 1: Only the QJ71E71-100 can detect disconnection.

Remark •

A system switching request is not issued when Ethernet interface module is mounted to the extension base unit.

• •

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(1) Overview of Communication with External Devices

(a) Communication by MC Protocol, and Data Link Instructions
For MC protocol, external devices can communicate with the specified system, i.e., control system, standby system, system A, or system B.

(b) Communication by Fixed Buffers and Random Access Buffers
For fixed buffers and random access buffers, external devices can communicate with the control system Ethernet module only, as processing via sequence programs is necessary.

(2) External Device Operation at System Switching
When system switching occurs in a redundant system, external devices operate differently according to the communication method.

(a) In the case of OPS connection
When system switching occurs in a redundant system, the OPS automatically switches the connection path, and continues the communication.

[Example]
Diagram 6.22 shows the external device operation when the control system Ethernet module detects a communication error.
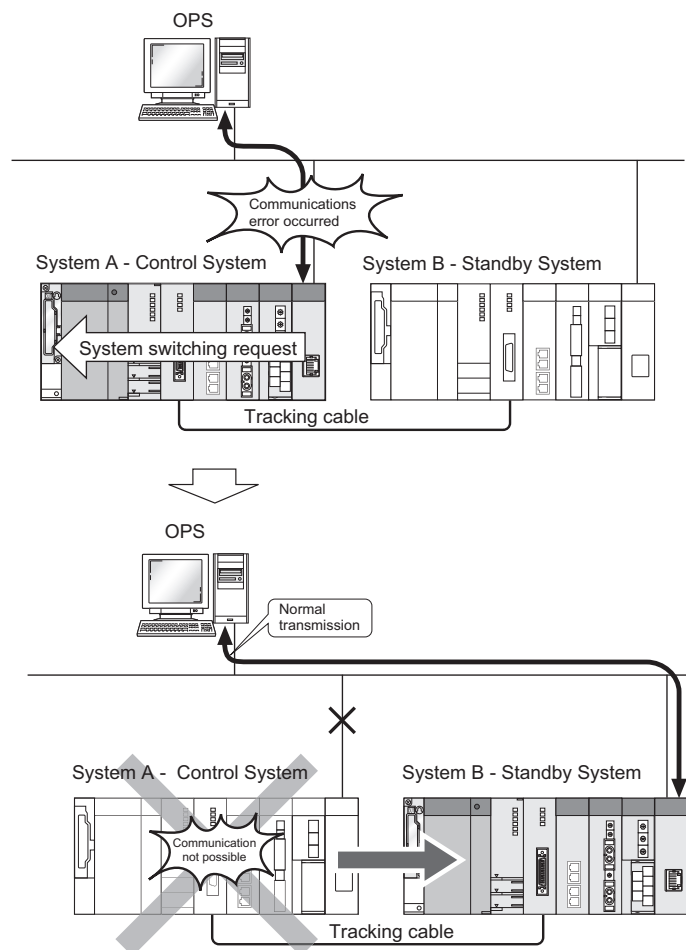
Diagram 6.22 Operation at Communication Error Detection

(b) Communication with the Control System/Standby System by MC Protocol or Data Link Instructions

Even when system switching occurs in a redundant system, communication can be continued if the communication path is normal.

When the communication cannot be continued the external device develops a communication error. In this case, review the communication path and restart the communication.

(c) Communication other than above

When system switching occurs in a redundant system, the external device develops a communication error occurs.

In this case, review the communication path and restart the communication.

(3) Network Parameter Settings

IP address, station No., and mode of Ethernet are set in [Redundant settings] of the network parameter in the redundant system.

(a) When mounting to the main base unit

When mounting to the main base unit, set [Network type] as [Ethernet (Main base)].

(b) When mounting to the extension base unit

When mounting to the extension base unit, set [Network type] as [Ethernet (Extension base)].

Write the set network parameters to the CPU modules of System A and System B.[1]
Refer to the following manual, for network parameters.

☞Q Corresponding Ethernet Interface Module User's Manual (Basic)
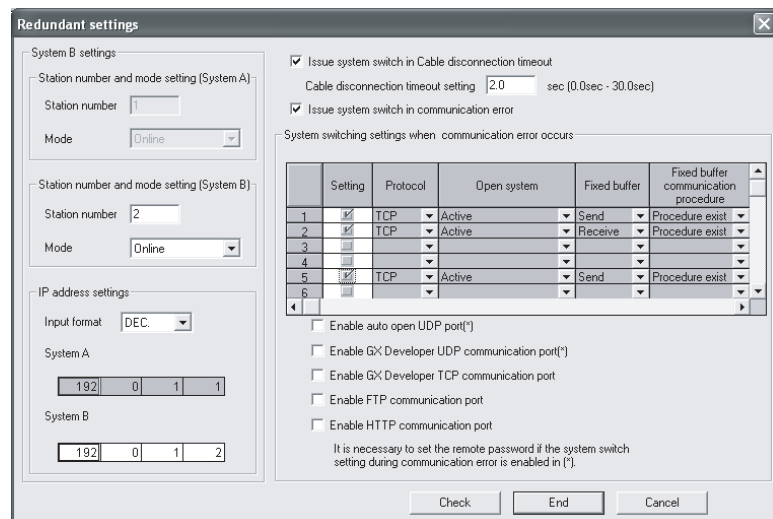
Diagram 6.23 Network Parameter Setting Window

* 1 : In the debug mode, the CPU module uses the parameters for system A to operate. Therefore, the station set as system B in the network parameters becomes absent station (disconnected station).

(4) System Startup Order

No restrictions apply to the startup order of system A and system B when connected to the Ethernet.

6.2.4 MODBUS/TCP

The transmission lines can be redundant by mounting MODBUS/TCP modules (slave function) on the main base units where the Redundant CPUs are mounded.
When the lines do not need to be redundant or using MODBUS/TCP modules as master stations, mount them on an extension base unit.
When any of following is occurred, a system switching request is issued.

- Ethernet cable disconnection detection
- Communication error with the MODBUS/TCP device
- Communication error with GX Developer

MODBUS/TCP master device

Communications
error occurred

System A - Control System

System switching request

MODBUS/TCP slave

System B - Standby System

MODBUS/TCP slave

MODBUS/TCP master device

System A - Standby System

Communication not possible
(malfunction, severed cable)

MODBUS/TCP slave

System B - Control System

MODBUS/TCP slave
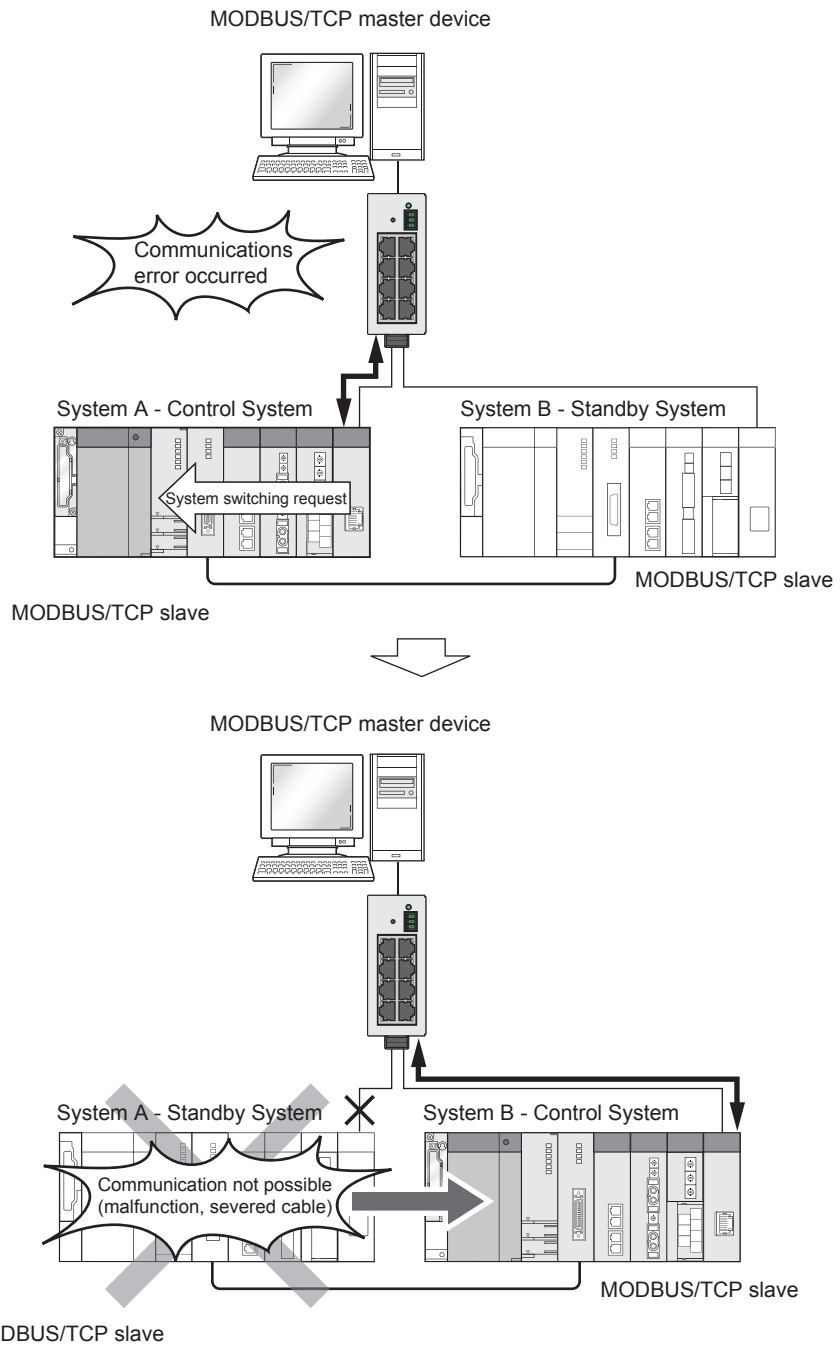
Diagram 6.24 Operation When a Communication Error or Disconnection is Detected

Remark

The systems are switched also when the redundant CPU detects an error in the control system.

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(1) System switching request to the control system CPU module

This function issues a system switching request to the control system CPU module if the QJ71MT91 mounted on the main base unit in a redundant system detects a communication error or disconnection.

MODBUS/TCP master device
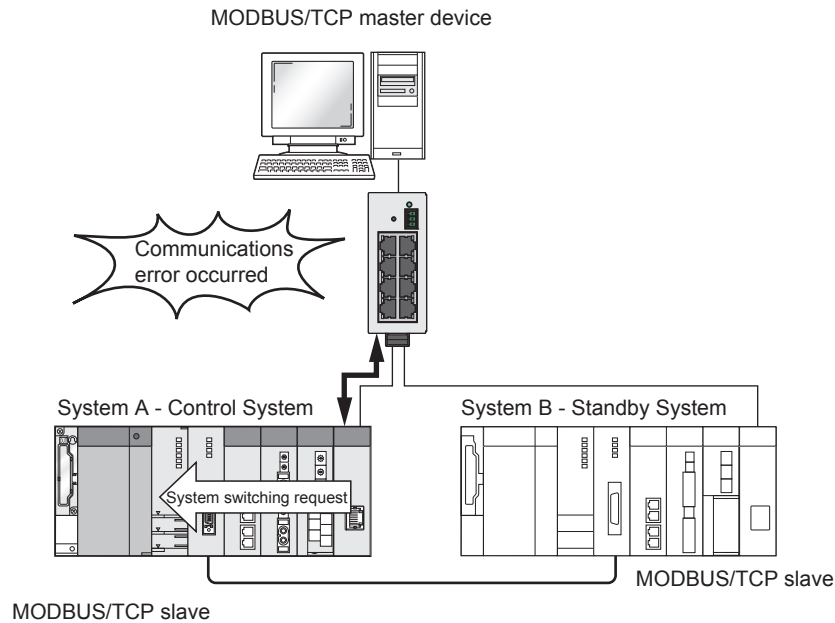
Diagram 6.25 System Switching Request to the Control System CPU Module

(2) Conditions under which a system switching request is issued

The QJ71MT91 issues a system switching request when the following conditions are satisfied.

Table6.5 System Switching Request Issuing Conditions

Condition		Description
• Communication error with the MODBUS/TCP device[1] • Communication error with GX Developer	KeepAlive timeout	After communications started, the existence of the target device cannot be confirmed.
	ULP timeout	An ACK response is not returned from the target device within the TCP ULP timer time.
Ethernet cable disconnection detection		The cable connected to the QJ71MT91 is disconnected, or the connection target device is powered off.

* 1: Applicable only when the slave function (automatic response function) is used.

☒POINT

- When the standby system has already been in error status, a system switching is not performed even if the QJ71MT91 issues a system switching request.
- Conditions under which a system switching request is issued are set using switch 5 (redundant settings) of the intelligent function module switch setting.

(3) System switching request operation due to communication error

The QJ71MT91 monitors communications with the target device for an error using a KeepAlive and TCP ULP timer.

(a) System switching timing when a KeepAlive is used

When the QJ71MT91 has not communicated with the target device where a TCP connection is open for a certain period of time, it sends a KeepAlive ACK message. If a response message is not returned from the target device, the QJ71MT91 detects a communication error and issues a system switching request to the control system CPU module.

[Example]

When KeepAlive resent count is two.
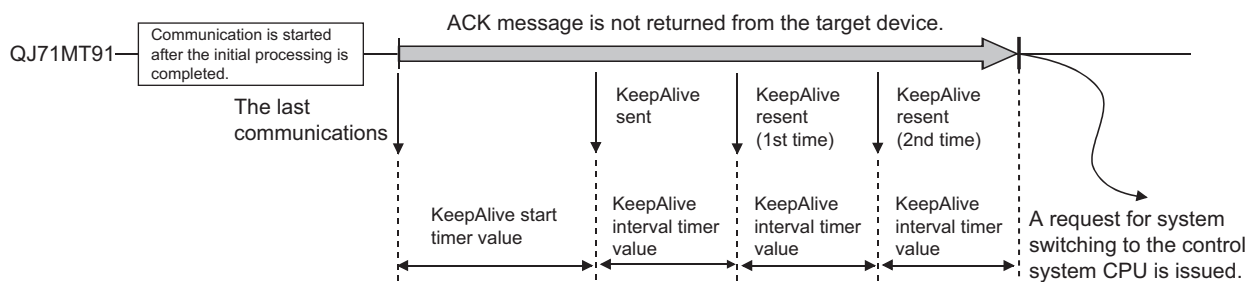
Diagram 6.26 System Switching Timing When a KeepAlive is Used

⊠POINT

For the setting method of KeepAlive, refer to the following.

☞MODBUS/TCP Interface Module User's Manual

(b) System switching timing when a ULP timeout is used

When ACK is not returned from the target device after the data has been sent from the QJ71MT91, data will be resent according to the setting value of the TCP resend timer until after time of the TCP ULP timer value has passed. If ACK is not returned from the target device within the TCP ULP timer time, the QJ71MT91 detects a communication error and issues a system switching request to the control system CPU module.
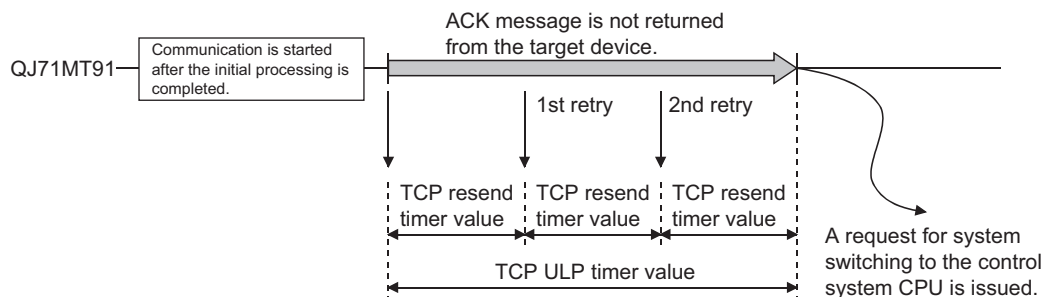
Diagram 6.27 System Switching Timing When a ULP Timeout is Used

⊠POINT

For the setting method of TCP ULP timer and TCP resend timer value, refer to the following.

☞MODBUS/TCP Interface Module User's Manual

(4) System switching request operation upon disconnection detection

The QJ71MT91 mounted on the control system CPU module monitors the connection status of the Ethernet cable connected to the QJ71MT91, and on detection of disconnection, it issues a system switching request to the control system CPU module.

(a) Conditions upon disconnection detection

Disconnection is detected in the following cases.

- Disconnection between the QJ71MT91 and a hub
- Ethernet cable removal from the hub side connector
- Hub power-off
- Ethernet cable removal from the QJ71MT91 side connector

(b) Disconnection detection timing

The QJ71MT91 starts disconnection detection after initial processing completion. On detection of disconnection, the QJ71MT91 performs a disconnection status time check, and when the disconnected status exceeds the disconnection detection time set using the switch 5 (redundant settings) of the intelligent function module switch setting, the QJ71MT91 issues a system switching request to the control system CPU module. When the disconnected status returns to normal within the disconnection detection time, the QJ71MT91 does not issue a system switching request.
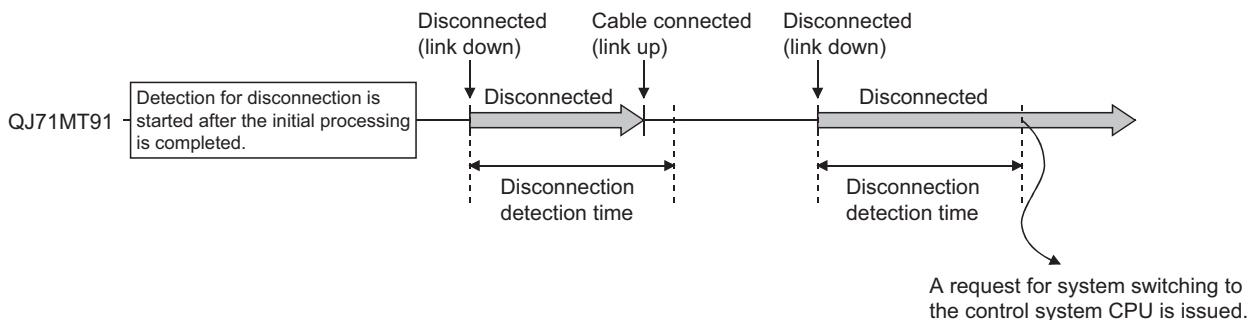
Diagram 6.28 System Switching Timing at Disconnection Detection

⊠POINT

- Disconnection is not detected when linkup has not yet been performed after system startup. (Disconnection is detected only when normal status turns to abnormal.)
- Disconnection of the Ethernet cable that is not directly connected to QJ71MT91 cannot be detected.
- Set the disconnection detection time from a few seconds to several tens of seconds. If the setting value of the disconnection detection time is too small, the system switching may occur even by noise or other factors.

(5) Redundant system operation at system switching

When system switching occurs in a redundant system, the MODBUS/TCP module operates differently according to the mode set using the switch 5 (redundant settings) of the intelligent function module switch setting.

Two modes are available: fixed IP mode and redundant IP mode.

(a) Fixed IP mode

Fixed IP addresses are assigned to system A and system B. Even if a system switching occurs, the IP addresses are not switched.

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MODBUS/TCP master device

Communications error occurred

System A - Control System

System switching request

MODBUS/TCP slave

IP address: 192.168.1.1

System B - Standby System

MODBUS/TCP slave

IP address: 192.168.1.2

MODBUS/TCP master device

System A - Standby System

Communication not possible (malfunction, severed cable)

MODBUS/TCP slave

IP address: 192.168.1.1

System B - Control System

MODBUS/TCP slave

IP address: 192.168.1.2

Diagram 6.29 Fixed IP Mode

⊠POINT

Processing of judging the current control system and switching the communication destination (system A or system B) on the MODBUS/TCP master side are required.

The MODBUS/TCP master can identify whether the target CPU module is the control system or standby system by reading SM1515 (Control system judgement flag) and SM1516 (Standby system judgement flag) of the CPU module.

(When the default settings are used for device assignment parameters: SM1515 = coil 21995, SM1516 = coil 21996)

(b) Redundant IP mode

IP addresses are assigned to the control system and standby system. If a system switching occurs, the IP addresses are also switched.

When the systems are switched, the access destination IP address needs not to be modified.

Use the fixed IP mode for communication specifying system A and system B.

MODBUS/TCP master device

Communications error occurred

System A - Control System

System switching request

System B - Standby System

MODBUS/TCP slave

MODBUS/TCP slave

IP address: 192.168.1.1

IP address: 192.168.1.2

MODBUS/TCP master device

System A - Standby System

Communication not possible (malfunction, severed cable)

System B - Control System

MODBUS/TCP slave

MODBUS/TCP slave

IP address: 192.168.1.2

IP address: 192.168.1.1

Diagram 6.30 Redundant IP Mode

POINT

- When system switching occurs, the TCP connection of the previously used is disconnected.
  Reconnect to a network from the MODBUS/TCP master and reopen the TCP connection.
- In the redundant IP mode, the IP addresses after a system switching are notified by issuing the Gratuitous ARP from the QJ71MT91 when system switching occurs. Use the fixed IP mode when using a MODBUS/TCP master device which does not support the Gratuitous ARP or disabling the Gratuitous ARP in a security software setting on the MODBUS/TCP master side.
- Use the fixed IP mode when using the QJ71MT91 as the MODBUS/TCP master. (The redundant IP mode cannot be used.)

(6) Intelligent function module switch setting

For the intelligent function module switch setting, refer to the following manual. The redundant system operates using the switch 5 (redundant settings) of the intelligent function module switch setting.

☞ MODBUS/TCP Interface Module User's Manual

(7) Parameters

Set the same parameters for both MODBUS/TCP modules in the control system and the standby system.

POINT

Set the parameters for the MODBUS/TCP modules using GX Developer.
Do not change the parameters using I/O signals (such as Basic parameter setting request, MODBUS device assignment parameter setting request).
If parameters are changed using I/O signals, the consistency of parameters for both the control system and the standby system may not be maintained.

(8) Communication procedure for access to the control system CPU module in a redundant system

The following shows a communication procedure example.

(a) For fixed IP mode

Communications can be continued by judging the current control system and switching the communication destination (system A or system B) on the MODBUS/TCP master side.

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Example of a communication procedure

Execute the open processing to the system A.

Execute the open processing to the system B.

Send a MODBUS request message.
Read SM1515 and SM1516.

ON: The system A is the standby system.

Is SM1515 (Operating system type) on?

OFF: The system A is the standby system.

Is SM1516 (Operating system type) on?

OFF → The TRK.CABLE ERR. occurred. For details, refer to the section 8.1.8.

ON: The system A is the control system.

Send a MODBUS request message.
Read SM1515 and SM1516.

ON: The system B is the control system.

Is SM1515 (Operating system type) on?

OFF: The system B is the standby system.

Is SM1516 (Operating system type) on?

OFF

ON: The system B is the standby system.

Send a MODBUS request message.
Execute device read/write.

NO   NO

Send a MODBUS request message.
Execute device read/write.

Was the response message received?

Was the response message received?

YES   YES

YES   Is this process repeated?   Is this process repeated?   YES

NO   NO

Execute the close processing to the system A.

Execute the close processing to the system B.

Execute the close processing to the system A.

Execute the close processing to the system B.

End

Diagram 6.31 Communication Example for Fixed IP Mode

6.2 Redundant System Network Overview
6.2.4 MODBUS/TCP

(b) For redundant IP mode

Communications continue because the MODBUS/TCP master accesses to the IP address of the control system.

```
        ╭─────────────────────────╮
        │  Example of a communication │
        │         procedure           │
        ╰─────────────────────────╯
                     │
                     ▼ ◄─────────────────────────┐
        ┌─────────────────────────┐              │
        │ Execute the open processing to │        │
        │ the IP address of the control system. │  │
        └─────────────────────────┘              │
                     │                            │
                     ▼ ◄──────────────┐           │
        ┌─────────────────────────┐   │           │
        │ Send a MODBUS request message. │ │        │
        │ Execute device read/write.     │ │        │
        └─────────────────────────┘   │           │
                     │                 │           │
                     ▼                 │           │
              ◇─────────────◇   NO     │           │
              │ Was the response │ ─────┼──────────┘
              │ message received? │      │
              ◇─────────────◇           │
                     │ YES              │
                     ▼                  │
        YES   ◇─────────────◇           │
         ◄────│ Is this process repeated? │
              ◇─────────────◇
                     │ NO
                     ▼
        ┌─────────────────────────┐
        │ Execute the close processing to │
        │ the control system.             │
        └─────────────────────────┘
                     │
                     ▼
              ╭─────────────╮
              │     End     │
              ╰─────────────╯
```
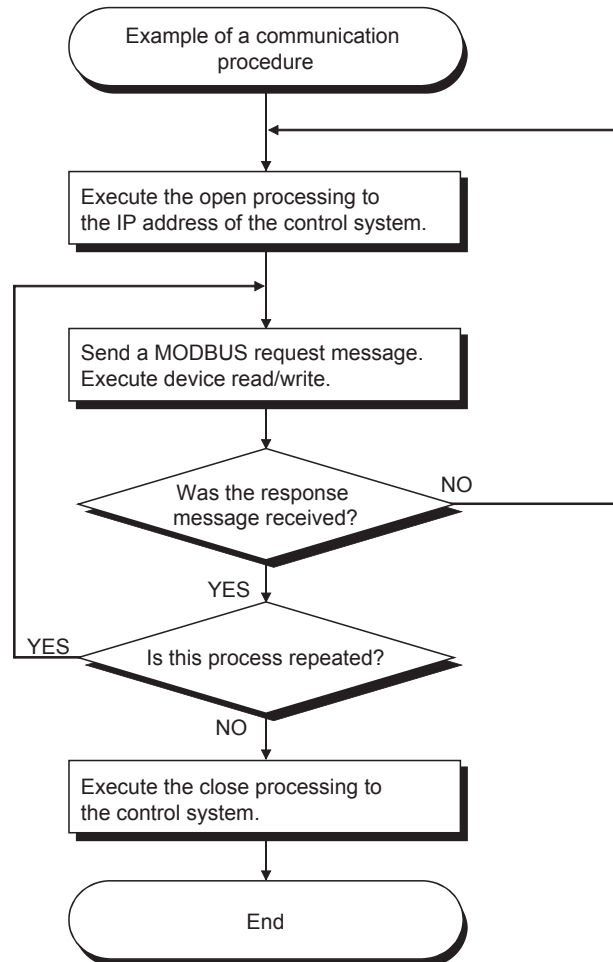
Diagram 6.32 Communication Example for Redundant IP Mode

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6.2.5 CC-Link

A redundant system can continue the CC-Link control by CC-Link standby master function, even when system switching occurs.

When using this function, set the system A as "master station" that controls the data link, and system B as "standby master station" for backup of "master station".

Refer to the following manual, for CC-Link standby master function.

☞ MELSEC-Q CC-Link System Master/Local Module User's Manual
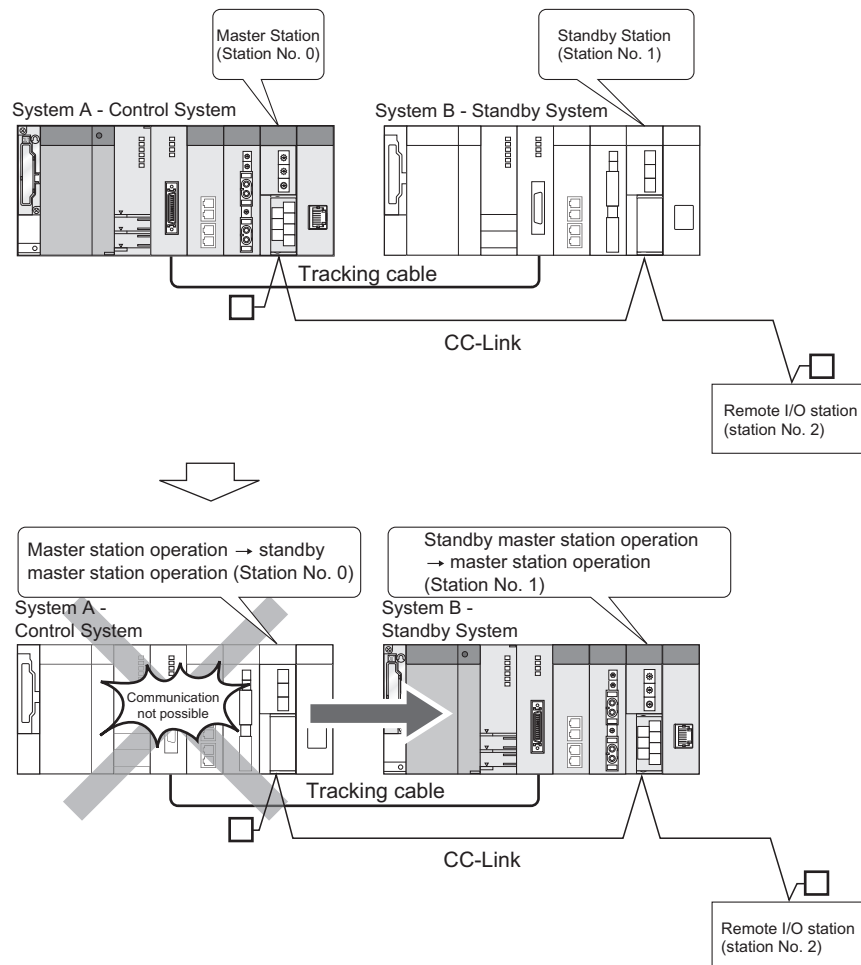
Diagram 6.33 CC-Link Operation at System Switching

⊠ POINT

Auto refresh can be made when mounting the CC-Link master module to the extension base unit. Set the tracking device setting to the device where the auto refresh is performed.

When using the auto refresh, set [Refresh settings] of the network parameter. Set the tracking device setting to the device where the auto refresh is set.

(1) Overview of Remote Stations

In a redundant system, the control system master station controls remote stations and sends/receives data to/from standby system master station.

The standby system standby master station receives data from the remote stations and sends/receives data to/from the master station, in order to continue the CC-Link control even when system switching occurs.
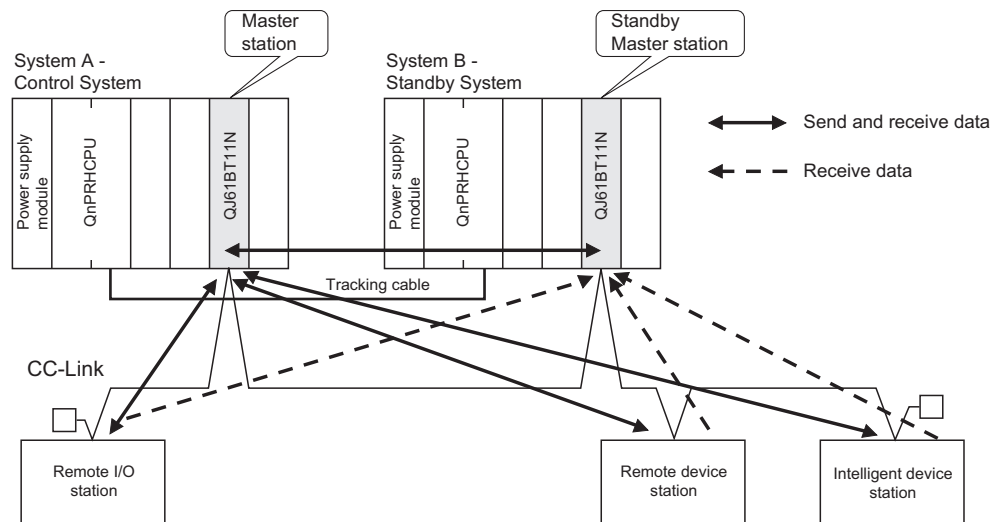
Diagram 6.34 Control of and Data Communication with Remote Stations

(2) Redundant system Operation at the time of System Switching

(a) When System Switching Occurs due to Control System Error

When an error occurs in the control system and system switching occurs, the new control system standby master station starts to operate as the master station and takes over the control of the remote stations.

Diagram 6.35 shows the redundant system operation when a stop error occurs in the control system CPU module.
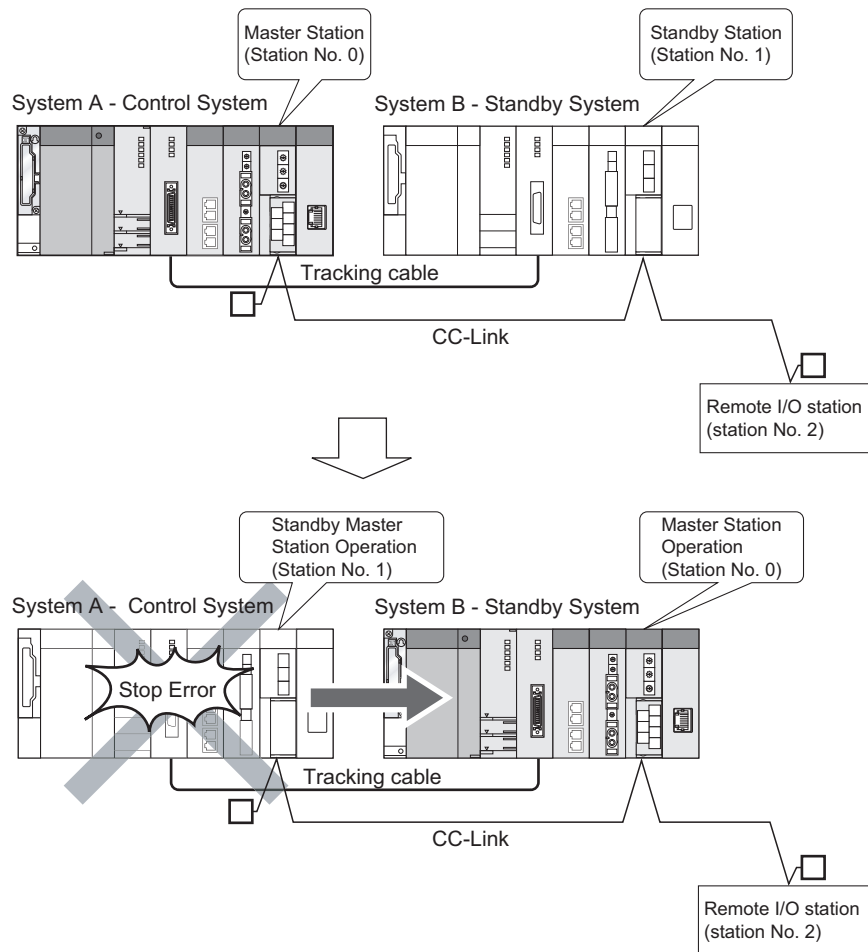
Diagram 6.35 Operation at System Switching due to Control System Error

(b) When System Switching Occurs due to Communication Error in Network other than CC-Link

When a communication error occurs in a network other than CC-Link, system switching occurs and the new control system takes over the control of the redundant system.

However, the new standby system master station does not switch to the standby master station, as it can communicate with remote stations.

Also, the new control system standby master station remains as the standby master station, and cannot control remote stations as the master station.

As a result, the new control system is unable to control the CC-Link.

Make sure to switch the data link control from the standby master station to the master station using the new control system's program.

Refer to Appendix 4 for program details.
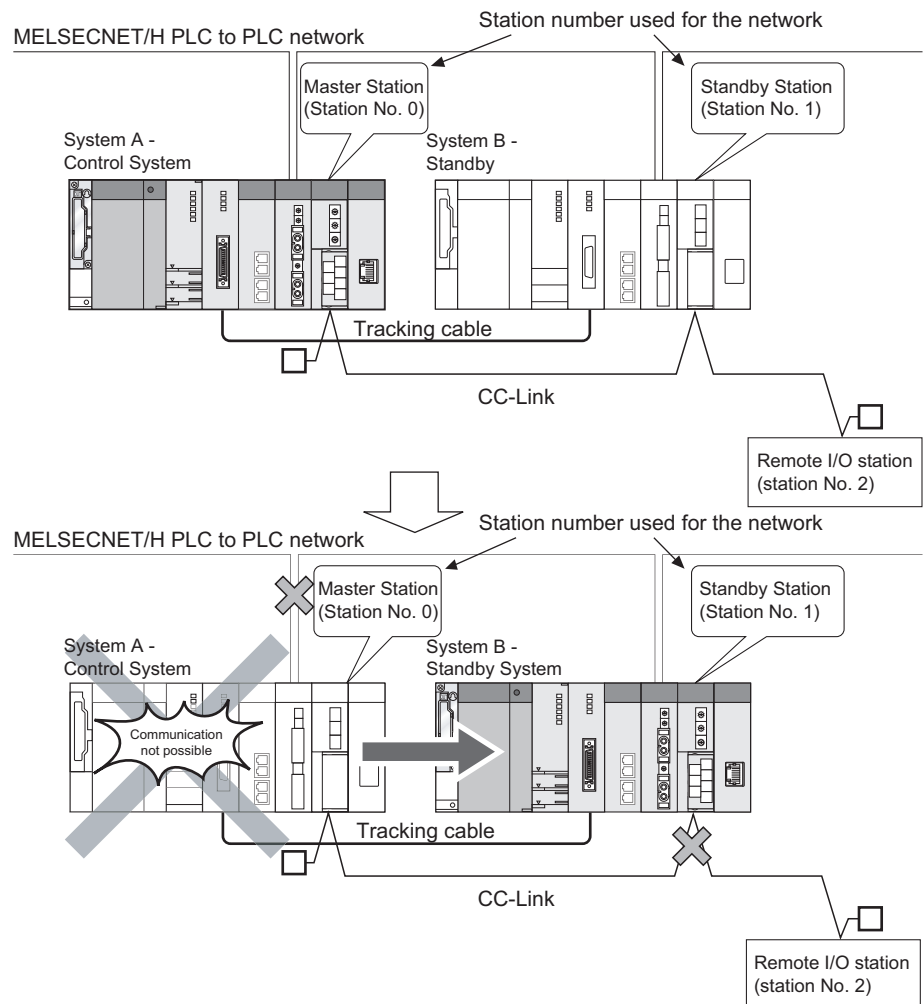
Diagram 6.36 Operation at System Switching due to Communication Error of Network other than CC-Link

(c) When System Switching is Manually Carried Out

When system switching is manually carried out, the new control system takes over the control of the redundant system.

However, the new standby system master station does not switch to the standby master station, as it can communicate with remote stations.

Also, the new standby system master station remains as the standby station and cannot control remote stations as the master station.

As a result, the new control system is unable to control the CC-Link.

Make sure to switch the data link control from the standby master station to the master station using the new control system's program.

Refer to Appendix 4 for program details.
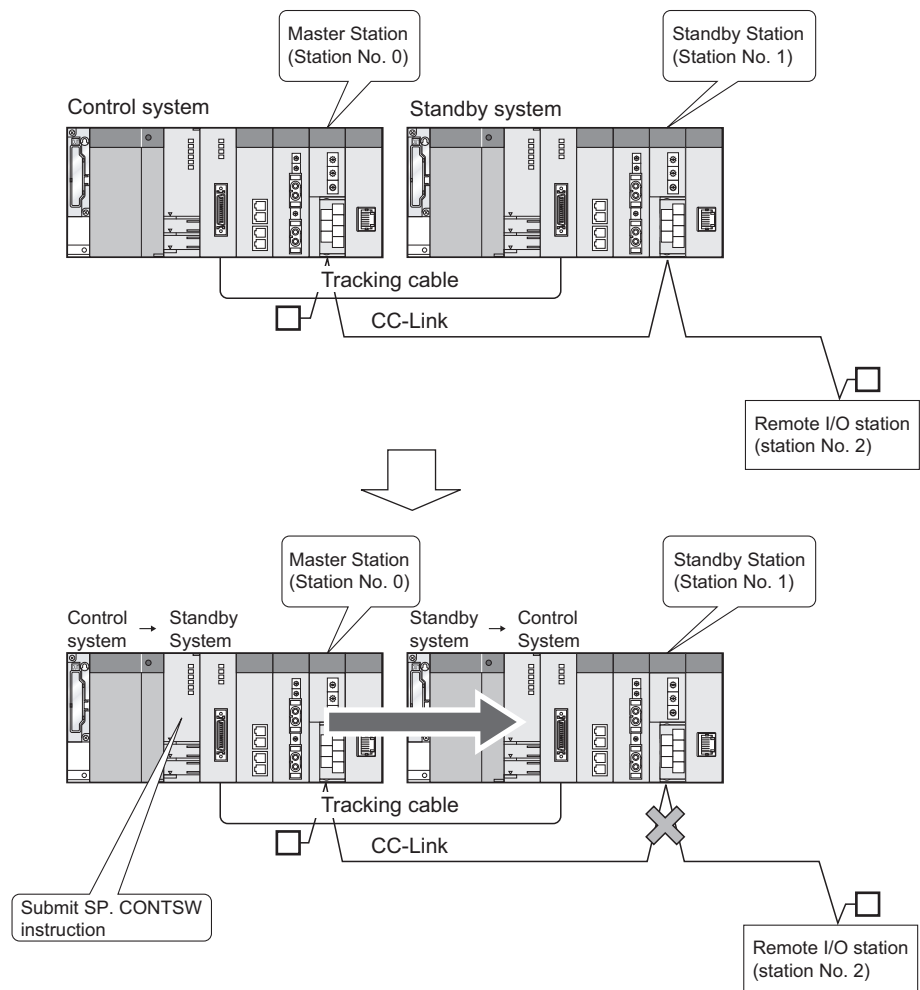
Diagram 6.37 Operation When System Switching Is Manually Carried Out

(3) Programs for Switching the Standby Master Station that Controls CC-Link

Refer to Appendix 4 for programs that switches the standby master station that controls the CC-Link from the previous control system standby master station to the new one when system switching occurs.

(4) Network Parameter Setting

Set [Type] (station type) of network parameter as follows:

(a) When mounting to the main base unit

Set station type as [Master station (Duplex function)].

(b) When mounting to the extension base unit

Set station type as [Master station (Extension base)].

Refer to Appendix 4 for network parameter settings.

(5) System Start-up

(a) The QJ61BT11N whose first 5 digits of serial No. is "07112" or later

When using the CC-Link, control by the CC-Link is enabled when starting up either system A or system B.

(b) The QJ61BT11N whose first 5 digits of serial No. is "07111" or earlier

When the redundant system is connected to CC-Link, start up the system so that system A will be the control system.
Control via CC-Link cannot be performed when system B only is started up.

(6) Checking the operating status of standby system

After power-ON, the status of CC-Link master module on the standby system can be checked with the link special register (SW80) of the control system CPU module.
If the normal data link status of the standby master station (the bit corresponding to the standby master station is OFF in SW80) stays ON for two seconds or more, the CC-Link master module on the standby system has started normally.

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(7) Cautions

(a) Station number setting

Set CC-Link master module station number so that station number 0 is assigned to system A (master station), and other than station number 0 (standby master station) is assigned to system B.

(b) Tracking device setting

Set a device that makes auto refresh setting to the CC-Link master module on the extension base unit as a tracking device.

Do not set the link special relay (SB) and link special register (SW) as tracking transfer device to the CC-Link master module mounted on the main base unit.

(c) When using CC-Link

When the CC-Link master module is mounted on main base unit, the redundant system cannot start with the previous control system. (☞ Appendix 5)

(d) Parameters in the debug mode

In the debug mode, the CPU module uses the parameters for system A to operate. Therefore, the station set as system B in the network parameters becomes absent station (disconnected station).

(8) Output Holding Time of Remote Station at System Switching

When system switching occurs, the remote station output is held until system switching is completed. (The remote station cannot be controlled from when system switching occurs until it is completed.)

Use the expression listed in Table6.6 to calculate the remote station output holding time (output holding time) at system switching occurrence.

Table6.6 Remote Station Output Holding Time

Reasons for System Switching	Output Holding Time Calculation Expression (ms)
Control system power off	•When $(3 \times LS) > 100ms$
Control system CPU module reset	(Output holding time) = (error detection processing time*1) + 100 + 6 × LS + SS + (I/O
Control system CPU module stop error	response time)
Control system CPU module hardware fault	•When $100ms > (3 \times LS)$ (Output holding time) = (error detection processing time*1) + 200 + 3 × LS + SS + (I/O response time)
System switching by GX Developer	•When $(3 \times LS) > 100ms$
System switching by system switching instruction	(Output holding time) = (error detection processing time*1) + 300 + 6 × LS + 2 × SS + (I/O response time)
System switching by system switching request from network module	•When $100ms > (3 \times LS)$ (Output holding time) = (error detection processing time*1) + 400 + 3 × LS + 2 × SS + (I/O response time)

LS : Link scan time

Refer to the following manual for the link scan time calculation method.

☞ MELSEC-Q CC-Link System Master/Local Module User's Manual

SS : Sequence program scan time

* 1 : Use the value in Table6.7 as the error detection processing time.

Table6.7 Error Detection Processing Time

Transmission speed	Error detection processing time
10Mbps	5ms
5Mbps	8ms
2.5Mbps	15ms
625kbps	50ms
156kbps	400ms

6.2.6 MODBUS

The transmission lines can be redundant by mounting MODBUS modules (slave function) on the main base units where the Redundant CPUs are mounded.
When the lines do not need to be redundant or using MODBUS modules as master stations, mount them on an extension base unit.

MODBUS® master device

QJ71MB91 (slave function)　　　　　　　QJ71MB91 (slave function)

Tracking cable
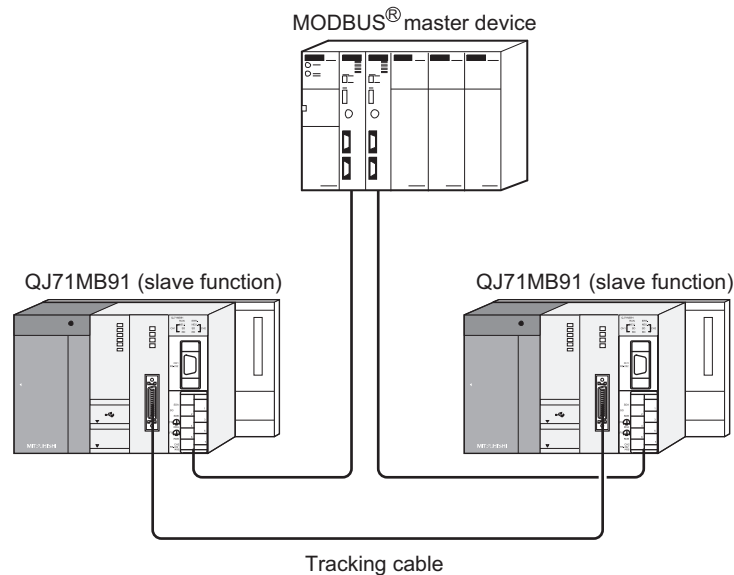
Diagram 6.38 Communications Through MODBUS

(1) Mounting the modules on the main base units (Configuring redundant transmission lines)

To configure redundant transmission lines, mount the MODBUS modules on the main base units. (Only the slave function can be used.)
With a backup line, data communications with the master device (or station) can be continued even when a MODBUS communication error occurs.
Note, however, that when a communication error occurs in MODBUS, the system will not be switched automatically. The system needs to be switched using a program.
For details of programming, refer to Appendix 5.

(a) Parameter settings

Set the same parameters for both communication-target master devices that communicate with the MODBUS modules.
Also, set the same parameters for both MODBUS modules in the control system and the standby system.

(b) MODBUS device assignment parameter settings

To change the MODBUS device assignment parameters from their default settings, use GX Configurator-MB.
Store the parameter settings in GX Configurator-MB, and terminate the GX Configurator. Then, execute the write to PLC function using GX Developer and write the setting data to the CPU modules in the control system and the standby system.

(c) Turning off the ERR. LED

An error in the MODBUS module of the standby system cannot be cleared using GX Configurator-MB, GX Works2, nor sequence programs.

To turn off the ERR. LED, issue a request message for clearing an error from the master station.

For details, refer to the following manual.

☞ MODBUS Interface Module User's Manual

(2) Mounting the modules on an extension base unit

When mounting the modules on an extension base unit, refer to Section 2.1 (7).

6.2.7 Serial Communication Modules

Mount the serial communication module on the MELSECNET/H remote I/O station or extension base unit. (The serial communication module cannot be mounted to the main base unit where the Redundant CPU module is mounted.)

Communication from the serial communication module to external devices can be made by MC protocol, nonprocedural protocol, and bidirectional protocol.

For MC protocol, external devices can communicate with the specified system, i.e., control system, standby system, system A, or system B.
Refer to the following manual for MC protocol.
☞MELSEC Communication Protocol Reference Manual

⊠**POINT**

When a serial communication module is mounted on an extension base unit, dedicated instructions cannot be used; therefore, create a program using the FROM/TO instructions.
For the sample program using the FROM/TO instruction, refer to Appendix 7.

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(1) Communication between External Devices and Control System CPU Module

(a) Communication by MC Protocol

1) When mounting to the extension base unit

There are restrictions on the connection destination depending on the command from the external device to MC protocol.
(Appendix 7 (1))

In addition, when system switching occurs, the communication timeout will occur since both old system and new system cannot respond. Therefore, perform retry processing by MC protocol.
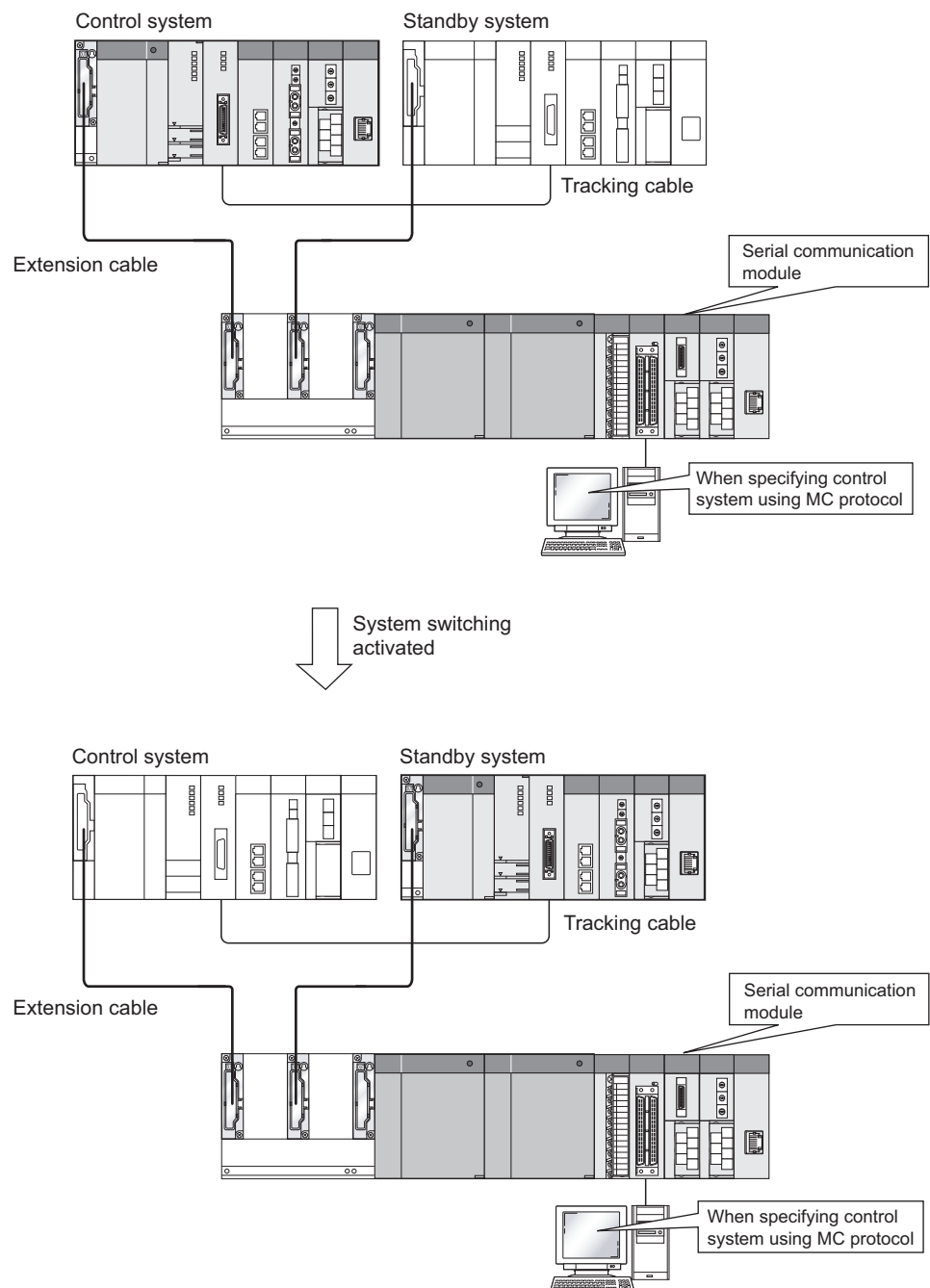
Diagram 6.39 Operation for Communication with Control System CPU Module by MC Protocol

2) When mounting to the main base unit

Specify the "control system" by MC protocol on each eternal device, and perform the communication with the control system CPU module.

If the "control system" is specified by MC protocol, communication with the new control system CPU module can be performed, even when system switching occurs.
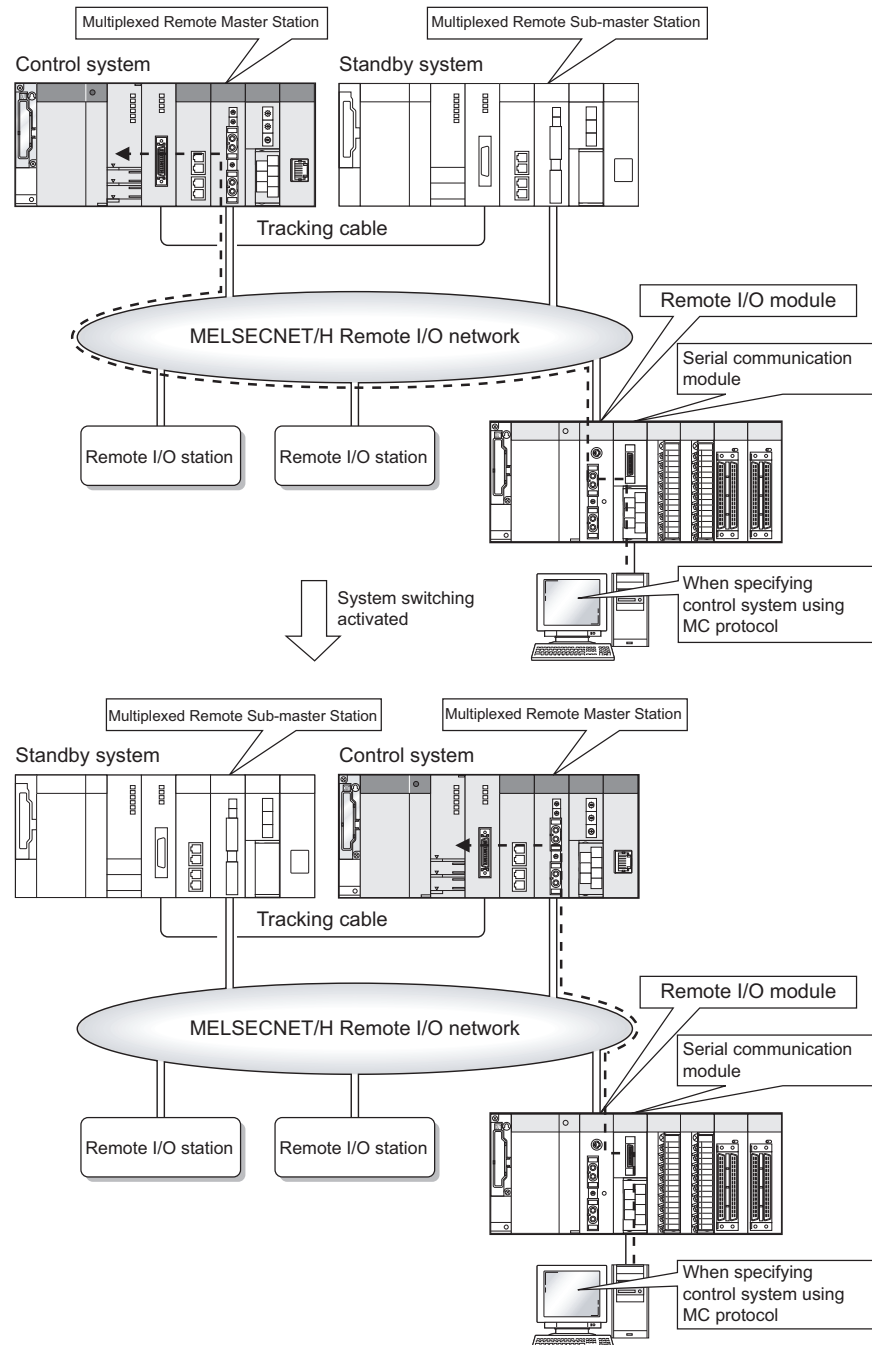
Diagram 6.40 Operation for Communication with Control System CPU Module by MC Protocol

(b) Communication by Nonprocedural Protocol/Bidirectional Protocol

For nonprocedural protocol/bidirectional protocol, communication with external devices can be performed using the control system CPU module's programs.

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(2) Communication between External Devices and the Standby System CPU Module

(a) Communication by MC Protocol

Specify the "standby system" by MC protocol on each external device, and perform the communication with the control system CPU module. If the "standby system" is specified by MC protocol, communication with the new standby system CPU module can be performed, even when system switching occurs. Communication can be performed by MC protocol only.
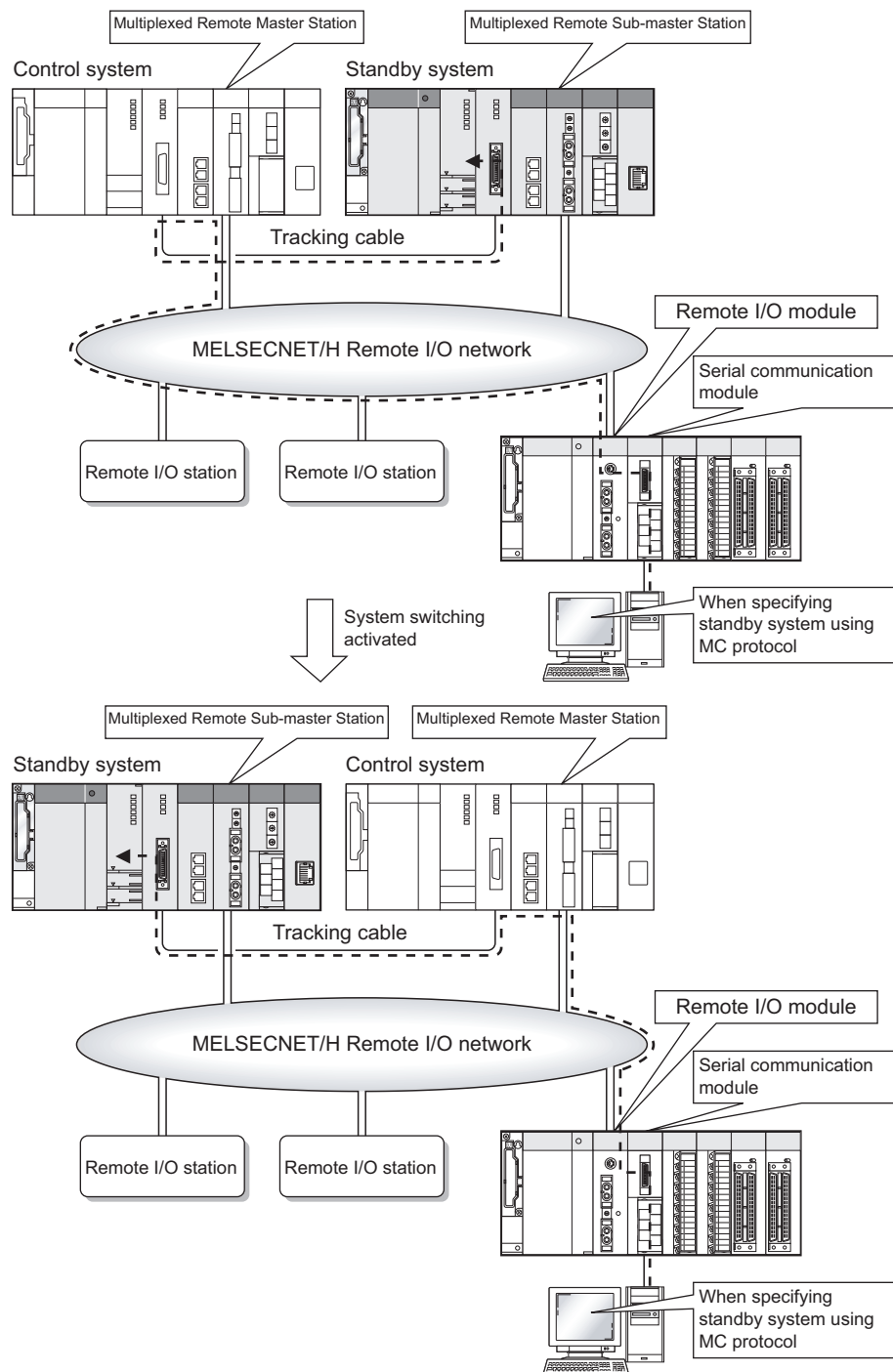
Diagram 6.41 Operation for Communication with Standby System CPU Module by MC Protocol

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(3) Communication between External Devices and System A/System B

(a) Communication by MC Protocol

In order to perform the communication with the system A/system B CPU module, specify "System A" or "System B" on each external device by MC protocol.

If "System A" or "System B" is specified by MC protocol, communication with the specified system CPU module can be performed even when system switching occurs.

This communication can be performed by MC protocol only.
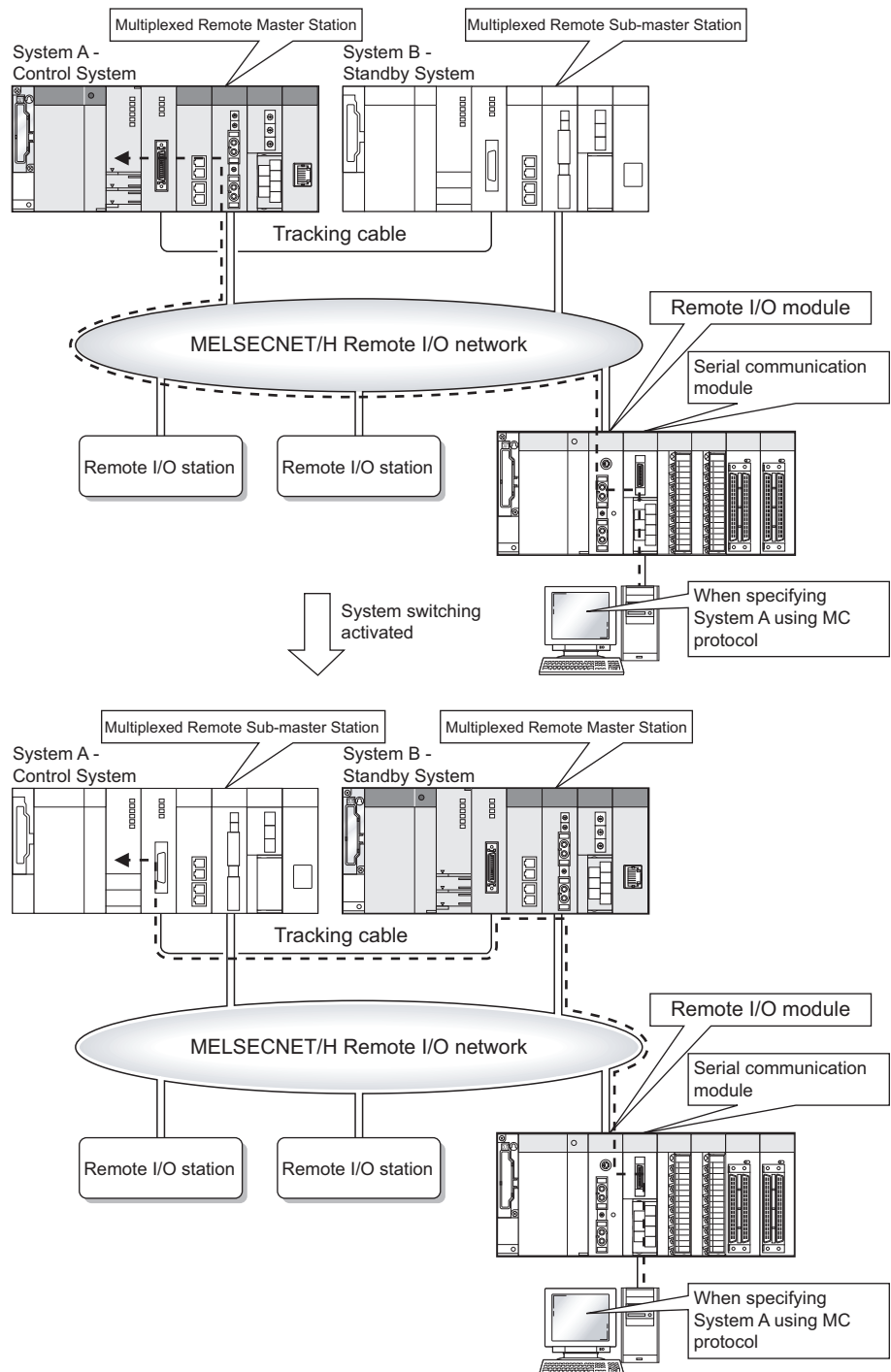
Diagram 6.42 Communication with System A CPU Module by MC Protocol

6.2.8 PROFIBUS-DP

(1) Communication overview of the PROFIBUS-DP

In redundant system, when the PROFIBUS-DP master module detects a fault or communication failure with DP-Slaves, the standby system master module is switched to new control system master module and inherits the PROFIBUS communications.

(2) Operation at system switching

The PROFIBUS-DP master modules switch each system on the following cases.
- When the PROFIBUS-DP master module detects a fault
- When a communication failure with DP-Slaves is detected
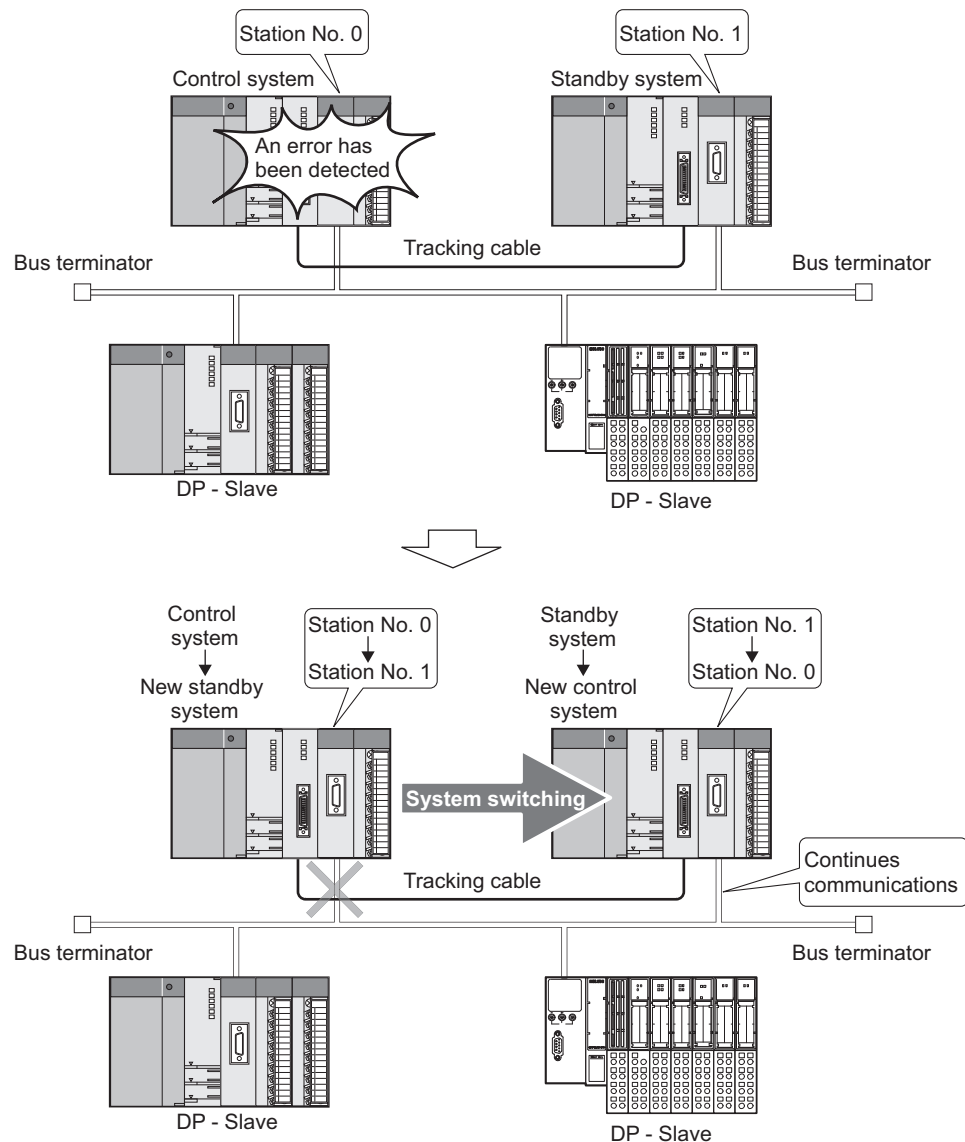
Diagram 6.43 Operation of the PROFIBUS-DP Master Module at System Switching

(3) Line redundant system

The line redundant system allows the system configuration using 2 lines, and either of the lines is used for slave station control. When an error occurs at the controlling line, the control is inherited to another line.

(4) Station number setting

Set the station number of the PROFIBUS-DP master module with GX Developer and GX Configurator-DP.

For details of setting method, refer to the following manual.

☞ PROFIBUS-DP Master Module User's Manual

(5) Startup order of system A and system B

When using the PROFIBUS-DP master module, startup order of system A and system B is unrestricted.

After the both system is started up and assigned their system (Control system/ standby system), data link is started.

(6) Precautions when using the PROFIBUS-DP master modules in redundant system

(a) Function version of the PROFIBUS-DP master modules

Use the PROFIBUS-DP master modules of function version D or later.

(b) GX Developer version

Use GX Developer version 8.18U or later.

(c) At redundant system startup

• Check for an error of the PROFIBUS-DP master module at local station error information area (Un\G23071).

For local station error information area, refer to the following manual.

☞ PROFIBUS-DP Master Module User's Manual

• When there is an error, clear the error to perform system switching.

(d) Continuing each function of the PROFIBUS-DP master module

For precautions to continue each function of the PROFIBUS-DP master module, refer to the following manual.

☞ PROFIBUS-DP Master Module User's Manual

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6.3 Communication between the Both Systems CPU Module and GOTs

When the GOT communicates with the standby system/control system CPU module, the communication target can be specified by the station No.
(The GOT cannot specify the system (control system, standby system, system A, or system B.))
Table6.8 lists the connection method and connectability when the GOT is used in the redundant system. For the restrictions when the GOT is used in the redundant system, refer to the following manual.

☞ GOT1000 Series Connection Manual (Mitsubishi Products)

Table6.8 Connection Method of GOT and its Connectability in Redundant System

Connection method		Connectability	Remarks
Main base unit where Redundant CPU is mounted	Bus connection	×	Not connectable since the stop error EXTEND BASE ERR. (error code: 2010)[1] occurs to the CPU module.
	CPU direct connection	○	----
	Computer link connection	×	Not connectable since the serial communication module cannot be mounted to the main base unit where the Redundant CPU is mounted.
	Ethernet connection	○	----
	CC-Link IE Controller Network	○	----
	MELSECNET/H PLC to PLC network	○	----
	MELSECNET/10 PLC to PLC network	○	----
	CC-Link connection	○	----
Extension base unit	Bus connection	×	Not connectable (No error occurs to the CPU module.)
	Computer link connection	○	----
	Ethernet connection	○	----
	CC-Link IE Controller Network	×	Not connectable since CC-Link IE Controller Network module cannot be mounted to the extension base unit.
	MELSECNET/H PLC to PLC network	×	Not connectable since MELSECNET/H module cannot be mounted to the extension base unit.
	MELSECNET/10 PLC to PLC network	×	Not connectable since MELSECNET/H module cannot be mounted to the extension base unit.
	CC-Link connection	○	----
MELSECNET/H remote I/O station	Bus Connection	×	----
	CPU Direct Connection	○	----
	Computer Link Connection	○	----
	Ethernet connection	○	----
MELSECNET/10 remote I/O station	Bus Connection	×	Not connectable since MELSECNET/10 is not compatible with the Redundant CPU.
	CPU Direct Connection	×	
	Computer Link Connection	×	

○: Applicable, ×: N/A

* 1: EXTEND BASE ERR. (error code: 2012) occurs to the CPU module whose first 5 digits of serial No. is "09012" or later.

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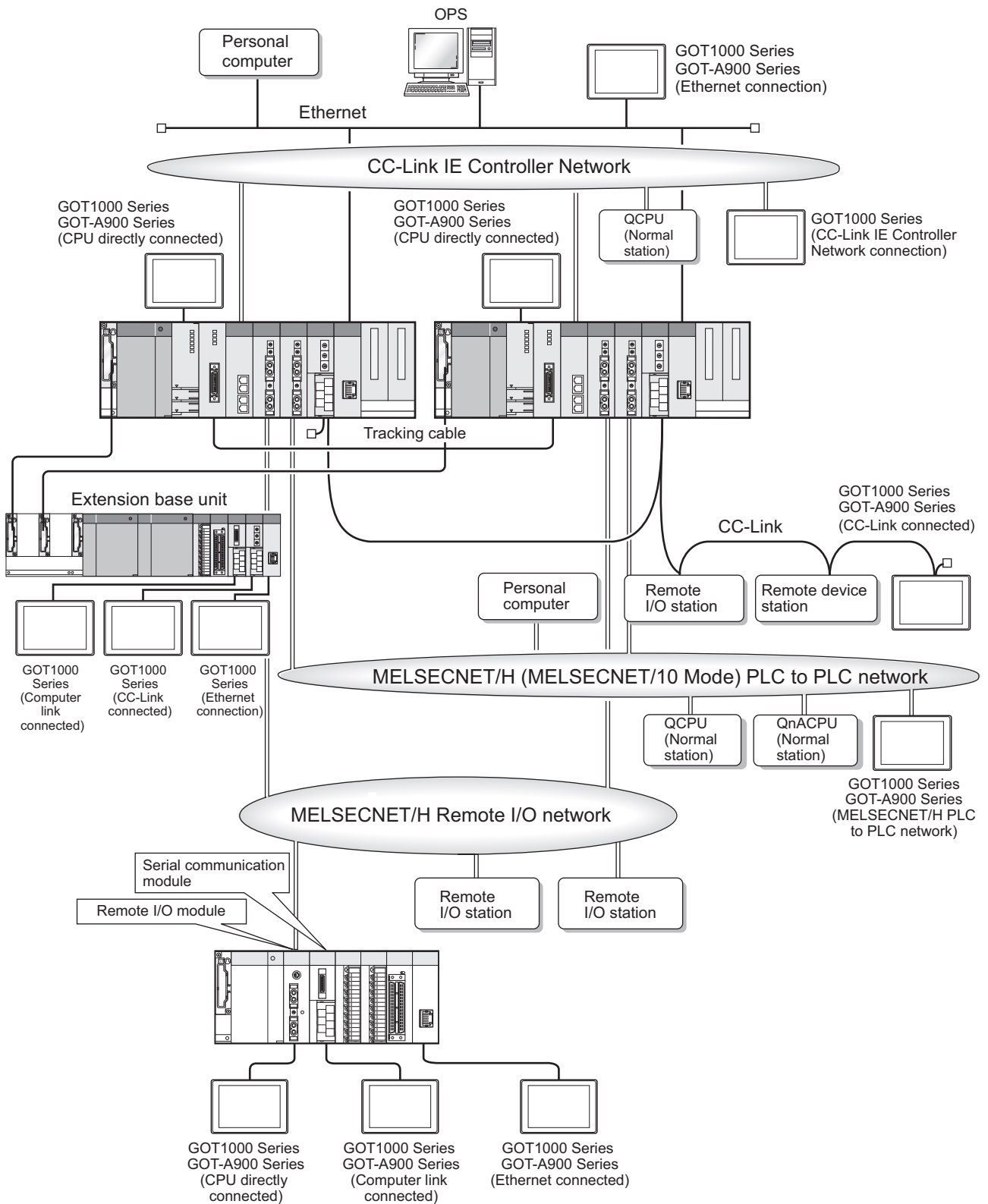
Diagram 6.44 GOT Connection Method Applicable to a Redundant System

6.3.1 When connecting GOTs to MELSECNET/H remote I/O station

For MELSECNET/H network connection, connect GOTs to a remote I/O module or serial communication module mounted on a MELSECNET/H remote I/O network remote I/O station.

The GOT cannot be connected to the base unit of a remote I/O station (bus connection). When connected to the base unit of a remote I/O station, the GOT will result in a communication error.

(1) GOT connection methods

Make sure to connect GOTs to a remote I/O station via "CPU direct connection" or "computer link connection".
For CPU direct connection, connect the GOT to the remote I/O module mounted on the remote I/O station via the RS-232 port.
For computer link connection, connect the GOT to a serial communication module mounted on a remote I/O station via the RS-232 port.
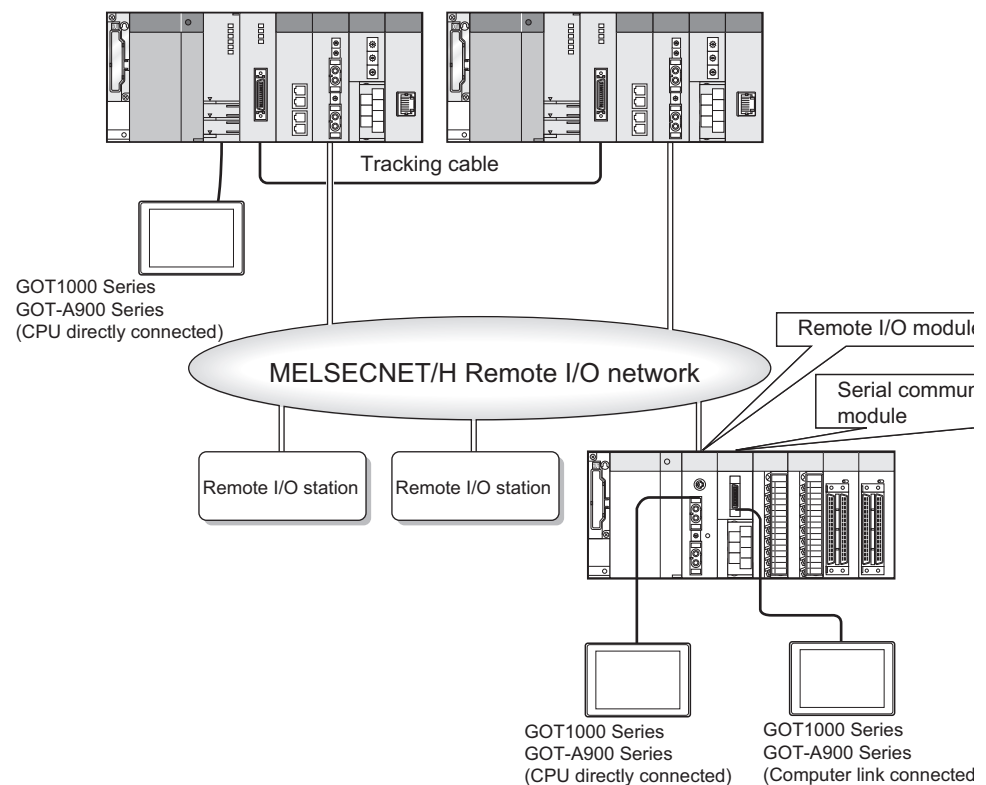
Diagram 6.45 GOT Connection Method

(2) Communication method

The GOT communicates with the control system CPU module since the remote I/O module communicates with the network module which operates as the master station by specifying station No. 0 in the GOT.

Even when system switching occurs, the remote I/O module communicates with the network module which operates as the master station in the new control system. Therefore, the GOT communicates with the new control system CPU module.

For details, refer to the following manual.

☞ GOT1000 Series Connection Manual (Mitsubishi Products)

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6.3 Communication between the Both Systems CPU Module and GOTs
6.3.1 When connecting GOTs to MELSECNET/H remote I/O station

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6.3.2 When Connecting GOTs to CC-Link

As for the GOT, connect it to the CC-Link on the main base unit or CC-Link on the extension base unit, or connect it to the CC-Link communication module (AJ65BT-G4-S3) connected to the CC-Link.
The GOTs will work as intelligent device stations or a remote device stations, depending on the CC-Link communication module used.
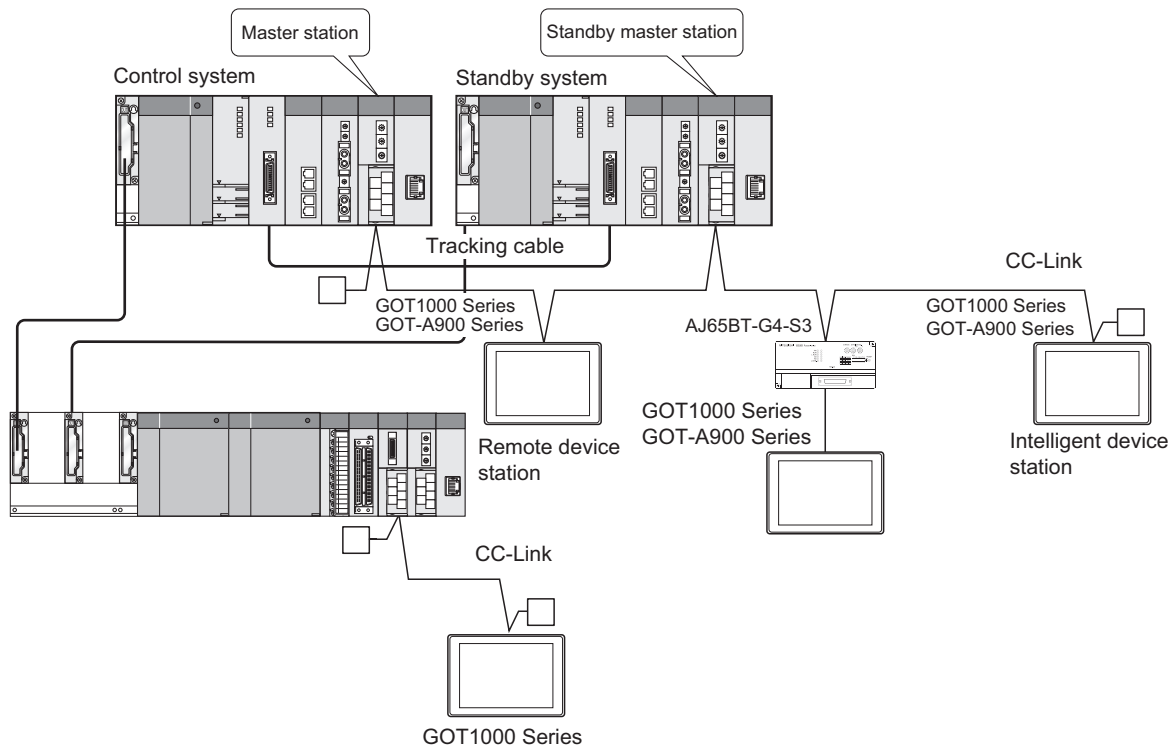
Diagram 6.46 System When Connecting GOTs to CC-Link

(1) GOT connection methods

The connection method for connecting GOTs to the CC-Link is referred to as "CC-Link connection".
In this method, mount a CC-Link communication unit (GOT-dedicated product) to a GOT, and then connect it to the CC-Link.

(2) Communication method

The GOT communicates with the control system CPU module of the master station by specifying station No. 0 in the GOT.
Even when system switching occurs, the network module of the new control system operates as the master station. Therefore, the GOT communicates with the new control system CPU module. (When connection is made via the extension base unit, the GOT always monitors the control system.)
For details, refer to the following manual.

☞ GOT1000 Series Connection Manual (Mitsubishi Products)

6.3.3 Communication when the GOT is Connected to CC-Link IE Controller Network, MELSECNET/H, or MELSECNET/10 PLC to PLC Network

Connect GOTs to a CC-Link IE Controller Network, MELSECNET/H, or MELSECNET/10 PLC to PLC network.

(1) GOT connection type

The following are connection types of the GOT.
- "CC-Link IE Controller Network connection" [1]
- "MELSECNET/H connection (PLC to PLC network)"
- "MELSECNET/10 connection (PLC to PLC network)"
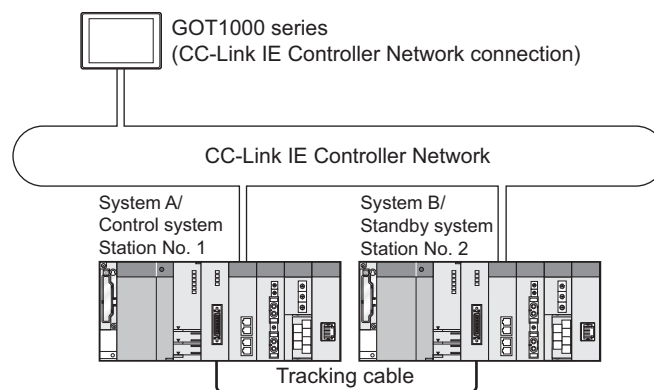
Diagram 6.47 GOT Connection Method (CC-Link IE Controller Network)

* 1: GOT-A900 series cannot be used in the CC-Link IE Controller Network connection.

(2) Communication method

(a) GOT1000 series

The GOT can monitor the control system of the redundant system by setting the Q redundant setting.
The monitoring target can be changed automatically even when system switching occurs.
For the function to enable this automatic changing of the monitoring target at the GOT, refer to the following manual.

☞ GOT1000 Series Connection Manual (Mitsubishi Products)

(b) GOT-A900 series

The GOT specifies the target communication station connected to the MELSECNET/10 PLC to PLC network by the network No. and station No.
It is necessary to create a window to switch station No. of systems A and B to monitor when system switching occurs.
For details, refer to the following manual.

☞ GOT-A900 Series User's Manual (GT Works2 Version2/GT Designer2 Version2 compatible Connection System Manual)

6.3 Communication between the Both Systems CPU Module and GOTs
6.3.3 Communication when the GOT is Connected to CC-Link IE Controller Network, MELSECNET/H, or

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6.3.4 When Connecting GOTs to a Ethernet

The GOT is connected to Ethernet module mounted on the main base unit or Ethernet module mounted on the extension base unit.

(1) GOT Connection Methods

Connect GOTs to a Ethernet via "Ethernet connection".
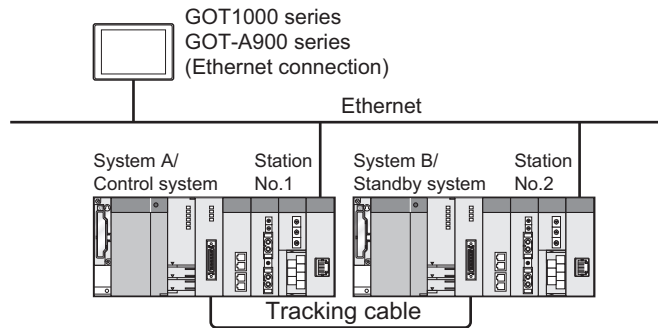
Diagram 6.48 GOT Connection Type (when Mounting to Main Base Unit)
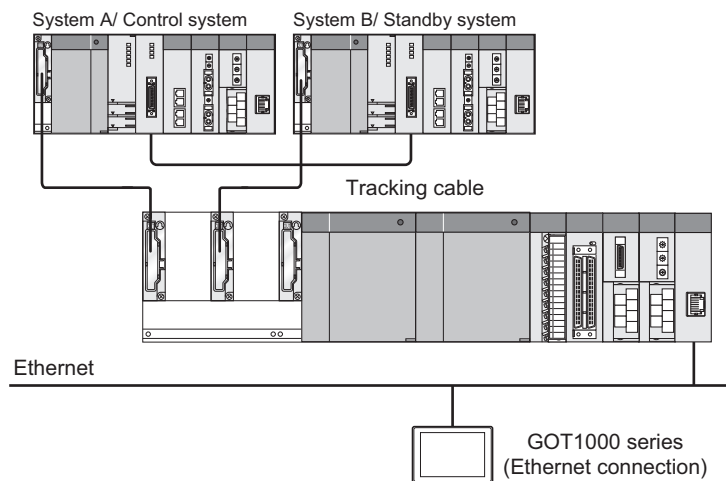
Diagram 6.49 GOT Connection Type (when Mounting to Extension Base Unit)

(2) Communication method

(a) GOT1000 series

The GOT can monitor the control system of the redundant system by setting the Q redundant setting.

The monitoring target can be changed automatically even when system switching occurs. (When connecting via the extension base unit, the control system is always monitored.)

For the function to enable this automatic changing of the monitoring target at the GOT, refer to the following manual.

☞ GOT1000 Series Connection Manual (Mitsubishi Products)

(b) GOT-A900 series

The GOT specifies the target communication station connected to Ethernet by the network No. and station No.

It is necessary to specify the station No. of systems A and B when communicating with the redundant system in the GOT. It is also necessary to create a window to switch station No. of systems A and B to monitor when system switching occurs in the redundant system.

For details, refer to the following manual.

☞ GOT-A900 Series User's Manual (GT Works2 Version2/GT Designer2 Version2 compatible Connection System Manual)

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6.3 Communication between the Both Systems CPU Module and GOTs
6.3.4 When Connecting GOTs to a Ethernet
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6.4 Precautions for Accessing Redundant CPU from Other Networks

In a system using CC-Link IE Controller Network, MELSECNET/H, MELSECNET/10 or Ethernet, use of GX Developer or MC protocol allows communication with a redundant CPU by specifying "control system", "standby system", "System A" or "System B".
Note that when accessing a redundant CPU from another network (network of different network No.), there are the following restrictions on the CPU modules that can be used as relay stations. (☞ Table6.9)

Table6.9 CPU Modules Applicable to Relay Stations for Communication with Redundant CPU from Other Networks

Serial No. of CPU module		06051 or earlier					06052 or later				
System specification		Not specified	Control system	Standby system	System A	System B	Not specified	Control system	Standby system	System A	System B
CPU module model name	Q00JCPU Q00CPU Q01CPU Q02CPU Q02HCPU Q06HCPU Q12HCPU Q25HCPU Q12PHCPU Q25PHCPU	○	×	×	×	×	○	○	○	○	○

○ : Applicable, × : Inapplicable

[Example]

Diagram 6.50 shows a system configuration example for making communication by specifying the "control system" of a redundant system by GX Developer and MC protocol of other networks.
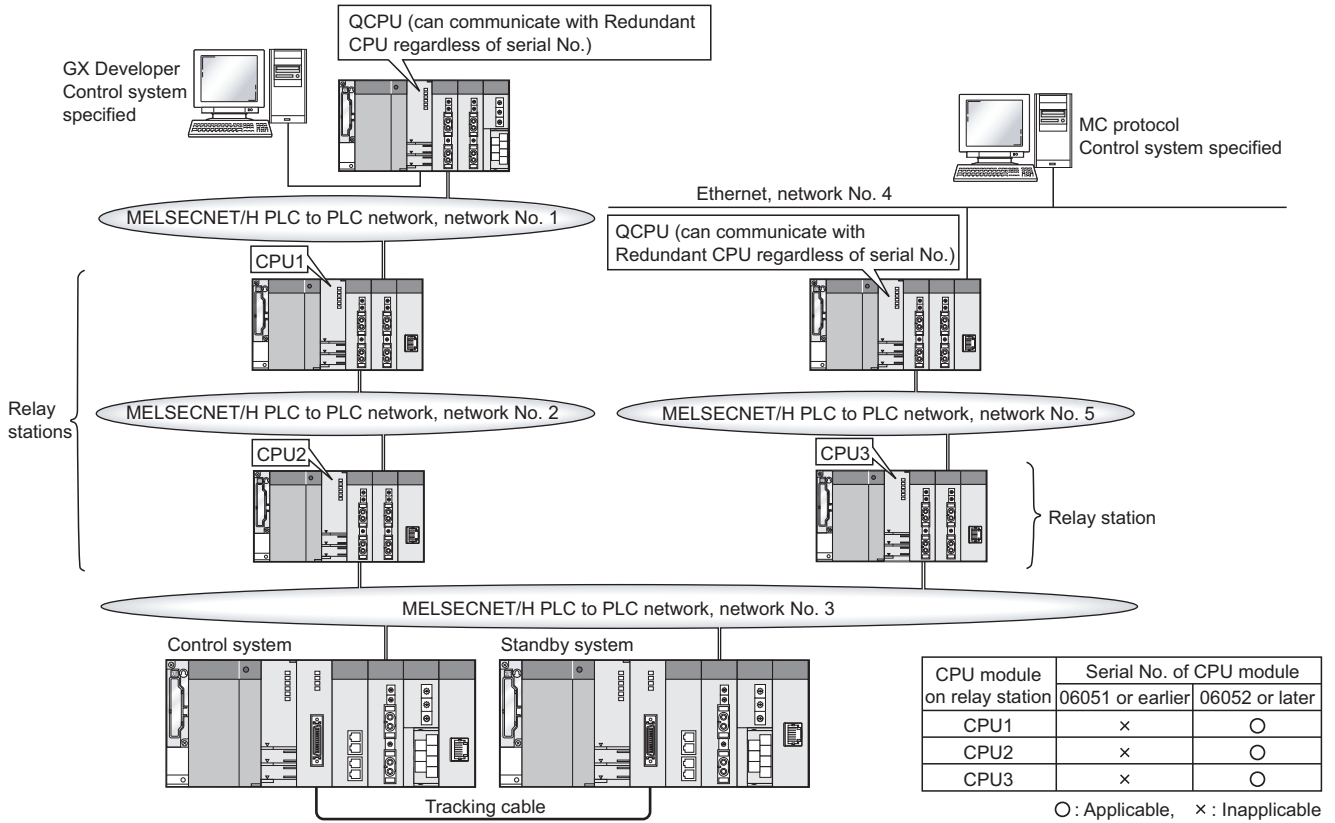
Diagram 6.50 System Configuration for Communication from Other Networks with "Control System" Specified

CPU module	Serial No. of CPU module	
on relay station	06051 or earlier	06052 or later
CPU1	×	○
CPU2	×	○
CPU3	×	○

○ : Applicable,   × : Inapplicable

6.5 Precautions for Writing Device Data from Other Station

(1) Operation When System Switching Occurs Until Tracking Is Completed

When the devices of the control system CPU module where data have been written are set to within the tracking range, the device data written in the control system CPU module are also tracked to the standby system CPU module.

However, if system switching occurs due to any of the following reasons from when write of device data to the control system CPU module is completed until tracking is completed, the device data written in the control system CPU module are not tracked to the standby system CPU module.

- Control system power off
- Control system CPU module reset
- Control system hardware fault
- Control system CPU module stop error

At this time, the new control system CPU module after system switching uses the old device data for control.

(2) Checking for system switching after device data write

After writing device data to the control system CPU module by GX Developer or other means, check for system switching occurrence.

System switching can be checked by either of the following methods.

(a) Checking for system switching by verifying written device data

After write of device data to the control system CPU module is completed, read the written device data from the control system CPU module to check whether system switching occurred or not.
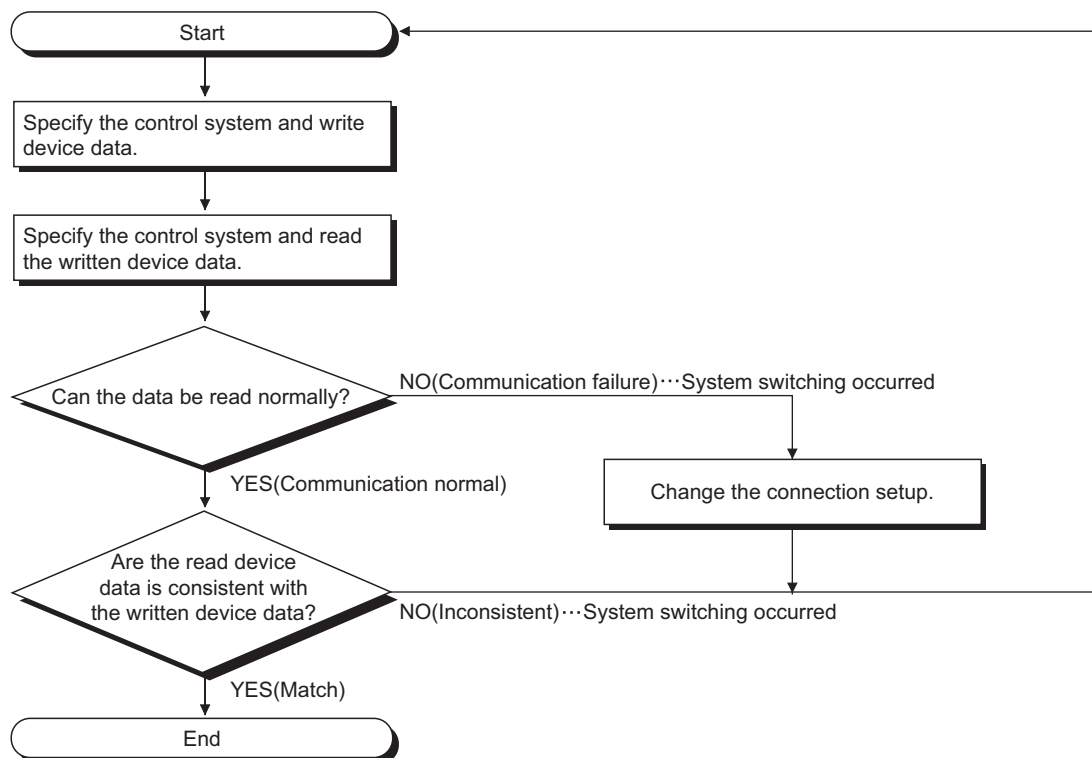
Diagram 6.51 Flowchart for Checking for System Switching with the Written Device Data

(b) Checking for system switching by system A and system B identification flags

Whether system switching occurred or not can be confirmed by checking the system A and system B identification flags before and after write of device data.

```
                        ┌──────────────────┐
                        │      Start       │◄─────────────────────────────┐
                        └────────┬─────────┘                              │
(1)                              │                                        │
┌────────────────────────────────────────┐                               │
│ Specify the control system and read     │                               │
│ the following special relays:           │                               │
│ ·System A identification flag (SM1511)  │                               │
│ ·System B identification flag (SM1512)  │                               │
└────────────────┬─────────────────────────┘                             │
(2)              │                                                        │
┌────────────────────────────────────────┐                               │
│ Specify the control system and write    │                               │
│ device data.                            │                               │
└────────────────┬─────────────────────────┘                             │
(3)              │                                                        │
┌────────────────────────────────────────┐                               │
│ Specify the control system and read     │                               │
│ the following special relays:           │                               │
│ ·System A identification flag (SM1511)  │                               │
│ ·System B identification flag (SM1512)  │                               │
└────────────────┬─────────────────────────┘                             │
                 │                                                        │
          ◇──────────────◇   NO(Communication failure)···System switching occurred
         ◇ Can the data be ◇────────────────────────────────────┐        │
          ◇ read normally? ◇                                     │        │
                 │                                                │       │
         YES(Communication normal)              ┌────────────────────────┐│
                 │                               │ Change the connection  ││
          ◇──────────────◇                       │ setup.                 ││
         ◇ Are the SM1511  ◇                      └────────────┬───────────┘│
        ◇ and SM1512      ◇  NO(Inconsistent)···System switching occurred  │
         ◇ contents read  ◇──────────────────────────────────────────────┘
          ◇ in (1) and (3)◇
          ◇ consistent?   ◇
                 │
          YES(Consistent)
                 │
        ┌──────────────────┐
        │       End        │
        └──────────────────┘
```

Diagram 6.52 Flowchart for Checking for System Switching with the system A and system B identification Flags

CHAPTER7 PROGRAMMING CAUTIONS

This chapter provides the programming cautions (restrictions on instructions, and fixed-scan clocks and fixed scan execution type programs).

7.1 Instructions Restricted in Use for Redundant System

Some instructions are restricted in use to a redundant system as indicated below.

(1) Instructions Requiring a Certain Number of Scans

(a) Instruction Operations
Some instructions require a certain number of scans from start to completion of the execution. If system switching conditions are satisfied while this kind of instruction is being executed, the CPU stops the execution and the relevant processing will not be completed.
In this case, it is necessary to use the user program to execute that instruction again after system switching.

Table7.1 Instructions Requiring a Certain Number of Scans

Instruction Classification		Instruction Symbol	Execution Completion Signal
Data-processing Instructions	Sort	• SORT • DSORT	Present
Character String Processing	Read	COMRD	Present
Other Convenient Instructions	Write data to specified file	SP.FWRITE	Present
	Read data to specified file	SP.FREAD	Present
Instructions Dedicated to Intelligent Function Modules [1]		–	Present

* 1: Refer to the manual of the intelligent function module used, for the instructions dedicated to intelligent function modules.

(b) Countermeasures

1) The instruction that includes the complete signal can be executed again by the new control system CPU module, if it has been suspended due to system switching.[2]

However, note that the same instruction might be executed twice.

[Example]

In the following program example, when system switching occurs during execution of the REMFR instruction (M201 : ON) in an MELSECNET/H remote I/O system, the REMFR instruction is re-executed by the new control system CPU module.

- System configuration

Diagram 7.1 shows the system configuration for the example of the REMFR instruction programming.
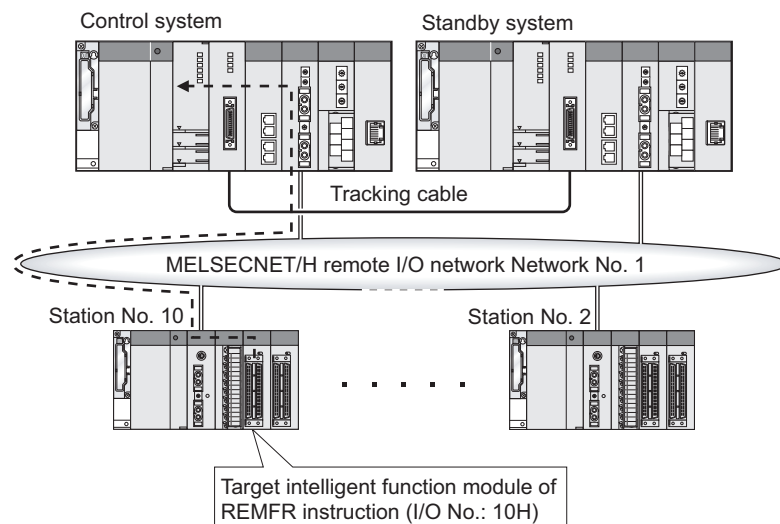
Diagram 7.1 System Configuration

- Relevant devices

Table7.2 indicates the devices used in the program example for the REMFR instruction.

Table7.2 Devices Used for Execution of REMFR Instruction

Device No.	Name	Remarks
SB20	Module status	Refer to the following manual for details of the link special relays (SB) and link special registers (SW).
SB47	Baton pass status of host	
SB48	Status of host	
SB49	Data link status of host	☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O Network)
SW70.9	Baton pass status of each station (10th station)	
SW74.9	Data link status of each station (10th station)	
SM1518	Standby system to control system switching status flag	----
M200	Read request flag	Change the device number according to the system.
M201	REMFR instruction execution flag	
M202	System switching-triggered REMFR instruction re-request flag	
M203	REMFR instruction completed flag	
M204	REMFR instruction abnormally completed flag	

* 2: The complete signal is not tracked even it is set for tracking.

• Program example
Diagram 7.2 shows a program that reads data from the intelligent function module on the remote I/O station by the REMFR instruction.

SM1518 M201 — [SET M202]	Turns ON M202 when system switching occurs during execution of the REMFR instruction.
SM1518 SB20 SB47 SB48 SB49 SW70.9 SW74.9 M203 M200 M201 — [SET M201] M202 — K0 →	Turns ON M201 to execute the REMFR instruction when M200 or M202 is ON, the MELSECNET/H remote I/O network is normal, and normal communication can be made with the remote I/O station of Station No. 10.
K0 → [Z.REMFR "j1" K1 K10 H1 H100 D200 K10 M203]	
SM1518 M203 — [RST M200] [RST M201] [RST M202]	Turns OFF M200 to M202 on completion of the REMFR instruction execution.
M204 — Processing at normal completion	
M204 — Processing at abnormal completion	

Diagram 7.2 Example of REMFR instruction programming

2) The instruction that includes no execution completion signal or write instruction needs to be executed again, as it is difficult to determine if its execution is completed or not.
However, note that the same instruction might be executed twice.

(2) Rise Instruction

If signal flow memory has not been tracked, after system switching, the rise instruction is processed as explained below.

(a) Processing

When the systems are switched, the new control system CPU module turns on data in the signal flow memory.

For this reason, the CPU module does not execute the rise instruction even though the rise instruction execution condition is satisfied before the systems are switched.

(b) Relevant Instructions

- LDP, ANDP, ORP
- MEP
- PLS
- □P (Examples: MOVP, INCP, etc.)
- SP.□ , GP.□ , ZP.□ , JP.□ (Intelligent function module dedicated instructions)
- FF, LEDR, DUTY, TRACE, TRACER

(3) Fall Instruction

If signal flow memory has not been tracked, after system switching, the fall instruction is processed as explained below.

(a) Processing

When the systems are switched, the new control system CPU module turns on data in the signal flow memory.

For this reason, the CPU module executes the fall instruction again if the fall instruction execution condition is turned off before the systems are switched.

(b) Relevant Instructions

- LDF, ANDF, ORF
- MEF
- PLF

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(4) SCJ Instruction
Note that jump processing for the specified pointer (P) varies with whether tracking signal flow memory has been tracked or not, if the SCJ instruction contact turns ON during system switching processing.

(a) When signal flow memory has not been tracked
Jumping is executed from the first scan after system switching.

(b) When signal flow memory has been tracked
Jumping is executed from the second scan or later after system switching.

(When Signal flow memory is not tracking)
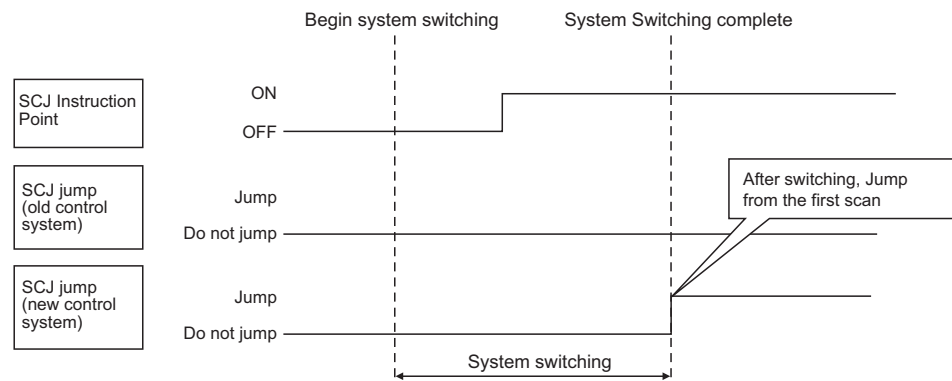
(When Signal flow memory is tracking)
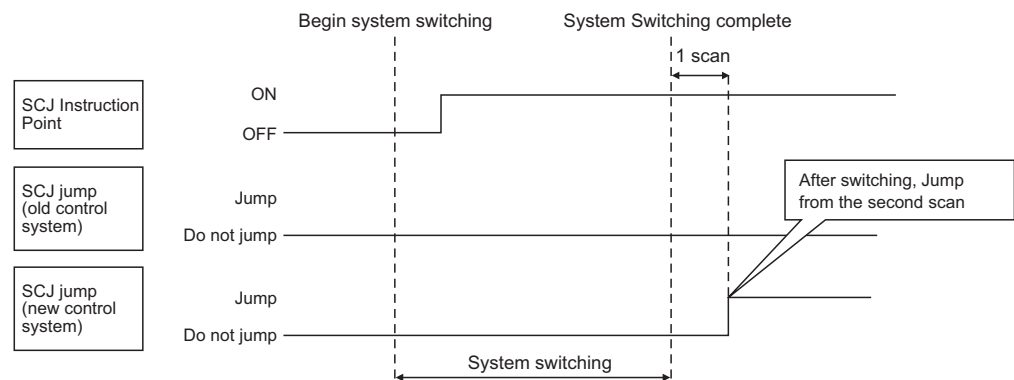
Diagram 7.3 ON/OFF Operation of SCJ Instruction When Signal Flow Has Been Tracked

(5) Instructions that Change CPU Status

When the instruction listed in Table7.3 is executed and the control system CPU module status changes, the information of the changed status will not be sent to the standby system CPU module.

Therefore, if system switching occurs, it is necessary to use the user program to execute that instruction in the new control system CPU, as necessary.

Table7.3 Instructions that Change CPU Status

Instruction Classification		Instruction Symbol
Program Execution Control	Disable Interrupt	DI
	Enable Interrupt	EI
	Interrupt Disable/Enable Setting	IMASK
Change Instruction	File Register Block No. Change	RSET
	File Register File Set	QDRSET
	Comment File Set	QCDSET
Application Instruction	Timing Clock	DUTY

(6) Restrictions when Using Special Relay (SM1518) "Standby System to Control System Switching Status Flag"

This section explains how the rise instruction, for which SM1518 has been set as its execution condition, is processed after system switching, on the assumption that signal flow memory has not been tracked.

(a) Processing

When system switching occurs, the control system CPU module turns on signal flow memory in all steps.

Therefore, the rise instruction, for which SM1518 has been set as its execution condition, cannot be executed after system switching.

After system switching, startup execution instructions are not run.

Diagram 7.4 Program for DUTY Instruction Using SM1518

Create a program to be executed at the time of SM1518 shutdown using shutdown pulse operation contact as shown in the diagram below when startup execution instructions with SM1518 execution conditions are executed.

The instruction is executed at the second scan after system switching, in order that the fall instruction will be executed upon SM1518 fall.

After system switching, perform DUTY instruction during SM1518 shutdown.

Diagram 7.5 Program That Executes DUTY Instruction on the Falling Edge of SM1518

(b) Relevant Instructions
- PLS
- □P(Examples: MOVP,INCP, etc.)
- SP.□ ,GP.□ ,ZP.□ ,JP.□ (Intelligent Function Module Dedicated Instructions)

(7) Restrictions on Use of COM and ZCOM Instructions

The COM and ZCOM instructions execute refresh between the Redundant CPU and network module during program execution.

In a redundant system, there are restrictions on the selection of the refresh items by the COM and ZCOM instructions.

Table7.4 lists the refresh items by the COM and ZCOM instructions and whether they can be selected or not in the redundant system.

Table7.4 Refresh Items by COM and ZCOM Instructions and Whether
They Can Be Selected or Not in Redundant System

Instruction symbol	Refresh item [3]	Selection in redundant system
COM	I/O refresh	○
	Network module refresh	× [1]
	Auto refresh of intelligent function module	× [2]
	Auto refresh of CPU shared memory	×
	General data processing	○
ZCOM	Network module refresh	× [1]
	Auto refresh of intelligent function module	× [2]

○ : Selectable, × : Not selectable

* 1: Tracking is not executed when the COM or ZCOM instruction is executed.
  If system switching occurs due to any of reasons for system switching indicated in No. 1 of Table7.5 from when the COM instruction or ZCOM instruction is executed until tracking is completed, system switching is done without tracking being performed.
  Hence, any change made to the output to the network module by the COM/ZOM instruction in the control system CPU module will not be reflected on the standby system CPU module.
  Since the new control system CPU module provides the old output to the network module after system switching, the output from the network module may change.

Table7.5 Reasons for System Switching and Output Changes at System Switching

No.	Reasons for System switching	Output change when COM/ ZCOM instruction is used
1	• Control system power off • Control system CPU module reset • Control system hardware fault • Control system CPU module stop error	Since system switching is executed without tracking, the output may change at the time of system switching.
2	• System switching request from network module • System switching instruction execution • System switching request from GX Developer or OPS	Since system switching is done after tracking, the output does not change at system switching.

* 2: Not selectable since an intelligent function module cannot be mounted on the main base unit in the redundant system.
* 3: For the COM instruction, select the refresh item with the special relay "Link refresh selection during COM instruction execution (SM775)" and special register "Link refresh selection during COM instruction execution (SD778)".

Remark •

Refer to the following manual for details of the COM instruction and ZCOM instruction.

☞ MELSEC-Q/L Programming Manual (Common Instruction)

• •

(8) Dedicated instructions for intelligent function module mounted to extension base unit

The dedicated instructions for the intelligent function module mounted to the extension base unit cannot be used.

If used, a stop error "OPERATION ERROR" (error code: 4122) occurs.

Remark •

For the dedicated instructions for the intelligent function module, refer to the manual for the intelligent function module to be used.

• •

7.2 Cautions on Fixed-Scan Clocks and Fixed Scan Execution Type Programs

(1) Fixed-scan Clocks (SM409 to SM415)

When system switching occurs, fixed-scan clock measurement is suspended until system switching is complete.
When system switching is complete, the new control system CPU module starts all fixed-scan clocks from OFF.

Therefore, the OFF time is extended (T+t') as shown in Diagram 7.6.
The maximum value of the extension time when t=t' is (T+t).

t : ? x fixed cycle interval
T : System switching time
t' : period between start of fixed cycle clock OFF and beginning of system switching ($0 \leqq t' < t$)
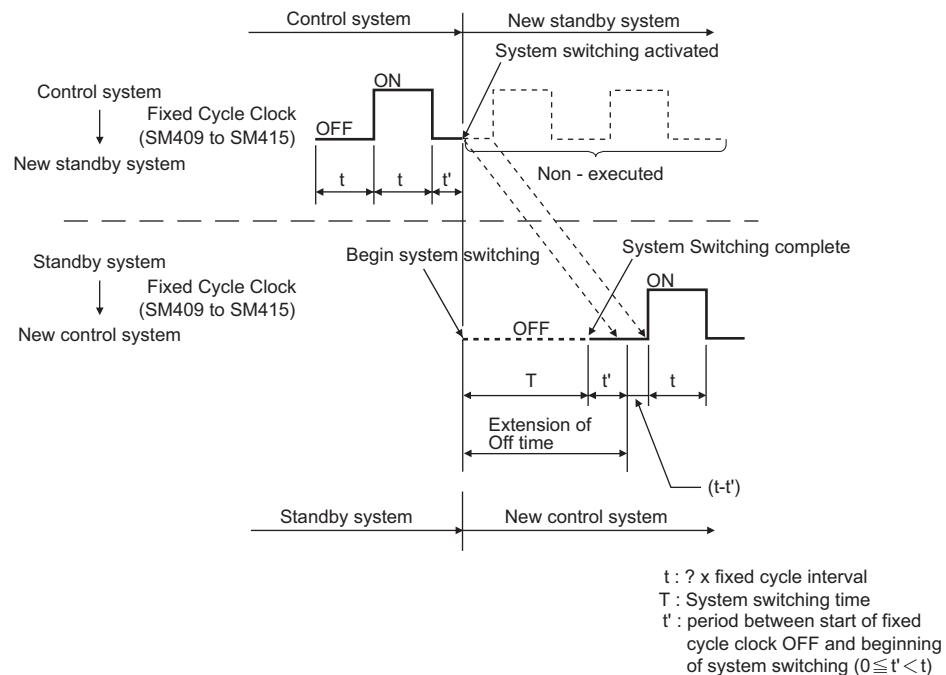
Diagram 7.6 Operations of Fixed-scan Clocks at System Switching

(2) Fixed-scan Clocks (SM420 to SM424)

When system switching is complete, SM420 to SM424 remain OFF in the new control system CPU module.
Execute the DUTY instruction in the new control system CPU module to make SM420 to SM424 usable in the new control system CPU module.

[Example]
A program starting an SM420 timing clock (1 scan: ON, 3 scan: OFF) by executing the DUTY instruction in the new control system CPU module.

Diagram 7.7 Program That Executes Fixed-scan Clock (SM420) after System Switching

* 1 : This is the contact point for 1 scan: ON in the new control system after SM1518 system switching.
If DUTY instructions are executed for SM1518 shutdown, the DUTY instructions are executed on the second scan following system switching.

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(3) Fixed scan execution type Program

When system switching occurs, the execution of fixed scan execution type programs is suspended until system switching is complete.

When system switching is complete, the new control system CPU module starts counting the fixed-scan interval time from 0.

Therefore, the fixed scan execution interval time is increased (T+α') as shown in Diagram 7.8.

The maximum value for the extension time is (T+α) when $\alpha = \alpha$'.

α : Fixed Cycle Interval
T : System switching time
α': Period between starting scan execution type program and system switching
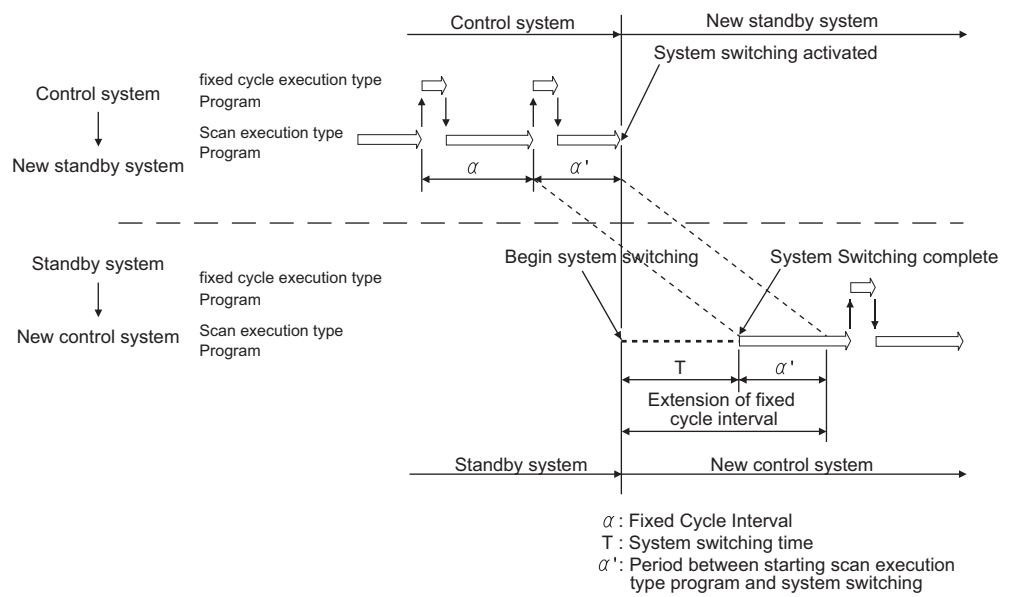
Diagram 7.8 Operations of Fixed Scan Execution Type Programs at System Switching

7.2 Cautions on Fixed-Scan Clocks and Fixed Scan Execution Type Programs

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(4) Interrupt by the Internal Timer (I28 to I31)

When system switching occurs, execution of interrupt is suspended until system switching is complete.

Also, interrupt from the module mounted on the extension base unit cannot be made. When system switching occurs, the new control system CPU module starts counting the interrupt interval time from 0.

Therefore, the fixed scan execution interval is increased (T+ α') as shown in Diagram 7.9.

The maximum value for the extension time is (T+ α) when $\alpha = \alpha$'.

α : Interrupt interval
T : System switching time
α' : Period between starting scan execution type program and system switching
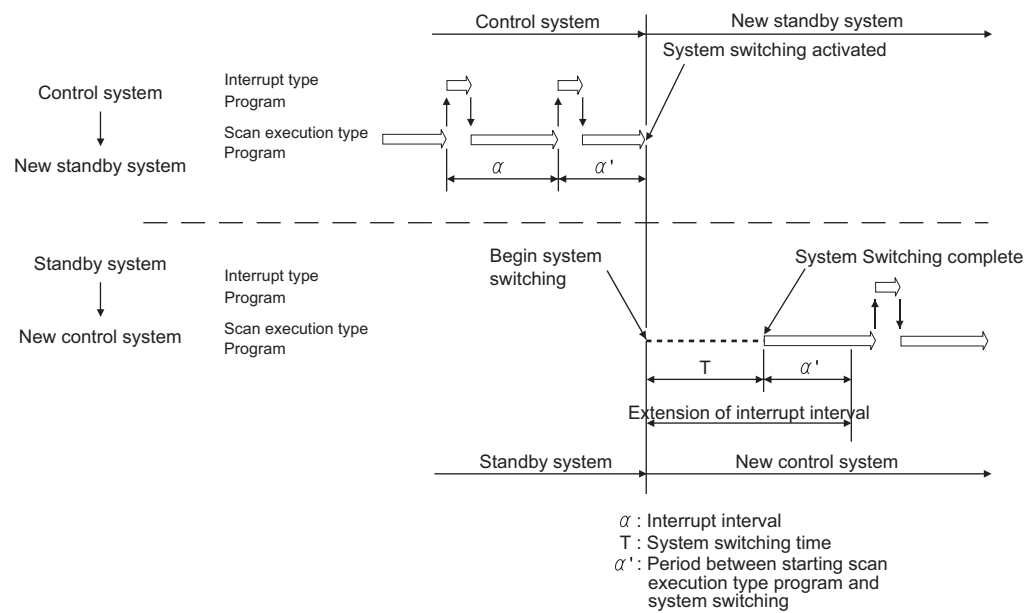
Diagram 7.9 Operations of Interrupts by Internal Timers at System Switching

(5) Interrupt from Network module

Execution of the interrupt program that corresponds to the interrupt factor sent from a network module varies according to the following conditions.

(a) When the Operation Mode is Backup Mode

1) When System Switching Occurs before Execution of the Interrupt Program

The control system CPU module holds the received interrupt factor, even when it becomes the standby system CPU module through system switching before the interrupted program is executed.

When switching is done again and the standby system CPU module returns to the control system CPU module, it executes the interrupt program for the held interrupt factor.

Since the interrupt factor accepted by the control system CPU module is not taken over by the new control system CPU module, the new control system CPU module does not execute the interrupt program of the interrupt factor accepted by the control system CPU module.

2) When the Standby System CPU Module receives an interrupt

The standby system CPU module holds the interrupt factor received from an intelligent function module.

When the standby system CPU module becomes the new control system CPU module through system switching, it executes the interrupt program for the held interrupt factor.

⊠**POINT**

The interrupt program corresponding to the held interrupt factor is executed when the standby system CPU module becomes the control system CPU module through system switching.

If multiple interrupt factors are held in the standby system CPU module, the scan time is widely extended.

(b) When the Operation Mode is Separate Mode

Both control system CPU module and standby system CPU module execute interrupt programs for the interrupt factors sent from a network module.

(c) When the Operation Mode is Debug Mode

The control system CPU module executes an interrupt program for the interrupt factor sent from a network module.

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(6) Interrupt during Tracking Processing

If interrupt is enabled (EI status) during END processing, when an interrupt is issued during tracking processing, the CPU will stop the tracking processing and execute the interrupt program.

Therefore, both data of before and after interrupt program execution might be tracked.

[Example]
The operations for interrupted (I31) execution via an internal timer are shown in Diagram 7.10.
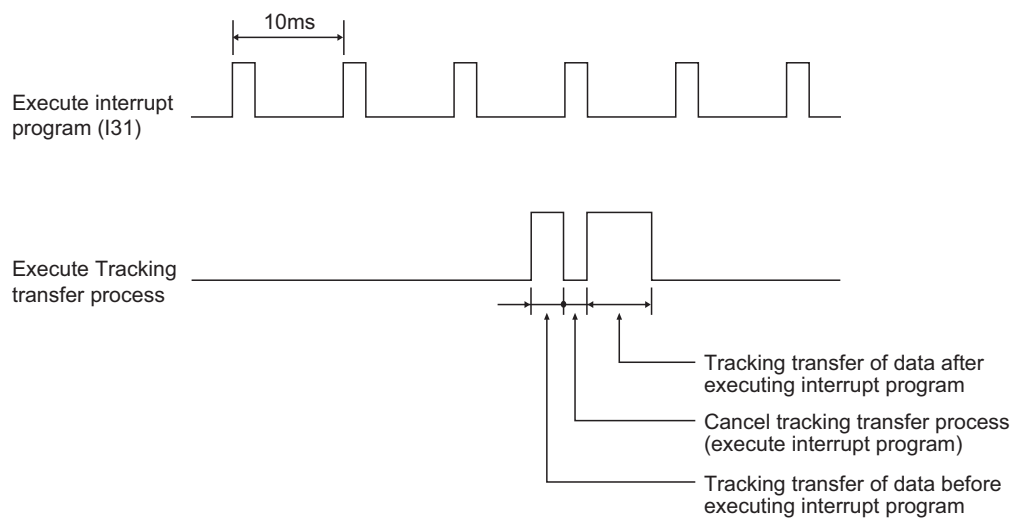
Diagram 7.10 Operations When Interrupt Is Executed by Internal Timer

When execution of programs interrupted during tracking processing is not done, execute DI instructions, then execute EI instructions at step 0 before executing END instructions, as shown in the program in the Diagram 7.11.

As interrupt is disabled during END processing (including tracking processing), the CPU will not execute the interrupt program.
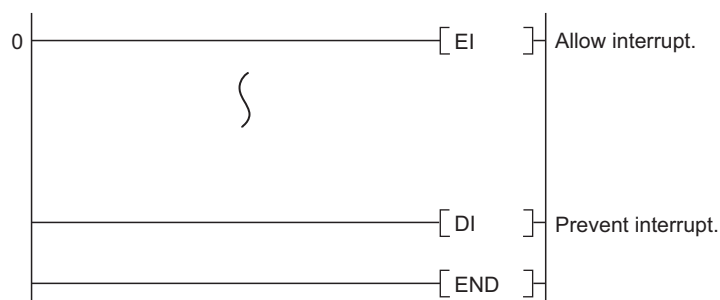
Diagram 7.11 Program Example That Disables Interrupts during END Processing

7.3 Precautions for Using Annunciator (F) in Redundant System

The annunciator defaults to no tracking.
In the tracking setting of the Redundant parameter dialog box, the annunciator can be set to within the tracking range.
Table7.6 provides an operation example of the control system and standby system CPU modules when the annunciator is set to within the tracking range and the annunciator (F10) is turned ON in the control system CPU module.

Table7.6 Operations of Control System and Standby System CPU Modules When F10 Is Turned ON in Control System CPU Module

Item		Control System CPU Module	Standby System CPU Module
F10	Annunciator	ON	ON
SM62	Annunciator detection	ON	OFF
SD62	Annunciator No.	The annunciator No. turned on is stored.	No change
SD63	No. of annunciators	Number of annunciators turned on is stored.	No change
SD64 to SD79	Annunciator detection number table	The annunciator No. turned on is stored.	No change
"USER" LED		On	Off

If system switching occurs when the annunciator (F10) turns on in the control system CPU module, whether the annunciator is on or not cannot be checked by the USER LED since the USER LED is off in the new control system CPU module.
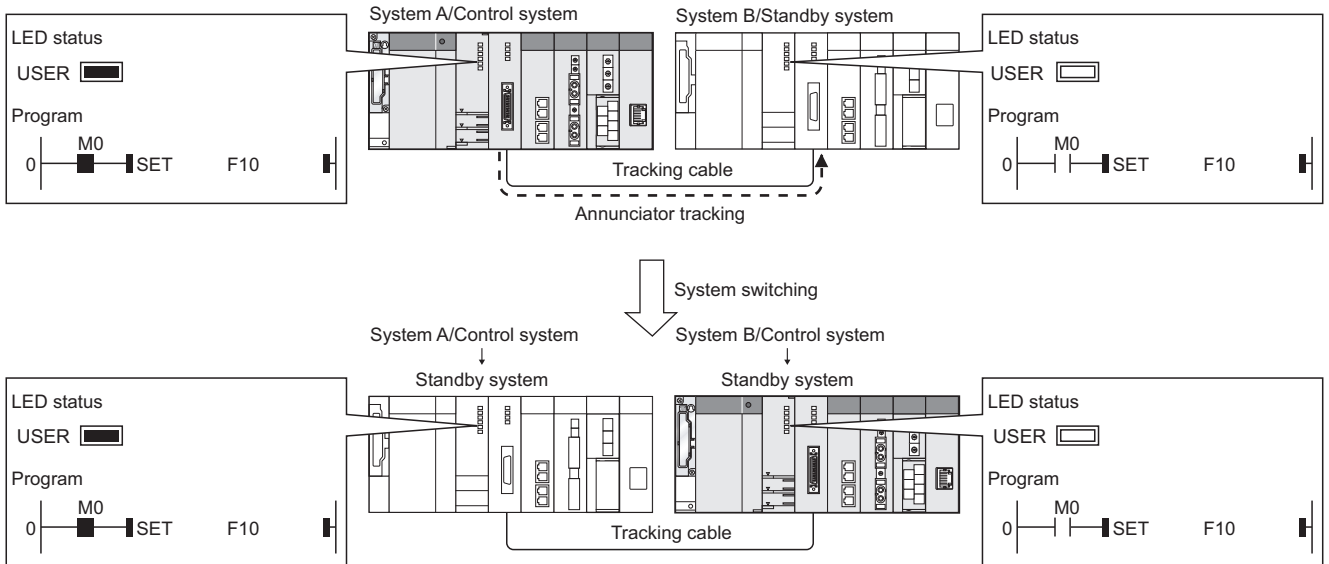
Diagram 7.12 Operation of USER LED When Annunciator (F10) Turns On

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Create the following program to turn on the "USER" LED of the new control system CPU module at occurrence of system switching.

(1) When turning on another annunciator at system switching to turn on the "USER" LED

When tracking the annunciator, create the following program to also turn on the "USER" LED of the new control system CPU module.

[Program example]
When any of the used 32 annunciators F0 to F31 is on in the new control system CPU module, the "USER" LED is turned on.
To turn off the "USER" LED, turn on the "USER" LED off command (M100).


```
     SM1518
0 ──┤ ├──[D<>    K8F0     K0 ]────────────[ SET   F2047 ]    When K8F0 ≠ 0, F2047 provided to
                                                              turn on the "USER" LED is turned on.
     M100
8 ──┤ ├──────────────────────────────────[ RST   F2047 ]    When M100 turns on, F2047 is turned off.

    └────────────────────────[DMOVP   K0      K8F0 ]         When M100 turns on, F0 to F31 are turned off.

    └──────────────────────────────────────[ RST   M100 ]   After F2047 is turned off and F0 to F31 are
                                                              turned off, M100 is turned off.
```
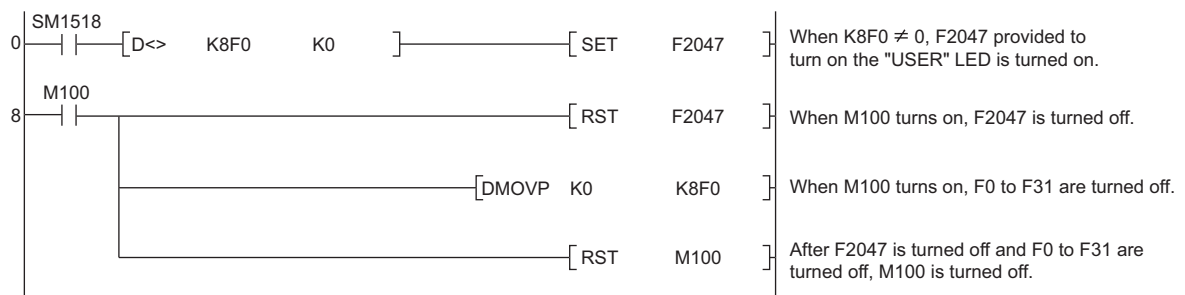
Diagram 7.13 Program That Turns on the "USER" LED after System Switching

(2) When turning on the annunciators in the new control system CPU module at system switching

By turning on the annunciators in the new control system, the "USER" LED can be turned on.

(a) When turning on the annunciators by the "OUT" instruction

By tracking the "OUT" instruction execution condition, the annunciators can also be turned on in the new control system CPU module at system switching.


```
        M0  ⤺ Tracking is executed
0 ──────┤ ├─────────────────────────────( F10 )    F10 is turned on after system switching.

        M1
3 ──────┤ ├─────────────────────────────( F11 )    F11 is turned on after system switching.
```
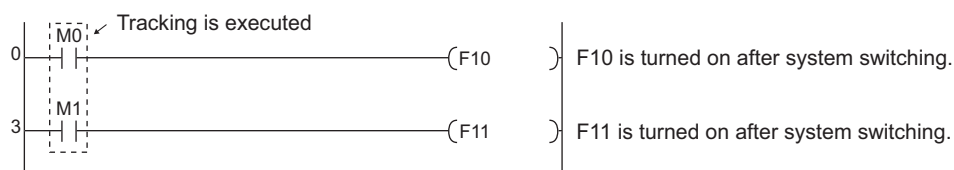
Diagram 7.14 Program That Turns on the Annunciators by the OUT Instruction after System Switching

(b) When turning on the annunciators by the "SET" instruction

By creating the following program and tracking the "SET" instruction execution condition, the annunciators can also be turned on in the new control system CPU module at system switching.

Tracking is executed

```
       M0    SM1518
0 ─────┤├──────┤/├──────────[SET    F10 ]   F10 is turned on at the second scan
                                             (SM1518: ON → OFF) after system switching.[1]

       M1    SM1518
4 ─────┤├──────┤/├──────────[SET    F10 ]   F11 is turned on at the second scan
                                             (SM1518: ON → OFF) after system switching.[1]
```
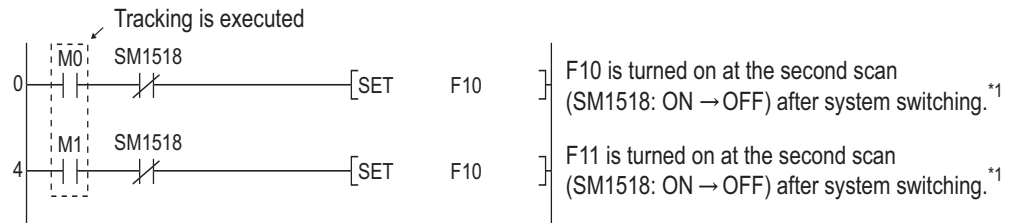
Diagram 7.15 Program That Turns on the Annunciators by the SET Instruction after System Switching

* 1: SM1518 is a contact that turns on in the new control at occurrence of system switching and remains ON for one scan.

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7.4 Precautions at System Switching Occurrence

(1) Precautions regarding access to intelligent function module and external device

Depending on timing of system switching occurrence such as turning power supply OFF, tracking transfer processing may be discontinued, and the device data may not be reflected to the new control system CPU module after switching systems.

In this case, the data output and the device data of the new control system CPU module may mismatch.

When the CPU module communicates with the intelligent function module or external device using the output (Y) and the buffer memory, a program may not operate properly due to device data mismatch after switching systems.

Diagram 7.17 shows operations when the system switching occurs before the tracking transfer processing is completed after outputting the output (Y).

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• Input is returned corresponding to output

Response (input) (X10)

Output (Y10)

[Program example]

```
    M0      X10
────┤├──────┤/├──────────────────[ SET      Y10      ]
```


Tracking setting is set to M, X, and Y
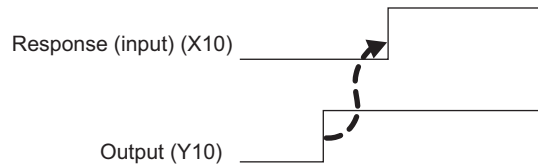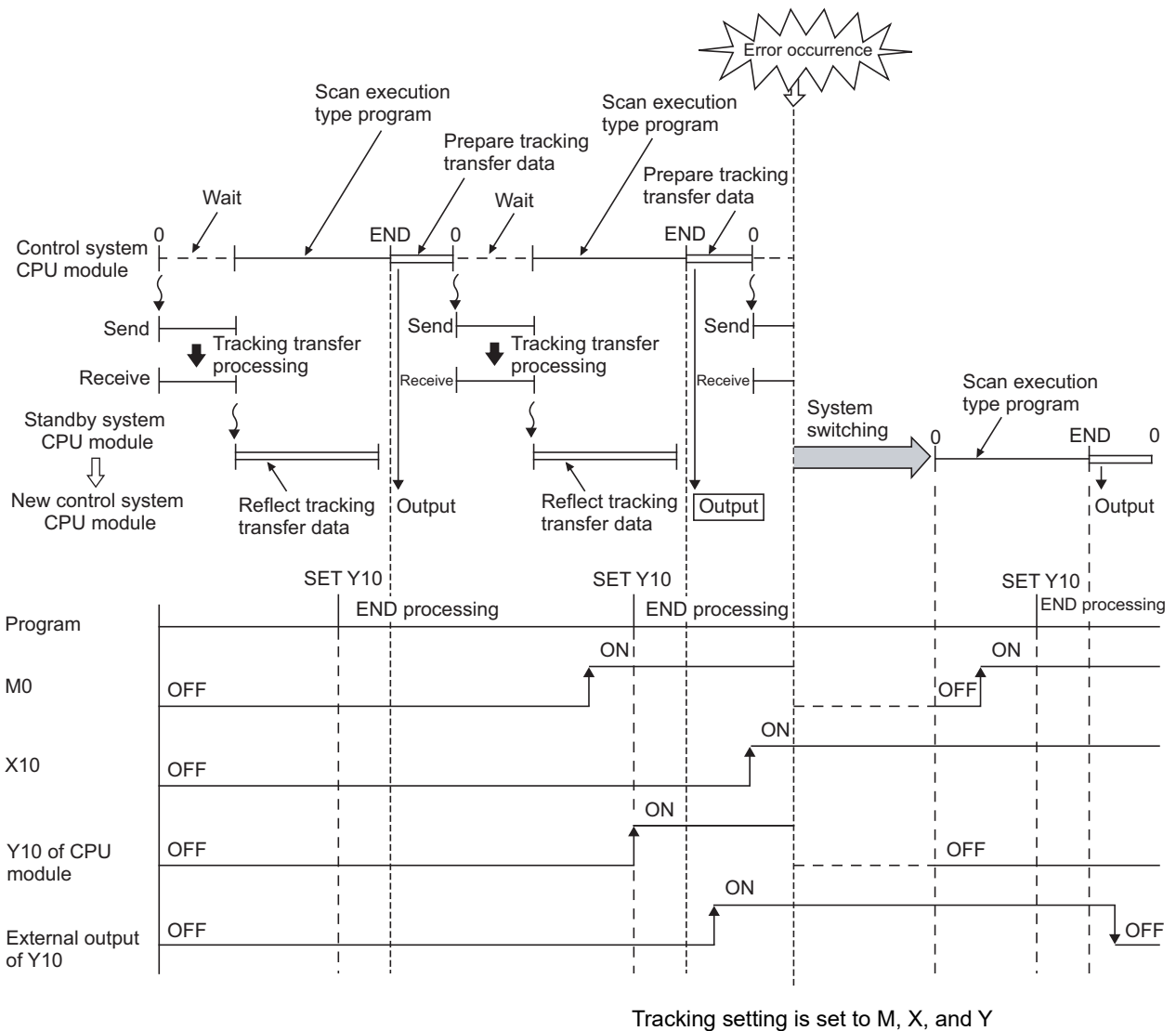
Diagram 7.16 Data Output is Not Reflected to New Control System CPU Module

7.4 Precautions at System Switching Occurrence

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When outputting the command output (e.g., output (Y), start-up by writing to buffer memory, clear etc.), consider time required for transferring conditions to the standby system CPU module from the control system CPU module.

Diagrams 7.18 and 7.19 show a program example which delays the output by one scan from the command output condition establishment.

(a) Input is returned corresponding to output

Response (input) (X10)

Output (Y10)

[Program example]

(Before measures)

```
  M0     X10     Y10
──┤ ├────┤/├─────┤/├──────────────────────[ SET     Y10    ]

  M10    X10     Y10
──┤ ├────┤ ├─────┤ ├──────────────────────[ RST     Y10    ]
```

(After measures)

```
  M1
──┤ ├───────────────────────────────────[ SET     Y10    ]

  M0     X10     Y10
──┤ ├────┤/├─────┤/├──────────────────────[ PLS     M1     ]    Delays SET Y10 by one
                                                               scan from PLS M1.

  M11
──┤ ├───────────────────────────────────[ RST     Y10    ]

  M10    X10     Y10
──┤ ├────┤ ├─────┤ ├──────────────────────[ PLS     M11    ]    Delays RST Y10 by one
                                                               scan from PLS M11.
```
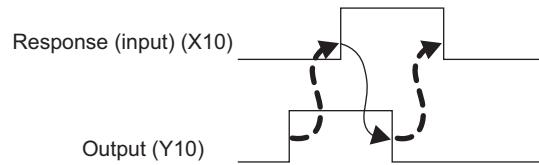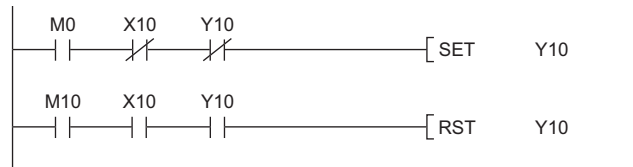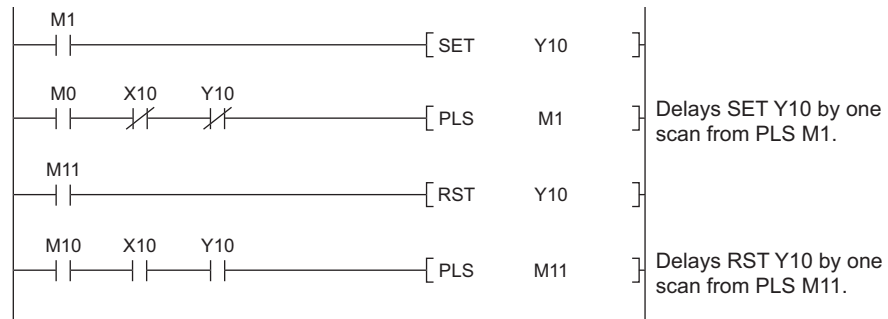
Diagram 7.17 Program Example when there is Response (Input) to Output

(b) Output is returned corresponding to external input

Response (input) (X10)

Output (Y10)

[Program example]

(Before measures)

```
  M0    X10   Y10
 ─┤ ├──┤ ├──┤/├────────────────[ SET      Y10  ]

  M10   X10   Y10
 ─┤ ├──┤/├──┤ ├────────────────[ RST      Y10  ]
```

(After measures)

```
  M1
 ─┤ ├──────────────────────────[ SET      Y10  ]

  M0    X10   Y10
 ─┤ ├──┤ ├──┤/├────────────────[ PLS      M1   ]    Delays SET Y10 by one
                                                     scan from PLS M1.
  M11
 ─┤ ├──────────────────────────[ RST      Y10  ]

  M10   X10   Y10
 ─┤ ├──┤/├──┤ ├────────────────[ PLS      M11  ]    Delays RST Y10 by one
                                                     scan from PLS M11.
```
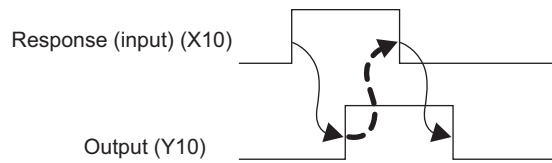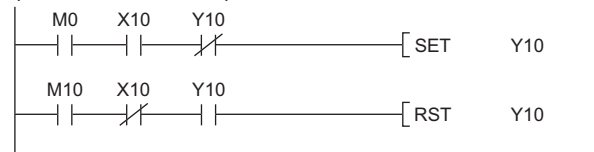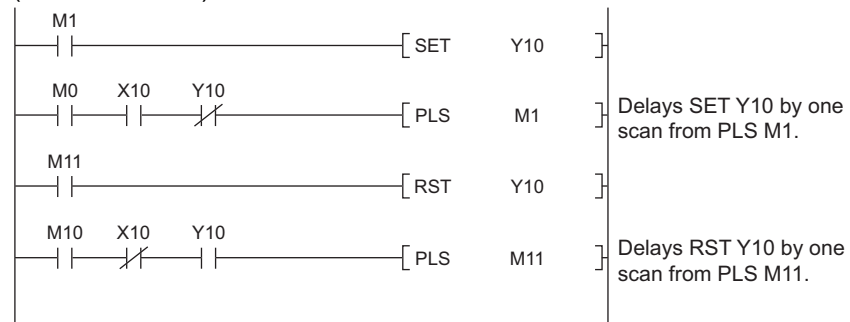
Diagram 7.18 Program Example when there is Response (Output) to External Input

⊠POINT

Set [Do tracking] of [Signal flow memory tracking setting] at [Tracking settings] of [Redundant parameter].

(2) Precautions regarding timer

Pay attention to the following points regarding timer at the time of system switching occurrence.

1) The present value of timer at the first scan of the new control system CPU module at the time of system switching occurrence.

2) Depending on timing of system switching occurrence such as turning power supply OFF, tracking transfer processing may be discontinued, and the device data may not be reflected to the new control system CPU module after switching systems.

   In this case, the timer whose time is up before switching systems may not be recognized even after the first scan after system switching.

3) When output (output (Y), writing to buffer memory) is performed from the timer contact, the timer goes into the above-mentioned 2) status, which leads to chattering of the output.
   When the CPU module communicates with the module or external device using the output (Y) and buffer memory, the program may not operate normally due to chattering of the output after system switching.
   The operation for the case where the system switching occurs before the tracking transfer processing is completed after outputting the output (Y) from the timer contact is shown in Diagram 7.19.

[Program example]
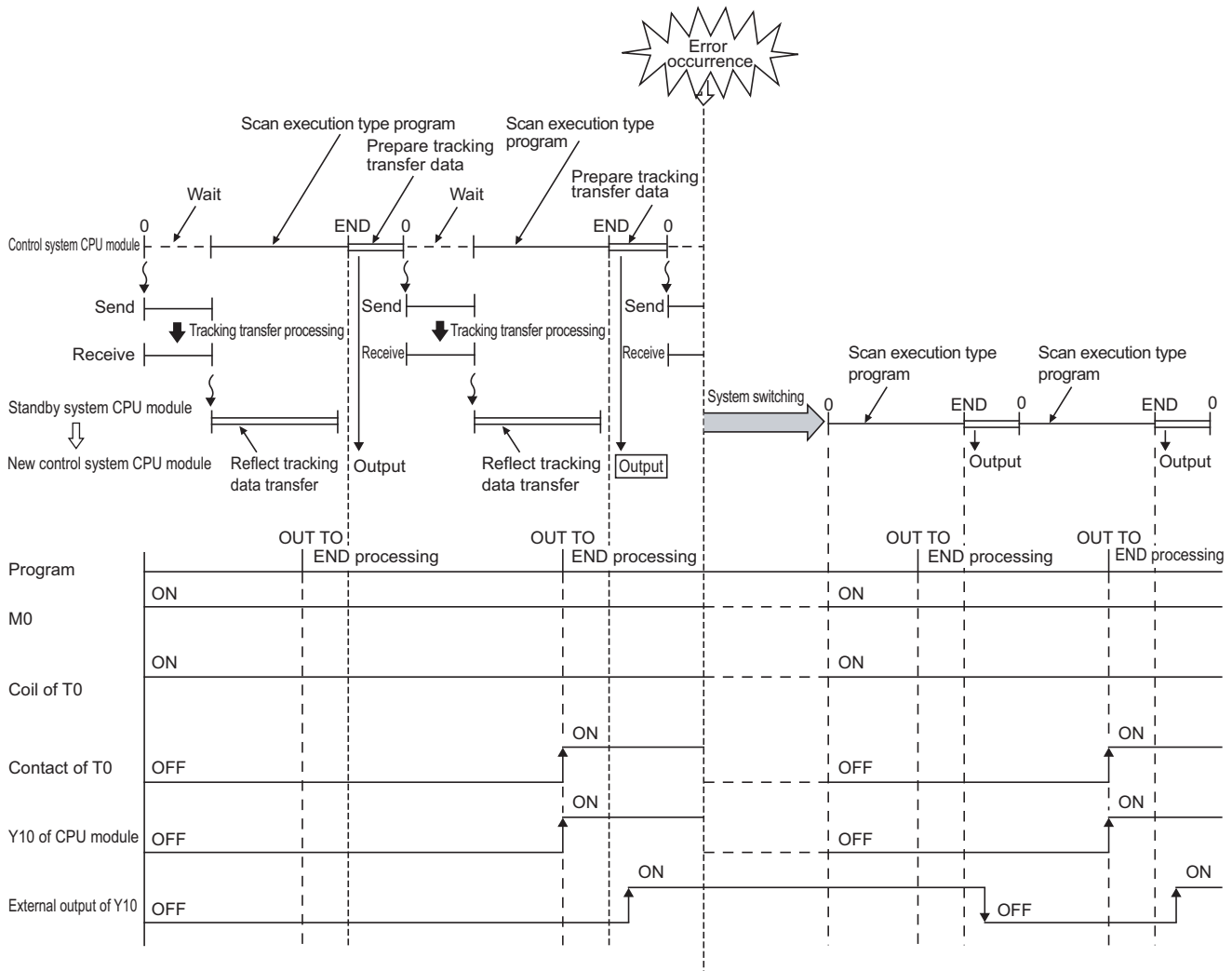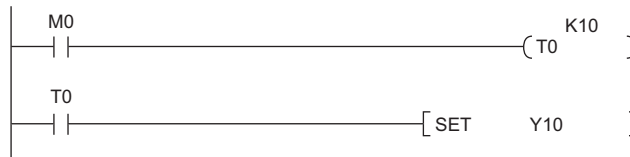
Diagram 7.19 Chattering Occurs to Output by Timer Contact

When outputting the output (Y) or writing buffer memory to a module or external device, consider time required for tracking transfer from the control system CPU module to the standby system CPU module.
The program example to output, delaying one scan from the time up of the timer, is shown in Diagram 7.20.

[Program example]

(Before measures)

```
   T0
───┤├──────────────────────────────[ SET      Y10    ]

   T10
───┤├──────────────────────────────[ RST      Y10    ]
```

(After measures)

```
   M1
───┤├──────────────────────────────[ SET      Y10    ]

   T0
───┤├──────────────────────────────[ PLS      M1     ]     Delays SET Y10 by one
                                                            scan from PLS M1.
   M11
───┤├──────────────────────────────[ RST      Y10    ]

   T10
───┤├──────────────────────────────[ PLS      M11    ]     Delays RST Y10 by one
                                                            scan from PLS M11.
```
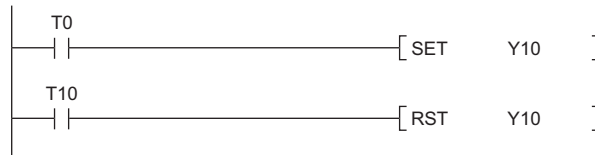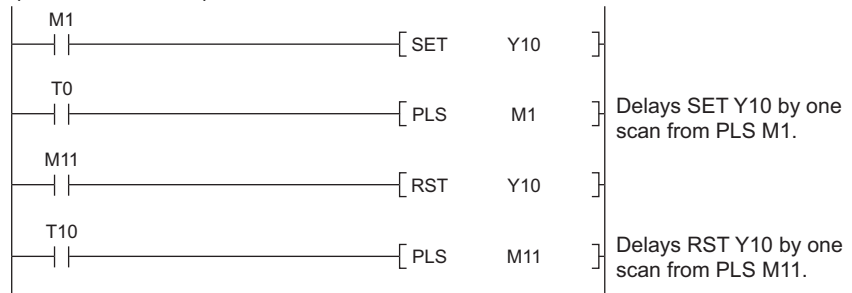
Diagram 7.20 Program Example when Outputting by timer contact

⊠POINT

Set [Do tracking] at [Signal flow memory tracking setting] on [Tracking settings] in redundant parameter.

(3) Precautions regarding writing data from the GOT and external device etc.

Pay attention to the following points regarding writing data from the GOT and external device etc.

1) The tracking data may not be reflected to the new control system CPU module depending on the timing of the system switching occurrence such as turning power supply OFF.
   In this case, data written immediately before switching systems by the GOT or external device may disappear. Rewrite data after switching systems.

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7.5 Precautions of Programming when Connecting Extension Base Unit

This section describes the precautions of programming when connecting the extension base unit.

(1) Precautions for using PX Developer

As for the following functions, use the dedicated instructions. Do not use them to Ethernet module mounted to the extension base unit.

- Communication control FB (SEND, RECV)
- Event notification

(2) Functions applicable in GX Works2, GX Developer, and PX Developer

MELSOFT products connectable to a module mounted on the extension base unit are GX Works2, GX Developer, and PX Developer. However, there are restrictions on applicable functions.

For details, refer to the following manuals.

☞ GX Works2 Version 1 Operating Manual (Common)

☞ GX Developer Version 8 Operating Manual

☞ PX Developer Version 1 Operating Manual (Programming Tool)

(3) Tracking device setting

When tracking device setting is not set, the program is executed using the value before refresh is performed at the first scan after switching systems

Set the following devices at the tracking device setting.

- Device which performs auto refresh setting to the intelligent function module mounted on the extension base unit by GX Configurator
- Device that makes auto refresh setting to the CC-Link master module on the extension base unit

(4) Prohibition of using an interrupt pointer

When interrupting from the intelligent function module mounted to the extension base unit, an interrupt pointer cannot be used.

If set, "CAN'T EXECUTE(I)" (error code: 4225) occurs at the time of start-up.

(5) Prohibition using of direct output (DY)

Do not use direct output (DY) to mounted modules on extension base unit.

When data are output to modules with direct output (DY), other 15 bits in 1 word may be off once at the first scan after the system switching.

[Example]

When DY13 turns on, Y10 to Y12 and Y14 to Y1F may turn off.
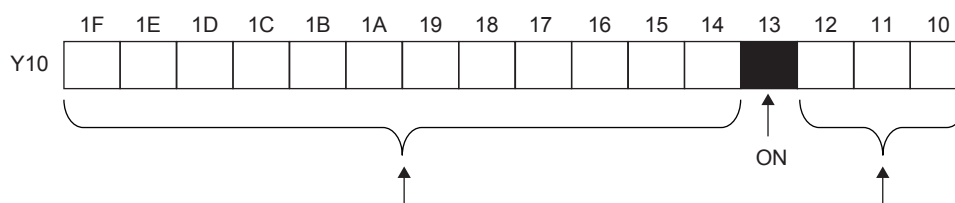
CHAPTER8 TROUBLESHOOTING

This chapter provides troubleshooting methods of redundant system.

Error codes, special relays, and special registers of redundant CPU are not covered in this manual. Refer to the following manual, for error codes, special relays, and special registers of redundant CPU.

☞QCPU User's Manual (Hardware Design, Maintenance and Inspection)

The CPU module status can be confirmed by the LEDs, which are situated on the front face of the CPU module. The CPU module LEDs necessary for troubleshooting of redundant system are explained here.
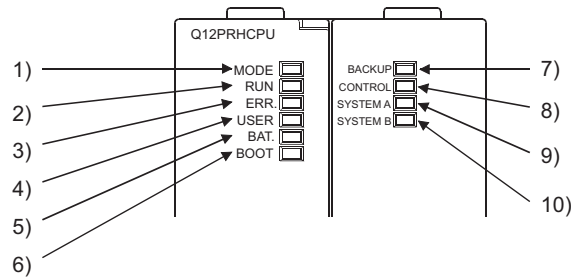
Diagram 8.1 CPU Module LEDs

Table8.1 LED Names and Explanations

No.	Name	Explanation
1)	MODE LED	Indicates the CPU module mode. On (Green)　　　: Q Mode. Flashing (Green) : External I/O Forced ON/OFF has been registered.
2)	RUN LED	Indicates the CPU module operation status. On　　　　: The CPU is Running. The RUN/STOP switch: RUN position. Off　　　　: The CPU has Stopped. The RUN/STOP switch: STOP position. 　　　　　　The standby system CPU module in backup mode. 　　　　　　(The RUN/STOP switch: RUN position.) 　　　　　　An error that stops operation has been detected. Flashing : The RUN/STOP switch is set to the STOP position to write parameters/ programs into CPU, and then the switch is returned from the STOP to RUN position. The standby system CPU module for which the operation mode is switched from backup mode to separate mode.
3)	ERR.LED	On　　　　: The self diagnostics error that does not stop the operation (other than battery error) is detected. 　　　　　　(The settings have been made by the parameter so that the operation is continued when an error is detected.) Off　　　　: Normal. Flashing : An error that stops operations has been detected. 　　　　　　Automatic write to the standard ROM is completed (BOOT LED is also flashing.)

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Table8.1 LED Names and Explanations (Continued)

No.	Name	Explanation
4)	USER LED	On : An error has been detected with the CHK instruction, or annunciator F turns on. Off : Normal. Flashing : Latch clear is executed.
5)	BAT.LED	On : A battery error has occurred due to battery voltage drop in the CPU module or memory card. Off : Normal.
6)	BOOT LED	On : Boot operation has started. Off : Boot operation has not been executed. Flashing : Automatic write to the standard ROM is completed. (The ERR.LED is also flashing.)
7)	BACKUP LED	Indicates the operation mode, i.e., backup mode or separate mode. On (Green) : Backup mode. On (Red) : Unable to continue the control (RUN) because of system switching. On (Amber) : Separate mode. Off : Debug mode. Indicates as shown below, when the memory copy from control system to standby system is being executed. _(see table below)_
8)	CONTROL LED	Indicates the system of the CPU module, i.e., control system or standby system. On : Control system (System switching is possible, as the standby system is normal.)Debug mode. Off : Standby system.
9)	SYSTEM A LED	Indicates the system A CPU module status. On : Operating as system A Debug mode Flashing : The tracking cable has been disconnected while the CPU module is normally operating as system A (Flashing until the system A connector of the tracking cable is connected.) Off : Not operating as system A, i.e., operating as system B. (The SYSTEM B LED is On.)
10)	SYSTEM B LED	Indicates the system B CPU module status. On : Operating as system B Flashing : The tracking cable has been disconnected while the CPU module is normally operating as system B. (Flashing until the system B connector of the tracking cable is connected.) Off : Not operating as system B, i.e., operating as system A. (The SYSTEM A LED is On.) Debug mode.

Table within BACKUP LED (7):

	Back up mode operation		Separate mode operation	
	Control system	Standby system	Control system	Standby system
Executing memory copy	Lit (Red)	Flashing (Red)	Lit (Amber)	Flashing (Amber)
Memory copy successfully completed	Lit (Red)	Lit (Red)	Lit (Amber)	Lit (Amber)

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8.1 Troubleshooting Flow

This section provides the troubleshooting for each possible case.

```
        ┌──────────────────────────┐
        │      Error Details       │
        └──────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────┐      ┌──────────────────────────────────────────────────────────┐
│ The "MODE" LED does not light up │─────▶│ Section 8.1.4  To the flow for when the "RUN" LED does not light up │
└─────────────────────────────────┘      └──────────────────────────────────────────────────────────┘
                    │
                    ▼
            ╱───────────────╲
          ╱  The "BACKUP" LED is ╲
          ╲   lit up solid red  ╱
            ╲───────────────╱
          NO │        │ YES
             │        ▼
             │   ┌─────────────────────────────────┐      ┌──────────────────────────────────────────┐
             │   │ The "SYSTEM A/B" LED is lit      │─────▶│ Section   To the flow for when the        │
             │   └─────────────────────────────────┘      │ 8.1.2     "BACKUP" LED is lit up solid red │
             │                                             └──────────────────────────────────────────┘
             │   ┌─────────────────────────────────┐      ┌──────────────────────────────────────────┐
             │   │ The "SYSTEM A/B" LED is flashing │─────▶│ Section   To the flow for when the        │
             │   └─────────────────────────────────┘      │ 8.1.3     "SYSTEM A/B" LED is flashing    │
             │                                             └──────────────────────────────────────────┘
             ▼
┌─────────────────────────────────┐      ┌──────────────────────────────────────────────────────────┐
│ The "RUN" LED does not light up  │─────▶│ Section 8.1.4  To the flow for when the "RUN" LED does not light up │
└─────────────────────────────────┘      └──────────────────────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────┐      ┌──────────────────────────────────────────────────────────┐
│ A system switching  has occurred │─────▶│ Section 8.1.5  To the flow for when a system switching has occurred │
└─────────────────────────────────┘      └──────────────────────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────┐      ┌──────────────────────────────────────────────────────────┐
│ The system switching could not be done │▶│ Section 8.1.6  To the flow for when a system switching could not be performed │
└─────────────────────────────────┘      └──────────────────────────────────────────────────────────┘
```

Diagram 8.2 Troubleshooting Flow

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8.1.1 Flow for the Case where the "MODE" LED is not ON

Diagram 8.3 is for the case where the "MODE" LED does not turn on when the programmable controller is powered on.
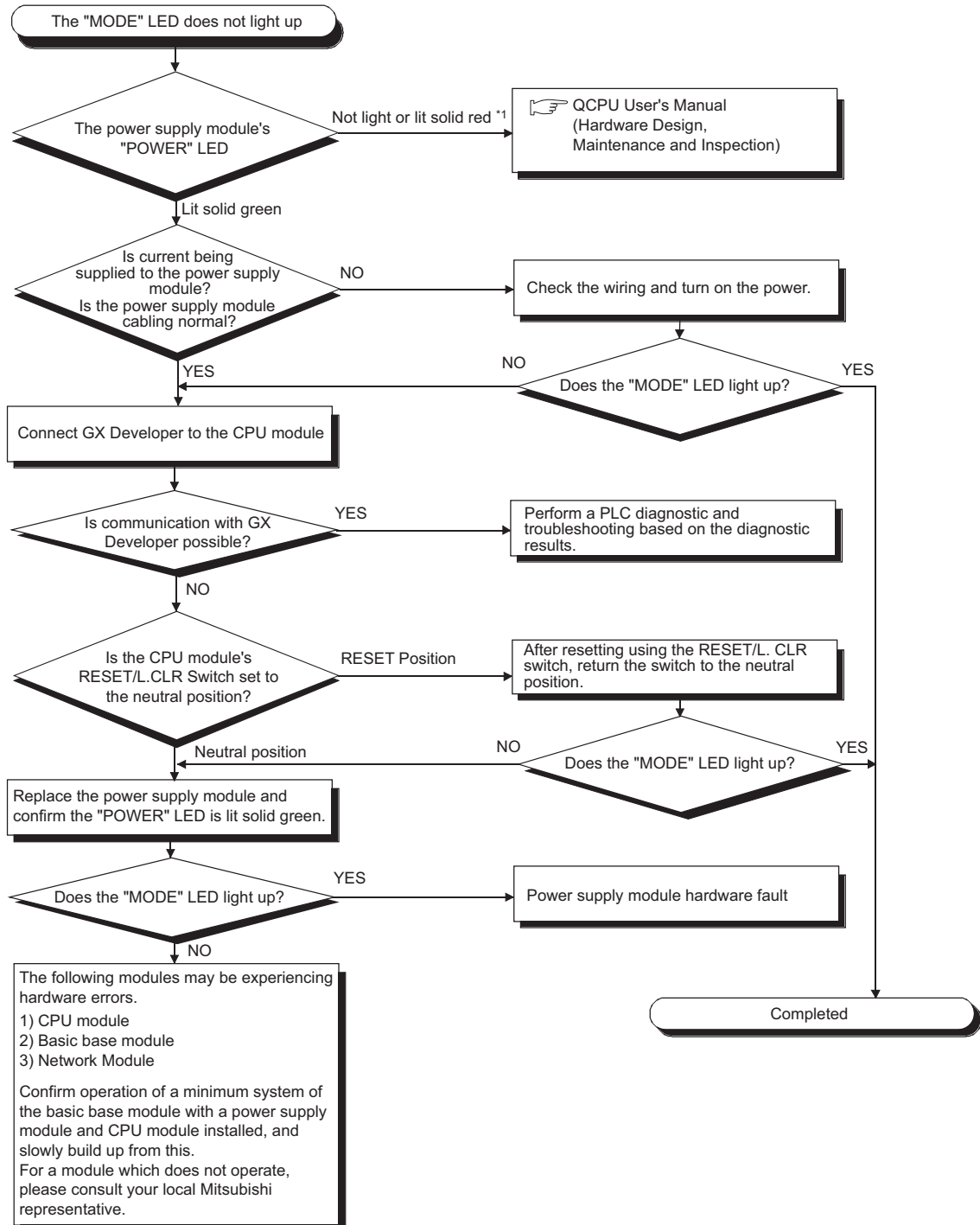
Diagram 8.3 Flow for the Case where the MODE LED is not On

* 1 : Relevant to the redundant power supply module.

8.1.2 When the CPU Module "BACKUP" LED is ON (Red)

The following flow (Diagram 8.4) is for the case where the "BACKUP" LED of the CPU module is on (red) while the redundant system is running.

1)

↓

Power off the standby system.

↓

Disconnect and then reconnect the tracking cable. (☞ Section 3.3)

↓

Power on the standby system.

↓

Reset the error of the control system CPU module. (Refer to Section 8.2)

↓

Is the "BACKUP" LED lit green? ──YES──→

│ NO

↓

Replace the tracking cable. (☞ Section 8.3.9)

↓

Clear the control system CPU module errors.(☞ Section 8.2)

↓

Is the "BACKUP" LED lit up solid green? ──YES──→

│ NO

↓

Replace standby system's CPU module.(☞ Section 8.3.1)

↓

Clear the control system CPU module errors.(☞ Section 8.2)

↓

Is the "BACKUP" LED lit up solid green? ──YES──→

│ NO

↓   ↓

2)   3)

2)

Replace control system's CPU
module.*1 (⌐☞ Section 8.3)

Clear the control system CPU
module errors. (⌐☞ Section 8.2)

Is the "BACKUP"
LED lit up solid
green?   YES

NO

Please consult your local Mitsubishi
representative.

Completed

Diagram 8.4 Flow for the Case where the CPU Module BACKUP LED is ON (Lit Red)

* 1: The control system, of which CPU module has been replaced, might start up as the standby
system.
Make sure to check the control system BACKUP LED after replacing the CPU module.

* 2: When using the CPU module whose first 5 digits of serial No. is "09012" or later, refer to Sections
8.1.9 and 8.1.10 for the description of error detected by the standby system.

8.1.3 When the "SYSTEM A/B" LED is flashing

The following flow (Diagram 8.5) is for the case where the control system CPU module "SYSTEM A/B" LED is flashing while the redundant system is running.
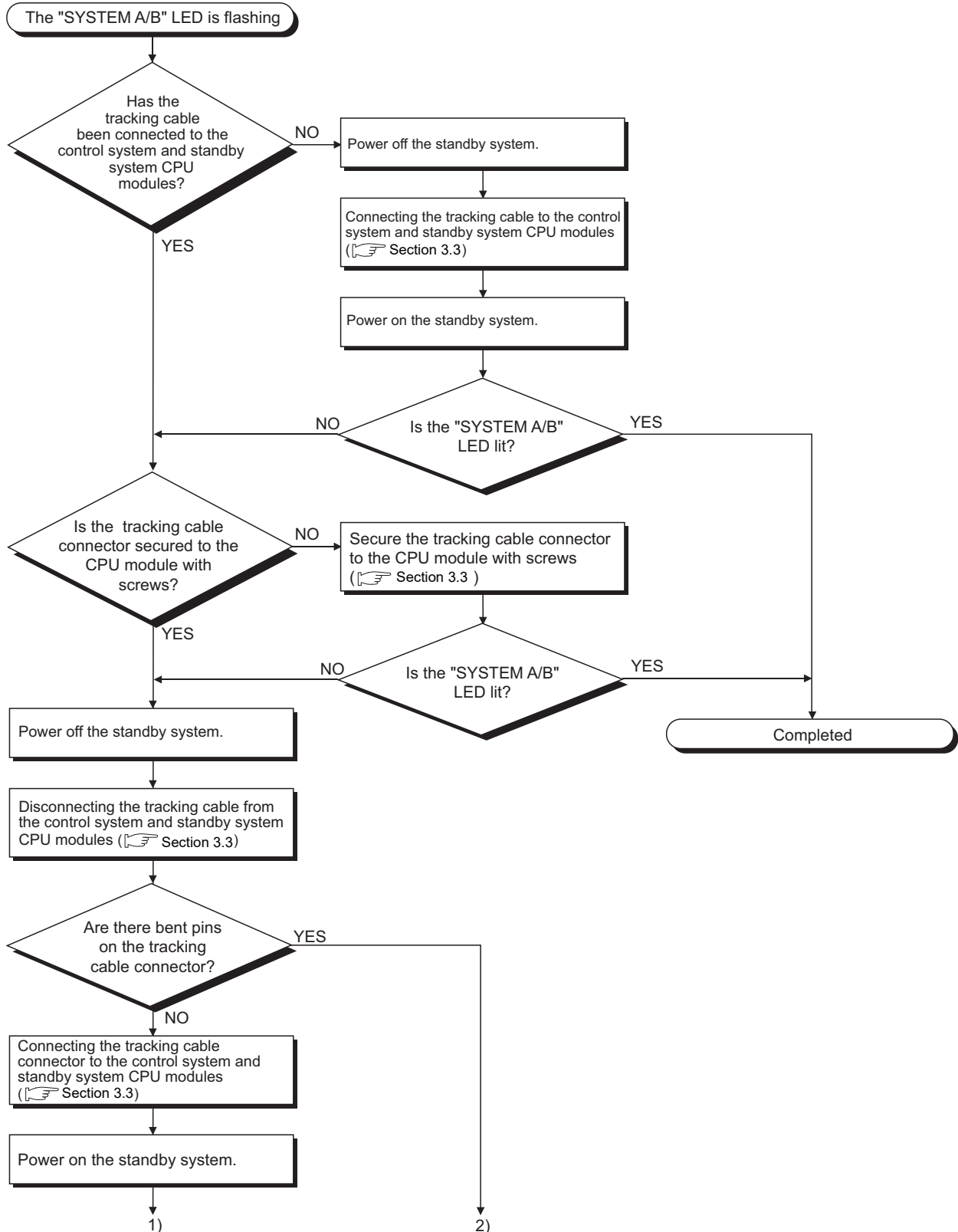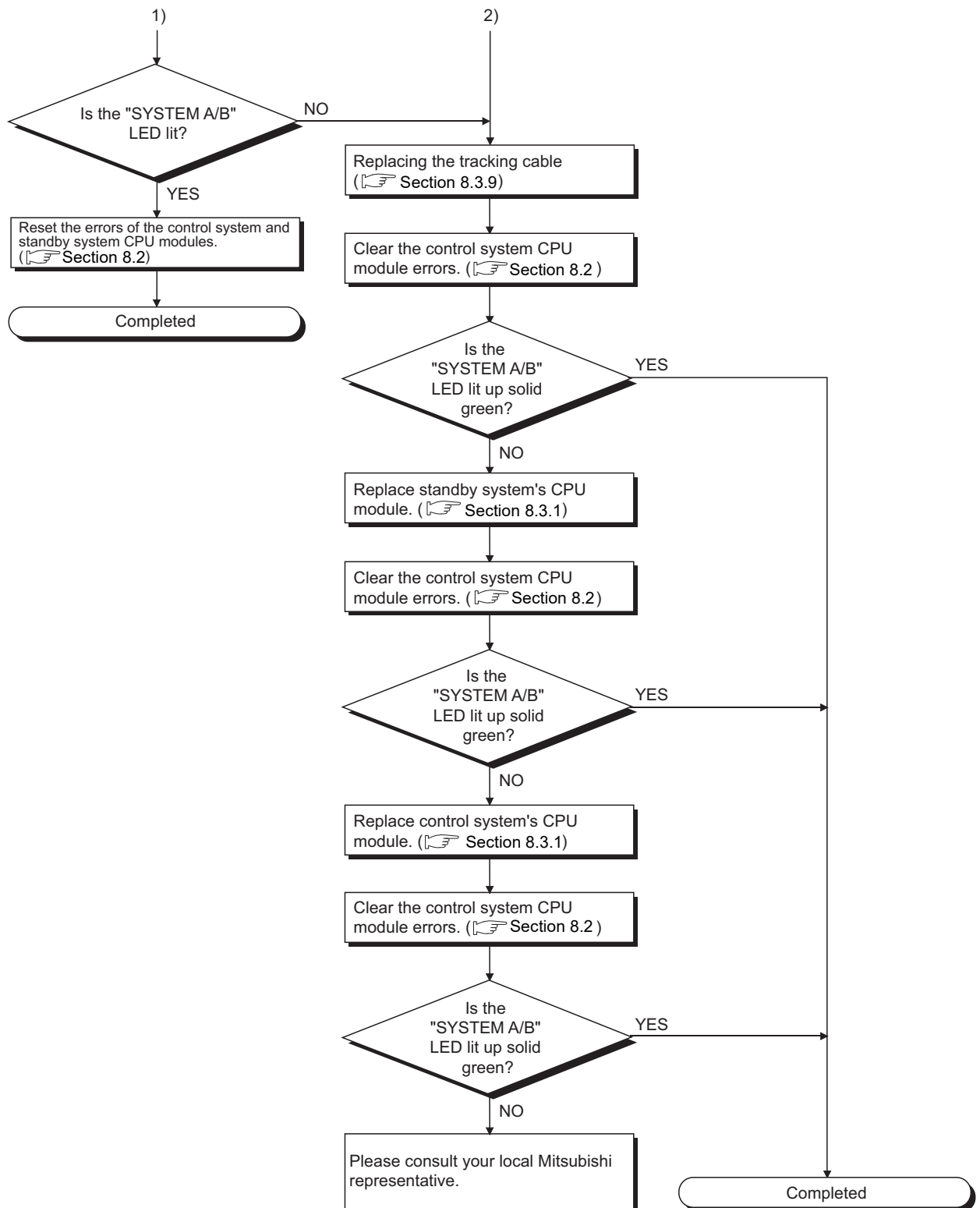
Diagram 8.5 Flow for the Case where the SYSTEM A/B LED is Flashing

1)

Is the "SYSTEM A/B" LED lit? — NO → (to 2) path)

YES ↓

Reset the errors of the control system and standby system CPU modules. (☞ Section 8.2)

Completed

2)

Replacing the tracking cable (☞ Section 8.3.9)

Clear the control system CPU module errors. (☞ Section 8.2)

Is the "SYSTEM A/B" LED lit up solid green? — YES → Completed

NO ↓

Replace standby system's CPU module. (☞ Section 8.3.1)

Clear the control system CPU module errors. (☞ Section 8.2)

Is the "SYSTEM A/B" LED lit up solid green? — YES → Completed

NO ↓

Replace control system's CPU module. (☞ Section 8.3.1)

Clear the control system CPU module errors. (☞ Section 8.2)

Is the "SYSTEM A/B" LED lit up solid green? — YES → Completed

NO ↓

Please consult your local Mitsubishi representative.

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8.1.4 When the System A/System B CPU module "RUN" LED is not ON

The following flow (Diagram 8.6) is for the case where the System A/System B CPU module "RUN" LED is not on.

```
                    ┌─────────────────────────────────┐
                    │  The "RUN" LED does not light up │
                    └─────────────────────────────────┘
                                    │
                                    ▼
 NO                        ╱ Is the running mode ╲
(Separate mode)*3         ╱   set to backup       ╲
◄─────────────────────────   mode? *1
                          ╲                       ╱
                           ╲                     ╱
                                    │
                             YES(Backup mode)
                                    │
                                    ▼
                          ╱ Is the control system ╲       NO     ┌──────────────────────────────┐
                         ╱  CPU module "RUN" LED    ╲ ──────────► │ Normal (the standby system CPU│
                         ╲  not lighting up? *2      ╱            │ module "RUN" LED is not ON)   │
                          ╲                         ╱             └──────────────────────────────┘
                                    │
                                   YES
                                    │
                                    ▼
                                                   NO
                          ╱                    ╲  (Flashing)   ┌──────────────────────────────┐
                         ╱  Is the "RUN" LED ON? ╲ ──────────► │ Reset with the CPU module's   │
                         ╲                       ╱             │ RESET/L.CLR switch            │
                          ╲                     ╱              └──────────────────────────────┘
                                    │
                              YES (not ON)
                                    │
                                    ▼
                          ╱ Is the RUN / STOP    ╲      NO     ┌──────────────────────────────┐
                         ╱  switch set to the     ╲ ─────────► │ Return the RUN / STOP switch  │
                         ╲  RUN position          ╱            │ to the RUN position           │
                          ╲                      ╱             └──────────────────────────────┘
                                    │
                                   YES
                                    │
                                    ▼
                                   1)
```
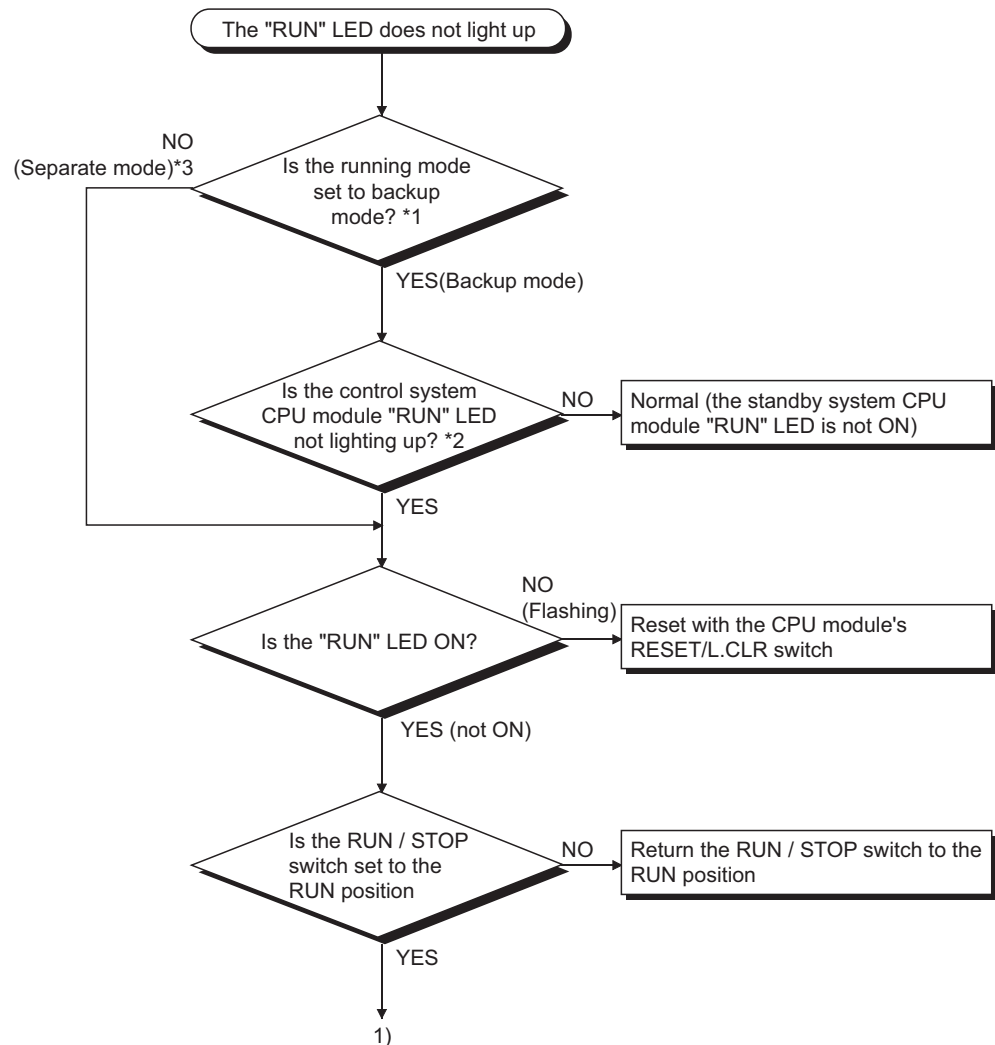
* 1: The operation mode can be confirmed by the "BACKUP" LED. (☞ CHAPTER 8)

* 2: The control system CPU module can be identified by the "CONTROL" LED. (☞ CHAPTER 8)

* 3: When the "RUN" LED of the standby system CPU module is flashing in the separate mode, set the RUN/STOP switch of the standby system CPU module from RUN to STOP to RUN.

* 4: When using the CPU module whose first 5 digits of serial No. is "09012" or later, refer to Sections 8.1.9 and 8.1.10 for the description of error detected by the standby system after switching systems.

1)

Is the "ERR." LED ON or flashing?

NO → Has a remote STOP/PAUSE been done?

YES → Perform a remote RUN to set to RUN status

YES ↓

NO ↓

Is the RUN contact/PAUSE contact ON?

YES → Set to RUN status by turning off the RUN contact / PAUSE contact

NO ↓

Connect GX Developer to the control system CPU module and check for faulty behavior using the System Monitor/PLC diagnostics. *4

A hardware failure has occurred in the CPU module. Please consult your local Mitsubishi representative.

Is there a hardware failure?

YES → Please consult your local Mitsubishi representative.

NO ↓

Clear the fault and reset with the RESET/L.CLR switch

Does the "RUN" LED light up?

NO → Please consult your local Mitsubishi representative.

YES ↓

Completed

Diagram 8.6 Flow for the Case where the System A/System B CPU Module "RUN" LED is not ON

8.1.5 When System Switching has Occurred

The following flow (Diagram 8.7) is for the case where system switching has occurred while the redundant system is running.

```
        ╭─────────────────────────────────╮
        │  A system switching has occurred │
        ╰─────────────────────────────────╯
                        │
                        ▼
        ┌─────────────────────────────────┐
        │ Connect GX Developer to the control │
        │ system CPU module and check the  │
        │ error log using the System Monitor / │
        │ PLC diagnostics.                 │
        └─────────────────────────────────┘
                        │
                        ▼
              ╱─────────────────╲          NO    ┌──────────────────────────────────┐
            ╱  Does the            ╲──────────────│ A system switching has not occurred. │
           ╱  control system CPU     ╲            └──────────────────────────────────┘
           ╲  module's error log contain: ╱
            ╲  "CONTROL.EXE (error   ╱
              ╲  code: 6200)"?     ╱
                ╲───────────────╱
                        │ YES
                        ▼
        ┌─────────────────────────────────┐
        │ Monitor the system switching cause │
        │ using GX Developer PLC diagnostic │
        │ error log and reviewing details for │
        │ "CONTROL.EXE (error code: 6200)". │
        └─────────────────────────────────┘
                        │
                        ▼
              ╱─────────────────╲    YES    ┌────────────────────────────────────┐
            ╱                     ╲──────────│ Turn ON the standby system power. Set │
            ╲  Is switch factor = 1? ╱        │ the CPU module's RESET/L.CLR switch  │
              ╲                   ╱          │ to the neutral position.             │
                ╲───────────────╱           └────────────────────────────────────┘
                        │ NO
                        ▼
                       1)
```

1)

Is switch factor = 2?
  YES → Connect GX Developer to the standby system CPU module and check for faulty behavior using the System Monitor/PLC diagnostics. Correct the fault. *1
  NO ↓

Is switch factor = 3?
  YES → Monitor the SD1690 with GX Developer and check the network module that requested the system switching. Correct the network fault.
  NO ↓

Is switch factor = 16?
  YES → Monitor the system switching cause using GX Developer PLC diagnostic error information and check for system switching instruction arguments. Correct abnormal behavior as appropriate for the argument.
  NO ↓

Is switch factor = 17?
  YES → Confirm with the GX Developer which performed the system switching.
  NO ↓

A hardware failure has occurred in the CPU module. Please consult your local Mitsubishi representative.

Diagram 8.7 Flow for the Case where System Switching Occurred

* 1: When using the CPU module whose first 5 digits of serial No. is "09012" or later, refer to Sections 8.1.9 and 8.1.10 for the description of error detected by the standby system after switching systems.

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8.1.6 When System Switching has failed

The following flow (Diagram 8.8) is for the case where system switching has failed, even though a system switching condition was satisfied while the redundant system was running.

(1) In the Case of System Switching by GX Developer

Diagram 8.8 Flow for the Case where System Switching Has Failed

(2) In the Case of System Switching due to Control System Error or System Switching Instruction Execution

Systems did not switch

↓

Is the "BACKUP" LED lit? → NO (Debug mode)

Green / Red (Backup Mode)
Amber (Separate Mode)

Turn off debug mode redundancy parameters and change to backup mode.

↓

Is the "SYSTEM A/B" LED lit? → NO

YES

Reconfirm the connection status of the tracking cable for both systems. (Reconnect.)

System A: For system A, if a cable has been disconnected during normal operation, the LED will flash until A system's connector is reconnected.

System B: For system B, if a cable has been disconnected during normal operation, the LED will flash until B system's connector is reconnected.

↓

Is the standby system's power turned ON? → NO

YES

Turn ON the standby system power.

4)

↓

Has the standby system's CPU module reset been canceled? → NO

YES

Cancel the standby system's CPU module reset.

4)

1)

1)

Is the standby system CPU module "ERR." LED flashing?

YES (Stop error) → Connect GX Developer to the standby system CPU module, use the System Monitor / PLC diagnostics to confirm the problem area, and resolve the problem.

↓ Restart the standby system (cycle the standby system power or reset the standby system CPU module).

→ 4)

NO
↓

For the standby system has a power OFF, reset or stop error occurred? *1

NO → 2)

YES
↓

Is the "BACKUP" LED ON solid green?

NO (Amber: Separate mode) → Use GX Developer to change the running mode to backup mode.

→ 4)

YES (Green: Backup mode)
↓

Check the system operation starting from a minimum configuration. For the module which does not operate, please consult your local Mitsubishi representative.

* 1 : The ERR. LED of the CPU module flashes when a stop error has occurred.

2)

```
          ┌──────────────────────┐
          │ Has an operation error │  YES
          │ occurred from the control├──────────┐
          │ system's system switching│          │
          │ instruction?          │             │
          └──────────┬───────────┘             │
                     │ NO                        │
                     │                ┌──────────▼──────────────────┐
                     │                │ Perform the following action depending on
                     │                │ the error code, and eliminate the error
                     │                │ cause.
                     │                │ · 4100 : Specify a value other than 0 for the
                     │                │           argument of the SP.CONTSW
                     │                │           instruction.
                     │                │ · 4120 : Turn on SM1592.
                     │                │ · 4121 : Change the program so that the
                     │                │           SP.CONTSW instruction is
                     │                │           executed in the control system,
                     │                │           not in the standby system, when
                     │                │           the system operates in separate
                     │                │           mode.
                     │                └──────────┬──────────────────┘
                     │                           │
                     │                          4)
          ┌──────────▼───────────┐
          │ Confirm individual information
          │ (SD16) for control system errors.
          └──────────┬───────────┘
                     │
              ┌──────▼──────┐  YES
              │ Is SD16=1?  ├─────────► Change the tracking cable.
              └──────┬──────┘
                     │ NO
              ┌──────▼──────┐  YES
              │ Is SD16=8?  ├─────────► Wait for the memory copy from control
              └──────┬──────┘           system to standby system to complete.
                     │ NO                        │
                     │                          4)
              ┌──────▼──────┐  YES
              │ Is SD16=9?  ├─────────► Wait for online program change to
              └──────┬──────┘           complete.
                     │ NO                        │
                    3)                          4)
```

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3)

Is SD16=10? — NO → Check operation starting from a minimum system and work your way up.
For a module which does not operate, please consult your local Mitsubishi representative.

YES

For the control system network module, are there any faulty modules? (SD1690 ≠ 0) — NO →

YES

4) → Confirm the status of the standby system network module (modules compatible with SD1690 bit set to ON) and correct any problems.

Using GX Developer or a switching instruction, reissue a system switching request and check that the system switches.

Did the switch occur normally? — YES → Completed

NO

Check again following the flow for "systems did not switch".
If the systems do not switch for the same reason even after performing the above checks, please consult your local Mitsubishi representative.

Diagram 8.9 Flow in the Case of System Switching due to Control System Error or System Switching Instruction Execution

8.1.7 When "TRK. INIT. ERROR (error code: 6140)" Occurred at Redundant System Startup

(1) "TRK. INIT. ERROR" occurrence conditions

(a) This error occurs when either of the following operations is performed during starting the redundant system and before the "BACKUP" LED turns green.

- Either system was powered off.
- The CPU module in either system was reset.

(b) This error may occur in the system using the redundant type extension base unit if extension cables are not connected and the system is not powered on as the procedures described in CHAPTER 4.

(2) Corrective action for "TRK. INIT. ERROR"

If "TRK. INIT. ERROR" has occurred during a startup of the redundant system, restart the system by performing either of the following operations.

(a) Power on System A and System B again

1) When System A/System B has been powered off, power on System A and System B again simultaneously.

2) The System A CPU module starts as a control system and the System B CPU module as a standby system.

(b) Set the RESET switches of System A and System B CPU modules to the neutral position simultaneously

1) When the System A/System B CPU module has been reset, reset the System A and System B CPU modules and then set their RESET switches to the neutral position simultaneously.

2) The System A CPU module starts as a control system and the System B CPU module as a standby system.

8.1.8 When "CONTROL SYS. DOWN (error code: 6310 to 6312)" Occurred at Redundant System Startup

(1) "CONTROL SYS. DOWN" occurrence conditions

"CONTROL SYS. DOWN" occurs when either of the following operations is performed until the BACKUP LED is lit green during a startup of the redundant system.

• Either system was powered off.

• The CPU module in either system was reset and then its RESET switch was set to the neutral position.

(2) Corrective action for "CONTROL SYS. DOWN"

If "CONTROL SYS. DOWN " has occurred during a startup of the redundant system, restart the system by performing either of the following operations.

(a) Power on System A and System B again

1) Power on System A and System B again simultaneously.

2) The System A CPU module starts as a control system and the System B CPU module as a standby system.

(b) Set the RESET switches of System A and System B CPU modules to the neutral position simultaneously

1) Reset the System A and System B CPU modules and then set their RESET switches to the neutral position simultaneously.

2) The System A CPU module starts as a control system and the System B CPU module as a standby system.

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8.1 Troubleshooting Flow
8.1.8 When "CONTROL SYS. DOWN (error code: 6310 to 6312)" Occurred at Redundant System Startup

8.1.9 When "ETX.CABLE ERR." Occurs

The following shows the flowchart for when "EXT.CABLE ERR." occurs during operation of the redundant system.
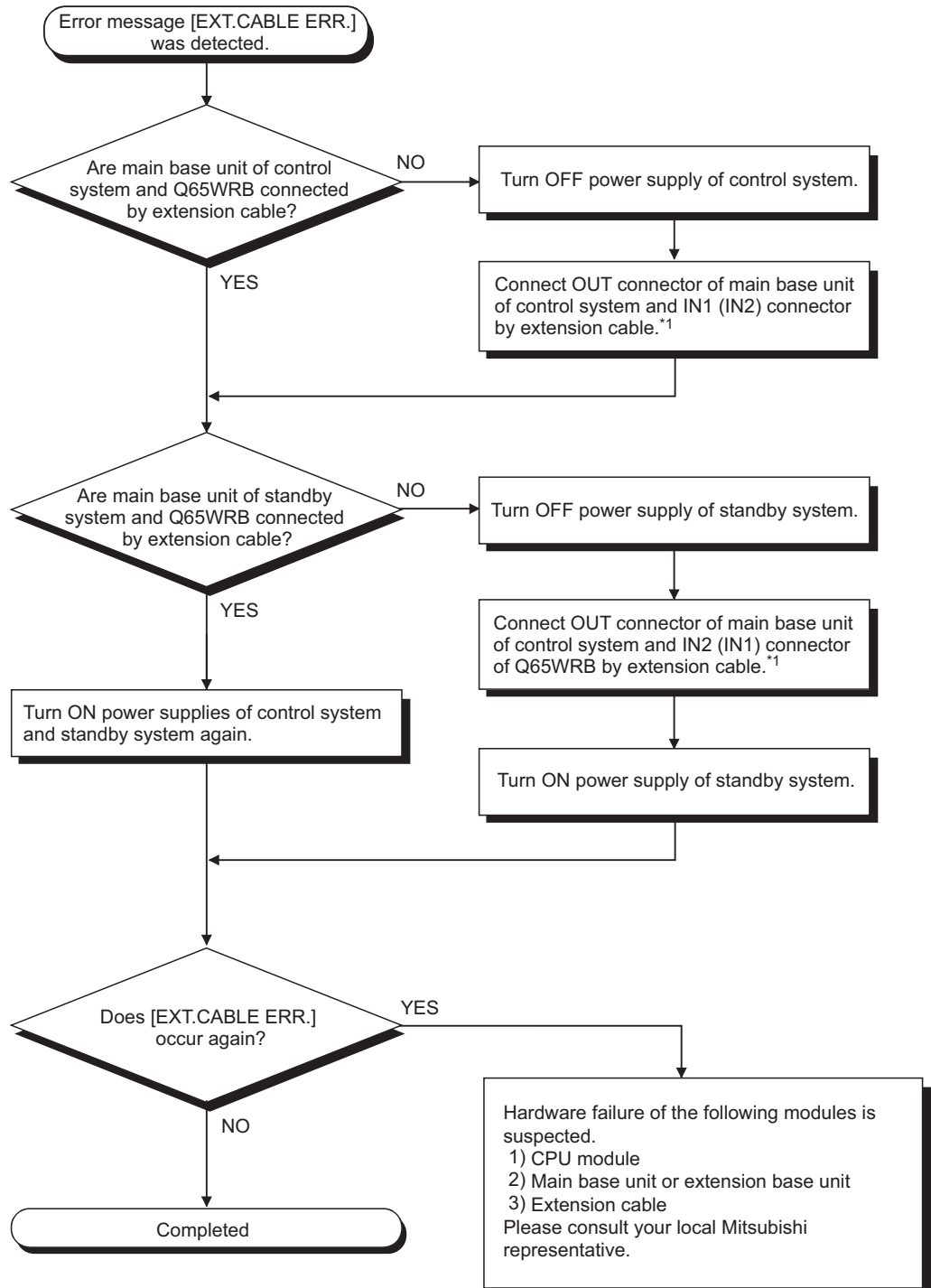
Diagram 8.10 Flowchart for when "EXT.CABLE ERR." occurs

* 1 : As for IN1 connector and IN2 connector of the redundant type extension base unit, connect one to the control system and connect the other to the standby system.

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8.1.10 When "BASE LAY ERROR" Occurs

The following shows the flowchart for when "BASE LAY ERROR" occurs during operation of the redundant system.

```
┌─────────────────────────────┐
│ Error message [BASE LAY      │
│ ERROR] was detected.         │
└─────────────────────────────┘
              │
              ▼
      ◇ Is error code [2010]? ◇ ──YES──► ◇ Does the number of stages of ◇ ──YES──► ┌────────────────────────────┐
              │                            extension base unit exceed            │ Change the number of stages of │
             NO                            specifications?                        │ extension base unit according to │
              │                                   │                               │ specifications.                │
              │                                  NO                               └────────────────────────────┘
              │                                   │
              │                                   ▼
              │                    ┌─────────────────────────────┐
              │                    │ Check serial No. of CPU module by │
              │                    │ system monitor of GX Developer. │
              │                    └─────────────────────────────┘
              │                                   │
              │                                   ▼
              │                    ◇ Is first 5 digits of serial ◇ ──NO──► ┌────────────────────────────┐
              │                      No. of CPU module [09012]            │ Replace CPU module with the one │
              │                      or later?                             │ compatible with extension base unit. │
              │                                   │                        └────────────────────────────┘
              │                                  YES
              │                                   │
              │                                   ▼
              │                    ┌─────────────────────────────┐
              │                    │ Hardware failure of the following │
              │                    │ modules is suspected.          │
              │                    │  1) Extension base unit        │
              │                    │  2) Extension cable            │
              │                    │ Please consult your local Mitsubishi │
              │                    │ representative.                │
              │                    └─────────────────────────────┘
              ▼
             1)
```

①

Is error code [2012]? ──YES──→

└─NO─→

Is GOT connected to main base unit via bus connection? ──YES──→ Remove bus connection cable connected to main base unit.

└─NO─→

Does Q65WRB exit? ──NO──┐

└─YES─→

Is the first extension stage Q65WRB? ──NO──→ Use Q65WRB in the first extension stage.

└─YES─→

Are the number of slots the same between main base units of control system and standby system? ──NO──→ Use the same model of main base unit in both systems A and B.

└─YES─→

Is QA base connected? ──YES──→ Remove QA base and replace with redundant power extension base unit.

└─NO─→

Is Q5□B (extension base unit incompatible with power supply module) connected? ──YES──→ Remove Q5□B and replace with redundant power extension base unit.

└─NO─→

Check serial No. of CPU module by system monitor of GX Developer.

│NO

Is first 5 digits of serial No. of CPU module [09012] or later? ──NO──→ Replace with CPU module compatible with extension base unit.

│YES

Is error code [2013]? ──YES──→ (to YES junction)

└─NO─→

A hardware failure has occurred in the CPU module. Please consult your local Mitsubishi representative.

Hardware failure of the following modules is suspected
 1) Extension base unit
 2) Extension cable
Please consult your local Mitsubishi representative.

Diagram 8.11 Flowchart for when "BASE LAY ERROR" Occurs

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8.1.11 When "UNIT LAY. DIFF." Occurs

The following shows the flowchart for when "UNIT LAY. DIFF." occurs during operation of the redundant system.

Error message [UNIT LAY. DIFF.] was detected.

Is error code [6030]? — YES

Are module mounting constitutions of control system and standby system of redundant system the same? — NO → Module mounting status of control system and standby system should be the same.

NO

YES

Are mode settings of systems A and B of network module the same? — NO → Set the mode setting of system B the same as mode setting of system A in Redundant settings of network parameter.

YES

Is error code [6035]? — YES → Since the CPU model name differs between control system and standby system in redundant system, use the same one.

NO

Is error code [6036]? — YES → Check to see if network cable is not broken, since remote I/O constitution of MELSECNET/H multiplexed remote I/O network differs between control system and standby system in the redundant system.

NO

Hardware failure of the following modules is suspected.
1) CPU module
2) Main base unit or extension base unit
3) Extension cable
Operate the systems sequentially from the minimum system which is the main base unit where the power supply module and the CPU module are mounted.
For a module which does not operate, please consult your local Mitsubishi representative.

Diagram 8.12 Flowchart for when "UNIT LAY. DIFF." Occurs

8.1.12 When "SP. UNIT DOWN" Occurs

The following shows the flowchart for when "SP. UNIT DOWN" occurs during operation of the redundant system.

```
An error message
[SP.UNIT DOWN] was detected.
        │
        ▼
Is CC-Link IE Controller ──YES──▶ Is first 5 digits of serial No. of the ──NO──▶ Replace the CPU module with the one
Network module mounted?          CPU module "10042" or later?                  whose first 5 digits is "10042" or later.
        │ NO                              │ YES
        │◀──────────────────────────────┘
        ▼
Is a module incompatible with the ──YES──▶ Remove the relevant module.
CPU module mounted?
        │ NO
        ▼
Is the module on
the relevant slot mounted ──NO──▶ Mount the module on the relevant slot
correctly and the extension cable        correctly or connect the extension cable of
of the relevant base unit                the relevant base unit correctly.
connected correctly?
        │ YES
        ▼
Check operation starting from a minimum
system. For a module which does not
operate, please consult your local Mitsubishi
representative.
```

Diagram 8.13 Flowchart for when "SP. UNIT DOWN" Occurs

8.1.13 When "SP. UNIT LAY ERROR" Occurs

The following shows the flowchart for when "SP. UNIT LAY ERROR" occurs during operation of the redundant system.

```
           ┌──────────────────────────┐
           │ An error message [SP.UNIT │
           │ LAY ERROR] was detected.  │
           └──────────────────────────┘
                        │
                        ▼
        ╱────────────────────────╲              ┌───────────────────────────────┐
       ╱ Are three or more CC-Link  ╲    YES     │ Reduce the number of mounted  │
      ╱  IE Controller Network        ╲─────────▶│ CC-Link IE Controller Network │
       ╲ modules mounted?             ╱          │ modules to two or one.        │
        ╲────────────────────────────╱          └───────────────────────────────┘
                        │ NO
                        ▼
        ╱────────────────────────╲              ┌───────────────────────────────┐
       ╱ Are five or more CC-Link  ╲    YES      │ Reduce the number of mounted  │
      ╱  IE Controller Network       ╲──────────▶│ CC-Link IE Controller Network │
      ╲  modules and MELSECNET/H     ╱           │ modules and MELSECNET/H       │
       ╲ modules mounted in total?  ╱            │ modules to four or less in    │
        ╲──────────────────────────╱            │ total.                        │
                        │ NO                     └───────────────────────────────┘
                        ▼
        ╱────────────────────────╲              ┌───────────────────────────────┐
       ╱ Are five or more          ╲    YES      │ Reduce the number of mounted  │
      ╱  MELSECNET/H modules         ╲──────────▶│ MELSECNET/H modules to four   │
       ╲ mounted?                   ╱            │ or less.                      │
        ╲──────────────────────────╱            └───────────────────────────────┘
                        │ NO
                        ▼
        ╱────────────────────────╲              ┌───────────────────────────────┐
       ╱ Are five or more Ethernet ╲    YES      │ Reduce the number of mounted  │
       ╲ modules mounted?          ╱────────────▶│ Ethernet modules to four or   │
        ╲──────────────────────────╱            │ less.                         │
                        │ NO                     └───────────────────────────────┘
                        ▼
        ╱────────────────────────╲              ┌───────────────────────────────┐
       ╱ Are the parameter contents╲    NO       │ Rewrite the network           │
       ╲ normal?                   ╱────────────▶│ parameters.                   │
        ╲──────────────────────────╱            └───────────────────────────────┘
                        │ YES
                        ▼
           ┌──────────────────────────────────┐
           │ A hardware failure has occurred  │
           │ in the CPU module. Please consult│
           │ your local Mitsubishi            │
           │ representative.                  │
           └──────────────────────────────────┘
```

Diagram 8.14 Flowchart for when "SP. UNIT LAY ERROR" Occurs

8.1.14 When "LINK PARA. ERROR" Occurs

The following shows the flowchart for when "LINK PARA. ERROR" occurs during operation of the redundant system.

```
                    ┌─────────────────────────┐
                    │ An error message [LINK   │
                    │ PARA. ERROR] was detected.│
                    └─────────────────────────┘
                                │
                                ▼
              ╱─────────────────────────╲
             ╱  Are pairing settings      ╲     NO    ┌──────────────────────────┐
            ╱   made to the Redundant       ╲─────────▶│ Recheck the pairing       │
            ╲   CPUs in the normal          ╱          │ settings.                 │
             ╲  station?                   ╱           └──────────────────────────┘
              ╲─────────────────────────╱
                        │ YES
                        ▼
              ╱─────────────────────────╲
             ╱  Is the number of          ╲     NO
            ╱   modules set in network      ╲─────────┐
            ╲   parameter same with         ╱         │
             ╲  the number of mounted      ╱          │
            ╲╲  modules?              ╱╱              │
              ╲─────────────────────────╱            │
                        │ YES                         │
                        ▼                             │
              ╱─────────────────────────╲            │
             ╱  Is the network            ╲     NO    │
            ╱   number specified in         ╲─────────┤
            ╲   network parameter           ╱         │
             ╲  same with the actual       ╱          │
            ╲╲  network number?       ╱╱              │
              ╲─────────────────────────╱            │
                        │ YES                         │
                        ▼                             │
              ╱─────────────────────────╲            │
             ╱  Is the start I/O          ╲     NO    │
            ╱   number set in network       ╲─────────┤
            ╲   parameter same with         ╱         │
             ╲  the actual start I/O       ╱          │
            ╲╲  number?               ╱╱              │
              ╲─────────────────────────╱            │
                        │ YES                         │
                        ▼                             │
              ╱─────────────────────────╲            │
             ╱  Is the network type        ╲     NO   │
            ╱   specified in network         ╲────────┤
            ╲   parameter same              ╱         │
             ╲  with the actual            ╱          │
            ╲╲  network type?         ╱╱              │
              ╲─────────────────────────╱            │
                        │ YES                         ▼
                        ▼              YES   ┌──────────────────────────────┐
              ╱─────────────────────╲───────▶│ Check the network parameter  │
             ╱  Is the refresh        ╲      │ and mounted status. If they   │
            ╲   parameter out of      ╱      │ differ, make them to the same.│
             ╲  the range?           ╱       └──────────────────────────────┘
              ╲─────────────────────╱
                        │ NO
                        ▼
                       ①
```

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Does the refresh range exceed the file register capacity? — NO → Change the file register so that all the range can be refreshed.

YES

CC-Link IE Controller Network module

Which is the module used?

MELSECNET/H module

Are the station numbers with pairing settings serial numbers? — NO

YES

Are parameters of the PLC to PLC network no settings when the station number is 0? — NO

YES

Are parameters of the remote master station no settings when the station number is other than 0? — NO → Correct the module type or station number.

YES

Are all parameter contents normal? — NO → Rewrite the network parameters.

YES

A hardware failure has occurred in the CPU module. Please consult your local Mitsubishi representative.

Diagram 8.15 Flowchart for when "LINK PARA. ERROR" Occurs

8.1 Troubleshooting Flow
8.1.14 When "LINK PARA. ERROR" Occurs

8.1.15 When "SP. UNIT VER. ERR." Occurs

The following shows the flowchart for when "SP. UNIT VER. ERR." occurs during operation of the redundant system.

```
An error message [SP.UNIT VER.ERR.] was detected.
        |
Is CC-Link IE Controller Network module of function version "D" used?  --NO--> Use CC-Link IE Controller Network module of function version "D".
        | YES
Is MELSECNET/H module of function version "D" used?  --NO--> Use MELSECNET/H module of function version "D".
        | YES
Is Ethernet module of function version "D" used?  --NO--> Use Ethernet module of function version "D".
        | YES
Check operation starting from a minimum system. For a module which does not operate, please consult your local Mitsubishi representative.
```

Diagram 8.16 Flowchart for when "SP. UNIT VER. ERR." Occurs

8.1.16 When "CAN'T SWITCH" Occurs to Control System CPU Module due to Communication Error when Turning ON/OFF Power Supply of CPU Module or Booting and Shutting Down Personal Computer in CC-Link IE Controller Network or MELSECNET/H

(1) Cause of "CAN'T SWITCH" occurrence

In the redundant system where CC-Link IE Controller Network or MELSECNET/H is used, CC-Link IE Controller Network or MELSECNET/H module of the control system may issue a switching request, detecting a communication error due to turning power supply ON/OFF of the other station (including the standby system) CPU module or booting and shutting down the personal computer where CC-Link IE Controller Network interface board or MELSECNET/H board is mounted.

For details of function requesting to switch system to the control system CPU module, refer to the following manuals.

☞ MELSEC-Q CC-Link IE Controller Network Reference Manual

☞ Q Corresponding MELSECNET/H Network System Reference Manual (PLC to PLC network)

☞ Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

Note that "CAN'T SWITCH" may be detected in the control system CPU module when the above-mentioned system switching is requested before the control system of the redundant system is started up. Although the control system operates normally even in this case, how to cancel "CAN'T SWITCH" is shown below.

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8.1 Troubleshooting Flow
8.1.16 When "CAN'T SWITCH" Occurs to Control System CPU Module due to Communication Error when

(2) How to cancel "CAN'T SWITCH"

Cancel "CAN'T SWITCH" detected by the control system CPU module after checking that the standby system and the CC-Link IE Controller Network module or MELSENET/H module operate normally by the special register.

A sample program to cancel an error by the error cancel command (M100) at the time of "CAN'T SWITCH" occurrence is shown in Diagram 8.17.

In this sample program, when "CAN'T SWITCH" occurs to the control system CPU module due to system switching request from the network module, an error "CAN'T SWITCH" can be cancelled by turning ON the error cancel command (M100) after checking that the standby system CPU module, CC-Link IE Controller Network module, or MELSECNET/H module operate normally.

However, when systems cannot be switched by "other than system switching request", "CAN'T SWITCH" cannot be cancelled in this sample program.

[Program example]

An error "CAN'T SWITCH" (No.6220) is cancelled when the system cannot be switched normally (SD1589≠0), system error information (SD1600), and system switching request module No. from the host system or other system network module (SD1590 and SD1690) are all normal in the system switching request by the network module (SD1588=3).
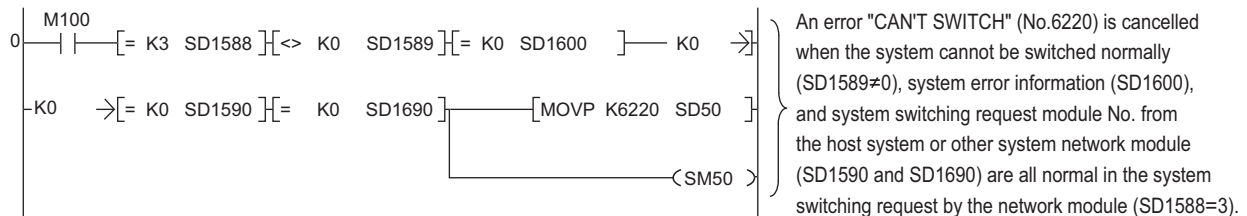
Diagram 8.17 Sample Program to Cancel an Error "CAN'T SWITCH"

When executing the error cancel command automatically, change error cancel command (M100) in Diagram 8.17 to be always ON (SM400).

(3) Programming of CC-Link IE Controller Network or MELSECNET/H

CC-Link IE Controller Network or MELSECNET/H network detects a temporary communication error depending on conditions such as power supply ON/OFF or cable and noise. Create the program using CC-Link IE Controller Network or MELSECNET/H so that it will not stop control even when the temporary communication error is detected.

For details, refer to the following manuals.

☞ MELSEC-Q CC-Link IE Controller Network Reference Manual

☞ Corresponding MELSECNET/H Network System Reference Manual
　(PLC to PLC network)

☞ Corresponding MELSECNET/H Network System Reference Manual
　(Remote I/O network)

8.1 Troubleshooting Flow
8.1.16 When "CAN'T SWITCH" Occurs to Control System CPU Module due to Communication Error when

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8.2 Error Clear

In a redundant system, the errors that continue the CPU module operation can be cleared.

The following methods for error clear are available in a redundant system.
- Clearing the host CPU module error
- Clearing the standby system CPU module error by the control system CPU module
  (This includes clearing the standby system CPU module error by GX Developer connected to the control system CPU module.)

(1) Clearing Host CPU Module Error

The host CPU module error can be cleared using a special relay (SM50) and a special register (SD50).

(a) Procedure

Error clear is performed according to the following procedure.

1) Remove the cause of target error.

2) Store the corresponding error code into a special register (SD50).

3) Turn special relay SM50 from OFF to ON.

4) The target error is cleared.

If the error is cleared and the CPU module returns to normal, the relevant special relay, special register and LED return to the previous statuses.
If the same error occurs again after that, it will be re-registered in the error history.

(b) Cautions

1) When the corresponding error code is stored in SD50 and error clear is performed, the last digit of the code No. will be ignored.
   When multiple errors, of which codes are different in the last digit only, occur, the errors can be simultaneously cleared.
   [Example]
   If errors that correspond to error codes 2100 and 2101 occur, both of them will be simultaneously cleared when either one is cleared.
   In the case of errors that correspond to error codes 2100 and 2111, both of them will not be simultaneously cleared even when either one is cleared.

2) If an error has occurred due to a problem other than that of the CPU module it will not be removed even when clearing the error is attempted using SM50 and SD50.
   [Example]
   The cause of the SP. UNIT DOWN error cannot be removed by performing error clear operation using SM50 and SD50, as the error could have occurred in a base unit (including extension cables), intelligent function module, etc.
    Remove the cause of the error by referring to the error code list.

3) If the cause of the error is not removed after error clear has been performed, the same error will be detected.

4) Error clear processing is performed by END processing.
Therefore, an error cannot be cleared unless the END instruction is executed with SM50 ON.

(2) Clearing the Standby System CPU Module Error by the Control System CPU Module

A standby system CPU module error is cleared with the user program of the control system CPU module, using SM1649 and SD1649.

When using GX Developer connected to the control system CPU module to clear a standby system CPU module error, SM1649 and SD1649 are also used.

(a) Procedure

Error clear is performed according to the following procedure.

1) Remove the cause of the target error from the standby system.

2) Store the corresponding error code into SD1649 in the control system CPU module.

3) Turn SM1649 in the control system CPU module from OFF to ON.

4) The target error is cleared from the standby system.

(b) Cautions

1) Error clear using SM1649 and SD1649 is enabled in the control system CPU module only.
If this method is executed in the standby system CPU module, the standby system error will not be cleared.
The operation modes applicable to this error clear method are listed in Table8.2.

Table8.2 Operation Modes Applicable to Clearing the Standby System Error using SM1649 and SD1649

Operation Mode	CPU Module Performing Error Clear	
	Control System CPU Module	Standby System CPU Module
Backup Mode	○	×
Separate Mode	×	×
Debug Mode	−	−

○: Standby System Error Clear Enabled, ×: Standby System Error Clear Disabled,
−: Irrelevant as Standby System Does not Exist

2) When the corresponding error code is stored in SD1649 and error clear is performed, the last digit of the code No. will be ignored.
When multiple errors, of which codes are different in the last digit only, occur, the errors can be simultaneously cleared.
[Example]
If errors that correspond to error codes 2100 and 2101 occur, both of them will be simultaneously cleared even when either one is cleared.
In the case of errors that correspond to error codes 2100 and 2111, both of them will not be simultaneously cleared even when either one is cleared.

3) If an error has occurred due to a problem other than that of the CPU module, it will not be removed even when clearing the error is attempted using SM1649 and SD1649.

   [Example]

   The cause of the SP. UNIT DOWN error cannot be removed by performing error clear operation using SM1649 and SD1649, as the error could have occurred in a base unit (including extension cables), network module, etc. Remove the cause of the error by referring to the error code list.

4) If the cause of the error is not removed after error clear has been performed, the same error will be detected.

5) Error clear processing is performed by END processing.

   Therefore, an error cannot be cleared unless the END instruction is executed with SM1649 ON.

(c) Sample Program for Clearing Standby System CPU Module Error

The following shows a sample program for clearing the standby system error by the control system CPU module.

[Sample Program]

A continuation error currently occurring in the standby system is cleared when the error clear command (M100) turns ON.

(Create the control system's program that enables the ON/OFF status of SM1649 to be held for one scan or longer so that the standby system will detect the SM1649 change, i.e., SM1649 turns from OFF to ON or OFF to ON.)
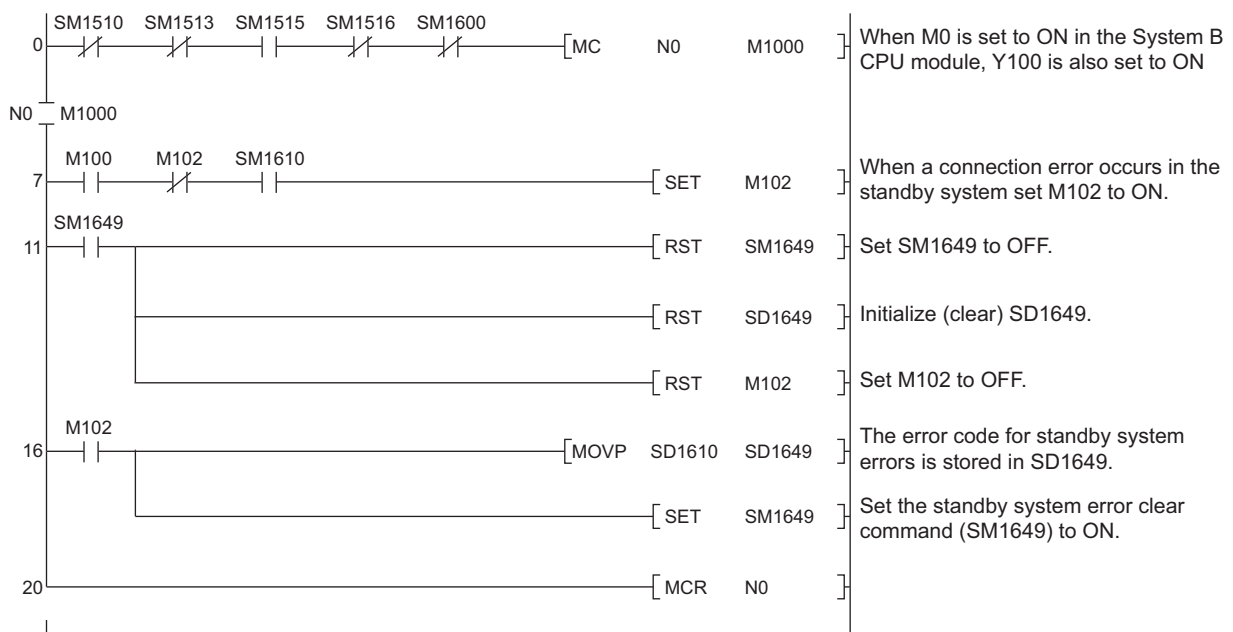
Diagram 8.18 Sample Program for Clearing Standby System CPU Module Error

(3) Corrective Actions When LEDs Do not Return to Status Prior to Error Occurrence

If error clear is performed but LEDs do not return to the status prior to the error occurrence, this might indicate that multiple continuation errors have occurred simultaneously or multiple annunciators are ON.

The following explains the methods of checking whether multiple continuation errors have occurred simultaneously or whether multiple annunciators are ON, and the method of clearing the errors.

(a) Continuation Errors other than Annunciator (F) ON (error code: 9000)

The error code of the latest continuation error is stored in a special register (SD0/SD1610).

If the LEDs do not return to the status prior to the error occurrence even when error clear operation has been performed for the error, which corresponds to the error code stored in special register (SD0/SD1610), check the error history information in the online PLC diagnostics of GX Developer.[1]

Clear the latest errors and any errors that occurred simultaneously in the error history.

* 1: When error clear operation is performed and the error is cleared, the SD0/SD1610 information shows "No Errors".
  Therefore, the errors that occurred simultaneously with the latest one cannot be confirmed by SD0/SD1610.

(b) Annunciator (F) ON (error code: 9000)

Whether Annunciator (F) is ON (error occurrence is detected) and the number of annunciators that detected errors can be checked using the special relay and special register below.

- SM62 (Detection of annunciator ON)
- SD63 (Number of annunciators ON)

Perform error clear operation repeatedly until SM62 will be off, or SD63 will be 0, then turn all annunciators from ON to OFF.

8.3 Replacing Module in Redundant System

8.3.1 CPU Module Replacement

(1) CPU Module Replacement

The control system CPU module cannot be replaced while redundant systems are running.
When replacing the control system CPU module, use GX Developer to switch its system to the standby system, then, start the replacement operation.

Replace after using GX Developer to switch over to the standby system.

GX Developer

Diagram 8.19 System where Control System CPU Module is Replaced

Replace the standby system CPU module after powering off the standby system.
The standby system can be powered off even while the redundant system is running.

Replace after turning OFF the standby system power.

GX Developer

Diagram 8.20 System where Standby System CPU Module is Replaced

(2) Replacement Procedure

The procedure for replacing the CPU module is shown in Diagram 8.21.

Start

Confirming the System of the Replacement Target CPU Module

Confirm that system of the target CPU module is the standby system (the CONTROL LED is off).When replacing the control system CPU module, switch its system to the standby system using GX Developer.

→Refer to Section 8.3.1, for system switching using GX Developer.

Power OFF the Standby System

↓

Disconnecting the Tracking Cable
Disconnect the tracking cable from the standby system CPU module. →Refer to Section 3.3, for disconnecting the tracking cable.

↓

Replacing the Standby System CPU Module
1) Remove the standby system CPU module from the main base unit. 2) Mount an alternative CPU module (the same model as the control system CPU module) to the main base unit. 3) Connect the CPU module battery connector to the battery connector pin. 　→Refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection), for removing/mounting the CPU module and battery connection.

↓

Connecting the Tracking Cable
Connect the tracking cable connector to the standby system CPU module. 　→Refer to Section 3.3, for connecting the tracking cable.

↓

Power ON the Standby System
1) Set the RUN/STOP switch of the standby system CPU module to the STOP position. 2) Set the RESET/L.CLR switch of the standby system CPU module to the central position (reset switch neutral position). 3) Power on the standby system.

↓

Confirming the POWER LED of the Power Supply Module
Confirm that the POWER LED of the power supply module is ON (lit green) and the module is being properly powered

↓

Executing the Memory Copy from Control System to Standby System
Perform the memory copy from control system to standby system using the GX Developer connected to the control system CPU module, and write the memory content from the control system CPU module to the standby system CPU module.

↓

Resetting the Standby System CPU Module
Set the RESET/L.CLR switch of the standby system CPU module to the RESET position.

↓

Setting the Switch of the Standby System CPU Module to That of the Control System
Set the RUN/STOP switch of the standby system CPU module to the same position of that of the control system CPU module.

↓

Setting the Reset Switch of the Standby System CPU Module to Neutral Position
Set the RESET/L.CLR switch of the standby system CPU module from the RESET position to the central position (reset switch neutral position).

↓

(Start standby system)

Diagram 8.21 CPU Module Replacement Procedure

⊠**POINT**

When the standby system is powered OFF, the control system CPU module develops STANDBY SYS.DOWN (error code: 6300) continuation error.
After the replacement of the standby system CPU module is complete, clear the error in the control system CPU module as necessary.
Refer to Section 8.2 for the error resetting method.

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8.3.2 Power Supply Module Replacement Procedure

(1) Power Supply Module Replacement[*1]

The control system power supply module cannot be replaced while redundant systems are running.

When replacing the control system power supply module, switch its system to the standby system by GX Developer, then, start the replacement operation.

Power supply module

Control system

Standby system

Tracking cable

GX Developer

Replace after using GX Developer to switch over to the standby system.
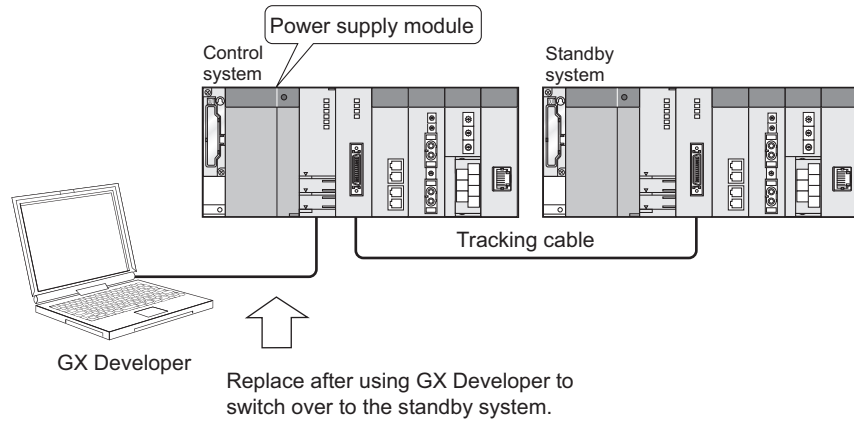
Diagram 8.22 System where Control System Power Supply Module is Replaced

Replace the power supply module for the standby system after turning the power supply for the standby system OFF.

The standby system power supply can be turned off even when the redundant system is active.

Power supply module

Control system

Standby system

Tracking cable

GX Developer

Replace after turning OFF the standby system power.
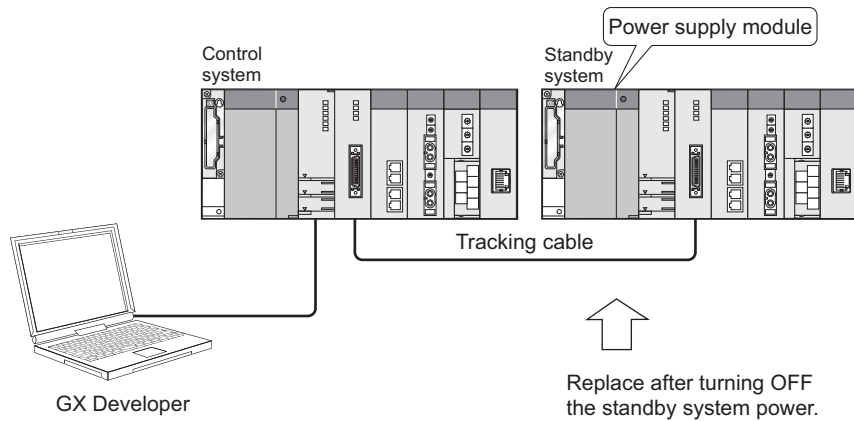
Diagram 8.23 System where Standby System Power Supply Module is Replaced

* 1: When a pair of redundant power supply modules is used in each system, one redundant power supply module can be replaced at a time while the redundant system is running.

(☞ Section 8.3.3)

(2) Replacement Procedure

The procedure for replacing the power supply modules is shown in Diagram 8.24.

```
                    ┌─────────────────┐
                    │      Start      │
                    └─────────────────┘
                             ↓
```

Confirming the System for the Power Supply Module to be Replaced
Confirm that the power supply module to be replaced is for the standby system (CONTROL LED OFF).When the control system power supply module is to be replaced, switch it to the standby system using GX Developer. → Refer to Section 5.2, for system switching using GX Developer.

↓

Turn the Standby System Power Supply OFF

↓

Removing the wiring
Disconnect the power supply cable from the standby system power supply module.

↓

Replacing the Standby System Power Supply Module
1) Remove the power supply module from the main base unit 2) Mount the alternative power supply module to the main base unit. → Refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection), for removing/mounting the power supply module.

↓

Wiring
Connect the power supply cable to the power supply module.

↓

Power ON the Standby System
1) Confirm that the RUN/STOP switch of the standby system CPU module is in the same position as that of the control system CPU module. 2) Confirm that the RESET/L.CLR switch of the control system CPU module is in the center position (reset switch neutral position). 3) Power on the control system.

↓

Confirm the Power Supply Module's POWER LED
Confirm that the power supply module POWER LED is lit (green), and that power is being supplied properly.

↓

```
                    ┌─────────────────────┐
                    │ Start standby system │
                    └─────────────────────┘
```

Diagram 8.24 Power Supply Module Replacement Procedure

⊠**POINT**

When the standby system is powered OFF, the control system CPU module develops in a STANDBY SYS.DOWN (error code: 6300) continuation error. After the replacement of the standby system CPU module is complete, reset errors in the control system CPU module as necessary.
Refer to Section 8.2 for the error resetting method.

8.3.3 Redundant Power Supply Replacement Procedure

When a pair of redundant power supply modules is used in each system, one redundant power supply module can be replaced at a time after powering off the module, while the redundant system is running. This operation can be performed in both systems.
System control can be continued while the power supply module is being replaced, because another power supply module supplies power to the modules mounted on the same base unit.
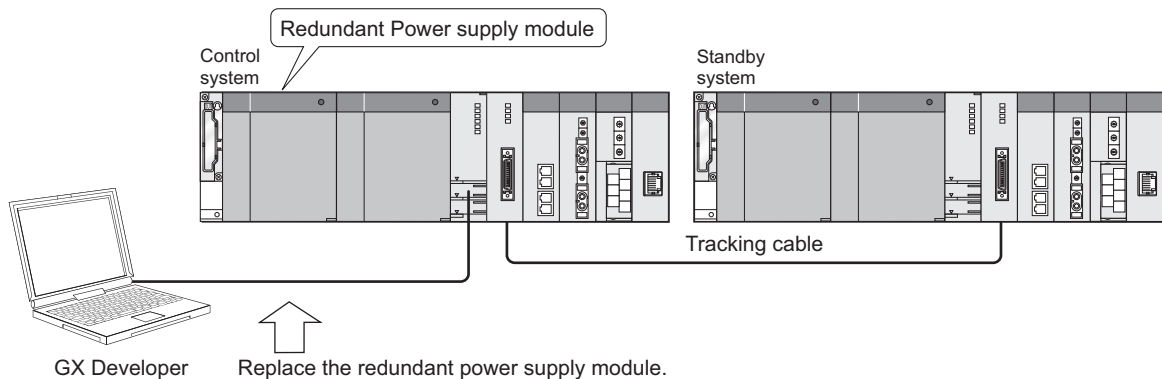
(1) Procedure for Replacing Redundant Power Supply Modules

The procedure for replacing redundant power supply modules is shown in the Diagram 8.25.
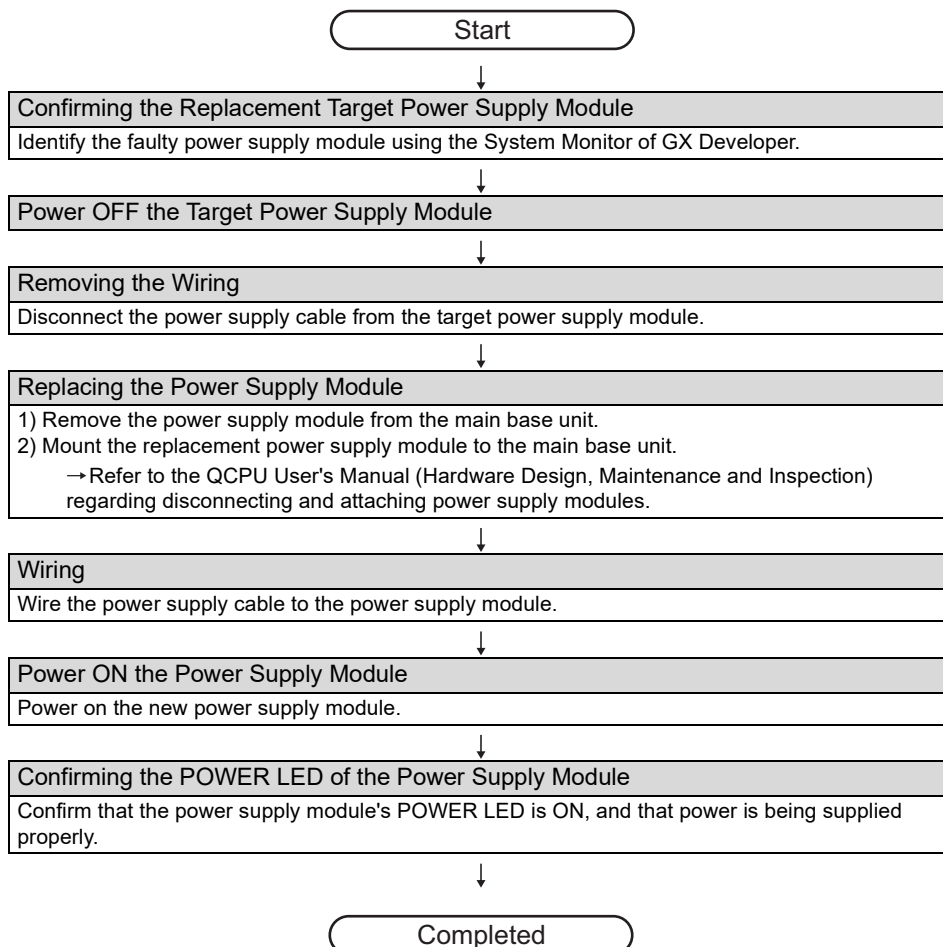
Diagram 8.25 Redundant Power Supply Replacement Procedure

8.3.4 I/O Module Replacement Procedure

(1) Module Replacement during Power OFF

When replacing the control system I/O module, switch its system to standby system, power off the standby system, and then start the replacement operation.
System switching is not necessary when replacing the standby system I/O module.
Make sure to power off the standby system before replacing the I/O module.
The standby system can be powered off while the redundant system is running.
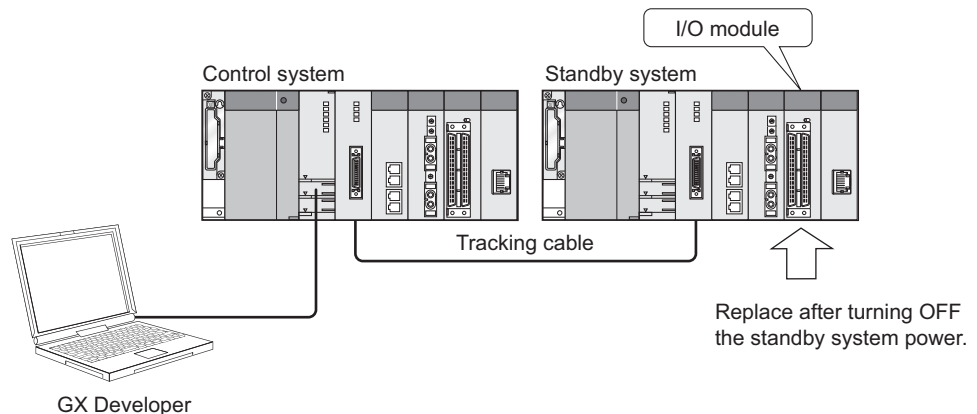
Diagram 8.26 I/O Module Replacement System during Power OFF

(2) Module Replacement during Power ON

By using the online module change of GX Developer, the I/O module can be replaced while the redundant system is running, regardless of its system, i.e., control system or standby system.
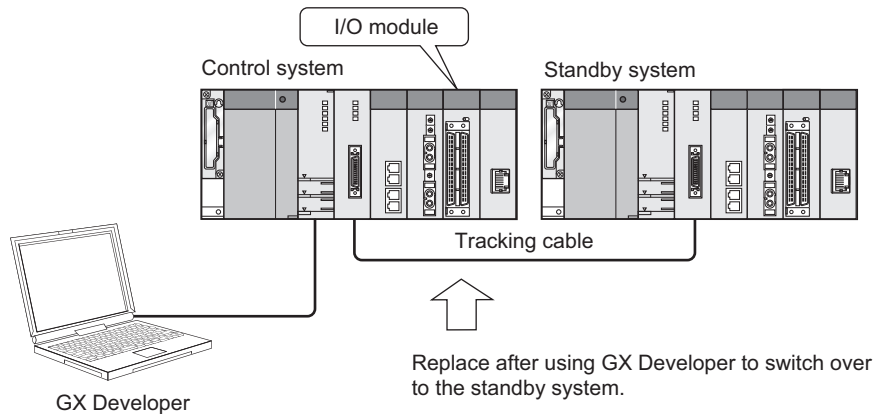
Diagram 8.27 I/O Module Replacement System during Power ON

⊠POINT

The I/O modules of control system and standby system cannot perform online module change (hot swapping) using GX Developer when connecting the extension base unit to the CPU module whose first 5 digits of serial No. is 09012 or later.
When replacing modules online using GX Developer in other than above cases, refer to the following manual.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

(3) Replacement Procedure during Power OFF

The I/O module replacement procedure is shown in Diagram 8.28.

```
                        ( Start )
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Confirm the I/O Unit Targeted for Replacement                   │
├───────────────────────────────────────────────────────────────┤
│ Confirm that the I/O unit to be replaced is the standby system  │
│ (CONTROL LED is off).When replacing the I/O unit for the        │
│ control system, use GX Developer to switch it to the standby    │
│ system.                                                         │
│    →Refer to Section 5.2, for system switching using GX         │
│      Developer.                                                 │
└───────────────────────────────────────────────────────────────┘
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Turn the Standby System's Power Supply OFF                      │
└───────────────────────────────────────────────────────────────┘
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Removing the Terminal Block/Connector from the I/O module       │
├───────────────────────────────────────────────────────────────┤
│ Remove the terminal block/connector from the I/O module.        │
└───────────────────────────────────────────────────────────────┘
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Replace the Standby System's I/O Unit                           │
├───────────────────────────────────────────────────────────────┤
│ 1) Disconnect the I/O module from the main base unit.           │
│ 2) Mount an alternative I/O module (the same model as the       │
│    control system I/O module) to the main base unit.            │
│    →Refer to the QCPU Module User's Manual (Hardware Design,     │
│      Maintenance and Inspection),  for mounting/removing the     │
│      I/O module.                                                │
└───────────────────────────────────────────────────────────────┘
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Mounting the Terminal Block/Connector to I/O module             │
├───────────────────────────────────────────────────────────────┤
│ Mount the terminal block/connector to the I/O module.           │
└───────────────────────────────────────────────────────────────┘
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Turn on the Standby System                                      │
├───────────────────────────────────────────────────────────────┤
│ 1) Align the position of the standby system CPU module's        │
│    RUN/STOP switch with that of the control system RUN/STOP      │
│    switch.                                                      │
│ 2) Set the standby system CPU module's RESET/L.CLR switch to     │
│    the central position (reset switch neutral position).        │
│ 3) Turn the standby system's power supply ON                    │
└───────────────────────────────────────────────────────────────┘
                            ↓
┌───────────────────────────────────────────────────────────────┐
│ Confirm the Power Supply Module's POWER LED                     │
├───────────────────────────────────────────────────────────────┤
│ Confirm that the power supply module's POWER LED is ON (green)   │
│ and that power is being supplied properly.                      │
└───────────────────────────────────────────────────────────────┘
                            ↓
                   ( Start standby system )
```

Diagram 8.28 I/O Module Replacement Procedure

⊠POINT

When the standby system is powered OFF, the control system CPU module develops in a STANDBY SYS.DOWN (error code: 6300) continuation error. After the replacement of the standby system CPU module is complete, reset errors in the control system CPU module as necessary.
Refer to Section 8.2 for the error resetting method.

8.3.5 Network Module Replacement Procedure

(1) Network Module Replacement

The control system network module cannot be replaced while the redundant system is running.

In this case, switch its system to the standby system, then, start the replacement operation.
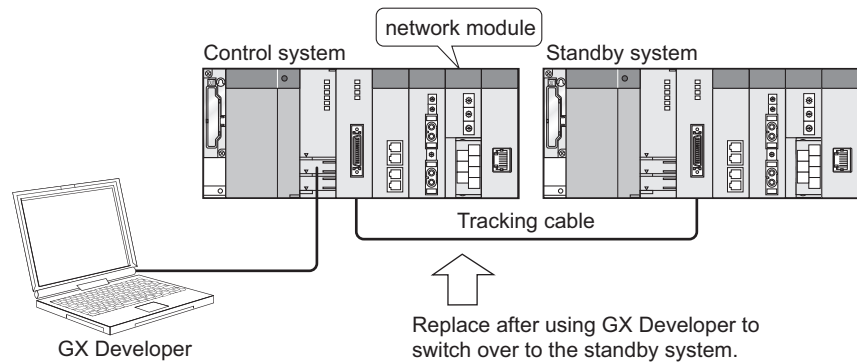
Diagram 8.29 System where Control System Network Module Is Replaced

Perform replacement of the standby system's network module after switching the standby system's power supply OFF.

The power supplies of standby systems can be turned OFF even when the redundant system is active.

Diagram 8.30 System where Standby System Network Module Is Replaced

(2) Replacement Procedure

The replacement procedure for network modules is indicated in Diagram 8.31.

Start

↓

Confirm the Network Module Targeted for Replacement

Confirm that the CPU module of the system to be replaced is the standby system (CONTROL LED is off).When replacing the network module of the control system, make it the standby system using GX Developer's system switching.

→ Refer to Section 5.2, for system switching using GX Developer.

↓

Turn the Standby System's Power Supply OFF

↓

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↓

Disconnecting the Cable
Disconnect the network cable from the target network module. → Refer to the manual of the network module, for disconnecting the network cable.

↓

Replacing the Standby System's Network Module
1) Disconnect the network module from the main base unit. 2) Attach the replacement network module (a network module of the same type as the control system network module). For removal and installation of the network module, refer to the manual of the used network module.

↓

Wiring
Connect the network cable to the network module. → Refer to the manual of the network module, for connecting the network cable.

↓

Turn on the Standby System's Power Supply
1) Match the position of the standby system CPU module's RUN/STOP switch with that of the control system. 2) Set the control system CPU module's RESET/L.CLR switch to the central position 3) Turn the standby system power supply ON.

↓

Confirm the Power Supply Module's POWER LED
Confirm that the power supply module's POWER LED is ON (green), and that power is being supplied properly.

↓

Confirming the Network Module Status
Confirm that the new network module has not developed an error by using the System Monitor of GX Developer.

↓

(Start standby system)

Diagram 8.31 Network Module Replacement Procedure

⊠POINT

When the standby system is powered OFF, the control system CPU module develops in a STANDBY SYS.DOWN (error code: 6300) continuation error. After the replacement of the standby system CPU module is complete, reset errors in the control system CPU module as necessary.
Refer to Section 8.2 for the error resetting method.

8.3.6 Main Base Unit Replacement Procedure

(1) Main Base Unit Replacement

The control system main base unit cannot be replaced while the redundant system is running.

In this case, switching its system to the standby system, then replace that main base unit.
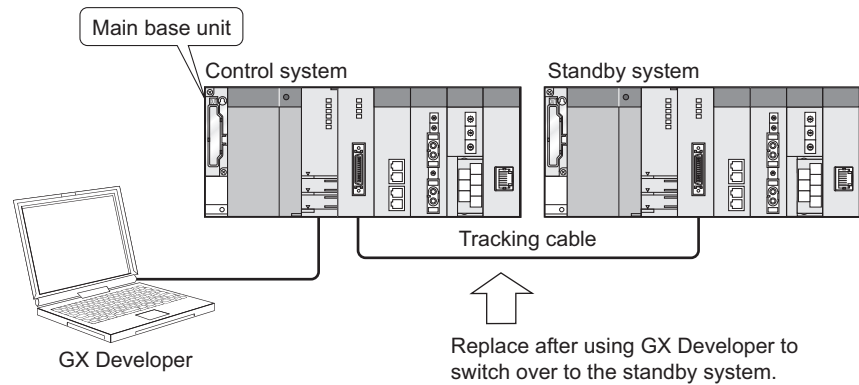
Diagram 8.32 System where Control System's Main Base Unit Is Replaced

Perform replacement of the standby system's main base unit after turning the standby system's power supply OFF.

The power supply for the standby system can be turned OFF even when the redundant system is active.
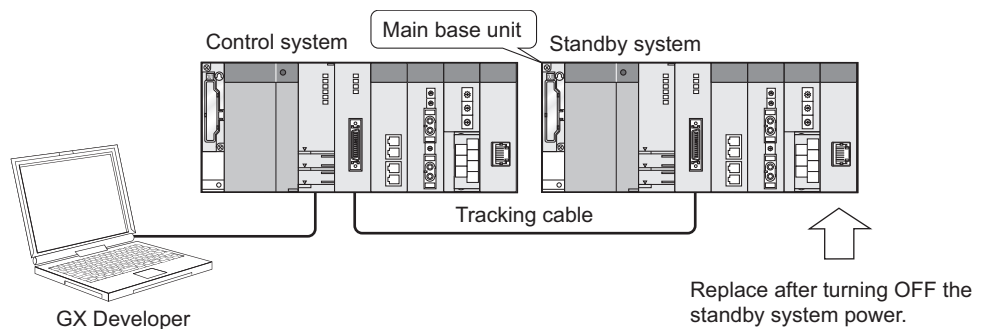
Diagram 8.33 System where Standby System's Main Base Unit Is Replaced

(2) Replacement Procedure

The replacement procedure for the main base unit is indicated in Diagram 8.34.

```
                    ┌─────────────── Start ───────────────┐
                                       ↓
```

Confirming the Main Base Unit Targeted for Replacement

Confirm that the main base unit to be replaced is for the standby system (CONTROL LED is off).When replacing the control system's power supply module, switch it to be the standby system using GX Developer's system switching.

→ Refer to Section 5.2 regarding system switching via GX Developer.

↓

Turn the Standby System's Power Supply OFF

↓

Disconnect the Cable

1) Disconnect the tracking cable from the standby system CPU module.

→ Refer to Section 3.3, for disconnecting the tracking cable.

2) Disconnect the power supply cable from the standby system power supply module.

3) Disconnect the network cable from the network module.

→ Refer to the manual of the network module, for disconnecting the network cable.

4) Remove the connector/terminal block from the I/O module.

5) Disconnect the extension cable for mounting the main base unit of the standby system.

↓

Removing Modules

Remove the modules from the main base unit.

→ Refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection), for removing modules.

↓

Replacing the Main Base Unit

1) Remove the main base unit from the control panel, etc.

2) Mount an alternative main base unit to the control panel, etc.

↓

Mounting Modules

Mount the module that was removed from the previous base unit to the new one.

(Mount the modules to the main base unit so that they will be located the same as those of the control system.)

→ Refer to the QCPU User's Manual (Hardware Design, Maintenance and Inspection), for mounting modules.

↓

Wiring

1) Connect the tracking cable to the standby system CPU module.

→ Refer to Section 3.3, for connecting the tracking cable.

2) Connect the power supply cable to the power supply module.

3) Connect the network cable to the network module.

→ Refer to the manual of the network module, for connecting the network cable.

4) Mount the terminal block/connector to the I/O module.

5) Connect the extension cable for mounting to the main base unit of the standby system.

↓

↓

Turn on the Standby System's Power Supply
1) Align the position of the standby system CPU module's RUN/STOP switch with that of the control system.
2) Set that standby system CPU module's RESET/L.CLR switch to the central position (reset switch neutral position).
3) Turn the standby system's power supply ON.

↓

Confirm the Power Supply Module's POWER LED
Confirm that the power supply module's POWER LED is it (green), and that power is being supplied properly.

↓

(Start standby system)

Diagram 8.34 Main Base Unit Replacement Procedure

⊠POINT

When the standby system is powered OFF, the control system CPU module develops in a STANDBY SYS.DOWN (error code: 6300) continuation error. After the replacement of the standby system CPU module is complete, reset errors in the control system CPU module as necessary.

Refer to Section 8.2 for the error resetting method.

8.3.7 Procedure for Replacing Module mounted on the I/O Station of Redundant System

By using the online module change of GX Developer, the module mounted on the MELSECNET/H remote I/O network remote I/O station can be replaced while the redundant system is running .
Following modules can be replaced by using this method.

- I/O Module [1]

- Intelligent Function Module [2]
  (Analog module, temperature input module, temperature control module, pulse input module)

* 1: Refer to the following manual, for module replacement by using online module change of GX Developer.

  ☞ Q-Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network)

* 2: Refer to the manual of the intelligent function module, for module replacement by using online module change of GX Developer.

⊠ POINT

Intelligent function modules other than the above cannot be replaced online using GX Developer.
When replacing these intelligent function modules, power off the remote I/O station in advance.

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8.3 Replacing Module in Redundant System
8.3.7 Procedure for Replacing Module mounted on the I/O Station of Redundant System

8.3.8 Replacement of Modules Mounted to Extension Base Unit

A module mounted to the extension base unit can be replaced online using GX Developer during operation of the system.
The following are the modules where online module change (hot swapping) can be performed using GX Developer.

- I/O module [*1]

- Intelligent function module [*2] (Analog module, temperature input module, temperature regulating module, and pulse input module)

* 1: For changing modules online (hot swapping) using GX Developer, refer to the following manual.

☞ QCPU User's Manual (Hardware Design, Maintenance and Inspection)

* 2: For changing modules online (hot swapping) using GX Developer, refer to the manual for the intelligent function module used.

⊠POINT

1. When connecting the extension base unit, use the Redundant CPU whose first 5 digits of serial No. is "09012" or later in both systems. In addition, connect the redundant type extension base unit to the first extension stage.

2. The intelligent function module other than the analog module, temperature input module, temperature regulating module, and pulse input module are not compatible with online module change (hot swapping) using GX Developer. For the intelligent function module which is not compatible with online module change (hot swapping) using GX Developer, turn OFF power supply of the power supply module before replacing modules.

8.3.9 Tracking Cable Replacement

(1) Tracking Cable Replacement

The tacking cable cannot be replaced while both systems are running.

After powering off the standby system (or keeping the standby system CPU module reset), replace the tracking cable.

The standby system can be powered off or reset while the redundant system is running.

Control system   Standby system

Tracking cable

Replace the tracking cable after powering off the standby system or while keeping the standby system CPU module reset.
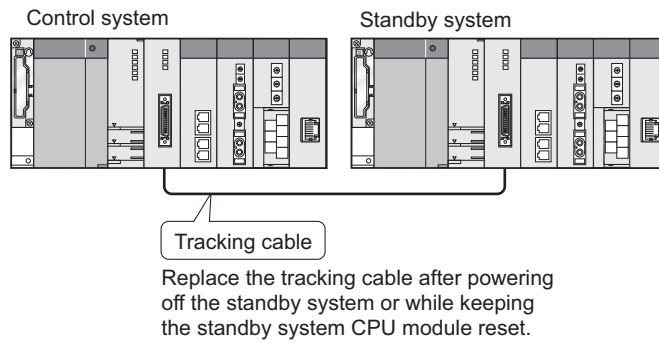
Diagram 8.35 System where Tracking Cable Replacement

(2) Replacement Procedure

The procedure of replacing the tracking cable is shown in the Diagram 8.36.

```
┌─────────────────────┐
│        Start        │
└─────────────────────┘
           ↓
```

Power OFF the Standby System

Power off the standby system. (Or, set the RESET/L.CLR switch to the RESET position (reset).)

↓

Tacking Cable Replacement

(1) Disconnect the tracking cable from the control system CPU module.
   → Refer to Section 3.3, for disconnecting the tracking cable.
(2) Disconnect the tracking cable from the standby system CPU module.
(3) Connect the tracking cable connector to the standby system CPU module.
   → Refer to Section 3.3, for disconnecting the tracking cable.
(4) Connect the tracking cable connector to the control system CPU module.

↓

Power ON the Standby System

(1) Confirm that the RUN/STOP switch of the standby system CPU module is in the same position as that of the control system CPU module.
(2) Power on the control system. (OR Set the RESET/L.CLR switch of the standby system CPU module to the central position (reset switch neutral position)).

↓

Confirm the Power Supply Module's POWER LED

Confirm that the power supply module POWER LED is lit (green), and that power is being supplied properly.

↓

```
┌─────────────────────┐
│ Start standby system │
└─────────────────────┘
```

Diagram 8.36 Tracking Cable Replacement

⊠**POINT**

Make sure to replace the tracking cable after powering off the standby system (or setting the RESET/L.CLR switch to the RESET position (reset)).
If the tracking cable is connected or disconnected while both systems are running, it may result in either of the following.

- The scan time is extended and the "WDT ERROR (ERROR CODE: 5000, 5001) occurs.
- The "TRK.CIR.ERROR (ERROR CODE: 1112, 1113, 1116)" occurs and the redundant CPU operation stops.

8.3.10 Replacement Procedures of Extension Cable

(1) Replacement of extension cable

An extension cable which connects the main base unit and the redundant type extension base unit of the control system cannot be replaced during operation of the redundant system.

Before replacing the extension cable, always switch the control system to the standby system by GX Developer.

(2) Replacement procedures

The replacement procedure of the extension cable is shown in Diagram 8.37.

```
                          ┌─────────────────────┐
                          │        Start        │
                          └─────────────────────┘
                                     ↓
```

Checking the system where the extension cable to be replaced is connected
Check that the extension cable to be replaced is connected to the standby system (CONTROL LED is turned OFF). When connecting an extension cable of the control system, switch system to the standby system by GX Developer.

↓

Turning OFF power supply of standby system

↓

Replacement of an extension cable of the standby system
Disconnect an extension cable from the main base unit. Connect the extension cable to be replaced to the main base unit.

↓

Turning ON power supply of standby system
(1) Check that RUN/STOP switch of the standby system CPU module is set to RUN/STOP position. (2) Check that RESET/L. CLR switch of the control system CPU module is set to center position (reset cancel). (3) Turn ON power supply of the standby system.

↓

Checking POWER LED of the power supply module
Check that POWER LED of the power supply module is turned ON (green) and power supply is supplied normally.

↓

```
                    ┌───────────────────────────┐
                    │    Start standby system   │
                    └───────────────────────────┘
```

Diagram 8.37 Replacement Procedures of Extension Cable

9 PROCESSING TIME IN REDUNDANT SYSTEM

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CHAPTER9 PROCESSING TIME IN REDUNDANT SYSTEM

The scan time of the control system CPU module in the redundant system is the total of I/O refresh time, instruction execution time, END processing time, and tracking time.

For the I/O refresh time, instruction execution time, and END processing of the control system CPU module (Redundant CPU), refer to the following.

☞ Qn(H)/QnPH/QnPRHCPU User's Manual (Function Explanation, Program Fundamentals)

This chapter describes the tracking time calculation method and the time required for system switching.

9.1 Increase in Scan Time due to Tracking

Calculate an increase in scan time of the control system CPU module due to tracking, referring to Table9.1.

Table9.1 Increase in Scam Time due to Tracking

Tracking Characteristics Setting			Increase in Scan Time (ms)
Synchronized tracking mode			$Ts = Tra + Trb + \alpha$
Program priority mode	$Tp >= Trb$		$Ts = Tra + \alpha$
	$Tp < Trb$		$Ts = Tra + Trb - Tp + \alpha$

Ts: Increase in scan time
Tra: Tracking data setup time
Trb: Tracking processing time
Tp: Program execution time
α: Overhead time for tracking (refer to the table on the right)

Condition	α (ms)
Both systems are operating normally.	Max. 4
A momentary power failure or power supply shut-off has occurred in the standby system.	Momentary power failure time to max. 40
Data communications are being performed via the tracking cable.	Max. 30

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(1) Tracking data setup time (Tra)

Use the following expression to calculate the tracking data setup time.

$$Tra = 1 + Tra1 + Tra2 + Tra3 + Tra4 \text{ (ms)}$$

Tra: Tracking data setup time

Tra1 to Tra4: Processing time of the transfer data listed in Table9.2

Table9.2 Processing Times of Tra1 to Tra4

	Transfer Data		Processing Time (ms)
Tra1	Signal flow memory	Time set in the tracking setting of redundant parameter	$1+0.13 \times 10^{-3} \times Z$
Tra2	SFC information	SFC program execution time	1 (Fixed)
Tra3	PID control instruction information	PIDINIT instruction execution time	0.5 (Fixed)
		S.PIDINIT instruction execution time	0.5 (Fixed)
Tra4	Device data	–	$X1+X2+X3^{*1}$

Z: Number of steps in the program

* 1: X1 to X3 are calculated as follows.
  - •X1: Processing time according to the number of device points in the tracking setting
    $X1=(D1 \times K1) + (D2 \times K2) + (D3 \times K3) + (D4 \times K4)$ [ms]
  - •X2: Processing time according to the number of device ranges in the tracking setting
    $X2=(E1 \times K5) + (E2 \times K6) + (E3 \times K7) + (E4 \times K8)$ [ms]
  - •X3: Processing time according to the number of tracking blocks in the tracking setting
    $X3=(F1 \times K9) + (F2 \times K10) + (F3 \times K11)$ [ms]

  D1 to D4, E1 to E4, F1 to F3, and K1 to K11 are values used in Table9.3.

Table9.3 Counting Value of D1 to D4, E1 to E4, F1 to F3, and K1 to K11

Symbol	Description	System Number Symbol	Counting Value
D1	Number of tracking device points of the devices other than the index register	K1	0.09×10^{-3}
D2	Number of tracking device points of the index register	K2	0.15×10^{-3}
D3	Number of tracking device points of the file register stored in the Standard RAM	K3	0.09×10^{-3}
D4	Number of tracking device points of the file register stored in the SRAM card	K4	0.42×10^{-3}
E1	Number of tracking device ranges of the devices other than the index register	K5	4×10^{-3}
E2	Number of tracking device ranges of the index register	K6	5×10^{-3}
E3	Number of tracking device ranges of the file register stored in the Standard RAM	K7	5×10^{-3}
E4	Number of tracking device ranges of the file register stored in the SRAM card	K8	5×10^{-3}
F1	Number of blocks not including the file register	K9	1×10^{-3}
F2	Number of blocks including the file register stored in the Standard RAM	K10	25×10^{-3}
F3	Number of blocks including the file register stored in the SRAM card	K11	*2

* 2: The value of K11 differs depending on the serial number of the QnPRHCPU used.
  • QnPRHCPU whose serial number (first five digits) is "06081" or earlier: $(120 + 3 \times G^{*3}) \times 10^{-3}$
  • QnPRHCPU whose serial number (first five digits) is "06082" or later: 120×10^{-3}

* 3: G is the number of clusters of the specified file register. Calculate it using the following expression.
  G = (file register capacity)/(size of one cluster)
  Round up the fractional portion of G calculated by the above expression.
  Use the following value as the size of one cluster.
  • Q2MEM-1MBSN, Q2MEM-1MBS: 256 words (512 bytes)
  • Q2MEM-2MBSN, Q2MEM-2MBS, Q3MEM-4MBS: 512 words (1024 bytes)

9 PROCESSING TIME IN REDUNDANT SYSTEM

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9

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(2) Tracking processing time (Trb)

Use the following expression to calculate the tracking processing time.

$$Trb = 0.26 \times 10^{-3} \times (N1 + N2 + N3 + N4) \text{ (ms)}$$

Trb: Tracking processing time

N1 to N4: Processing time of the transfer data listed in Table9.4
(unit: word)

Table9.4 Number of N1 to N4 Data Transferred

	Transfer Data		Number of Data Transferred (Words)
N1	Signal flow memory	Time set in the tracking setting of redundant parameter	Σ (Number of steps in each program/16)[*1]
N2	SFC information	SFC program execution time	13312 (13k) (Fixed)
N3	PID control instruction information	PIDINIT instruction execution time	1024 (1k) (Fixed)
		S.PIDINIT instruction execution time	1024 (1k) (Fixed)
N4	Device data	–	4+D1+D2+D3+D4 D1: Inside device (except the index register) D2: Index register D3: File register (in the Standard RAM) D4: File register (in the SRAM card)

* 1: Fractions are rounded up.

9.2 System Switching Time

System switching time is the time required from detecting a switching factor in the control system to starting an operation in the new control system.
Use the following expression to calculate the system switching time.

$$Tsw = \alpha + T\alpha m + Trc \text{ (ms)}$$

Tsw : System switching time[3]

Trc : Time required for the standby system CPU module to reflect the tracking data

Tαm: CC-Link IE Controller Network, MELSECNET/H, CC-Link, PROFIBUS-DP automatic refresh time
(Refer to the manual for the network module used.)

α : When an extension base unit is connected
  • Signal flow memory is not transferred: 31.5ms
  • Signal flow memory is transferred: 12.5ms
When no extension base unit is connected
  • Signal flow memory is not transferred: 20.5ms
  • Signal flow memory is transferred: 1.5ms
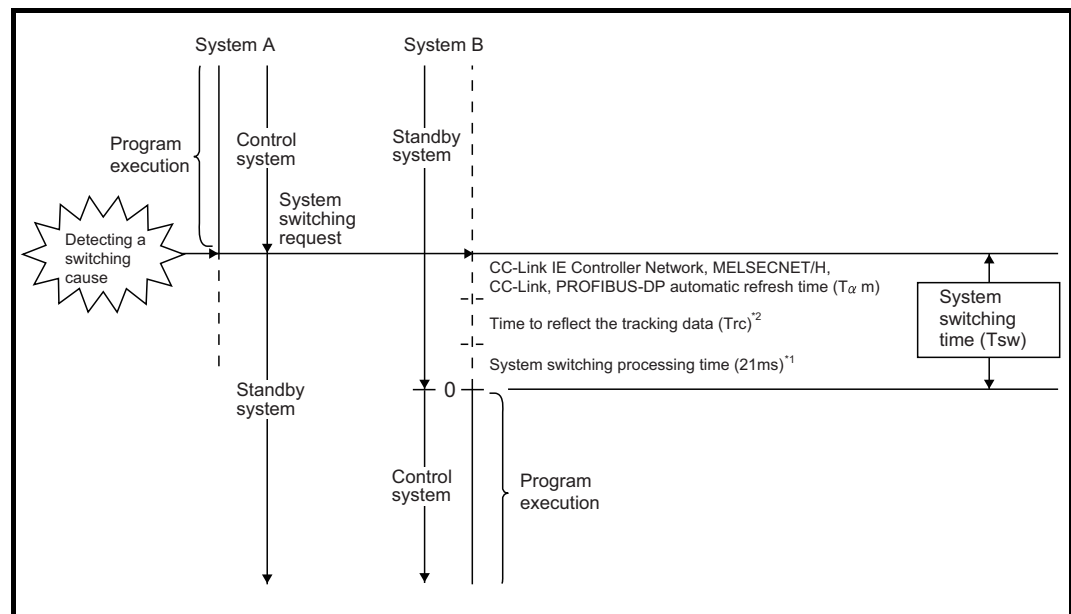
Diagram 9.1 System Switching Timing

* 1: This is the time when the signal flow memory is set to "No tracking" in the tracking setting of redundant parameter.
* 2: The time is 0ms before the tracking processing completes.
* 3: This is the maximum time required for system switching.

(1) Tracking data reflection time (Trc)

Use the following expression to calculate the tracking data reflection time.

Trc = 1 + Trc1 + Trc2 + Trc3 + Trc4 (ms)

Trc : Tracking data reflection time

Trc1 to Trc4 : Processing time of the transfer data listed in Table9.5

Table9.5 Processing Times of Tra1 to Tra4

	Transfer Data		Processing Time (ms)
Trc1	Signal flow memory	Time set in the tracking setting of redundant parameter	$1+0.13 \times 10^{-3} \times Z$
Trc2	SFC information	SFC program execution time	1 (Fixed)
Trc3	PID control instruction information	PIDINIT instruction execution time	0.5 (Fixed)
		S.PIDINIT instruction execution time	0.5 (Fixed)
Trc4	Device data	–	$X1 + X2 + X3$[1]

Z: Number of steps in the program

* 1: X1 to X3 are calculated as follows.
- X1: Processing time according to the number of device points in the tracking setting

$X1=(D1 \times K1) + (D2 \times K2) + (D3 \times K3) + (D4 \times K4)$ [ms]
- X2: Processing time according to the number of device ranges in the tracking setting

$X2=(E1 \times K5) + (E2 \times K6) + (E3 \times K7) + (E4 \times K8)$ [ms]
- X3: Processing time according to the number of tracking blocks in the tracking setting

$X3=(F1 \times K9) + (F2 \times K10) + (F3 \times K11)$ [ms]

D1 to D4, E1 to E4, F1 to F3, and K1 to K11 are values used in Table9.6.

Table9.6 Counting Value of D1 to D4, E1 to E4, F1 to F3, and K1 to K11

Symbol	Description	System Number Symbol	Counting Value
D1	Number of tracking device points of the devices other than the index register	K1	0.09×10^{-3}
D2	Number of tracking device points of the index register	K2	0.15×10^{-3}
D3	Number of tracking device points of the file register stored in the Standard RAM	K3	0.09×10^{-3}
D4	Number of tracking device points of the file register stored in the SRAM card	K4	0.42×10^{-3}
E1	Number of tracking device ranges of the devices other than the index register	K5	4×10^{-3}
E2	Number of tracking device ranges of the index register	K6	5×10^{-3}
E3	Number of tracking device ranges of the file register stored in the Standard RAM	K7	5×10^{-3}
E4	Number of tracking device ranges of the file register stored in the SRAM card	K8	5×10^{-3}
F1	Number of blocks not including the file register	K9	1×10^{-3}
F2	Number of blocks including the file register stored in the Standard RAM	K10	25×10^{-3}
F3	Number of blocks including the file register stored in the SRAM card	K11	*2

* 2: The value of K11 differs depending on the serial number of the QnPRHCPU used.

•QnPRHCPU whose serial number (first five digits) is "06081" or earlier: $(120 + 3 \times G^{*3}) \times 10^{-3}$

•QnPRHCPU whose serial number (first five digits) is "06082" or later: 120×10^{-3}

* 3: G is the number of clusters of the specified file register. Calculate it using the following expression.

G = (file register capacity)/(size of one cluster)

Round up the fractional portion of G calculated by the above expression.

Use the following value as the size of one cluster.

•Q2MEM-1MBSN, Q2MEM-1MBS: 256 words (512 bytes)

•Q2MEM-2MBSN, Q2MEM-2MBS, Q3MEM-4MBS: 512 words (1024 bytes)

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Appendix 1 Comparison of Q4ARCPU and QnPRHCPU

A comparison of Q4ARCPU and QnPRHCPU redundant systems is listed in Table App.1.

Table App.1 Comparison of Q4ARCPU and QnPRHCPU Redundant Systems

Item		QnPRHCPU Redundant System	Q4ARCPU Redundant System
Performance	Tracking Time	Internal device 48K Word Setting Time	Internal device 48K Word Setting Time
		Synchronized Tracking Mode: 41 ms [*1]	-
		-	• Batch Transfer Mode: 68.4 ms
		Program Priority Mode: 21 ms [*1]	• Repeat Mode: 34.2 ms [*1]
	System Switching Time	Tsw=21 + T + Trc (Refer to Section 9.2)	300ms
System Configuration	A Series Modules	N/A	Applicable
	QnA Series Modules	N/A	Applicable
	CC-Link Auto Refresh Setting	Applicable (Maximum 4 Modules)	N/A (Performed using FROM/TO instruction)
	Maximum Number of Modules Mounted on Main/ Extension Base Unit	<<First 5 digits of serial No. is "09011" or earlier>> 11 modules (Main base unit only) → Modules which are not duplicated are mounted to MELSECNET/H remote I/O station (Number of mountable modules on remote I/O station: 64 modules per station) <<First 5 digits of serial No. is "09012" or later>> Up to 63 modules (Main base unit + extension base unit: 7 stages)	58 Modules (main base unit + extension base unit : 7 stages)

* 1: Q4ARCPU repeat mode results in program priority mode on QnPRHCPU.

Table App.1 Comparison of Q4ARCPU and QnPRHCPU Redundant Systems (Continued)

Item		QnPRHCPU Redundant System	Q4ARCPU Redundant System
System Configuration	System Extension via Extension Base Unit	<<First 5 digits of serial No. is "09011" or earlier>> N/A → Modules for the expanded system are mounted to MELSECNET/H remote I/O station. [Restrictions on Mounting Modules on Remote I/O Stations] • FROM/TO instructions and intelligent function module devices (U☐\G☐) are inapplicable. Use REMFR/REMTO for accessing. Or, in GX Configurator, configure the settings for intelligent function modules on remote I/O stations.[2] • The following modules cannot be mounted to remote I/O stations: CC-Link IE Controller Network module, MELSECNET/H module, interrupt module, Web server module, MES interface module, PROFIBUS-DP master module, PROFIBUS-DP slave module, PROFIBUS-DP interface module, DeviceNet master module, DeviceNet slave module, and AS-i master module. • For Ethernet modules, dedicated instructions, interrupt pointers, e-mail function, communication by the fixed buffer, FTP server function, web server function is not usable. For intelligent function modules other than the above, dedicated instructions and interrupt pointers are not usable. <<First 5 digits of serial No. is "09012" or later>> Applicable (Extension base units: Up to 7) • The following modules cannot be mounted: Interrupt module, CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module (function version: B or earlier), Web server module (first 5 digits of serial No.: "09011" or earlier), PROFIBUS-DP master module, PROFIBUS-DP slave module, PROFIBUS-DP interface module, DeviceNet master module, and DeviceNet slave module. • For intelligent function modules, dedicated instructions and interrupt pointers are not usable.	Applicable (Extension base units: Maximum 7 stages)
	Single CPU System	Applicable (Debug mode only)	Applicable

* 2: MELSECNET/H remote I/O stations have a limit for the maximum number of parameters that can be set with GX Configurator as intelligent function modules.
　•The maximum number of parameter settings for initialization settings: 512
　•The maximum number of parameter settings for automatic refresh settings: 256

APPENDICES

Table App.1 Comparison of Q4ARCPU and QnPRHCPU Redundant Systems (Continued)

Item			QnPRHCPU Redundant System	Q4ARCPU Redundant System
System Configuration	GOT Connection Type	Bus Connection	N/A	Applicable
		CPU Direct Connection	Applicable (Communication with the CPU module connected to the GOT only.)	Applicable
		Computer Link Connection	N/A	Applicable
		MELSECNET/H Remote I/O Station Connection	Applicable (N/A for extension base unit)	N/A
		CC-Link Connection	Applicable	Applicable
		MELSECNET/H PLC to PLC Network Connection	Applicable (N/A for extension base unit)	N/A
		Ethernet Connection	Applicable	Applicable
	Mounting I/O module or network module on slot 0		Disabled (Slot 1 becomes I/O number "0") → Mount I/O modules and network modules on slots 1 and later.	Enabled
	16 character LED display (auto diagnostics information and comments are displayed.)		N/A → Auto diagnostics error information and comments, etc. can be confirmed using GX Developer.	Available
	Manual System Switching		System switching by the system switching instructions or redundant operation of GX Developer	System switching using switches of bus switching module (A6RAF)
	Manual operational mode switching		Operation mode change by redundant operation of GX Developer	Operation mode change using switches of bus switching module (A6RAF)
	CPU module damage external output		Power supply module error contact output	System management module (AS92R) CPU/ALRAM/WDT contact point output
Programming Tool	Q6PU		N/A	Applicable
	SW□IVD-GPPQ		N/A	Applicable
	GX Developer		Version 8.18U or later is applicable.	SW0D5C-GPPW or later is applicable.
	GX Works2		Version 1.87R or later is applicable.	N/A
	MX Links		N/A → Substituted with MX Component. (An application program on the personal computer side needs to be corrected.)	Applicable
	MX Monitor			
	MX Chart			
	Connection Port		RS-232, USB	RS422 (RS-232/RS-422 converter)

Table App.1 Comparison of Q4ARCPU and QnPRHCPU Redundant Systems (Continued)

	Item	QnPRHCPU Redundant System	Q4ARCPU Redundant System
Program	Instruction Restrictions	Instructions listed in Table App.2 are inapplicable.	-
	Special Relay	Some special relays are different. [*3]	-
	Special Register	Some special registers are different. [*3]	-
	A-compatible Special Relay (SM1000 and later)	N/A →Must be changed to a special relay applicable for QnPRHCPU. [*3]	Applicable
	A-compatible Special Registers (SD1000 and later)	N/A →Must be changed to a special register applicable for QnPRHCPU. [*3]	Applicable
	Number of Steps	Number of steps for some instructions are different.	-
	Low-speed Execution Type Program	N/A	Applicable
Debug Function	Status Latch	N/A	Applicable
	Program Trace	N/A	Applicable
	Simulation	N/A → Substituted with GX Simulator	Applicable
	Step Execution / Sequence Program	N/A → Substituted with GX Simulator	Applicable
	Step Execution / SFC Program	N/A	

* 3: For details, refer to the following.

☞ QCPU User's Manual (Hardware Settings, Maintenance and Inspection)

Table App.2 Instructions Inapplicable for QnPRHCPU

Instruction symbol	Instruction Name	Instruction symbol	Instruction Name
LED	LED Display of ASCII code	PR	Print ASCII code
LEDC	LED display of Comments	PRC	Print Comments
SLT	Status Latch Set	KEY	Numerical Key Input
SLTR	Status Latch Reset	UDCNT1	1-phase Input Up/Down Counter
STRA	Sampling Trace Set	UDCNT2	2-phase Input Up/Down Counter
STRAR	Sampling Trace Reset	TTMR	Teaching Timer
PTRAEXE(P)	Program Trace Execution	STMR	Special Function Timer
PTRA	Program Trace Set	ROTC	Rotary Table Near Path Rotation Control
PTRAR	Program Trace Reset	RAMP	Ramp Signal
MSG	Message Displayed on Peripheral Devices	SPD	Pulse Density Measurement
PKEY	Peripheral Device Keyboard Input	PLSY	Pulse Output
RFRF	Read From Remote I/O Station Special Function Module	PWM	Pulse Width Modulation
RTOP	Write To Remote I/O Station Special Function Module	MTR	Matrix Input

Appendix 2 Comparison of Qn(H)CPU and QnPRHCPU

A Comparison of Qn(H)CPU and QnPRHCPU is listed in Table App.3.

Table App.3 Comparison of Qn(H)CPU and QnPRHCPU

	Item	QnPRHCPU	QnHCPU
Performance	Scan Time	Scan time is increased by the tracking time. Inside device 48K word setting time • Synchronized tracking mode: 41 ms • Program priority mode: 21 ms	–
System Configuration	A Series Module	N/A	Applicable
	Maximum Number of Modules Mounted on Main/Extension Base Unit	<<First 5 digits of serial No. is "09011" or earlier>> 11 modules (Main base unit only) → Modules which are not duplicated are mounted to MELSECNET/H remote I/O station (Number of mountable modules on remote I/O station: 64 modules per station) <<First 5 digits of serial No. is "09012" or later>> Up to 63 modules (Main base unit + extension base unit: 7 stages)	64 Slots (Main base unit + Extension base unit: 7 stages)

Table App.3 Comparison of Qn(H)CPU and QnPRHCPU (Continuation)

Item		QnPRHCPU	QnHCPU
System Configuration	System Expansion via Extension Base Unit	<<First 5 digits of serial No. is "09011" or earlier>> N/A → Modules for the expanded system are mounted to MELSECNET/H remote I/O station. [Restrictions on Mounting Modules on Remote I/O Stations] • FROM/TO instructions and intelligent function module devices (U☐\G☐) are inapplicable. Use REMFR/REMTO for accessing. Or, in GX Configurator, configure the settings for intelligent function modules on remote I/O stations.[1] • The following modules cannot be mounted to remote I/O stations: CC-Link IE Controller Network module, MELSECNET/H network module, interrupt module, Web server module, MES interface module, PROFIBUS-DP master module, PROFIBUS-DP slave module, PROFIBUS-DP interface module, DeviceNet master module, DeviceNet slave module, and AS-i master module. • For Ethernet interface modules, dedicated instructions, interrupt pointers, e-mail function, communication by the fixed buffer, FTP server function, web server function is not usable. For intelligent function modules other than the above, dedicated instructions and interrupt pointers are not usable. <<First 5 digits of serial No. is "09012" or later>> Applicable (Extension base units: Up to 7) • The following modules cannot be mounted: Interrupt module, CC-Link IE Controller Network module, MELSECNET/H network module, Ethernet interface module (function version: B or earlier), Web server module (first 5 digits of serial No.: "09011" or earlier), PROFIBUS-DP master module, PROFIBUS-DP slave module, PROFIBUS-DP interface module, DeviceNet master module, and DeviceNet slave module. • For intelligent function modules, dedicated instructions and interrupt pointers are not usable.	Applicable (Extension base units: maximum 7 levels)

* 1: MELSECNET/H network system remote I/O stations have a limit for the maximum number of parameters that can be set with GX Configurator as intelligent function modules.
  • The maximum number of parameter settings for initialization settings: 512
  • The maximum number of parameter settings for automatic refresh settings: 256

Table App.3 Comparison of Qn(H)CPU and QnPRHCPU (Continuation)

Item			QnPRHCPU	QnHCPU
System Configuration	Multi CPU System		N/A	Applicable
	Single CPU System		Applicable (Debug mode only)	Applicable
	GOT Connection Type	Bus Connection	N/A	Applicable
		CPU Direct Connection	Applicable (Communication with the CPU module connected to the GOT only)	Applicable
		Computer Link Connection	N/A	Applicable
		Ethernet Connection	Applicable	Applicable
		CC-Link IE Controller Network Connection	Applicable (N/A for extension base unit)	Applicable
		MELSECNET/H PLC to PLC Network Connection	Applicable (N/A for extension base unit)	Applicable
		CC-Link Connection	Applicable	Applicable
		MELSECNET/H Remote I/O Station Connection	Applicable (N/A for extension base unit)	Applicable
	Mounting I/O module or network module on slot 0		Disabled (Slot 1 becomes I/O number "0") → Mount I/O modules and network modules on slots 1 and later.	Enabled
	Restriction on the applicable intelligent function modules		Applied → The Ethernet modules and MELSECNET/H modules of serial No. "06052" or later are applicable.	Not applied
Programming Tool	GX Developer		Version 8.18U or later is applicable.	Version 4 or later is applicable.
	GX Works2		Version 1.87R or later is applicable.	Version 1.15R or later is applicable.
Program	Instruction restriction		• Instructions listed in Table App.4 cannot be used. • Instructions listed in Table App.5 can be used under restrictions.	–
	Floating point calculations		Only internal operation processing with single precision. (Internal operation processing precision level (single/double) is not selectable.)	Internal operation processing precision level (single/double) is selectable.
	High-speed interrupt (I49)		N/A	Applicable
	Slow-speed execution-type program		N/A	Applicable

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Table App.4 Instructions Inapplicable for QnPRHCPU

Instruction symbol	Instruction Name	Instruction symbol	Instruction Name
PLOADP	Program Load from Memory Card	PLSY	Pulse Output
PUNLOADP	Program Unload from Memory Card	PWM	Pulse Width Modulation
PSWAP	Load + Unload	MTR	Matrix input
PR	Print ASCII code	S.TO	Write To Host Station CPU Shared Memory
PRC	Print Comments	S(P).SFCF	Request of Motion SFC Program Startup
KEY	Numerical Key Input	S(P).SVST	Request of Servo Program Startup
UDCNT1	1-phase Input Up/Down Counter	D(P).CHGV	Axis Speed Change during Positioning and JOG operation
UDCNT2	2-phase Input Up/Down Counter	D(P).CHGT	Torque Control Value Change during Operation and Suspension in Real Mode
TTMR	Teaching Timer	D(P).CHGA	Current value Change of Halted Axis/Synchronized Encoder/Cam axis
STMR	Special Timer	D(P).DDWR	Write Other CPU Device Data into Host CPU
ROTC	Rotary Table Near Path Rotation Control	D(P).DDRD	Reads other CPU device data into the host CPU
RAMP	Ramp Signal	D(P).GINT	Request of Other CPU Interrupt Program Startup.
SPD	Pulse Density Measurement		

Table App.5 Instructions Restricted for QnPRHCPU

Instruction Symbol	Instruction Name	Remark
COM	Selection Refresh	For restrictions on COM and ZCOM, refer to Section 7.1 (7).
ZCOM	Refresh of Specified Module	

Appendix 3 Comparison of QnPHCPU and QnPRHCPU

A comparison of QnPHCPU and QnPRHCPU is listed in Table App.6.

Table App.6 Comparison of QnPHCPU and QnPRHCPU

Item		QnPRHCPU	QnPHCPU
Performance	Scan Time	Scan time is increased by the tracking time. Internal device 48K word setting time • Synchronized tracking mode: 41 ms • Program priority mode: 21 ms	-
System Configuration	Maximum Number of Modules Mounted on Main/ Extension Base Unit	<<First 5 digits of serial No. is "09011" or earlier>> 11 modules (Main base unit only) → Modules which are not duplicated are mounted to MELSECNET/H remote I/O station (Number of mountable modules on remote I/O station: 64 modules per station) <<First 5 digits of serial No. is "09012" or later>> Up to 63 modules (Main base unit + extension base unit: 7 stages)	64 Slots (Main base unit + Extension base unit: 7 stages)

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Table App.6 Comparison of QnPHCPU and QnPRHCPU (Continued)

Item		QnPRHCPU	QnPHCPU
System Configuration	System expansion using extension base units	<<First 5 digits of serial No. is "09011" or earlier>> N/A → Modules for the expanded system are mounted to MELSECNET/H remote I/O station. [Restrictions on Mounting Modules on Remote I/O Stations] • FROM/TO instructions and intelligent function module devices (U☐\G☐) are inapplicable. Use REMFR/REMTO for accessing. Or, in GX Configurator, configure the settings for intelligent function modules on remote I/O stations.[1] • The following modules cannot be mounted to remote I/O stations: CC-Link IE Controller Network module, MELSECNET/H module, interrupt module, Web server module, MES interface module, PROFIBUS-DP master module, PROFIBUS-DP slave module, PROFIBUS-DP interface module, DeviceNet master module, DeviceNet slave module, and AS-i master module. • For Ethernet modules, dedicated instructions, interrupt pointers, e-mail function, communication by the fixed buffer, FTP server function, web server function is not usable. For intelligent function modules other than the above, dedicated instructions and interrupt pointers are not usable. <<First 5 digits of serial No. is "09012" or later>> Applicable (Extension base units: Up to 7) • The following modules cannot be mounted: Interrupt module, CC-Link IE Controller Network module, MELSECNET/H module, Ethernet module (function version: B or earlier), Web server module (first 5 digits of serial No.: "09011" or earlier), PROFIBUS-DP master module, PROFIBUS-DP slave module, PROFIBUS-DP interface module, DeviceNet master module, and DeviceNet slave module. • For intelligent function modules, dedicated instructions and interrupt pointers are not usable.	Applicable (Extension base units: maximum 7 levels)

* 1: MELSECNET/H remote I/O stations have a limit for the maximum number of parameters that can be set with GX Configurator as intelligent function modules.
  • The maximum number of parameter settings for initialization settings: 512
  • The maximum number of parameter settings for automatic refresh settings: 256

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Table App.6 Comparison of QnPHCPU and QnPRHCPU (Continued)

Item			QnPRHCPU	QnPHCPU
System Configuration	Multi CPU System		N/A	Applicable
	Single CPU System		Applicable (Debug mode only)	Applicable
	GOT Connection Type	Bus Connection	N/A	Applicable
		CPU Direct Connection	Applicable (Communication with the CPU module connected to the GOT only)	Applicable
		Computer Link Connection	N/A	Applicable
		Ethernet Connection	Applicable	Applicable
		CC-Link IE Controller Network Connection	Applicable (N/A for extension base unit)	Applicable
		MELSECNET/H PLC to PLC Network Connection	Applicable (N/A for extension base unit)	Applicable
		CC-Link Connection	Applicable	Applicable
		MELSECNET/H Remote I/O Station Connection	Applicable (N/A for extension base unit)	Applicable
	Mounting I/O module or network module on slot 0		Disabled (Slot 1 becomes I/O number "0".) → Mount I/O modules and network modules on slots 1 and later.	Enabled
	Restriction on the applicable intelligent function modules		Applied →The Ethernet modules and MELSECNET/H module of serial No. "06052" or later are applicable.	Not applied
Programming Tool	GX Developer		Version 8.18U or later is applicable.	Version 7 or later is applicable.
	GX Works2		Version 1.87R or later is applicable.	Version 1.87R or later is applicable.
	PX Developer		Version 1.06G or later is applicable.	Version 1.00A or later is applicable.
Program	Instruction restriction		Instructions listed in Table App.7 are inapplicable.	-
	Low-speed Execution Type Program		N/A	Applicable

Appendix 3 Comparison of QnPHCPU and QnPRHCPU App - 11

Table App.7 Instructions Inapplicable for QnPRHCPU

Instruction Symbol	Instruction Name	Instruction Symbol	Instruction Name
PLOADP	Program Load from Memory Card	PLSY	Pulse Output
PUNLOADP	Program Unload from Memory Card	PWM	Pulse Width Modulation
PSWAP	Load + Unload	MTR	Matrix Input
PR	Print ASCII code	S.TO	Write To Host Station CPU Shared Memory
PRC	Print Comments	D(P).SFCF	Request of Motion SFC Program Startup
KEY	Numerical Key Input	D(P).SVST	Request of Servo Program Startup
UDCNT1	1-phase Input Up/Down Counter	D(P).CHGV	Axis Speed Change during Positioning and JOG operation
UDCNT2	2-phase Input Up/Down Counter	D(P).CHGT	Torque Control Value Change during Operation and Suspension in Real Mode
TTMR	Teaching Timer	D(P).CHGA	Current value Change of Halted Axis/Synchronized Encoder/Cam axis
STMR	Special Timer	D(P).DDWR	Write Host CPU Device Data into Other CPU devices
ROTC	Rotary Table Near Path Rotation Control	D(P).DDRD	Read Other CPU Device Data into Host CPU.
RAMP	Ramp Signal	D(P).GINT	Request of Other CPU Interrupt Program Startup.
SPD	Pulse Density Measurement		

Table App.8 Instructions Restricted for PRHCPU

Instruction Symbol	Instruction Name	Remark
COM	Selection Refresh	For restrictions on COM and ZCOM, refer to Section 7.1 (7).
ZCOM	Refresh of Specified Module	

Appendix 4 Sample Programs When CC-Link is Used

This section provides sample programs that continue the control of CC-Link network after the system is switched in a redundant system.

When CC-Link is used in a redundant system, create the sample programs provided in Appendix 4.5.

Appendix 4.1 System Configuration

Diagram App.1 shows the system configuration for creating sample programs and setting CC-Link network parameters.

In the diagram, the I/O numbers assigned to the CC-Link master module will be X/Y40 to X/Y5F. (☞ Section 2.4)

If the system being used is different from the diagram (Diagram App.1), change the settings for the sample program device Nos., and for CC-Link network parameters.
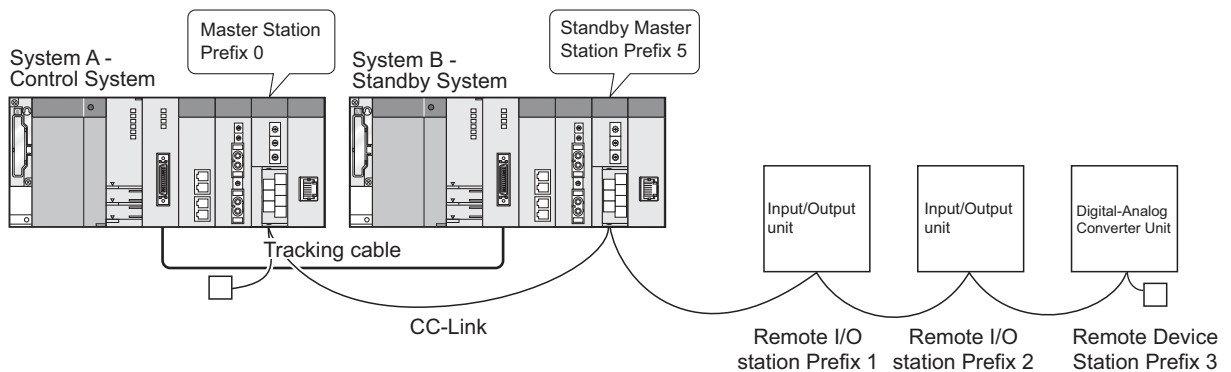
Diagram App.1 System Configuration

Appendix 4.2 Sample Program Names

The sample program names are listed in Table App.9.

Change the program names to match the system used.

Accordingly, change the program name in the Program tab of the PLC parameter setting as well.

Table App.9 Sample Program Names

Program Name	Execution Type	Processing Content
CHANGE	Scan	A processing program that makes QJ61BT11N usable with redundant system CPUs Make the program settings in the PLC settings so that "MAIN" will be executed after "CHANGE".
MAIN	Scan	A CC-Link control processing program

Appendix 4.3 Devices Used in Programs

(1) Devices in a CPU module

Table App.10 and Table App.11 list device numbers used in sample programs and their applications.

Table App.10 Devices in a CPU Module

Device Number	Application	Remarks
SM400	Always ON	-
SM402	ON for 1 scan only after RUN	-
SM1515	Control system judgment flag	Control system: SM1515: ON, SM15165: OFF
SM1516	Standby system judgment flag	Standby system: SM1515: OFF, SM1516: ON
SM1518	Standby system to control system switching status flag	-
SM1592	Enable manual system switching flag	OFF : Manual switching prohibited ON : Manual system switching enabled
M100	Enable control program execution flag	OFF : Control program execution not possible ON : Control program execution possible
M101	System switching execution flag	OFF : System switching must not be executed ON : System switching executed
M102	System B first startup system switching flag	OFF : System switching must not be executed ON : System switching executed
M103	Scan waiting completion after saving the link devices at master switching	OFF : Scan waiting not completed ON : Scan waiting completed
M202	SP.CONTSW instruction error flag	OFF : Normal ON : Error
M4531	During data link execution	OFF : Not executed data link ON : During data link execution
D0	Number of scans after saving the link devices at master switching	After saving the link devices at master switching, the value is incremented by one for each scan until the return processing is executed.
D100 to D107	Interrupt enable or interrupt disable (IMASK instruction)	0: interrupt prohibited 1: interrupt enabled
W1200 to W1209	Device to back up data in remote output (RY)	-
W1300 to W1309	Device to back up data in remote input (RX)	-
W1400 to W1413	Device to back up data in remote register (RWw)	-
W1500 to W1513	Device to back up data in remote register (RWr)	-
SD1601	System switching condition	16: system switching instruction
SD1602	System switching instruction argument	Argument specified by SP.CONTSW instructions
I41	Pointer performed at STANDBY error	Switches the stand-by master station in CC-Link to the master station

(2) Devices in a CC-Link master module

Table App.11 Devices in a CC-Link Master Module

Device Number [*1]	Application	Remarks
X40	Module error	OFF : Module normal ON : Module error
X41	Host data link status	OFF : Data link is stopped ON : Data linking in progress
X4F	Module ready	OFF : Operation not possible ON : Operation possible
SB40C	Forced master switching	OFF : Not requested ON : Requested
SB401	Refresh instruction at standby master switching	OFF : Not instructed ON : Instructed
SB442	Refresh instruction acknowledgment status at standby master switching	OFF : Not executed ON : instruction acknowledged
SB443	Refresh instruction complete status at standby master switching	OFF : Not executed ON : Switching complete
SB45A	Master switching request acknowledgment	OFF : Not acknowledged ON : Request acknowledged
SB45B	Master switching request complete	OFF : Not complete ON : Complete
SW443	Refresh instruction at standby master switching result	0: Normal Other than 0: Stores an error code

* 1: Indicates the device number on CPU side in (3) of this Section.

(3) Refresh Devices

In redundant systems, refresh of remote inputs (RX), remote outputs (RY) and remote registers (RWr, RWw) are set with the program.

Refresh settings of special relays (SB) and special registers (SW) are configured with network parameters.

The CC-Link refresh devices and refresh ranges for the system in Appendix 4.1 (using 5 stations) are listed in Table App.12.

Change the transfer range on the CC-Link side, and the device range on the CPU side to match them with the number of stations and module types on the system used.

Table App.12 Refresh Devices

	CC-Link Side			CPU Side
Device Name	Transfer Range	Buffer Memory Head Address	Number of Data Transferred (Words)[*1]	Device Used
Remote Input (RX)	RX0-RX9F	224(E0H)	10	X1000-X109F
Remote Output (RY)	RY0-RY9F	352(160H)	10	Y1000-Y109F
Remote Register (RWr)	RWr0-RWr20	736(2E0H)	20	W1000-W1013
Remote Register (RWw)	RWw0-RWw20	480(1E0H)	20	W1100-W1113
Special Relay (SB)	SB0-SB1FF	-	-	SB400-SB5FF
Special Register (SW)	SW0-SW1FF	-	-	SW400-SW5FF

* 1: Indicates the number of transferred data that is specified in the BMOV instruction.

Appendix 4.4 Parameter Settings

The PLC parameters and network parameters for using the sample program are shown here.

(1) Program settings

The program settings of the PLC parameter settings are shown in Diagram App.2. Set "MAIN" as a number lower than "CHANGE" in program settings.
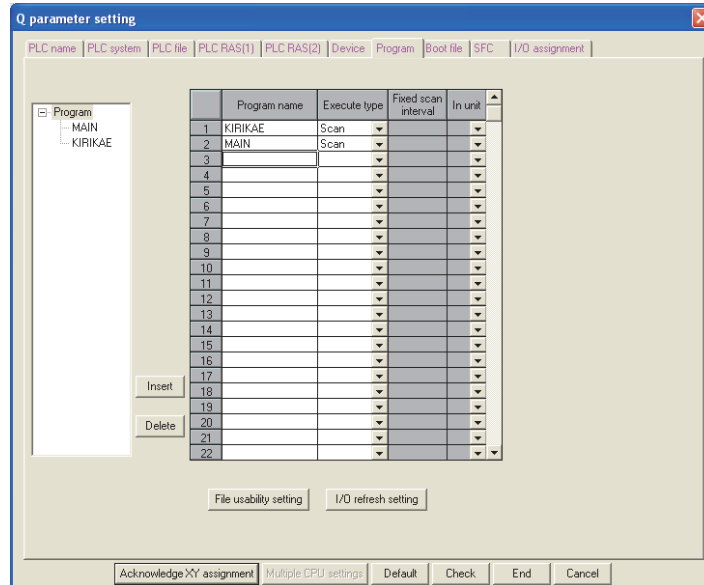
Diagram App.2 Program Setting Window

(2) Tracking settings

Set the tracking settings as shown in Diagram App.3.
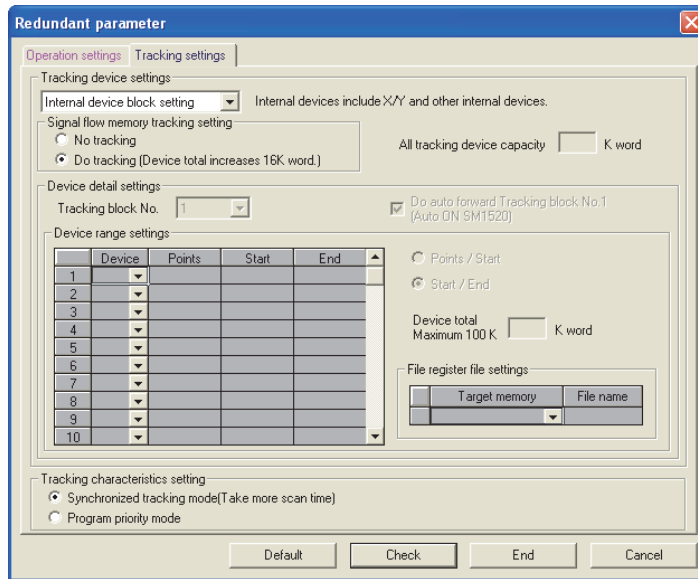
Diagram App.3 Tracking Setting Window

(3) CC-Link network parameter settings

(a) Setting example
An example of CC-Link network parameter settings is shown in Diagram App.4. Refer to (b) for the station information setting.
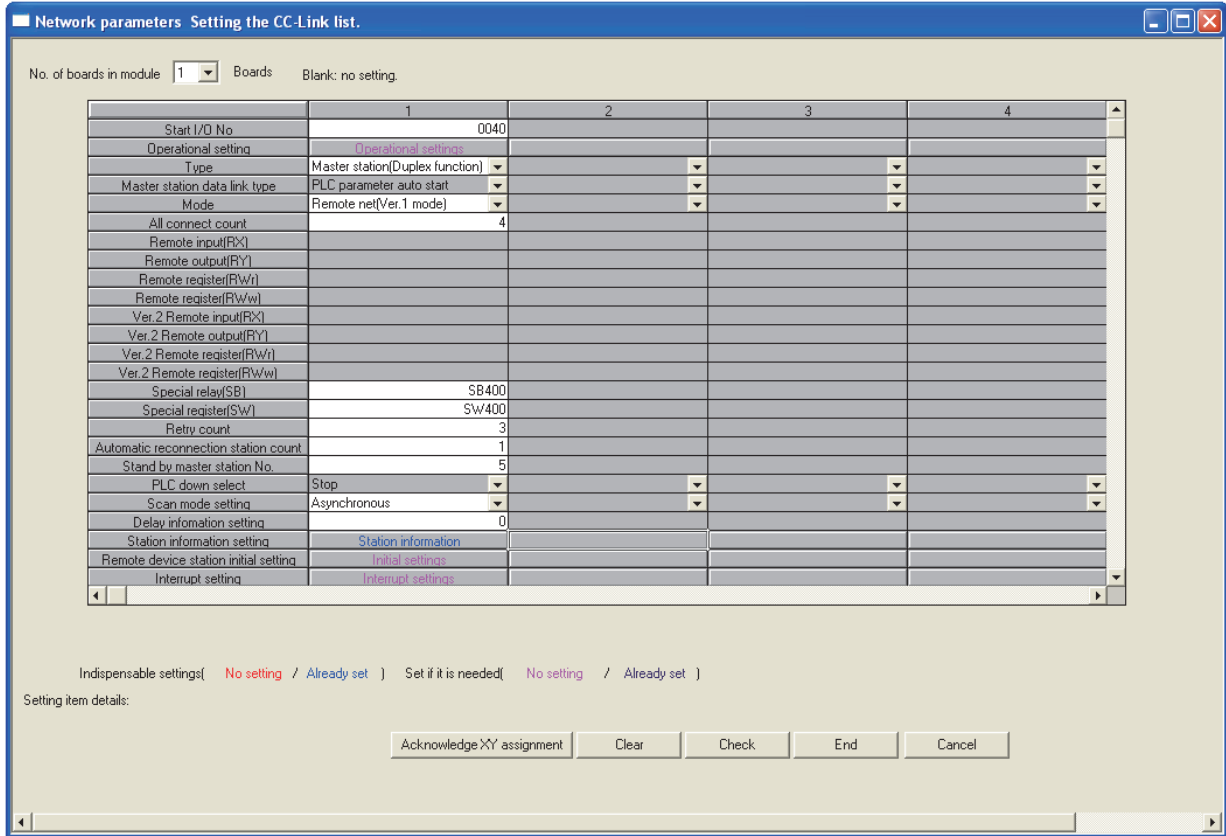
Diagram App.4 CC-Link Network Parameter Setting Window

(b) Station information setting
Set the station information as shown in Diagram App.5
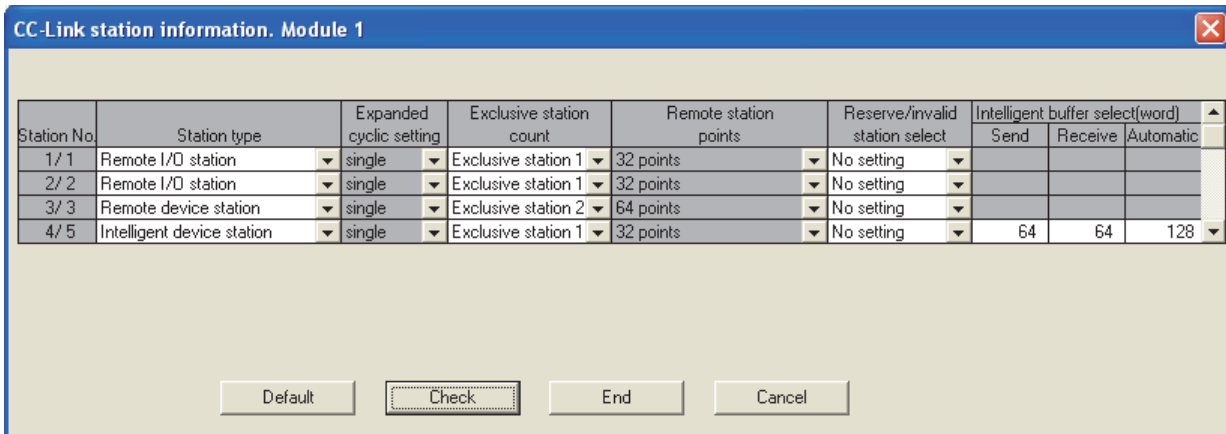
Diagram App.5 CC-Link Station Information Setting

Appendix 4.5 Sample Program

(1) When the QJ61BT11N's serial No. (first 5 digits) is "07112" or later

    (a) Sample program name: CHANGE

        1) General flow

```
┌─────────────────────┐          ┌─────────────────────┐
│       CHANGE        │          │         I41         │
└─────────────────────┘          └─────────────────────┘
          │                                 │
┌─────────────────────┐          ┌─────────────────────┐
│  Set I41 to be valid.│          │ Forcibly change the │
│  (Step 0 to 11)     │          │ system that         │
└─────────────────────┘          │ communicates with   │
          │                      │ the CC-Link.        │
┌─────────────────────┐          │ (Step 103 to 105)   │
│ Initialize devices  │          └─────────────────────┘
│ after the           │                    │
│ system switching.   │          ┌─────────────────────┐
│ (Step 12 to 17)     │          │        IRET         │
└─────────────────────┘          └─────────────────────┘
          │
┌─────────────────────┐
│ After saving the    │
│ link devices when   │
│ the standby master  │
│ station is requested│
│ the system switching│
│ wait a fixed number │
│ of scans.(Step 18   │
│ to 25)              │
└─────────────────────┘
          │
┌─────────────────────┐
│ Reverse the refresh │
│ devices when the    │
│ standby master      │
│ station is requested│
│ the system switching│
│ (Step 26 to 68)     │
└─────────────────────┘
          │
┌─────────────────────┐
│ Refresh the link    │
│ devices.            │
│ (Step 69 to 89)     │
└─────────────────────┘
          │
┌─────────────────────┐
│ Refresh the CC-Link │
│ (Step 90 to 101)    │
└─────────────────────┘
          │
┌─────────────────────┐
│        FEND         │
└─────────────────────┘
```

Diagram App.6 General Flow

2) Sample program

Step	Contacts	Instruction	Comment
0	SM402	FMOV H0FFFF D100 K8	
	SM1518	MOV H200 D102	Adds I41 to the allowable interrupt defaults (I0 to I31, I48 to I255).
8		DI	
9		IMASK D100	
11		EI	
12	SM1518	RST SB40C	Set CC-Link forced master switching flag to OFF.
		RST M100	Set control program execution flag to OFF.
		RST M103	Set scan waiting completion to OFF (scan waiting incomplete) after saving the link devices at master switching.
		MOV K0 D0	Clear the number of scans after saving the link devices at master switching.
18	SB45A M103	INC D0	After saving the link devices at master switching, wait a fixed number of scans.
	> D0 *1	SET M103	
26	SB45A	BMOVP U4\G352 W1200 K10	Save RY, RX, RWw, RWr data to W device
		BMOVP U4\G224 W1300 K10	
		BMOVP U4\G480 W1400 K20	
		BMOVP U4\G736 W1500 K20	
47	SB45B M103	BMOVP W1300 U4\G352 K10	Set the saved data to RY, RX, RWw, RWr
		BMOVP W1200 U4\G224 K10	
		BMOVP W1500 U4\G480 K20	
		BMOVP W1400 U4\G736 K20	

* 1: After saving the link devices, wait a fixed number of scans and execute the processing which sets the link devices saved at master switching and Refresh instruction at standby master switching (SB401).
For details, refer to the following.
MELSEC-Q CC-Link System Master/Local Module User's Manual

Line	Ladder	Description
69	M100 ─┤├─── [BMOV K4Y1000 U4\G352 K10]	Performs a refresh of RY (Y1000 to Y109F).
	[BMOV U4\G224 K4X1000 K10]	Performs a refresh of RX (X1000 to X109F).
	[BMOV W1100 U4\G480 K20]	Performs a refresh of RWw (W1100 to W1113).
	[BMOV U4\G736 W1000 K20]	Performs a refresh of RWr (W1000 to W1013).
90	SB45A SB45B M103 ─┤├──┤├──┤├── [SET SB401]	Set refresh update request signal to ON.
	[RST M103]	Set scan waiting completion to OFF (scan waiting incomplete) after saving the link devices at master switching.
95	SB442 SB443 ─┤├──┤├── [RST SB401]	Set refresh update request signal to OFF.
	[= K0 SW443] [SET M100]	Set control program execution flag to ON.
102	[FEND]	End main routine program.
I41 103	SM400 ─┤├── [SET SB40C]	Set CC-Link forced master switching flag to ON.
106	[IRET]	End interrupt program.
107	[END]	

Diagram App.7 Sample Program: CHANGE

(b) Sample program name: MAIN

1) General flow

Diagram App.8 General Flow

2) Sample program

Diagram App.9 Sample Program: MAIN

☒**POINT**

Control the CC-Link control program operation of when the master station or the standby master station is oprating with the CJ instruction as this example program.
When the program is controlled with the MC instruction, output may turn off at the system switching.

(2) When the QJ61BT11N's serial No. (first 5 digits) is "07111" or earlier

(a) Sample program name: CHANGE

1) General flow

```
┌─────────────────────────┐              ┌─────────────────────────┐
│         CHANGE          │              │           I41           │
└─────────────────────────┘              └─────────────────────────┘
             │                                        │
             ▼                                        ▼
┌─────────────────────────┐        ┌─────────────────────────────────┐
│   Set I41 to be valid.  │        │  Forcibly change the system that │
│      (Step 0 to 11)     │        │  communicates with the CC-Link.  │
└─────────────────────────┘        │       (Step 127 to 129)         │
             │                      └─────────────────────────────────┘
             ▼                                        │
┌─────────────────────────┐                           ▼
│  Initialize devices after│              ┌─────────────────────────┐
│   the system switching.  │              │          IRET           │
│      (Step 12 to 19)    │              └─────────────────────────┘
└─────────────────────────┘
             │
             ▼
┌───────────────────────────────┐
│ After saving the link devices │
│ when the standby master station│
│ is requested the system        │
│ switching, wait a fixed        │
│ number of scans. (Step 20 to 27)│
└───────────────────────────────┘
             │
             ▼
┌───────────────────────────────┐
│ Reverse the refresh devices when│
│ the standby master station is   │
│ requested the system switching.│
│        (Step 28 to 70)         │
└───────────────────────────────┘
             │
             ▼
┌───────────────────────────────┐
│ Refresh the link devices and   │
│ enable system switching.       │
│       (Step 71 to 92)          │
└───────────────────────────────┘
             │
             ▼
┌───────────────────────────────┐
│    Refresh the CC-Link.        │
│      (Step 93 to 111)          │
└───────────────────────────────┘
             │
             ▼
┌───────────────────────────────┐
│ Perform system switching when  │
│ system B starts up as the      │
│ control system. (Step 112 to 125)│
└───────────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│          FEND           │
└─────────────────────────┘
```

Diagram App.10 General Flow

9

PROCESSING TIME FOR REDUNDANT SYSTEMS

APPENDICES

INDEX

2) Sample program

Line	Contacts/Instructions	Description
0	SM402 ── [FMOV H0FFFF D100 K8]	
	SM1518 ── [MOV H200 D102]	
8	── [DI]	Adds I41 to the allowable interrupt defaults (I0 to I31, I48 to I255).
9	── [IMASK D100]	
11	── [EI]	
12	SM1518 ── [RST SB40C]	Set CC-Link forced master switching flag to OFF.
	── [RST M100]	Set control program execution flag to OFF.
	── [SET M101]	Set system switching execution flag to ON.
	── [RST M102]	Set System B first startup system switching flag to OFF.
	── [RST M103]	Set scan waiting completion to OFF (scan waiting incomplete) after saving the link devices at master switching.
	── [MOV K0 D0]	Clear the number of scans after saving the link devices at master switching.
20	SB45A M103 ── [INC D0]	After saving the link devices at master switching, wait a fixed number of scans.
	[> D0 *1] ── [SET M103]	
28	SB45A ── [BMOVP U4\G352 W1200 K10]	Save RY, RX, RWw, RWr data to W device
	── [BMOVP U4\G224 W1300 K10]	
	── [BMOVP U4\G480 W1400 K20]	
	── [BMOVP U4\G736 W1500 K20]	
49	SB45B M103 ── [BMOVP W1300 U4\G352 K10]	Set the saved data to RY, RX, RWw, R...
	── [BMOVP W1200 U4\G224 K10]	
	── [BMOVP W1500 U4\G480 K20]	
	── [BMOVP W1400 U4\G736 K20]	

* 1: After saving the link devices, wait a fixed number of scans and execute the processing which sets the link devices saved at master switching and Refresh instruction at standby master switching (SB401).
For details, refer to the following.
☞ MELSEC-Q CC-Link System Master/Local Module User's Manual

Line	Ladder	Instruction	Comment
71	M100	BMOV K4Y1000 U4\G352 K10	Performs a refresh of RY (Y1000 to Y109F).
		BMOV U4\G224 K4X1000 K10	Performs a refresh of RX (X1000 to X109F).
		BMOV W1100 U4\G480 K20	Performs a refresh of RWw (W1100 to W1113).
		BMOV U4\G736 W1000 K20	Performs a refresh of RWr (W1000 to W1013).
		SET SM1592	Allows system switching by SP.CONTSW.
93	SB45A SB45B M103	SET SB401	Set refresh update request signal to ON.
		RST M103	Set scan waiting completion to OFF (scan waiting incomplete) after saving the link devices at master switching.
98	SB442 SB443	RST SB401	Set refresh update request signal to OFF.
	= K0 SW443	SET M100	Set control program execute flag to ON.
105	= SD1601 K16 = SD1602 K2	SET M100	When System B has started first and a system switch has occurred, sets the control program execution flag to ON.
112	M101 X41 SM1515 SM1516 SB47B	SP.CONTSW K2 M202	Switches the system when System B has started first.
		SET M102	Set System B first startup system change flag to ON.
126		FEND	End main routine program.
127	I41 M102	SET SB40C	Set CC-Link forced master switching flag to ON.
130		IRET	End interrupt program.
131		END	

Diagram App.11 Sample Program: CHANGE

(b) Sample program name: MAIN

1) General flow


```
        ┌─────────────────────────────┐
        │            MAIN             │
        └──────────────┬──────────────┘
                       │
        ┌──────────────▼──────────────┐
        │ Turn the enable control     │
        │ program execution flag ON.  │
        │      (Step 0 to 1)          │
        └──────────────┬──────────────┘
                       │
        ┌──────────────▼──────────────┐
        │  Control the CC-Link.       │
        │      (Step 2 to 18)         │
        └──────────────┬──────────────┘
                       │
        ┌──────────────▼──────────────┐
        │            END              │
        └─────────────────────────────┘
```

Diagram App.12 General Flow

2) Sample program

Diagram App.13 Sample Program: MAIN

⊠**POINT**

Control the CC-Link control program operation of when the master station or the standby master station is oprating with the CJ instruction as this example program.
When the program is controlled with the MC instruction, output may turn off at the system switching.

Appendix 5 Sample Programs When MODBUS is Used

This section provides sample programs that switch the system when a communication error occurs in a MODBUS module mounted on the main base unit in the control system. If a slave station (connected to the CPU module in the control system) cannot receive the alive check data that has been sent by the master station for a specified period, the system will be switched.

When configuring redundant transmission lines for MODBUS modules, create the sample programs provided in this section.

Appendix 5.1 System Configuration

Diagram App.14 shows the system configuration for creating sample programs and setting parameters. In the sample programs, the QJ71MB91s are used as master stations.
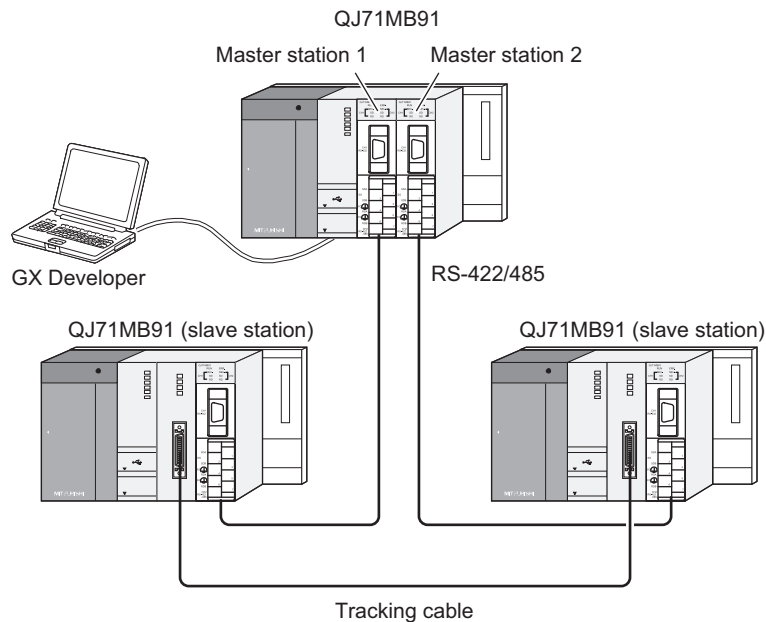
Diagram App.14 System Configuration

I/O numbers of each MODBUS module will be as follows:

      Master station 1: X/Y0 to X/Y1F

      Master station 2: X/Y20 to X/Y3F

      Slave stations (in the control system and standby system): X/Y0 to X/Y1F

Appendix 5.2 Sample Programs for Master Stations

This section describes parameter settings and sample programs for master stations.
When redundant transmission lines are configured, a program that sequentially performs the following communications needs to be created.

      1) Read data of SM1515 (Control system judgement flag) and SM1516 (Standby system judgement flag).
      2) Send the alive check data.
      3) Communicate with slave stations.

Sample programs provided in this section perform the communications above (1) to 3)) every five seconds.
To perform the communications (1) to 3)) at a constant frequency, set the total response monitoring timer value of the MBRW instruction used in each program not to exceed the total communication time.
(The response monitoring timer value of the MBRW instruction in each program is set to one second in the sample programs.)
In the sample programs, the default settings are used for the MODBUS device assignment parameters for slave stations. If the parameters need to be changed, set the corresponding device number to the MODBUS device head number.

(1) Parameter settings

(a) Intelligent function module switch setting

Set the intelligent function module switches for the MODBUS modules used as a master station 1 and 2 as shown in Diagram App.15.

Diagram App.15 Intelligent Function Module Switch Setting

(2) Devices used in the sample programs

Table App.13 lists devices used in the sample programs.

Table App.13 Devices Used in the Sample Programs

Device Number		Application
Master Station 1	Master Station 2	
X0	X20	Module ready
X10	X30	Intelligent function module switch change status
M8172	M8182	MBRW instruction execution trigger (for reading data of SM1515 and SM1516)
M8173	M8183	MBRW instruction execution signal (for reading data of SM1515 and SM1516)
M8174	M8184	MBRW instruction completion signal (for reading data of SM1515 and SM1516)
M8175	M8185	MBRW instruction completion monitoring flag (for reading data of SM1515 and SM1516)
M8176	M8186	MBRW instruction interlock signal (for sending the alive check data)
M8177	M8187	MBRW instruction execution trigger (for sending the alive check data)
M8178	M8188	MBRW instruction execution signal (for sending the alive check data)
M8179	M8189	MBRW instruction completion signal (for sending the alive check data)
M8180	M8190	MBRW instruction completion monitoring flag (for sending the alive check data)
D12130 to D12146	D12210 to D12226	MBRW instruction control data (for reading data of SM1515 and SM1516)
D12150	D12230	Read data storage device (for reading data of SM1515 and SM1516)
D12160	D12240	Write data storage device (for reading data of SM1515 and SM1516)
D12170 to D12186	D12250 to D12266	MBRW instruction control data (for sending the alive check data)
D12190	D12270	Read data storage device (for sending the alive check data)
D12200	D12280	Write data storage device (for sending the alive check data)
T2044	T2046	Initial start-up wait
T2045	T2047	MBRW instruction execution interval timer

(3) Sample program for the master station 1

This program reads the data in the special relay (SM1515, SM1516) and sends the alive check data.

(a) General flow

Diagram App.16 General Flow

Appendix 5 Sample Programs When MODBUS is Used
Appendix 5.2 Sample Programs for Master Stations

(b) Sample program

Step	Ladder instruction		Comment
0	X0 X10 —(T2044) K50		The wait time to start up the slave station (5 seconds)
6	T2044 T2045 —(T2045) K50		Perform a set of communications (reading the data in the special relay (SM1515, SM1516), sending the alive check data, and communicating with slave stations) every five seconds.
12	T2045 —[PLS M8172]		Turn on the MBRW instruction execution trigger.
15	M8172 —[MOV H0 D12130]		Fixed to 0
	—[MOV H0 D12131]		Clear the completion status to 0.
	—[MOV H0 D12132]		Clear MODBUS exception code to 0.
	—[MOV K2 D12133]		Specify the target channel.
	—[MOV H0 D12134]		Fixed to 0
	—[MOV K1 D12135]		The target station number (station No.1)
	—[MOV H0 D12136]		Fixed to 0
	—[MOV K100 D12137]		Response monitoring timer value (1 second)
	—[MOV H100 D12138]		Type specification of the target MODBUS device (100H: Read coils)
	—[MOV K0 D12139]		Target file number
	—[MOV H55EB D12140]		Target MODBUS device head number (Specify the coil 021996 and read the data in SM1515 and SM1516.)
	—[MOV K2 D12141]		Access points (2 points)
	—[MOV K1 D12142]		Read data storage area (1 point)
	—[MOV K1 D12146]		Write data storage area size (dummy)
	—[Z.MBRW "U0" D12130 D12150 D12160 M8173]		Execute the dedicated instruction.
	—[RST M8172]		Turn off the MBRW instruction execution trigger.
55	M8173 M8174 —[SET M8175]		A process upon normal completion (M8173: ON, M8174: OFF)
	M8174 —[RST M8175]		A process upon abnormal end (M8173: ON, M8174: ON)
	—[SET M8176]		Turn on the interlock trigger for the MBRW instruction.
64	SM402 —[MOV K1 D12200]		Store the initial value of alive check data.
67	M8176 —[PLS M8177]		Turn on the MBRW instruction execution trigger.

Diagram App.17 Sample Program for the Master Station 1

The ladder program contains the following rungs and comments:

Rung	Instruction	Comment
70 M8177	[MOV H0 D12170]	Fixed to 0
	[MOV H0 D12171]	Clear the completion status to 0.
	[MOV H0 D12172]	Clear MODBUS exception code to 0.
	[MOV K2 D12173]	Specify the target channel.
	[MOV H0 D12174]	Fixed to 0
	[MOV K1 D12175]	The target station number (station No.1)
	[MOV H0 D12176]	Fixed to 0
	[MOV K100 D12177]	Response monitoring timer value (1 second)
	[MOV H5 D12178]	Type specification of the target MODBUS device (5H: Write holding registers)
	[MOV K0 D12183]	Target file number
	[MOV H2FFF D12184]	Target MODBUS device head number (Specify the holding register 412288 and write the data to D12287.)
	[MOV K1 D12185]	Access points (1 point)
	[MOV K1 D12186]	Write data storage area size (1 point)
	[Z.MBRW "U0" D12170 D12190 D12200 M8178]	Execute the dedicated instruction.
	[RST M8176]	Turn off the MBRW instruction execution trigger.
108 M8178 M8179	[SET M8180]	A process upon normal completion (M8178: ON, M8179: OFF)
M8179	[RST M8180]	A process upon abnormal end (M8178: ON, M8179: ON)
	[INC D12200]	Increment the alive check data.
118 M8175 M8180 D12150.0 D12150.1	Perform communications.	Perform communications with the slave station connected to the control system.
	[RST M8175]	
	[RST M8180]	
D12150.0 D12150.1	[RST M8175]	Do not perform communications with the slave station connected to the standby system.
	[RST M8180]	
132	[END]	

(4) Sample program for the master station 2

This program performs the same operations as the master station 1.

(a) General flow

Refer to Appendix 5.3 (3).

(b) Sample program

Rung	Ladder	Comment
0	X20 X30 —(T2046) K50	The wait time to start up the slave station (5 seconds)
6	T2046 T2047 —(T2047) K50	Perform a set of communications (reading the data in the special relay (SM1515, SM1516), sending the alive check data, and communicating with slave stations) every five seconds.
12	T2047 [PLS M8182]	Turn on the MBRW instruction execution trigger.
15	M8182 [MOV H0 D12210]	Fixed to 0
	[MOV H0 D12211]	Clear the completion status to 0.
	[MOV H0 D12212]	Clear MODBUS exception code to 0.
	[MOV K2 D12213]	Specify the target channel.
	[MOV H0 D12214]	Fixed to 0
	[MOV K1 D12215]	The target station number (station No.1)
	[MOV H0 D12216]	Fixed to 0
	[MOV K100 D12217]	Response monitoring timer value (1 second)
	[MOV H100 D12218]	Type specification of the target MODBUS device (100H: Read coils)
	[MOV K0 D12219]	Target file number
	[MOV H55EB D12220]	Target MODBUS device head number (Specify the coil 021996 and read the data in SM1515 and SM1516.)
	[MOV K2 D12221]	Access points (2 points)
	[MOV K1 D12222]	Read data storage area (1 point)
	[MOV K1 D12226]	Write data storage area size (dummy)
	[Z.MBRW "U2" D12210 D12230 D12240 M8183]	Execute the dedicated instruction.
	[RST M8182]	Turn off the MBRW instruction execution trigger.
55	M8183 M8184 [SET M8185]	A process upon normal completion (M8183: ON, M8184: OFF)
	M8184 [RST M8185]	A process upon abnormal end (M8183: ON, M8184: ON)
	[SET M8186]	Turn on the interlock trigger for the MBRW instruction.
64	SM402 [MOV K1 D12280]	Store the initial value of alive check data.
67	M8186 [PLS M8187]	Turn on the MBRW instruction execution trigger.

Step	Ladder instruction	Comment
70	M8187 —[MOV H0 D12250]	Fixed to 0
	[MOV H0 D12251]	Clear the completion status to 0.
	[MOV H0 D12252]	Clear MODBUS exception code to 0.
	[MOV K2 D12253]	Specify the target channel.
	[MOV H0 D12254]	Fixed to 0
	[MOV K1 D12255]	The target station number (station No.1)
	[MOV H0 D12256]	Fixed to 0
	[MOV K100 D12257]	Response monitoring timer value (1 second)
	[MOV H5 D12258]	Type specification of the target MODBUS device (5H: Write holding registers)
	[MOV K0 D12263]	Target file number
	[MOV H2FFF D12264]	Target MODBUS device head number (Specify the holding register 412288 and write the data to D12287.)
	[MOV K1 D12265]	Access points (1 point)
	[MOV K1 D12266]	Write data storage area size (1 point)
	[Z.MBRW "U2" D12250 D12270 D12280 M8188]	Execute the dedicated instruction.
	[RST M8186]	Turn off the MBRW instruction execution trigger.
108	M8188 M8189 —[SET M8190]	A process upon normal completion (M8188: ON, M8189: OFF)
	M8189 —[RST M8190]	A process upon abnormal end (M8188: ON, M8189: ON)
	[INC D12280]	Increment the alive check data.
118	M8185 M8190 D12230.0 D12230.1 [Perform communications.]	Perform communications with the slave station connected to the control system.
	[RST M8185]	
	[RST M8190]	
	D12230.0 D12230.1 [RST M8185]	Do not perform communications with the slave station connected to the standby system.
	[RST M8190]	
132	[END]	

Diagram App.18 Sample Program for the Master Station 2

Appendix 5 Sample Programs When MODBUS is Used
Appendix 5.2 Sample Programs for Master Stations

Appendix 5.3 Sample Programs for Slave Stations

This section describes parameter settings and a sample program for slave stations.
The sample program switches the system if a slave station cannot receive the alive check data for 10 seconds.

(1) Parameter settings

(a) Redundant parameter
Select "Do tracking (Device total increases 16K word.)" for "Signal flow memory tracking setting" in the Tracking settings parameter.
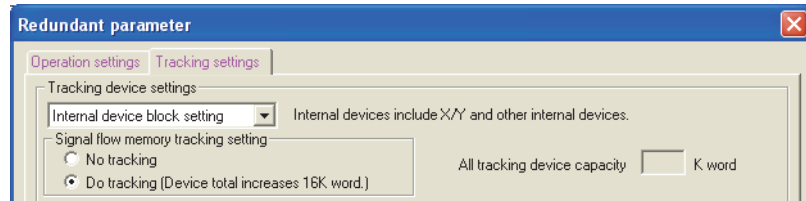
Diagram App.19 Redundant Parameter

(b) Intelligent function module switch setting
Set the intelligent function module switches for the MODBUS modules used as a slave station as shown in Diagram App.20.
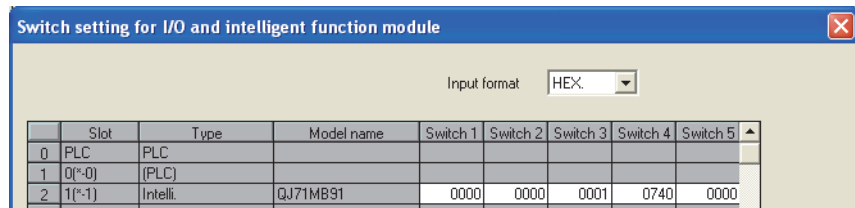
Diagram App.20 Intelligent Function Module Switch Setting

(c) MODBUS device assignment parameter
Default settings are used in the sample program. No settings are required.

(2) Devices used in the sample program

Table App.14 lists devices used in the sample program.

Table App.14 Devices Used in the Sample Program

Device Number	Application
SM400	Always ON
SM1515	Control system judgement flag
SM1516	Standby system judgement flag
SM1518	Standby system to control system switching status flag
SM1592	Enable/disable user system switching
M8190	First data receive signal
M8191	Status when the SP.CONTSW instruction is completed
D12286	Alive check data storage device (last value)
D12287	Alive check data storage device (received value)
T2047	Data reception monitoring timer

(3) Sample program

(a) General flow

```
              ┌──────────────────────┐
              │         MAIN         │
              └──────────────────────┘
                         │
  ┌────────────────────────────────────────┐
  │ Enable the system switch with the       │
  │ SP.CONTSW instruction.                   │
  │ (Step 0 to step 1)                       │
  └────────────────────────────────────────┘
                         │
  ┌────────────────────────────────────────┐
  │ Check that the data for alive check from │
  │ the master station is being received.    │
  │ (Step 2 to step 23)                      │
  └────────────────────────────────────────┘
                         │
  ┌────────────────────────────────────────┐
  │ If the data for alive check cannot be    │
  │ received for a certain time, switch the  │
  │ system with the SP.CONTSW instruction.   │
  │ (Step 24 to step 41)                     │
  └────────────────────────────────────────┘
                         │
              ┌──────────────────────┐
              │         END          │
              └──────────────────────┘
```
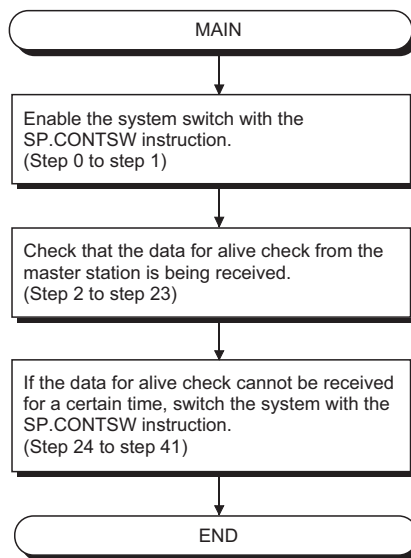
Diagram App.21 General Flow

APPENDICES

MELSEC **Q** series

(b) Sample program


```
 0   SM400 ───────────────────────────────────────────[SET    SM1592 ]
 2   M8190 ─[<>  K0    D12287]─────────────────────────[SET    M8190  ]
        ─/│─
 7   M8190 SM1515 SM1516                                        K100
       ─│├─ ─│├─  ─/│─┬─[=    D12287  D12286]───────────────(T2047  )
                      └─[<>   D12287  D12286]─────[MOV   D12287  D12286 ]
24   T2047 ─┬───────────────────────────[SP.CONTSW  K1    M8191  ]
        ─│├─ └──────────────────────────────────────[RST    T2047  ]
37   SM1518 ──────────────────────────────────────────[RST    T2047  ]
        ─│├─
42   ──────────────────────────────────────────────────────────[END    ]
```

	Comment
0	Turn on the manual switching enable flag to enable execution of the SP.CONTSW instruction.
2	Turn on M8190 to enable exection of system switching after the first alive check data has been received from the master station.
7	Monitor if the alive check data have been received from the master station (10 seconds).
24	Switch the system if no data have been received for 10 seconds.
	Reset the monitoring timer value.
37	Reset the monitoring timer value if system switching has occurred due to an error other than a MODBUS communication error.

Diagram App.22 Sample Program for Slave Stations

9

PROCESSING TIME FOR REDUNDANT SYSTEMS

APPENDICES

INDEX

Appendix 6 Method for Starting up the Previous Control System

When both systems are simultaneously powered on, or when the reset switches of both system CPU modules are simultaneously set to neutral position in a redundant system, the redundant system will start up with system A as the control system.

Even when the power supplies for both systems go off temporarily due to a power failure while system B is operating as the control system, system A will start up as the control system when the power supplies of both systems are turned ON.

In order to start up with the previous control system, i.e., system B as the control system in this condition, create the following program (Diagram App.23) that uses the special relay, "Previous control system identification flag" (SM1519).

However, when mounting a network module on the main base unit or extension base unit, create an interlock circuit as shown on the programs in Diagram App.29 and Diagram App.31 before executing the SP.CONTSW instruction.

If battery error occurs in either system and device data cannot be held, the operation cannot be guaranteed.

(1) When network module is not mounted

The following program shows an operation when the previous control system starts with no network module mounted.

(a) Program Example

Diagram App.23 A program example

(b) Operation Image

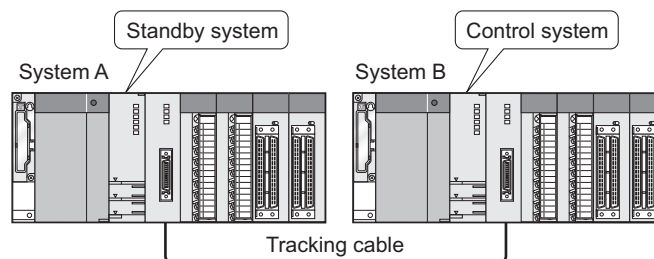#### 1) System B is operating as the control system.

**Diagram App.24 The system when System B is operating as the
control system**

2) Power supplies of both systems are temporarily OFF because of a power failure, etc.

System A   System B

Tracking cable

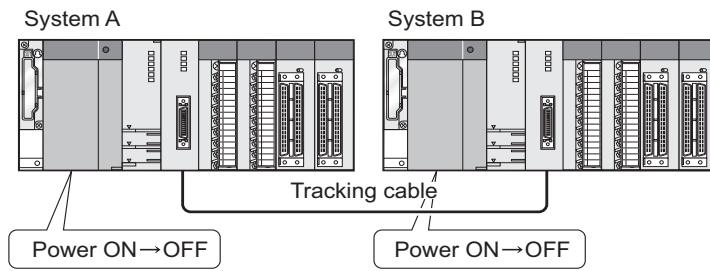Power ON→OFF   Power ON→OFF

Diagram App.25 The system when power supplies of both systems are temporarily OFF

3) System A starts as the control system when both systems are simultaneously powered ON.

(The SM1519 is ON for one scan after the system A CPU module has run.)

[SP.CONTSW K1 M0]   [SP.CONTSW K1 M0]
            [GOEND]   [GOEND]

Control system   Standby system

System A   System B

Tracking cable

Power OFF→ON[*1]   Power OFF→ON[*1]
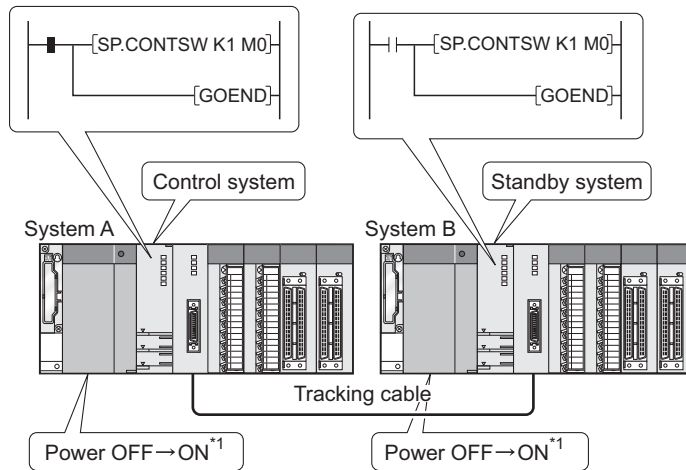
Diagram App.26 The system when both systems are simultaneously powered ON

* 1: After turning on one of the power supply modules, turn the other one on within 3 seconds.

4) Switching System B to the control system through a system switching instruction

Standby system   Control system

System A   System B

System switching

Tracking cable

Diagram App.27 The system when System B is switched to the control system through a system switching instruction

⊠ **POINT**

Create a system switching program while paying attention to the following points.
- Turn on the special relay, "Manual System Switching Enabled Flag" (SM1592) by executing SP.CONTSW instruction.
An "OPERATION ERROR (error code: 4120)" will occur if the SP.CONTSW instruction is executed while SM1592 is OFF.
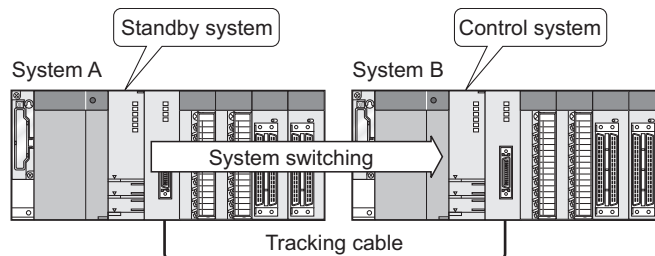- Set any value other than 0 as the parameter for SP.CONTSW instruction. If the SP.CONTSW instruction is executed with the parameter set as 0, the "OPERATION ERROR (error code: 4100)" will occur.

(2) When network module is mounted

Make sure that the network module has started up, and then create a program that executes the SP.CONTSW instruction.

(a) CC-Link IE Controller Network module, MELSECNET/H module or Ethernet module is mounted on the main base unit.
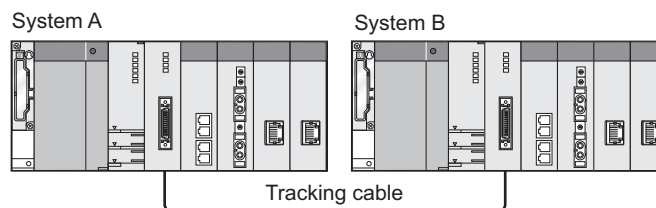
[System Configuration]

Diagram App.28 System configuration when CC-Link IE Controller Network module, MELSECNET/H module or Ethernet module is mounted on the main base unit

[Program Example]

```
     SM1519
  0 ──┤↑├──────────────────────────────────────────[SET    M8191 ]

     M8191
  2 ──┤ ├──────────────────────────────────────────[CALL   P100  ]
        └───────────────────────────────────────────[GOEND        ]

  6  ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
     │                  User program                        │
     └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘

 39 ───────────────────────────────────────────────[FEND        ]

P100  M8191                                                  K100
 55 ──┤ ├──┬──────────────────────────────────────────────(T0   )
           │  SW70.1
           ├──┤/├──[= SD1690 H0 ]──┬───────────────[SET   SM1592 ]
           │                        ├──[SP.CONTSW K1 M100         ]
           │                        └───────────────[RST   M8191  ]
           │  T0
           └──┤ ├──────────────────────────────────[RST   M8191  ]

 79 ───────────────────────────────────────────────[RET         ]

 80 ───────────────────────────────────────────────[END         ]
```
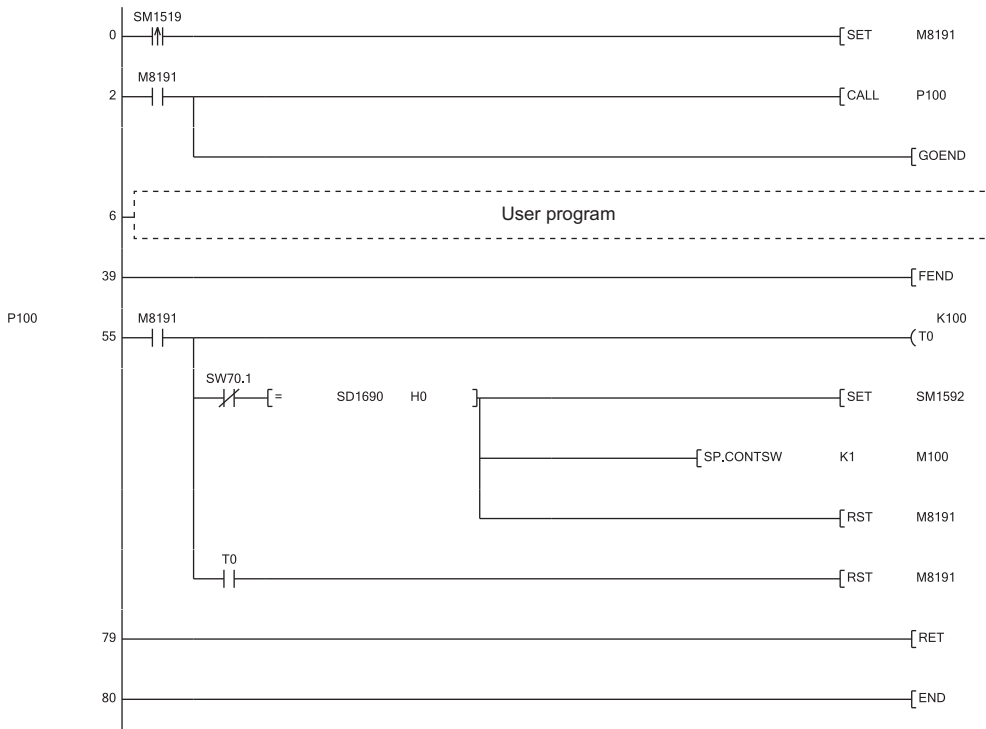
Diagram App.29 A program example

(0)   Saves the ON/OFF status of SM1519 (Previous Control System Identification Flag) to M8191 (System B restart flag) since SM1519 is on during only one scan after the operating status of the CPU module has changed to RUN.

(2)   Makes the subroutine program (P100) execute while M8191 (System B restart flag) is on.

Jumps the processing to the END instruction not to execute the user program while M8191 is on.

(39)   Ends the main routine program.

(55)   Starts measuring the timeout time (ten seconds (Timer Limit Setting: 100ms)) for the startup of previous control system.

Checks the following before executing the SP.CONTSW instruction: one of the device area from SW0070 to SW0073 for checking that the data link status of the network modules in the system B is normal (the device area and bit vary depending on the network modules and the station number in the system B); SD1690 (Network module head address, which requested system switching on host (control) system) for checking that system switching requests are not received from the network modules in the system B.

Sets SM1592 (Enable/disable user system switching) after the network module communications in the system B have been established successfully. (The manual system switching function is enabled.)

Executes the SP.CONTSW instruction.

Turns off M8191 (System B restart flag).

Turns off M8191 as well when the timeout time (ten seconds) has elapsed, because system switching is not performed and the CPU module proceeds to the next scan to execute the user program while the system A remains as the control system. (The timeout time (ten seconds) needs to be adjusted depending on the system configuration and environment.)

(79)   Ends the subroutine program.

(b) CC-Link master module is mounted on the extension base unit.

[System Configuration]

System A   System B

Tracking cable

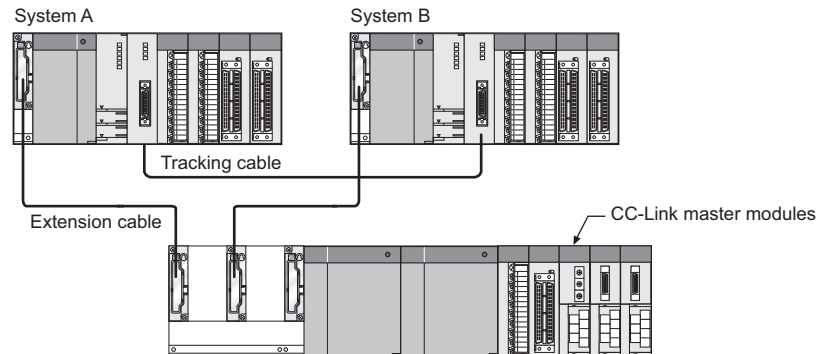Extension cable   CC-Link master modules

Diagram App.30 System configuration when CC-Link master module is mounted on the extension base unit

[Program Example]

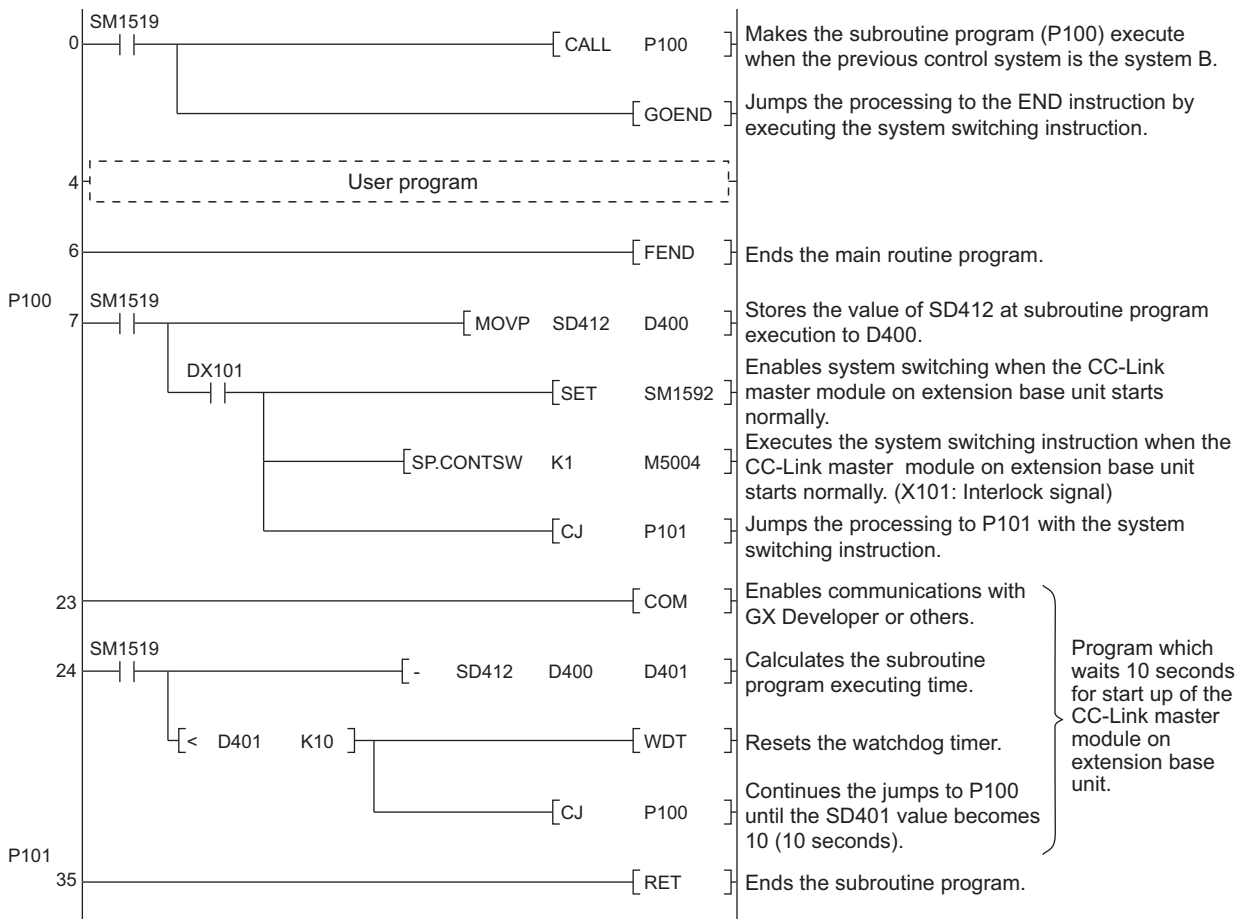(The I/O number assigned to CC-Link master module is from X100 to 11F.)

Diagram App.31 A program example

⊠**POINT**

1. If CC-Link system master/local modules are mounted on the main base unit, system B cannot be started up as the control system.
    Start up system A as the control system.
2. If all stations are faulty in CC-Link network system, system A will be control system since Xn1 does not turn on. To start with the previous control system, power on the programmable controller CPU after powering on the CC-Link remote I/O stations.
3. In the user program, SM402 (After RUN, ON for 1 scan only) and SM403 (After RUN, OFF for 1 scan only) cannot be used because the system switching instruction (SP.CONTSW) takes several scans to complete the processing. Use other devices instead. For example, use an alternative device to SM402 to turn it ON on the rising edge of SM1519 (Previous Control System Identification Flag) and make it turn off after the first execution of the user program. Make an alternative device to SM403 to turn on at the head of the next scan following the falling edge of the alternative device to SM402.
4. To use the Rise/Fall execution instruction in a program of system B after system switching, set [Do tracking] at [Signal flow memory tracking setting] on [Tracking settings] in redundant parameter.

Appendix 7 Precautions for Using Serial Communication Module

The dedicated instructions of the serial communication module for the module mounted to the extension base unit cannot be used in the redundant system.
For the functions to communicate using the dedicated instructions, create programs by using the FROM/TO instruction.

The dedicated instruction applicable in the serial communication module and the changeability by the FROM/TO instruction are listed in Table App.15.

Table App.15 Serial Communication Module Dedicated Instruction List

Instruction name	Function overview	Changeability by FROM/TO instruction	Reference section
CSET	Sets initial setting of the unit (word/byte) of the number of send/receive data and the send/receive area size.	Applicable	Appendix 7.1
	Registers/cancels programmable controller CPU monitoring to use the programmable controller CPU monitoring function.	N/A	-
	Clears receive data without stopping the send processing in the nonprocedural protocol.	Applicable	Appendix 7.1
UINI	Switches mode, transmission specifications, and host station number.	Applicable[1]	Appendix 7.2
BUFRCVS	Receives data in the interrupt program by the nonprocedural or bidirectional protocol communication.	N/A	-
SPBUSY	Reads send/receive status of data by dedicated instructions.	N/A	-
INPUT	Receives data by user arbitrary transmission format in the nonprocedural protocol.	Applicable	Appendix 7.3
PUTE	Registers user registration frame.	Applicable	Appendix 7.4
GETE	Reads user registration frame.	Applicable	Appendix 7.5
ONDEMAND	Sends data by the on-demand function of MC protocol.	Applicable	Appendix 7.6
OUTPUT	Sends data as much as specified by the nonprocedural protocol communication.	Applicable	Appendix 7.7
PRR	Sends data by user registration frame according to specification at user registration frame specification area for sending in the nonprocedural protocol communication.	Applicable	Appendix 7.8
BIDOUT	Sends data as much as specified by the bidirectional protocol communication.	Applicable	Appendix 7.9
BIDIN	Reads data received by the bidirectional protocol communication.	Applicable	Appendix 7.10

* 1: Station number or operating status (independent/linked) cannot be changed.

A sample program of the serial communication module where dedicated instructions are changed to the FROM/TO instruction is described in the next section or later.
For the precautions at system switching, refer to Section 7.4.

Appendix 7.1 CSET Instruction

(1) When setting initial setting of the unit (word/byte) of the number of send/ receive data and the send/receive area size

(a) Setting the unit of send/receive data length

The following tables list the devices and buffer memory area used in the sample program of the send/receive data length unit setting.

1) I/O signal

Table App.16 List of I/O Signal

I/O signal		Signal name	Description of signal
CH1 side	CH2 side		
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated

2) Buffer memory

Write 0 (word unit) or 1 (byte unit) to the following address.

Table App.17 List of Buffer Memory

Buffer memory address hexadecimal (decimal)		Buffer memory name
CH1 side	CH2 side	
96_H(150)	136_H(310)	Word/byte units designation

⊠POINT

Set the send/receive data length unit setting before communication.
In addition, change the setting when the ready signal X(n+1)E of a module is ON.

The program example of send/receive data length unit setting is shown in Diagram App.32. (For the I/O signal is X/Y80 to X/Y9F)

```
        X9E    X9F
0 ──────┤├──────┤/├──────────[TOP    H8      H96     K1      K1    ]─────
```
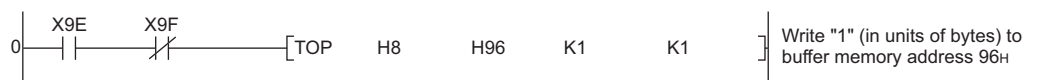Write "1" (in units of bytes) to buffer memory address 96_H

Diagram App.32 Program Example

(b) Specification of buffer memory head address and buffer memory size used in on-demand function

For the specification, refer to Appendix 7.6.

(c) Specification of head address/area size of send area/receive area

The following tables list the devices and buffer memory areas used in the sample program of specifying the head address and area size.

1) I/O signal

Table App.18 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated

2) Buffer memory

Table App.19 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Buffer memory name
CH1 side	CH2 side	
$A2_H(162)$	$142_H(322)$	Transmission buffer memory head address designation
$A3_H(163)$	$143_H(323)$	Transmission buffer memory length designation
$A6_H(166)$	$146_H(326)$	Receive buffer memory head address designation
$A7_H(167)$	$147_H(327)$	Receive buffer memory length designation

⊠ **POINT**

When using the following functions simultaneously, be careful not to duplicate the assignment of buffer memory which stores send data and receive data dealt with the function to be used.

- On-demand function of MC protocol
- Send/receive function of nonprocedural protocol
- Send/receive function of bidirectional protocol

The program example of specifying the send area head address and the send area size is shown in Diagram App.33.
(For the I/O signal is X/Y80 to X/Y9F)

```
        X9E     X9F
0 ─────┤├─────┤╱├─────┬─────────────────[MOVP   H0C00   D0  ]    Sets D0 to head address C00H.
                      │
                      ├─────────────────[MOVP   H100    D1  ]    Sets D1 to buffer memory length 100H.
                      │
                      └──[TOP   H8    H0A2    D0    K2  ]         Writes send area setting value.
```
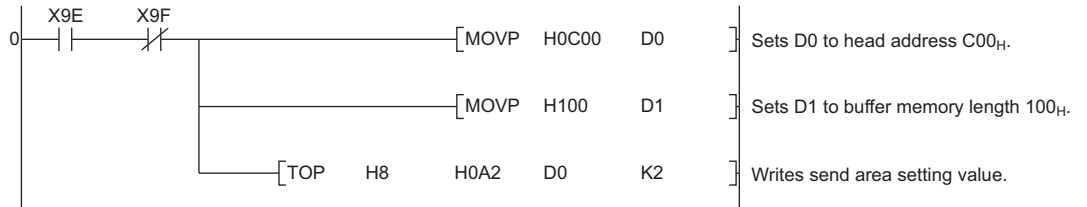
Diagram App.33 Program Example

The program example of specifying the receive area head address and the receive area size is shown in Diagram App.34.
(For the I/O signal is X/Y80 to X/Y9F)

```
        X9E     X9F
0 ─────┤├─────┤╱├─────┬─────────────────[MOVP   H0D00   D0  ]    Sets D0 to head address D00H.
                      │
                      ├─────────────────[MOVP   H300    D1  ]    Sets D1 to buffer memory length 300H.
                      │
                      └──[TOP   H8    H0A6    D0    K2  ]         Writes receive area setting value.
```

Diagram App.34 Program Example

(2) When clearing receive data without stopping the send processing in nonprocedural protocol

The following tables list the devices and buffer memory area used in the sample program of clearing receive data.

(a) Device of programmable controller CPU

Table App.20 Device Used in the Program

Device No.	Application	Remarks
X23	Receive data clear request command	ON: Receive data clear request
M11	Receive processing	ON: Executing, OFF: Not executed
M12	Send processing	ON: Executing, OFF: Not executed
M15	Receive data clear request pulse	ON: Receive data clear request
M16	Receive data clear request acceptance flag	ON: Receive data clear request acceptance
M17	Receive data clear request completion flag	ON: Receive data clear request completion
M18	Communication disable	ON: Communication disable
M19	Communication enable	ON: Communication enable

(b) I/O signal

Table App.21 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn3	XnA	Reception data read request	ON: Requesting read
Xn4	XnB	Reception abnormal detection	ON: Abnormal detection
Yn1	Yn8	Reception data read completion	ON: Data read completed

(c) Buffer memory

When all of the receive processing, send processing, and receive data clear processing are not executed, write 1 to the following address.

Table App.22 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Buffer memory name
CH1 side	CH2 side	
$A8_H$(168)	148_H(328)	Receive data clear request

☒ **POINT**

1. When using the Q series C24 (function version A), restart the data communication when 100ms has passed after the buffer memory address $A8_H$ (for CH1)/148_H (for CH2) was changed from 1 to 0.

2. Do not execute clear request of receive data during communicating data with the external device, since data communication is discontinued when clear request is performed to the receive data.

The program example of clearing receive data is shown in Diagram App.35.
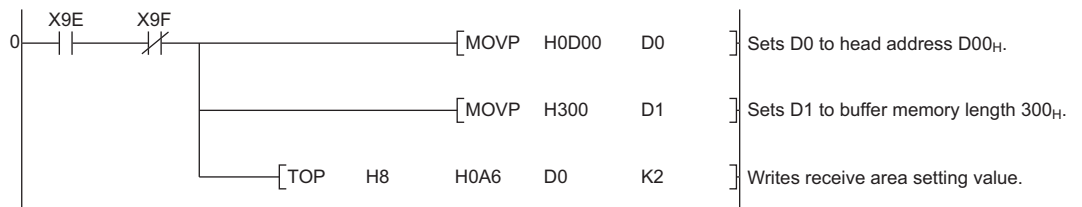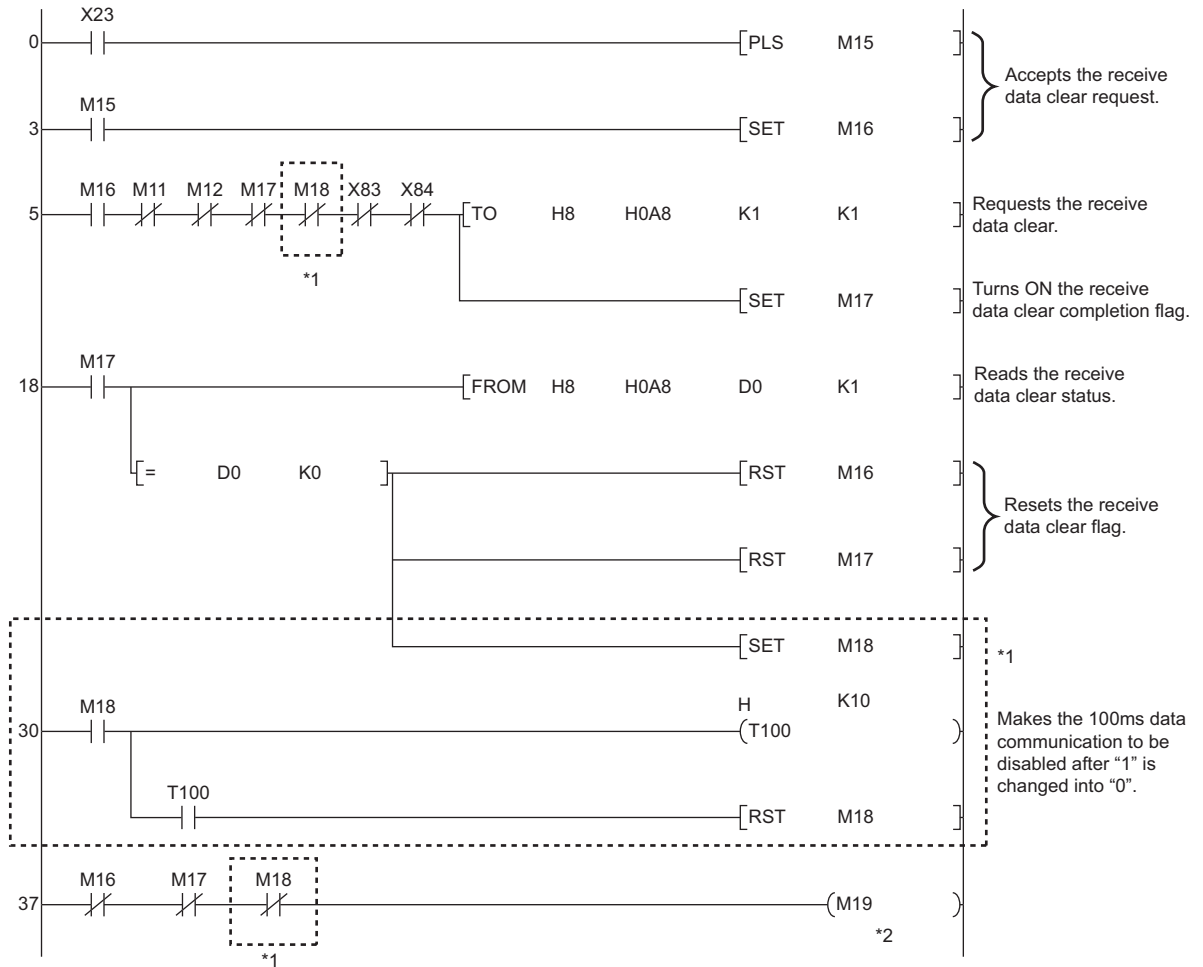(For the I/O signal is X/Y80 to X/Y9F)

```
     X23
0   ─┤├────────────────────────────────────[PLS    M15   ]    ⎫ Accepts the receive
                                                                ⎬ data clear request.
     M15                                                       ⎭
3   ─┤├────────────────────────────────────[SET    M16   ]

     M16  M11  M12  M17 ┌M18┐ X83  X84
5   ─┤├──┤/├──┤/├──┤/├──┤/├──┤/├──┤/├──[TO  H8  H0A8  K1   K1   ]    Requests the receive
                        └─ ─┘                                        data clear.
                         *1
                                           [SET    M17   ]    Turns ON the receive
                                                             data clear completion flag.

     M17
18  ─┤├────────────────────────[FROM  H8  H0A8  D0   K1  ]    Reads the receive
      │                                                        data clear status.
      │ ┌[=    D0    K0  ]──────────────[RST    M16   ]    ⎫
      └─┤                                                   ⎬ Resets the receive
                                                            ⎭ data clear flag.
                                           [RST    M17   ]

   ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─[SET    M18   ] ─ ┐   *1
   │                                                         │
   │ M18                                      H   K10        │  Makes the 100ms data
30 │─┤├──┬─────────────────────────────────( T100     )     │  communication to be
   │     │    T100                                           │  disabled after "1" is
   │     └───┤├──────────────────────────────[RST    M18 ]   │  changed into "0".
   └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
     M16  M17 ┌M18┐
37  ─┤/├──┤/├──┤/├────────────────────────────( M19      )
              └─ ─┘                                    *2
               *1
```

Diagram App.35 Program Example

* 1: When using the Q series C24 (function version A), add the dotted line to the sequence program.
* 2: Communicate data when M19 is ON

Appendix 7.2 UINI Instruction

The following tables list the devices and buffer memory areas used in the sample program for mode switching.

(1) Device of programmable controller CPU

Table App.23 Device Used in the Program

Device No.	Application	Remarks
X52	Mode switching request clear command	ON: Mode switching request clear
X60	Mode switching command	ON: Mode switching
M11	Receive processing	ON: Executing, OFF: Not executed
M12	Send processing	ON: Executing, OFF: Not executed
M50	Mode switching completion flag	ON: Mode switching completion

(2) I/O signal

Table App.24 List of I/O Signal

I/O signal		Signal name	Device to be turned ON/OFF		Timing
CH1 side	CH2 side		CPU	C24	
Xn6	XnD	Mode switching	-	○	
Yn2	Yn9	Mode switching request	○	-	(Switching in execution) Completed

Table App.25 List of I/O Signal

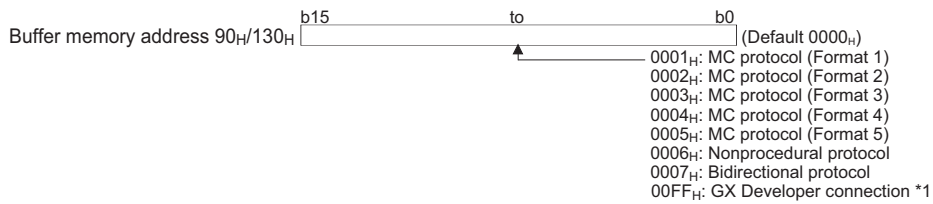| I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn3	XnA	Reception data read request	ON: Requesting read
Xn4	XnB	Reception abnormal detection	ON: Abnormal detection
XnE		CH1 ERR. occurrence	ON: Error occurring
XnF		CH2 ERR. occurrence	ON: Error occurring
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated

(3) Buffer memory

When all of the receive processing, send processing, and receive data clear processing are not executed, write 1 to the following address.

Table App.26 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name		Setting value Stored value
CH1 side	CH2 side			
90_H (144)	130_H (304)	For mode switching specification	Switching mode No. specification (Refer to (a))	• 0001_H: MC protocol (Format 1) • 0007_H: Bidirectional protocol • $00FF_H$: GX Developer connection
91_H (145)	131_H (305)		Transmission specification after switching (Refer to (b))	• 0000_H: Set the same setting as the setting of GX Developer • 8000_H to $8FFF_H$: Set the setting the same as this area setting
203_H(515)		For switching setting and mode switching confirmation	Switch setting error, mode switching error status	• 0: No error • Other than 0: Switch setting error, mode switching error

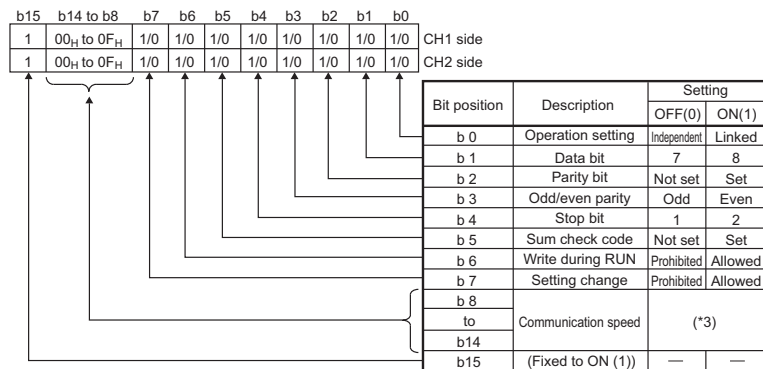### (a) Switching mode No. specification area (Address: 90$_H$, 130$_H$)

The mode No. after switching (0001$_H$ to 0007$_H$, 00FF$_H$) is written to this area.

Buffer memory address 90$_H$/130$_H$

b15	to	b0

(Default 0000$_H$)

0001$_H$: MC protocol (Format 1)
0002$_H$: MC protocol (Format 2)
0003$_H$: MC protocol (Format 3)
0004$_H$: MC protocol (Format 4)
0005$_H$: MC protocol (Format 5)
0006$_H$: Nonprocedural protocol
0007$_H$: Bidirectional protocol
00FF$_H$: GX Developer connection *1

* 1: When specifying GX Developer connection mode in Switch setting of GX Developer, specify [00$_H$] to the communication protocol.

(b) Transmission specification area after switching (Address: 91$_H$, 131$_H$)

1) Specify the transmission specification after mode switching. *2

2) Write [0000$_H$] when initializing settings set by GX Developer.

3) When setting the arbitrary transmission specifications (transmission specifications other than set in GX Developer), write the value corresponding to ON/OFF of the relevant bit shown below. Specification of 1(ON)/0(OFF) of the relevant bit is the same as that of transmission setting of GX Developer.

b15	b14 to b8	b7	b6	b5	b4	b3	b2	b1	b0	
1	00$_H$ to 0F$_H$	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	CH1 side
1	00$_H$ to 0F$_H$	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	CH2 side

Bit position	Description	Setting	
		OFF(0)	ON(1)
b 0	Operation setting	Independent	Linked
b 1	Data bit	7	8
b 2	Parity bit	Not set	Set
b 3	Odd/even parity	Odd	Even
b 4	Stop bit	1	2
b 5	Sum check code	Not set	Set
b 6	Write during RUN	Prohibited	Allowed
b 7	Setting change	Prohibited	Allowed
b 8 to b 14	Communication speed	(*3)	
b 15	(Fixed to ON (1))	—	—

* 2: Specify [8000$_H$] when selecting "GX Developer connection" for the switching mode No. specification.
* 3: The following table lists the specified values of the communication speed.

Communication speed (Unit: bps)	Bit position b14 to b8	Communication speed (Unit: bps)	Bit position b14 to b8
50	0F$_H$	14400	06$_H$
300	00$_H$	19200	07$_H$
600	01$_H$	28800	08$_H$
1200	02$_H$	38400	09$_H$
2400	03$_H$	57600	0A$_H$
4800	04$_H$	115200	0B$_H$
9600	05$_H$	230400	0C$_H$

- 230400bps is applicable for the CH1 side of the QJ71C24N(-R2/R4) only.
- When connecting external devices to two interfaces (CH1 and CH2), the total of communication speed of two interfaces should be within 115200bps (230400bps for the QJ71C24N(-R2/R4)).
  When connecting an external device to either interface (CH1 or CH2), the communication speed can be set up to 115200bps (230400bps for the CH1 side of the QJ71C24N(-R2/R4)). In this case, the communication speed of the interface where the external device is not connected should be 300bps.
- Set [00$_H$] to the interface side where "GX Developer connection" is set in the communication protocol setting. The serial communication module can operate at speed set for GX Developer side.

The program example for mode switching is shown in Diagram App.36.
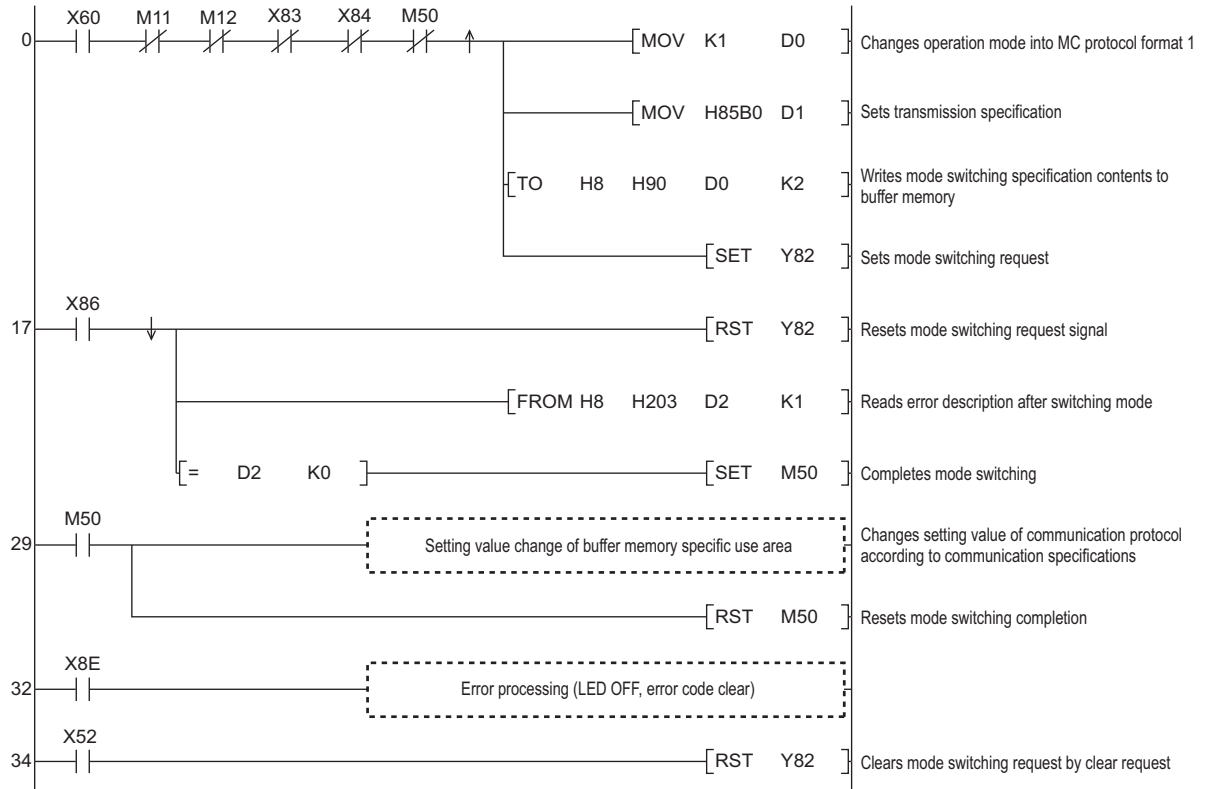(For the I/O signal is X/Y80 to X/Y9F)

```
0   X60  M11  M12  X83  X84  M50
    ┤├──┤/├──┤/├──┤/├──┤/├──┤↑├────────────────[MOV   K1     D0 ]   Changes operation mode into MC protocol format 1

                                              [MOV   H85B0  D1 ]   Sets transmission specification

                                        [TO   H8   H90   D0   K2 ]  Writes mode switching specification contents to
                                                                    buffer memory

                                              [SET          Y82 ]   Sets mode switching request

     X86
17  ┤├──────↓───────────────────────────────────[RST          Y82 ]   Resets mode switching request signal

                              [FROM  H8   H203   D2   K1 ]   Reads error description after switching mode

          [=   D2    K0 ]────────────────[SET          M50 ]   Completes mode switching

     M50
29  ┤├────────────────┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐   Changes setting value of communication protocol
                       Setting value change of buffer memory specific use area   according to communication specifications
                      └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘

                                              [RST          M50 ]   Resets mode switching completion

     X8E
32  ┤├────────┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
                Error processing (LED OFF, error code clear)
               └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘

     X52
34  ┤├──────────────────────────────────────────[RST          Y82 ]   Clears mode switching request by clear request
```

Diagram App.36 Program Example

☒**POINT**

1. Stop all data communication before mode switching. Data communication will be stopped when mode switching is performed during data communication.
2. Note that station No. setting change and switching to linked operation/ switching from linked operation to independent mode cannot be made.
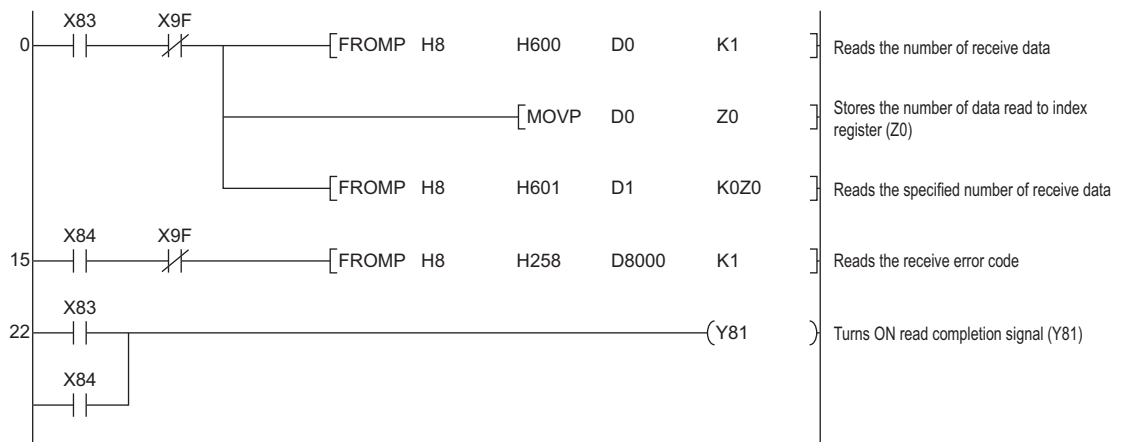
Appendix 7.3 INPUT Instruction

The following tables list the devices and buffer memory areas used in the sample program of receiving data by the nonprocedural protocol communication.

(1) I/O signal

Table App.27 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn3	XnA	Reception data read request	ON: Requesting read
Xn4	XnB	Reception abnormal detection	ON: Abnormal detection
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred / OFF: Module being normally operated
Yn1	Yn8	Reception data read completion	ON: Data read completed

(2) Buffer memory

Table App.28 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
$258_H(600)$	$268_H(616)$	Data reception result	0 : Normal completion / 1 or more: Abnormal completion (error code)
$600_H(1536)$	$A00_H(2560)$	Receive data count (Number of data for which read is requested)	0: No receive data / 1 or later: Number of receive data
601_H to $7FF_H$ (1537 to 2047)	$A01_H$ to BFF_H (2561 to 3071)	Receive data	Data received from an external device

The following shows the program example of receiving data by the nonprocedural protocol communication is shown in Diagram App.37.
(For the I/O signal is X/Y80 to X/Y9F)

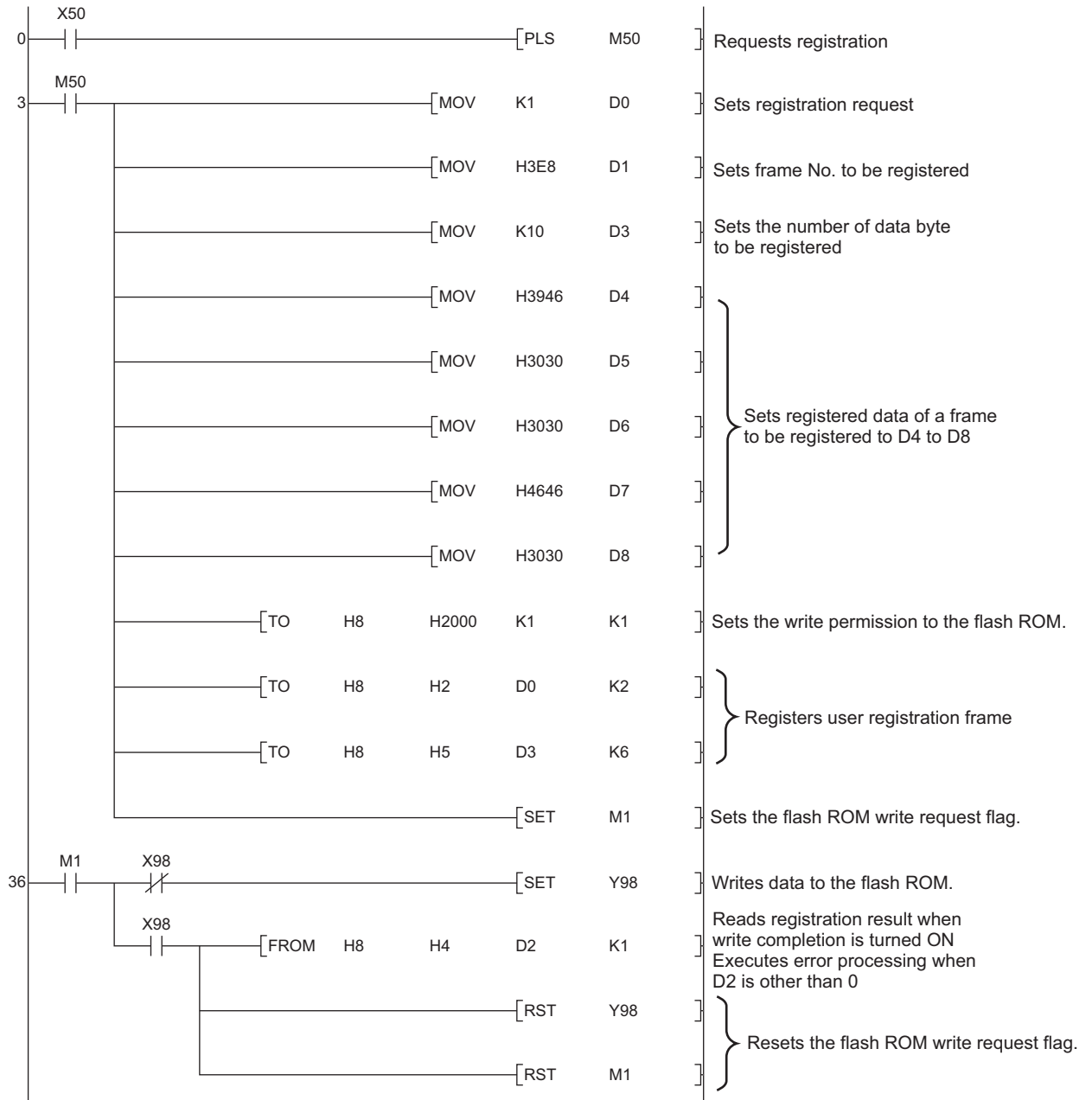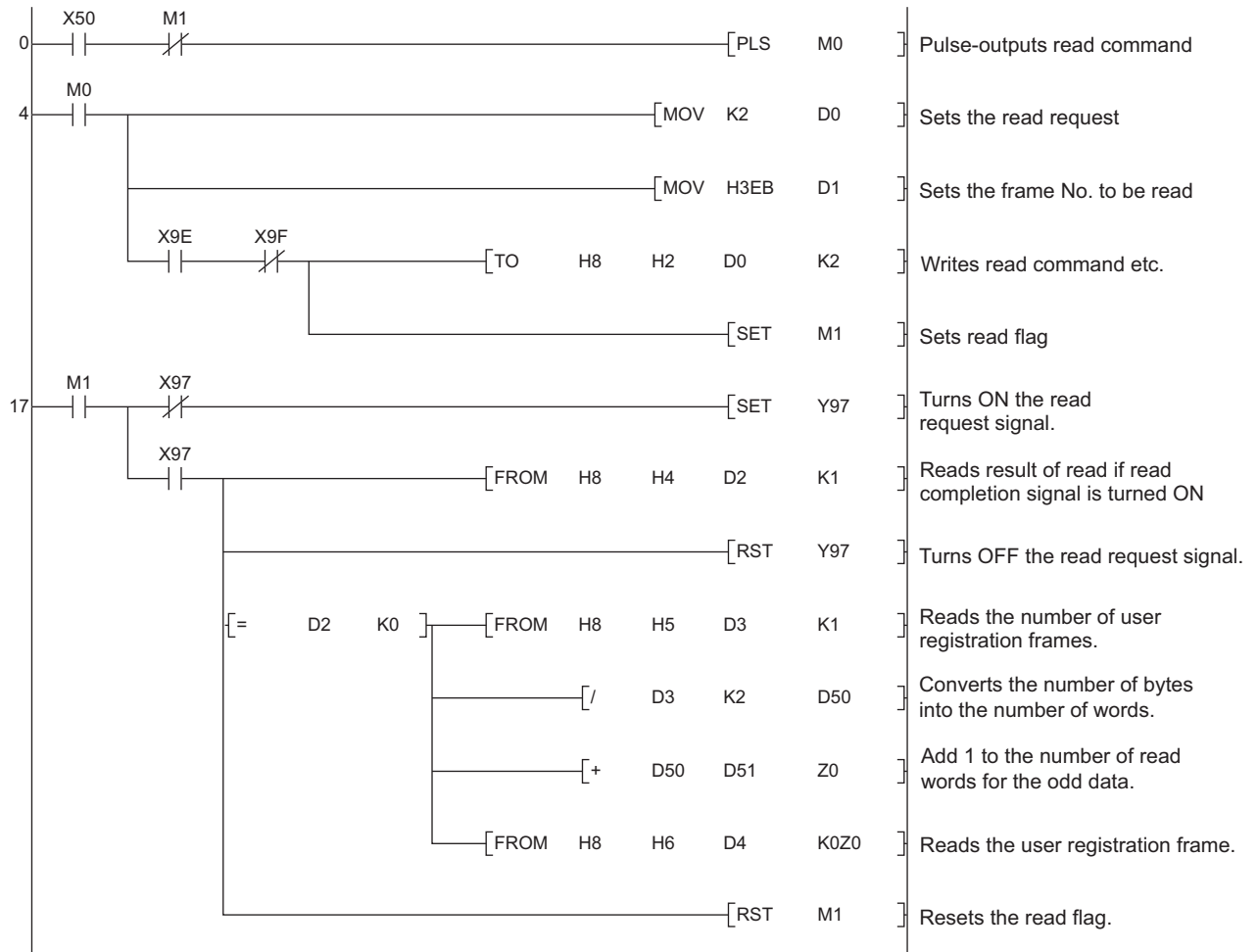|	
0 X83 X9F —[FROMP H8 H600 D0 K1]—	Reads the number of receive data
—[MOVP D0 Z0]—	Stores the number of data read to index register (Z0)
—[FROMP H8 H601 D1 K0Z0]—	Reads the specified number of receive data
15 X84 X9F —[FROMP H8 H258 D8000 K1]—	Reads the receive error code
22 X83 —(Y81)—	Turns ON read completion signal (Y81)
X84	

Diagram App.37 Program Example

Appendix 7.4 PUTE Instruction

The following tables list the devices and buffer memory areas used in the sample program of registering the user registration frame.

(1) Device of programmable controller CPU

Table App.29 Device Used in the Program

Device No.	Application	Remarks
X50	Register request command	ON: Register request
M1	Flash ROM write request flag	ON: Flash ROM write request start
M50	Register request set	ON: Registering

(2) I/O signal

Table App.30 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
X(n+1)8		Flash ROM write completion	ON: Completed
Y(n+1)8		Flash ROM write request	ON: Requesting

(3) Buffer memory

Table App.31 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
$2_H(2)$		Register/read/delete instructions	0: No request 1: Registration request 2: Read request 3: Deletion request
$3_H(3)$		Frame No. direction	0: No designation Other than 0: Frame No.
$4_H(4)$		Registration/read/delete result storage	0: Normal completion Other than 0: Abnormal completion
$5_H(5)$		Number of data bytes registered designation	0 : No designation Other than 0: Number of data bytes registered (maximum 80 bytes)
6_H to $2D_H$(6 to 45)		User frame	0 : No designation Other than 0: Registered data (maximum 80 bytes)
2000_H(8192)		Flash ROM write allow/prohibit designation	0: Write prohibited 1: Write allowed

The program example of registering the user registration frame No.3E8H is shown in Diagram App.36.
(For the I/O signal is X/Y80 to X/Y9F)

```
        X50
0      ─┤ ├─────────────────────────────────[PLS    M50    ]   Requests registration

        M50
3      ─┤ ├──┬──────────────────────────────[MOV    K1     D0 ]   Sets registration request

             ├──────────────────────────────[MOV    H3E8   D1 ]   Sets frame No. to be registered

             ├──────────────────────────────[MOV    K10    D3 ]   Sets the number of data byte
                                                                    to be registered

             ├──────────────────────────────[MOV    H3946  D4 ]   ┐
                                                                   │
             ├──────────────────────────────[MOV    H3030  D5 ]   │
                                                                   │
             ├──────────────────────────────[MOV    H3030  D6 ]   ├ Sets registered data of a frame
                                                                   │  to be registered to D4 to D8
             ├──────────────────────────────[MOV    H4646  D7 ]   │
                                                                   │
             ├──────────────────────────────[MOV    H3030  D8 ]   ┘

             ├────[TO    H8    H2000  K1     K1 ]   Sets the write permission to the flash ROM.

             ├────[TO    H8    H2     D0     K2 ]   ┐
                                                    ├ Registers user registration frame
             ├────[TO    H8    H5     D3     K6 ]   ┘

             └──────────────────────────────[SET    M1     ]   Sets the flash ROM write request flag.

        M1    X98
36     ─┤ ├──┬─┤/├────────────────────────────[SET    Y98    ]   Writes data to the flash ROM.

              X98
             ├─┤ ├──┬──[FROM  H8    H4     D2    K1 ]   Reads registration result when
                                                         write completion is turned ON
                                                         Executes error processing when
                                                         D2 is other than 0
                     ├────────────────────────[RST    Y98    ]   ┐
                                                                  ├ Resets the flash ROM write request flag.
                     └────────────────────────[RST    M1     ]   ┘
```
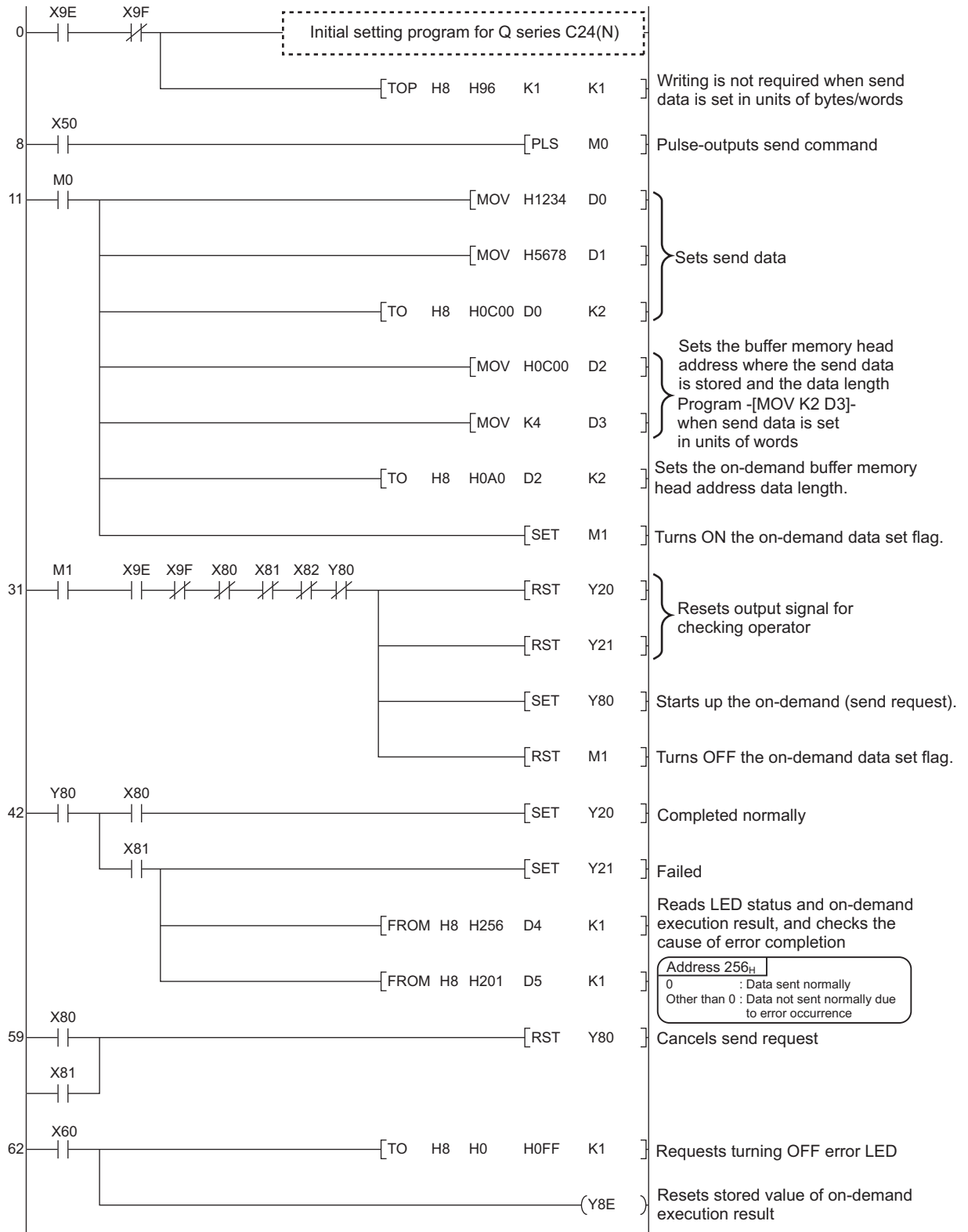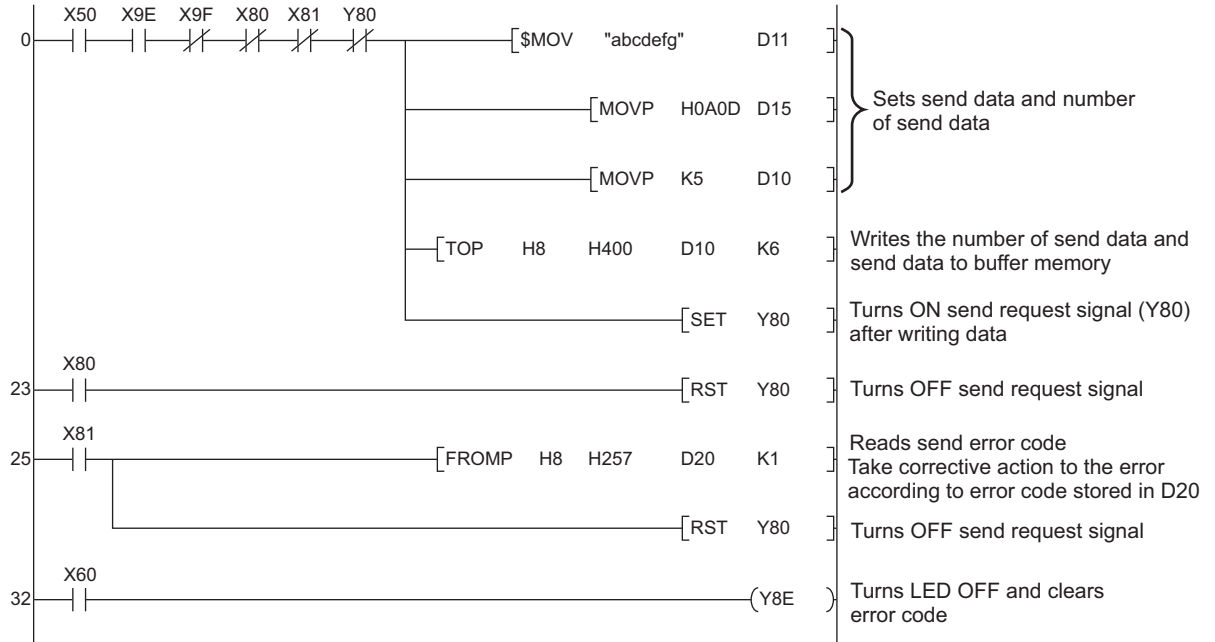
Diagram App.38 Program Example

Appendix 7.5 GETE Instruction

The following tables list the devices and buffer memory areas used in the sample program of reading the user registration frame.

(1) Device of programmable controller CPU

Table App.32 Device Used in the Program

Device No.	Application	Remarks
X50	Read command	ON: Read command
M0	Read command acceptance	ON: Read command acceptance
M1	Read flag	ON: Reading

(2) I/O signal

Table App.33 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
X(n+1)7		Flash ROM read completion	ON: Completed
Y(n+1)7		Flash ROM read request	ON: Requesting
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated

(3) Buffer memory

Table App.34 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
$2_H(2)$		Register/read/delete instructions	0: No request 1: Registration request 2: Read request 3: Deletion request
$3_H(3)$		Frame No. direction	0: No designation Other than 0: Frame No.
$4_H(4)$		Registration/read/delete result storage	0: Normal completion Other than 0: Abnormal completion
$5_H(5)$		Number of data bytes registered designation	0 : No designation Other than 0: Number of data bytes registered (maximum 80 bytes)
6_H to $2D_H$(6 to 45)		User frame	0 : No designation Other than 0: Registered data (maximum 80 bytes)

The program example of reading the user registration frame is shown in Diagram App.39.
(For the I/O signal is X/Y80 to X/Y9F)

|		
0	X50 M1 —[PLS M0]	Pulse-outputs read command
4	M0 —[MOV K2 D0]	Sets the read request
	—[MOV H3EB D1]	Sets the frame No. to be read
	X9E X9F —[TO H8 H2 D0 K2]	Writes read command etc.
	—[SET M1]	Sets read flag
17	M1 X97 —[SET Y97]	Turns ON the read request signal.
	X97 —[FROM H8 H4 D2 K1]	Reads result of read if read completion signal is turned ON
	—[RST Y97]	Turns OFF the read request signal.
	[= D2 K0] —[FROM H8 H5 D3 K1]	Reads the number of user registration frames.
	—[/ D3 K2 D50]	Converts the number of bytes into the number of words.
	—[+ D50 D51 Z0]	Add 1 to the number of read words for the odd data.
	—[FROM H8 H6 D4 K0Z0]	Reads the user registration frame.
	—[RST M1]	Resets the read flag.

Diagram App.39 Program Example

Appendix 7.6 ONDEMAND Instruction

The following tables list the devices and buffer memory areas used in the sample program of sending data by the on-demand function.

(1) Device of programmable controller CPU

Table App.35 Device Used in the Program

Device No.	Application	Remarks
X50	Transmission command	ON: Transmission completion
X60	Error reset command	ON: Error reset
Y20	For checking normal completion	ON: Normal completion
Y21	For checking abnormal completion	ON: Abnormal completion
M0	Transmission data set	ON: Transmission data set
M1	On-demand data set	ON: On-demand data set

(2) I/O signal

Table App.36 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn0	Xn7	Transmission normal completion	ON: Normal completion
Xn1	Xn8	Transmission abnormal completion	ON: Abnormal completion
Xn2	Xn9	Transmission processing	Transmission in progress
XnE	XnF	ERR. occurrence	ON: Error occurring
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated
Yn0	Yn7	Transmission request	ON: Requesting transmission

(3) Buffer memory

Table App.37 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
$0_H(0)$	$1_H(1)$	Communication error clear request and to turn LED off	0: OFF, No initialization request 1: OFF, Initialization requested
$96_H(150)$	$136_H(310)$	Word/byte units designation	0: Word units 1: Byte units
$A0_H(160)$	$140_H(320)$	Buffer memory head address for on-demand	400_H to $1AFF_H$ 2600_H to $3FFF_H$
$A1_H(161)$	$141_H(321)$	On-demand data length	0000_H to 3400_H
$201_H(513)$		LED ON status and communication error status	0: Turned off/OFF, no error 1: Turned on/ON, error
$256_H(598)$	$266_H(614)$	On-demand execution result	0: Completed normally 1 or later: Error code
$C00_H$ to $1AFF_H$ (3072 to 6911)		User free area	----

The program example of sending data by the on-demand function is shown in Diagram App.40. (For the I/O signal is X/Y80 to X/Y9F)

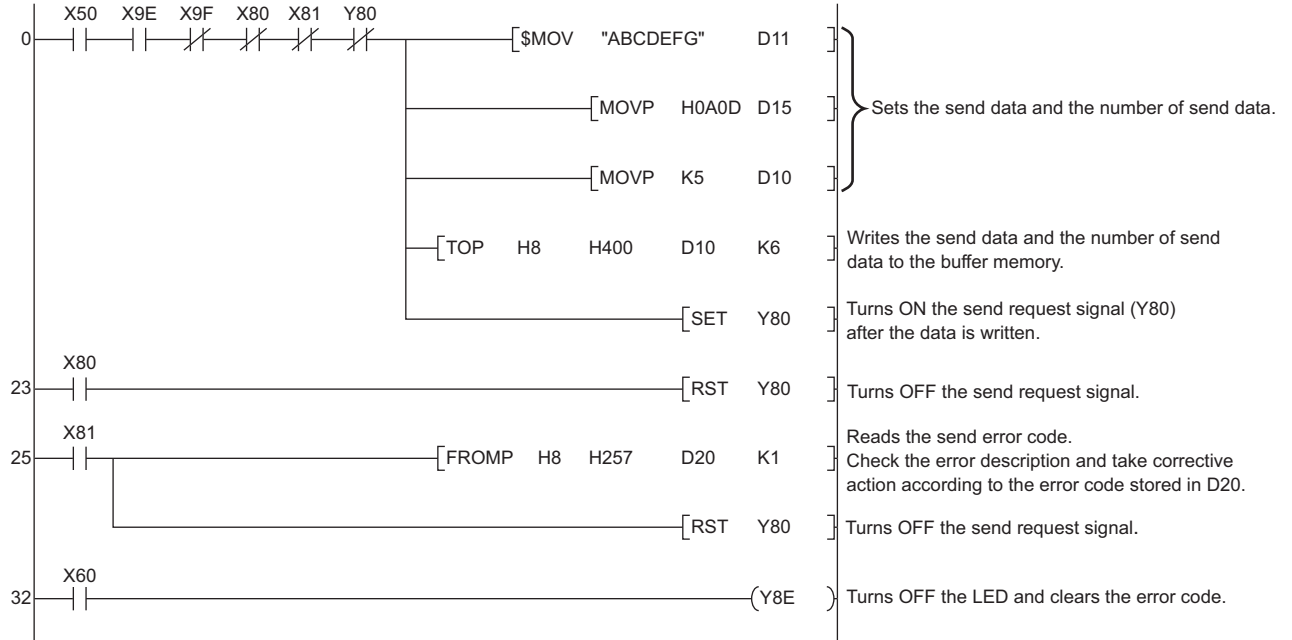| Rung	Ladder instruction	Comment
0	X9E ┤├ X9F ┤/├ — Initial setting program for Q series C24(N)	
	[TOP H8 H96 K1 K1]	Writing is not required when send data is set in units of bytes/words
8	X50 ┤├ [PLS M0]	Pulse-outputs send command
11	M0 ┤├ [MOV H1234 D0]	Sets send data
	[MOV H5678 D1]	
	[TO H8 H0C00 D0 K2]	
	[MOV H0C00 D2]	Sets the buffer memory head address where the send data is stored and the data length Program -[MOV K2 D3]- when send data is set in units of words
	[MOV K4 D3]	
	[TO H8 H0A0 D2 K2]	Sets the on-demand buffer memory head address data length.
	[SET M1]	Turns ON the on-demand data set flag.
31	M1 ┤├ X9E ┤├ X9F ┤/├ X80 ┤/├ X81 ┤/├ X82 ┤/├ Y80 ┤/├ [RST Y20]	Resets output signal for checking operator
	[RST Y21]	
	[SET Y80]	Starts up the on-demand (send request).
	[RST M1]	Turns OFF the on-demand data set flag.
42	Y80 ┤├ X80 ┤├ [SET Y20]	Completed normally
	X81 ┤├ [SET Y21]	Failed
	[FROM H8 H256 D4 K1]	Reads LED status and on-demand execution result, and checks the cause of error completion
	[FROM H8 H201 D5 K1]	Address 256H 0 : Data sent normally Other than 0 : Data not sent normally due to error occurrence
59	X80 ┤├ [RST Y80]	Cancels send request
	X81 ┤├	
62	X60 ┤├ [TO H8 H0 H0FF K1]	Requests turning OFF error LED
	(Y8E)	Resets stored value of on-demand execution result

Diagram App.40 Program Example

Appendix 7.7 OUTPUT Instruction

The following tables list the devices and buffer memory areas used in the sample program of sending data by the nonprocedural protocol communication.

(1) Device of programmable controller CPU

Table App.38 Device Used in the Program

Device No.	Application	Remarks
X50	Transmission command	ON: Transmission completion
X60	Error reset command	ON: Error reset

(2) I/O signal

Table App.39 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn0	Xn7	Transmission normal completion	ON: Normal completion
Xn1	Xn8	Transmission abnormal completion	ON: Abnormal completion
Xn2	Xn9	Transmission processing	Transmission in progress
XnE	XnF	ERR. occurrence	ON: Error occurring
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated
Yn0	Yn7	Transmission request	ON: Requesting transmission

(3) Buffer memory

Table App.40 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
257_H(599)	267_H(615)	Data transmission result	0 : Normal completion 1 or more: Abnormal completion (error code)
400_H(1024)	800_H(2048)	Transmission data count designation	0: No designation 1 or more: Number of send data
401_H to $5FF_H$ (1025 to 1535)	801_H to $9FF_H$ (2049 to 2559)	Transmission data designation	Data to be sent to an external device

The program example of sending data by the nonprocedural protocol communication is shown in Diagram App.41.
(For the I/O signal is X/Y80 to X/Y9F)

```
     X50  X9E  X9F  X80  X81  Y80
0    ─┤├──┤├──┤/├──┤/├──┤/├──┤/├───────────[$MOV    "abcdefg"      D11 ]─┐
                                                                        │  Sets send data and number
                                            ─[MOVP    H0A0D  D15 ]─      │  of send data
                                                                        │
                                            ─[MOVP    K5     D10 ]─      │
                                     ─[TOP   H8      H400   D10   K6 ]─     Writes the number of send data and
                                                                           send data to buffer memory
                                            ─[SET    Y80 ]─                 Turns ON send request signal (Y80)
                                                                           after writing data
     X80
23   ─┤├──────────────────────────────[RST    Y80 ]─   Turns OFF send request signal

     X81
25   ─┤├────────────────[FROMP   H8   H257   D20   K1 ]─   Reads send error code
                 │                                        Take corrective action to the error
                 │                                        according to error code stored in D20
                 └──────────────────[RST    Y80 ]─        Turns OFF send request signal

     X60
32   ─┤├──────────────────────────────────(Y8E )─   Turns LED OFF and clears
                                                     error code
```

Diagram App.41 Program Example

Appendix 7.8 PRR Instruction

The following tables list the devices and buffer memory areas used in the sample program of sending data by the user registration frame of the nonprocedural protocol communication.

(1) Device of programmable controller CPU

Table App.41 Device Used in the Program

Device No.	Application	Remarks
X50	Transmission command	ON: Transmission completion
X60	Transmission command pulse	ON: Read completion

(2) I/O signal

Table App.42 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn0	Xn7	Transmission normal completion	ON: Normal completion
Xn1	Xn8	Transmission abnormal completion	ON: Abnormal completion
Xn2	Xn9	Transmission processing	Transmission in progress
XnE	XnF	ERR. occurrence	ON: Error occurring
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated
Yn0	Yn7	Transmission request	ON: Requesting transmission

(3) Buffer memory

Table App.43 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
$B7_H$(183)	157_H(343)	For user frame being transmitted designation	CR/LF output designation 0: Do not send 1: Send.
$B8_H$(184)	158_H(344)		Output head pointer designation 0: No designation 1 to 100: Send from nth
$B9_H$(185)	159_H(345)		Output count designation 0: No designation 1 to 100: Output n
BA_H to $11D_H$ (186 to 285)	$15A_H$ to $1BD_H$ (346 to 445)		Output frame No. designation (A maximum of 100 can be specified) 0: No designation 1 or more: Output frame No.
257_H(599)	267_H(615)	Data transmission result	0 : Normal completion 1 or more: Abnormal completion (error code)
400_H (1024)	800_H (2048)	Transmission data count designation	0: No designation 1 or more: Number of send data
401_H to $5FF_H$ (1025 to 1535)	801_H to $9FF_H$ (2049 to 2559)	Transmission data designation	Data to be sent to an external device

APPENDICES

The program example of sending data by the user registration frame of the nonprocedural protocol communication is shown in Diagram App.42.
(For the I/O signal is X/Y80 to X/Y9F)
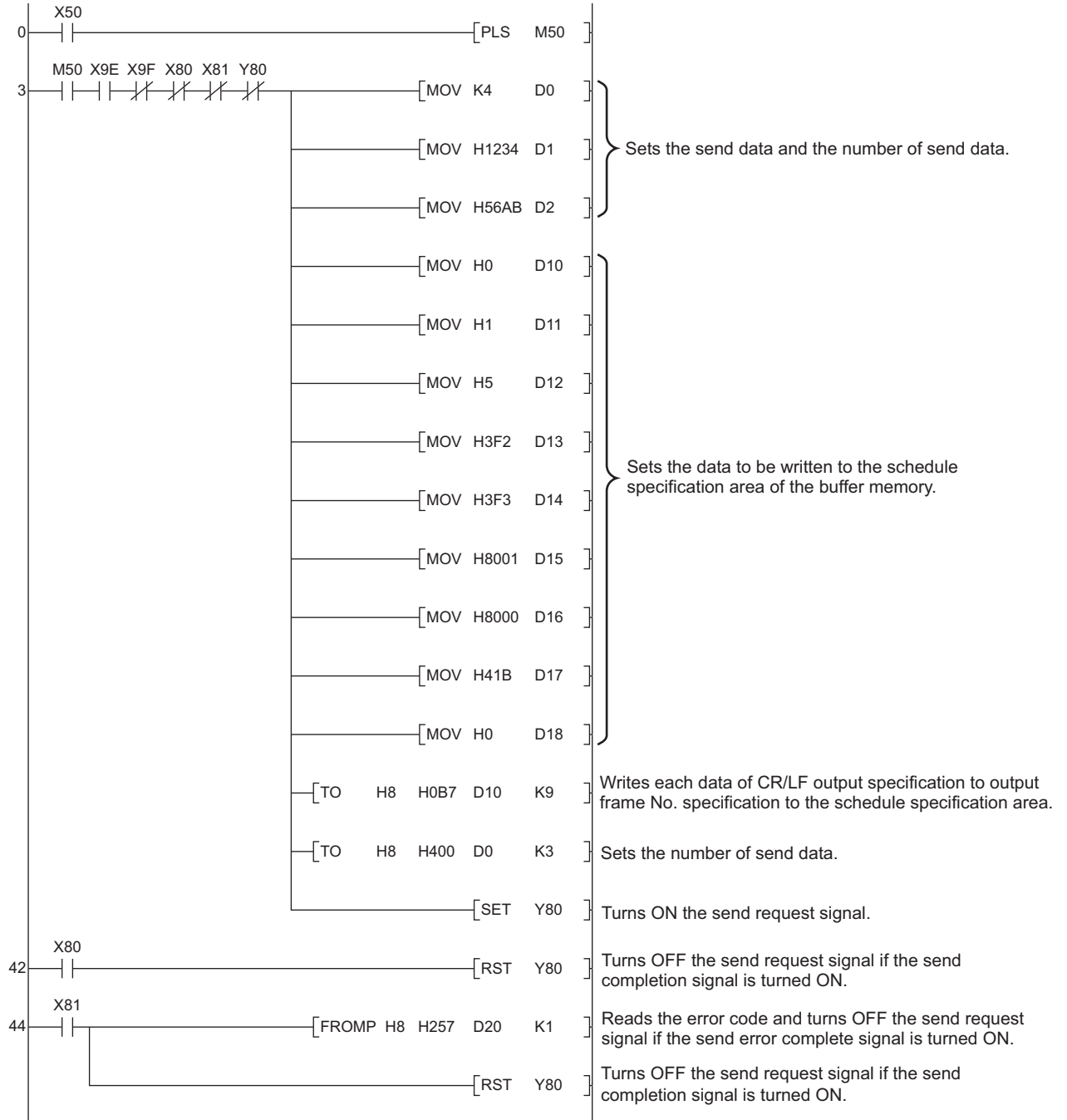
Diagram App.42 Program Example

MELSEC **Q** series

Appendix 7.9 BIDOUT Instruction

The following tables list the devices and buffer memory areas used in the sample program of sending data by the bidirectional protocol communication.

(1) Device of programmable controller CPU

Table App.44 Device Used in the Program

Device No.	Application	Remarks
X50	Transmission command	ON: Transmission completion
X60	Clear command	ON: Clear completion

(2) I/O signal

Table App.45 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn0	Xn7	Transmission normal completion	ON: Normal completion
Xn1	Xn8	Transmission abnormal completion	ON: Abnormal completion
Xn2	Xn9	Transmission processing	Transmission in progress
XnE	XnF	ERR. occurrence	ON: Error occurring
X(n+1)E		Q series C24 ready	ON: Accessible
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated
Yn0	Yn7	Transmission request	ON: Requesting transmission

(3) Buffer memory

Table App.46 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
257_H(599)	267_H(615)	Data transmission result	0 : Normal completion 1 or more: Abnormal completion (error code)
400_H (1024)	800_H (2048)	Transmission data count designation	0: No designation 1 or more: Number of send data
401_H to $5FF_H$ (1025 to 1535)	801_H to $9FF_H$ (2049 to 2559)	Transmission data designation	Data to be sent to an external device

APPENDICES

MELSEC **Q** series

The program example of sending data by the bidirectional protocol communication is
shown in Diagram App.43.
(For the I/O signal is X/Y80 to X/Y9F)

Diagram App.43 Program Example

Appendix 7 Precautions for Using Serial Communication Module
Appendix 7.9 BIDOUT Instruction

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Appendix 7.10 BIDIN Instruction

The following tables list the devices and buffer memory areas used in the sample program of receiving data by the bidirectional protocol communication.

(1) Device of programmable controller CPU

Table App.47 Device Used in the Program

Device No.	Application	Remarks
X30	Error code read command	ON: Error code read
X60	Clear command	ON: Clear completion

(2) I/O signal

Table App.48 List of I/O Signal

I/O signal		Signal name	Description
CH1 side	CH2 side		
Xn3	XnA	Reception data read request	ON: Requesting read
X(n+1)F		Watchdog timer error (WDT error)	ON : Module error occurred OFF: Module being normally operated
Yn1	Yn8	Reception data read completion	ON: Data read completed

(3) Buffer memory

Table App.49 List of Buffer Memory

Buffer memory address Hexadecimal (decimal)		Name	Stored value
CH1 side	CH2 side		
258_H(600)	268_H(616)	Data reception result	0 : Normal completion 1 or more: Abnormal completion (error code)
600_H(1536)	$A00_H$(2560)	Receive data count (Number of data for which read is requested)	0: No receive data 1 or more: Number of receive data
601_H to $7FF_H$ (1537 to 2047)	$A01_H$ to BFF_H (2561 to 3071)	Receive data	Data received from an external device

The program example of receiving data by the bidirectional protocol communication is shown in Diagram App.44.
(For the I/O signal is X/Y80 to X/Y9F)

```
     X83      X9F
0  ──┤├──────┤/├────┬──[FROMP   H8      H600      D0       K1  ]     Reads the number of receive data
                    │
                    ├─────────────[MOVP  D0       Z0  ]            Stores the number of read data to index
                    │                                               register (Z0)
                    │
                    └──[FROMP   H8      H601      D1      K0Z0 ]    Reads the receive data for the
                                                                    number of receive data.

     X30      X9F                                                   Reads the receive error code.
15 ──┤├──────┤/├──────[FROMP   H8      H258      D8000     K1  ]    Check the error description and take corrective
                                                                    action according to the error code stored in D8000.

     X83
22 ──┤├───────────────────────────────────────────────(Y81 )      Turns ON the read completion signal.

     X60
24 ──┤├───────────────────────────────────────────────(Y8E )      Turns LED OFF and clears error code
```

Diagram App.44 Program Example

Appendix 8 Cautions on Communications Made via Module on Extension Base Unit

(1) MC protocol frames available for communications

Use QnA-compatible 2C/3C/4C frame, QnA-compatible 3E frame, or 4E frame for the access.

(2) MC protocol commands available for communications

Table App.50 lists whether each access target can be specified for each MC protocol command or not when communications are made via a module on an extension base unit.

Table App.50 Applicability of connection destination specification of each command from request source

Function		Connection destination specification				
Target	Command name	Control system	Standby system	No system specification	System A	System B
Device memory	Batch read	○	○	○	○	○
	Batch write	○	○	○	○	○
	Random read	○	○	○	○	○
	Test (Random write)	○	○	○	○	○
	Monitor data registration	×	×	×	○	○
	Monitor	×	×	×	○	○
	Multiple block batch read	○	○	○	○	○
	Multiple block batch write	○	○	○	○	○
Intelligent function module	Batch read	○	○	○	○	○
	Batch write	○	○	○	○	○
Programmable controller CPU	Remote RUN	○	○	○	○	○
	Remote STOP	○	○	○	○	○
	Remote PAUSE	○	○	○	○	○
	Remote latch clear	○	○	○	○	○
	Remote RESET	○	○	○	○	○
	CPU model name read	○	○	○	○	○
File	Directory/file information read	×	×	×	○	○
	Directory/file information search	×	×	×	○	○
	New file creation	×	×	×	○	○
	File deletion	×	×	×	○	○
	File copy	×	×	×	○	○
	File attribute change	×	×	×	○	○
	File creation data change	×	×	×	○	○
	File open	×	×	×	○	○
	File read	×	×	×	○	○
	File write	×	×	×	○	○
	File close	×	×	×	○	○

Remark •

For details of each command, refer to the following manual

☞ MELSEC Communication Protocol Reference Manual

• •

(3) System switching during communication made via a module on an extension base unit

If system switching occurs during communication made via a module on an extension base unit by MC protocol or a dedicated instruction, both the old and new control systems may not be able to respond, and this may cause a communication timeout.

Memo

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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.
7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

(2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

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

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.

(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

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SH(NA)-080486ENG-Z(2209)MEE

MODEL: QNPRHCPU-U-NI-E

MODEL CODE: 13JR76

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